Territorial Analysis

1st Draft version

16.11.2026.

H-1406 Budapest, Pf. 7.

cesci@cesci-net.eu

www.cesci-net.eu

TABLE OF CONTENTS

I. PREAMBLE 3

II. EXECUTIVE SUMMARY AND SYNTHESIS 6

2.1 Context 6

2.2 Mission statement 6

2.2.1 Key findings of the evaluation 6
2.2.2 Recommendations 12

III DETAILED TERRITORIAL ANALYSIS 13

3.1 Territorial cohesion 13

3.1.1 Landscape, environmental factors, climate change 13
3.1.2 Characteristics of urban network 54
3.1.3 Status of the borders 63
3.1.4 Territorial cooperation and governance framework 67

3.2 Economic cohesion 73

3.2.1 General Economic Picture of the Danube Region (The Danube Region in the EU and Internal Economic Relations) 73
3.2.2 The existing economic infrastructure (accessibility and energetics) 122

3.3 Social cohesion 152

3.3.1 Demographic conditions 152
3.3.2 Social disparities 166
3.3.3 Labour force migration, training and employment 169
3.3.4 Interethnic conditions and cultural relations 194

IV STAKEHOLDER ANALYSIS 198

ANNEX 1 – TABLE OF FIGURES 199

ANNEX 2 – DOCUMENT ANALYSIS 202

I. PREAMBLE

CURRENT STATUS

The actual version (draft of the Territorial Analysis provided by 16th November) can be regarded as an intermediate product, as the final version is expected to be provided in March 2027. Although the analysis is currently considered a working draft – given that the unified visualisation and processing of data from diverse sources is a highly time-consuming task – the planners made a concerted effort to ensure that the ongoing territorial analysis could provide preliminary findings to support the parallel preparatory work for Programme planning. While the material will undergo further fine-tuning over the next months – first of all, incorporating results from the stakeholder analysis and refining the visual presentation – its core findings, derived from the preliminary analysis of data and documents, are already considered well-founded and suitable for discussion. Consequently, the current version of the document could already be used as a debate paper to discuss the major territorial challenges for the planning process of the future Programme. The draft secures to contain all the most relevant fields of the table of content. The draft document already provides territorial evidence for programming by touching upon all the main trends, relevant aspects of cohesion of transnational relevance.

1. Steps done

Major analytical steps carried out so far include the followings:

- Data process and harmonisation workflow begins with gathering all accessible and comparable data, followed immediately by the identification of data gaps. As part of the data collection country-specific data request tables were originally sent out on the 28th of April. To address these gaps, a data request is issued through official channels by the Task Force and the MA/JS. These indicators are provided to the competent bodies of each country to eventually establish a complete database. A comprehensive data collection phase was closed on 17th July. To ensure sufficient time for data processing, visualisation, and the overall feasibility of drafting the document, the original deadline for sending data had been set for the end of June and subsequently had been extended. The processing of the received data, the comparison of differing national methodologies – which is inevitable for a macro-region of this scale – and the necessary data harmonisation tasks are finished. This process was essential to identify the final scope of data that can be effectively analysed and visualised for the Territorial Analysis.
- An important step was finalised starting from 16th July, namely the document review, to provide a review of the latest territorial developments, policy trends, and emerging

challenges affecting the Programme area. Possible suggestions, including any missing documents or other relevant references were asked to be communicated by 31st July 2026, though the latest materials were sent as late as 4th September. To ensure that the updated Territorial Analysis reflects the most relevant evidence and recent developments, a broad collection of documents at European, macro-regional, national, and sectoral levels were compiled involving the Task Force members, who were asked to suggest further documents. As part of the analysis 67 elements were taken into account. Relevant elements include regional and macro-regional strategic documents, thematic and sectoral studies, policy papers and action plans; research reports and scientific publications, programme evaluations or territorial assessments, and other publications of great relevance. Short analyses were conducted about the respective documents' content as an executive summary, thematic alignment, key findings, and policy needs and recommendations (the latter two organised into three thematic pillars of Climate change and water scarcity; Right to Stay; and Special territorialities, border regions).

- Using qualitative and quantitative information and outputs, a comprehensive textual analysis has been compiled. Based on a cohesion-focused perspective (territorial, economic, and social cohesion) the analytical evidence base for the DRP will be safeguarded, ensuring that future transnational cooperation addresses the most pertinent challenges and capitalises on existing strengths across the macro-region, and provides a set of transnational cooperation needs and potential interventions.
- Survey complilation: the survey as part of the stakeholder consultation process had been compiled and shared with the MA/JS, and latter with the Task Force members for fine-tuning.

2. Future steps

Major further steps to be carried out include the followings:

- The second pillar of the qualitative input is a targeted stakeholder consultation conducted via a survey. This survey is to be distributed to relevant national and EUSDR stakeholders, including dedicated experts, professionals, and decision-makers, to gather input on territorial challenges of transnational relevance, transnationally relevant development or cooperation activities, the cross-sectoral topic of Right to Stay, and territorial integration. The subsequent survey analysis will focus on categorising and analysing stakeholder opinions. This step is essential to determine the popularity and relevance of challenges and proposed interventions.

- Visualisation: based on the incoming comments, final versions of maps and tables will be created. Very few additional figures will be drawn based on the results of the final step of data collection and harmonisation process.
- Using the additional data and the visualisations the gaps in the textual analysis will be filled in.
- Writing the stakeholder analysis: based on the conducted survey, results will be analysed extensively.
- Finalisation of the draft document with the help of TF's comments at the beginning of next year, when it is in a more definitive form and incorporates the stakeholder consultation findings.

II. EXECUTIVE SUMMARY AND SYNTHESIS

2.1 Context

The final Territorial Analysis will offer a full analytical toolkit; the content can be sum up as follows:

- Mission statement;
- Recommendations (deriving from the findings of the analysis);
- Territorial analysis (full inventory of figures and related textual analysis);

2.2 Mission statement

The mission statement of this document will describe the fundamental matters of the situation of the macro-region which would be worth taking into consideration in the upcoming programming process. The statement will contain the transnationally most relevant factors which either strengthen or weaken the cohesion of the macro-region. It provides a clear description of what makes the Danube macroregion unique compared to other macro-regions, and how to specify its development path in the frames of this particular transnational programme to avoid one size fits all type of future interventions. It will give a general direction for the future programming by highlighting the main topics and areas of potential interventions. Thus, this future text can act as a basis of all future planning considering this transnational cooperation programme.

2.2.1 Key findings of the evaluation

This subchapter will highlight all the key findings derived from the detailed territorial analysis and stakeholder analysis in order to support the discussion process regarding the elaboration of the transnational programme of the upcoming planning period. Based on the numerous figures created, the main findings of the evaluation will be grouped into the following categories depending on their validity, time frame and territorial focus.

- **Still valid findings**: It consists of strengthening or weakening factors of cohesion which *have been persisting* since the beginning of the current programme, and which have not changed much since the statements of the previous territorial analysis.
- **No longer valid findings**: It consists of strengthening or weakening factors of cohesion which *have ceased to exist* since the beginning of the current programme, and which have altered much *not to be regarded as significant factor* during further planning.

- **New conditions**: It consists of strengthening or weakening factors of cohesion which *have emerged and became vivid* only in the very recent years representing challenges which *used to be unfamiliar or unknown* in the period of 2020-2027 in the macroregion, but in the upcoming period *they are worth taking into account* during further planning.
- **Main "Danubian" trends and topics**: It consists of statements which are not only valid but are currently the *most significant potentials and challenges* of the cohesion in the macro-region. These trends and topics are *specific to the Danube Region exclusively*, and not only characterise the macro-region but summarise *in what factors the macro-region is distinct* from the rest of Europe and the other macroregions.

Still valid findings on territorial cohesion

- Shared transboundary river basins, groundwater aquifers, and natural habitats face chronic environmental degradation, requiring unified, catchment-scale governance.
- Accelerating climate change impacts drive severe soil moisture deficits, prolonged droughts, and biodiversity loss across shared agricultural lowlands like the Pannonian and Wallachian plains.
- Extreme hydrographic volatility persists along the Danube and Sava corridors, oscillating between catastrophic riverine flood surges and prolonged, navigation-halting low-water periods.
- Contiguous transboundary ecosystems and UNESCO World Heritage sites remain subject to fragmented national regulations, uncoordinated protected area management, and local tourism pressures.
- Urban networks exhibit a rigid monocentric hierarchy where prosperous capital agglomerations contrast sharply with extensive, service-deprived inner peripheries.
- Severe physical accessibility deficits to essential public services, including emergency healthcare, secondary education, and elderly care, continue to isolate rural, mountain, and borderland communities.
- Cross-border functional areas and twin cities remain constrained by persistent administrative disconnects, non-aligned municipal competences, and fragile, project-dependent governance.
- Cross-border Interreg cooperation networks remain territorially polarized, leaving eastern and Western Balkan borderlands in a persistent cooperation shadow.

Still valid findings on economic cohesion

- An entrenched West-East economic divide persists across the basin, generating multi-fold per capita GDP disparities that reach extreme levels between western cores and candidate peripheries.
- Intra-regional foreign direct investment and intellectual property creation remain heavily asymmetrical, with outward capital and EPO patent co-inventions overwhelmingly concentrated in Germany and Austria.
- The macro-region functions as Europe's central industrial and manufacturing workshop, creating strong supply-chain integration but exposing regional suppliers to external deindustrialisation and green transition risks.
- Small and medium-sized enterprises represent over 99% of all enterprises but suffer from low density per 1,000 inhabitants, weak capitalisation, and limited access to international value chains.
- Research, development, and high-tech employment remain locked within western innovation hubs and isolated capital city „islands", leaving peripheral regions trapped in low value-added assembly activities.
- Tourism remains deeply polarised between hyper-congested coastal and Alpine destinations and extensive inland „tourism deserts" that fail to valorise rich local cultural and natural assets.
- High gross inland reliance on fossil fuels and vulnerable import dependencies continue to undermine macro-regional energy resilience.
- Strategic transport corridors suffer from missing multimodal infrastructure links, slow rail modernisation, and navigation bottlenecks along the Danube inland waterway.

Still valid findings on social cohesion

- Chronic depopulation, sub-replacement fertility, and rapid demographic aging continue to erode the active working-age foundation across eastern, southern, and rural peripheries.
- A continuous, one-way outward drain of young, tertiary-educated talent („brain drain") drains peripheral communities of vital human capital and reinforces regional contraction.
- Deep educational attainment divides persist, characterised by high early school leaving in rural areas and extreme employment penalties for low-educated workers.
- Contiguous cross-border belts of high poverty and material deprivation persist in structurally lagging rural and deindustrialized borderlands.

- Marginalised Roma communities and vulnerable groups face entrenched spatial segregation, educational exclusion, and severe labour market barriers.
- Cross-border labour mobility continues to encounter administrative, social security, and tax obstacles, alongside a lack of synchronized cross-border public transit.

No longer valid findings

- Universal and rising unemployment: The assumption of generalised, high, and rising unemployment across the macro-region is no longer valid, as Central and Eastern European economies have transitioned to tight labour markets, near-full employment, and severe skilled labour shortages.
- Protracted, static pre-accession holding patterns: The perception of an indefinite freeze in European enlargement has been superseded by Montenegro entering the final stage of negotiations for 2028 EU accession, alongside official candidate status and active negotiations granted to Ukraine, Moldova, and Bosnia and Herzegovina.
- Persistent Schengen barriers along internal Southeastern EU borders: The status of Croatia, Romania, and Bulgaria as non-Schengen border-controlled territories has ceased to exist following Croatia's entry in 2023 and Romania and Bulgaria's full Schengen accession in 2025.
- Uninterrupted convergence in economic growth: The historical narrative of continuous macroeconomic catching-up across Eastern Member States has altered into post-2022 stagnation, characterised by industrial deceleration and widening gaps against EU growth benchmarks.
- Stable external energy import dependencies: The assumption of reliance on stable, low-cost external fossil fuel deliveries from the East has been dismantled, forcing an urgent structural decoupling and reconfiguration of energy supply routes.
- Marginal renewable energy adoption in catching-up states: The characterisation of Central and Southeastern Europe as passive renewable followers is no longer valid, given the massive, leap-frogging expansion of solar photovoltaics and residential heat pumps across transition economies.
- Uniform digital governance deficits across the Eastern basin: The assumption of comprehensive institutional backwardness in public digitalisation has been overturned by Ukraine's emergence as a top-ranking European leader in digital public services and e-citizen engagement.

New conditions

- Geopolitical instability and wartime disruptions: Russia's war of aggression against Ukraine has generated profound territorial disruptions, causing severe infrastructure destruction, trade route realignments, and long-term integration needs for beneficiaries of temporary protection.
- The Danube as a strategic „Solidarity Lane": Riverine and Black Sea ports (such as Izmail, Reni, Giurgiulești, Galați, and Constanța) have acquired critical geopolitical importance as vital transport lifelines for continental agricultural and energy security.
- Re-emerging internal border friction: The reintroduction of temporary Schengen border controls in response to migration and security concerns has reinstated physical friction along internal corridors, challenging free movement.
- Expanded EU enlargement arena: The macro-region has become the central operational laboratory for European enlargement, requiring pre-accession regulatory convergence and institutional capacity building across the Western Balkans, Moldova, and Ukraine.
- Acute water scarcity and compound heat extremes: Climate change has rapidly shifted atmospheric regimes from warm-summer to hot-summer and semi-arid conditions, escalating chronic drought stress and expanding destructive wildfire risks into temperate and mountain zones.
- A multi-speed circular economy transition: Significant divergence has emerged between Central European leaders in packaging waste recycling and southeastern territories experiencing regulatory regression and high landfill dependence.
- Metropolitan housing affordability crises: Severe inflation in real estate and rental prices across capital cities has created acute urban housing strain, contrasting sharply with high rural vacancy and property dilapidation in peripheral hinterlands.
- Institutionalisation of the „Right to Stay": A fundamental policy consensus has emerged to counteract peripheral depopulation by guaranteeing spatial justice, decentralised services of general interest, and local economic viable pathways.
- Horizontal governance of „Special Territorialities": Complex territorial spaces including cross-border functional areas, twin cities, mountain ranges, vulnerable sub-catchments, and external borderlands now demand dedicated, place-based governance instruments.

Main „Danubian" trends & topics

- Hydrological and ecological interdependence: Downstream territories inherit up to 95% of their surface water flows from upstream neighbours, making water quality and water

supply concerns, plastic pollution abatement, and nature-based water retention indivisible shared challenges.

- The central arena for European reunification: Stretching from the Western European core to the Black Sea, the macro-region links established Member States, recent Schengen entrants, and fast-advancing candidate countries within a single operational cooperation framework.
- Europe's industrial manufacturing workshop: The basin hosts an exceptional concentration of continental industrial output and SME turnover, but faces severe structural risks of deindustrialisation and middle-income traps.
- The macro-regional „innovation paradox": High-level research expenditure, patent co-inventions, and high-tech employment remain hyper-concentrated in the German-Austrian core and isolated capital islands, leaving eastern and rural territories in a persistent innovation shadow.
- Acute demographic contraction and workforce depletion: Pervasive natural population decline combined with selective youth out-migration demands an urgent macro-regional shift from unilateral brain drain to reciprocal „brain circulation" to safeguard the „Right to Stay".
- A polarised, monocentric urban hierarchy: Fast-growing, overheated capital agglomerations stand in stark contrast to shrinking non-metropolitan hinterlands that face declining public service viability and extended travel times to basic facilities.
- Divergent, multi-speed energy systems: High baseline fossil fuel dependencies and climate-vulnerable hydro assets coexist with rapid decentralised solar and heat pump adoption, requiring cross-border smart grid interconnections and the joint valorization of deep Pannonian geothermal reserves.
- The duality of debordering and border friction: The historical achievement of a continuous internal Schengen area from the Alps to the Black Sea is challenged by temporary internal border checks and multi-hour freight clearance bottlenecks at external non-Schengen frontiers.
- The necessity of cross-sectoral, landscape-scale synergies: Strengthening territorial resilience requires moving beyond siloed, single-sector interventions toward integrated solutions that combine related topics across shared borders.

2.2.2 Recommendations

Here a matrix will be provided consisting of the the following columns:

- References: the concrete sections (subchapters) of the territorial analysis where the main challenge derives from.
- Main challenges: the descrtiption of the actual main challenges, based on the territorial analysis, which are supposed to be tackled by the strategic directions of the new Programme.
- Transnational cooperation needs: these can be consired as responses to the challenges in order to reach higher level of cohesion within the programme area. Only those activities are listed which requires transnational initiaties and interventions.
- Fit to the EUSDR Action Plan: it describes how the Priority Areas (PAs) of the European Union Strategy for the Danube Region relate and support the realisation of the identified cooperation needs.
- Fit to the programming regulations: it describes how the different (new) programming regulations also relevant for the Danube Region relate and support the realisation of the identified cooperation needs.

The main aim of the matrix will be to provide the stakeholders with the exhaustive list of territorial, economic and social challenges identified in the macro-region in order to set-up a sound basis for the identification of the programme priorities. It is important to note that the matrix will be structured according to the methodology applied to the territorial analysis which may not be fully appropriate for programming purposes; instead the listed topics may be re-organised around priority areas to be selected by the Task Force.

III DETAILED TERRITORIAL ANALYSIS

3.1 Territorial cohesion

3.1.1 Landscape, environmental factors, climate change

Landscape and land use features

There are as many as seven biogeographical regions within the Danube Region, all of which have a transboundary nature. This means that flora and fauna do not stop at national borders; artificial state boundaries are not aligned with the natural borders of environmental regions. The only country that can be considered homogeneous is Hungary, which belongs entirely to the Pannonian region. The Continental region, being the most widespread type, forges the macroregion into a sort of unity, as it can be found in all participating states except Slovakia, Hungary, and Montenegro. Overall, the macroregion is rather a colourful mosaic of diverse environments. However, these regions unite many areas across state borders: the Pannonian region expands into Hungary, Slovakia, Czechia, Ukraine, Romania, and Serbia, while the Alpine region covers various territories across Austria, Slovakia, Ukraine, Romania, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, and Bulgaria.

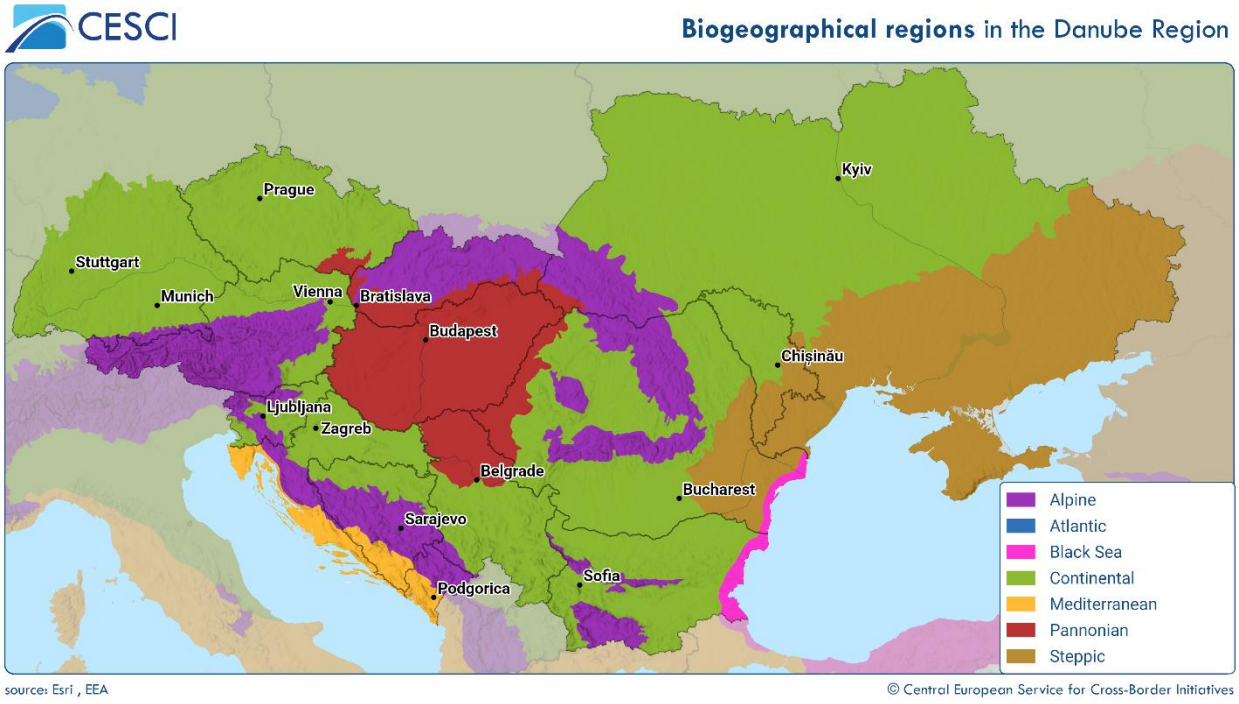


Figure 1: Biogeographical regions in the Danube Region

The ecological landscape of the Danube Region is highly heterogeneous, yet several ecoregions foster cohesion across the ecological geographies of the participating states. While no single

type unites the entire macroregion, all 13 ecoregions identified within the area possess a distinct transboundary character. For instance, Pannonian mixed forests are autochthonous in as many as 10 countries. Other ecoregions with prominent transboundary features include the Carpathian montane coniferous forests (Czechia, Slovakia, Ukraine, and Romania), the Dinaric Mountains mixed forests and Illyrian deciduous forests (Slovenia, Croatia, Bosnia and Herzegovina, and Montenegro), as well as the East European forest steppe (Ukraine, Moldova, Romania, and Bulgaria). The most homogeneous countries in terms of ecoregional coverage are Hungary (comprising only Pannonian mixed forests), Slovakia (Carpathian montane coniferous forests and Pannonian mixed forests), Bulgaria (predominantly Balkan mixed forests and Rodope montane mixed forests), Serbia (mostly Pannonian mixed forests and Balkan mixed forests), and Montenegro (mostly Illyrian deciduous forests and Dinaric Mountains mixed forests). Nevertheless, the majority of the territory exhibits a rich mosaic of natural flora, as demonstrated by Romania or smaller states like Slovenia, which harbors a remarkable variety of ecoregions despite its size. This transboundary diversity underscores the vital importance of coordinated transnational protection and environmental management.

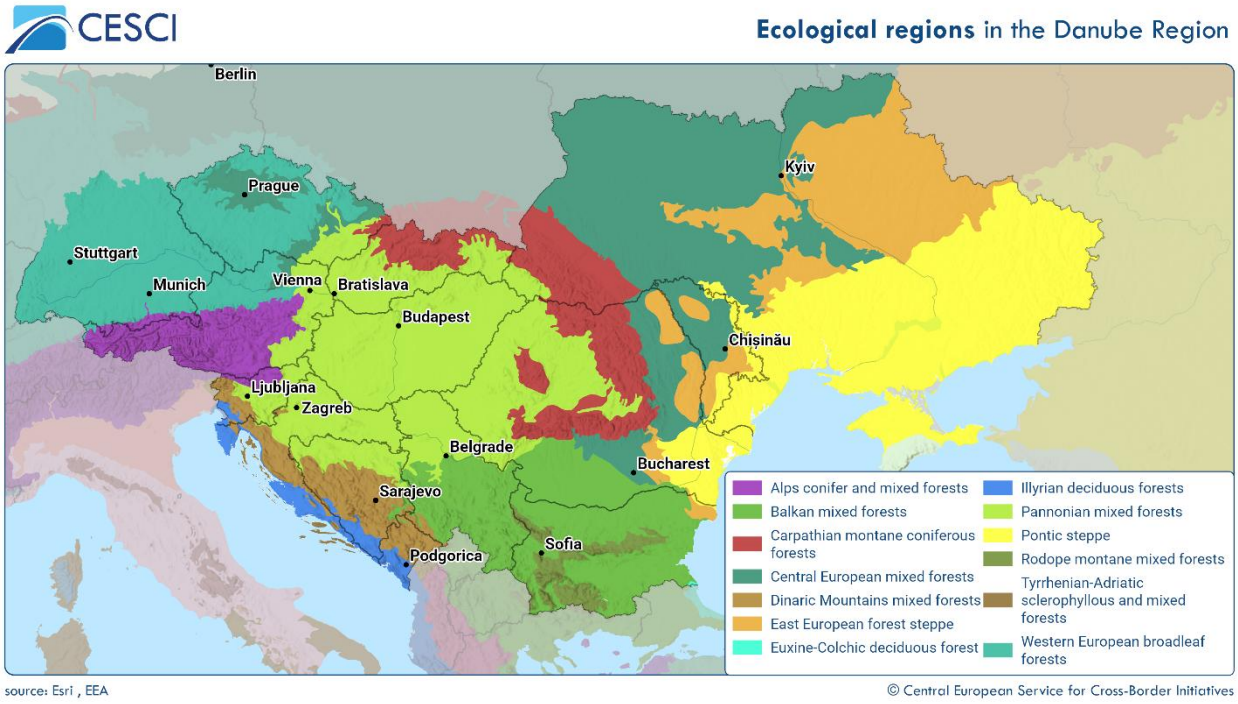


Figure 2: Ecological regions in the Danube Region

The Danube Region features an exceptionally favorable soil composition highly suited for intensive agricultural production. High-fertility soil types dominate the landscape, led by Cambisols (32.1%, calculated excluding newly incorporated Ukrainian regions), Luvisols (16.8%), humus-rich Chernozems (12.0%), Phaeozems (9.0%), and alluvial Fluvisols (7.3%). In contrast, less productive or agriculturally unfavorable soils – such as Leptosols, Podzols, and Solonetz – constitute only a minor fraction of the macroregion's total area.

However, despite this inherent pedological advantage especially taking into account extensive high-quality soils found in Ukraine, the region's soil resources face escalating climate and anthropogenic pressures. Rising mean temperatures, prolonged multi-month droughts, and irregular precipitation patterns are driving severe soil moisture deficits, increasing soil aridity, and accelerating erosion risks across key agricultural zones like the Pannonian Basin and Banat Plains. Furthermore, intensive farming practices continue to generate diffuse agricultural nutrient runoff, which poses a threat to transboundary groundwater aquifers and river systems. It is a joint challenge to safeguard soil ecosystem services and long-term food security. Needs for proactive drought management, natural water retention measures (NWRM), the integration of small-scale wetlands into agricultural landscapes, and the promotion of chemical-free, climate-resilient soil management have to be mentioned.

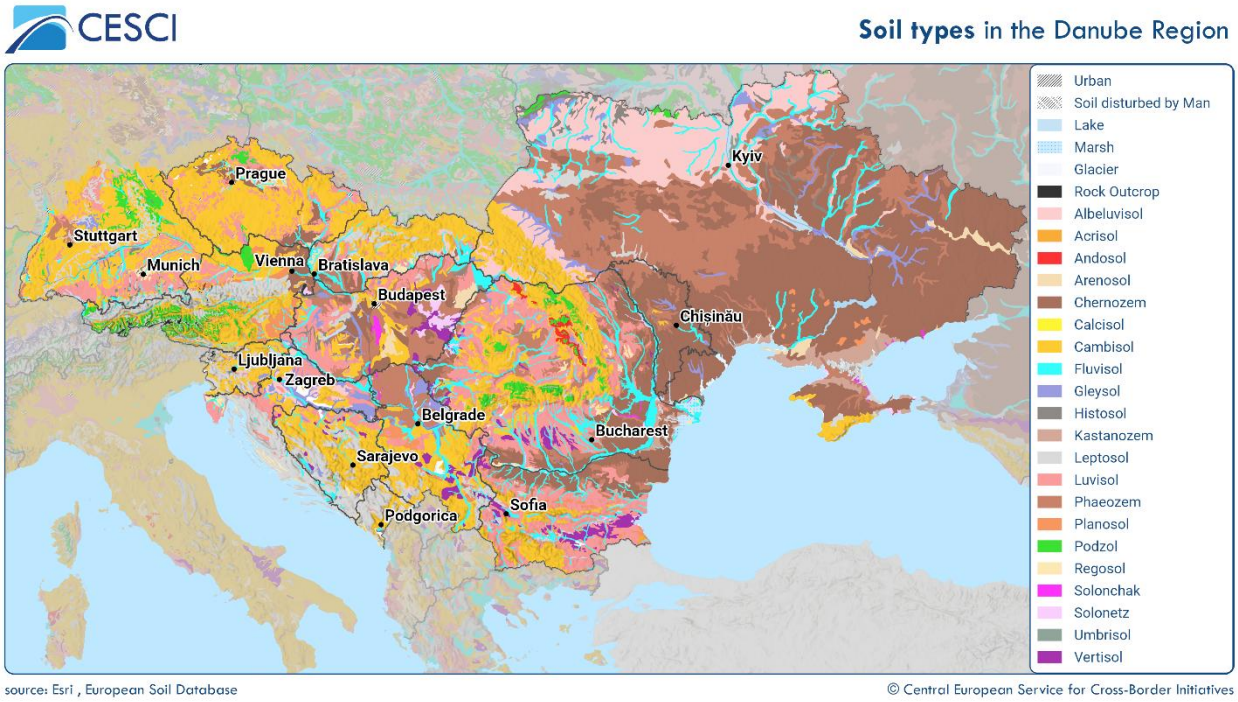


Figure 3: Soil types in the Danube Region

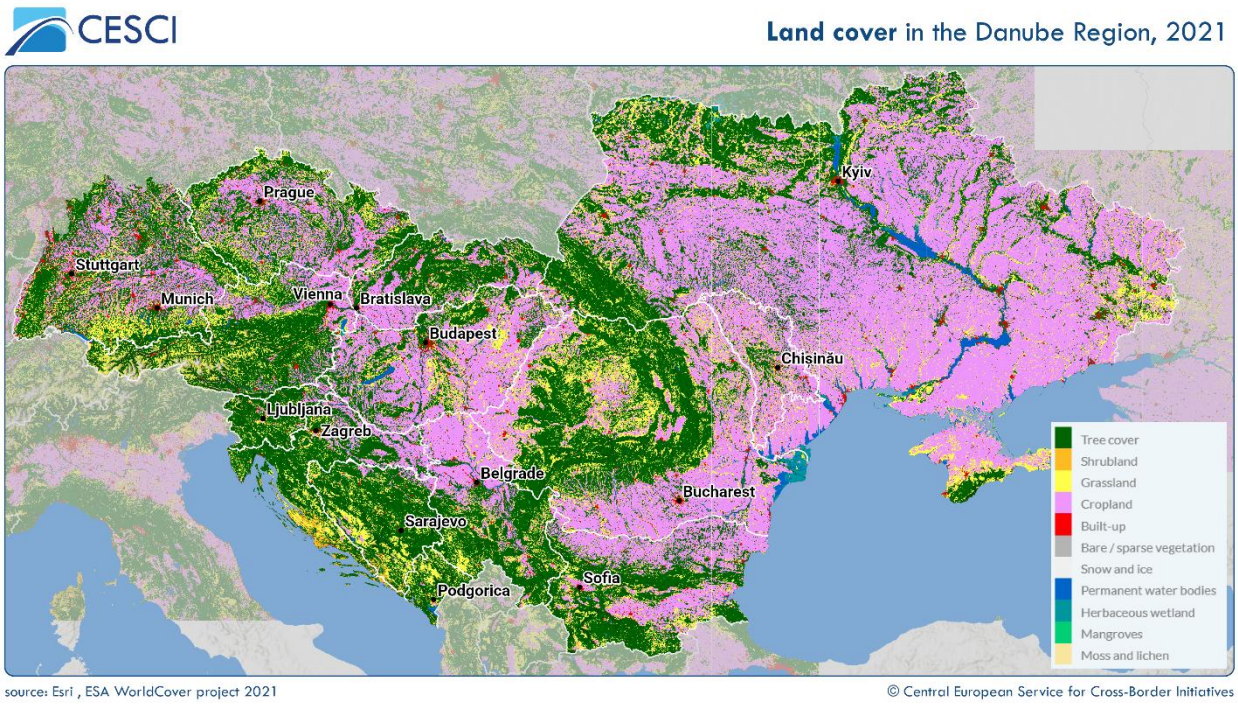


Figure 4: Land cover in the Danube Region

Considering land cover, the Danube Region is predominantly characterised by arable land (33.6%, calculated excluding the eastern regions of Ukraine) and forests (30.0%), which collectively dominate the land cover and encompass nearly two-thirds of the macroregion. Total agricultural areas account for slightly more than half of the territory (50.5%), surpassing the combined share of forest and semi-natural landscapes (42.3%).

The spatial configuration of land use exhibits marked regional variation. Arable land is particularly dominant across extensive lowland plains (most notably the Black Sea Lowland in Ukraine, the Hungarian Great Plain, the Wallachian Plain in Romania, Vojvodina in Serbia, and the Danubian Plain in Bulgaria. Many of these fertile plains stretch continuously along the Danube River and its major tributaries, giving them a distinctly transboundary character. Beyond their food production capacity, these agricultural and forest ecosystems serve as the foundation of the macroregion's bioeconomy, providing essential forestry biomass and an expanding volume of biogenic agricultural residues. However, these intensive farming landscapes increasingly face land-use competition with wetland and peatland conservation, prompting strategic policy shifts toward smart landscape water retention, agroforestry, and the restoration of small-scale ecological buffer zones within farmland.

Conversely, forests account for high proportions of land cover in mountainous and pre-Alpine countries such as Austria and Slovenia, with extensive contiguous forests closely tied to major mountain ranges like the Alps and the Carpathians. Overall, while the western part of the macroregion, including the Western Balkans, features a highly heterogeneous, mosaic-like landscape, central and eastern lowland territories display a significantly simpler and more monolithic spatial structure.

Nature protection

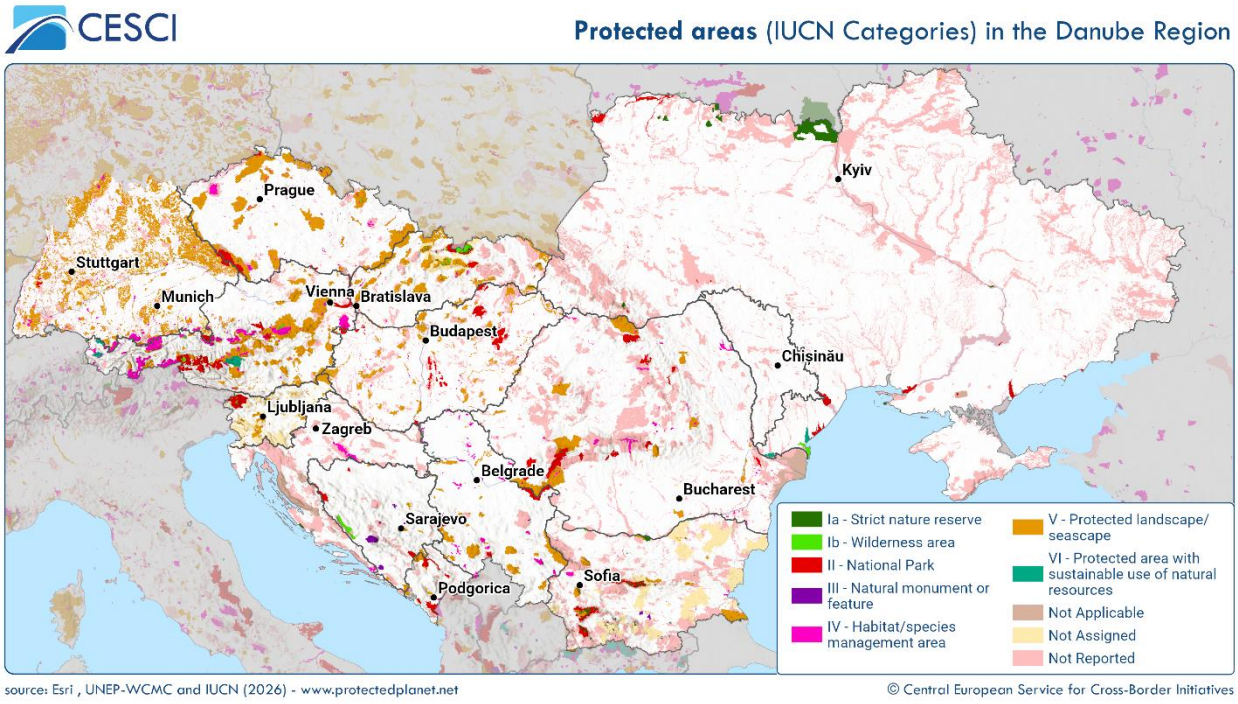


Figure 5: Protected areas in the Danube Region

The Danube Region is rich in diverse categories of protected areas, featuring transboundary zones of exceptional biodiversity that stretch from lowland wetlands and river gorges (e.g., the Danube Delta, the Iron Gates) to hilly and mountainous landscapes (e.g., the Dinaric Alps, the Balkan Mountains, and the Bohemian/Bavarian Forest). Numerous extensive protected areas are located directly along national borders, encompassing shared ecosystems whose flora, fauna, and landscape values call for harmonised transnational management and development.

However, effective nature protection across these shared ecosystems continues to face significant governance challenges. Management efforts are frequently hampered by a persistent lack of integrated joint protection initiatives, as well as notable national disparities in environmental regulations, institutional competencies, and financial or human resource allocations. While milestone achievements, such as the five-country Mura-Drava-Danube Transboundary Biosphere Reserve and joint commitments under EUSDR Priority Area 6, demonstrate the potential for cross-border synergy, state borders often remain hard artificial barriers that fragment otherwise contiguous natural environments.

There is a need for advancing green and blue infrastructure networks, harmonising Natura 2000 management standards, and embedding nature-based solutions to safeguard ecological connectivity and flagship species across the basin.

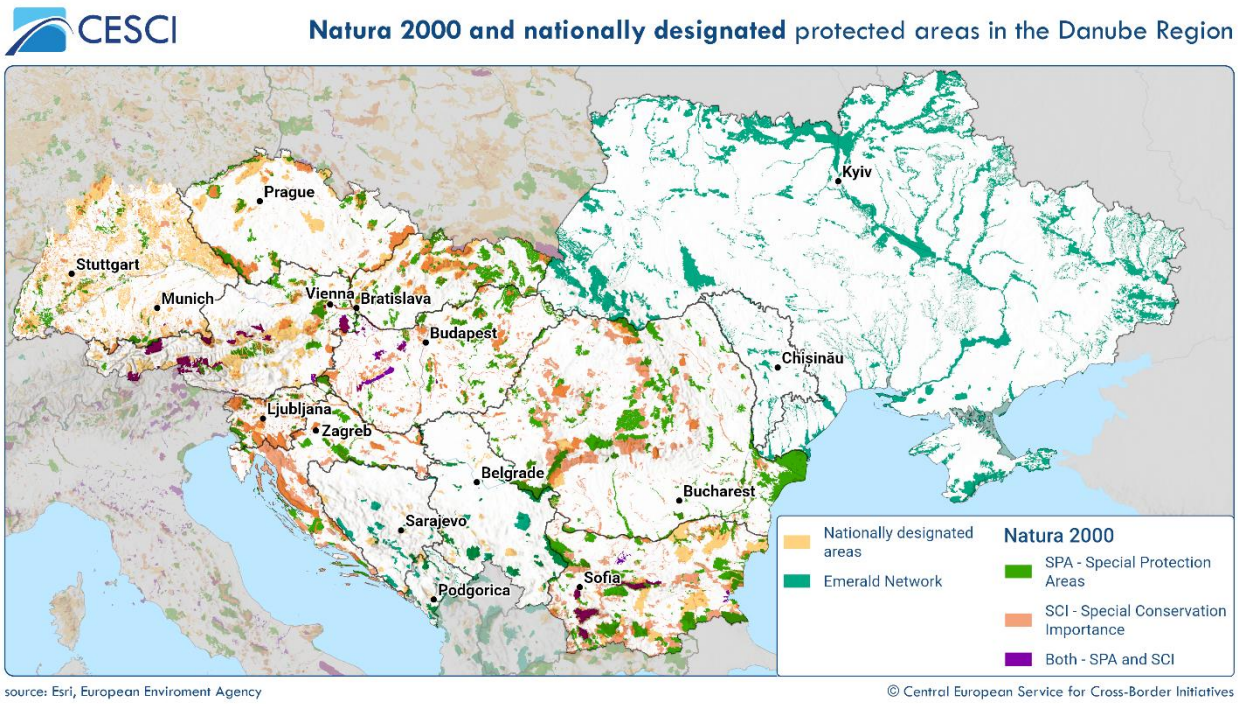


Figure 6: Natura 2000 and nationally designated areas in the Danube Region

Under alternative classifications that distinguish between nationally designated sites and Natura 2000 networks, a pronounced spatial heterogeneity of protected areas remains evident across the macroregion. While several Central and Southeastern European Danube states, most notably Slovenia, Croatia, Bulgaria, and Slovakia, boast Natura 2000 coverage substantially exceeding the European Union average of 18%, others fall short of this baseline, pointing to varying national protection frameworks.

Nevertheless, extensive contiguous landscapes exhibit paramount transboundary relevance for nature conservation. Major mountain chains (such as the Alps, Carpathians, and Dinaric Range) and expansive wetland habitats, among which the Danube River Basin and the Danube Delta are of outstanding international importance, form vital ecological lifelines for the continent. In line with macroregional commitments under EUSDR Priority Area 6 and the ICPDR Danube Declaration, maintaining the ecological integrity of these shared assets increasingly demands basin-wide ecosystem restoration, the protection of migratory fish corridors, and the integration of natural water retention measures to buffer biodiversity against severe climate and land-use stresses.

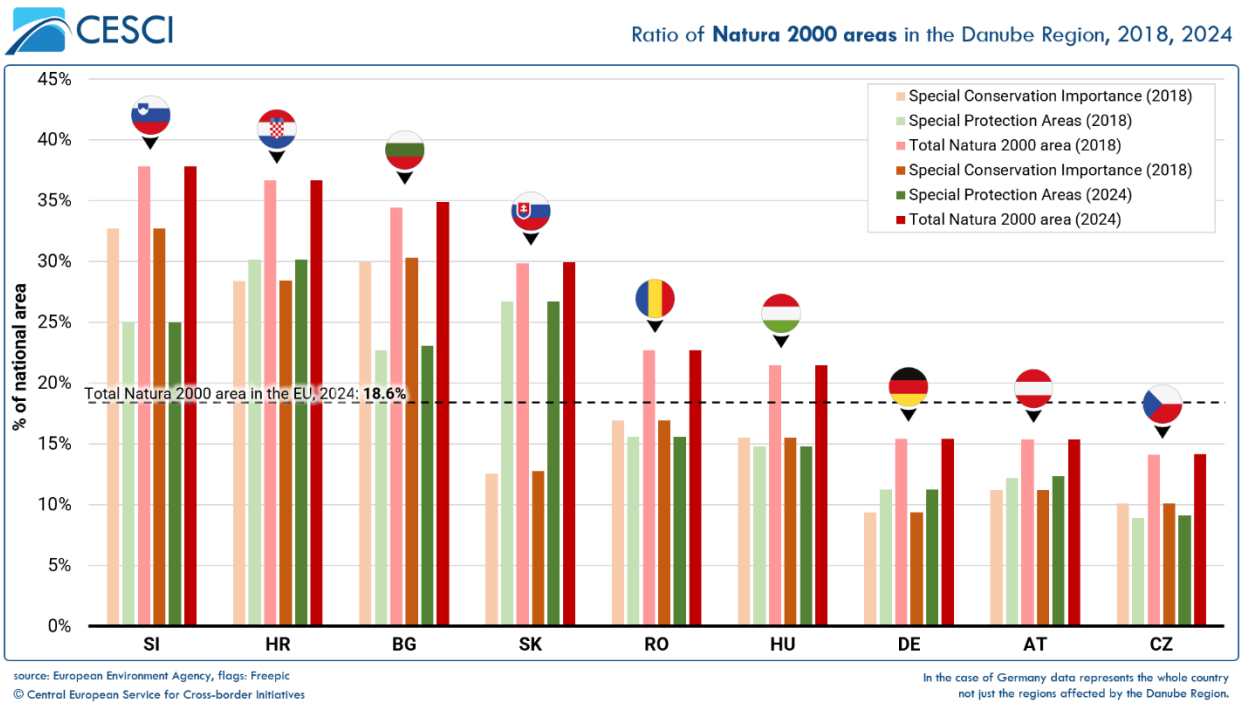


Figure 7: Ratio of Natura 2000 areas in the Danube Region

Across the Danube Region, the spatial distribution of protected areas (by ratio) reveals both a rich ecological heritage and profound institutional variations in environmental governance. The majority of central and southeastern Danube states maintain protection ratios significantly above the European Union average baseline of 18.6% (2024). A leading frontrunner tier is formed by Slovenia (37.9%), Croatia (36.7%), Bulgaria (34.9%), and Slovakia (30.0%), followed by an intermediate convergence group comprising Romania (22.7%) and Hungary (21.4%). In contrast, older EU Member States and central core economies – specifically Germany (15.4%), Austria (15.4%), and Czechia (14.2%) – register coverage levels below the EU benchmark. Between 2018 and 2024, spatial designation across the macroregion remained virtually static, with near-zero percentage-point growth across most national territories. This plateau reflects a broader paradigm shift in European environmental policy, where focus is transitioning from expanding static legal boundaries toward improving the qualitative management, connectivity, and climate resilience of existing protected sites.

Historically, rigid state borders acted as artificial barriers that fragmented these contiguous natural landscapes, compounding environmental stresses through mismatched national regulations, uneven technical resources, and siloed monitoring systems.

Despite these historical divides, the Danube Region possesses unique ecological complementarities that present vast opportunities for joint macroregional action. Upstream and downstream territories are bound by absolute hydrological and ecological interdependencies; environmental conservation or pollution abatement in upstream states directly safeguards water quality, flood retention, and biodiversity for downstream nations. This functional synergy is exemplified by landmark transboundary initiatives, such as the five-country Mura-Drava-Danube

Transboundary Biosphere Reserve and joint restoration projects along the Danube Delta and major river tributaries.

Building on established governance frameworks like the International Commission for the Protection of the Danube River (ICPDR) and Priority Area 6 of the EU Strategy for the Danube Region (EUSDR), the region has immense potential to scale up green and blue infrastructure networks. Ultimately, by leveraging sustainable community-led eco-tourism and establishing joint cross-border management tools, the Danube states can transform shared environmental vulnerabilities into a powerful driver of macroregional integration and territorial cohesion.

The Danube Region features an exceptionally rich concentration of UNESCO World Heritage Sites, which serve as global cultural and natural treasures, vital anchors of regional identity, and strategic assets for sustainable territorial development. The spatial distribution of these designated sites across the macroregion remains uneven: the highest numbers of properties are clustered in Germany, Austria, Czechia, Bulgaria, Croatia, and Romania, while countries such as Bosnia and Herzegovina, Montenegro, Moldova, and Ukraine host fewer recognised sites relative to their geographical area. The vast majority of properties consist of cultural monuments, historic urban cores, and cultural landscapes, alongside iconic natural reserves. A significant proportion of these heritage assets possess an inherently transnational character or sit directly within border areas, reflecting centuries of shared history, trade, and continuous ecological corridors.

In recent years, the UNESCO World Heritage framework in the Danube Region has expanded through landmark multi-national inscriptions that unite neighboring states. Transnational sites shared by at least two countries in the macroregion include:

- Frontiers of the Roman Empire – The Danube Limes (Western Segment): Inscribed in 2021, this extensive Roman military frontier system spans Germany, Austria, and Slovakia along the Danube River.
- The Great Spa Towns of Europe: Inscribed in 2021, this transnational property includes historic thermal spa destinations across Austria (Baden bei Wien), Czechia (Karlovy Vary, Mariánské Lázně, Františkovy Lázně), and Germany (Baden-Baden, Bad Ems, Bad Kissingen).
- Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe: Continuously expanded (most recently in 2021), this natural heritage network spans 18 European countries, incorporating major virgin forest reserves across Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Germany, North Macedonia, Romania, Slovakia, Slovenia, and Ukraine.
- Wooden Tserkvas of the Carpathian Region in Poland and Ukraine: Inscribed in 2013, this shared property protects 16 wooden churches representing distinct vernacular timber architecture across the Carpathian mountain range.

- Prehistoric Pile Dwellings around the Alps: Shared across Austria, Germany, and Slovenia (alongside Switzerland, France, and Italy).
- Fertő / Neusiedlersee Cultural Landscape: Shared between Austria and Hungary.
- Stećci Medieval Tombstone Graveyards: Shared across Bosnia and Herzegovina, Croatia, Montenegro, and Serbia.
- Venetian Works of Defence between the 16th and 17th centuries: Stato da Terra – western Stato da Mar: Shared across Croatia and Montenegro (alongside Italy).
- Caves of Aggtelek Karst and Slovak Karst: Shared between Slovakia and Hungary.
- Struve Geodetic Arc: Spanning Moldova and Ukraine (alongside eight other Northern and Eastern European states).

As highlighted in regional research studies and macroregional policy evaluations (such as the *MYSTICAL DANUBE* project), cultural and natural heritage is increasingly recognised as strategic development infrastructure rather than static preservation areas. Transnational cultural routes, historic landscapes, and heritage hubs serve as economic multipliers that stimulate local micro-enterprises, foster community-based sustainable tourism (CBT), and generate quality employment in peripheral and rural regions. By creating local economic value chains around traditional crafts, gastronomy, and eco-tourism, heritage conservation directly supports youth retention and protects the "Right to Stay" in depopulating hinterlands.

However, heritage assets across the macroregion face severe compounding risks. Thre is a need for integrated spatial planning that combines shared disaster risk monitoring, digital heritage mapping (such as open-access GIS heritage atlases and 3D digital twins), and sustainable green transport links to ensure heritage continues to drive territorial cohesion and resilience across the Danube basin.

Hydrological features



Figure 8: Chemical status of the rivers in the Danube River Basin, source: ICDPR

The Danube River Basin is the most international river basin in the world, interconnecting 14 sovereign states ranging from long-standing European Union Member States to Western Balkan candidate countries and Eastern Neighborhood partners. Within this shared hydrographic system, the chemical status of surface waters, evaluated under the EU Water Framework Directive (WFD) and systematically mapped in the International Commission for the Protection of the Danube River (ICPDR) Danube River Basin Management Plan (DRBMP Update 2021), serves as a vital diagnostic indicator of environmental health and industrial safety. Water quality in the macroregion is an inherently transboundary issue due to extreme hydrological exposure. In middle and downstream territories, up to 95% of all surface water flows originate beyond national borders, reaching an extraordinary 94-96% in Hungary. Consequently, chemical contamination introduced upstream directly dictates downstream ecological conditions, necessitating unified macroregional governance frameworks.

A spatial analysis reveals a sharp geographical divide between river stretches achieving good chemical status (represented in blue) and those failing to reach good status (represented in red) due to priority substances exceeding environmental quality standards. One category is the Middle Danube and tributary hotspots (failing good status): a continuous, prominent red

corridor dominates the Hungarian main stem of the Danube, extending from the Slovak-Hungarian border section near Győr, through the Budapest agglomeration, down to the southern border near Mohács. In Slovakia, major tributaries including the Váh, Nitra, Hron, and Ipeľ, exhibit widespread failing chemical status. Across the Pannonian plain and Tisza catchment, several secondary rivers and agricultural drainage canals (such as the Hortobágy-Berettyó, Sebes-Körös, and Sajó) fail to reach good status. In the upper catchment, red stretches are also concentrated along the headwaters of the German Danube (from the source near Ulm to Ingolstadt) and key tributaries in Czechia (e.g., the Morava). These hot spots stem from historical industrial legacies, intensive agrochemical application, dense urban settlement, and pervasive priority pollutants such as mercury, polycyclic aromatic hydrocarbons (PAHs), and synthetic pesticides. Another category can be detected, which can be named as Alpine upper catchments and lower basin (good status): In contrast, the Austrian section of the Danube and its major Alpine tributaries (including the Inn, Salzach, Enns, Mur) display a consistently good chemical status (marked in dark blue). Similarly, the Sava and Drava river networks across Slovenia and Croatia demonstrate strong chemical performance. Most notably, the Lower Danube main stem, stretching along the Romanian and Bulgarian border, through the Danube Delta, and discharging into the Black Sea, is categorised as achieving good chemical status with high-to-medium confidence. However, despite this positive rating along the main Lower Danube channel, downstream aquatic systems remain highly vulnerable to cumulative toxic loads, microplastics, and seasonal low-flow conditions.

The persistent failure of specific water bodies to achieve good chemical status is driven by a combination of diffuse, point-source, and emerging environmental pressures across the basin. Intensive agricultural practices across the Pannonian and Wallachian plains release heavy loads of synthetic fertilizers (nitrates, phosphorus) and chemical pesticides into surface streams and vulnerable transboundary aquifers, causing widespread eutrophication.

Another major challenge of transantional relevance is the municipal wastewater infrastructure deficit: severe structural gaps in municipal wastewater collection and treatment persist across southeastern EU Member States and non-EU candidate countries. For example, in Serbia, only 12% of the population was connected to urban wastewater treatment facilities in 2017. Furthermore, physical water distribution losses (Non-Revenue Water) exceed 50–60% across lower and middle basin nations like Bulgaria, Bosnia and Herzegovina, Serbia, Montenegro, and Romania, contrasting sharply with upper basin leaders such as Austria (5–10% NRW).

Plastic pollution represents a critical, emerging threat to the ecological integrity of the Danube River Basin, heavily manifesting along transboundary sub-basins like the Tisza and its upper tributaries originating in Ukraine and Slovakia. During seasonal flood surges and high-water events, massive volumes of uncollected municipal solid waste and macro-plastics are washed from upstream riverbanks in the Carpathian catchments into rivers such as the Latorica, Uzh,

and Upper Tisza. This creates recurring environmental emergencies as dense carpets of floating plastic debris travel downstream across international borders, straining municipal infrastructure and water habitats.

The root of this transboundary waste crisis lies in severe municipal waste management deficits, low recycling rates, and the presence of unmanaged landfills located in vulnerable mountain floodplains across upper catchment territories. Because downstream regions inherit up to 95% of their surface water flows from beyond national borders, upstream municipal collection failures inevitably convert local solid waste into a shared macroregional hazard.

At last but not least, industrial, mining, and geopolitical contamination has to be addressed. Legacy industrial brownfields, mining tailings (releasing heavy metals and salt into the Tisza and Banat river networks), and natural well-water arsenic contamination present localised chemical hazards. These traditional risks are now compounded by conflict-related pollution in Ukraine, where the wartime destruction of industrial plants, chemical storage sites, and water infrastructure has released toxic contaminants and hazardous debris into shared Black Sea inflow basins.

Consequently, transnational warning and monitoring systems, upgraded water management systems, upgrade in wastewater treatment and solid waste management, implementing proactive Nature-based Solutions (NbS) is ouf outstanding importance across large parts of the Danube Region.

Table 1: Transboundary water supplies[1]

NAME OF THE GROUNDWATER BODY	SIZE (km²)			AQUIFER TYPE[2]	UTILISATION[3]	CRITERIA FOR IMPORTANCE
	TOTAL	COUNTRIES AFFECTED	AREA PER COUNTRY			
Deep Thermal	5 900		1 650	K	SPA, CAL	Intensive use
			4 250			
Upper Jurassic – Lower Cretaceous	24 374		13 034	F, K	DRW, AGR, IND	>4000 km²
			11 340			
Middle Sarmatian - Pontian	22 308		9 662	P	DRW, AGR, IND	>4000 km2, GW use, GW resource
			12 646			
Sarmatian	5 495		3 308	K, F-K	DRW, AGR, IND	>4000 km2
			2 187			
Mures / Maros	7 216		4 989	P	DRW, IRR, IND	>4000 km2, GW resource, DRW protection
			2 227			

[1] source: International Commission for the Protection of the Danube River
[2] Predominantly: P = porous; K = karst; F = fissured
[3] DRW = drinking water; AGR = agriculture; IRR = irrigation; IND = Industry; SPA = balneology; CAL = caloric energy; OTH = other

NAME OF THE GROUNDWATER BODY	SIZE (km²)			AQUIFER TYPE[2]	UTILISATION[3]	CRITERIA FOR IMPORTANCE
	TOTAL	COUNTRIES AFFECTED	AREA PER COUNTRY			
Somes / Szamos	2 493		1 034	P	DRW, AGR, IRR	GW resource, DRW protection
			1 459			
Upper PannonianLower Pleistocene / Vojvodina / Duna-Tisza köze déli r.	28 959		7 098	P	DRW, AGR, IND, IRR	> 4000 km², GW use, GW resource, DRW protection
			11 355			
			10 506			
Podunajska Basin, Zitny Ostrov / Szigetköz, Hanság Rábca	3 338		1 152	P	DRW, IRR, AGR, IND	GW resource, DRW protection, dependent ecosystems
			2 186			
Bodrog	2 220		750	P	DRW, IRR	GW resource, DRW protection, dependent ecosystems
			1 470			
Slovensky kras / Aggteleki-hegység	1 091		493	K	DRW, OTH	GW resource, DRW protection, dependent ecosystems
			598	K, F		
Komarnanska Vysoka Kryha / Dunántúli-khg északi r.	3 900		3 337	K	DRW, SPA, CAL	Thermal water resource
			563	F, K		
Ipel / Ipoly	344		146	P	DRW, AGR	DRW protection, dependent ecosystems, GW resources
			198			

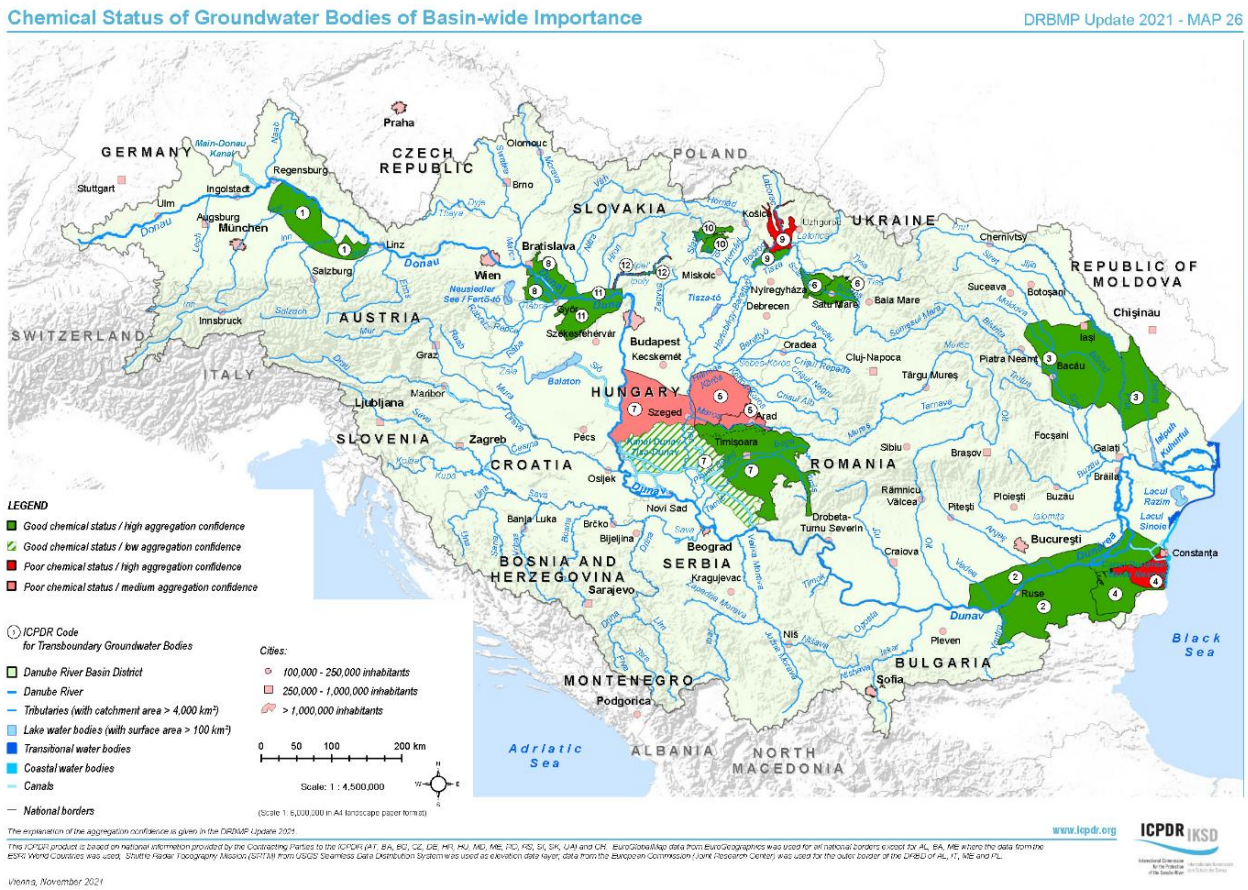


Figure 9: Chemical status of groundwater bodies of basin-wide importance in the Danube River Basin, source: ICDPR

An analysis of ICPDR map (DRBMP Update 2021) demonstrates that transboundary groundwater bodies of basin-wide importance across the Danube Region exhibit a predominantly good chemical status (green), functioning as critical reserves for drinking water, agriculture, and industry. However, significant localised zones of poor chemical status (red) persist across major agricultural and industrial plains, most notably within the Upper Pannonian aquifers spanning southern Hungary, western Romania, and northern Serbia (aquifers 5 and 7), as well as the Bodrog groundwater body along the Slovakian-Hungarian border (aquifer 9). These water quality deficits are primarily driven by diffuse agricultural nutrient loading, legacy industrial contamination, and untreated urban wastewater, which are increasingly compounded by climate-induced drought stress, groundwater table subsidence, and physical distribution losses (non-revenue water) exceeding 50-60% across lower and middle basin utilities. Safeguarding these vital transboundary aquifers requires coordinated macroregional governance, focusing on harmonised monitoring, digital leakage analytics, nature-based water retention, and strict compliance with European Water Framework Directive standards.

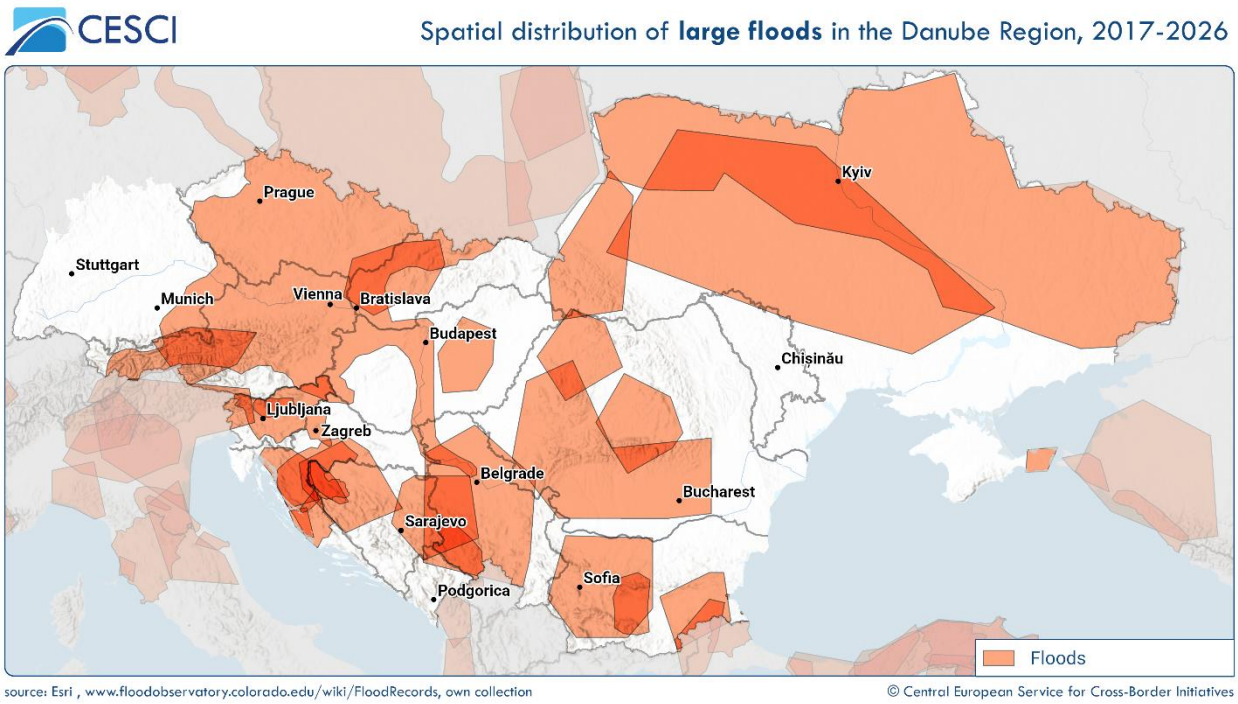


Figure 10: Spatial distribution of large floods in the Danube Region

Oftentimes the opposite of water scarcity plays thee most crucial role within the Danube Basin. Driven by climate change there are cases when it is the abundance of water (source) falling down or melted by a peak event, which causes international challenges to be tackled jointly across the macroregion. The Danube River Basin represents one of Europe's most hydrologically exposed macroregions, where flood hazards inherently transcend national borders across its 800,000 square kilometre catchment. Mapping spatial flood records between 2017 and mid-2024 highlights several primary hazard corridors, including the Dinaric and Sava Basin across Slovenia, Croatia, Bosnia and Herzegovina, Serbia, and Montenegro, where steep topography and rapid orographic rainfall trigger severe riverine surges. Similarly, the Upper Tisza catchment across Eastern Slovakia, Northeastern Hungary, Western Ukraine, and Northern Romania faces recurring compound flooding from snowmelt and torrential rain, while the Lower Danube plains in Romania, Bulgaria, Moldova, and Ukraine absorb the cumulative discharge of the entire basin. This baseline of chronic vulnerability was dramatically accentuated in mid-September 2024 by Storm Boris, an extreme atmospheric event that dumped over 300 to 400 millimeters of rainfall across Central Europe in just four days. Storm Boris triggered historic, multi-billion-euro inundations across Eastern Austria, Czechia, Slovakia, Hungary, and Eastern Romania, overtopping levees along secondary tributaries like the Kamp and Morava before sending a massive downstream surge cresting along the main stem past Vienna, Bratislava, and Budapest.

These recurring disasters underline the profound transnational interdependencies embedded within shared river catchments. Downstream states suffer extreme asymmetric vulnerability, as up to 95% of their surface water originates beyond national borders, leaving regions in Hungary, Moldova, and Romania acute recipients of upstream hydrological decisions. Effective cross-

border flood management is further constrained by persistent data debt, non-interoperable SCADA and GIS monitoring platforms, and uncoordinated physical infrastructure between EU Member States and non-EU candidate countries. When upstream territories rely exclusively on hard-engineering solutions like raised river embankments, flood energy is often deflected downstream, while historic river channelisation accelerates water velocities and intensifies surge peaks.

To counteract these systemic risks, macroregional challenges require a fundamental paradigm shift toward proactive landscape-based water retention and Nature-Based Solutions. There has been a growing need for reconnecting degraded floodplains, restoring wetlands, and establishing controlled polders along transboundary river corridors like the Tisza, Sava, and Drava allow excess surface water to dissipate naturally, significantly dampening peak flood discharges. Consequently, the establishment of well-functioning forecasting tools and early warning networks to secure long-term macroregional resilience is out outmost importance across the Danube Region.

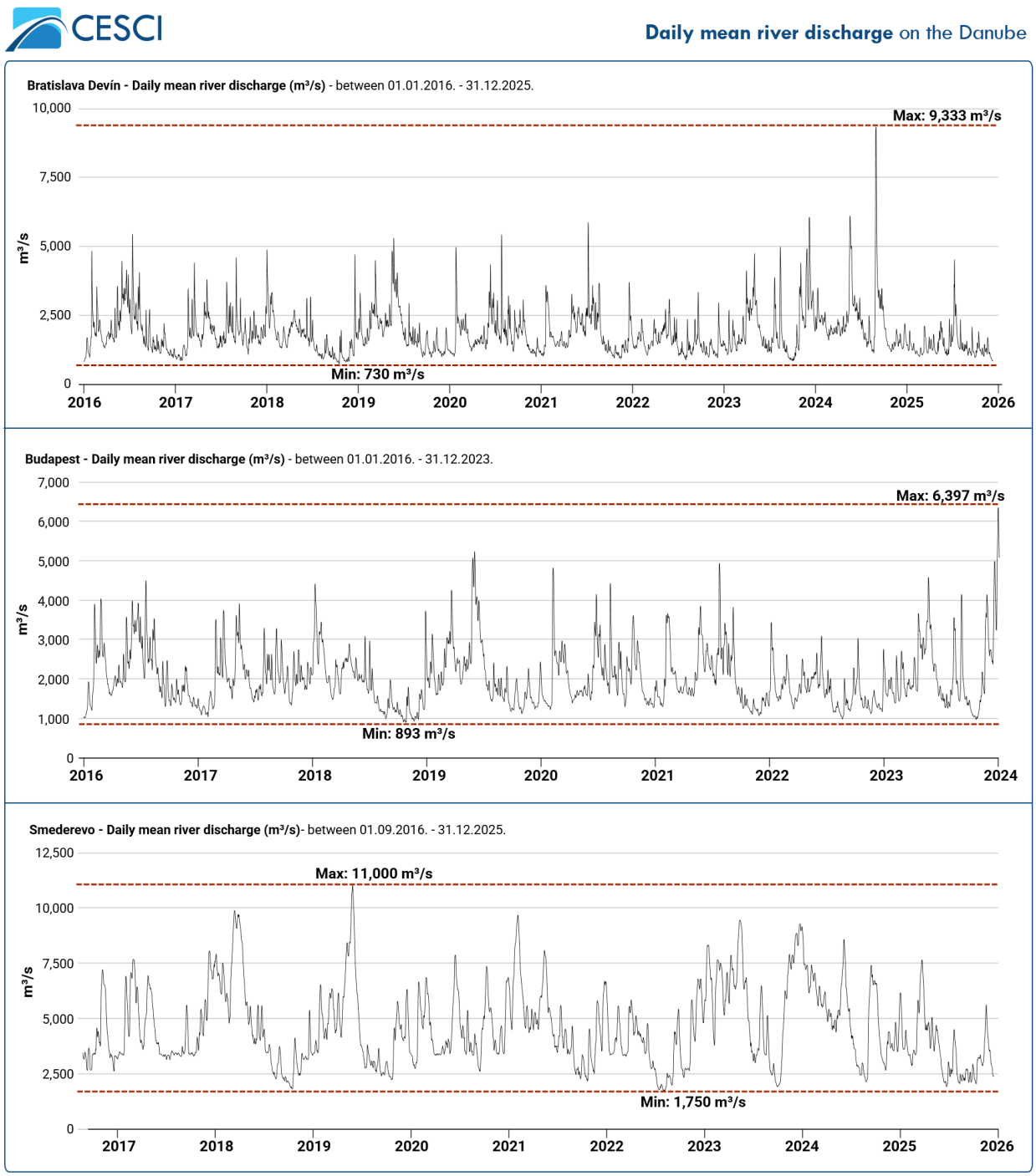


Figure 11: Bratislava Devín, Budapest, Smederovo – Dainly mean river discharge

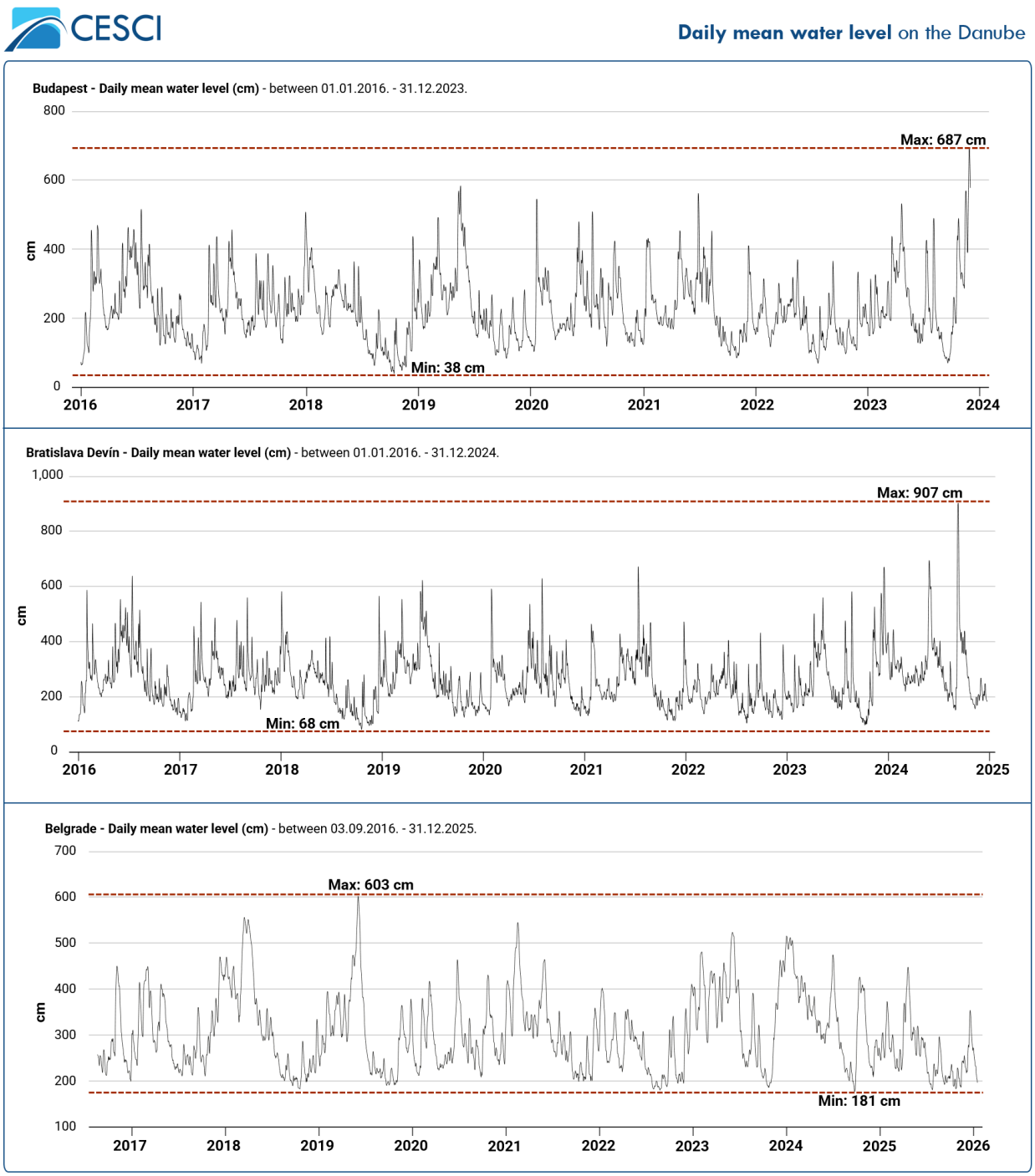


Figure 12: Budapest, Bratislava Devín, Belgrade – Daily mean water level

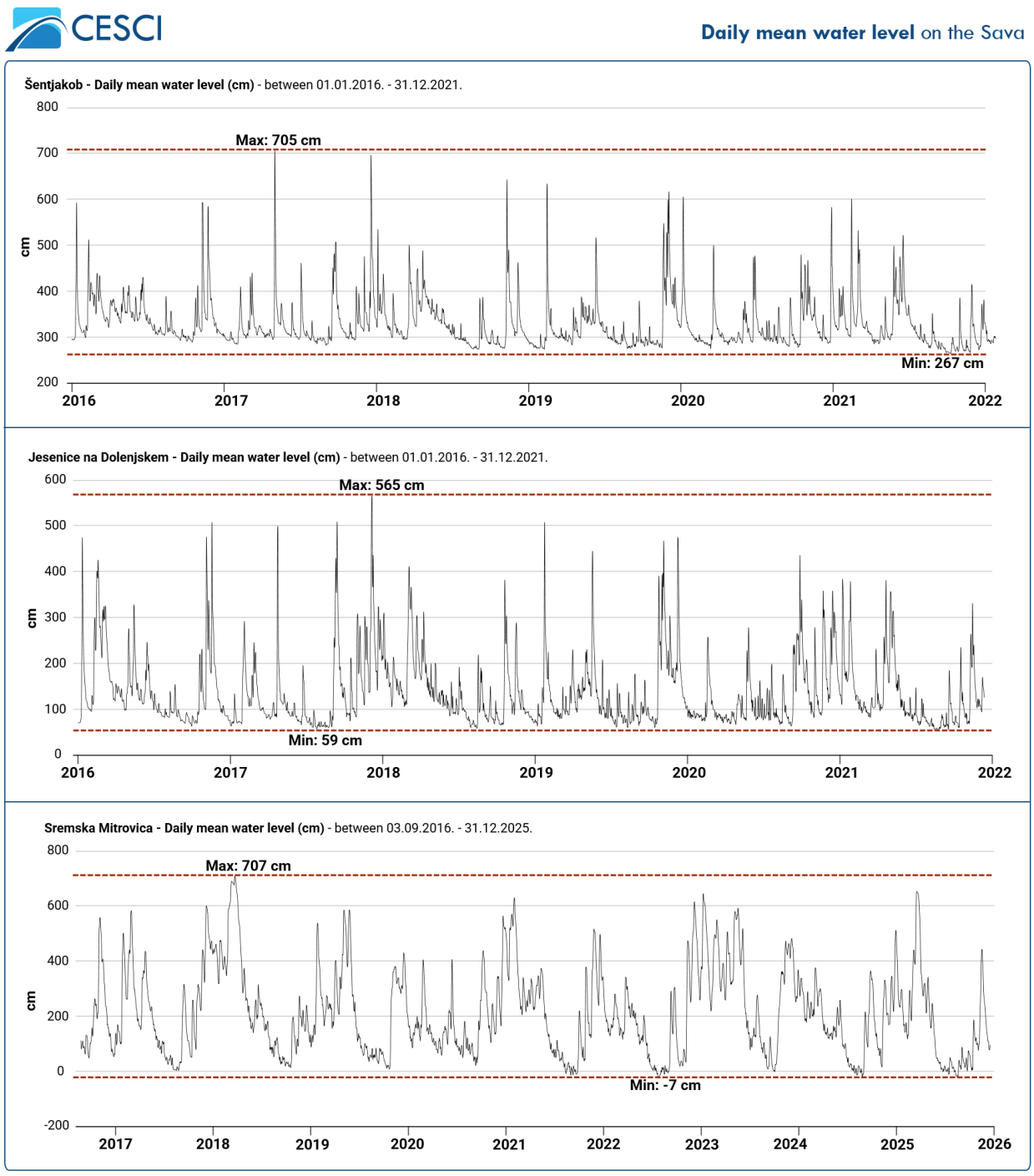


Figure 13: Šentjakob, Jesenice na Dolenjskem, Sremska Mitrovica – Daily mean water level

An analysis of long-term (historic) hydrographic records across the Danube River Basin reveals profound hydrological volatility, characterised by extreme disparities between minimum and peak (maximum) discharge and water levels along the macroregion's major arterial waterways. Multi-year monitoring data from key stations on the Danube and Sava rivers demonstrates a dramatic swing between acute low-flow droughts and catastrophic flood surges. Danube River discharge swings can be underlined e.g. by the Bratislava Devín station, where discharge fluctuates by a factor of nearly thirteen. Corresponding daily mean water levels exhibit massive

vertical amplitudes, expanding by 839 cm at Bratislava Devín (68 cm to 907 cm). Sava River water level disparities are also pronounced. In the lower Serbian section at Sremska Mitrovica, the water level experiences a 714 cm total range, dropping below the gauge datum to -7 c during peak drought before swelling to 707 cm during severe flood events.

These widening hydrographic amplitudes illustrate the two-sided climate challenge facing the Danube macroregion. Intensifying climate change is simultaneously amplifying both ends of the hydrological spectrum: sudden, high-intensity precipitation events trigger flash floods and severe riverine inundations, whereas prolonged dry spells and heatwaves drive extended low-flow periods and severe aridity. Each extreme imposes heavy socio-economic costs. Peak flood surges cause multi-billion-euro infrastructure damage and urban inundations, while low water levels severely impair freight shipping along the Danube TEN-T transport corridor, reduce hydropower generation, threaten municipal drinking water supplies, and accelerate groundwater table subsidence across major agricultural plains. Crucially, these shared vulnerabilities physically and strategically unite upstream and downstream states. To build macroregional resilience against growing extremities, there is a need fot a shift toward proactive landscape-based water retention and nature-based solutions (NbS). Harmonising cross-border hydrological monitoring systems (e.g., DanubeHIS, EFAS) and focusing more on water retention is of great importance.

Climate change, natural hazards, disaster risks

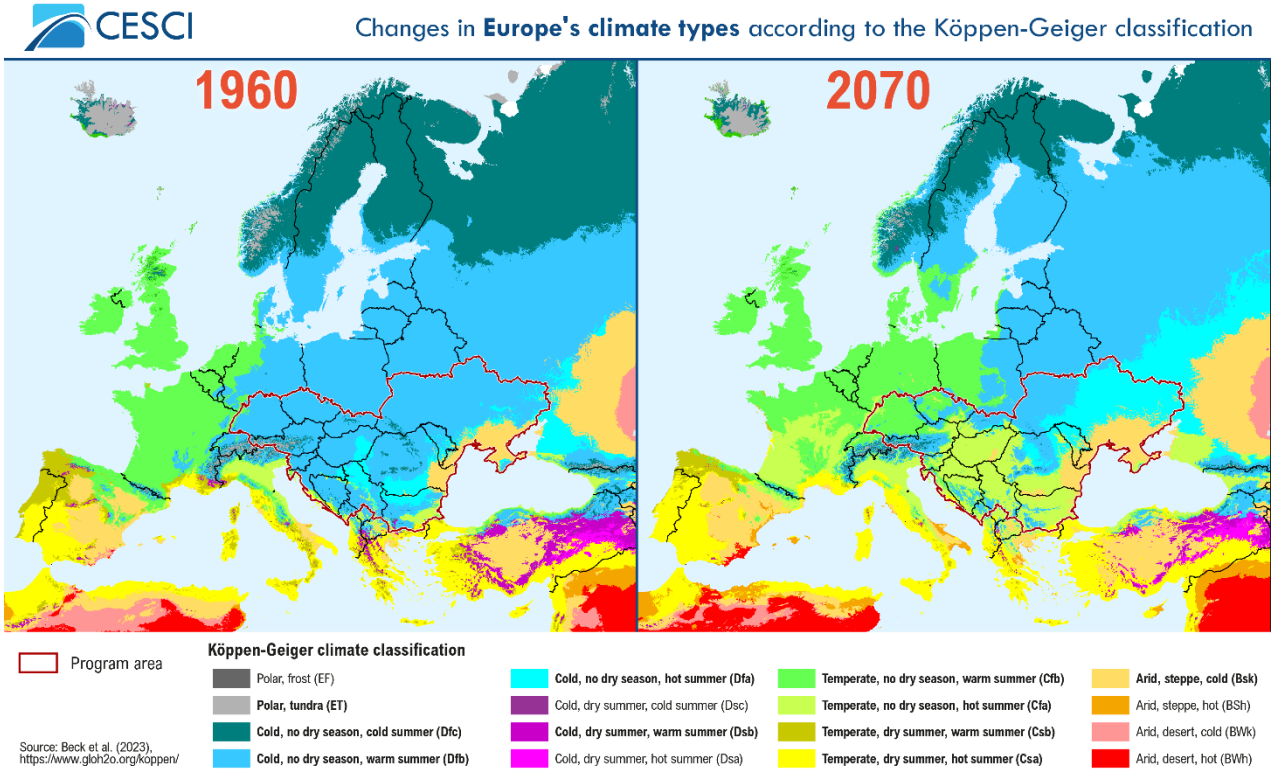


Figure 14: Changes in Europe's climate types according to the Köppen-Geiger classification

Climate change represents an unprecedented systemic challenge that is rapidly altering the environmental foundations of the European continent. In response, the European Union has established ambitious frameworks, most notably through the European Green Deal and the European Climate Law. These initiatives aim to decouple economic growth from resource use while simultaneously building a climate-resilient society through comprehensive long-term strategies. Achieving these targets demands a fast-paced escalation of both mitigation and adaptation strategies across the entire continent, with a particularly urgent focus on the Danube Region. As outlined by the program area boundaries, the macroregion stands out as one of the most geographically vulnerable territories in Europe, where shifting climatic baselines threaten to disrupt fragile river ecosystems, water security, and transboundary socio-economic networks alike.

A comparative analysis of the Köppen-Geiger climate classification zones between 1960 and the 2070 projections reveals a profound transformation within the red-bordered Danube Region. In 1960, the macroregion was heavily dominated by the "Cold, no dry season, warm summer" (Dfb) category across its central, northern, and eastern territories, while its western upper reaches were anchored by the "Temperate, no dry season, warm summer" (Cfb) climate. By 2070, the spatial distribution shifts dramatically as the previously dominant continental Dfb zone virtually fades out from the lowlands, retreating exclusively to high-altitude alpine corridors. Replacing it, the "Temperate, no dry season, hot summer" (Cfa) and "Cold, no dry season, hot summer" (Dfa) categories emerge as the most relevant and widespread climate types, thoroughly enveloping the Pannonian Basin and the lower Danube plains. Furthermore, warmer and more arid categories, such as the Mediterranean "Temperate, dry summer, hot summer" (Csa) and the "Arid, steppe, cold" (Bsk) zones, noticeably creep into the southern and eastern peripheries of the program area, marking a clear historical departure from warm-summer regimes toward hot-summer, moisture-deficit environments.

These shifting boundaries indicate a fundamental alteration in the macroregion's core atmospheric parameters, characterized by surging average temperatures, altered seasonal precipitation distributions, and severely reduced soil moisture levels. In terms of climate adaptation, transitioning into hot-summer and semi-arid classifications means regional planners can no longer rely on historical baselines, as the environment faces an increase in both the frequency and intensity of compound natural risks. The region will be forced to address chronic droughts and prolonged, severe heatwaves that aggravate the urban heat island effect and stress natural water reserves. Additionally, these hyper-warm and dry conditions will inherently trigger a rise in destructive vegetation and forest fires, while altered winter dynamics will alter storm tracks, escalating the threat of severe windstorms and facilitating the rapid, unhindered spread of invasive alien species across changing ecosystems.

Because these climatic disruptions respect no political borders, addressing their systemic impacts effectively requires the immediate deployment of joint, cross-border transnational solutions. Many regions across the Danube territory will simultaneously face a critical need for structural restructuring in agriculture due to changing crop suitabilities, demanding the deployment of nature-based solutions in a cross-sectoral way to retain water in the landscape. Joint urban and land-use planning must be integrated with modernised disaster management systems to establish resilient infrastructure capable of handling shared transboundary hazards. Furthermore, shifting climate profiles will inevitably redirect tourism flows and radically change regional energy profiles; as summer cooling demands surge, comprehensive transboundary grid developments and coordinated electricity infrastructure upgrades will become paramount to maintaining macroregional stability and energy security.

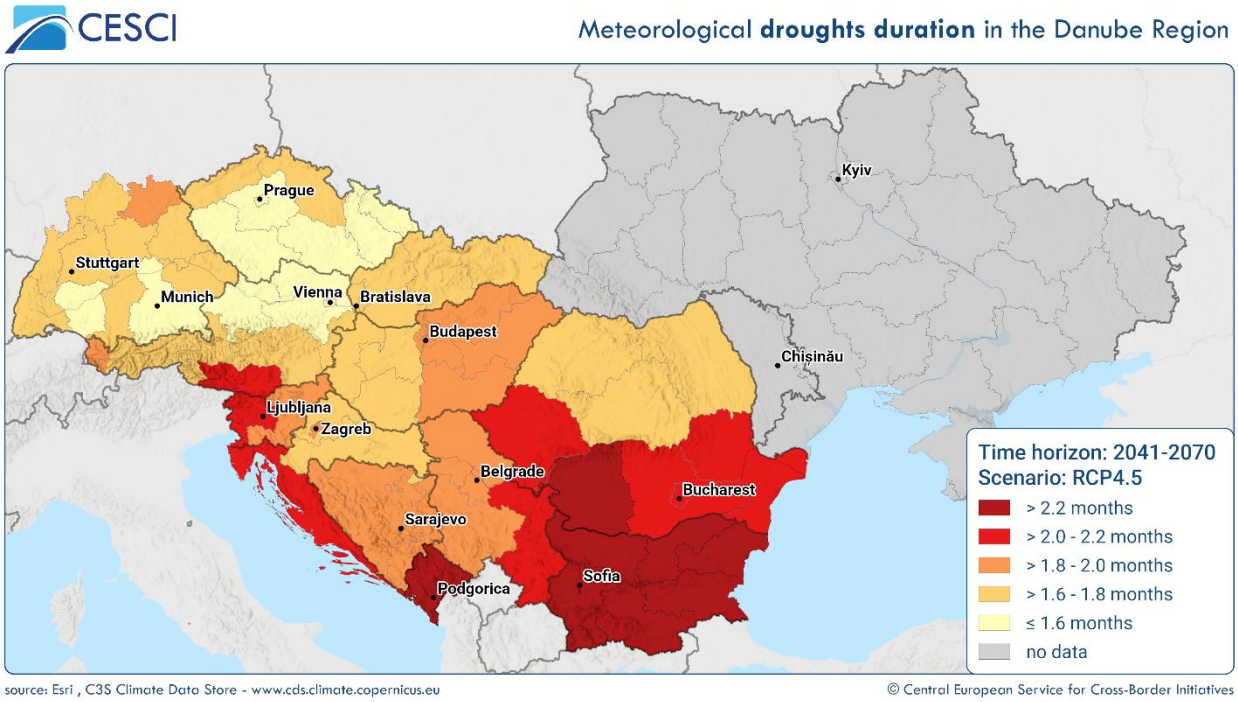


Figure 15: Meteorological droughts duration in the Danube Region

In the contemporary landscape of global climate risk, droughts have emerged as one of the most severe threats to both human health and the environment, causing profound disruptions to vulnerable ecosystems, including sensitive flora and fauna. The impacts of extended moisture deficits carry far-reaching consequences across multiple economic sectors, necessitating comprehensive adjustments in agricultural production, water security, energy production, and crisis management systems. The Danube Region is highly exposed to this environmental hazard, positioning it as one of the most severely affected territories on the European continent, rivaled in vulnerability primarily by the Mediterranean climatic zones of the Iberian, Italian, and southern Balkan peninsulas. To map these patterns effectively, regional climate projections evaluate the maximum continuous duration of severe drought events, revealing a stark geographic imbalance in environmental resilience across the macroregion.

The general spatial configuration reveals that the longest continuous drought durations are heavily concentrated in the central and southeastern plains of the macroregion. These most afflicted hotspots, marked by a deep red colour, form an extensive corridor of high climatic risk that encompasses the lowlands of the Pannonian Basin, and the expansive agricultural areas of Romania, northern Serbia, and northern Bulgaria (before extending directly into the continental plains of Moldova and Ukraine). Apart from Western Slovenia and Carintha in Austria all the regions that will face severe droughts (longer than a 2 months-period) regarding the time horizon between 2041 and 2070 are all situated in the aforementioned regions and countries such as Montenegro, Bulgaria and Romania.

In contrast, the western and higher-altitude portions of the Danube catchment area demonstrate a significantly more resilient profile against extended aridity. The pale yellowish colour covers the westernmost territories, highlighting that the least affected areas are localised mostly across the Alpine and pre-Alpine landscapes of Austria and southern Germany, particularly within the states of Bavaria and Baden-Württemberg. This spatial distribution indicates that regular orographic precipitation and stable atmospheric moisture transport from the Atlantic act as powerful natural buffers, shielding the upper-catchment zones from the multi-month severe anomalies seen downstream. All the regions exposed to droughts with a duration of maximum 1.6 months are located exclusively in Austria, Czechia and Germany. This geographic configuration emphasises that the downstream countries of the lower Danube remain trapped in a continuous zone of severe drought risk, requiring targeted transnational cohesion to secure drought-related crisis management risks, regional water infrastructure and manage adaptation in agricultural production.

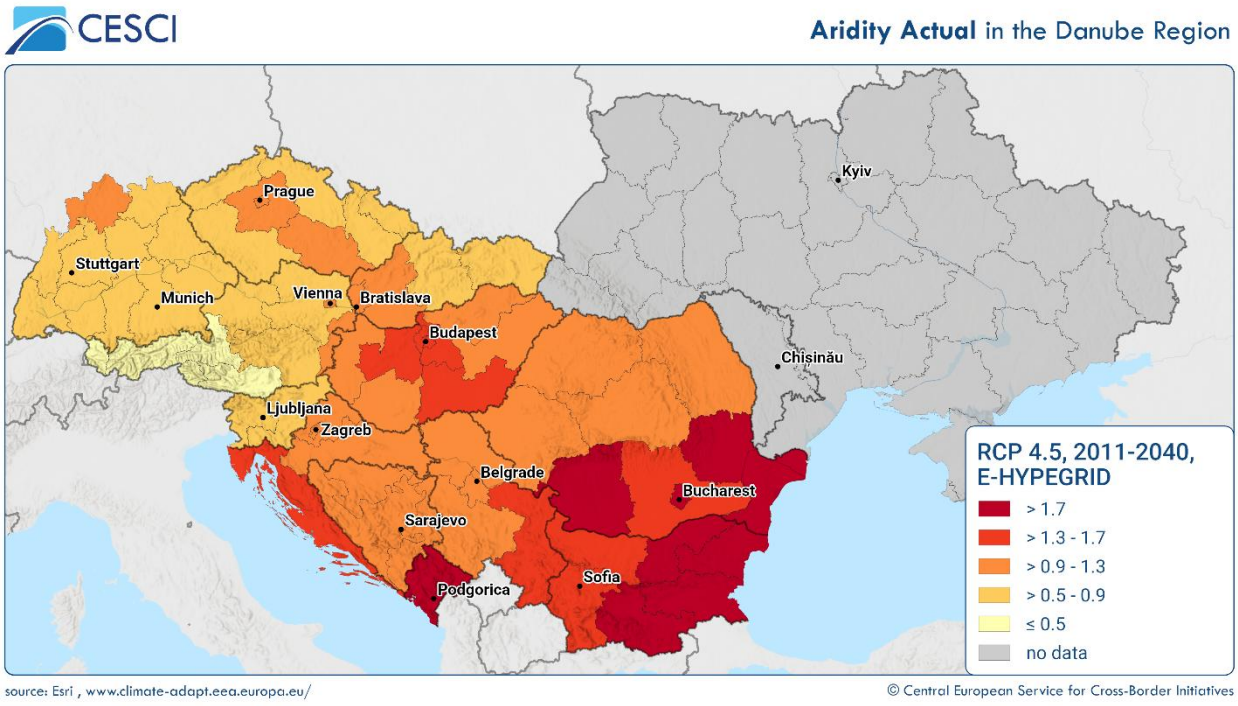


Figure 16: Aridity Actual in the Danube Region

Under the RCP 4.5 climate projection for the 2011-2040 timeframe, actual aridity across the Danube Region exhibits a pronounced northwest-to-southeast gradient, heavily driven by low-altitude continental topography and increasing distance from Atlantic moisture sources. The most severe aridity hotspots are concentrated across the Bulgarian and Romanian lowlands of the Lower Danube Basin and the coastal-mountainous hinterlands of the Western Balkans. This hyper-arid belt encompasses Wallachia and Dobrogea in Southern and Eastern Romania, vast agricultural expanses across Southern and Eastern Bulgaria, and Montenegro. A secondary core of intense water stress incorporates the Pannonian Basin, dominating the Great Hungarian Plain, Northern Serbia's Vojvodina region, and Banat shared with Romania. Conversely, the Alpine upper catchments in Southern Germany, Western Austria, and Alpine Slovenia remain relatively resilient, functioning as critical freshwater buffers for the broader macroregion.

Owing to the fact that aridity respects no state borders, its impacts heavily concentrate along shared border zones where water stress acts as a direct transboundary hazard. The Lower Danube border region between Romania and Bulgaria faces peak aridity, placing severe strain on rainfed crop production and alluvial water tables. Similarly, the tri-border agricultural plains connecting Hungary, Serbia, and Romania, and at smaller extent, the plains connecting Hungary, Slovakia (Danubian Lowland), Czechia and Hungary (Little Hungarian Plain), experience continuous soil moisture deficits, forcing heavy reliance on groundwater abstraction. Meanwhile, along the karst and mountainous frontiers linking Serbia with Bulgaria, as well as Montenegro with Bosnia and Herzegovina and Croatia, seasonal water scarcity elevates municipal supply shortages and wildfire risks.

These spatial patterns generate compounding socio-economic and environmental challenges. Accelerating aridity drives soil degradation and crop yield volatility across the macroregion's primary grain-producing plains. This agricultural pressure is further compounded by severe municipal infrastructure deficits, where physical water losses exceeding 50% in middle and lower basin utilities coincide with falling groundwater tables. Because downstream nations inherit up to 95% of their surface water from beyond national borders, isolated national responses are inherently insufficient to address these escalating deficits. The summer droughts of 2026 in Central Europe showed how exposed and vulnerable large parts of the macroregion are to aridity and water scarcity in particular causing economic loss, disruptions in hydroelectric and nuclear power generation, massive wildfires, ecological loss regarding water habitats and flatland forests .

Addressing macroregional aridity requires a paradigm shift from reactive crisis intervention toward proactive, landscape-scale water retention. In line with the ICPDR Danube Declaration and EUSDR Priority Areas 4 and 5, there is a joint challenge which requires transnational cooperation focusing on deploying nature-based solutions, restoring small-scale agricultural wetlands, expanding agroforestry, and implementing smart irrigation practices. Synchronising

cross-border drought monitoring systems like DriDanube and DanubeHIS and embedding water retention priorities is needed with the aim of protecting shared aquifers and build long-term climate resilience across shared river catchments.

The Danube Region has experienced an unprecedented surge in wildfire frequency, intensity, and burnt area, with a large number of fire events and heavy damages recorded across several participating states. Driven by compound climate extremes, most notably multi-month summer heatwaves, soil moisture deficits, and escalating aridity, wildfire risks have expanded far beyond traditional Mediterranean hotspots into temperate, mountainous, and agricultural landscapes throughout the macroregion as a new transnational challenge.

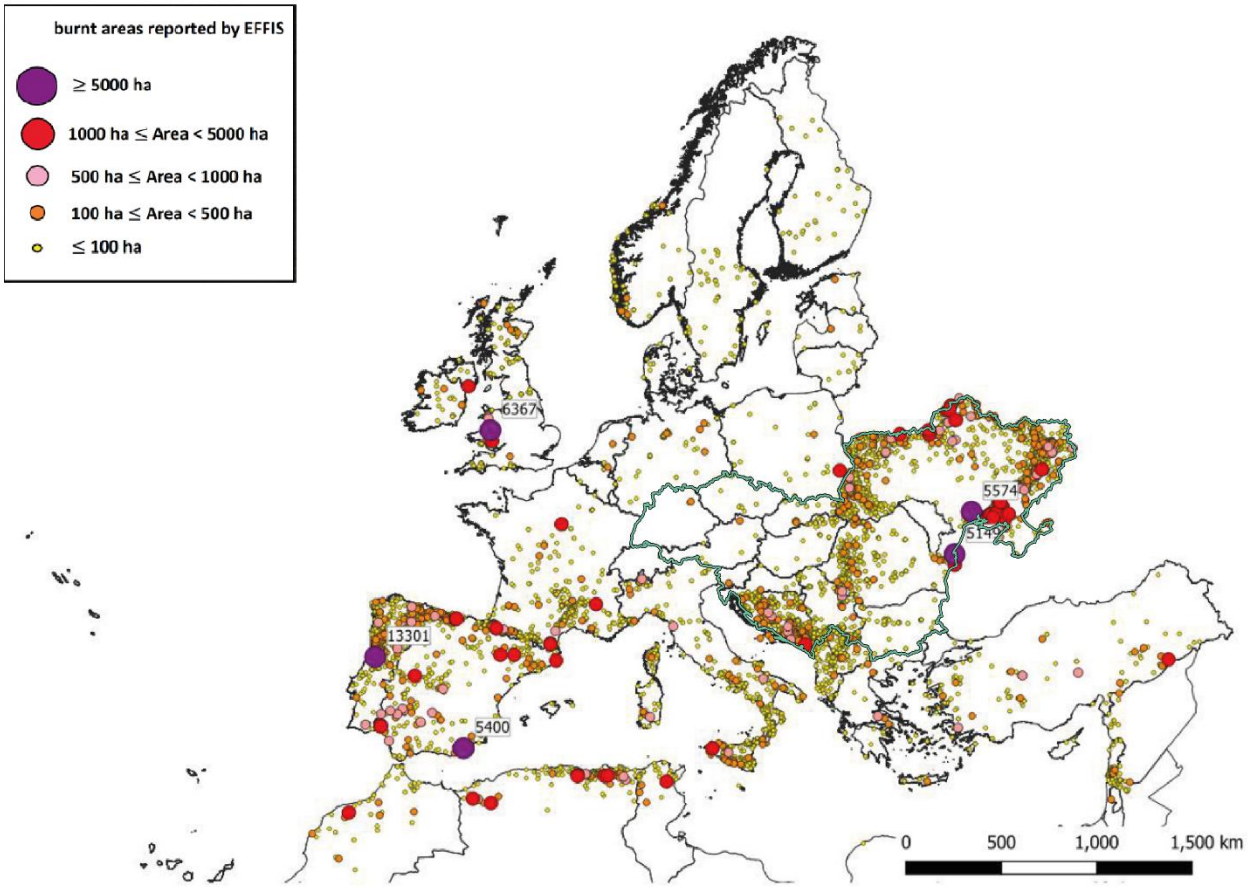


Figure 17: Spatial distribution of fire events in 2026, source: JRC, EFFIS (European Forest Fire Information System)

The spatial footprint of these fire events reveals widespread vulnerability across distinct sub-regions. 1. Southeastern Europe and the Western Balkans: Countries such as Bulgaria, Romania, Serbia, Montenegro, and Bosnia and Herzegovina have registered recurring catastrophic wildfires across dry karst, sub-Mediterranean, and oak-pine ecosystems. Prolonged aridity combined with rural depopulation and land abandonment has led to heavy fuel accumulation, triggering high-intensity blazes that destroy thousands of hectares annually. 2. Ukraine and the Eastern borderlands: Ukraine has suffered extraordinary wildfire damage. Severe climate aridity across eastern pine forests and steppe zones has been dramatically exacerbated by Russia's war of aggression, where military operations, shelling, and unexploded ordnance have ignited vast,

uncontainable forest fires that devastate protected ecosystems and overwhelm local emergency services. 3. Central Europe and Southern Germany: Historically resilient temperate regions – including Bavaria and Baden-Württemberg in Southern Germany, Austria, Czechia, and Slovakia – have witnessed a marked rise in forest fire incidents. Prolonged summer droughts and bark beetle infestations have converted monoculture pine and spruce stands into highly flammable fuel beds, exemplified by major cross-border fires in the Bohemian/Bavarian Forest borderlands. The damages inflicted by these fire events extend far beyond immediate timber loss. Wildfires cause severe ecological degradation across Natura 2000 sites, UNESCO Biosphere Reserves, and primary beech forests, destroying irreplaceable biodiversity, neutralising forest carbon sinks, and exposing burned slopes to post-fire soil erosion and landslide hazards during subsequent heavy rainfall events. Furthermore, large-scale flushes of particulate matter severely compromise regional air quality and public health.

Addressing this escalating hazard requires robust transnational cooperation. There is a need for shifting toward:

1. Proactive landscape management: Transitioning from reactive fire suppression to nature-based landscape management, including prescribed grazing, fuel-load reduction, agroforestry buffer strips, and replacing monoculture plantations with climate-resilient, mixed broadleaf forests.
2. Cross-border civil protection: Institutionalizing joint emergency response protocols, standardized cross-border firefighting training, and shared aerial firefighting assets among EU Member States and candidate countries.
3. Integrated early warning systems: Leveraging real-time satellite monitoring, harmonized fire danger rating indices, and localized risk mapping to enable rapid, coordinated intervention before fire events escalate into uncontrollable macroregional disasters.

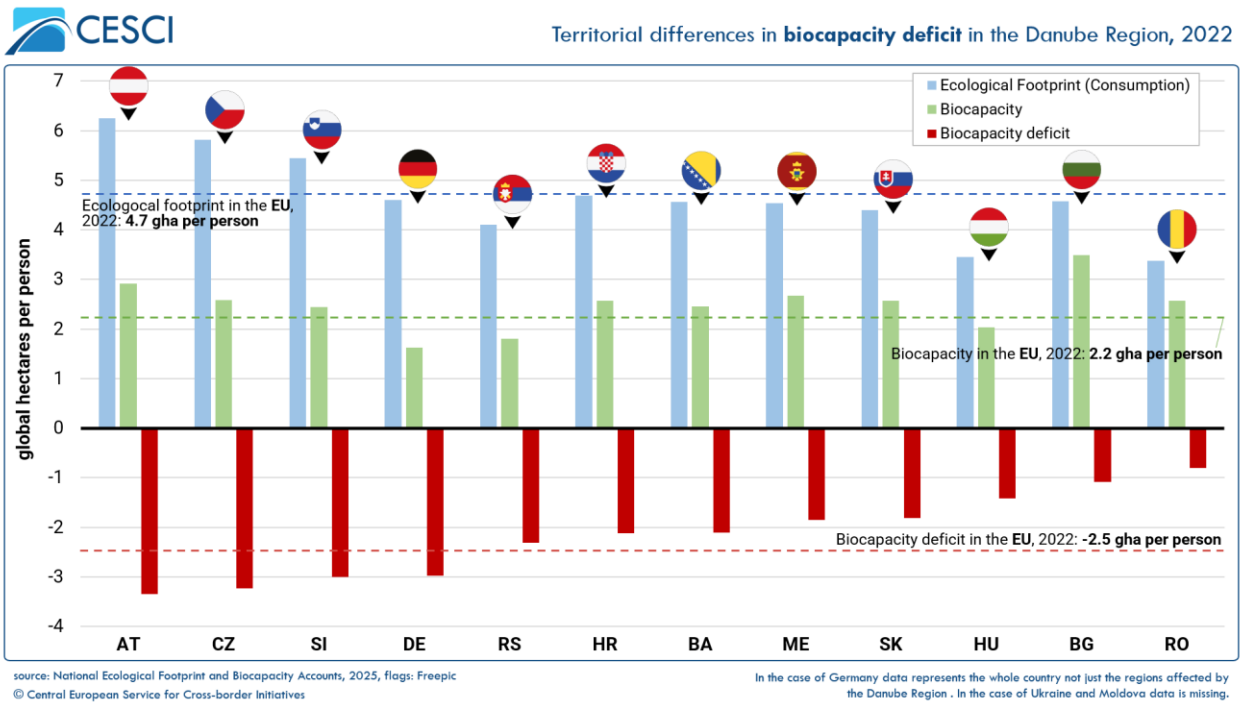


Figure 18: Territorial differences in biocapacity deficit in the Danube Region

Every country across the Danube Region operates under a biocapacity deficit, meaning national resource consumption consistently surpasses the regenerative capacity of local ecosystems. A strong socio-economic core-periphery divide characterises the macroregion's ecological footprint and biocapacity distribution. Core Western and Central European economies exhibit the highest per capita ecological footprints and the deepest biocapacity deficits, led by Austria with an ecological footprint of 6.26 gha per person and a deficit of -3.34 gha per person, followed by Czechia (-3.24 gha per person), Slovenia (-3.00 gha per person), and Germany (-2.98 gha per person). All four of these nations record biocapacity deficits significantly higher than the European Union average deficit of -2.48 gha per person.

Conversely, lower-income and transitional economies in Eastern and Southeastern Europe generally maintain smaller per capita ecological footprints, resulting in less severe biocapacity deficits. Romania registers the lowest biocapacity deficit in the macroregion at -0.81 gha per person, driven by a modest ecological footprint of 3.38 gha per person, while Bulgaria (-1.09 gha per person) and Hungary (-1.42 gha per person) also operate well below the EU deficit baseline. Natural biocapacity reserves also vary considerably across national landscapes, ranging from 1.63 gha per person in densely populated Germany to 3.49 gha per person in Bulgaria. Densely forested and mountainous countries such as Austria, Montenegro, Croatia, Slovakia, and Romania possess higher natural biocapacity endowments around 2.57 to 2.92 gha per person, yet in high-consumption frontrunners like Austria and Czechia, intense industrial and consumer demands completely overwhelm these local ecological assets.

These shared ecological imbalances underline an urgent imperative for coordinated macroregional action to decouple economic development from resource depletion. High carbon footprints across central manufacturing hubs necessitate comprehensive energy efficiency interventions, accelerating industrial waste heat recovery and transitioning away from fossil fuel reliance. Furthermore, expanding the circular bioeconomy is critical to resource efficiency, given that circular material use rates vary from nearly 14% in Austria down to under 2% in downstream nations like Romania. Transforming agricultural waste into bioenergy, adopting sustainable forestry practices, and scaling up cross-border material reuse networks will help safeguard regional natural capital. Finally, addressing unsustainable land use and groundwater over-abstraction requires aligning National Energy and Climate Plans with transboundary governance frameworks, ensuring the collective restoration of soil organic matter, the expansion of Natura 2000 ecological corridors, and the protection of shared hydrographic basins.

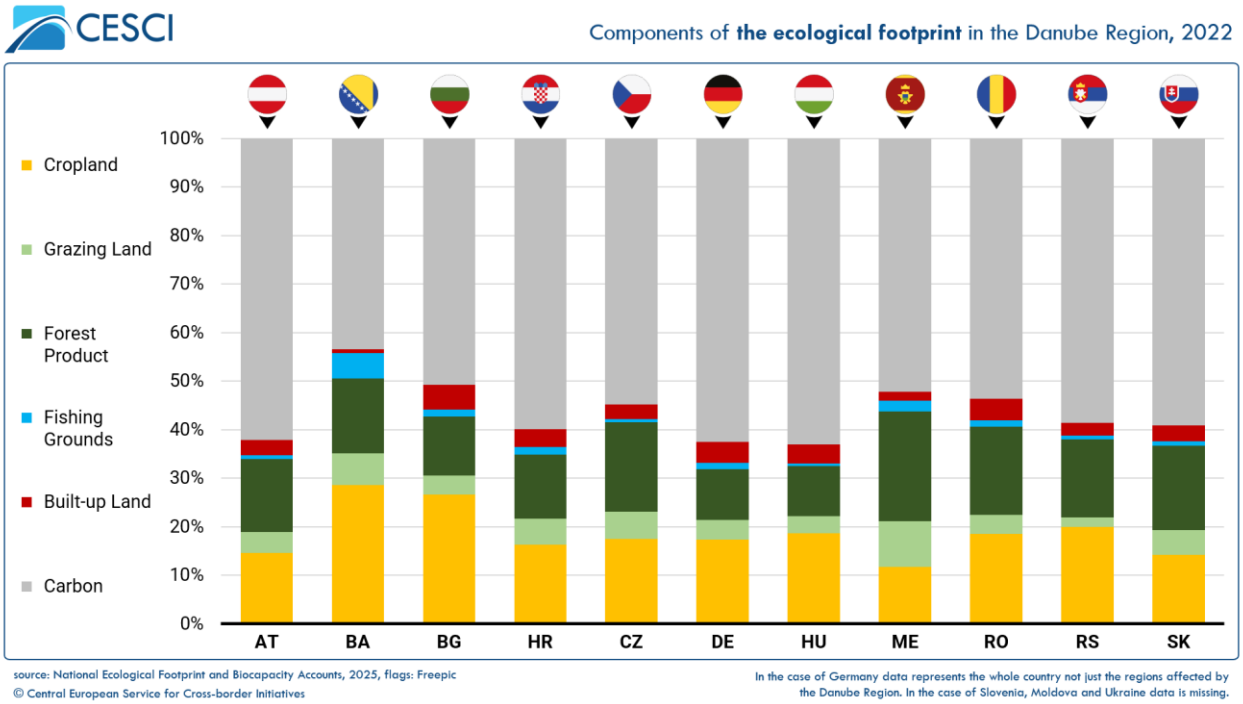


Figure 19: Components of the ecological footprint in the Danube Region

Considering the composition of the ecological footprint, the footprint constitutes the overwhelming majority of total resource demand across all 12 analyzed Danube Region states, accounting for between 43.5% (Bosnia and Herzegovina) and 63.1% (Hungary) of national ecological footprints. In core industrial economies, absolute carbon demand reaches its peak, led by Austria (3.89 gha per person), Czechia (3.19 gha per person), and Germany (2.88 gha per person). In contrast, eastern and southeastern states generate lower carbon pressures per capita, led by Romania (1.81 gha per person) and Bosnia and Herzegovina (1.98 gha per person).

Beyond carbon emissions, cropland and forest product footprints highlight notable structural differences between energy-intensive core economies and agrarian or forest-dense catchments. With regard to cropland demand: Bosnia and Herzegovina (1.31 gha per person) and Bulgaria (1.22 gha per person) exhibit the highest per capita cropland footprints in the macroregion, reflecting strong domestic reliance on agricultural land use, whereas Hungary (0.65 gha per person) and Slovakia (0.63 gha per person) record substantially lower cropland footprints. Forest product demand is heaviest in heavily timbered and wood-industrial nations, specifically Czechia (1.08 gha per person), Montenegro (1.03 gha per person), and Austria (0.95 gha per person), contrasting sharply with Hungary (0.35 gha per person) and Germany (0.48 gha per person). Grazing land demand peaks in Montenegro (0.43 gha per person) and Czechia (0.33 gha per person), while built-up land footprints are highest in dense urban and industrialized states, including Bulgaria (0.24 gha per person), Austria (0.20 gha per person), and Germany (0.20 gha per person).

The shared dominance of carbon demand across all member states underscores an urgent need for macroregional decarbonisation, focusing on industrial waste heat recovery, energy efficiency upgrades, and renewable energy integration. Simultaneously, heavy agricultural and forestry footprints call for joint land-use management. Strategic priorities must focus on scaling up the circular bioeconomy, promoting sustainable forest management, deploying agroforestry buffer strips within agricultural landscapes.

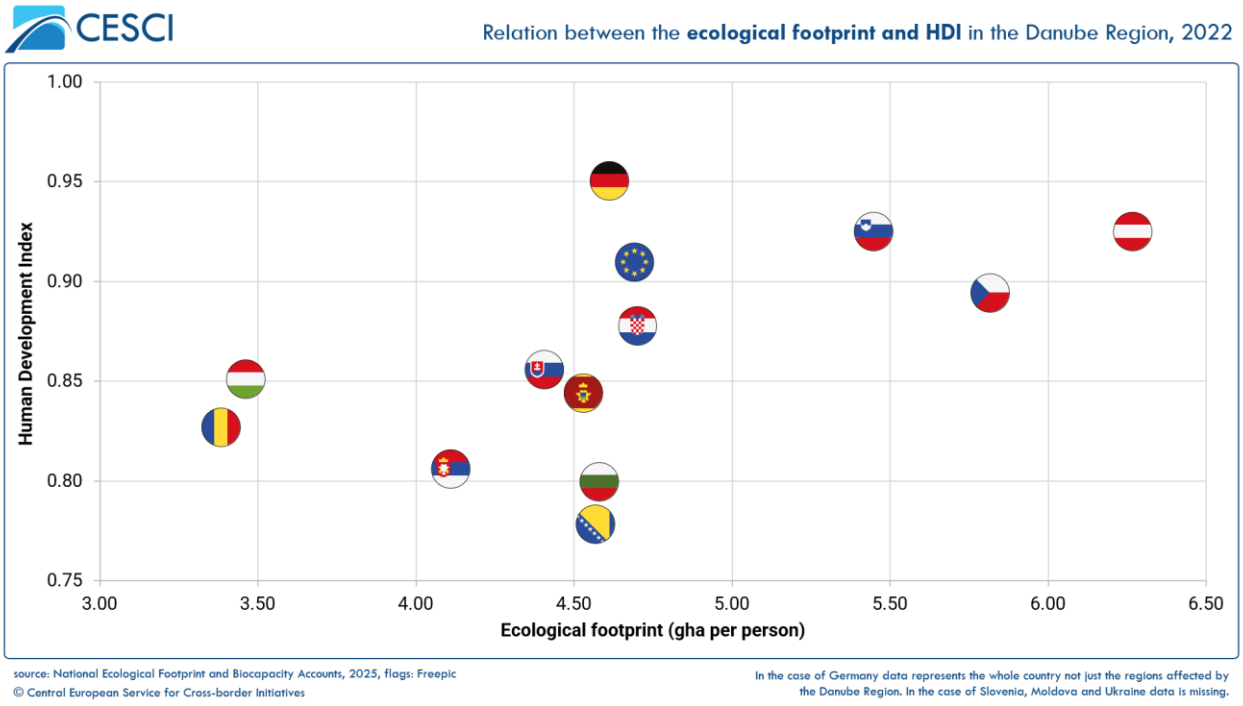


Figure 20: Relation between the ecological footprint and HDI in the Danube Region

An analysis of the dataset linking the Total Ecological Footprint and the Human Development Index (HDI) across the Danube Region reveals a positive, non-linear correlation (r=approx 0.57),

illustrating how higher levels of socio-economic development are generally accompanied by greater per capita natural resource consumption. However, significant structural variations exist across the macroregion, separating high-efficiency industrial frontrunners from carbon-intensive transition states. Crucially, not a single Danube country meets the global benchmark for sustainable development, defined as achieving very high human development (HDI: 0.80) while remaining within global per capita biocapacity boundaries as all national footprints range between 3.38 and 6.26 gha per person, oftentimes exceeding the European Union average baseline of 4.68 gha per person.

The macroregion can be categorised into three distinct development-consumption tiers: 1. High human development & intensive consumption core: Austria, Slovenia, and Czechia represent the highest consumption tier, where advanced industrial economies and elevated living standards drive resource demands far above the EU average. Germany stands out as a notable eco-efficiency outlier within this top group, achieving the macroregion's highest HDI (0.950) with a footprint of 4.61 gha per person, slightly below the EU benchmark. 2. High human development & relative resource efficiency: Hungary and Romania demonstrate the lowest per capita ecological footprints in the Danube basin. These nations manage to secure high human development outcomes while maintaining resource consumption significantly below both the EU average (4.68 gha) and their central European peers, primarily due to lower per capita carbon emissions and moderate resource footprints. Slovakia and Croatia occupy an intermediate position within this group. 3. Transition Economies with High Resource Intensity: Southeastern EU member states and Western Balkan candidate countries exhibit a disproportionately high ecological footprint relative to their HDI levels. States like Bulgaria and Bosnia and Herzegovina generate per capita ecological demands comparable to Germany or the EU average despite lower HDI scores, driven by carbon-heavy energy grids, aging municipal utilities, high industrial energy intensity, and low circular material reuse rates.

The overarching challenge facing the Danube Region is decoupling human well-being and economic growth from environmental degradation. Because carbon emissions represent the single largest component of the ecological footprint, transnational cooperation must prioritise decarbonising energy grids, upgrading industrial energy efficiency, and modernising district heating systems. This is particularly critical in Western Balkan and Eastern partner states, where reliance on legacy fossil fuels inflates carbon footprints without yielding proportional gains in human development.

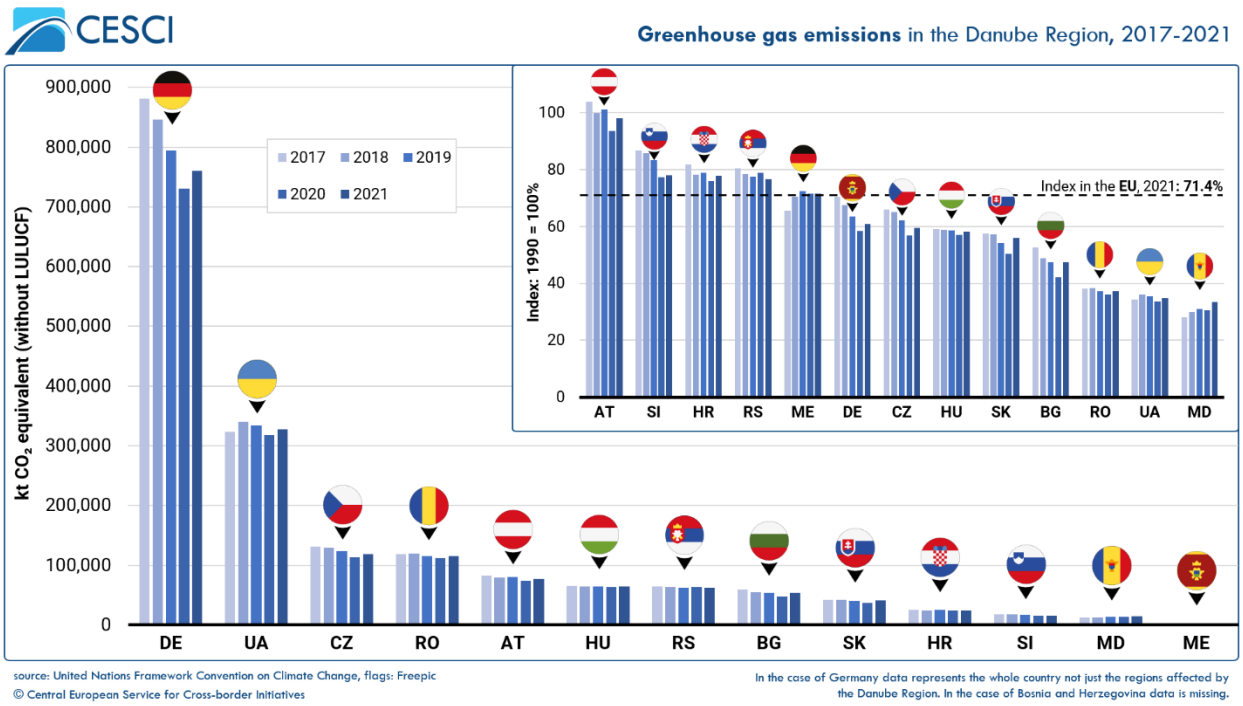


Figure 21: Greenhouse gas emissions in the Danube Region

An analysis of total greenhouse gas (GHG) emissions excluding LULUCF (in kilotonnes of CO_2 equivalent) across the Danube Region highlights a profound structural divergence between 1990 and 2021. While the European Union as a whole reduced its total GHG emissions to 71.4% of its 1990 base-year level by 2021, trajectory dynamics across the 12 analyzed Danube states vary significantly based on historical industrial restructuring, energy grid composition, and economic growth. The macroregion displays three distinct historical emission patterns relative to 1990 baselines. 1. Deep post-industrial reductions: Eastern partner countries and Southeastern European states recorded the most dramatic drops in total emissions, primarily driven by the collapse of heavy Soviet-style industrial capacity in the early 1990s. Countries which can be listed here are Moldova, Ukraine, Romania, and Bulgaria. 2. A second group can be characterised by modernisation-driven declines: Central European EU Member States achieved steady, policy-driven decarbonisation through technological modernisation, industrial energy efficiency, and EU Emissions Trading System (ETS) compliance. Germany, Czechia, Hungary, and Slovakia represent this tier. 3. A third group exhibits limited emission reductions relative to 1990 levels. Austria recorded the highest baseline persistence. Similarly, Slovenia, Croatia, Serbia, and Montenegro show moderate reductions that lag behind the broader EU convergence rate.

In absolute volume terms, Germany and Ukraine dominate the macroregion's carbon footprint, together accounting for the vast majority of total emissions. Between 2017 and 2021, most EU Member States sustained downward trajectories. Conversely, Eastern partner countries such as Moldova and Montenegro experienced minor rebounds between 2017 and 2021, reflecting economic stabilisation and rising transport demand prior to recent geopolitical shocks.

Joint challenges and cooperation needs are focused on decarbonisation across the Danube Basin, which requires targeted macroregional cooperation. Key joint challenges include phasing out fossil fuels in power and heating: replacing coal-fired power generation in Western Balkan and Eastern partner states (e.g., Serbia, Bulgaria, Czechia) while expanding district heating modernisation and renewable integration. Another aspect is the decarbonisation of transport corridors.

Circular economy

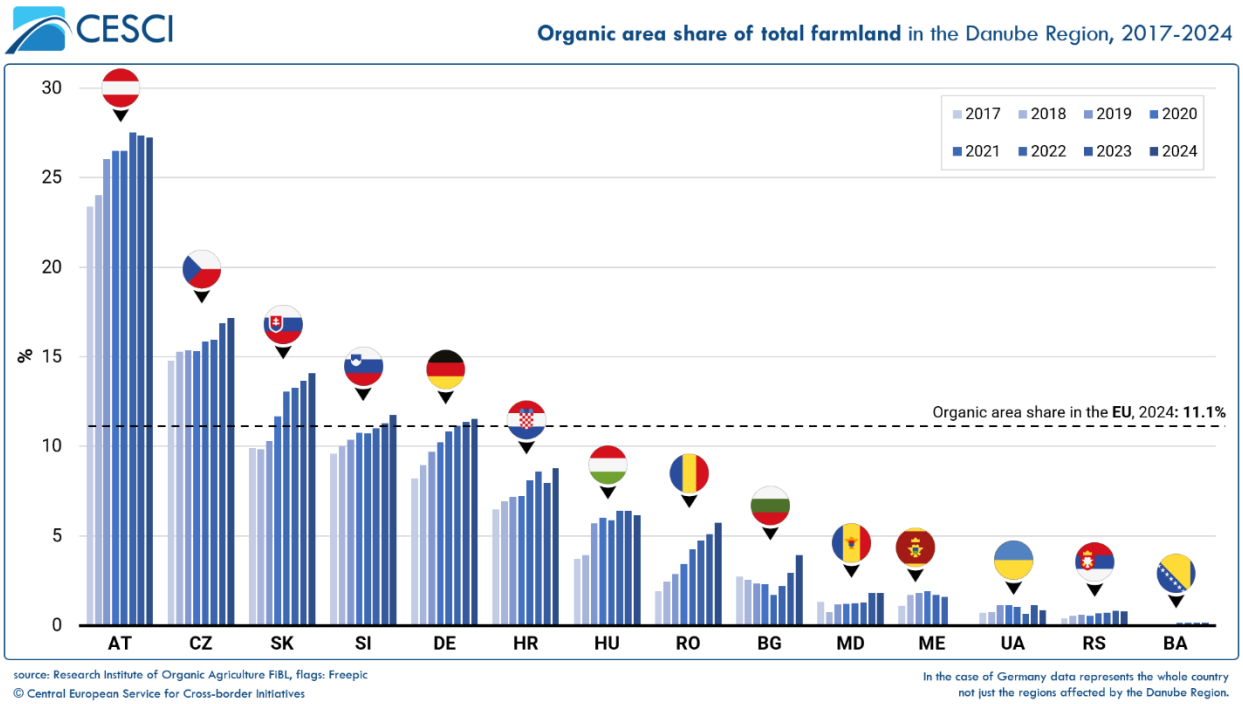


Figure 22: Organic area share of total farmland in the Danube Region

The proportion of organic farmland across the Danube Region reveals a pronounced west-to-east performance gap. While almost all states expanded their organic footprint between 2017 and 2024, adoption remains heavily concentrated in Central and Western European member states. Austria leads both the macroregion and the broader European Union with 27.24% of its farmland under organic management in 2024, followed comfortably above the EU 2024 average baseline of 11.14% by Czechia (17.16%), Slovakia (14.09%), Slovenia (11.74%), and Germany (11.52%).

An intermediate catch-up group comprising Croatia (8.78%), Hungary (6.16%), Romania (5.75%), and Bulgaria (3.92%) has recorded steady progress, with Slovakia and Romania demonstrating some of the macroregion's largest overall percentage-point gains since 2017. In sharp contrast, non-EU candidate and partner countries in the Western Balkans and Eastern Neighborhood lag severely below the 2% threshold. Moldova (1.82%), Montenegro (1.60%), Ukraine (0.85%), Serbia (0.79%), and Bosnia and Herzegovina (0.14%) face persistent structural hurdles, including limited

certification infrastructure, weak domestic consumer demand, and a lack of direct conversion subsidies, pressures further compounded in Ukraine by wartime land contamination and agricultural export disruptions.

This uneven transition poses systemic risks to shared hydrographic basins, where intensive conventional farming across the Pannonian and Wallachian plains drives diffuse nitrate and pesticide pollution into river tributaries and ultimately the fragile Black Sea ecosystem. Because downstream nations receive up to 95% of their surface water from beyond national borders, accelerating low-input organic farming is a shared transboundary challenge. Macroregional cooperation needs to focus on scaling up smart farming tools, deploying agroecological buffer strips along shared river corridors, harmonising organic certification standards, and help Eastern and Western Balkan smallholders' transition to sustainable, climate-resilient agrifood systems.

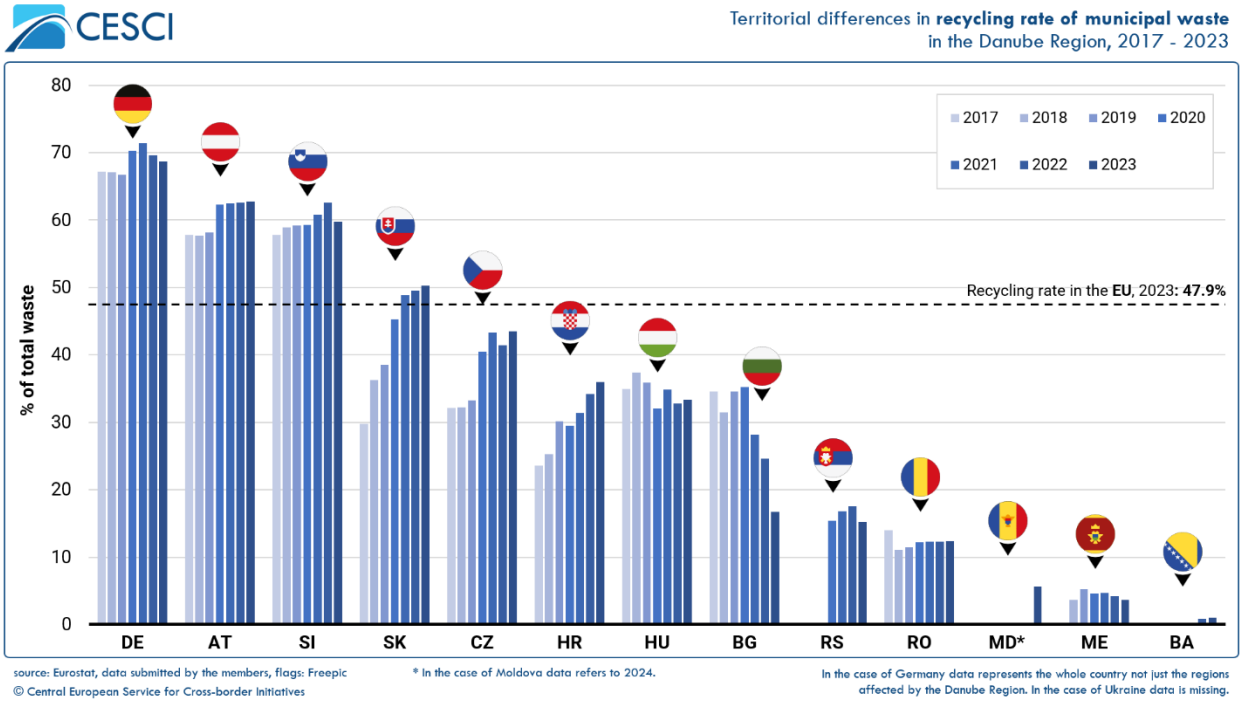


Figure 23: Territorial differences in recycling rate of municipal waste in the Danube Region

The transition toward a circular economy shows a deeply fragmented spatial pattern, where the recycling rate of municipal waste functions as a primary indicator of environmental performance and resource efficiency. Based on the latest data for 2023, the macroregion is characterised by a significant gap between highly efficient closed-loop systems and lagging territories still entrenched in linear waste management models. The EU27 average stands at 47.9%, a baseline that only four countries in the region currently exceed. namely Germany, Austria, Slovenia and Slovakia as a new frontrunner. Germany continues to excel with a recycling rate of 68.7%, followed by Austria (62.8%) and Slovenia (59.8%), all of which demonstrate a well-developed infrastructure for material recovery. On the contrary, the southeastern peripheries exhibit severe bottlenecks; Romania (12.4%) and Bulgaria (16.7%) perform significantly below the EU average,

while Montenegro (3.7%) and Bosnia and Herzegovina (1.0%) remain at the bottom of the spectrum, indicating a high reliance on landfilling and a deficit in high-scale sorting capacities.

Focusing on the changes between 2017 and 2023, a trend of selective convergence can be detected, defined by the leap-frogging of certain Central European economies. The most outstanding progress within the macroregion was achieved by Slovakia, which recycling rate surged from 29.8% to 50.3%, a transformative leap of over 20%-points that reflects successful systemic shifts and investments in preparative-for-reuse technologies. Serbia also recorded a notable increase from a near-zero baseline of 0.3% in 2017 to 15.2% in 2023, while Croatia and the Czech Republic improved by 12.4 and 11.4 percentage points respectively. However, this positive momentum is not universal; Bulgaria experienced a sharp deteriorating tendency, with its rate dropping from 34.6% to 16.7%, and slight declines were also noted in Hungary and Romania.

In conclusion, the current landscape of uneven development reveals that while the majority of Central European states are rapidly catching up to the EU27 average, the widening divide with the southeastern peripheries necessitates targeted interventions to promote successful material recovery models to lagging regions, fostering true territorial convergence through the implementation of waste hierarchy strategies.

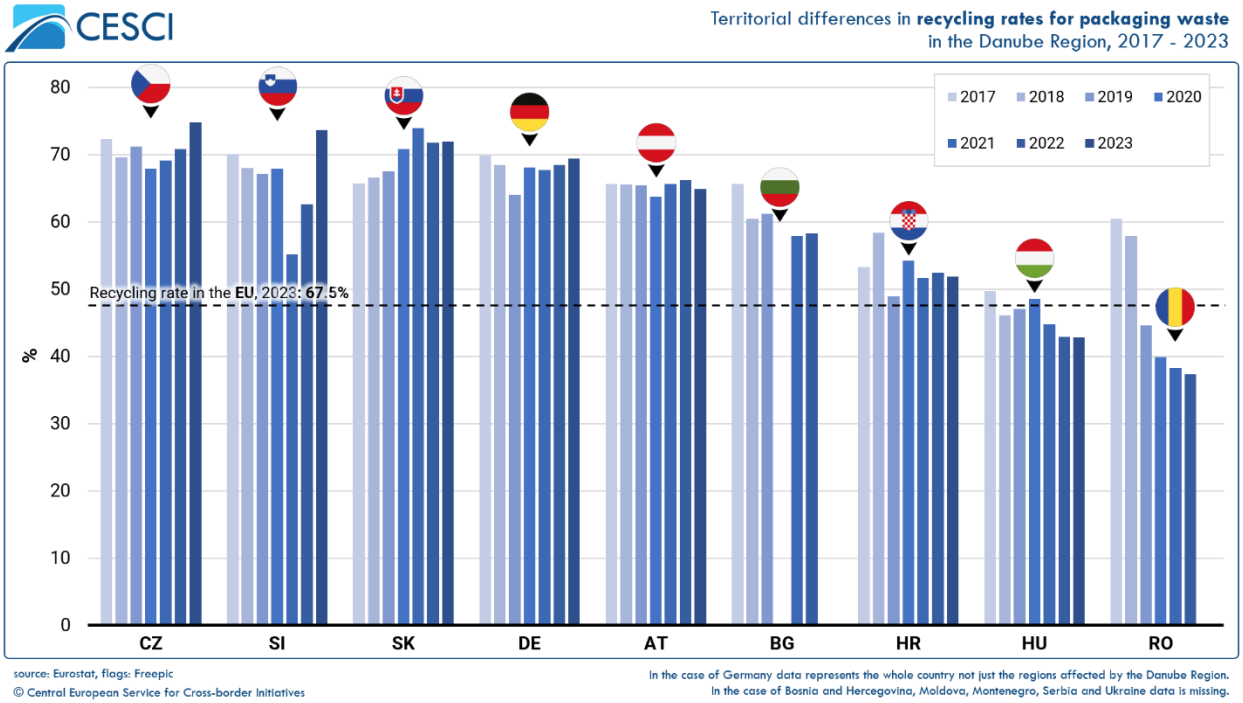


Figure 24: Territorial differences in recycling rates for packaging waste in the Danube Region

Taking into account another important indicator for circular economy, the recycling rate for packaging waste, it can be stated that in terms of the maturity of Extended Producer Responsibility (EPR) systems and the overall efficiency of circular value chains, the Danube Region remains a highly fragmented space, with significant disparities.

Regarding the current performance and territorial disparities (2023/2022), the latest statistical evidence reveals a macroregion increasingly divided into distinct performance tiers. A significant shift in the regional hierarchy has occurred, with Central European states emerging as the primary leaders of closed-loop systems. Czechia (74.8%), Slovenia (73.6%), and Slovakia (71.9%) have successfully established themselves as frontrunners, significantly exceeding both the European baseline (EU27: 67.5%) and the performance of traditionally developed economies like Germany (69.4%) and Austria (64.9%). In stark contrast, the southeastern parts of the macroregion continue to struggle. Romania records the lowest performance in the macroregion at 37.3% (2022 data), followed by Hungary (42.8%) and Croatia (51.9%). These figures underscore a persisting east-west divide that has evolved into a more complex mosaic, where the lack of industrial-scale sorting and harmonised Extended Producer Responsibility (EPR) frameworks in lagging territories hinders the development of circular economy.

Focusing on the dynamics and convergence trends between 2017 and 2023, data highlights a multi-speed transition characterised by the rapid "leap-frogging" of select states and a concerning regression in the eastern parts of the region. The most outstanding catching-up process was achieved by Slovakia, which realised a surge of 6.2 percentage points (from 65.7% to 71.9%), followed by Slovenia (+3.5 pp) and Czechia (+2.5 pp), reflecting successful systemic policy interventions and investments in material recovery infrastructure. Conversely, the macroregion is witnessing a deeply problematic deteriorating tendency in several Member States. Romania experienced a transformative collapse in its recorded recycling performance, with its rate plummeting by 23.1 percentage points (from 60.4% to 37.3%), while Bulgaria (-7.3 pp) and Hungary (-6.9 pp) also saw significant declines. Even the highly developed economies of Germany and Austria recorded slight drops, suggesting that previous gains in the waste hierarchy are not yet fully resilient against increasing waste volumes or evolving reporting standards. The current landscape illustrates a deepening fragmentation where the rapid advancement of Central European "leap-frog" states stands in sharp contrast to the dramatic regression of the southeastern peripheries, threatening to consolidate a multi-speed circular transition.

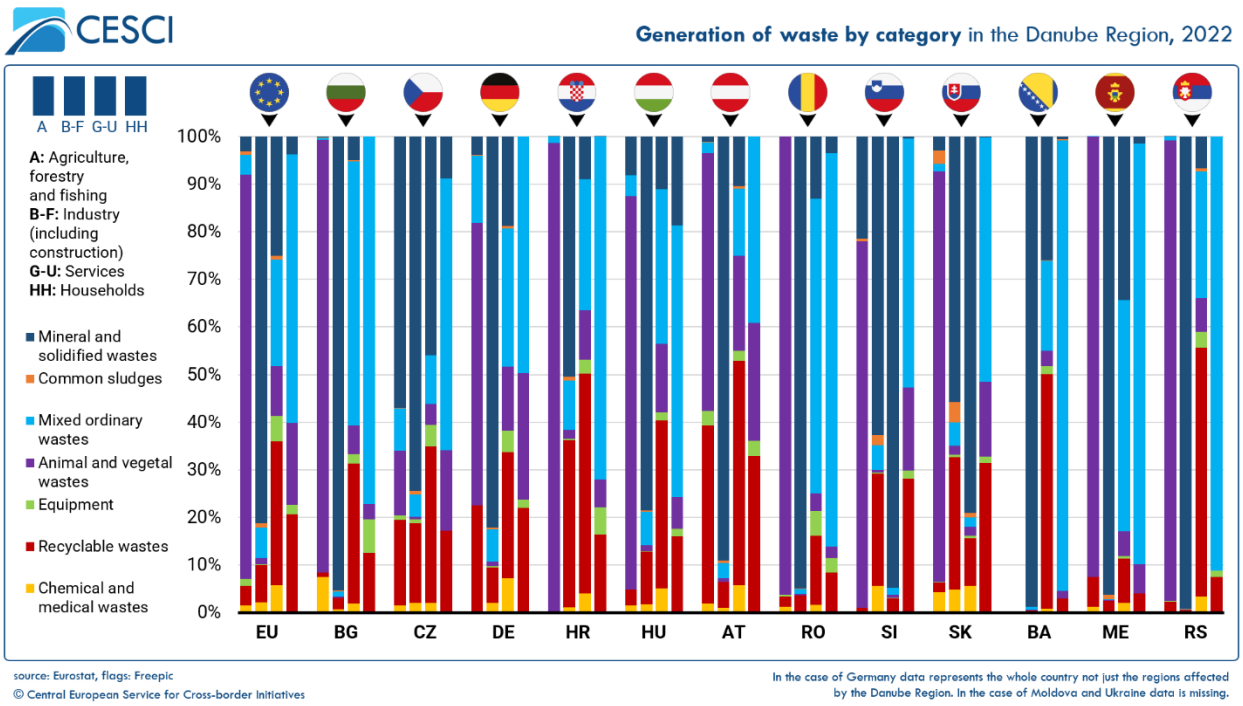


Figure 25: Generation of waste by category in the Danube Region

The generation of waste across the Danube Region reflects deep structural linkages between sectoral economic activity, resource extraction, and industrialisation. Across the countries, waste generation is overwhelmingly concentrated in industrial, mining, quarrying, and construction activities (NACE Rev. 2 codes B-F), which produce over 957 million tonnes of waste, representing the vast majority of all recorded waste streams. Total waste volumes vary substantially across national territories, ranging from industrial heavyweights such as Germany (384.2 million tonnes), Serbia (176.8 million tonnes), and Romania (160.2 million tonnes), to smaller transition economies such as Slovenia (11.4 million tonnes), Croatia (7.05 million tonnes), and Montenegro (1.27 million tonnes).

From a waste category perspective, mineral and solidified wastes dominate the regional waste profile, accounting for 82.0% of total generated waste (874.9 million tonnes). This massive volume originates primarily from construction, demolition, and heavy mineral extraction activities. Mixed ordinary wastes represent 7.26% (77.5 million tonnes), while recyclable wastes encompassing paper, glass, metals, and plastics account for 6.69% (71.4 million tonnes).

National waste composition profiles reveal marked structural divergences across the macroregion. In non-EU candidate countries and eastern transitional economies such as Bosnia and Herzegovina (98.8%), Serbia (98.5%), Romania (95.1%), and Bulgaria (94.4%), industrial, mining, and construction sectors (NACE B-F) generate over 94% of all waste, overwhelmingly composed of mineral waste and heavy mining tailings. Conversely, Central European EU Member States exhibit a more diversified waste structure characterised by higher shares of municipal, commercial, and recyclable waste streams. For instance, recyclable waste accounts

for 29.7% of total waste in Croatia, 23.6% in Slovakia, and 19.3% in Czechia. Slovenia presents a unique service-driven profile, where service activities (NACE G-U) generate 66.4% of total waste, while household waste shares peak in Montenegro (20.2%), Slovakia (18.1%), Hungary (17.9%), and Croatia (17.4%).

These shared structural characteristics and national divergences highlight critical joint challenges for environmental management and circular economy integration across the Danube basin. High waste intensity, low municipal recycling rates, and inadequate hazardous waste containment, particularly regarding historical mining tailings and industrial brownfields, continue to pose direct transboundary risks to shared river networks, contributing to chemical contamination and riverine plastic pollution. There is a need for expanding modern municipal sorting and recycling infrastructure, and establishing harmonised monitoring for hazardous industrial waste and wastewater sludges.

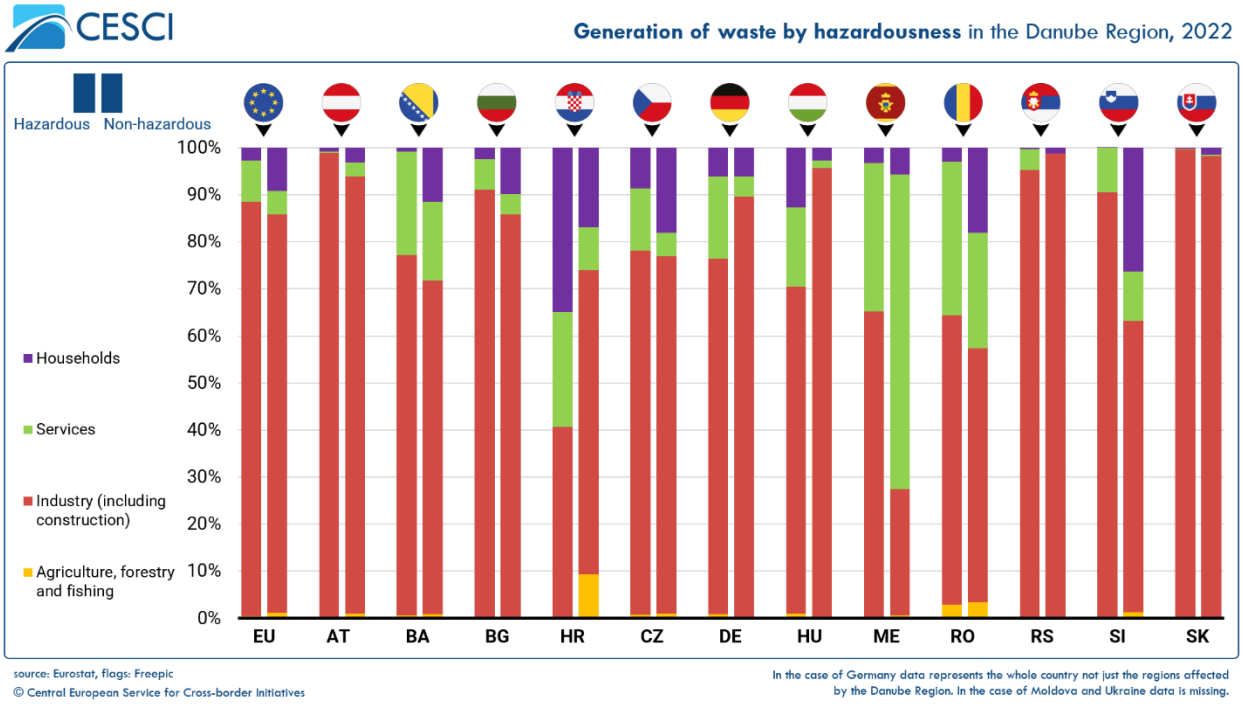


Figure 26: Generation of waste by hazardousness in the Danube Region

The generation of waste by hazardousness across the Danube Region shows that non-hazardous waste constitutes the vast majority of total volume, while hazardous waste represents a small yet environmentally critical fraction of regional waste streams. Hazardous waste production is overwhelmingly concentrated in industrial processing, mining, metallurgy, and construction activities (NACE Rev. 2 codes B-F), which account for 94.8% of all hazardous waste generated in the macroregion (69.2 million tonnes).

A comparative assessment reveals striking structural variations in both total hazardous waste volumes and the proportional share of hazardous material within national waste profiles. Slovenia exhibits the highest hazardous waste proportion at 23.3% of its total waste stream,

followed by Slovakia, where heavy industrial manufacturing drives a massive hazardous waste, representing 16.9% of its total waste generation. Austria also generates a substantial volume of hazardous waste (15.0% of its total waste), while Bulgaria records 5.9%, largely tied to industrial and metallurgical operations. These top four countries generate hazardous waste shares above the European Union average baseline of 5.35%.

Conversely, several Member States and Western Balkan candidate countries report markedly lower hazardous waste proportions relative to their overall waste output. Serbia, Montenegro, Hungary, Germany, Czechia, Croatia, and Romania maintain relatively low hazardous proportions (below 4%). These wide disparities reflect not only differences in industrial composition, but also variations in national reporting definitions, tracking methodologies, and classification thresholds for mining tailings and industrial residues between EU Member States and candidate countries.

These structural patterns highlight critical joint challenges for environmental protection and industrial safety across shared catchments. Industrial brownfields, active mining tailing ponds, and chemical processing hubs – particularly along sub-basins like the Tisza, Sava, and Lower Danube – present acute transboundary hazards during extreme weather events. Climate-driven severe floods, such as Storm Boris, heighten the risk of dam breaches and toxic spills, which can rapidly pollute downstream surface streams and alluvial aquifers. Furthermore, ongoing geopolitical disruptions and military conflict in Ukraine have introduced chemical contaminants and uncontained hazardous debris into shared river networks.

Addressing these shared hazards requires robust transnational cooperation, where actions must focus on harmonising hazardous waste tracking protocols, updating chemical risk mapping, and strengthening real-time alert networks like the Accident Emergency Warning System (AEWS). Required actions across the macroregion include ecological remediation of high-risk industrial sites, expanding specialised hazardous waste treatment infrastructure, and promoting circular economy solutions that safely recover secondary raw materials across the Danube basin.

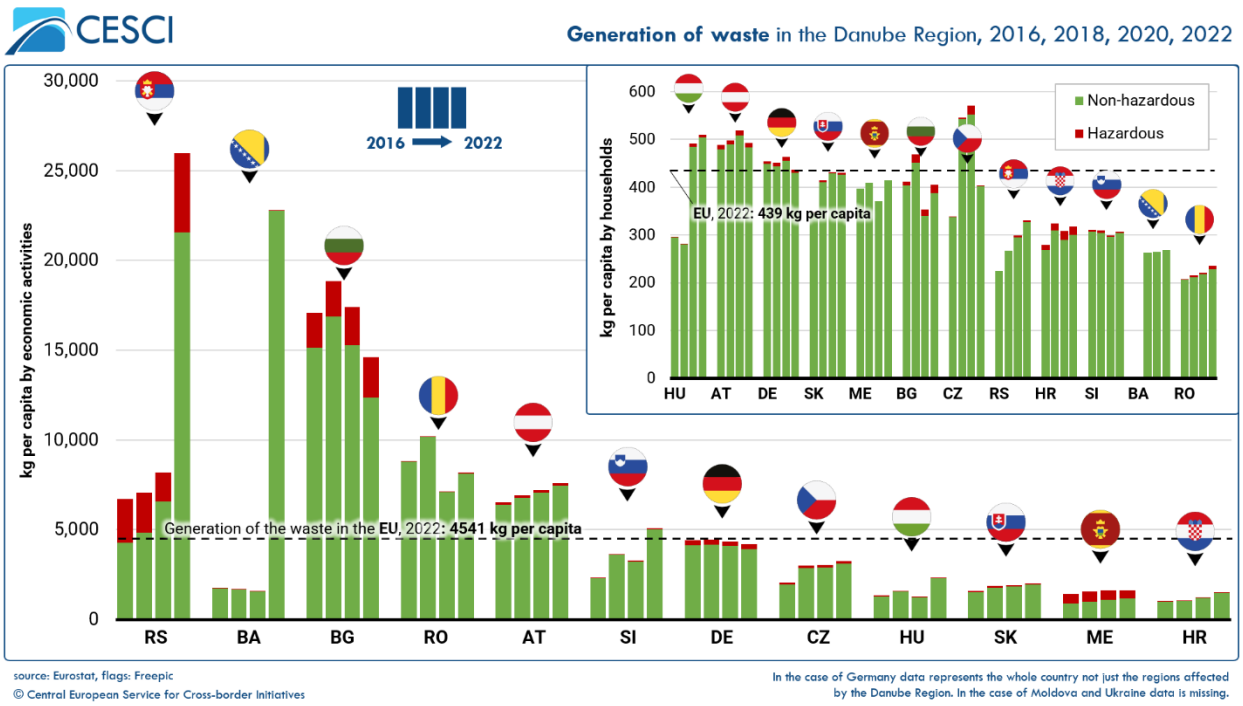


Figure 27: Generation of waste in the Danube Region

Per capita household waste generation across the Danube Region displays significant regional variation around the 2022 European Union benchmark of 439 kg per person (comprising 432 kg non-hazardous and 7 kg hazardous waste). High-consumption and modernising economies record the highest household waste output, led by Hungary at 510 kg per capita and Austria at 493 kg per capita, followed closely by Germany (437 kg per capita), Slovakia (430 kg per capita), and Montenegro (415 kg per capita). Conversely, lower household waste generation is observed in Romania (236 kg per capita), Bosnia and Herzegovina (269 kg per capita), Slovenia (307 kg per capita), and Croatia (317 kg per capita). Across all countries, non-hazardous municipal waste comprises over 96% of household waste, though hazardous household components reach localised peaks in Bulgaria (17 kg per capita) and Croatia (16 kg per capita), reflecting differing national sorting protocols and municipal collection coverage.

When evaluating total economy waste across all NACE activities, per capita volumes expand by an order of magnitude, driven by heavy industrial processing, mineral extraction, construction, and power generation. Against an EU average baseline of 4 541 kg per capita in 2022, the macroregion features extreme industrial outliers in Southeastern Europe. Serbia generates an extraordinary 25 993 kg per capita, which includes a massive 4 440 kg per capita of hazardous waste tied to intensive mining tailings and industrial residues. Bosnia and Herzegovina recorded a sharp surge to 22 779 kg per capita, while Bulgaria produced 14 599 kg per capita. Intermediate economic waste scales occur in Romania (8 174 kg per capita), Austria (7 586 kg per capita), and Slovenia (5 091 kg per capita), whereas lower per capita economic waste totals are reported in Czechia (3 268 kg), Hungary (2 340 kg), Slovakia (2 028 kg), and Croatia (1 521

kg). Notably, Montenegro maintains a high hazardous waste proportion relative to its overall waste footprint, producing 477 kg per capita of hazardous waste out of 1,635 kg total.

These contrasting per capita trends underscore urgent joint challenges for environmental governance across the shared basin. While growing household waste intensity threatens municipal landfill capacities and accelerates riverine plastic pollution, the vast scale of industrial mining waste and hazardous tailing ponds along tributaries like the Tisza and Sava poses severe transboundary contamination risks during climate-driven flood surges. Strategic priorities must focus on expanding municipal sorting, scaling up secondary material recovery in the bioeconomy, harmonising hazardous waste tracking via the Accident Emergency Warning System (AEWS).

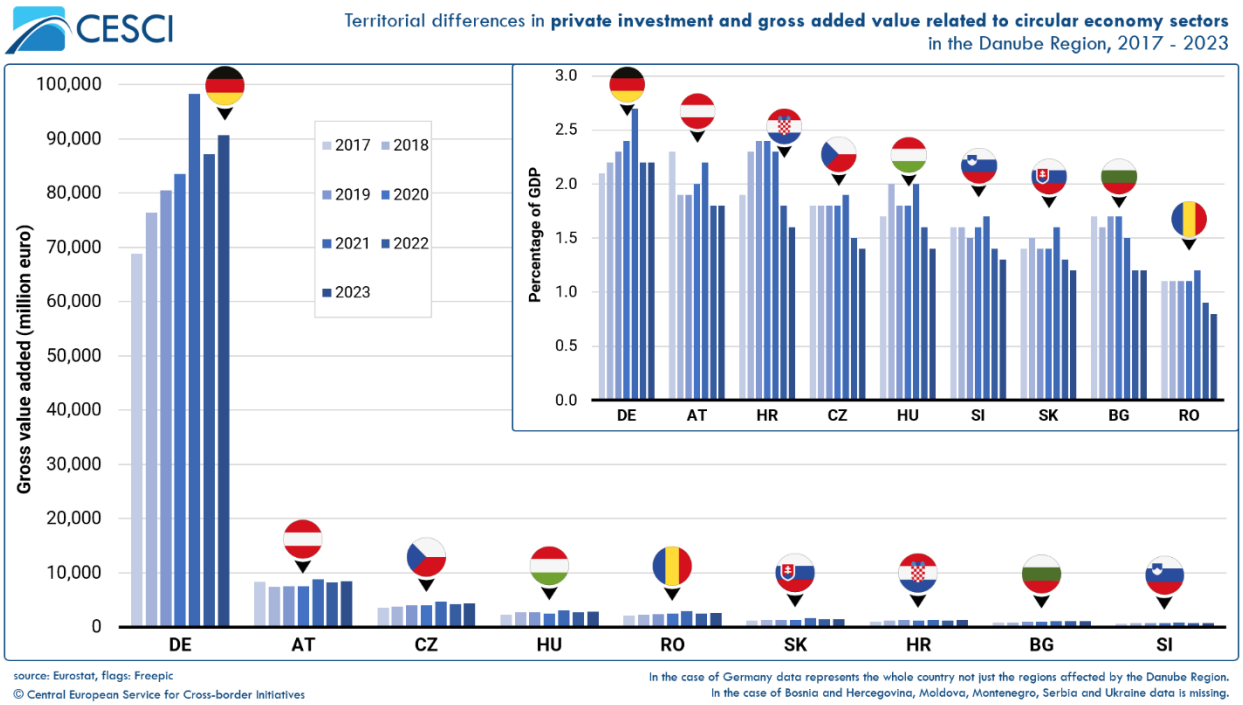


Figure 28: Gross value added of circular economy sectors

The assessment of private investment and gross added value within circular economy sectors highlights a complex economic landscape defined by significant volume growth parallel to a relative structural backdrop. The latest data from 2023 reveals a macroregion characterised by extreme economic diversity and fragmented performance levels. In terms of absolute volumes, Germany continues to serve as the dominant economic engine of the region, with investments reaching 90 644 million EUR, followed by Austria (8 407 million EUR) and Czechia (4 385 million EUR). Conversely, the territorial inequalities are more pronounced when examining the share of GDP. While Germany (2.2%) and Austria (1.8%) align with or lead the EU average of 1.8%, the southeastern countries demonstrate significant structural bottlenecks. Romania records the lowest relative performance at 0.8% of GDP, while Bulgaria and Slovakia (1.2% each) also lag

significantly behind the regional leaders, underscoring a persisting divide in the capacity to integrate circularity into the core of national economic structures.

A longitudinal comparison between 2017 and 2023 illustrates a dual-speed development path within the macroregion. In absolute monetary terms (million EUR), every country witnessed a notable increase compared to the 2017 base year :Germany achieved the highest absolute growth, increasing its investment volume by 31.8%.Croatia and Slovakia demonstrated significant dynamic expansion, with their circular investment volumes rising by 35.1% and 28.4% respectively. Hungary (+26.4%), Romania (+25.6%), Bulgaria (+22.6%), and Czechia (+22.2%) also realized growth rates that exceeded the EU27 average volume increase of 20.5%. Slovenia (+17.5%) and Austria (+1.2%) experienced more moderate absolute growth during this period. Despite this universal rise in million EUR volumes, the majority of the macroregion experienced a relative backdrop in terms of GDP percentages. Apart from Germany, which saw its share rise from 2.1% to 2.2%, all other analysed states recorded a decline in the relative weight of circular sectors within their economies. This trend is most pronounced in Austria (2.3% to 1.8%), Czechia (1.8% to 1.4%), and Romania (1.1% to 0.8%), confirming that general economic growth in other sectors has outpaced circular advancements. Consequently, when considering GDP shares, the Danube Region fundamentally underperforms the EU average, indicating that the transition to a circular economy is not yet sufficiently institutionalised to maintain its structural importance during periods of rapid general expansion.

The current status reveals that absolute growth in circular investments is insufficient to bridge the territorial circularity gap, as general economic expansion continues to favour traditional linear models in the lagging southeastern peripheries in particular. To ensure true territorial cohesion, policy must move beyond isolated investments and focus on the systemic harmonisation of circular value chains and the stimulation of green growth to prevent circular sectors from becoming marginal components of the macroregional economy.

NEXT STEPS IN DATA VISUALISATION

Additional figures to be created:

- World Heritage Sites in the Danube Region

3.1.2 Characteristics of urban network

Urban areas and public services

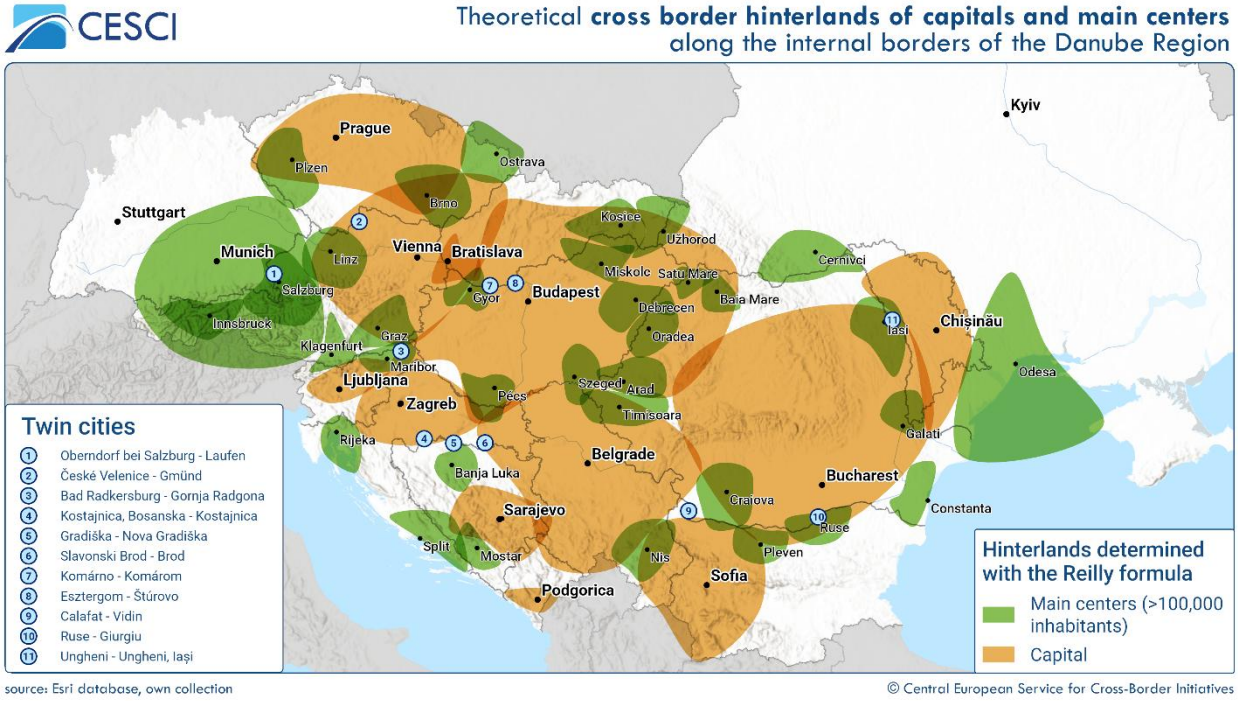


Figure 29: Theoretical internal cross-border hinterlands of the main and subcenters of the Danube Region

The urban network of the Danube Region is having an increasingly transboundary character. The current network exhibits a pronounced spatial contrast: polycentric settlement structures with dense clusters of major cities (exceeding 100,000 inhabitants) dominate in Germany, Romania, and Ukraine, whereas monocentric, single-center urban hierarchies characterise Czechia, Slovakia, Slovenia, Croatia, Serbia, Moldova, and Montenegro. Extensive spatial gaps in high-hierarchy urban centers persist across vast interstitial corridors, such as the territory bounded by Prague, Vienna, Bratislava, Zagreb, and Novi Sad. However, European integration and progressive debordering have enabled theoretical hinterlands to materialise into actual cross-border settlement relations. Monocentric inland networks are increasingly complemented by urban centers on the opposite side of national borders, converting former 180° border peripheries into integrated 360° cross-border living areas ("bassins de vie") where daily commuting, service access, and commerce naturally cross state boundaries. There are several transboundary hinterlands with already existing space organising power (e.g. around the capitals of Vienna, Bratislava, or smaller regional centres such as Salzburg, Košice) or potential intensive gravitational power with the EU integration (e.g. Uzhhorod, Iași) with different level of integration interms of cross-border flows, size of perimeters, and governance structures attached to them.

The emergence of cross-border functional areas (CBFAs) across the macroregion should be underlined. Functional urban influences routinely spill across administrative lines, creating

overlapping catchment zones that require joint planning, management and governance frameworks. By combining multi-sectoral indicators – including road drive-time accessibility, real-time social media mobility flows, population density, and natural hazard risks – ESPON CROSSGOV delineates distinct Cross-Border Functional Areas (CBFAs) along the Danube basin. These functional zones prove that urban organising power is re-establishing itself across historical divides, transforming borders from barriers into functional interconnections that enhance regional competitiveness and public service delivery.

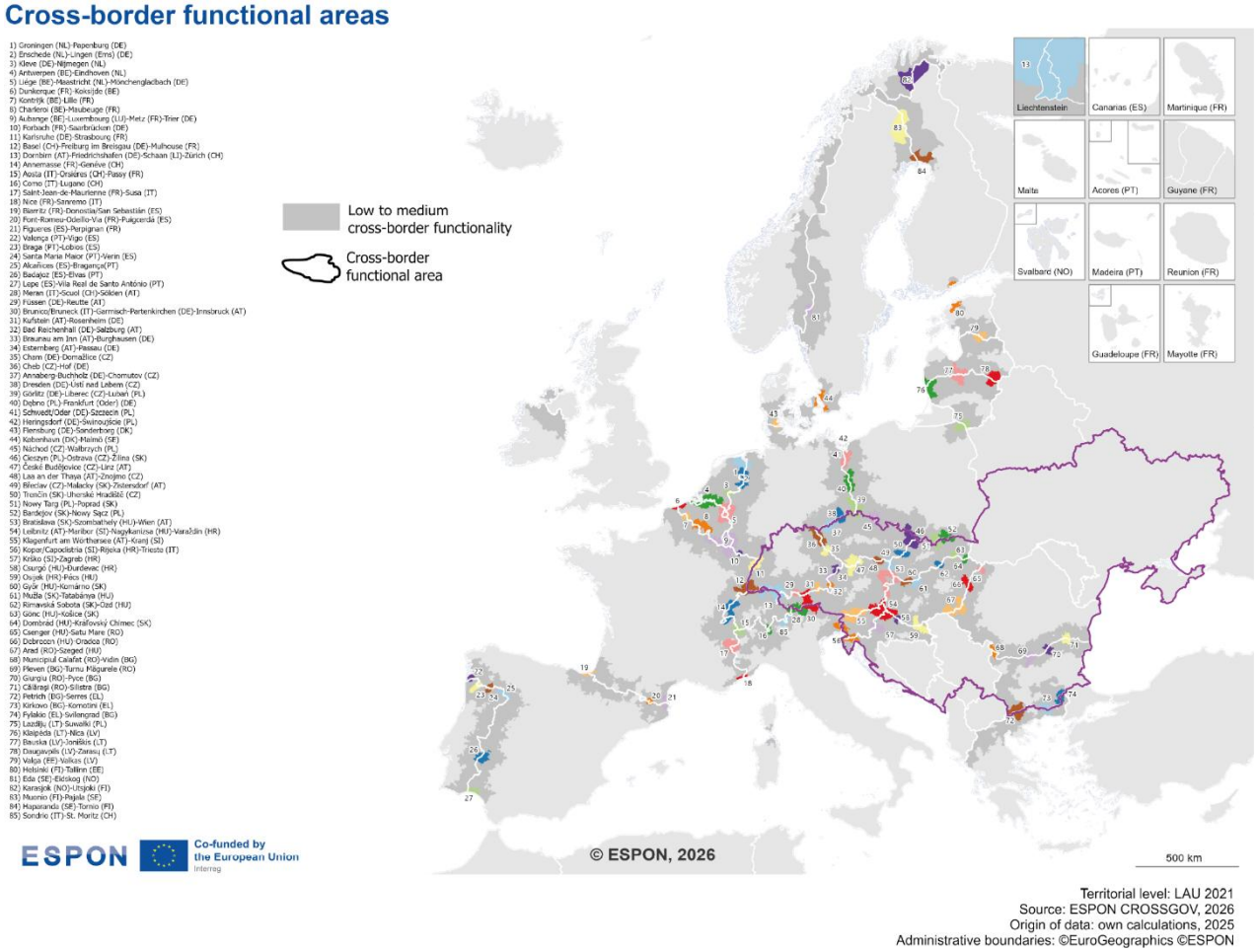


Figure 30:Cross-border functional areas in Europe, source: ESPON CROSSGOV project

A specific type of functional relations have formed with regard to the twin cities of the macroregion such as Gmünd-České Velenice, Komárno-Komárom, or along the Sava between Croatia and Bosnia and Herzegovina. For instance, the Gmünd–České Velenice twin town (AT/CZ) demonstrates micro-regional integration via the Healthcenter Gmünd, treating both Austrian and Czech patients, and shared secondary education and municipal utility links.

Joint transboundary challenges to better coordinate and manage CBFAs and twin cities include:

- Administrative disconnects and legal asymmetries: Divergent planning laws, differing municipal competences (e.g., centralised vs. decentralised administrative systems), and

non-aligned reimbursement rules hamper joint public service delivery, particularly in cross-border healthcare, emergency response, and municipal utilities.

- Infrastructure deficits and border friction: Physical connectivity suffers from uncoordinated cross-border public transport networks, lack of integrated e-ticketing, and long clearance delays at external EU borders, compounded by the temporary re-emergence of internal Schengen controls.
- Institutional fragility and project dependency: Many twin-city and regional partnerships rely heavily on short-term Interreg project cycles rather than permanent institutions, creating administrative fatigue, staff turnover risks, and funding gaps once grant cycles end.
- Spillover distortions and social friction: Asymmetric housing price differentials and wage gaps frequently drive one-sided residential relocations and heavy commuting flows, placing localised pressure on transport corridors, public services, and municipal tax distribution.

To manage cross-border functional areas effectively, macroregional policy must transition from temporary, project-based Interreg cycles toward permanent multi-level governance frameworks. Establishing legal entities such as European Groupings of Territorial Cooperation (EGTCs) and deploying place-based Cohesion Policy tools, specifically Integrated Territorial Investments (ITIs) and Community-Led Local Development (CLLD), provides the administrative stability and dedicated budget required for long-term spatial coordination. Furthermore, local authorities must leverage dedicated legal mechanisms like BRIDGEforEU and b-solutions to resolve administrative bottlenecks in cross-border public services, such as healthcare reimbursement, public transit e-ticketing, and mutual diploma recognition.

Spatial accessibility to essential services of general interest (SGIs) – specifically acute healthcare, secondary education, and elderly care – is distributed unevenly across the Danube Region. While metropolitan agglomerations and primary transport corridors maintain dense, highly accessible service networks, peripheral rural hinterlands, mountainous zones (such as the Carpathians, Dinaric Alps, and Balkan Mountains), outer borderlands face severe physical accessibility deficits. Under the ESPON DESIRE analytical framework, these disadvantaged territories are delineated as „inner peripheries" (of the EU and adjecent territories) areas where relative travel times by car to essential facilities significantly exceed those of surrounding regions due to sparse facility placement, rugged topography, or underfunded road infrastructure. When essential public services require extended drive times, local quality of life deteriorates, placing severe socio-economic strain on peripheral populations.

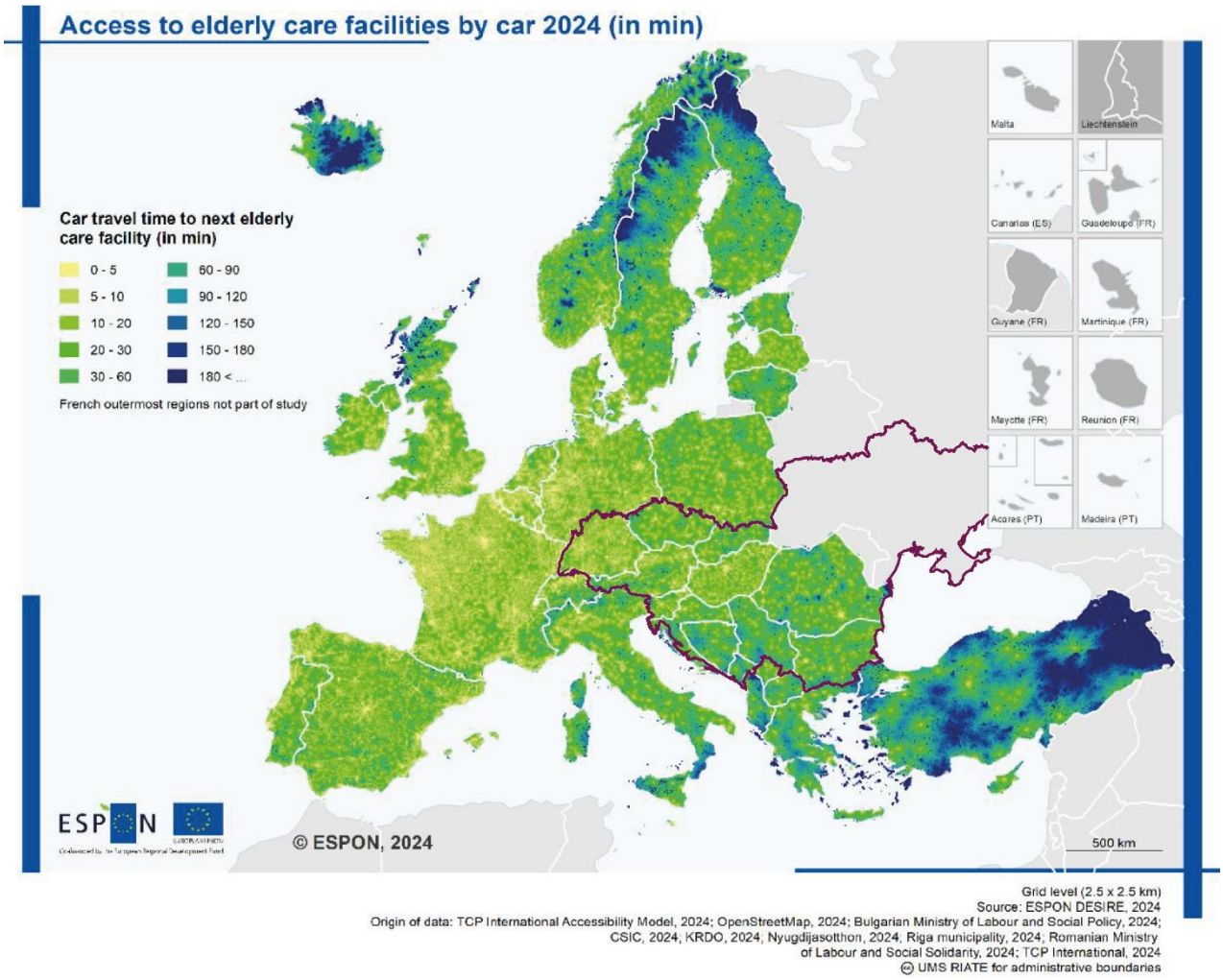


Figure 31: Access to elderly care facilities by car, source: ESPON DESIRE project

Empirical findings from the ESPON DESIRE project outputs illustrate the spatial severity of these accessibility gaps across various service categories. In inpatient healthcare, car travel times to the nearest hospital frequently exceed the standard 30-to-60-minute acceptable threshold in peripheral NUTS3 regions. For instance, over 18% of the population in Croatia, 12% in Romania, 11% in Bosnia and Herzegovina, and 12% in Montenegro must travel between 30 and over 120 minutes by car to reach emergency hospital care. Accessibility to secondary education reveals similar regional divides, where inner peripheries affect significant proportions of national populations, including 8.3% in Slovenia, 6.6% in Slovakia, and 5.8% in both Hungary and Czechia, while in Serbia over 21% of residents face drive times exceeding 30 minutes to reach secondary schooling. The most severe spatial disparities occur in social care for the elderly. Major care deserts characterise Eastern European and Western Balkan candidate states; in Serbia, over 43% of the population lives more than 30 minutes away from a retirement or nursing home, whereas in Montenegro, an alarming 74.3% of the population must drive between 30 and over 120 minutes to access an elderly care facility.

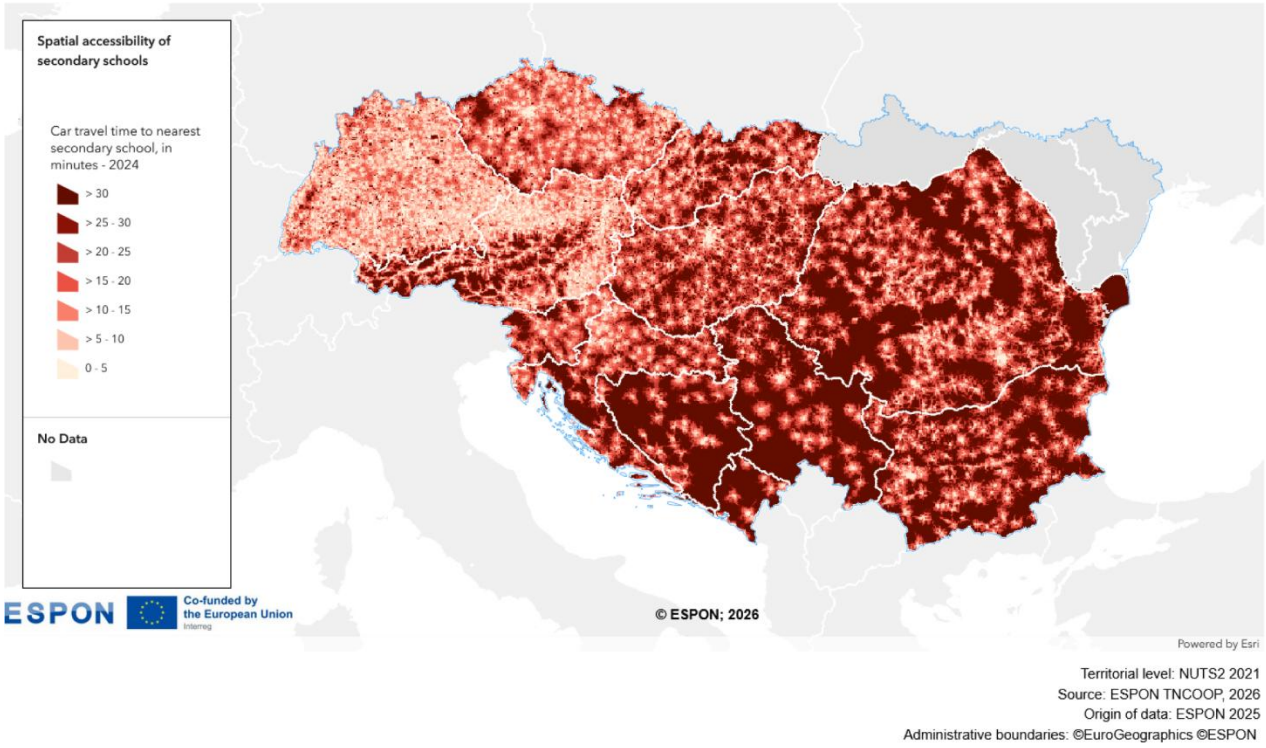


Figure 32: Spatial accessibility of secondary schools, source: ESPON TNCOOP project

These spatial accessibility deficits generate compounding socio-economic challenges across the macroregion that trigger „vicious cycles" of regional contraction. In weakly accessible sub-regions, such as the Pannonian agricultural rural areas, the Banat Plains, Eastern Romanian border districts, Southern and Eastern Serbia, and rural Bulgarian territories like Severozapaden, long travel times to urban functions accelerate youth out-migration and demographic aging. As active working-age populations and young families leave, local tax bases shrink and consumer demand falls, prompting service providers to consolidate or close remaining public and private facilities. This micro-economic cost-cutting shifts the financial and physical burden onto remaining residents, further eroding territorial cohesion and isolating vulnerable, non-mobile social groups.

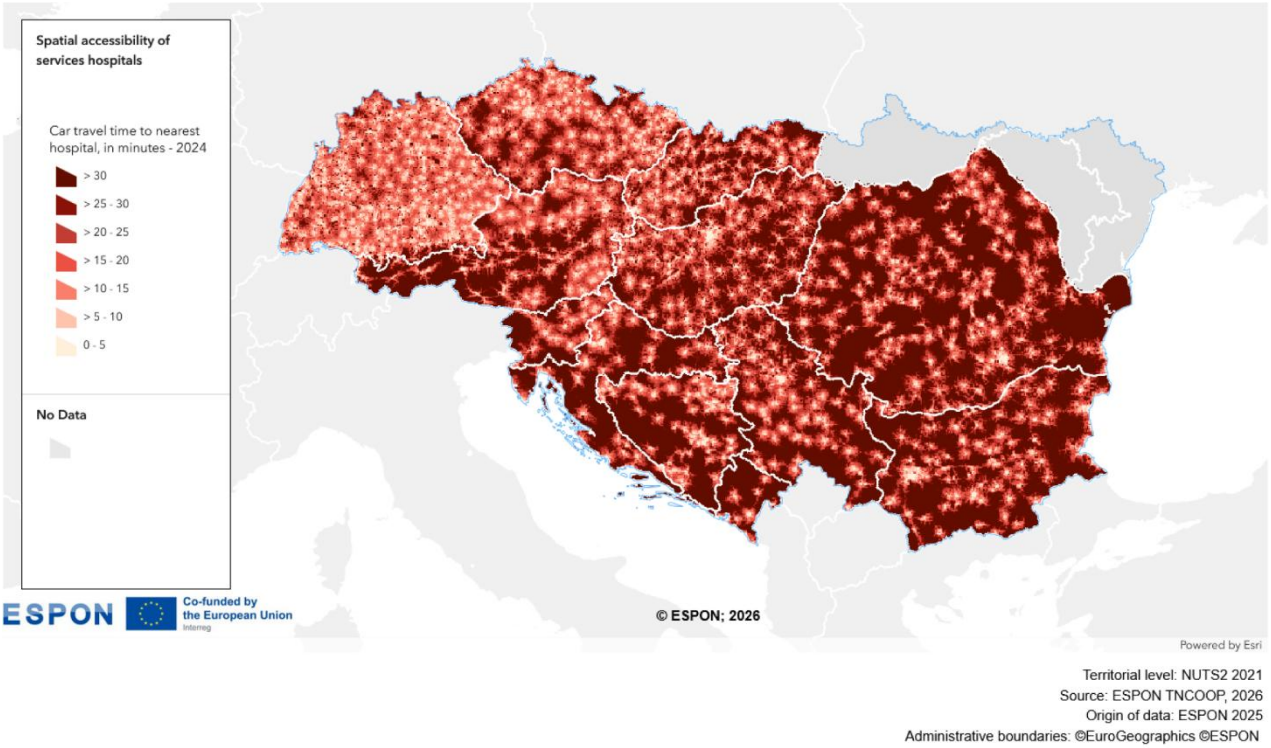


Figure 33: Spatial accessibility of hospitals, source: ESPON TNCOOP project

To break these cycles of decline, macroregional development strategies must be anchored in the policy framework of the „Right to Stay". The Right to Stay asserts that citizens in rural, peripheral, and border regions should not be forced to migrate to urban centers or abroad due to a lack of basic public infrastructure and services. Operationalising this principle requires place-based, flexible policy responses rather than one-size-fits-all closures. Key joint transnational needs include deploying mobile service units (such as mobile health clinics and eldercare visits), expanding digital healthcare platforms (telemedicine) with assisted access for non-digitalised seniors, and introducing demand-responsive public transport (DRT) to connect remote villages with secondary urban hubs. There is also a need for cross-border public services (CBPS), pooling hospital capacity, school enrollments, and emergency services between cities, twin towns like Gmünd–České Velenice or Komárno–Komárom to sustain facility viability. By embedding these innovative delivery mechanisms population retention and secure spatial justice should be strengthened across lagging peripheral territories in particular.

Housing, housing prices

The evolution of real estate prices reflects a profound socio-economic challenge that directly impacts territorial and social cohesion. Setting 2015 as the base year (100%), the latest statistical evidence illustrates a macroregion facing a drastic and uneven surge in housing costs, which has become a primary bottleneck for regional development. The price index for newly built dwellings reveals extreme territorial inequalities across the macroregion. Hungary stands as the absolute outlier with a price index of 383.1, representing a nearly fourfold increase since 2015, followed

by Czechia at 261.6. Both countries significantly exceed the European Union average of 170.41. In contrast, traditionally more stable markets such as Germany (149.8) and Romania (160.06) have experienced more moderate growth, currently performing below the EU baseline. Other states like Slovakia (184.24), Croatia (184.39), and Slovenia (173.32) occupy a middle tier, yet their growth still surpasses the European average, signaling a regional trend.

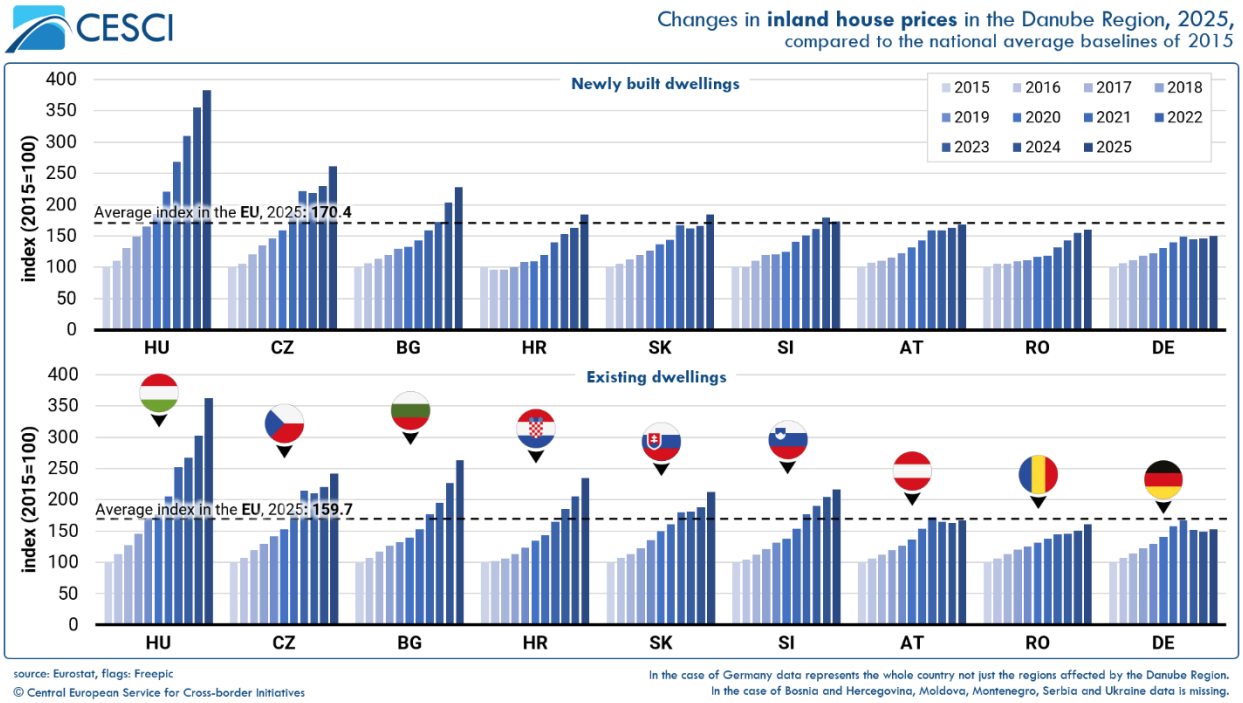


Figure 34: Changes in inland house prices in the Danube Region

Regarding the market for existing dwellings, price growths mirror these disparities, though the internal hierarchy shifts slightly. Hungary again leads with an index of 362.14, followed by Bulgaria (263.26) and Czechia (242.3). It is noteworthy that in Croatia (234.73) and Slovenia (216.49), the price increase for existing housing has outpaced that of new constructions, suggesting a high demand for available housing stock that the new supply cannot meet. Compared to the EU average of 159.7, the majority of the macroregion, excluding Germany (153.1), shows a significantly higher rate of appreciation. This trend underscores a general decline in housing affordability across the central and eastern parts of the region.

The drastic rise in housing prices has evolved into a joint macroregional challenge that actively weakens cohesion and hinders mobility. This pressure is particularly acute in former socialist states such as Hungary, Slovakia, and Romania, where the share of population living in privately owned housing is exceptionally high. For these citizens, the surge in prices, coupled with increasing household costs, has placed housing poverty at the forefront of the social problem map. The lack of affordable, quality housing acts as a barrier to labour force migration and prevents younger generations from establishing independent households, thereby deepening the demographic crisis and regional disparities. The urban-rural divide has intensified due to the

housing crisis as well, meaning also that there is a lack of sufficient housing stock in major employment centres, while rural areas and peripheries often offer vacant and deteriorating homes in growing numbers. The current landscape indicates that the dramatic inflation of real estate prices has outpaced income growth in most Member States. To ensure long-term territorial stability, future cohesion policy should prioritise the development of affordable and social housing sectors through regional planning and targeted interventions that address the structural deficiencies of the macroregional housing market.

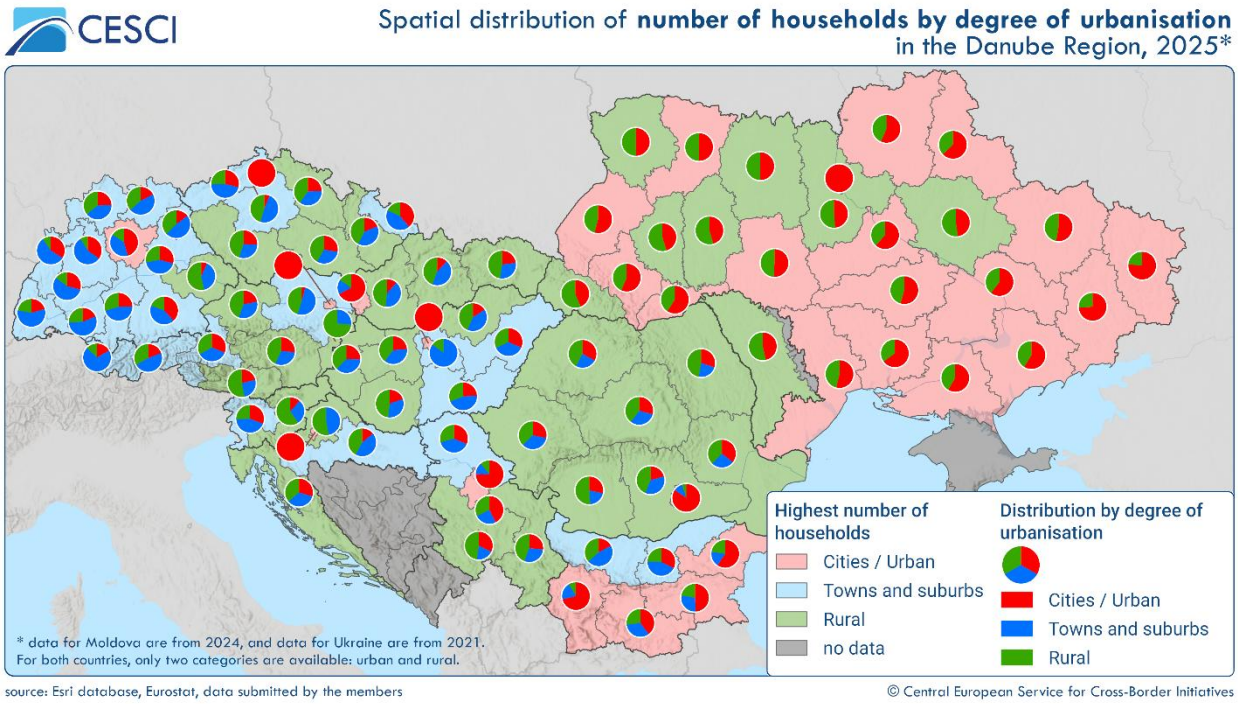


Figure 35: Spatial distribution of number of households by degree of urbanisation

An analysis of the household distribution across the degree of urbanisation reveals profound territorial inequalities and structural settlement divides across the Danube Region. Compared to the European Union average baseline, where 42.0% of private households reside in dense cities, 34.3% in intermediate towns and suburbs, and 23.7% in rural areas, the macroregion displays an unusually broad settlement spectrum ranging from hyper-urbanised capital cores to vast, rural-dominated hinterlands. This spatial heterogeneity reflects historical patterns of industrial development, administrative centralisation, and geographic topography, shaping distinct domestic settlement balances across Member States and accession candidate countries.

Based on household distribution patterns, the Danube macroregion can be disaggregated into three distinct territorial groups. The first tier consists of highly suburbanised and polycentric regions, led by Germany, Czechia, and Hungary. In Germany, intermediate towns and suburbs contain the largest share of households (42.4%), followed by cities (39.5%) and rural areas (18.1%). A similar suburban-intermediate dominance is visible in Czechia (34.3% in towns and suburbs, 33.9% in rural areas, and 31.8% in cities) and Hungary (36.5% in towns and suburbs,

36.0% in cities, and 27.5% in rural areas). In these territories, small and medium-sized towns act as vital regional service anchors, buffering the transition between major metropolitan hubs and agricultural areas.

The second tier comprises highly polarised, urban-centric states where households are concentrated heavily in major cities, leaving a relatively thin intermediate suburban cushion. This group includes Bulgaria (51.0% city households, 28.4% in towns/suburbs, and 20.6% in rural areas), Serbia (42.6% city households, 25.2% in towns/suburbs, and 32.2% in rural areas), Austria (37.1% cities, 30.5% towns/suburbs, and 32.4% rural), and Croatia (34.9% cities, 31.9% towns/suburbs, and 33.2% rural). In these countries, primary urban centers absorb a disproportionate share of population growth and investment, creating stark internal contrasts against surrounding rural territories.

The third tier is defined by predominantly rural and peripheral settlement structures, where rural households constitute the largest single category or a massive share of the overall population. This tier encompasses Slovenia (43.7% rural households vs. 20.6% in cities), Slovakia (42.2% rural households vs. 23.2% in cities), Romania (38.2% rural households vs. 36.1% in cities), Moldova (53.5% rural households vs. 46.5% in cities based on 2024 census figures), and Ukraine (40.8% rural households across its 25 oblasts). Across these Eastern and Southeastern European regions, extensive rural settlement networks stretch across the Carpathian, Dinaric, and Balkan mountain systems and agricultural basins, maintaining deep-seated rural traditions alongside high spatial vulnerability.

Sub-national data further accentuates extreme intra-national inequalities, driven by the overwhelming dominance of capital city regions over their rural hinterlands. In capital agglomerations, city household shares reach absolute peaks: 100% in Wien, Berlin, Hamburg, Praha, Grad Zagreb, Budapest, and Kyiv city, 84.5% in București-Ilfov, 75.2% in Beogradski region, 71.3% in Yugozapaden (Sofia), and 67.4% in Bratislavský kraj. Conversely, neighbouring or peripheral regions display extreme rural concentrations. In Austria, Burgenland features 73.6% rural households and 0% city households, while Kärnten reaches 53.4% rurality. In Croatia, Sjeverna Hrvatska contains 52.7% rural households and 0% city households. In Slovakia, Západné Slovensko (48.3% rural), Východné Slovensko (47.6%), and Stredné Slovensko (44.3%) stand in sharp contrast to Bratislava. In Romania, Sud-Vest Oltenia (51.2% rural) and Nord-Est (47.3% rural) illustrate deep internal disparities against the capital core. In Serbia, Region Šumadije i Zapadne Srbije (47.8% rural) and Region Južne i Istočne Srbije (44.3% rural) lag far behind Belgrade, while in Ukraine, western and central oblasts such as Zakarpatska (56.4% rural), Ternopilska (54.9%), Khmelnytska (54.5%), and Poltavska (52.4%) contrast sharply with major industrial and administrative hubs. Notable suburban expansion is also visible in capital peripheries, exemplified by Pest county surrounding Budapest, where 85.1% of households live in towns and suburbs, and Střední Čechy surrounding Prague (48.5%).

These spatial imbalances generate severe macroregional challenges that intersect directly with territorial cohesion and service provision. As established in regional analyses, highly rural and peripheral regions heavily coincide with inner peripheries and lagging regions that suffer from long car drive-times to essential Services of General Interest (SGIs), such as hospitals, secondary schools, and elderly care facilities. Inadequate public service delivery, sparse transport connectivity, and limited high-value employment in rural hinterlands drive continuous youth out-migration and brain drain toward capital metropolises or Western European economies. This selective talent depletion triggers vicious demographic cycles, accelerating population aging, eroding local municipal tax bases, and leaving small towns with vacant housing and underfunded public utilities.

Addressing these persistent rural-urban divides requires robust, multi-level transnational cooperation To protect the "Right to Stay" and foster population retention in lagging rural hinterlands, macroregional strategies must prioritise place-based, community-led Smart Village initiatives. Policy responses could focus on deploying mobile and digital public services (e-health, distance education), expanding demand-responsive rural transit, upgrading local digital infrastructure, and diversifying rural economies beyond low-productivity agriculture toward sustainable value chains, agro-tourism, and local craft networks. Simultaneously, strengthening Functional Urban Area (FUA) governance and deploying Integrated Territorial Investments (ITIs) can better connect rural hinterlands to secondary urban anchors, ensuring equitable access to essential services, bridging capital-periphery divides, and building a balanced, polycentric spatial structure across the entire Danube Basin.

3.1.3 Status of the borders

The related map illustrates one of the most significant geopolitical transformations currently underway in Europe: the gradual eastward extension of the European integration area and the corresponding strengthening of territorial cohesion within the Danube Region. As of 30 September 2026, the macroregion encompasses countries representing almost every stage of the European integration process, ranging from long-standing EU and Schengen members to candidate countries at different phases of accession negotiations. This unique position makes the Danube Region both a laboratory and a strategic corridor for European integration.

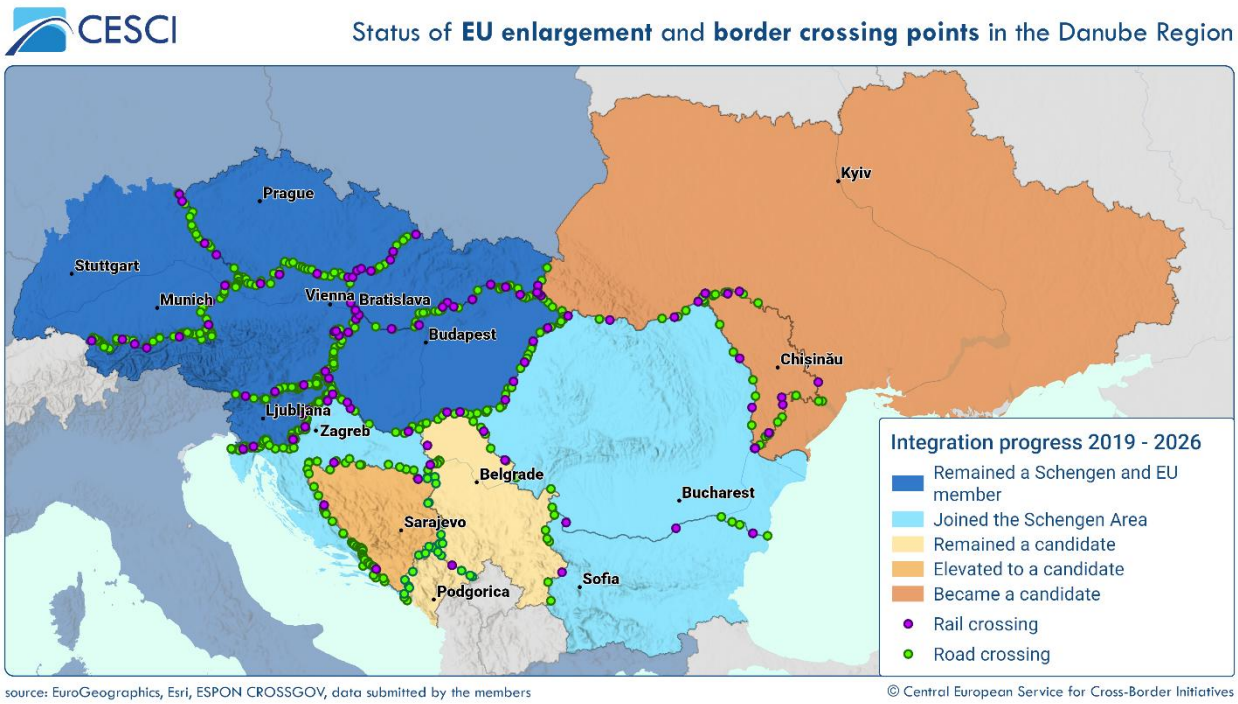


Figure 36: Status of EU enlargement and border crossing points in the Danube Region

During the latest period Croatia joined the Schengen Area in January 2023, while Romania and Bulgaria completed their full Schengen accession in January 2025. As a result, the internal Schengen border now extends deep into the lower Danube basin, creating an unprecedented territorial continuum of free movement from Southern Germany to the Black Sea. This long-term process of debordering has generated substantial opportunities for economic, social and territorial integration. Reduced border controls have facilitated labour mobility, cross-border commuting, tourism, investment flows and business cooperation. Regions previously located at the margins of national economies have increasingly become gateways between markets.

At the same time, the map also highlights that European integration remains an unfinished project. Temporary border controls, reintroduced on several internal Schengen borders in response to migration pressures, security concerns and geopolitical uncertainties, demonstrate that integration can be affected by re-emerging bordering effects.

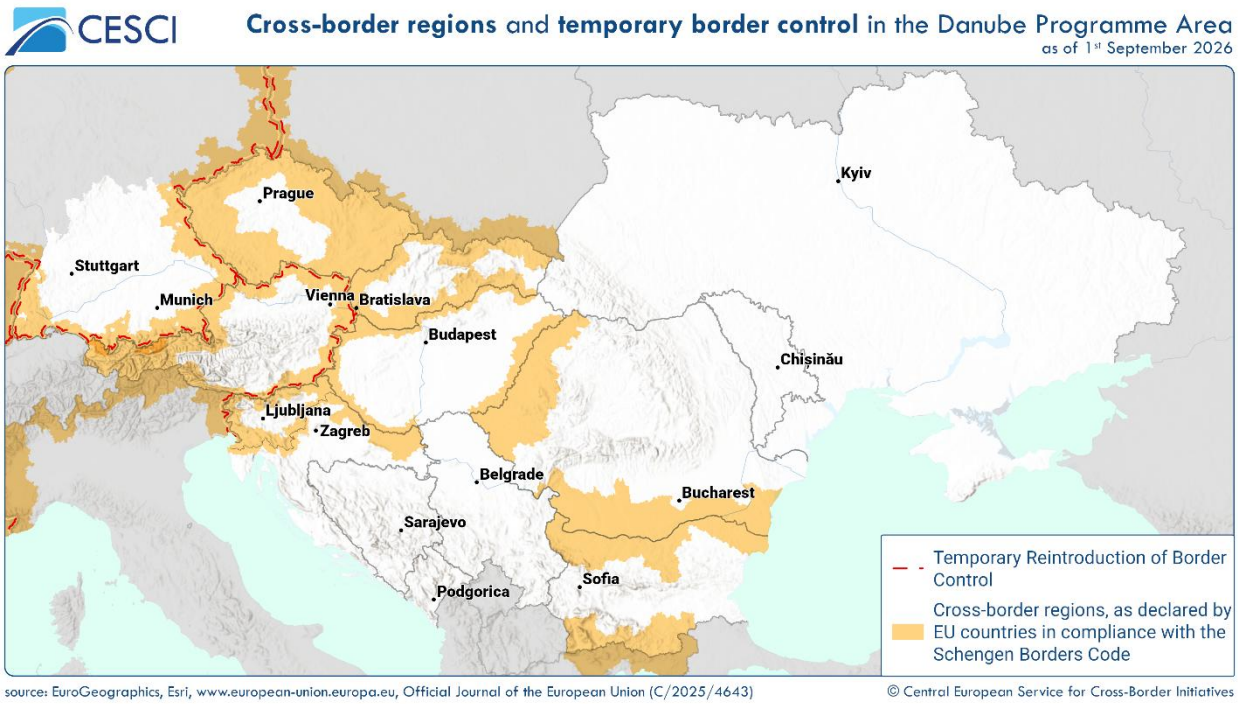


Figure 37: Cross-border regions and temporary border control in the Danube Programme Area

From a geopolitical perspective, the Danube Region occupies a uniquely strategic position. Stretching from the heart of Western Europe to the Black Sea and the Western Balkans, it forms the principal geographical bridge between the established core of the European Union and the countries preparing for future accession. The Danube Region is becoming the primary arena of the next phase of European enlargement. While Germany, Austria, Czechia, Slovakia, Hungary, Slovenia, Croatia, Romania, and Bulgaria are already integrated into the EU, several neighbouring countries continue along differentiated accession paths. In this context, Montenegro stands out as the clear frontrunner of the enlargement process, having opened all negotiating chapters, provisionally closed a substantial number of acquis chapters with the EU, and officially entered the final stage of accession negotiations with the target of becoming a full Member State in 2028. Concurrently, Serbia continues along its accession path, Bosnia and Herzegovina has recently advanced to candidate status, while Ukraine and Moldova became candidate countries in 2022 and have since emerged as central actors in the Union's enlargement agenda. Consequently, almost all current and prospective accession processes within Europe are concentrated in or directly connected to the Danube macroregion.

This situation creates a historically unprecedented opportunity for the region to become a major interconnector in the reunification of the European family. The Danube Region is not located at the periphery of enlargement; rather, it constitutes its geographical and political centre. It is the territory where existing EU members and future members interact most intensively through trade, transport, labour mobility, cultural exchange, and institutional cooperation. The macroregion therefore serves as a bridge not only between countries but also between different stages of European integration, dynamically linking mature Single Market economies, fast-

advancing frontrunners approaching the completion of negotiations, and candidate countries undergoing structural reforms.

The advanced accession trajectory of Montenegro, having entered the final stage of negotiations to become a full Member State even in 2028 after closing numerous negotiation chapters, alongside the candidate status and progress of Ukraine, Moldova, Serbia, and Bosnia and Herzegovina, confirms that the Danube Region will remain at the forefront of European integration in the coming years and decades. Its strategic location between current and future member states positions it as one of the most important territorial platforms for strengthening cohesion, supporting enlargement, and strengthening the unity of Europe.

This deepening integration process is continuously shaped by evolving border dynamics and joint cohesion challenges. European territorial integration remains vulnerable to re-emerging bordering effects, as temporary internal border controls introduced in response to migration pressures, cybersecurity concerns, and hybrid security risks reinstate physical friction along key corridors. Concurrently, external borders separating EU Member States from candidate countries continue to encounter severe bottlenecks, uncoordinated customs procedures, and transit delays that hinder smooth mobility and territorial cooperation in general.

Overcoming these structural obstacles requires an urgent commitment to legal harmonisation, regulatory convergence, and institutional integration across national borders. Divergences between EU acquis directives and the domestic legal frameworks of non-EU candidate countries generate persistent administrative barriers in managing e.g. shared river catchments, cross-border energy grids, and multimodal transport links. Addressing these gaps demands the systematic harmonisation of customs protocols through digital systems, the establishment of permanent cross-border public service (CBPS) frameworks, and the deployment of specialised legal mechanisms such as b-solutions and European Groupings of Territorial Cooperation (EGTCs). By anchoring these harmonised legal standards and administrative capacities into post-2027 frameworks, the Danube Region can effectively eliminate border friction, transform peripheral borderlands into integrated functional corridors, and serve as the central driver for European reunification.

NEXT STEPS IN DATA VISUALISATION

Additional figures to be created:

- Border areas in the Danube Region

3.1.4 Territorial cooperation and governance framework

Governance

Public sentiment toward the European Union across 13 Danube Region countries between 2019 and 2026 reveals a nuanced and polarised sociopolitical landscape that reflects both tangible convergence toward European integration and persistent pockets of public skepticism. Average public trust in the EU across the surveyed Danube Region states expanded to 49.7% in 2026, aligning closely with the European Union average baseline of 51.0% (where EU-wide distrust stands at 43.0%). However, beneath this regional average lies significant divergence in public confidence. Montenegro has emerged as the macro-region's absolute frontrunner in European sentiment, registering a decisive trust level of 65.0% against just 31.0% distrust. This represents an extraordinary trust surge of 17.8 percentage points since 2019, a direct dividend of the country opening all negotiation chapters, provisionally closing numerous acquis chapters, and entering the final phase of accession negotiations aimed at full EU membership in the near future. Clear pro-European majorities and pluralities also characterise Bosnia and Herzegovina (56.0% trust vs. 40.0% distrust), Croatia (55.0% trust vs. 41.0% distrust, with trust rising by 9.1 percentage points since 2019), Bulgaria (52.0% trust vs. 37.0% distrust), Germany (51.0% trust vs. 43.0% distrust), Hungary (51.0% trust vs. 44.0% distrust), and Moldova (50.0% trust vs. 36.0% distrust). In contrast, public sentiment is tightly divided in Austria (49.0% trust vs. 45.0% distrust), Slovakia (48.0% trust vs. 45.0% distrust), Romania (48.0% trust vs. 46.0% distrust), and Czechia (46.0% trust vs. 49.0% distrust, despite an increase of 10.6 percentage points in trust since 2019). Majorities expressing distrust continue to dominate in Slovenia (54.0% distrust vs. 39.0% trust) and most acutely in Serbia, where distrust climbed to 59.0% against a modest 36.0% trust rate.
This uneven landscape highlights an acute systemic risk: the deepening threat of institutional alienation, civic disillusionment, and entrenched anti-EU sentiment if the enlargement momentum stalls or fails to produce tangible milestones in the immediate years ahead. Decades of protracted negotiations and perceived shifting goalposts have already cultivated severe accession fatigue, public apathy, and political skepticism in parts of the Western Balkans, as vividly illustrated by the high distrust levels in Serbia. If candidate countries perceive the accession process as an endless holding pattern rather than a credible, merit-based pathway toward full membership, public faith in democratic and regulatory convergence will inevitably unravel. Such stagnation creates an ideological and geopolitical vacuum that hostile external actors can readily exploit, threatening regional stability, accelerating the out-migration of pro-European educated youth (brain drain), and compromising cross-border security along the Union's external perimeter. Maintaining a credible, predictable enlargement perspective is therefore not merely a technical diplomatic process, but an existential prerequisite for

safeguarding democratic resilience and long-term geopolitical cohesion across Southeastern Europe.

Within this fragile environment, the Danube Region occupies a strategic position as an indispensable operational platform for sustaining and rebuilding trust between EU Member States and accession candidate nations. The macro-regional framework of the EU Strategy for the Danube Region (EUSDR) and the INTERREG-funded Danube Region Programme function as a vital counterweight to accession fatigue. By engaging candidate states – such as Montenegro, Serbia, Bosnia and Herzegovina, Moldova, and Ukraine – on an equal footing with established EU Member States within joint decision-making bodies and cross-border partnerships, the macro-region translates abstract European values into visible, everyday improvements. Collaborative transnational projects in e.g. flood protection, clean energy integration, university twinning, digital public services, and transport connectivity demonstrate the direct socio-economic benefits of European integration long before official accession is finalised. This practical, place-based co-governance bridges historical and administrative divides, fosters institutional trust, and anchors candidate societies firmly within the European democratic sphere.

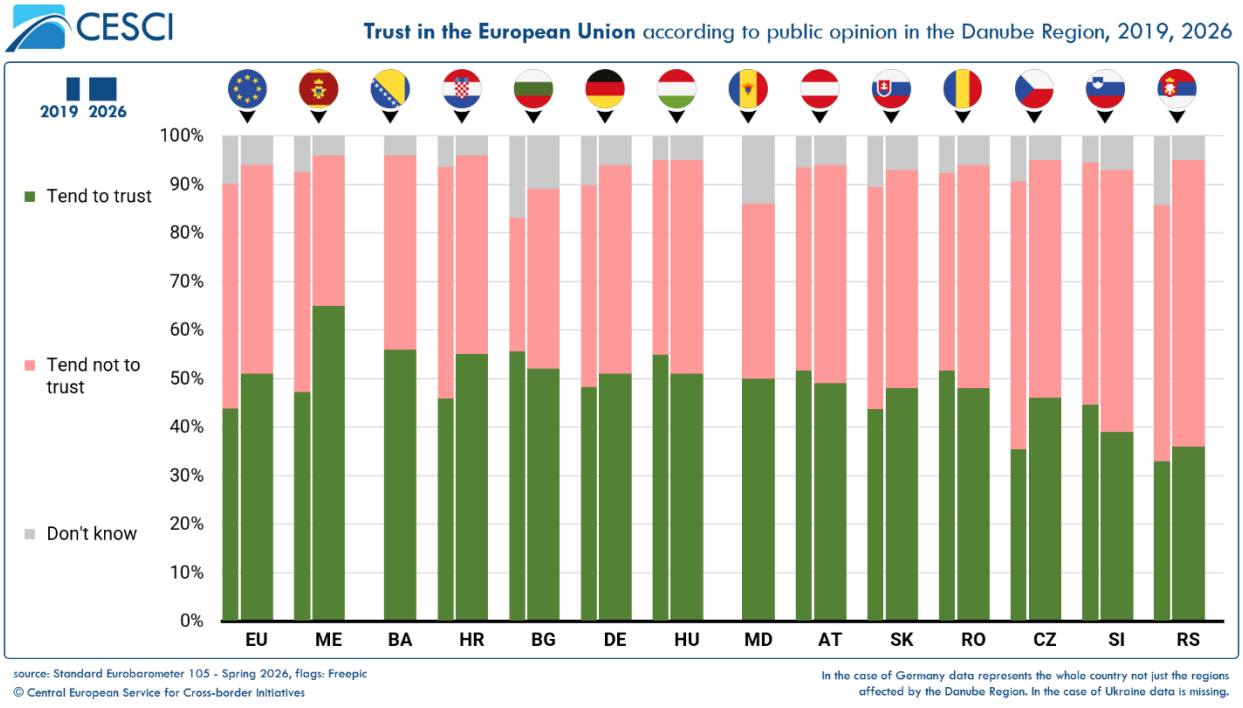


Figure 38: Trust in the European Union according to public opinion in the Danube Region

Regarding the current state and territorial inequalities, the latest data from 2024 reveals that the Danube Region remains a highly fragmented space in terms of digital governance, reflecting broader socio-economic disparities. Germany (0.9382) and Austria (0.9065) continue to act as the primary leaders of the macroregion, occupying the top positions in the E-Government Development Index (EGDI). A noteworthy development is the emergence of Ukraine (0.8841) as a frontrunner, now ranking third within the region and surpassing several EU Member States.

Conversely, the southern and eastern peripheries still face challenges in catching up, with Bosnia and Herzegovina (0.6329) and Montenegro (0.7211) recording the lowest index values. These figures underscore a persisting territorial inequality where the „digital gap" between the western core and the southeastern convergence regions remains a decisive factor for the overall cohesion of the macroregion.

Focusing on component-level disparities, the sub-indexes highlights distinct national strengths and structural weaknesses across the region. Considering E-Participation and Online Services: A sharp contrast is visible here; Ukraine achieves a perfect score in the E-Participation Index (1.000) and a near-perfect Online Service Index (0.9854), demonstrating a massive leap in digital citizen engagement. In contrast, Montenegro (0.5214) and Bosnia and Herzegovina (0.5003) lag significantly in online service provision, representing a bottleneck for institutional integration. Taking into account human capital, the related values remain a more stable pillar for the western and central parts of the region. Germany (0.9672) and Austria (0.9003) lead, while Hungary (0.8703) also shows strong performance in educational attainment relevant to digital transition. Considering telecommunication, infrastructure levels are relatively more balanced than services, yet disparities persist. Austria (0.9810) and Germany (0.9236) lead, but notably, Serbia (0.9221) and Montenegro (0.9229) have developed robust infrastructure that surpasses their performance in online service delivery.

With regard to temporal dynamics and convergence between 2018 and 2024, the macroregion experienced a general upward trend in digital governance, though the pace of improvement was uneven. The most outstanding „catching-up" process was achieved by Ukraine, whose EGDI rose from 0.6165 to 0.8841, a massive increase of over 0.26 points. Croatia (+0.18) and Serbia (+0.15) also demonstrated significant progress, moving closer to the regional average. In contrast, the most developed economies like Germany and Austria saw more moderate increases, as they had already reached a high baseline. The smallest degree of change was observed in Montenegro, where the index stagnated with only a marginal improvement of approximately 0.02 points, further deepening its relative lag behind neighbouring states.

The current status indicates that while the digital divide is narrowing in certain countries lagging behind like Ukraine and Serbia, the Danube Region remains a region of inequalities due to the uneven integration of online administrative services in particular. To achieve true territorial cohesion, a shift is needed from purely infrastructure-oriented development support toward harmonised e-governance models that facilitate the flow of e-data and services, particularly targeting the lagging non-EU Member States in the Western Balkans, and the sustainability of the well-performing e-government in Ukraine.

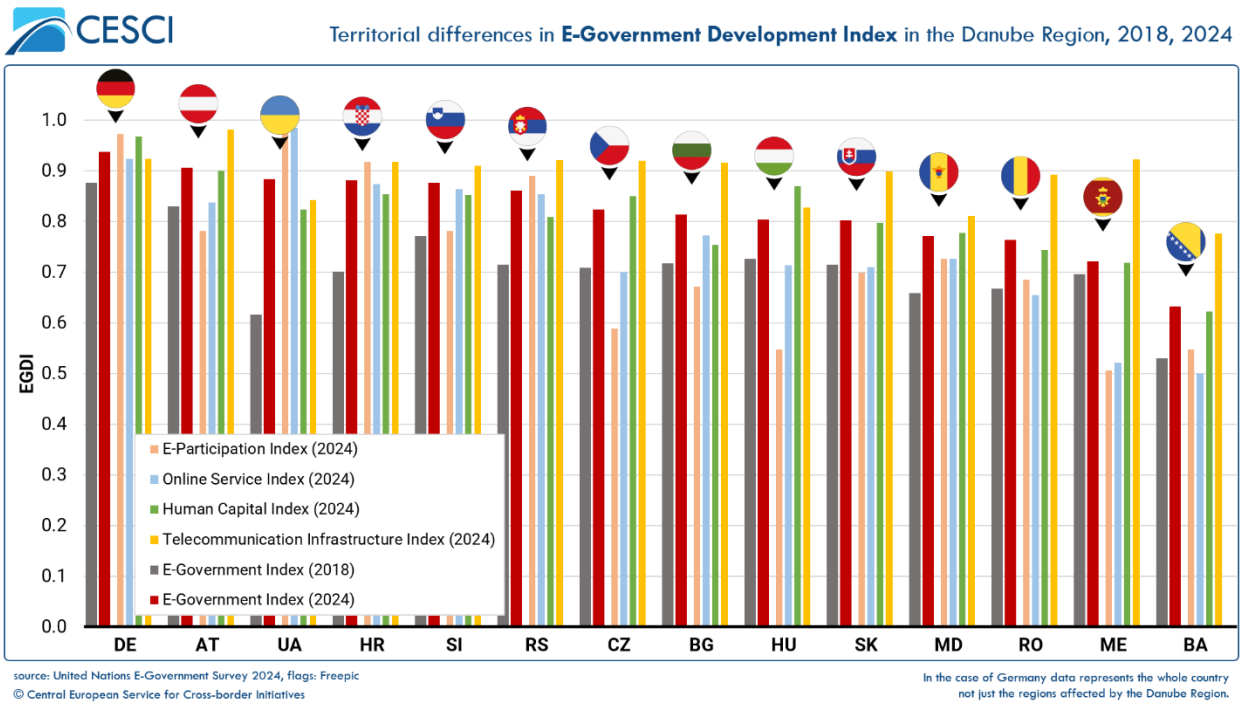


Figure 39: Territorial differences in E-Government Development Index in the Danube Region

Territorial cooperation

The spatial distribution of Interreg V A (2014–2020) cooperation networks across the Danube Region[4] illustrates a profound structural gradient in transnational partnership density and cross-border connectivity. An analysis of the macroregional network reveals a marked West-to-East and EU-to-non-EU divide in cooperation density. The highest intensity of Interreg partnerships is heavily clustered in the upper Danube basin and the Alpine-Adriatic arc. Southern Germany (Baden-Württemberg and parts of Bavaria) and Austria, alongside Slovenia and Adriatic Croatia, form the macroregion's core cooperation engine. These upper basin territories benefit from mature institutional frameworks, well-funded regional development agencies and services, long-standing Euroregion and other institutionalised traditions, and high public administrative capacities that enable local stakeholders to consistently generate and absorb transnational projects. A secondary, moderate-density corridor extends across Central European Member States including parts of Czechia, Slovakia, and Western Hungary.

[4] This indicator shows the density of Interreg V A (2014–2020) cooperation networks. It is based on the location of, and links between, Interreg project partners and aggregates the information on linkages into a European-wide density map. A dark colour signifies a high intensity of connections and thus a high density of partners and projects. The lighter the colour, the fewer partners and projects are present in the area resulting in fewer connections. Interreg cooperations cannot be seen as definitive proxies for all cooperations due to their specialised nature. Nevertheless, they indicate areas of potential stronger interlinkages and those with weaker interlinkages from a cross-border perspective. Source: https://gis-portal.espon.eu/arcgis/apps/storymaps/collections/345c978adf784adfac30c16b90219d35?item=6

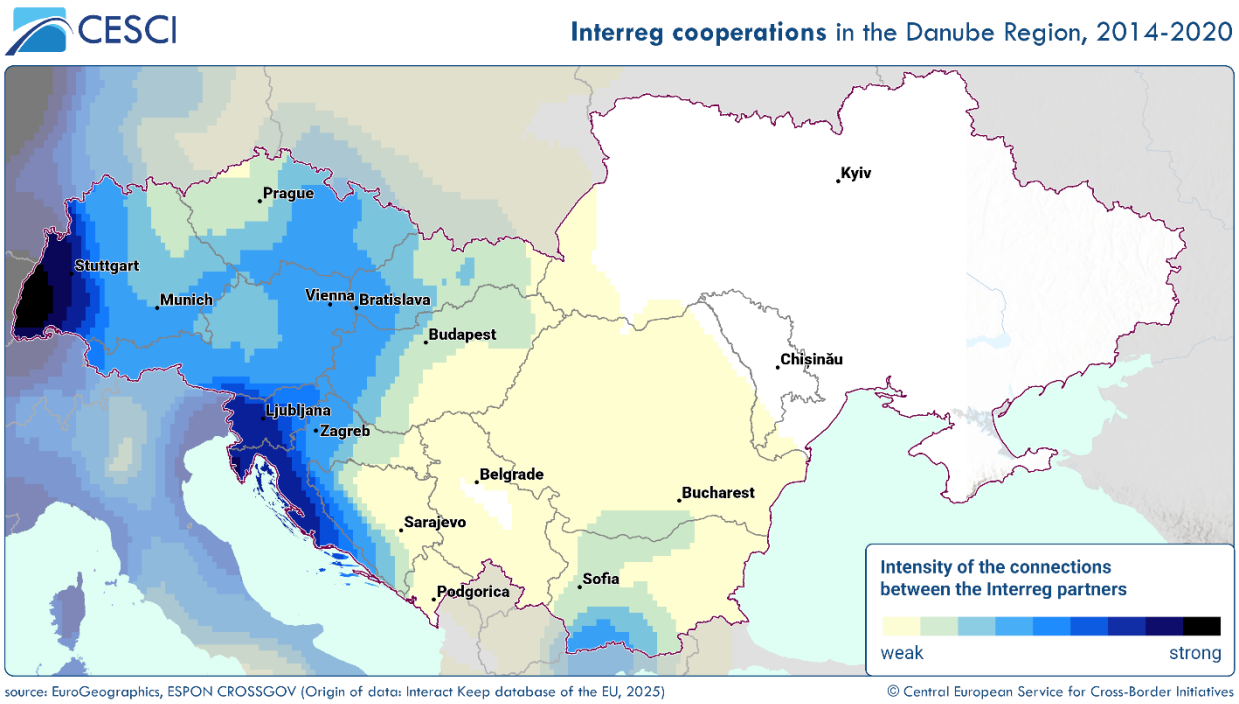


Figure 40: Interreg cooperations in the Danube Region

In stark contrast, large areas of the Eastern and Southeastern Danube Basin exhibit persistent network peripherality, characterised by extremely loose, weak connections and sparse partner representation. This low-density belt, depicted in pale yellow and light tones, encompasses the rural borderlands between Romania and Bulgaria, the Lower Danube river corridor, the tri-border agricultural plains connecting Hungary, Romania, and Serbia, as well as the broader territory of non-EU candidate and partner states, including Bosnia and Herzegovina, Montenegro, Moldova, and Ukraine. Peripheral border areas across the Western Balkans and Eastern Neighborhood suffer from structural barriers to cooperation, including limited municipal fiscal autonomy, low baseline awareness of Interreg mechanisms, acute administrative staff turnover, and strict co-financing requirements that disadvantage smaller local authorities. In Ukraine and Moldova, these pre-existing capacity deficits have been further compounded by severe external shocks, war-induced infrastructure destruction, and administrative strains associated with emergency crisis management.

Bridging these deep network asymmetries represents one of the primary joint challenges for the long-term cohesion and resilience of the Danube macroregion. Overcoming the isolation of weakly connected borderlands requires moving beyond short-term, competitive project cycles toward targeted capacity building and permanent institutional capacity support. Macroregional governance could deploy simplified funding mechanisms (such as micro-grants, „Small Project Funds") to enable resource-scarce municipalities, local civil society organisations, and non-EU stakeholders to participate on equal footing. Furthermore, establishing structured knowledge-transfer between high-density Western hubs and peripheral Eastern actors can facilitate joint support for the gradual integration of candidate countries into the European Union.

NEXT STEPS IN DATA VISUALISATION

Additional figures to be created:

- EGTCs in the Danube Region

3.2 Economic cohesion

3.2.1 General Economic Picture of the Danube Region (The Danube Region in the EU and Internal Economic Relations)

Overall economic performance based on GDP and GVA

An evaluation of real economic performance based on national level GDP per capita in constant 2015 US dollars between 2018 and 2025 illustrates a profoundly divided economic landscape across the Danube Region. The macro-region exhibits stark territorial inequalities structured along an entrenched West-East and core-periphery gradient. In 2025, only Austria (46,090 USD) and Germany (44,147 USD) surpass the European Union average benchmark of 35,365 USD, registering 130.3% and 124.8% of the EU level respectively. The remaining twelve participating states perform entirely below the European baseline, forming three distinct lower-tier clusters: a Central European convergence group comprising Slovenia (74.6% of the EU average), Czechia (59.4%), Slovakia (56.5%), Croatia (52.1%), and Hungary (47.3%); a Southeastern EU tier represented by Romania (35.5%) and Bulgaria (29.6%); and a structurally lagging periphery in the Western Balkans and Eastern Neighborhood, where Serbia (24.9%), Montenegro (24.8%), Bosnia and Herzegovina (19.6%), Moldova (11.4%), and Ukraine (6.2%) remain far below European living standards. This persistent divide results in an extreme macro-regional disparity of nearly twenty-one times between the wealthiest state (Austria) and the most distressed territory (Ukraine), underscoring the macro-region's role as a complex transition zone bridging mature Single Market economies, industrial manufacturing hubs, and candidate countries undergoing structural transformation.

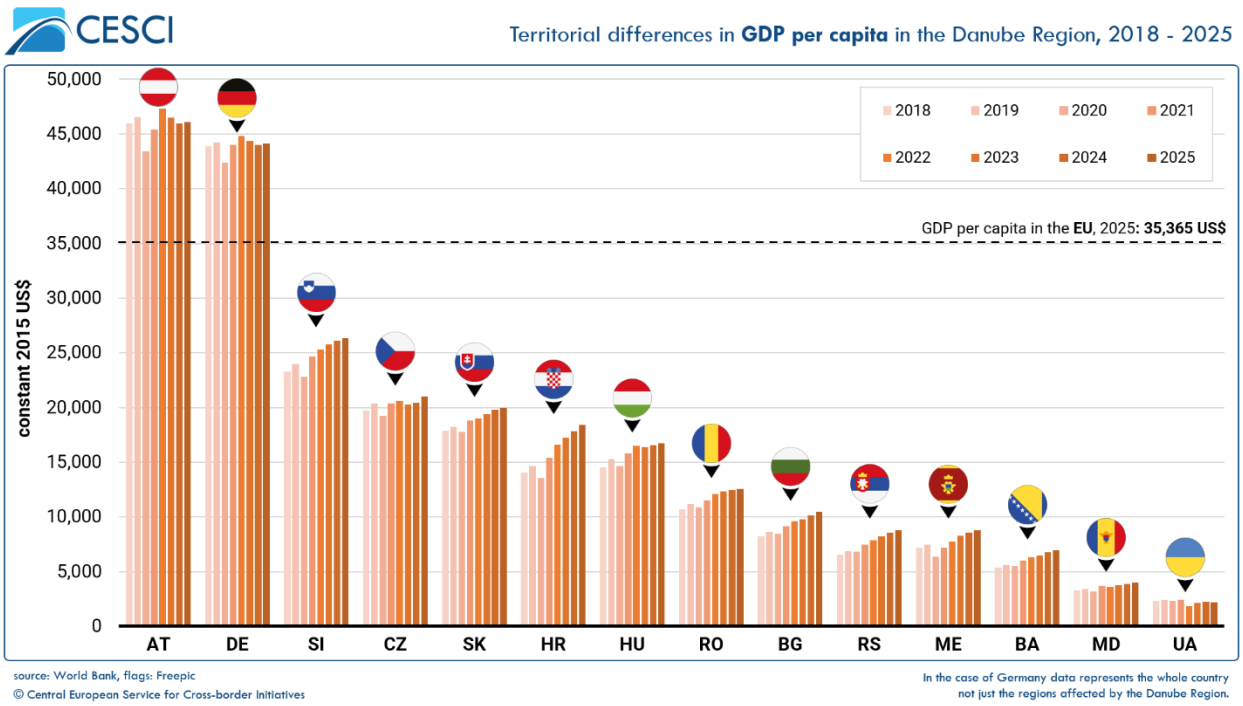


Figure 41: Territorial differences in GDP per capita in the Danube Region on national level (2018-2025)

Analysing the dynamic changes between 2018 and 2025 reveals significant divergence in growth trajectories, characterised by a rapid catching-up process among lower- and middle-income economies alongside near-stagnation in the western industrial core. The strongest relative growth over the seven-year period occurred in the Western Balkans and Southeastern Europe, led by Serbia with an expansion of 34.95% (+2,280 USD), Croatia with 30.96% (+4,353 USD), Bosnia and Herzegovina with 29.54% (+1,583 USD), and Bulgaria with 27.57% (+2,259 USD), followed by solid gains in Moldova (+22.97%), Montenegro (+22.63%), and Romania (+17.28%). Central European transition states also sustained steady convergence, with Hungary expanding by 14.98%, Slovenia by 13.19%, Slovakia by 11.74%, and Czechia by 6.46%. In sharp contrast, the macro-region's mature western engines experienced real per capita stagnation, with Germany growing by a modest 0.55% (+241 USD) and Austria by just 0.30% (+139 USD), reflecting post-2022 industrial deceleration, elevated energy costs, and external trade headwinds. Ukraine represents the sole economy in real contraction, loosing 4.85% (-112 USD) of its real per capita output between 2018 and 2025 due to the severe infrastructure destruction and economic dislocations caused by Russia's war of aggression. While these differentiated growth rates demonstrate that economic convergence is actively functioning across Central and Southeastern Europe, the widening absolute wealth gap against the easternmost war-affected borderlands highlights the imperative for targeted transnational cooperation.

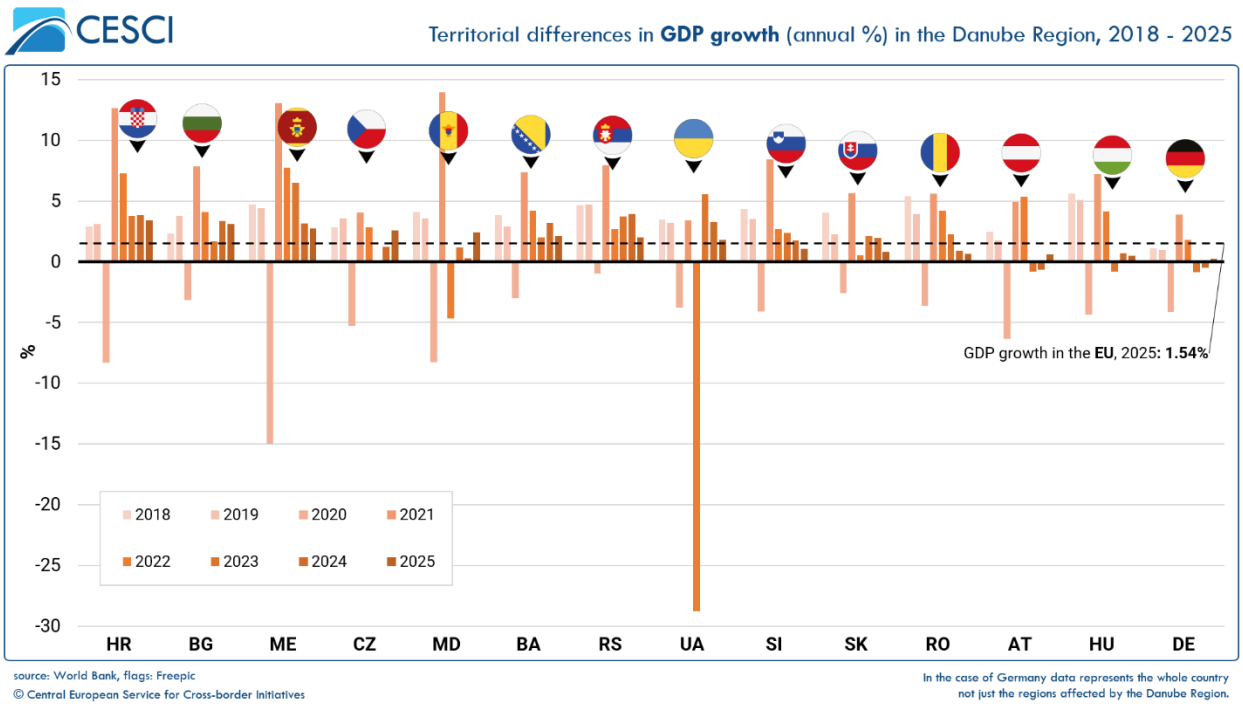


Figure 42: Territorial differences in GDP growth in the Danube Region on national level (2018-2025)

An analysis of annual GDP growth across the Danube Region reveals a bifurcated macro-regional economic landscape marked by sharp territorial inequalities when benchmarked against the European Union average baseline. In 2025, the European Union registered an annual growth rate of 1.54%, down from 2.05% in 2018. Across the Danube Basin, participating economies have diverged into two distinct performance tiers. The faster-growing cluster comfortably outperforms the European benchmark, led by Croatia (3.40%), Bulgaria (3.10%), Montenegro (2.74%), Czechia (2.58%), Moldova (2.42%), Bosnia and Herzegovina (2.13%), Serbia (2.03%), and Ukraine (1.82%). In sharp contrast, a pronounced growth slowdown characterises the macro-region's mature western engines and parts of Central Europe, where annual expansion falls well below the EU baseline, as seen in Slovenia (1.06%), Slovakia (0.81%), Romania (0.68%), Austria (0.62%), Hungary (0.51%), and Germany (0.24%). This dynamic underscores a structural complementarity across the basin: while the western industrial core and export-dependent Central European economies grapple with structural deindustrialisation, elevated energy costs, and muted external demand, Southeastern European Member States and Western Balkan candidate territories continue to act as relative growth drivers supported by service expansion, tourism flows, and pre-accession convergence momentum.

Examining the evolution between 2018 and 2025 illustrates a widespread deceleration across the Danube space, interrupted by profound intermediate crises. In 2018, the macro-region was defined by robust convergence, with nearly all Central, Eastern, and candidate states achieving high growth rates between 2.8% and 5.6%, led by Hungary (5.61%), Romania (5.39%), Montenegro (4.73%), and Serbia (4.65%), while Germany expanded by a modest 1.14%. By 2025, twelve of the fourteen economies recorded lower growth rates than their 2018 starting baselines.

The most severe decelerations occurred in Hungary (-5.10 percentage points, falling to 0.51%) and Romania (-4.72 percentage points, dropping to 0.68%), followed by Slovenia (-3.32 pp), Slovakia (-3.25 pp), and Serbia (-2.62 pp), whereas only Bulgaria (+0.77 pp, reaching 3.10%) and Croatia (+0.49 pp, reaching 3.40%) achieved higher annual growth in 2025 than in 2018. Between these years, the macro-region weathered extraordinary volatility, including the 2020 pandemic downturn (which contracted Montenegro by -14.99% and Croatia by -8.31%), the subsequent double-digit rebounds of 2021, the severe wartime contraction in Ukraine (-28.76% in 2022), and the technical recessions of 2023 in Germany (-0.87%), Hungary (-0.82%), and Austria (-0.79%). Although all Danube economies returned to positive growth by 2025, the widening gap between sluggish core industrial economies and resilient Southeastern convergence poles represents a critical structural challenge for long-term territorial cohesion and macro-regional integration.

In terms of GDP per capita on regional level, the macroregion remains one of the most polarised areas in Europe, characterised by significant territorial inequalities. The NUTS3 regions of Germany and Austria clearly constitute the core areas of the EU and its best-performing, developed regions. Some of the best-performing regions of Europe are located within the macroregion along with Luxembourg, some French, Irish, Dutch and Danish regions. The economit output is outstanding in these regions, which include Ingolstadt, Kreisfreie Stadt (164 200 EUR per capita), München, Landkreis (149 200 EUR), Coburg, Kreisfreie Stadt (122 400 EUR), Erlangen, Kreisfreie Stadt (118 700 EUR) or Stuttgart, Stadtkreis (118 100 EUR). All the regions exceeding the threshold of 100 000 EUR per capita are situated in the westernmost regions of the macroregion, in Bavaria and Baden-Württemberg, Germany.

As seen from the German data regarding Paris, Dublin or Amsterdam, on European scale, major cities, typically capital cities and their functional urban areas, are among the most developed regions. This is especially true in the case of the Danube Region, partly due to the catching-up processes of recent years and decades. The economic motors of many eastern and southeastern countries are these metropolitan and capital city regions, lead by Praha (63 500), and followed by the regions of Bucureşti (48 900 EUR), Budapest (44 700 EUR), Bratislava (Bratislavský kraj, 46 100 EUR) and Ljubljana (Osrednjeslovenska, 44 700 EUR). A persistent urban-rural divide exists between capital regions and the more rural and remote regions of the Danube Region in the majority of countries apart from Germany and Austria, which has not changed profoundly in the last decade. The differences are extreme between these regions and the least developed region of the same countries (e.g. 6.1 times in Romania, 4.8 times in Hungary, 4.7 times in Bulgaria, 3.9 times in Serbia, 3.2 times in Slovakia).

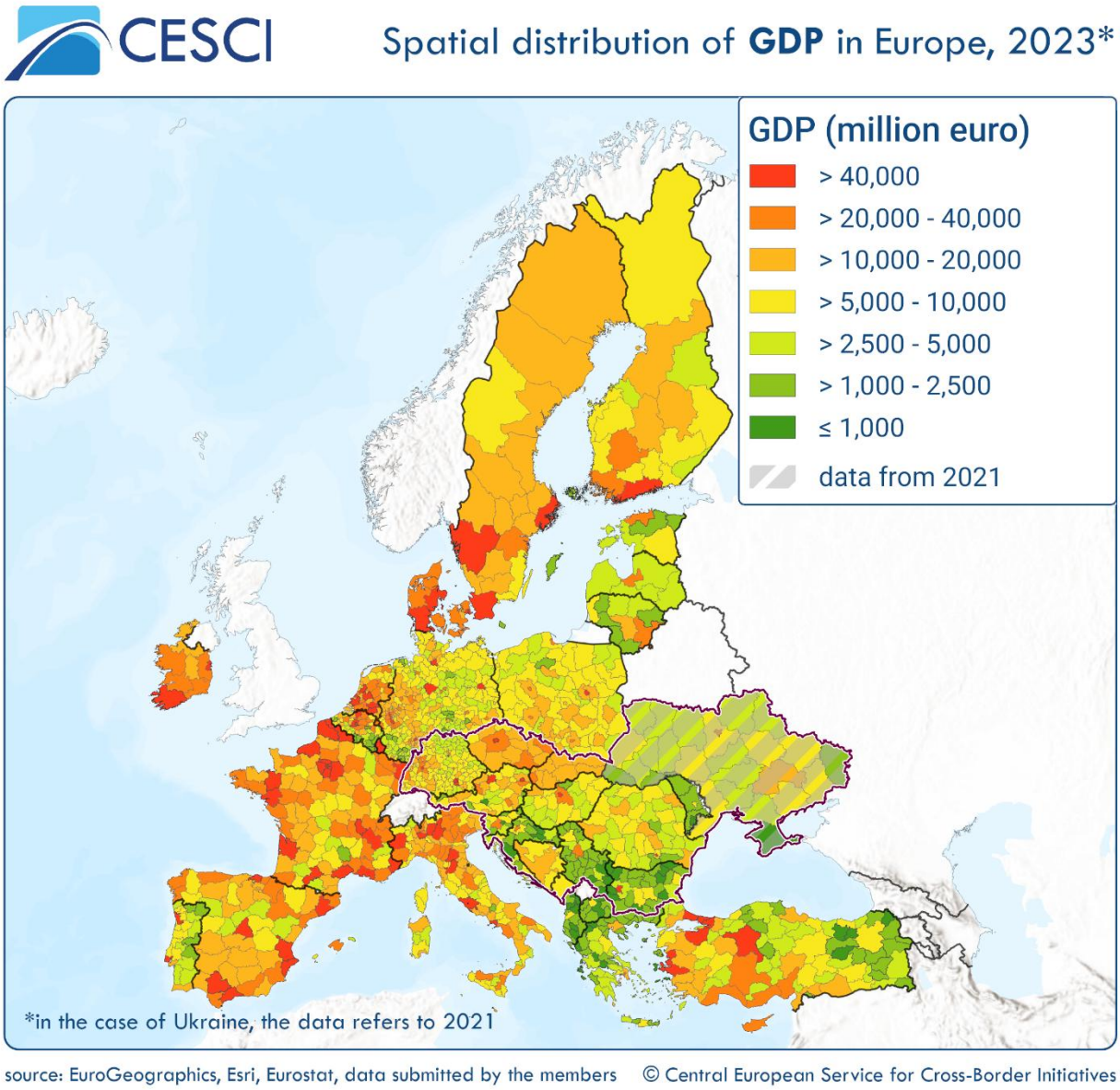


Figure 43: Spatial distribution of GDP in Europe on regional level

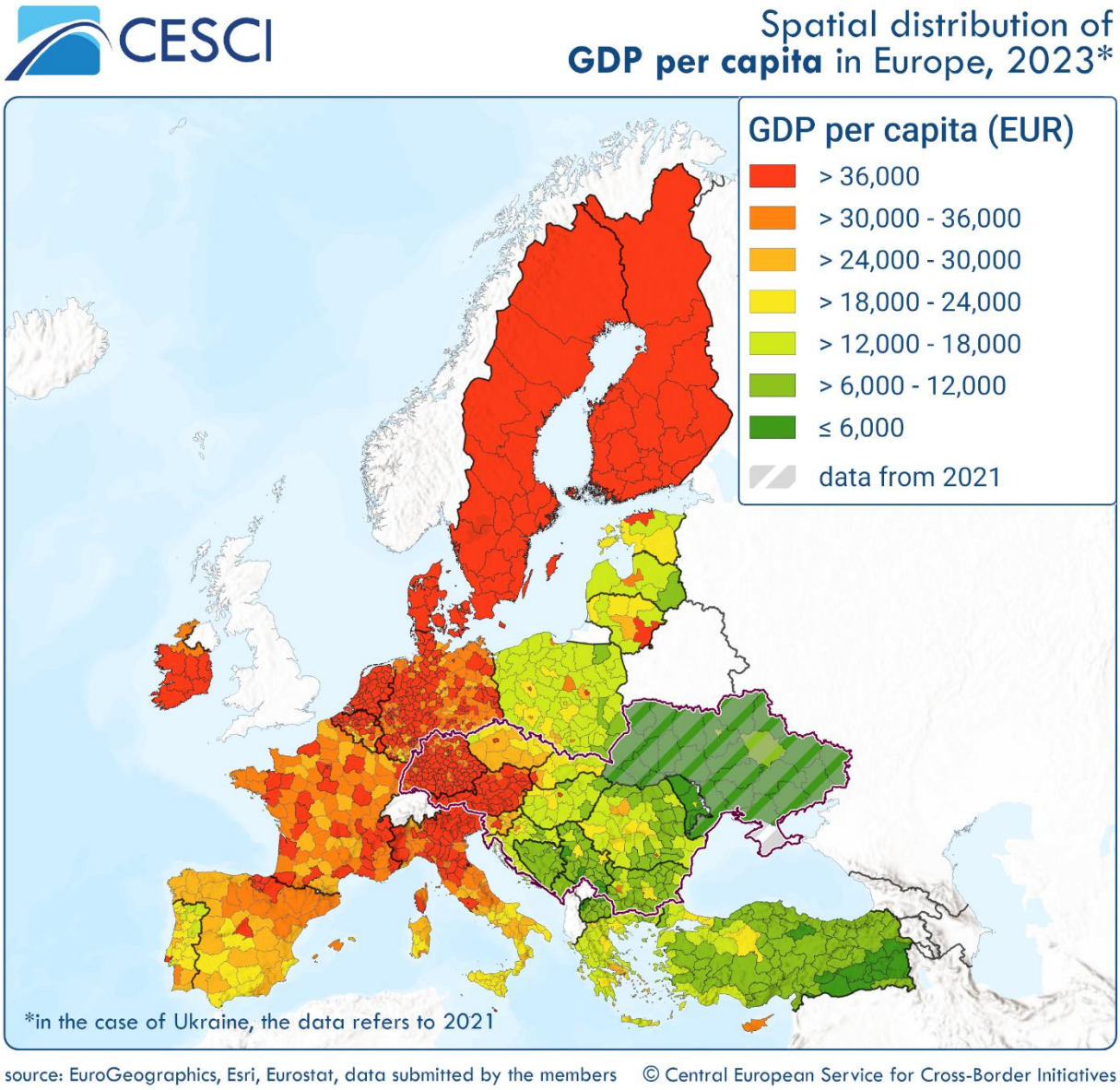


Figure 44: Spatial distribution of GDP per capita in Europe on regional level

On the other hand, the macroregion consists of less developed, catching-up regions of the continent. Strong east-west divide persists at European level, which is very much reflected in the Danube Region. This duality is the most relevant of territorial inequalities within the macroregion as the highest values surpass the lowest ones by several times (the gap being 33.5 times when comparing the Western core to Serbia, expanding to 53.7 times with Moldova, and reaching more than 214 times when taking into account the most war-affected Ukrainian regions). Regions such as Pcinjska oblast (GDP per capita: 4 900 EUR), Macvanska oblast and Jablanicka oblast (5 500 EUR each) from Serbia, Silistra and Haskovo (6,700 EUR each) from Bulgaria, Vaslui (7,500 EUR) from Romania, as well as the regions of Bosnia and Herzegovina (7,400 EUR and 7,600 EUR), being part of the least developed group of regions across Europe, do not even reach the limit of 8,000 EUR per capita. The economic lag is even more severe in the Eastern Neighborhood, where non-capital regions of Moldova – such as South (3,100 EUR), UTA

Găgăuzia (3,100 EUR), Center (3,400 EUR), and North (3,500 EUR) – as well as most Ukrainian regions (ranging between 765 EUR and 3,800 EUR) generate less than half of this threshold. Apart from Nógrád (9,300 EUR) in Hungary, all the worst-performing regions (below 10,000 EUR per capita) are located in the eastern-southeastern part of the macroregion, namely in Serbia, Bulgaria, and Romania, as well as across Bosnia and Herzegovina, Moldova, and Ukraine.

Furthermore, regions along the EU's external borders, such as Szabolcs-Szatmár-Bereg (12,000 EUR) or Botoșani (8,000 EUR), are typically the worst-performing convergence regions, where economic development faces serious obstacles, partly due to the separating role of borders. This territorial divide is exacerbated across the border in neighbouring non-EU territories, where Moldovan border regions (North at 3,500 EUR, Center at 3,400 EUR) and adjacent Ukrainian oblasts exhibit steep developmental cliffs directly at the Union's external border.

A transition is most visible in Czechia and Slovenia, as well as the Bratislavský and Trnavský kraj regions, which are directly attached to the EU's central, developed axis. The macroregion remains a transition zone that can still gain significantly from its position between old and new Member States, as well as from east-west and north-south trans-European economic relations and its „turntable" or interface function, thereby contributing to greater regional convergence.

The location along the borders of non-EU Member States and associated or potential candidate countries is of particular importance. Recently this position resulted in economic loss, but the enlargement process could give new impetus to these less developed regions suffering from being an outer periphery. This represents an asset to be utilised within the European integration process. Various activities aimed at strengthening economic cohesion can be built upon this territorial (positional) capital namely, the proximity to both the western core area and the catching-up regions of the Eastern Neighborhood and Western Balkans – by increasingly enforcing the four freedoms. Regions which are now considered to be economically outer peripheries could find themselves in a more central position along the transnational axis between Germany, the Western Balkans, Moldova, and Ukraine, and be transformed into areas that capitalise from the intensifying flows of goods, capital, people and knowledge.

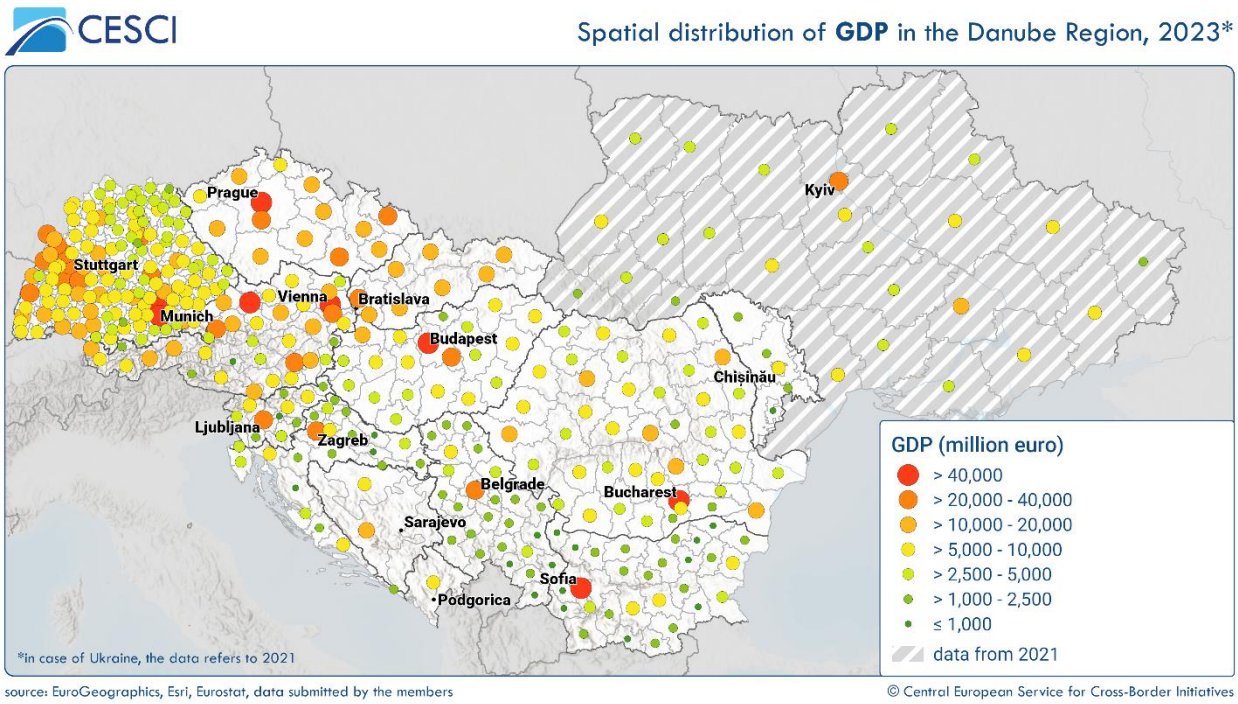


Figure 45: Spatial distribution of GDP in the Danube Region, 2023

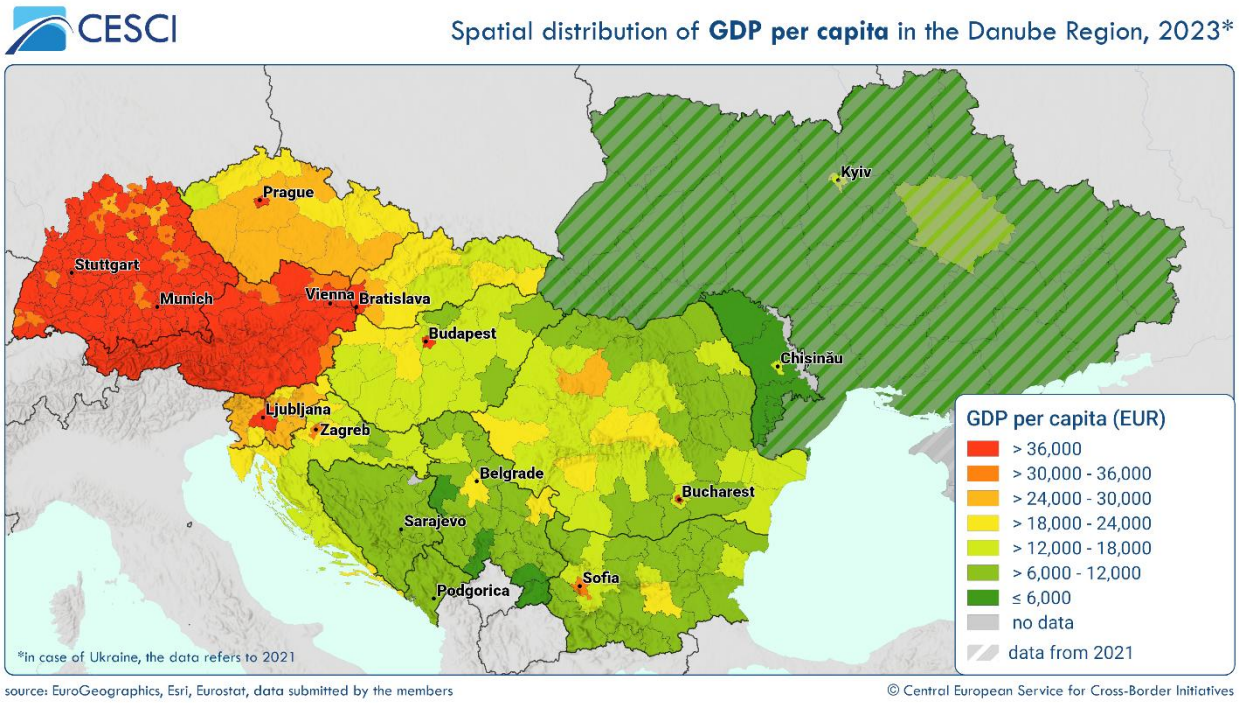


Figure 46: Spatial distribution of GDP per capita in the Danube Region

Analysing GDP growth dynamics of 2017-2024, first it has to be added that the Danube Region has been identified as a „catching-up economic zone" historically , with national economies often achieving higher annual growth rates compared to the European Union average. The data for 2017 confirms this trend, as the Danube Region (3.1% compared to previous year) acted as a relative „driving force", outperforming both the European Union (2.8%) and the EU14 (2.6%). This period was characterized by strong convergence and the utilization of the region's territorial

capital to narrow the development gap. Between 2018 and 2019, the macroregion experienced a normalization of growth rates, aligning closely with the EU average at 1.6%. However, the onset of the global economic crisis in 2020 revealed unique patterns of resilience and vulnerability. While the whole macroregion was hit severely by the recession, the Danube Region (-4.3%) demonstrated a higher degree of relative resilience compared to the more dramatic contractions in the European Union (-5.6%) and the EU14 (-5.8%). This suggests that the region's diverse economic structure and its status as a „transit and interface zone" provided a temporary buffer against external shocks.

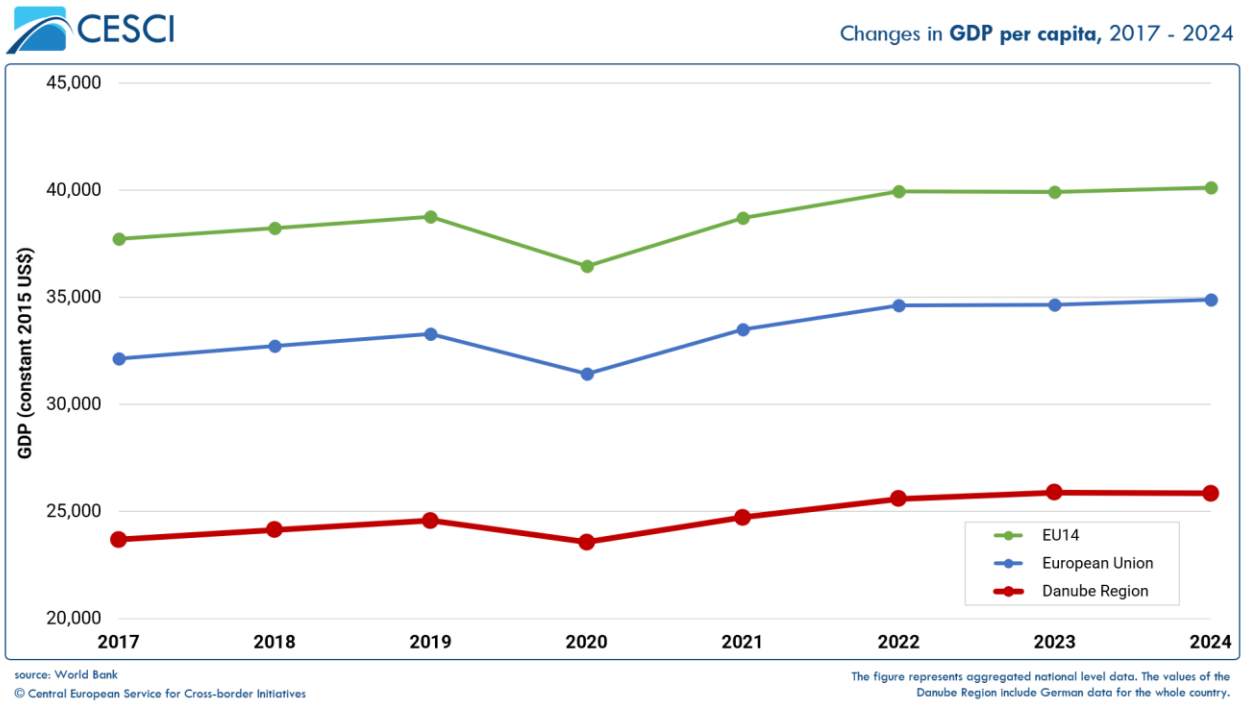


Figure 47: Changes (volume) in GDP per capita

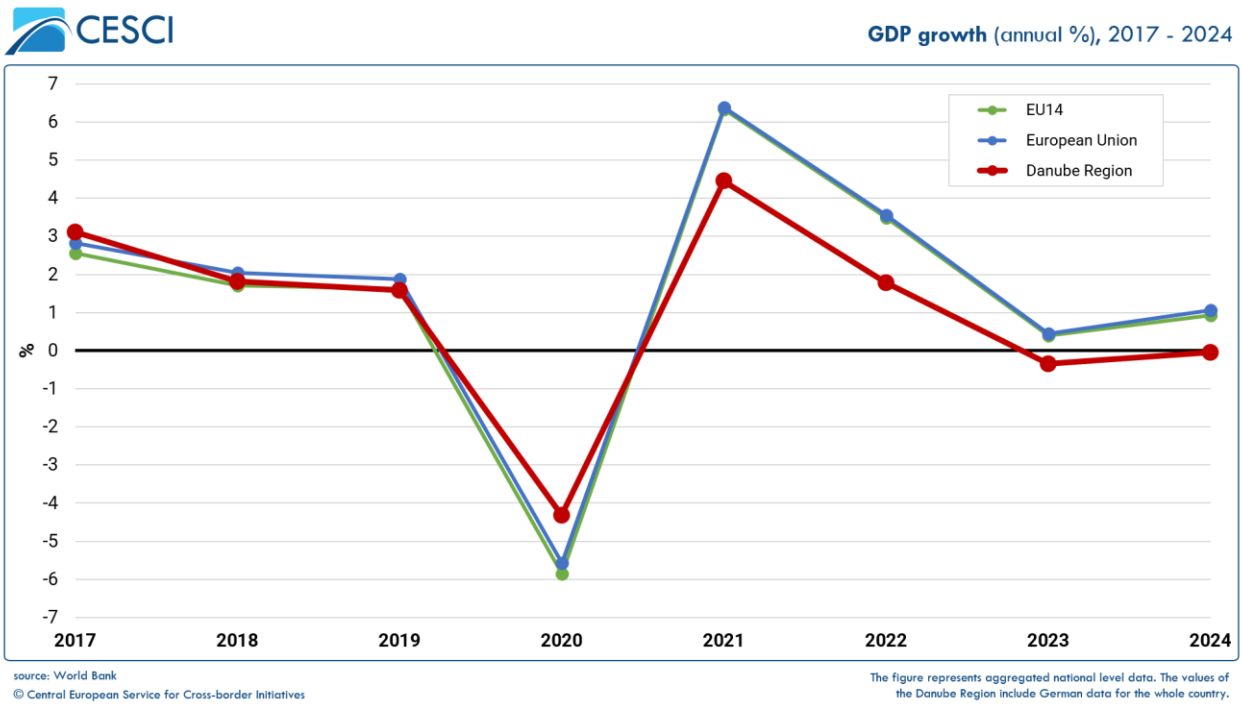


Figure 48: Changes (%) in GDP per capita

The post-crisis recovery, however, indicates a significant shift in the convergence path. In 2021, the rebound in the Danube Region (4.4%) was notably lower than the rates achieved by the European Union (6.4%) and EU14 (6.3%). This gap widened further between 2022 and 2024. While the EU baselines maintained positive momentum, the Danube Region's growth slowed to 1.8% in 2022 and slipped into stagnation or slight contraction in 2023 (-0.3%) and 2024 (0.0%). It has to be noted that Russia's war on Ukraine, the weakening economic ties due to military activities, economic sanctions and the fear of both investors and producers made the foresights less optimistic, and investments experienced a shrink in many regions.

Based on the data for GDP per capita (constant 2015 US$), an evaluation of economic performance between 2017 and 2024 reveals a macroregion characterised by initial steady growth followed by a stagnation that challenges long-term convergence objectives. In 2017, the Danube Region's GDP per capita stood at 23 679 USD, representing 73.7% of the EU average (32 136 USD) and 62.8% of the EU14 (37 722 USD). By 2024, the region reached 25 834 USD, slightly improving its relative position to 74.0% of the EU average (34 896 USD) and 64.4% of the EU14 (40 125 USD). While these figures indicate a marginal catching-up process, the convergence path has significantly slowed in the post-2022 period; specifically, between 2023 and 2024, the Danube Region experienced a slight relative backdrop, with its GDP per capita decreasing from 25 885 USD to 25 834 USD, while the EU and EU14 benchmarks continued to grow. From a cohesion policy perspective, this suggests that the macroregion is struggling to maintain its role as a „driving force" of European growth, risking a stabilisation at a lower development tier rather than achieving full territorial integration with the western core.

From a cohesion policy perspective, these trends highlight two critical phenomena. One is considered as stalling convergence: the consistent underperformance of the macroregion relative to the EU average since 2022 represents a significant threat to the „unity in diversity" objective. The previously successful catching-up process appears to have stalled, potentially due to the high level of fragmentation and the specific exposure of these national economies to recent geopolitical uncertainties and energy dependencies. The other can be named as deepening territorial disparities: the stagnation in 2023-2024 compared to the continued growth in the EU core indicates that the macroregion is struggling to maintain its competitiveness. This trend risks reinforcing the „region of barriers" status as the economic divide between the core EU countries and the Danube space begins to widen again.

When it comes to Cohesion Policy implications, the current situation reveals that while the Danube Region showed initial resilience, its recovery and long-term sustainable growth are increasingly challenged by structural bottlenecks and external market fluctuations. To ensure true economic cohesion, future transnational programming must focus on transitioning from labour-intensive to technology-intensive solutions and strengthening internal market integration. Without coordinated intervention to boost resilience and innovation-led growth, the region faces the risk of a „middle-income trap", where convergence with the western core becomes permanently halted.

An analysis of the gross value added of agriculture, forestry, and fishing as a percentage of GDP between 2017 and 2025 highlights profound territorial inequalities and structural divides across the Danube Region. The macro-region stands out as one of the most intensely agricultural parts of the European continent, with the Danube Region average (1.38% in 2025) consistently surpassing both the European Union baseline (1.37%) and the EU-14 average of older Member States (1.25%). Beneath this macro-regional benchmark lies a stark East-West and core-periphery gradient: ten of the fourteen participating states exhibit agricultural GDP shares that vastly exceed European averages. The highest agrarian dependency is concentrated across the fertile Black Sea lowlands and Eastern Neighbourhood, led by Ukraine (7.57% in 2025) and Moldova (7.38%), which continue to function as vital continental breadbaskets. A secondary high-intensity agrarian belt spans the Western Balkans and Southeastern Europe, including Bosnia and Herzegovina (4.36%), Montenegro (3.37%), Serbia (3.29%), and Romania (3.00%), followed by the Pannonian and Central European agricultural plains of Croatia (2.83%), Hungary (2.65%), Bulgaria (2.47%), Czechia (1.95%), Slovenia (1.63%), and Slovakia (1.59%). In sharp contrast, the western industrial core represents an entirely post-agrarian economic model, with Austria (1.26%) and Germany (0.87%) recording minimal primary sector shares, illustrating the macro-region's structural complementarity between capital-intensive western industrial centers and agrarian eastern supplier basins.

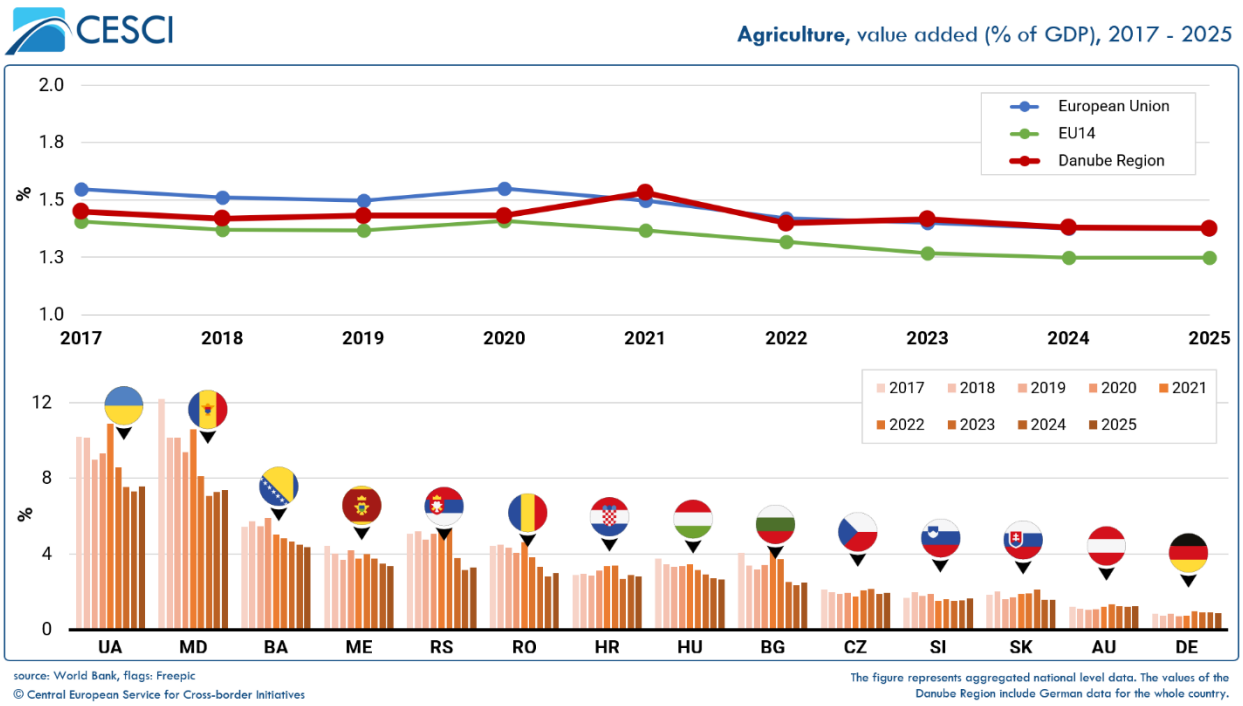


Figure 49: Agriculture, value added (% of GDP), 2017-2025

Comparing the 2017 and 2025 data reveals a broad, macro-region-wide structural contraction in agriculture's relative economic weight, driven by expanding industrial and service sectors alongside recurring climate shocks. With the exception of marginal, near-stagnant gains in Austria (+0.06 percentage points to 1.26%) and Germany (+0.01 pp to 0.87%), every other Danube economy registered a marked decline in agriculture's share of national GDP over the eight-year period. The most substantial percentage-point reductions occurred in the Eastern Neighborhood and Southeastern Europe, led by Moldova (-4.82 percentage points, dropping from 12.20% to 7.38%), Ukraine (-2.60 pp, falling from 10.18% to 7.57%), Serbia (-1.77 pp to 3.29%), Bulgaria (-1.57 pp to 2.47%), Romania (-1.44 pp to 3.00%), Hungary (-1.09 pp to 2.65%), and Bosnia and Herzegovina (-1.08 pp to 4.36%). Throughout this timeframe, the primary sector experienced severe intermediate volatility, characterised by bumper harvest years and agricultural commodity price spikes in 2021, where Ukraine peaked at 10.89% and Moldova at 10.59%, followed by sharp downturns caused by catastrophic summer droughts, surging fertiliser and energy costs, and the wartime logistics disruptions of Russia's invasion of Ukraine.

This heavy reliance on agriculture leaves peripheral and rural communities acutely vulnerable to climate-driven droughts, market price shocks, and low value-added employment traps that accelerate rural depopulation. To address these systemic vulnerabilities, transnational cooperation needs to focus on scaling up landscape-level natural water retention and climate-smart irrigation, harmonising agroecological standards, and integrating local agricultural producers into high-value bioeconomy networks and cross-border short food supply chains.

An evaluation of the gross value added of industry (including construction) as a percentage of GDP between 2017 and 2025 demonstrates the paramount structural importance of manufacturing across the Danube Region. The macro-region stands as the undisputed industrial backbone of the European continent, with its macro-regional benchmark (23.23% in 2025) consistently surpassing both the European Union baseline (21.32%) and the EU-14 average of older Member States (20.90%). This macro-regional industrial pre-eminence is anchored by a contiguous Central and Southeastern European manufacturing spine, where half of the participating economies generate industrial shares well above 25% of GDP. Czechia leads both the region and the wider continent with industry accounting for 28.71% of its GDP in 2025, closely followed by Slovenia (28.34%), Slovakia (28.10%), Romania (25.34%), Germany (25.16%), and Austria (23.98%), with Hungary (22.97%) and Serbia (22.31%) also remaining above the European average. In contrast, peripheral and service- or tourism-oriented economies exhibit lower industrial weights, including Bosnia and Herzegovina (21.54%), Bulgaria (21.21%), Croatia (18.95%), Ukraine (17.87%), Moldova (16.92%), and Montenegro (11.25%). This spatial layout reflects an integrated macro-regional production network where high-tech German and Austrian capital goods, automotive engineering hubs in Czechia, Slovakia, and Hungary, and cost-competitive component manufacturing in Romania and Serbia form deeply interdependent cross-border value chains.

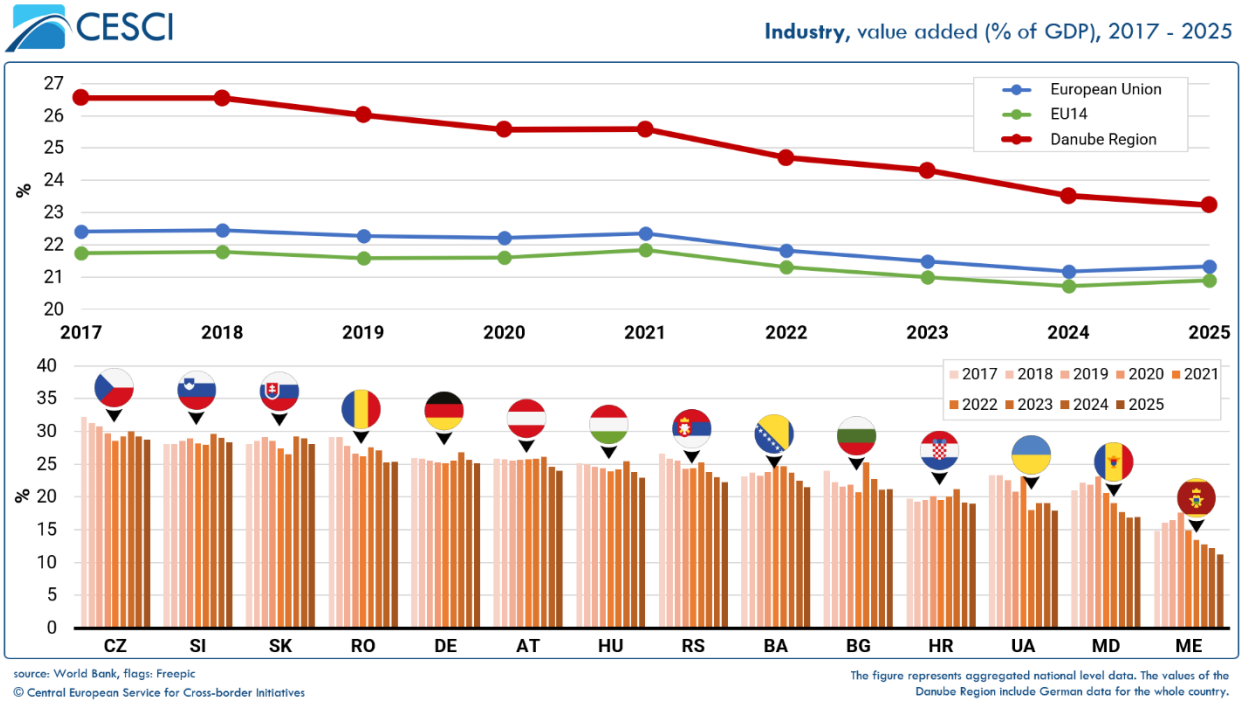


Figure 50: Industry, value added (% of GDP), 2017-2025

Analysing structural shifts between 2017 and 2025 reveals a broad, macro-region-wide contraction in industry's relative economic share, reflecting broader European deindustrialisation pressures. The Danube Region average dropped by 3.32 percentage points over the eight-year period (from 26.55% to 23.23%), outpacing the more moderate declines observed in the EU (-

1.09 pp) and EU-14 (-0.85 pp). Except for minimal stabilisation in Slovenia (+0.31 percentage points to 28.34%) and Slovakia (+0.03 pp to 28.10%), all other Danube countries registered marked industrial shrinkage between 2017 and 2025. The steepest relative contractions occurred in the war-affected and transitional eastern peripheries, led by Ukraine (-5.42 pp, plummeting from 23.29% to 17.87% due to wartime physical asset destruction and energy grid disruption), Serbia (-4.29 pp to 22.31%), Moldova (-4.10 pp to 16.92%), Romania (-3.77 pp to 25.34%), Montenegro (-3.58 pp to 11.25%), and Czechia (-3.53 pp to 28.71%), alongside noticeable drops in Bulgaria (-2.78 pp), Hungary (-2.19 pp), Austria (-1.82 pp), and Germany (-0.82 pp). While the post-pandemic recovery spurred temporary industrial value spikes in 2021–2023 across Central European automotive and energy clusters, subsequent shocks, most notably surging electricity and natural gas tariffs, sluggish export demand, and rising global competition, have accelerated industrial retrenchment.

This heavy structural reliance on manufacturing exposes the Danube economies to significant transition risks, as high industrial energy intensity and the phase-out of fossil fuels threaten the competitiveness of regional supply chains. To safeguard the macro-region's industrial leadership, transnational cooperation could focus on accelerating industrial decarbonisation through cross-border hydrogen and renewable energy networks, supporting SME adoption of Industry 4.0 and advanced robotics, and harmonising circular economy standards across adjacent border regions.

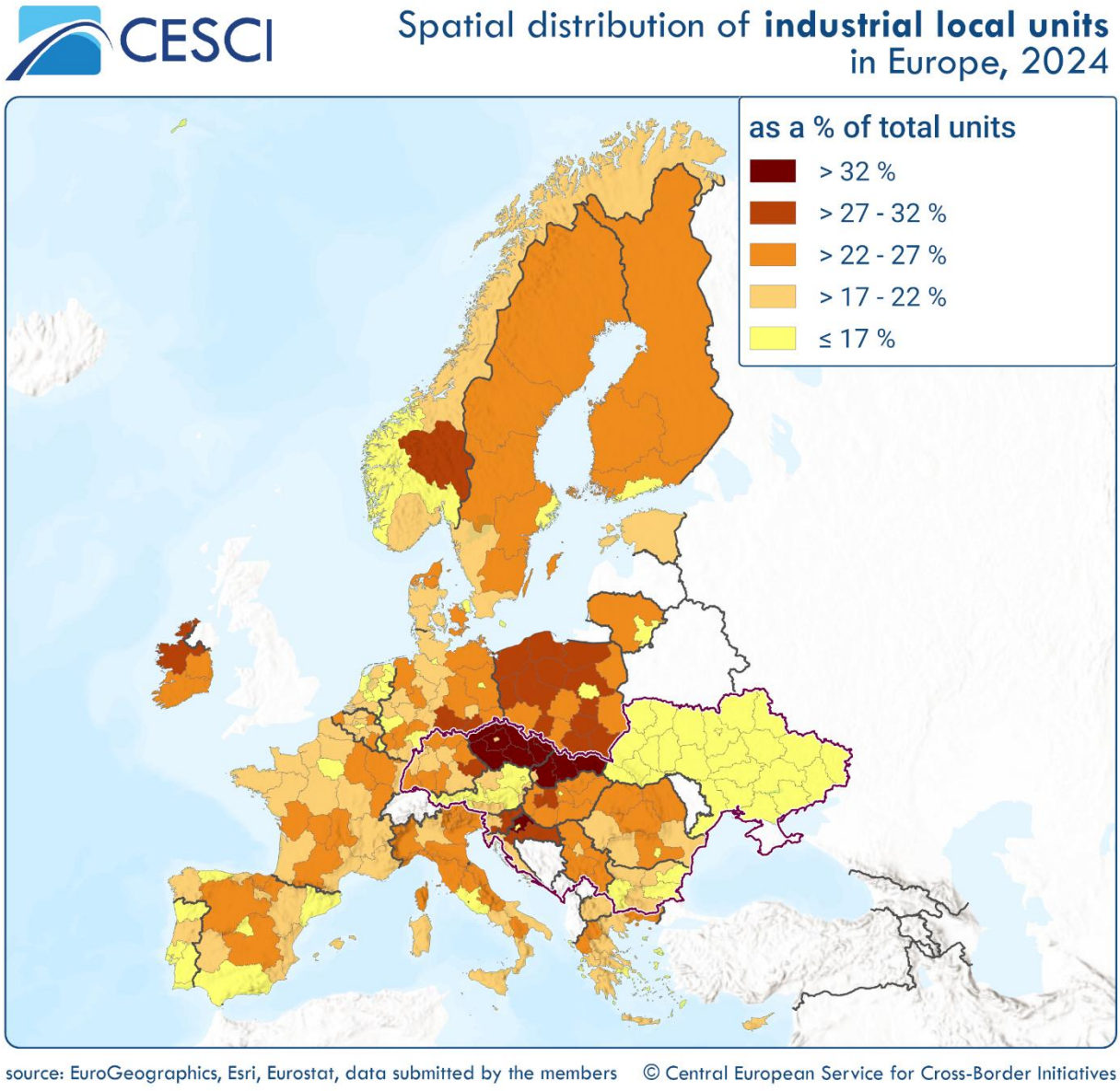


Figure 51: Spatial distribution of industrial units in Europe

Focusing on industrial units in particular, the Danube Region contains Europe's most prominent industrial production spine, while exhibiting sharp internal contrasts and a distinct capital-periphery division. Two countries stand out with their hyper-industrialised core: Czechia and Slovakia, where regions universally exceeding 32% of industrial local units, the highest density on the continent. In contrast, southern Germany, Austria, Hungary, and Romania form an intermediate, mature industrial belt (predominantly 17% to 27%), where extensive manufacturing is balanced by high-value corporate and technical services. Meanwhile, the southern and eastern margins display markedly lower industrial densities, visible in Bulgaria (largely 17% to 22% or lower) and Ukraine (uniformly ≤17%), alongside an evident data divide in the Western Balkans and Moldova. A defining macro-regional pattern is the „capital city island" effect, where metropolises such as Prague, Bratislava, Vienna, Budapest, Bucharest, and Zagreb stand out as

service-dominated enclaves (≤17%) surrounded by heavily industrialised manufacturing hinterlands.

This spatial concentration underscores the disproportionate exposure of non-metropolitan regions to decarbonisation pressures and green transition frictions, rising energy costs, and automated production shifts. To prevent industrial decay and protect the „Right to Stay" across peripheral factory towns, transnational cooperation must accelerate cross-border supplier-upgrading initiatives and technology-transfer corridors linking western research hubs with eastern industrial clusters. Furthermore, integrating Western Balkan and Eastern candidate territories into shared macroregional innovation networks and smart specialisation strategies will be vital.

An evaluation of the gross value added of services as a percentage of GDP between 2017 and 2025 illustrates an advancing yet structurally constrained tertiarisation process across the Danube Region. While the service sector constitutes the largest single component of economic output across all fourteen participating countries, the macro-region as a whole lags consistently behind wider European benchmarks. In 2025, the Danube Region average stood at 64.27% of GDP, falling below both the European Union baseline (66.99%) and the EU-14 average of older Member States (67.83%). This structural deficit directly mirrors the macro-region's distinctive identity as the agricultural and industrial heartland of Europe, where heavy manufacturing and farming absorb substantially larger shares of GDP than in Western Europe. Territorial disparities within the macro-region reveal that not a single Danube country reached the EU-14 benchmark in 2025. The highest service shares are clustered in the advanced western economies and tourism-specialised coastal nations, led by Germany (64.46%), Austria (64.05%), Montenegro (63.38%), and Bulgaria (63.31%). An intermediate convergence group comprises Romania (61.74%), Moldova (61.46%), Ukraine (60.99%), Croatia (60.93%), Czechia (60.80%), and Hungary (60.06%), whereas the lowest service proportions are recorded in Slovakia (59.81%), Serbia (59.73%), Slovenia (58.64%), and Bosnia and Herzegovina (57.69%). In industrialised Central European states like Slovenia, Slovakia, and Czechia, the relatively depressed service share does not indicate developmental backwardness, but rather reflects the formidable economic weight of their export-oriented automotive and engineering clusters.

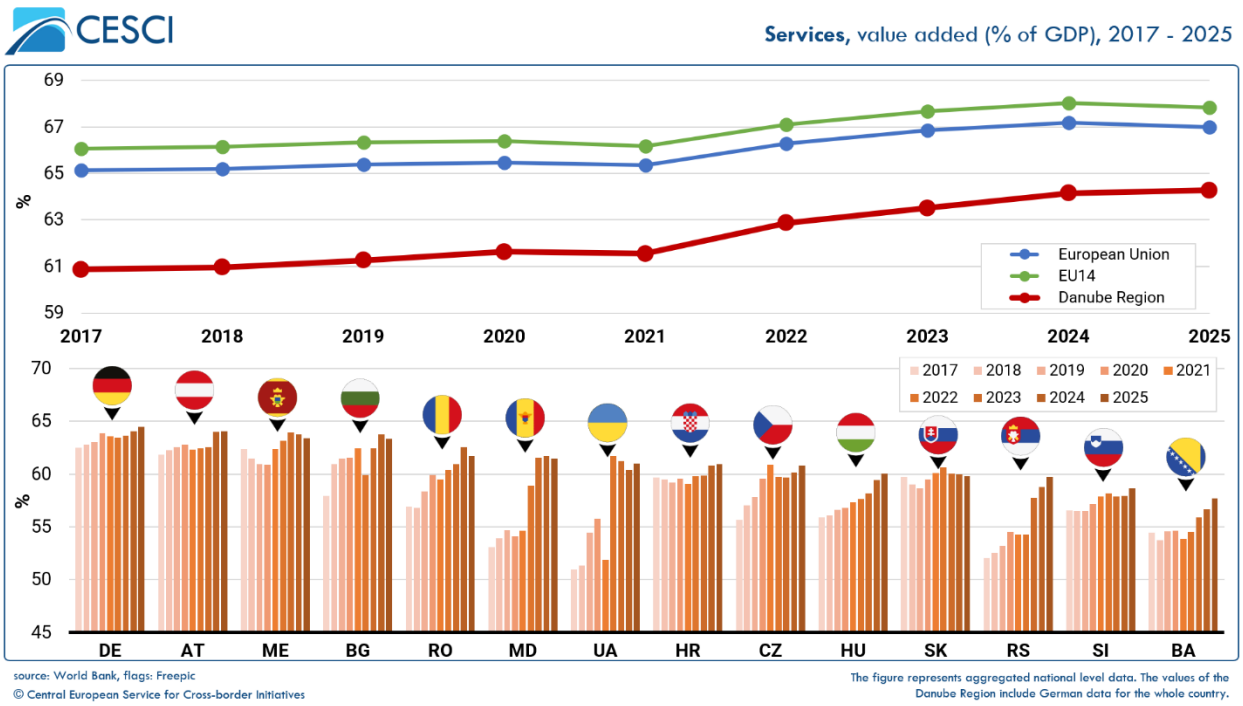


Figure 52: Services, value added (% of GDP), 2017-2025

Examining structural trajectories between 2017 and 2025 reveals a universal expansion of the service sector across the entire macro-region, with the Danube Region average gaining 3.41 percentage points (rising from 60.86% to 64.27%) and outpacing the more moderate growth of the EU baseline (+1.86 pp). This structural shift was overwhelmingly driven by rapid catching-up dynamics across Eastern Europe, the Western Balkans, and candidate countries. The most dramatic service expansions occurred in Ukraine (+10.03 percentage points, surging from 50.96% to 60.99%) and Moldova (+8.35 pp, rising from 53.11% to 61.46%), where wartime disruptions and the severe contraction of heavy industrial capacity accelerated a structural reallocation toward service activities. Strong tertiarisation was also registered in Serbia (+7.68 pp to 59.73%), Bulgaria (+5.35 pp to 63.31%), Czechia (+5.14 pp to 60.80%), Romania (+4.83 pp to 61.74%), and Hungary (+4.14 pp to 60.06%), contrasting with more moderate, stabilising growth in mature economies like Austria (+2.19 pp), Slovenia (+2.05 pp), Germany (+1.97 pp), Croatia (+1.26 pp), Montenegro (+1.00 pp), and Slovakia (+0.10 pp).

Despite this aggregate growth, the service sector across the eastern and southern peripheries remains disproportionately weighted toward basic retail, hospitality, and public administration rather than knowledge-intensive business services and high-tech digital solutions, leaving peripheral labour markets vulnerable to brain drain and low wage trajectories. To overcome this bottleneck transnational cooperation could foster cross-border digital service networks, promote technology transfer in professional and business services, and support high-value community-led ecotourism and creative industries that retain educated youth.

To sum up, an assessment of the sectoral composition of gross value added across the Danube Region illustrates a macro-regional economy defined by an exceptionally strong industrial backbone, a structurally polarised agrarian footprint, and an expanding yet comparatively constrained service sector when compared to the European Union average. Services constitute the largest share of economic output across all fourteen participating countries, yet the Danube Region's aggregate service weight (64.27% of total value added in 2025) remains consistently below the EU benchmark (67.52%). This structural gap is the direct corollary of the macro-region's distinct identity as the primary industrial powerhouse of the continent: industry (including construction) accounts for 23.23% of total value added in the Danube Basin, significantly surpassing the European average of 20.71%. This industrial intensity is anchored by Central European manufacturing hubs, most notably Slovenia (29.88%), Czechia (29.35%), Slovakia (25.04%), Serbia (24.79%), Austria (24.24%), Romania (23.15%), and Germany (22.95%), whose deeply integrated automotive and mechanical engineering value chains bind the macro-region together. Concurrently, while agriculture represents an identical 1.38% share in both the Danube Region and the EU overall, the macro-region exhibits profound internal polarisation. Highly developed western economies have transitioned into post-agrarian models where farming accounts for under 1.2% of output (Germany 0.73%, Austria 1.13%), whereas Eastern Neighborhood partners like Ukraine (11.94%) and Moldova (11.61%), alongside Western Balkan and Southeastern states like Bosnia and Herzegovina (4.80%), Bulgaria (3.87%), Romania (3.85%), and Serbia (3.84%), maintain substantial primary sector dependencies that exceed the EU baseline by three to eight times.

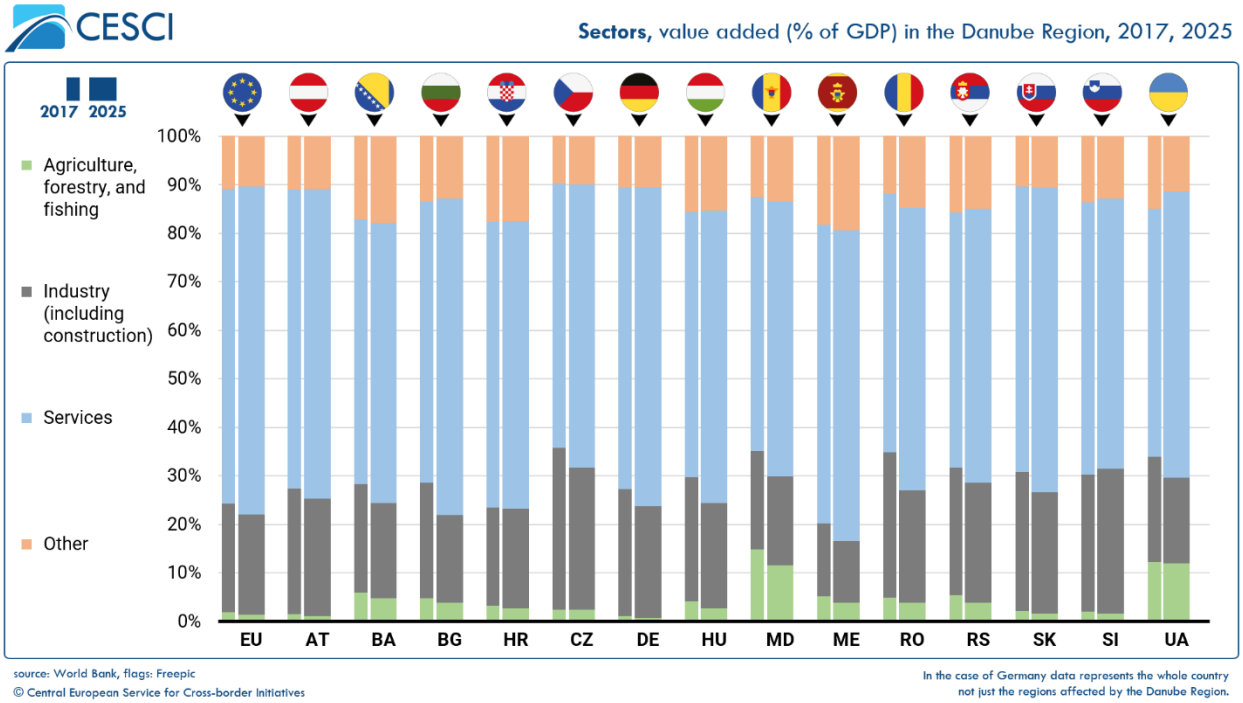


Figure 53: Sectors, value added (% of GDP) in the Danube Region, 2017-2025

Examining structural dynamics between 2017 and 2025 highlights a uniform macro-regional reallocation from secondary production toward tertiarisation, though the magnitude of change varies sharply across sub-regions. Across the Danube Basin, the service sector expanded by 3.41 percentage points (rising from 60.86% to 64.27%), outpacing the European Union's service growth of 2.38 percentage points. This catching-up dynamic was particularly pronounced across Eastern and Southeastern Europe, led by Ukraine (+7.71 pp), Bulgaria (+7.09 pp), Hungary (+5.48 pp), Romania (+4.83 pp), and Moldova (+4.14 pp), whereas mature Western economies experienced more moderate expansion (Germany +3.47 pp, Austria +2.10 pp) and Slovenia recorded a slight contraction (-0.50 pp). In contrast, the relative weight of industry underwent a macro-regional retrenchment of 3.32 percentage points (falling from 26.55% to 23.23%), which was nearly double the rate of EU-wide industrial contraction (-1.70 pp). Steep industrial contractions occurred in Romania (-6.86 pp), Bulgaria (-5.73 pp), Czechia (-4.09 pp), Ukraine (-4.08 pp), Hungary (-4.04 pp), Slovakia (-3.60 pp), and Germany (-3.34 pp), reflecting elevated energy tariffs, structural supply-chain realignments, and external competitive pressures, with only Slovenia (+1.50 pp) and Croatia (+0.21 pp) defying this downward trend. Agriculture experienced modest contraction overall (-0.07 pp in the Danube Region vs. -0.16 pp in the EU), led by structural reductions in Moldova (-3.00 pp), Serbia (-1.27 pp), Hungary (-1.03 pp), and Montenegro (-1.02 pp). This ongoing shift underscores the imperative for transnational cooperation to ensure that deindustrialisation pressures are offset by modern, knowledge-intensive business services and digital innovation rather than low-productivity tertiary activities, thereby safeguarding high-value employment across the entire basin.

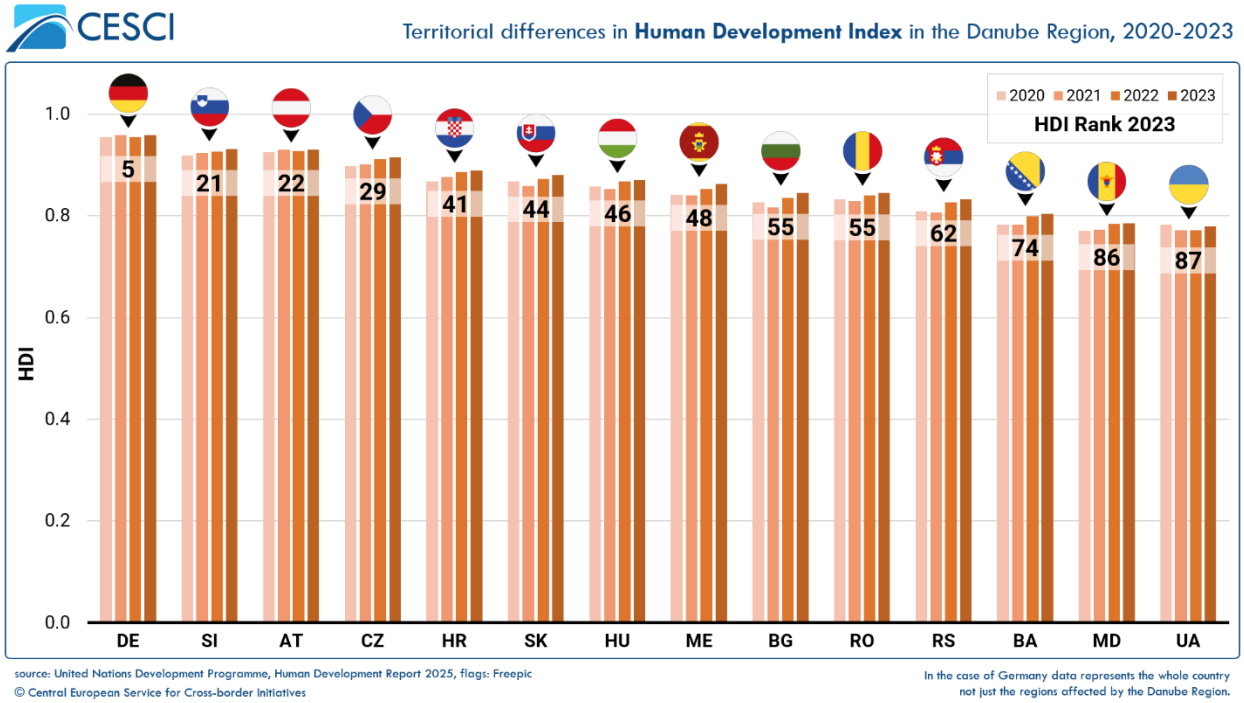


Figure 54: Territorial differences in HDI in the Danube Region

An evaluation of the Human Development Index (HDI) across the Danube Region highlights an overarching trajectory toward higher living standards alongside an entrenched West-East gradient that reflects the macro-region's structural core-periphery divide. In 2023, the macro-regional HDI average reached 0.866, with twelve of the fourteen participating countries positioned within the global „Very High Human Development" tier (scores exceeding 0.800). Nevertheless, territorial disparities remain pronounced, spanning an 82-place gap in global rankings between Germany (ranked 5th worldwide with an index of 0.959) and Ukraine (ranked 87th at 0.779). The macro-region divides into three distinct tiers: a top-performing western and central cluster comprising Germany (0.959), Slovenia (0.931), Austria (0.930), and Czechia (0.915); an intermediate convergence tier spanning Central and Southeastern Europe, including Croatia (0.889), Slovakia (0.880), Hungary (0.870), Montenegro (0.862), Bulgaria (0.845), Romania (0.845), Serbia (0.833), and Bosnia and Herzegovina (which crossed into the very high development tier at 0.804); and a lagging eastern periphery comprising Moldova (0.785) and Ukraine (0.779), both remaining in the „High Human Development" category. This spatial pattern demonstrates that while institutional and educational baselines have advanced across Southeastern Europe, substantial gaps in gross national income per capita and social service accessibility still separate the Alpine-Danubian core from the eastern and southern borderlands.

Examining dynamic developments between 2020 and 2023 reveals a widespread post-pandemic recovery and catching-up process across nearly the entire basin, counterbalanced by war-induced regression in the east. Driven by rebounds in life expectancy and economic activity following the 2020–2021 pandemic downturn, the strongest human development gains were achieved across the Western Balkans and Southeastern Europe, led by Serbia (+0.024 points), Croatia (+0.022), Montenegro (+0.021), Bosnia and Herzegovina (+0.021), and Bulgaria (+0.019). Mature frontrunners like Austria (+0.005) and Germany (+0.004) exhibited incremental stabilisation at their already high levels. In contrast, Ukraine was the sole country to experience an overall contraction, dropping from 0.783 in 2020 to 0.779 in 2023 (-0.004 points) as the severe human, economic, and infrastructural disruptions of war eroded living conditions and educational continuity. To prevent deepening socioeconomic polarisation and curb talent out-migration from vulnerable peripheries, transnational cooperation under EUSDR Priority Areas 9 (People & Skills) and 10 (Institutional Capacity) must focus on strengthening primary healthcare access and modernizing educational infrastructure in rural borderlands. Furthermore, joint macro-regional initiatives should promote university twinning and cross-border skills mobility to transform unilateral brain drain into reciprocal "brain circulation" and safeguard the „Right to Stay" across all Danube territories.

Tourism potential and flows

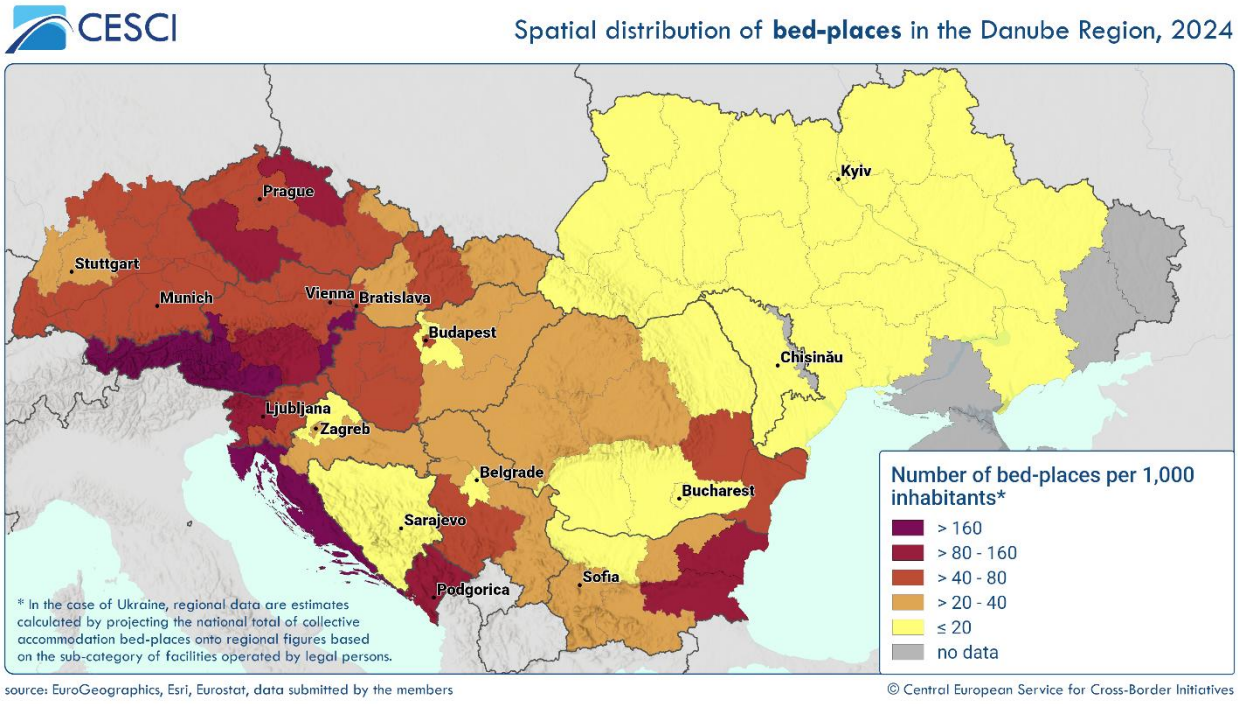


Figure 55: Spatial distribution of bed-places in the Danube Region

The following territorial analysis examines the tourism capacity of the Danube Region through the lens of accommodation supply, based on data on total bedplaces and intensity (per 1 000 inhabitants) from 2024. From a regional development and cohesion perspective, the data reveals a macroregion characterized by extreme spatial polarisation between Europe-wide or even globally recognised tourism hotspots and extensive peripheral areas with minimal hospitality infrastructure. Focusing on the territorial inequalities in accommodation supply, the distribution of tourism infrastructure across the Danube Region is marked by profound disparities, both in absolute volume and in the number of bedplaces per 1 000 inhabitants. While the EU27 average intensity stands at 66.2 bedplaces per 1 000 population, the macroregion contains both the highest and lowest extremes in Europe. The most significant concentration of tourism capacity is found in the Adriatic coast of Croatia and the Alpine regions of Austria. Istarska županija represents the absolute peak of tourism intensity with 1 527 bedplaces per 1 000 inhabitants, indicating a specialised economy. Similar high-intensity patterns are observed in Ličko-senjska (1 024), Zadarska (916), and the Austrian Tiroler Oberland (842). Other high-intensity zones and agglomerations can be found with regard to urban centres: in absolute terms, significant volumes of bedplaces are concentrated in major capital cities and metropolitan functional urban areas, though their intensity ratios are lower due to high population numbers. Prague (Hlavní město Praha) and Vienna (Wien) both concentrate nearly 100 000 bedplaces, while Budapest holds approximately 67 767. These centers act as the primary gateways for international arrivals, yet they maintain intensity levels (e.g., Budapest at 40.2 or Vienna at 49.5) that are below the EU27 average.

Focusing on extreme lows, in southeastern parts of the macroregion tourism supply is critically underdeveloped. Worst performers include several regions in Bulgaria and Serbia. Pernik (4.9), Targovishte (6.8), and Yambol (7.0) in Bulgaria, along with the Podunavska oblast (7.5) in Serbia, represent territories where the hospitality sector provides minimal supply to potential visitors. Inland disparities: Even within high-performing countries like Croatia, a sharp divide exists between the coast and the hinterland, as seen in Koprivničko-križevačka županija (11.5) or Sisačko-moslavačka županija (12.5), which lag significantly behind their coastal counterparts. Similar division applies to Romania and Bulgaria.

The current landscape illustrates that while the Adriatic and Alpine clusters have successfully leveraged their natural capital into world-class destinations, the massive structural gap between these hubs and the "tourism-desert" regions of the Western Balkans and inland Eastern Europe risks cementing long-term economic marginalisation. Consequently, future cohesion policy could move beyond supporting established destinations and prioritise the development of sustainable, niche destinations and tourism products in the lagging inland regions to foster a more balanced polycentric hospitality network and reduce the dependency on a few hyper-intensified coastal and mountain tourism regions.

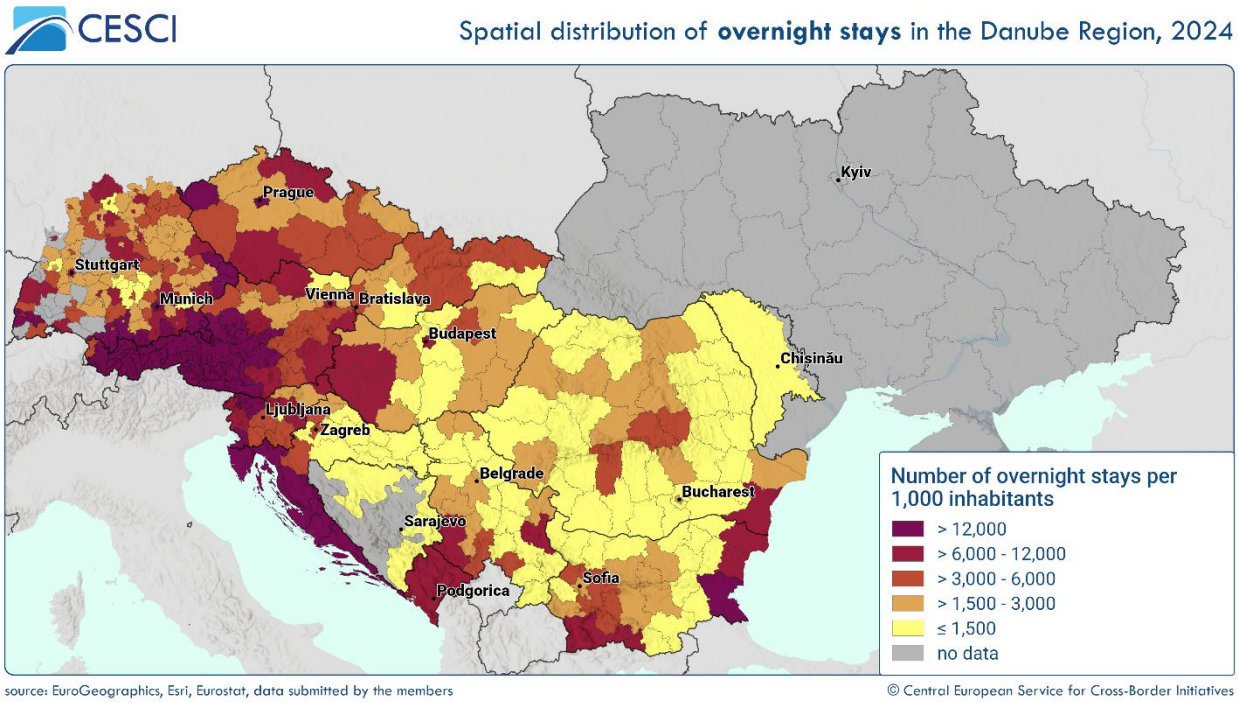


Figure 56: Spatial distribution of overnight stays in the Danube Region

Spatial distribution of nights spent in tourist accommodation serves as a vital indicator of tourism intensity from the demand side. Based on the statistical evidence for 2024, the macroregion exhibits a deeply polarised spatial pattern with great inequalities both on transnational and national levels, where a few highly intensified water-related coastal and mountainous areas

along with some city destinations stand in sharp contrast to extensive inland areas remaining in a "tourism shadow".

The EU27 average tourism intensity stands at 6 496 nights per 1 000 inhabitants, a benchmark that serves as a dividing line for the macroregion's performance. Regions of outstanding intensity involve the Adriatic coast of Croatia, furthermore the Austrian Alps concentrating the highest numbers of tourism traffic in the macroregion. Istarska županija remains the absolute peak performer with 131 855 nights per 1 000 population, which is more than 20 times the EU average, signaling a state of hyper-intensification where tourism is the dominant economic driver. High-intensity destinations include the Austrian Tiroler Oberland (41 080), Pinzgau-Pongau (40 845), and the Croatian Zadarska županija (39 267). As part of the second tier below the world-class destinations, other well-performing regions on macroregional level mainly cover the Black Sea coastlines of Bulgaria (Sunny Beach in particular, Burgas: 25 765), Obalno-kraška (27 912) and Romania (Mamaia surroundings, Constanța: 8 464), other Adriatic coasts like Obalno-kraška in Slovenia (27 912), Montenegro (8 339) and some mountain resorts such as Garmisch-Partenkirchen (35 500) or Gorenjska in Slovenia (18 971).

Focusing on the total number of guest nights, massive concentrations are found in major metropolitan gateways and specialised resorts. Istarska županija leads with 26.5 million total nights, followed by Splitsko-dalmatinska županija (14.2 million), Wien (12.6 million), and Hlavní město Praha (12.5 million). These hubs demonstrate high attractiveness but also face the immediate pressures of overtourism.

In relation to "shadow" regions and underperformance, a vast part of the macroregion remains largely excluded from the benefits of international tourism traffic. Regions such as Zasavska in Slovenia (182), Pernik (183) and Razgrad (194) in Bulgaria, and the Podunavska oblast in Serbia (208) exhibit intensity levels that are a mere fraction of the European average, highlighting a significant failure in tourism valorisation.

At last but not least some cohesion policy implications should be noted. The current status of the macroregion reveals that while a few destinations struggle with the negative externalities of overtourism, such as soaring real estate and rental prices, the degradation of the natural environment, increased environmental loads, and extreme overcrowding, extensive peripheral areas rich in natural and cultural heritage remain largely undiscovered or restricted to domestic tourism. From a cohesion policy perspective, future programming must prioritise the transition from hyper-intensified mass tourism toward sustainable, green, and slow tourism models that emphasize the protection of local assets. By fostering the small-scale, locally adapted development of tourism in remote nature-based or heritage-rich regions currently situated far from economic centers, tourism can act as a crucial tool for poverty reduction, income

diversification, and green employment expansion, thereby bridging the widening territorial divide across the Danube Region.

An analysis of cross-border tourist mobility across the Danube Region demonstrates an exceptionally strong pattern of intra-regional integration, with total cross-border tourist flows reaching 45 079 638 persons (approximately 45.1 million cross-border tourists). The largest absolute volumes of tourist traffic are heavily concentrated along the western and central axes of the macroregion. The bilateral flow between Austria and Germany represents the single largest cross-border movement in the basin, accounting for 12 969 982 persons. Other primary bilateral corridors include Germany to Croatia (3 071 260 persons), Germany to Czechia (2 372 694 persons), Germany to Austria (2 131 281 persons), Slovenia to Croatia (1 570 541 persons), Austria to Croatia (1 509 598 persons), Slovakia to Czechia (896 999 persons), Romania to Bulgaria (906 966 persons), and Hungary to Croatia (758 540 persons).

In relative terms, tourists originating from within the Danube Region represent a commanding share of overall incoming tourist traffic across numerous participating states. Croatia records the highest relative reliance on macroregional tourism, with 45.45% of all incoming tourists originating from Danube Region countries. Similarly prominent macroregional shares are observed in Austria (37.29%), Slovenia (35.19%), Moldova (34.36%), Serbia (23.25%), Slovakia (21.11%), Bulgaria (19.85%), Hungary (19.44%), and Czechia (19.25%). This high share underscores that intra-regional tourism is a vital economic backbone for the macroregion. This strong reliance is supported by geographical proximity and direct multimodal accessibility via Trans-European Transport (TEN-T) corridors, motorways, and EuroVelo cycling networks; shared historical, linguistic, and cultural ties stemming from former state formations; and strong functional complementarities between Alpine ski destinations, Adriatic and Black Sea coastal resorts, Pannonian thermal spas, and historic capital city heritage hubs.

Despite these robust flows, the macroregion's tourism sector is defined by acute spatial polarisation, characterised by severe overtourism and seasonal infrastructure strain in coastal, Alpine, and capital city hotspots, contrasted with extensive rural "tourism deserts" in inland peripheries. Addressing this territorial imbalance requires strategic transnational cooperation. Key cooperation needs include developing integrated transboundary thematic routes, promoting sustainable, community-based tourism (CBT) models, and expanding green intermodal transport connections to redirect visitor demand away from saturated hotspots toward under-visited rural hinterlands. Furthermore, deploying digital destination management tools (such as open-access GIS heritage atlases, smart visitor monitoring, and multi-lingual digital interpretation) alongside supporting local SME integration into short regional supply chains, ensures that tourism spending remains within host communities, transforming heritage assets into drivers of youth retention, economic diversification, and the "Right to Stay" across depopulating borderlands.

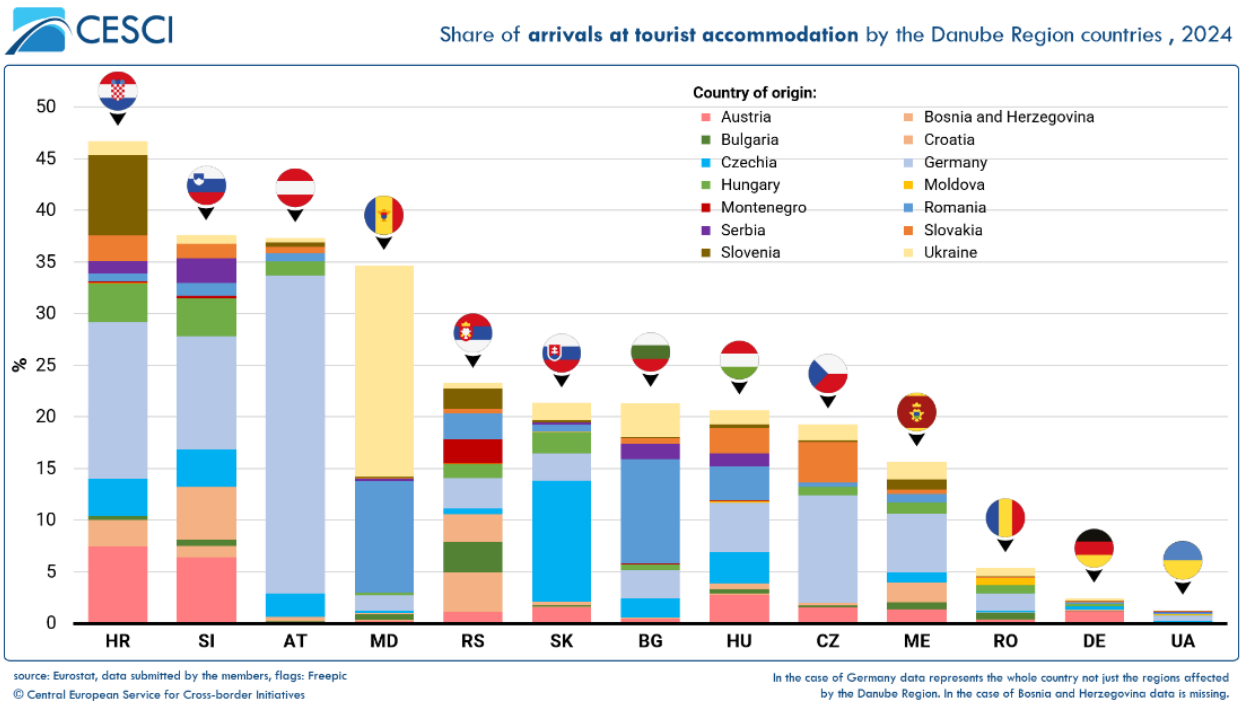


Figure 57: Share of tourists within the macroregion coming from Danube Region countries

SMEs

An evaluation of the density of small and medium-sized enterprises per 1,000 inhabitants across the Danube Region reveals a critical structural deficit and an acute entrepreneurial lag when benchmarked against European averages. While SMEs account for virtually all active enterprises numerically, their density relative to population size is markedly depressed across the basin: in 2024, the Danube Region recorded only 55.98 SMEs per 1,000 inhabitants, falling well below both the European Union baseline (75.50 per 1,000 inhabitants) and the EU-14 average of older Member States (73.21 per 1,000 inhabitants). This creates an extensive macro-regional enterprise gap of nearly twenty businesses per thousand residents (-19.53 compared to the EU-27; -17.23 compared to the EU-14), meaning the Danube Region generates barely 74% of the European average's enterprise density. This per-capita deficit exposes a pronounced shortage of operating businesses, reflecting underlying structural bottlenecks such as subdued business creation rates, a fragile venture capital and micro-credit landscape, and lingering institutional barriers to self-employment. Particularly across post-socialist Member States and Eastern and Western Balkan candidate territories, the low density of SMEs mirrors deep-seated deficits in entrepreneurial education, commercialization capacity, and business skills, which leaves the regional economic fabric thinner and less diversified than in Western Europe.

Examining dynamic shifts between 2021 and 2024 indicates that while SME density expanded across all monitored territories, the macro-region experienced relative divergence rather than catching-up convergence. Over this four-year period, the Danube Region added 2.98 SMEs per 1,000 inhabitants (+5.63%), an expansion rate that lagged substantially behind the gains

achieved across the EU-27 (+5.99 per 1,000 inhabitants; +8.62%) and the EU-14 (+5.99 per 1,000 inhabitants; +8.91%). Because continental new firm creation outpaced the macroregion's registration rate by two to one, the structural gap separating the Danube Region from the European benchmark widened steadily (expanding by 3.02 SMEs per 1,000 residents over the period). To overcome this systemic shortfall and stimulate bottom-up enterprise formation outside dominant capital cities, transnational cooperation needs to prioritise establishing cross-border start-up accelerators, and specialised entrepreneurial training curricula tailored to youth and women. Furthermore, developing shared regional business mentoring networks and simplifying administrative barriers for doing business abroad and cross-border enterprise creation is essential.

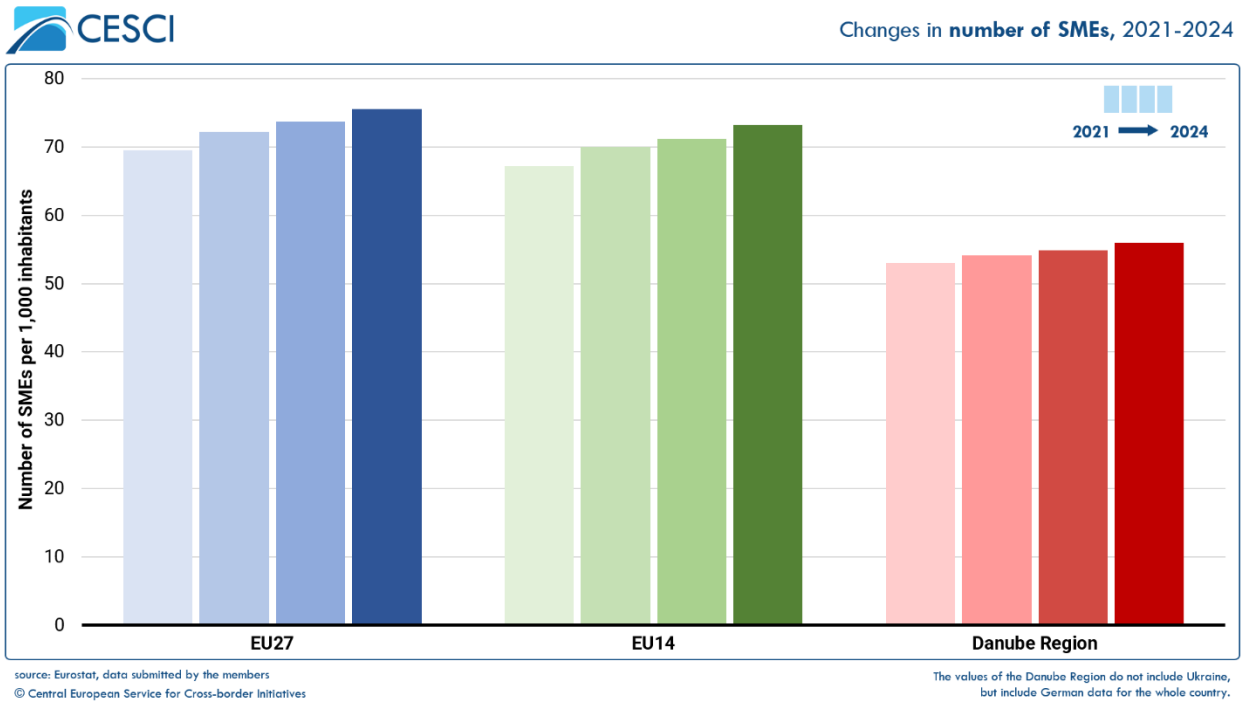


Figure 58: Changes in number of SMEs, 2021-2024

An evaluation of the proportion of small and medium-sized enterprises (SMEs) as a percentage of total active enterprises across the Danube Region illustrates an overarching structural universality coupled with subtle yet critical territorial variations when compared to European standards. Across all participating economies, small and medium-sized enterprises represent the overwhelming structural foundation of the business ecosystem, universally exceeding 99% of all enterprises. In 2024, the Danube Region benchmark stood at 99.73%, positioned slightly below both the European Union baseline (99.84%) and the EU-14 average of older Member States (99.83%). This structural alignment confirms that micro, small, and medium businesses constitute the primary economic fabric across the entire basin, though the participating countries divide into distinct clusters based on their relative enterprise concentration and the presence of large corporate actors. The upper tier of SME dominance surpasses the European benchmark, led by Slovakia (99.90%), Montenegro (99.90%), Hungary (99.89%), Czechia (99.87%), Slovenia

(99.87%), Ukraine (99.87%), and Romania (99.84%). In these Central and Eastern European economies, micro-enterprises and small sole proprietorships comprise an extraordinarily high fraction of total business registrations, reflecting both active post-transition enterprise creation and a relative scarcity of domestic large corporate headquarters. An intermediate tier closely tracks the European baseline, including Croatia (99.83%), Bulgaria (99.82%), and Austria (99.76%). Conversely, the lowest relative SME shares – and consequently the highest densities of large enterprises employing 250 or more persons – are recorded in Bosnia and Herzegovina (99.68%), Serbia (99.66%), Germany (99.54%), and Moldova (99.23%). In Germany, a lower SME percentage directly mirrors the formidable presence of multinational industrial conglomerates (*Großunternehmen*) and large-scale *Mittelstand* leaders that anchor global value chains, whereas in Moldova, Serbia, and Bosnia and Herzegovina, the lower SME ratio reflects narrower private business formation, legacy state-owned utilities, and higher barriers to new firm registration.

Examining dynamic developments between 2021 and 2024 reveals a high degree of macroeconomic stability across the business population, with the Danube Region average edging up incrementally (+0.004 percentage points) in contrast to a slight contraction at the EU level (-0.010 percentage points). The most notable catching-up expansion occurred in Moldova (+0.134 percentage points), accompanied by steady upward gains across catching-up and candidate economies, including Ukraine (+0.042 percentage points), Montenegro (+0.036 percentage points), Bosnia and Herzegovina (+0.029 percentage points), Croatia (+0.018 percentage points), Bulgaria (+0.015 percentage points), Romania (+0.012 percentage points), Slovakia (+0.011 percentage points), Slovenia (+0.011 percentage points), and Czechia (+0.011 percentage points). Conversely, mild consolidations occurred in Serbia (-0.027 percentage points), Hungary (-0.011 percentage points), Germany (-0.009 percentage points), and Austria (-0.007 percentage points), where corporate mergers and post-pandemic market exits slightly rebalanced the enterprise landscape. Crucially, while SMEs constitute virtually all enterprises numerically, their vulnerability to escalating energy costs, complex cross-border administrative hurdles, and restricted access to venture capital poses a systemic risk to macroregional resilience. To address these structural bottlenecks and prevent peripheral business closures, transnational cooperation could prioritise integrating Eastern and Western Balkan SMEs into high-value European supply chains. Furthermore, establishing macroregional incubation platforms and cross-border innovation clusters will be essential to assist traditional small businesses in navigating the twin green and digital transitions.

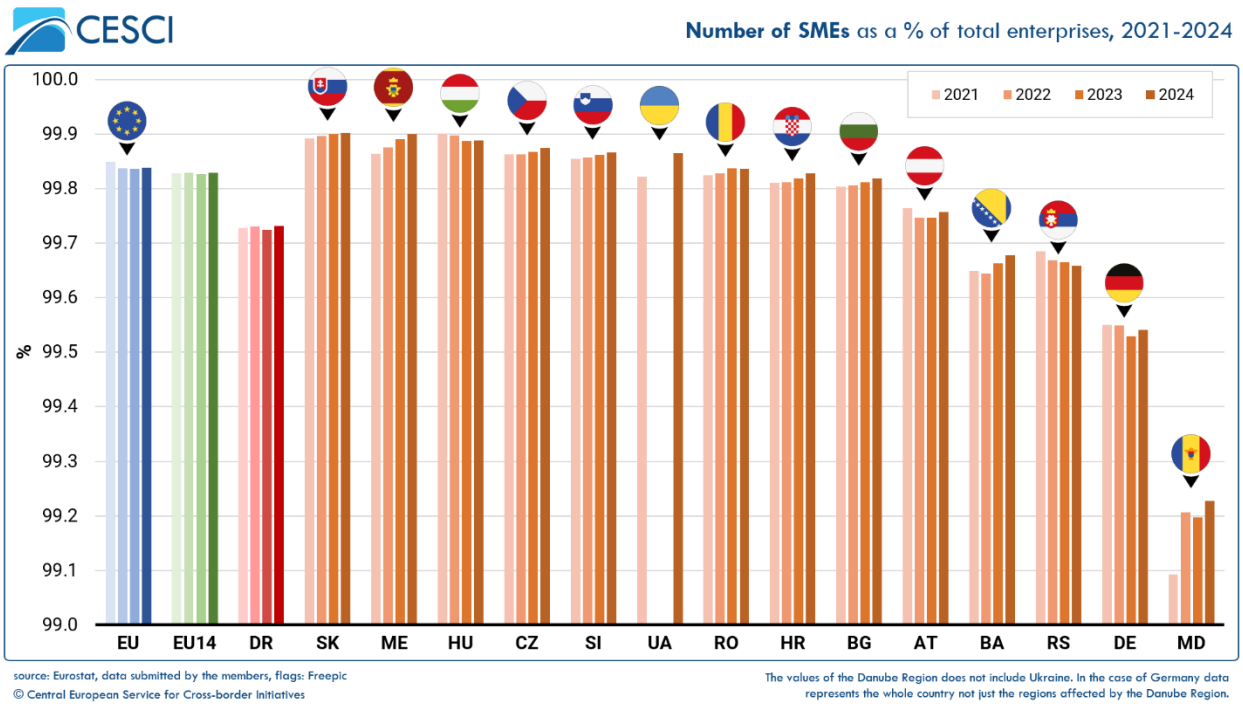


Figure 59: Number of SMEs as a % of total enterprises, 2021-2024

An evaluation of the sectoral distribution of small and medium-sized enterprises across the Danube Region reveals a distinctive economic profile characterised by strong industrial, digital, and commercial specialisations alongside structural lags in knowledge-intensive and social services when benchmarked against European standards. The macroregional enterprise architecture is anchored by wholesale and retail trade (Sector G), which constitutes the single largest sectoral concentration representing 23.31% of all Danube SMEs and significantly exceeding both the EU-27 baseline (+5.23 percentage points) and the EU-14 benchmark (+5.80 percentage points), effectively hosting over 41.5% of all trade SMEs in the Union. Beyond commerce, the macroregion exhibits two profound comparative specificities: manufacturing (Sector C) comprises 8.43% of all active SMEs, comfortably surpassing the EU-27 (+1.66 percentage points) and EU-14 (+2.67 percentage points) while concentrating over 40.1% of all European manufacturing SMEs; concurrently, information and communication (Sector J) forms an exceptionally dense entrepreneurial cluster comprising 7.19% of regional SMEs, outperforming the EU-27 (+2.38 percentage points) and EU-14 (+3.03 percentage points) to house an astonishing 48.12% of the Union's entire ICT SME stock. Conversely, the macro-region displays substantial structural deficits in private social and advanced services: human health and social work activities (Sector Q) represent only 4.98% of regional SMEs, lagging severely behind the EU-27 (-2.94 percentage points) and EU-14 (-3.91 percentage points) due to legacy state-dominated welfare systems; likewise, moderate under-representations characterise professional, scientific, and technical activities (-2.07 percentage points), financial and insurance activities (-0.77 percentage points), education (-0.87 percentage points), and construction (-1.52 percentage points).

This sectoral configuration illustrates profound joint dependencies and cross-border complementarities that bind the Danube economies into a highly synchronised macro-regional supply chain. Rather than operating in isolation, the macro-region's disproportionate share of European manufacturing (40.15%) and ICT enterprises (48.12%) provides a powerful structural substrate for technological cross-fertilisation: innovative software houses and digital engineering startups in Central and Southeastern Europe act as essential technological providers to specialized manufacturing, automotive, and mechatronic suppliers embedded across the basin. This creates a functional division of labour where mature Western corporate anchors and research institutions interlock seamlessly with agile Central and Eastern European production networks, sub-contractors, and logistics corridors. However, the persistent underdevelopment of localised professional consulting, venture financing, and private health services exposes an ongoing vulnerability, as peripheral manufacturing and ICT SMEs remain heavily reliant on external capital, western intellectual property licensing, and foreign contract-based outsourcing rather than developing end-to-end proprietary ecosystems. To transform these complementary linkages into shared, high-value resilience and overcome structural bottlenecks in enterprise upgrading the transnational cooperation must prioritise establishing cross-border industrial-digital alliances, technology-transfer corridors, and joint smart specialisation platforms.

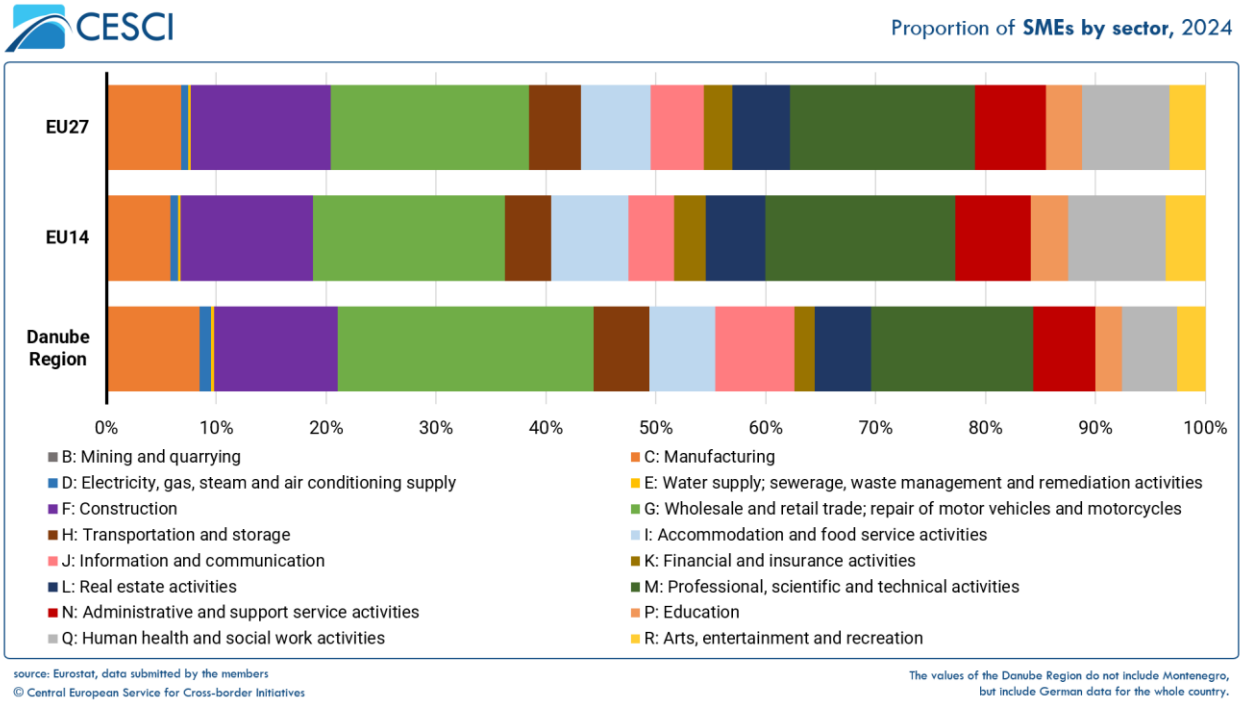


Figure 60: Proportion of SMEs by sector, macroregional level

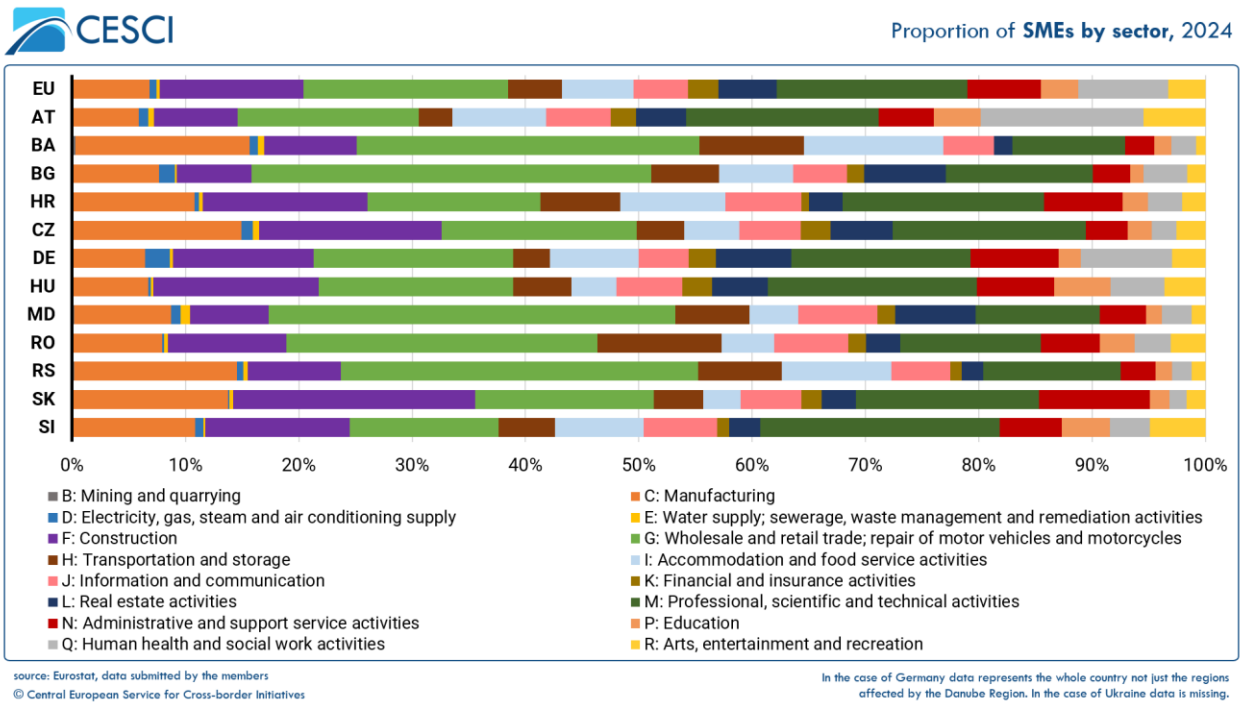


Figure 61: Proportion of SMEs by sector, national level

An evaluation of the sectoral turnover of small and medium-sized enterprises across the Danube Region illustrates a powerful industrial orientation and shared commercial foundations, generating EUR 6.22 trillion in combined revenue and accounting for 37.90% of the entire European Union SME turnover (EUR 16.41 trillion). Benchmark comparisons against the EU baseline reveal striking macro-regional similarities alongside distinct structural specificities. Wholesale and retail trade (Sector G) universally functions as the primary turnover generator across all thirteen reporting countries, though its aggregate macroregional share of 36.61% remains below the EU benchmark (41.32%). The defining structural hallmark of the Danube Region is its disproportionate reliance on manufacturing (Sector C), which generates 14.70% of total SME turnover, nearly double the European Union average of 7.66%. Remarkably, every single Danube country surpasses the EU manufacturing turnover benchmark, demonstrating that the macroregion operates as Europe's central „SME industrial workshop". Construction (Sector F) represents the third shared pillar, capturing 9.01% of macro-regional SME turnover compared to 7.09% across the EU, while transportation and storage (Sector H, 5.28% vs. 5.48% in the EU) and information and communication (Sector J, 3.90% vs. 4.34% in the EU) exhibit stable cross-border cohesion, confirming the Danube's role as a vital logistics highway and emerging digital corridor.

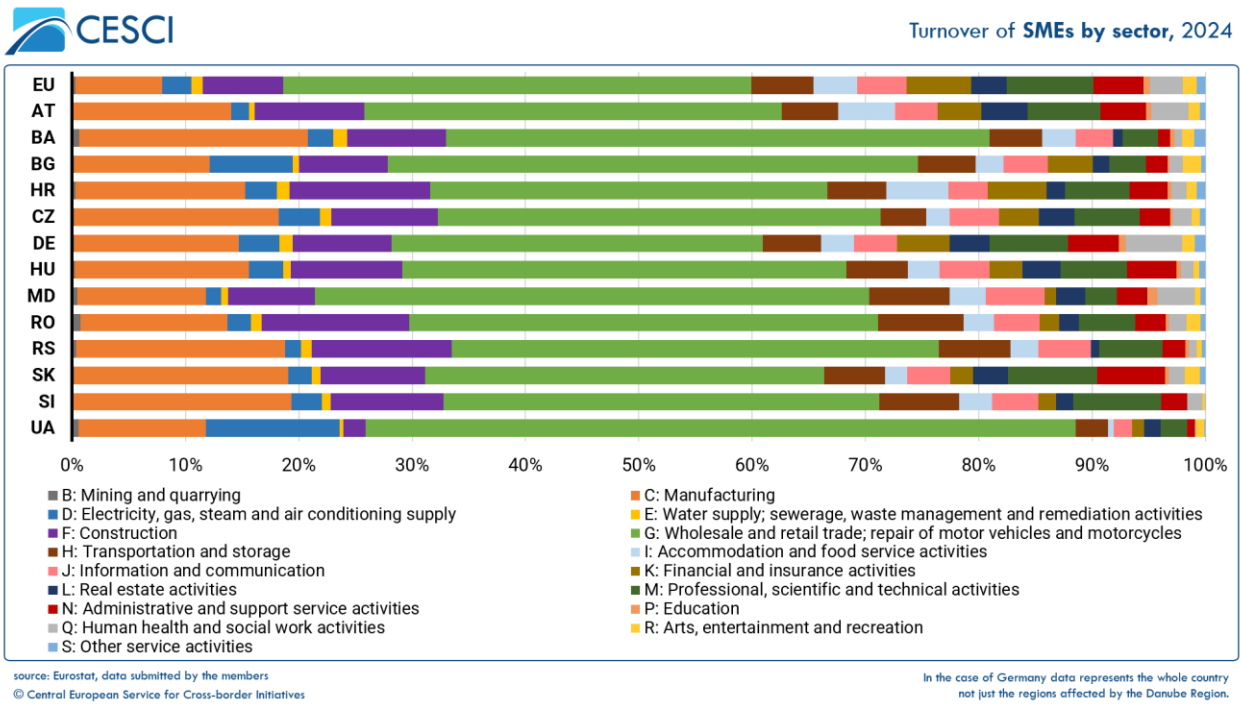


Figure 62: Turnover of SMEs by sector, national level

Based on their distinct sectoral compositions and structural specialisations, the participating economies can be classified into four coherent country groups. The first group comprises the advanced, diversified industrial and high-value service core (Germany and Austria), characterised by the lowest reliance on basic trade (32.77% in Germany and 36.84% in Austria), solid manufacturing shares (14.54% and 13.91%), and the highest concentration of high-value professional, scientific, and technical services (6.91% and 6.41%), healthcare (5.01% in Germany), and tourism (5.02% in Austria). The second group forms the Central European industrial and engineering powerhouse (Czechia, Slovakia, Slovenia, and Hungary), distinguished by exceptionally elevated manufacturing SME turnover capturing roughly a fifth of national totals (19.22% in Slovenia, 18.89% in Slovakia, 18.03% in Czechia, and 15.34% in Hungary), robust construction (~9% to 10%), and dynamic knowledge-intensive services (reaching 7.85% in Slovakia and 7.77% in Slovenia). The third group encompasses the Southeastern European infrastructure, manufacturing, and tourism transition economies (Romania, Serbia, Croatia, and Bosnia and Herzegovina), defined by massive construction-driven SME revenues (13.02% in Romania, 12.40% in Croatia, and 12.34% in Serbia), strong Western Balkan manufacturing footprints (20.19% in Bosnia and Herzegovina and 18.43% in Serbia), and distinct sub-regional specializations such as coastal tourism in Croatia (5.47%) and road-freight logistics in Romania (7.53%). The fourth group consists of the trade-intensive and energy-exposed eastern peripheries (Bulgaria, Moldova, and Ukraine), where SME turnover is heavily skewed toward wholesale and retail trade (46.81% in Bulgaria, 48.93% in Moldova, and an extraordinary 62.63% in Ukraine), alongside elevated shares in energy supply (11.81% in Ukraine and 7.30% in Bulgaria) and under-represented knowledge-intensive technical services (2.35% to 3.28%). To overcome

the structural vulnerability of peripheral SMEs that remain trapped in low-margin commercial trade and subcontracted manual assembly, transnational cooperation could prioritise cross-border supplier-upgrading programs, digital cluster alliances, and technology-transfer corridors.

An evaluation of the value added at factor cost of small and medium-sized enterprises (SMEs) as a percentage of total enterprise value added reveals notable structural disparities across the Danube Region while underscoring a broader macroregional underperformance relative to European benchmarks. In 2024, the Danube Region's average value stood at 48.93%, reflecting a continuous decline from 49.98% in 2021. This places the Danube macroregion consistently below both the EU-27 baseline (50.68% in 2024) and the EU-14 average (50.06%). This overall deficit highlights the macroregion's structural economic vulnerabilities, where enterprise value generation remains heavily split between large industrial conglomerates in core Western economies and under-capitalised, low-productivity SME sectors across Eastern and Southeastern peripheries.

Analysing individual country performances reveals distinct regional groupings that reflect underlying economic models. The highest relative SME value-added shares are recorded in Southeastern European and Western Balkan economies, led by Bosnia and Herzegovina (68.89% in 2024), Slovenia (63.84%), Croatia (63.82%), and Bulgaria (62.28%). In these states, SMEs generate the overwhelming majority of business value added; however, this high proportion frequently signals a structural absence of large, capital-intensive multinational corporations rather than exceptional SME productivity. A second, tightly clustered group comprises Central and Eastern European Member States and accession candidates, including Austria (55.22%), Slovakia (54.65%), Czechia (54.28%), Hungary (54.02%), Romania (53.73%), Serbia (53.28%), and Ukraine (52.07%). Conversely, Germany represents a distinct structural outlier with an SME value-added share of just 46.23% in 2024. Germany's heavy concentration of large multinational OEM manufacturers (such as automotive and chemical conglomerates) dominates national value creation, which heavily weights the aggregate macroregional average downward below 49%.

Despite the high reliance on SMEs in Eastern and Southeastern countries, low overall productivity and weak value-addition remain major disadvantages for peripheral, non-metropolitan, and rural areas. In lagging hinterlands, small enterprises are frequently trapped in low value-added, traditional service or assembly-based production models, suffering from limited access to private R&D capital, digital technologies, and international supplier networks. This weak regional SME ecosystem directly stifles local labour market development, resulting in persistent wage disparities, structural underemployment, and a shortage of attractive career pathways for tertiary-educated youth. Consequently, underdeveloped SME sectors act as a primary catalyst for outward migration and brain drain in particular, and severe rural depopulation, stripping peripheral communities of vital human capital and forcing young adults to migrate toward major capital metropolises or Western European industrial hubs.

To break these cycles of decline and safeguard the „Right to Stay", transnational interventions need to focus on unlocking local economic potential by fostering sustainable, landscape-based economies and promoting green diversification in lagging regions. Key opportunities lie in valorising natural and cultural heritage through community-based ecotourism and sustainable heritage management, integrating rural micro-enterprises into broader European value chains. Furthermore, deploying place-based smart solutions – such as „Smart Villages", „smart shrinkage" planning frameworks, and silver economy services tailored to aging rural demographics – can maintain essential service provision while creating new entrepreneurial niches. By aligning Smart Specialisation Strategies (S3), strengthening cross-border cluster networking, and facilitating technology transfer between Western innovation centers and Eastern SMEs, the Danube Region economies can enhance local value addition.

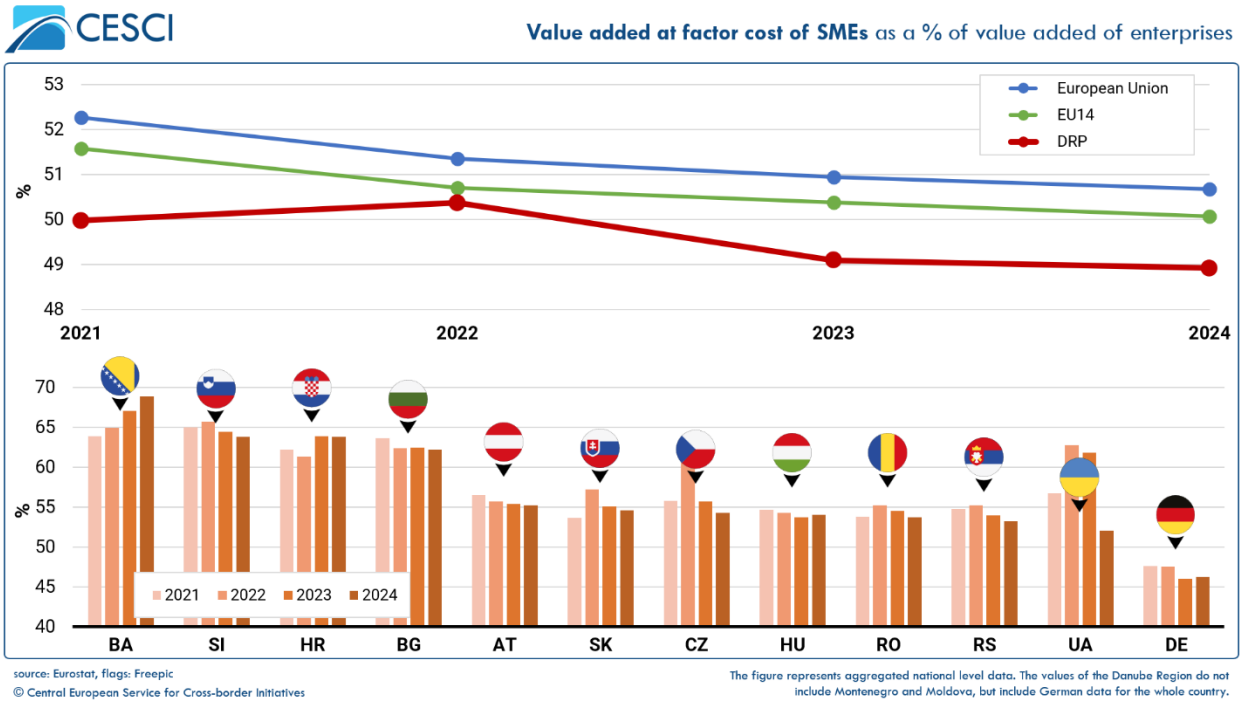


Figure 63: Value added at factor cost of SMEs as a % of value added of enterprises in the Danube Region

RDI and digital transition

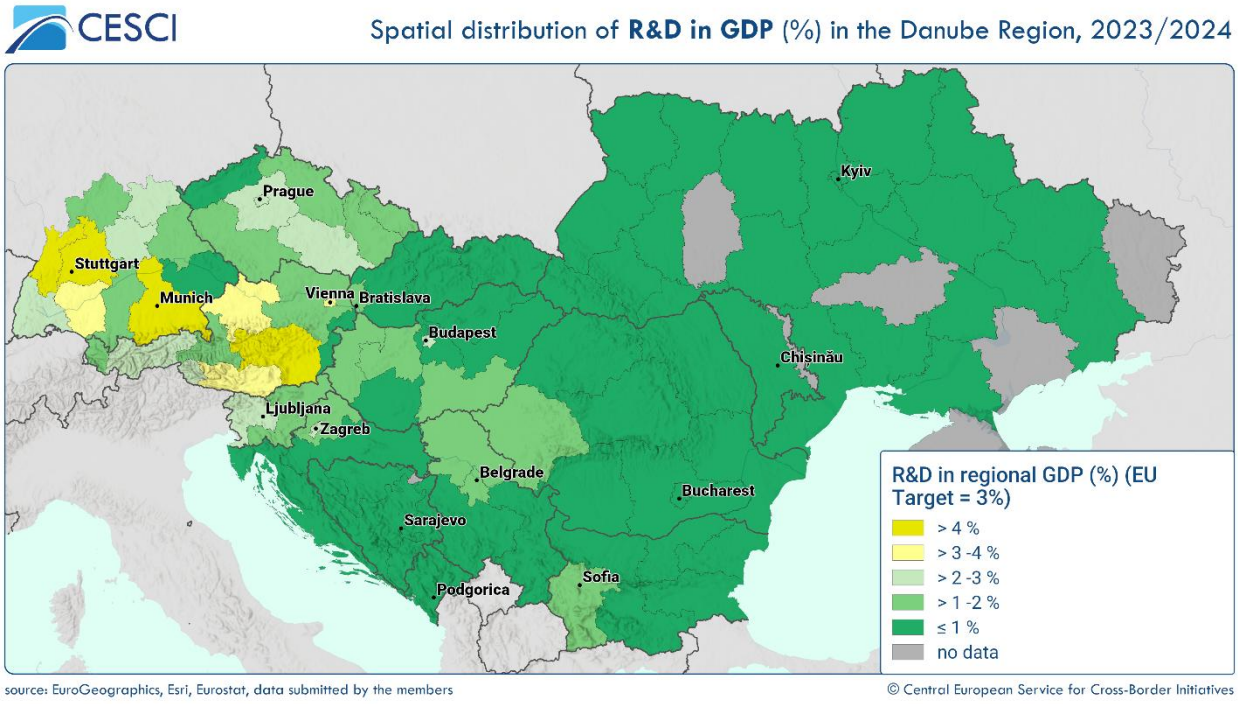


Figure 64: Spatial distribution of RDI in GDP (%) in the Danube Region

The spatial distribution of Gross Domestic Expenditure on Research and Development (GERD) as a percentage of GDP serves as a primary indicator for identifying knowledge-intensive economies and the maturity of innovation ecosystems. Based on the statistical evidence for 2024, the Danube Region remains a deeply fragmented space, where a handful of innovation "hubs" stand in stark contrast to extensive territories characterised by a significant lack of knowledge-based investment.

Analysing innovation intensity and territorial disparities, it can be said that data reveals profound territorial inequalities, primarily following a northwest-to-southeast gradient, further complicated by a strong urban-rural divide. The EU27 average for R&D expenditure stands at 2.26% of GDP, a benchmark that acts as a decisive dividing line within the macroregion.

Knowledge-intensive leaders of the macroregion are exclusively concentrated in Germany and Austria. Stuttgart represents the absolute peak of RDI intensity with 7.33% of its GDP dedicated to research, followed by Karlsruhe (5.88%), Steiermark (5.32%), and Oberbayern (5.22%). These regions, together with Austrian hubs like Wien (3.91%) and Oberösterreich (3.54%), constitute the macroregion's innovation backbone, demonstrating advanced transition toward Industry 4.0.

Transition and "leap-frog" areas as secondary tier of regions has managed to reach or approach the EU average, showing significant potential for polycentric innovation development. Zahodna Slovenija and Praha (both at 2.63%) exceed the EU baseline, while Budapest (2.25%), Jihovýchod

(2.17%), and Grad Zagreb (2.17%) act as important national RDI anchors that are closely integrated into European knowledge networks.

Terciary tier of regions can be regarded as "shadows" and lagging regions. A massive share of the Danube Region suffers from marginal level of R&D spending. The most marginal expenditures relative to GDP are found in Romania and Serbia, with Sud-Est (0.12%), Sud-Vest Oltenia (0.17%), and the Šumadija and Western Serbia region (0.19%) recording expenditure levels that are more than 20 times lower than the regional leaders. Similarly low rates characterize many Bulgarian regions, such as Severozapaden (0.26%), further reinforcing the persistent east-west divide in knowledge production.

From a cohesion policy perspective, the current landscape confirms that the Danube Region is suffering from an intensifying "innovation paradox", where the gap between high-performing metropolitan hubs and lagging rural peripheries continues to widen. The dominance of the western core and a few capital cities reinforces a one-sided attraction force, which contributes to the brain drain of highly skilled human resources from the east toward more innovative receiving regions. Consequently, future transnational programming must move beyond supporting established R&D centers and prioritise the diffusion of knowledge and the creation of transboundary innovation corridors. By fostering the institutionalisation of the Triple/Quadruple Helix approach in lagging regions, policy interventions can stimulate local knowledge management, knowledge and technology-intensive employment, thereby preventing the consolidation of a permanent "multi-speed" transition in the Danube macroregion.

An analysis of the spatial distribution of intramural research and development expenditure (GERD) across Europe in 2024 reveals a deeply polarised landscape structured along a pronounced Northwest-to-Southeast gradient, positioning the Danube Region as a structurally fragmented and predominantly weak innovation performer within the continental hierarchy. While Northern and Western Europe form a contiguous high-spending innovation core exceeding 1,200 euros per inhabitant, the Danube macro-region is characterised by an acute expenditure divide, where the vast majority of its fourteen participating countries operate far below the European average. Specifically, six Danube countries (Romania, Bulgaria, Serbia, Montenegro, Bosnia and Herzegovina, Moldova, and Ukraine) are members of the lowest European expenditure group of 150 euros or less per inhabitant. A lower-intermediate convergence tier of 150 to 300 euros per inhabitant incorporates Croatia, Hungary, and Slovakia, while Czechia and Slovenia occupy a moderate middle tier of 300 to 600 euros per inhabitant. In stark contrast, Germany and Austria stand out as the macro-region's sole top-tier performers, exceeding 1,200 euros per inhabitant and serving as the uncontested engines and drivers of macro-regional technological progress. This expenditure polarisation creates an immense intra-regional gap exceeding eight to ten times between the Alpine-Danubian core and the

southeastern peripheries, reinforcing a structural "innovation paradox" where high-level research and experimental development remain hyper-concentrated in the western core and isolated capital city agglomerations. Crucially, examining the sectoral composition of performance reveals a sharp functional divide across the basin: while business enterprises finance and execute over two-thirds of all R&D activities in mature industrial engines like Germany, Austria, and Slovenia, scientific performance across the eastern and southern peripheries, most notably in Montenegro, Moldova, Serbia, and Croatia, remains disproportionately confined to government and higher education institutions due to weak private-sector research demand. Overcoming this structural disconnect requires fostering robust cross-sectoral and multi-thematic cooperation through Triple and Quadruple Helix partnerships, systematically bridging academic research with industrial SMEs and regional governance to build a truly integrated and effective macro-regional innovation ecosystem. This structural lack of commercialisation capacity, private venture capital, and corporate research labs traps peripheral manufacturing ecosystems in low value-added assembly and subcontracting roles (the middle-income trap), while starving rural and candidate borderlands of knowledge-intensive employment. Consequently, these persistent research disparities act as a primary catalyst for the continuous, one-way out-migration of scientists, engineers, and tertiary-educated youth toward Western European institutions or overheated capital metropolises, accelerating demographic erosion and depleting source regions of the human capital necessary for post-industrial transition. To bridge these widening scientific cleavages transnational cooperation must prioritise the deployment of cross-border technology-transfer corridors and the establishment of structured university-industry twinning networks linking leading German and Austrian research centers with peripheral institutions.

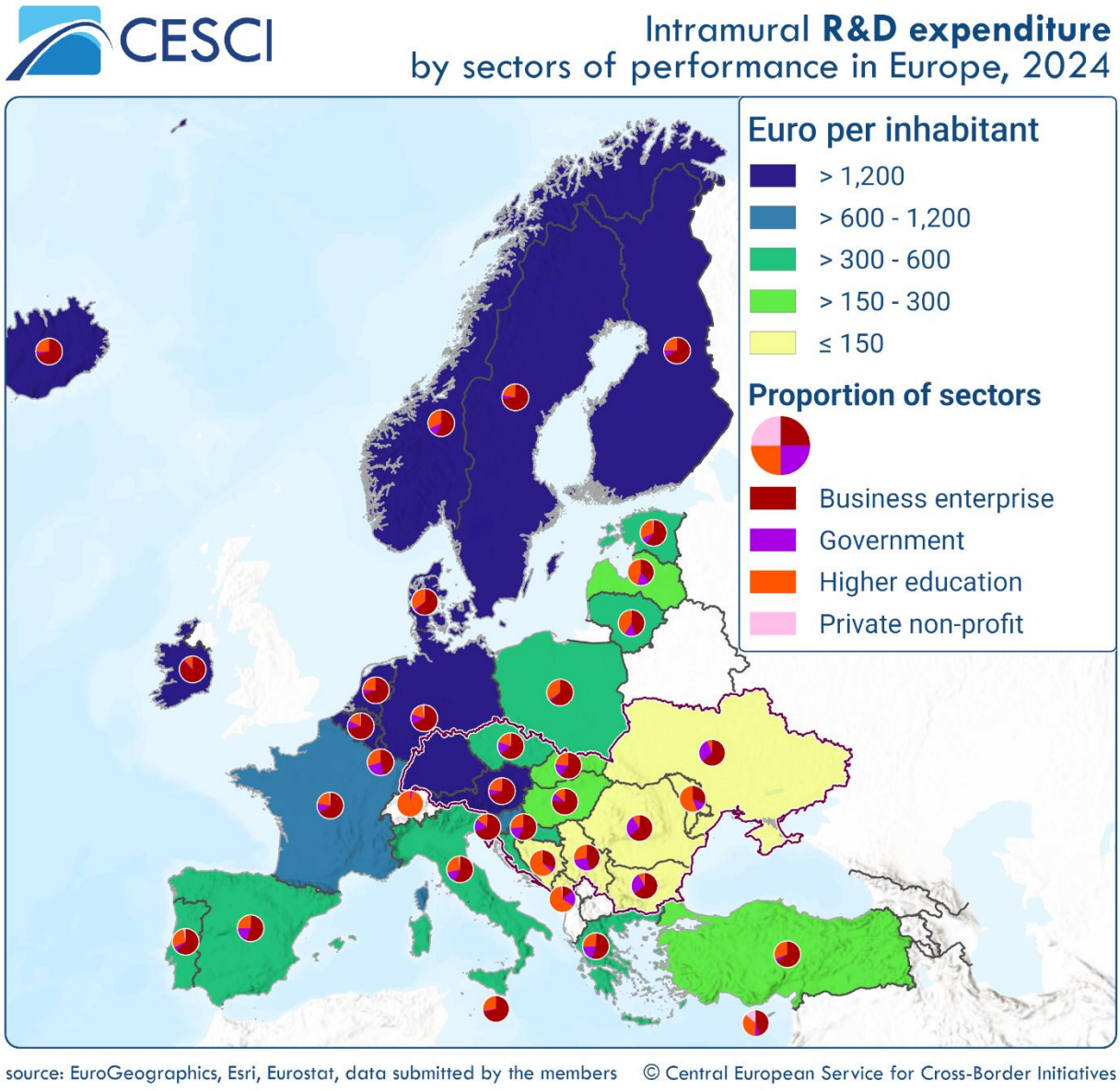


Figure 65: Intramural RDI expenditure (GERD) by sectors of performance in Europe

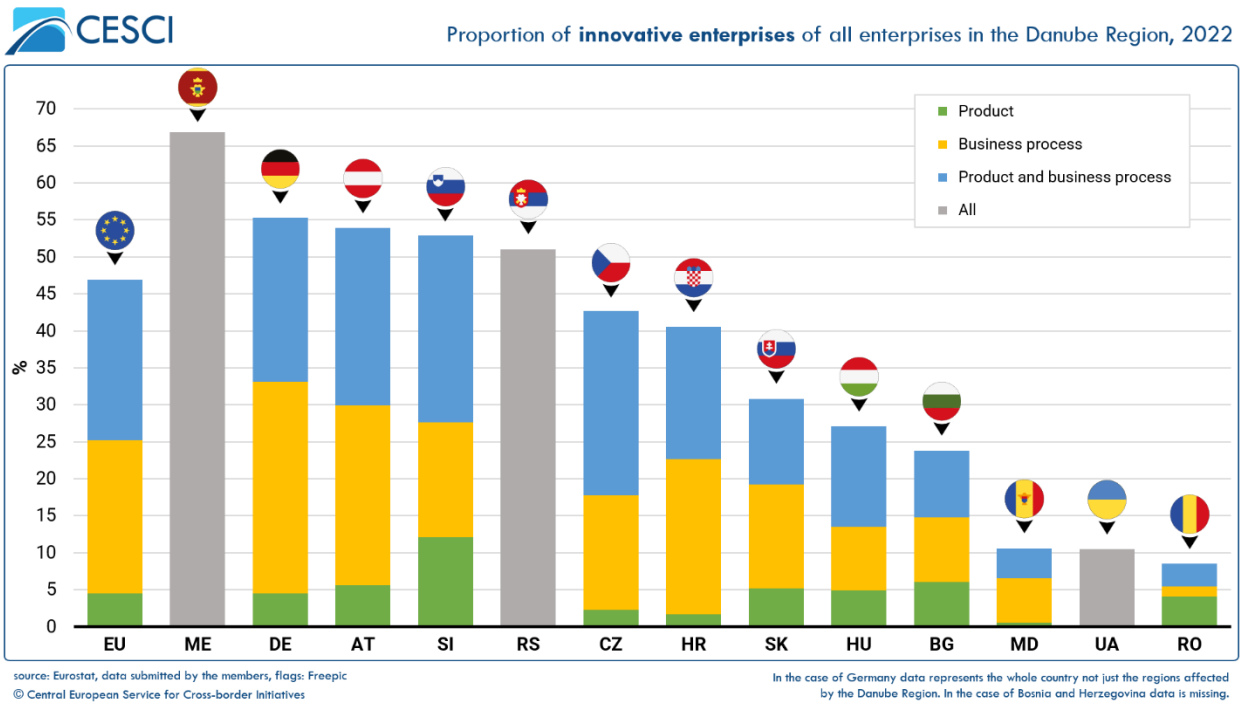


Figure 66: Proportion of innovative enterprises of all enterprises in the Danube Region

An analysis of enterprise innovation data across the Danube Region from 2022 reveals a profound structural divide and a multi-speed innovation landscape. Against the European Union average baseline, where 46.89% of all enterprises are classified as innovative (comprising 4.52% product-only, 20.74% business process-only, and 21.64% combined product and process innovations), the proportion of innovative enterprises across Danube states ranges dramatically from a high of 66.9% to a low of 8.5%. Based on their performance profiles, the countries and sub-regions can be classified into four distinct tiers. The first tier comprises the innovation frontrunners, whose overall proportion of innovative enterprises exceeds the EU-27 benchmark. This top group is led by Montenegro (66.9%), Germany (55.28%), Austria (53.91%), Slovenia (52.91%), and Serbia (51.0%). Within this frontrunner group, business process innovation (28.59% in Germany, 24.36% in Austria) and combined product/process developments (22.16% in Germany, 23.97% in Austria, 25.26% in Slovenia) form the primary backbone of corporate competitiveness, while Slovenia stands out with the macroregion's highest product-only innovation rate (12.08%). The second tier consists of moderate innovators performing close to the European average, including Czechia (42.72%) and Croatia (40.56%). The third tier encompasses lagging innovators, where innovative enterprise shares range between 15% and 31%: Slovakia (30.82%), Hungary (27.10%), Bulgaria (23.79%), and Republika Srpska / Bosnia and Herzegovina (16.9%). The fourth tier represents the structurally distressed group, where overall innovation rates fall near or below 10%: Moldova (10.60%), Ukraine (10.50%), and Romania (8.51%).

A primary joint characteristic across the macroregion is the generally low share of product-only innovation, which remains under 6.0% in almost all states, demonstrating that process

modernisation and organisational restructuring serve as the main drivers of enterprise adaptation. Differing characteristics are rooted in the persistent East-West and urban-rural RDI divides. While core Western economies and capital agglomerations concentrate high private R&D spending (GERD) and advanced technology-intensive activities, regional SMEs in eastern and southeastern peripheries face weak business networking, low digital/tech adoption, and the risk of getting trapped in low value-added assembly models (middle-income trap). The main joint challenges include unifying fragmented cross-border innovation ecosystems, integrating peripheral SMEs into regional supplier networks and value chains, and stemming the continuous out-migration of skilled human capital (brain drain). Addressing these bottlenecks requires structured transnational cooperation focused on aligning national and regional Smart Specialisation Strategies (S3), strengthening Triple/Quadruple Helix synergies between universities, research centers, public authorities, and private enterprises, and expanding knowledge-transfer "twinning" partnerships between high-performing Western innovation hubs and under-represented Eastern and Southern institutions.

An evaluation of employed persons in technology and knowledge-intensive sectors as a percentage of total employment between 2022 and 2024 reveals pronounced territorial inequalities across the Danube Region while showcasing a strong macro-regional orientation toward high-tech services.[5] In 2024, the Danube Region benchmark reached 4.01%, slightly outperforming the European Union average baseline of 3.88% (which rose from 3.70% in 2022). Based on their 2024 employment shares, the participating states can be grouped into three distinct categories. The upper tier of high-tech employment frontrunners exceeds the European average, led unexpectedly by Ukraine (5.72%), whose resilient digital, software engineering, and remote ICT services have remained despite wartime conditions, followed by Croatia (4.41%), Serbia (4.38%), Bulgaria (4.27%), Slovakia (4.27%), and Germany (4.05%). The intermediate tier encompasses economies operating in close proximity to the EU benchmark, comprising Czechia (3.81%), Hungary (3.81%), Austria (3.54%), Slovenia (3.51%), and Moldova (3.48%). Conversely, the lower tier consists of structurally constrained labour markets where high-tech employment accounts for smaller proportions of the active workforce, represented by Bosnia and Herzegovina (3.05%), Romania (2.63%), and Montenegro (2.62%). This spatial configuration underscores a dual economic reality: while dynamic metropolitan tech hubs in countries like Serbia, Bulgaria, and Croatia have successfully leveraged ICT nearshoring and specialised service clusters, large parts of Romania and the Western Balkans remain anchored in traditional manufacturing, agriculture, or basic service employment.

[5] Crucially, this evaluation must account for a significant methodological break in time series and definition differences introduced across European Labor Force Survey (EU-LFS) datasets around 2021/2022, which restructured the classification of knowledge-intensive activities and statistical sampling, necessitating that the 2022–2024 trajectory be analysed as a distinct and self-contained observation window.

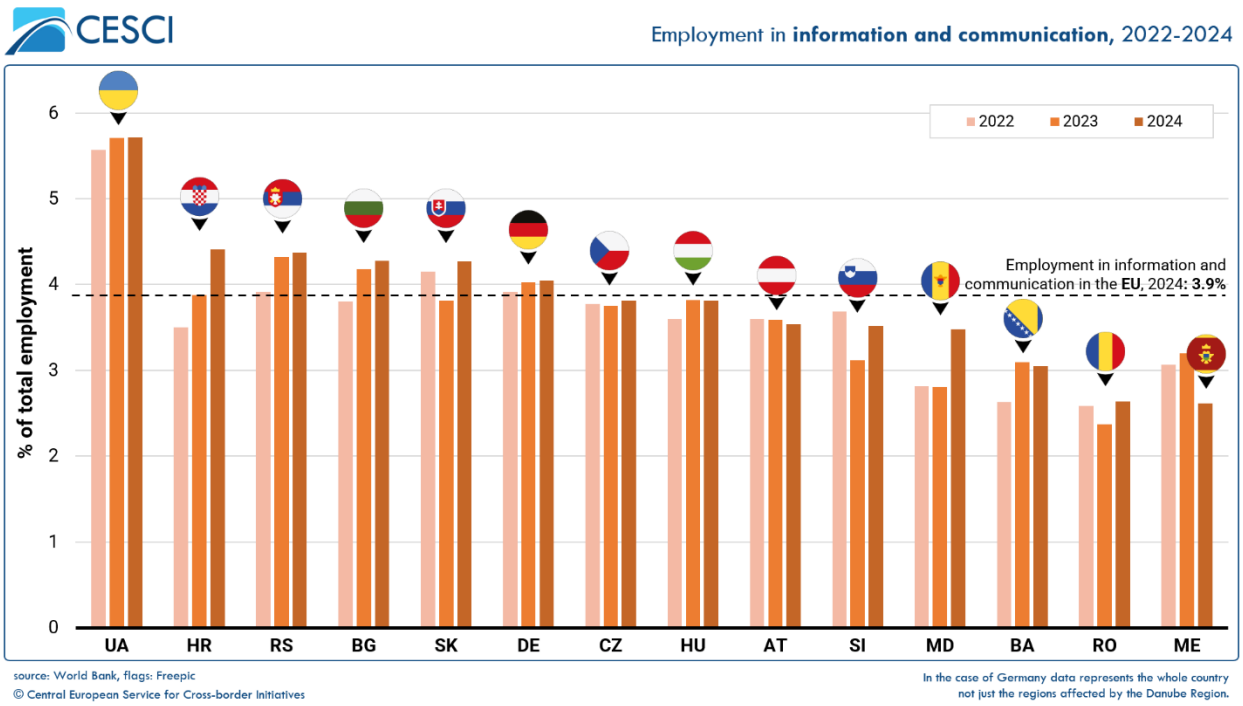


Figure 67: Employment in information and communication in the Danube Region

Examining dynamic shifts between 2022 and 2024 reveals notable upward momentum across most participating economies, though growth rates diverged considerably across sub-regions. The strongest catching-up dynamic was achieved by Croatia, where the share of technology-intensive employment surged by 0.91 percentage points (a 25.95% relative increase), alongside rapid expansions in Moldova (+0.66 pp), Bulgaria (+0.47 pp), Serbia (+0.46 pp), and Bosnia and Herzegovina (+0.42 pp). Minor contractions were recorded in Austria (-0.06 pp), Slovenia (-0.17 pp), and Montenegro (-0.45 pp). Looking forward, the primary macro-regional challenge remains the severe monocentric concentration of these high-value jobs within isolated capital city „islands", which starves peripheral hinterlands of technical skills and accelerates the out-migration of educated youth. Addressing these imbalances requires structured transnational cooperation under the Danube Region Programme to establish technology-transfer corridors, expand digital hub „twinning" partnerships between western centers and eastern universities, and deploy remote-work frameworks that retain high-tech talent and safeguard the „Right to Stay" across lagging territories.

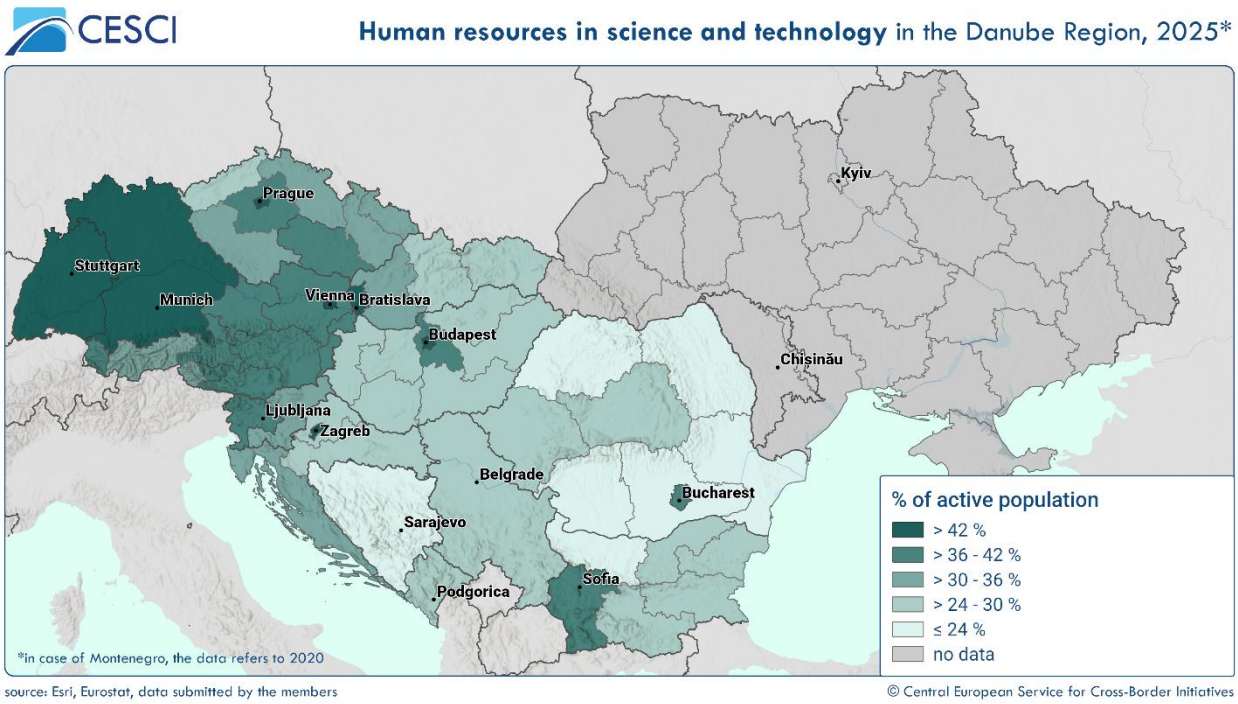


Figure 68: Human resources in science and technology in the Danube Region

The spatial distribution of human resources in science and technology (HRST) across the Danube Region shows a profound divide and a multi-tier regional innovation landscape. The primary joint characteristic across almost all participating countries is the prominent "capital city island" phenomenon. Metropolitan capital regions such as Prague, Vienna, Bratislava, Budapest, Ljubljana, Zagreb, Belgrade, Sofia, and Bucharest, consistently act as high-density knowledge hubs where HRST accounts for the top category of the active population (exceeding 42.0%). In these primary urban centers, dense university networks, public research institutes, corporate headquarters, and advanced services concentrate the vast majority of scientific and technological talent across national territories.

Beyond these capital islands, however, the macroregion exhibits starkly divergent territorial patterns that separate Western core economies from Eastern and Southeastern peripheries. In Southern Germany (Baden-Württemberg and Bavaria surrounding Stuttgart and Munich) and Austria, high HRST shares (36.0% to over 42.0%) extend well beyond capital boundaries, forming a broad, contiguous cross-border belt of knowledge-intensive human capital. Conversely, across Central, Eastern, and Southeastern European Member States and accession candidate countries – particularly in rural Romania, Southern Serbia, Bosnia and Herzegovina – HRST presence drops sharply outside capital agglomerations into the lowest categories (below 24.0% or 24.0-30.0%). This spatial fragmentation reflects the "innovation paradox" and the talent development trap detailed in macroregional diagnostics, where capital hubs thrive as knowledge anchors while surrounding rural hinterlands remain locked in lower-tech, assembly-based economic activities.

These extreme spatial disparities generate critical joint challenges for macroregional cohesion. The hyper-concentration of scientific opportunities in Western core hubs and capital metropolises drives a continuous, one-way out-migration of young, tertiary-educated talent ("brain drain") from peripheral and candidate territories, depleting local human capital, accelerating demographic aging, and undermining regional catching-up. To break these cycles of decline and safeguard the "Right to Stay", transnational cooperation must foster "brain circulation" rather than permanent talent loss. Key policy interventions should focus on aligning regional Smart Specialization Strategies (S3), strengthening Triple and Quadruple Helix partnerships, and institutionalising university-industry "twinning" schemes connecting leading Western research centers (e.g., Fraunhofer, TU Munich, AIT) with regional "bridging" institutions across Eastern and Southeastern Europe. By expanding remote research frameworks, modernising local VET and tertiary curricula, and building decentralised innovation ecosystems, the Danube states can retain local talent, promote two-way knowledge exchange, and ensure balanced, polycentric development.

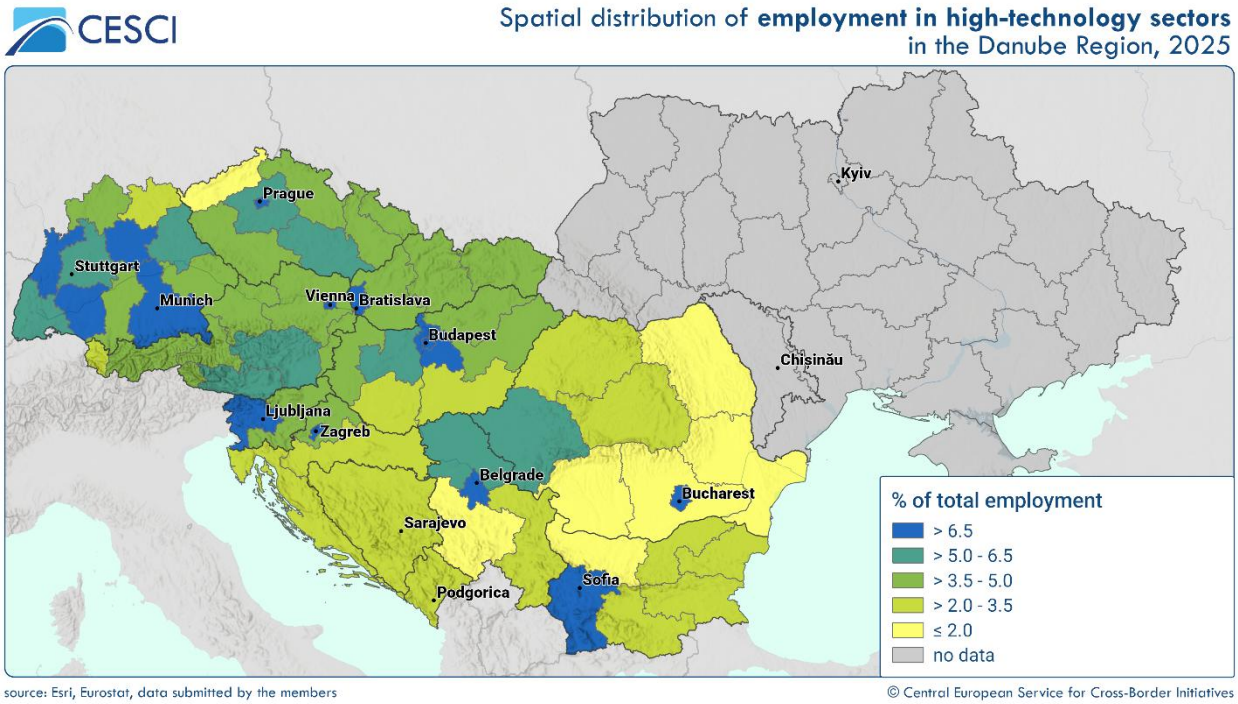


Figure 69: Spatial distribution of employment in high-technology sectors in the Danube Region

The spatial distribution of employment in high-technology sectors across the Danube Region illustrates a profound East-West structural dichotomy and a stark urban-rural polarisation. The most prominent joint characteristic of the macroregion is the extreme territorial concentration of high-value, technology-intensive jobs. High-tech employment reaches its peak exceeding 6.5% of total employment across a contiguous, highly integrated western innovation core in Southern Germany (specifically Baden-Württemberg and Bavaria surrounding Stuttgart and Munich). Outside this western engine, however, high-tech employment across Central, Eastern, and Southeastern Europe manifests almost exclusively as a series of isolated, monocentric capital

city "islands" (most notably Prague, Bratislava, Vienna, Budapest, Ljubljana, Zagreb, Belgrade, Sofia, and Bucharest) where shares similarly surpass the 6.5% benchmark.

In sharp contrast to these metropolitan growth poles, extensive rural hinterlands, outer borderlands, and peripheral regions across Eastern and Southeastern Europe exhibit severe high-tech employment deficits. Vast territories across Romania, Bulgaria, Moldova, and the Western Balkans register high-tech employment shares below 2.0% or between 2.0% and 3.5%. This spatial pattern mirrors the "innovation paradox" and the functional middle-income trap identified in macroregional diagnostics, where capital cities successfully integrate into global knowledge networks, while surrounding provinces remain locked in low value-added, assembly-based production modes. The sudden drop in technology-intensive employment immediately outside capital boundaries underscores an incomplete structural transition toward a knowledge-based economy across the macroregion's eastern and southern peripheries.

These severe spatial imbalances create critical joint challenges for macroregional cohesion, as the hyper-concentration of high-tech opportunities in capital metropolises and Western European hubs fuels continuous, skill-selective out-migration from lagging areas. This persistent brain drain strips peripheral territories of young, tertiary-educated talent, accelerating demographic aging and locking local economies into persistent developmental traps. Transnational cooperation would require supporting "brain circulation". Key policy interventions could focus on building cross-border talent development and retention networks, twinning partnerships between Western/capital hubs and peripheral institutions. By decentralising technology transfer, supporting remote high-tech work frameworks, and strengthening local Triple and Quadruple Helix innovation ecosystems, the Danube states can create high-value local employment, and retain regional talent.

Internal economic relations and cooperation

An evaluation of the Thematic Smart Specialisation Partnerships (TSSPs) across the Danube Region reveals an active yet territorially asymmetrical innovation landscape structured around 32 interregional alliances across four thematic platforms. Industrial modernisation overwhelmingly dominates the macro-regional portfolio with 23 partnerships, followed by Agri-food (5), Energy (2), and Sustainable Blue Economy (2), focusing heavily on advanced engineering, artificial intelligence, battery materials, circular bioeconomy, and precision agriculture. Formal leadership is highly concentrated in a handful of regional anchors, specifically Pomurje of Slovenia in plant-based food innovation, the North Great Plain (Észak-Alföld) of Hungary co-leading sustainable buildings alongside North West Croatia, Bavaria steering safe and sustainable mobility, North-East Romania leading textile innovation, and Slovenia coordinating SME integration for Industry 4.0. In terms of overall network connectivity, Slovenia functions as the undisputed macro-regional champion, participating in 17 partnerships across all

thematic domains, while Baden-Württemberg and North-East Romania serve as primary pillars with six partnerships each. Solid multilateral engagement is sustained across Lower and Upper Austria, Bavaria, Czech regions such as Liberec and Olomouc, and Hungarian counties including Hajdú-Bihar and South Transdanubia, establishing an integrated Central European manufacturing and technology-transfer corridor. High potential lies in combining the various stakeholders and excellene across the macroregion. There are certain joint endowment as well as complementary characteristics which could be utilised in the future with industrial modernisation and agri-food type of partnerships seem to be the centerpiece of potential cooperation.

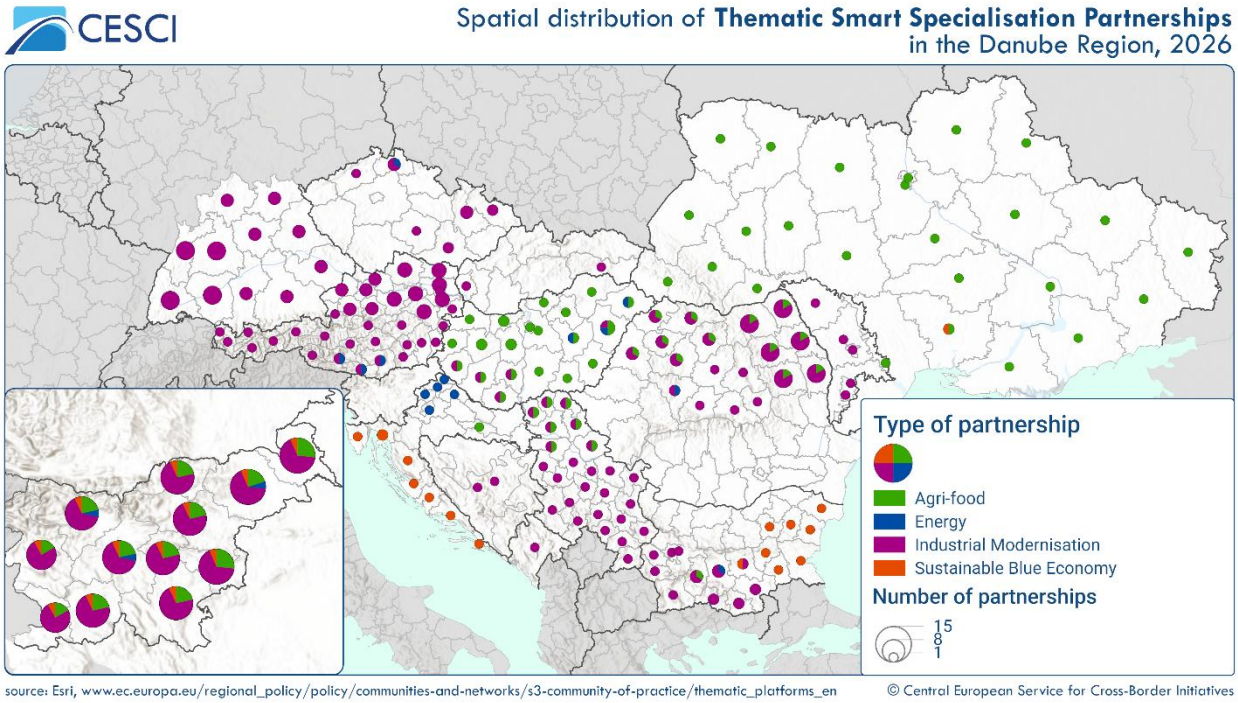


Figure 70: Spatial distribution of Thematic Smart Specialisation Partnerships in the Danube Region

These partnerships are defined by a bottom-up, Quadruple Helix governance model that unites regional development agencies, research technology organisations, business clusters, and universities to advance high Technology Readiness Levels (TRL 5–8) and cross-sectoral hybridisation. However, their spatial configuration exposes an acute territorial divide separating the EU Member States from the accession peripheries. While German and Austrian hubs specialise in high-capital deep tech, space, photonics, and hydrogen ecosystems, and Central European members drive industrial digitisation and sustainable construction, candidate and Eastern partner countries remain largely trapped in an innovation shadow. Serbia, Ukraine, Bosnia and Herzegovina, Montenegro, and Moldova record marginal, fragmented participation confined to creative industries, circular bioeconomy, or basic agri-food platforms, while being entirely absent from advanced manufacturing, battery storage, and artificial intelligence partnerships. To prevent a widening technological gap and counteract the persistent brain drain of technical talent toward western hubs, transnational cooperation must deploy dedicated

widening mechanisms, cluster-twinning schemes, and co-investment support to integrate candidate economies into high-value European value chains.

Detecting cluster collaborations is another way to analyse internal macroregional cooperation forms in the economy and science sector. The majority of countries are having multiple settlements where clusters have built collaborations with other Danubian clusters. On country level Germany, Romania and Ukraine stands out. Regarding regional levels, Bavaria, Moravia and Transylvania stands out. Certain settlements act as real hubs for transnational collaboration including Kyiv, Cluj-Napoca, Stântu Gheorghe, Regensburg as the first tier, followed by cities such as Munich, Nuremberg, Brno, Graz, Novi Sad, Belgrade, Bucharest, Sofia, Ruse, Lviv, and Vynnitsia. Areas lacking cluster collaborations or weak connections can be found in Bosnia and Herzegovina, Croatia, Montenegro, Moldova, along with Eastern Bulgaria and Eastern Ukraine. Transnational cooperation could support the better territorial coverage of the macroregion by fostering collaborations with the Western Balkan countries, Ukraine and Moldova. Combining the comparative advantages of certain companies and clusters across the macroregion to form well-functioning collaborations is of great relevance within the macroregion. It would support job opportunities, research and technology workplaces in regions presently less integrated into the wider European market. Cluster collaborations are a useful way to encourage knowledge and technology transfer, product development and market penetration across the Danube Region to support both economic competitiveness and the „Right to Stay" to many skilled people.

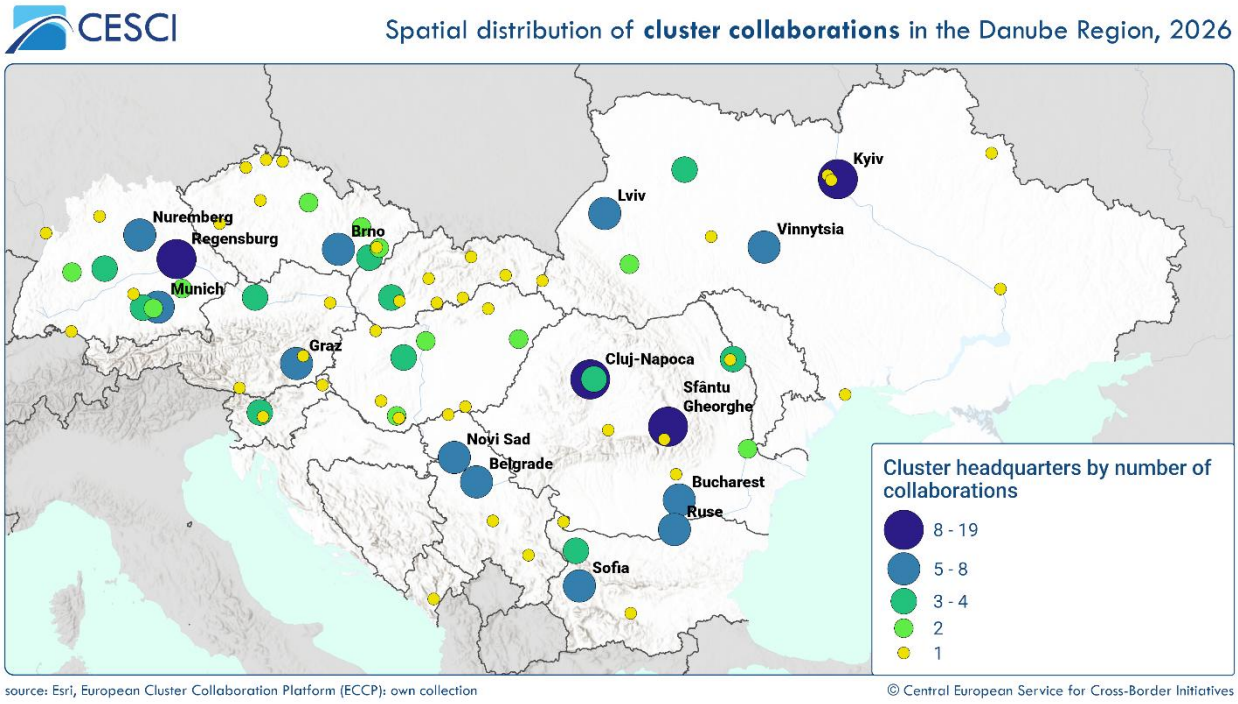


Figure 71: Spatial distribution of cluster collaborations in the Danube Region[6]

[6] The main information source was the European Cluster Collaboration online database. Those settlement and seats are shown on the map for which information was available on the website. The figure shows the identifiable number of cluster connections of the seats (settlements) of the European clusters located within the Danube Region and having collaborations with clusters from the macroregion.

The composition and intensity of foreign direct investment (FDI) relations within the Danube Region reveals a deeply integrated yet structurally asymmetrical macroregional economy. Driven by total intra-regional inward FDI stocks exceeding 1.04 trillion USD, the Danube Basin serves as a major economic engine where capital flows connect core Western Member States, Central European manufacturing hubs, and accession candidate countries. However, this investment landscape is defined by profound structural capital asymmetries. Outward investment capacity is overwhelmingly concentrated in Germany and Austria, which together account for 825.05 billion USD, or 79.29% of all positive intra-macroregional FDI stocks. Germany leads as the largest single source of capital with 436.59 billion USD (41.96%), followed closely by Austria with 388.46 billion USD (37.33%). These two mature economies provide the equity, technology transfer, and corporate governance that anchor industrial supply chains throughout the Danube Region. In contrast, outward investment from Eastern and Southeastern European participating states remains modest, creating a persistent core-periphery capital dependency where eastern economies rely heavily on external multinational decisions for structural modernisation.

Evaluating inward investment intensity highlights sharp territorial inequalities between aggregate economic size and per-capita capital absorption. In absolute terms, the primary manufacturing economies of Central and Eastern Europe represent the largest capital destinations, led by Czechia (186.82 billion USD), Austria (178.34 billion USD), Germany (149.27 billion USD), Romania (111.66 billion USD), and Hungary (102.76 billion USD). These countries are followed by Slovakia (69.65 billion USD), Croatia (65.74 billion USD), and Serbia (49.85 billion USD). When benchmarked on a per-inhabitant basis, however, a distinct tier of high-intensity capital magnets emerges. Austria leads the macroregion with 19 472 USD per inhabitant, closely followed by Czechia (17 139 USD), Croatia (17 023 USD), Slovenia (15 235 USD), and Slovakia (12 839 USD). These high-penetration territories contrast with Moldova (1 790 USD) and Ukraine (447 USD), where Ukraine's investment absorption has been severely suppressed by wartime instability and geopolitical risk.

The strongest economic and business connections across the Danube Region follow three primary spatial dynamics. First, the bilateral investment loop between Germany and Austria constitutes the single largest economic axis in the basin, comprising 176.29 billion USD from Germany into Austria and 125.91 billion USD from Austria into Germany. Second, massive Western core-to-CEE manufacturing highways connect German and Austrian headquarters to Central European production centers, represented by heavy bilateral stocks such as Germany to Czechia (90.39 billion USD), Austria to Czechia (63.97 billion USD), Germany to Hungary (54.29 billion USD), Germany to Romania (48.53$ billion USD), Austria to Romania (47.19 billion USD), and Austria to Hungary (43.25 billion USD). Third, secondary regional investors play a crucial role in binding neighbouring countries together. Czechia and Slovakia maintain an intense mutual investment relationship (27.24 billion USD from Czechia into Slovakia and 24.68 billion

USD vice-versa), while Hungary has established a prominent outward investment footprint in Croatia (12.51 billion USD), Germany (12.01 billion USD), Romania (9.56 billion USD), Bulgaria (7.50 billion USD), and Serbia (5.57 billion USD). Similarly, Slovenia serves as a crucial capital bridge into the Western Balkans (7.57 billion USD in Croatia and 7.55 billion USD in Serbia), while Croatia, Serbia, and Austria anchor investment in Bosnia and Herzegovina, and Romania provides a vital economic lifeline to Moldova (1.40 billion USD).

These intra-macroregional investment ties position the Danube Region as a primary economic engine for European enlargement and cohesion. By channeling capital, technology, and managerial standards from EU Member States into candidate countries, cross-border investments accelerate structural reforms and prepare non-EU economies for full Single Market integration long before official accession. However, as economic cohesion deepens, new operational bottlenecks and policy challenges surface. Heavy reliance on foreign capital leaves peripheral regions vulnerable to global corporate restructuring, risking a functional middle-income trap where regions remain confined to low value-added assembly operations, driving the out-migration of tertiary-educated youth and undermining the „Right to Stay". Furthermore, cross-border business activities continue to face legal and administrative friction, double-taxation hurdles, divergent regulatory frameworks, and non-Schengen border delays along external frontiers, while regional SMEs suffer from acute information deficits regarding cross-border market opportunities.

Addressing these bottlenecks requires structured transnational cooperation. Transnational interventions could prioritise establishing dedicated business information services to provide SMEs with real-time legal, tax, and market information, alongside deploying legal obstacle-clearing mechanisms to streamline cross-border operations and labour mobility. To transition from one-way capital dependency to balanced „brain circulation", policy frameworks should encourage foreign investors to embed R&D facilities, high-tech nodes, and university-industry twinning partnerships within peripheral regions. The Danube countries can ensure that foreign investment generates high-value local employment, retains regional talent, and promotes sustainable, polycentric growth across the entire macroregion.

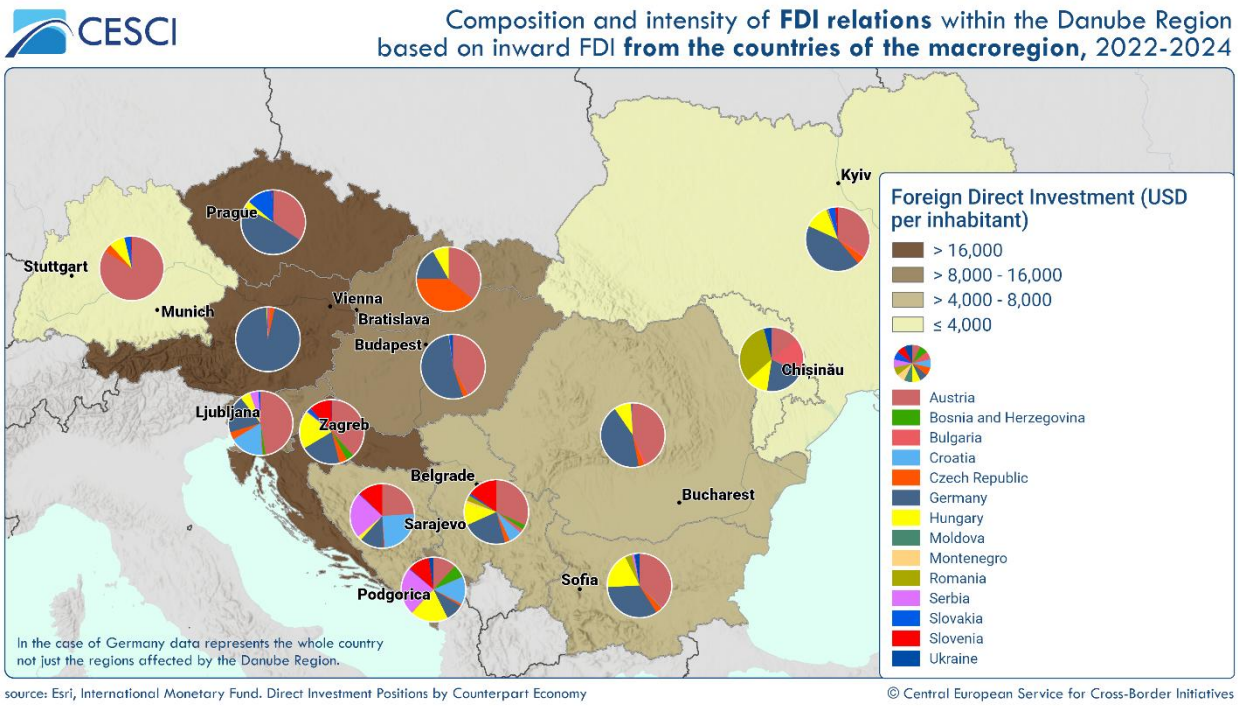


Figure 72: Composition and intensity of FDI relations within the Danube Region based on inward FDI from the countries of the microregion

An analysis of patent applications to the European Patent Office (EPO) featuring co-inventors from the Danube Region reveals a deeply interconnected yet highly asymmetrical knowledge and innovation ecosystem. Across the fourteen participating states, a total of 542 unique bilateral co-patent relations are recorded, demonstrating that transnational research and development is an active driver of macro-regional integration. However, this co-invention architecture is organised around a pronounced core-periphery model dominated by Germany and Austria. Germany functions as the primary technological anchor of the river basin, participating in 490 out of the 542 total co-patent connections (an overwhelming 90.41%), while Austria participates in 322 connections (59.41%). The bilateral corridor between Germany and Austria represents the single largest co-invention axis in the macro-region, comprising 295 co-patents and accounting for more than half (54.43%) of all intra-Danube co-patent output. This pre-Alpine axis reflects decades of institutional integration, shared research infrastructures, and deeply synchronised industrial clusters across Bavaria, Baden-Württemberg, and Austrian federal states.

Beyond the German-Austrian core, the most intensive co-invention flows follow major Western-to-Central European corporate R&D highways, largely driven by multinational automotive, mechanical engineering, electronics, and pharmaceutical value chains. Germany's strongest external bilateral research connections within the basin are established with Hungary (77 co-patents, representing 14.21% of the macro-regional total) and Czechia (49 co-patents, or 9.04%), followed by Slovenia (21), Romania (17), Slovakia (12), Bulgaria (10), Ukraine (5), and Croatia (4). Similarly, Austria maintains vital technological links with its eastern neighbours, led by Hungary (10 co-patents), Slovakia (5), Slovenia (5), Czechia (3), Croatia (3), and Bulgaria (1). These figures

illustrate that foreign direct investment from the western core has successfully generated cross-border knowledge spill-overs, embedding Central European subsidiaries and engineering centers into transnational patenting activities.

Outside the German and Austrian hubs, cross-border neighborhood ties and historical path dependencies define the remaining bilateral connections. The most prominent non-core partnership exists between Czechia and Slovakia, which share 12 co-patents, reflecting the enduring functional integration and academic networks. In the Alpine-Adriatic arc, Slovenia and Croatia have established an active cross-border innovation linkage with 7 co-patents. Meanwhile, Czechia has emerged as a secondary technological bridge for the eastern basin, engaging in co-invention with Ukraine (2 co-patents), Romania (1), Slovenia (1), and Bulgaria (1). Along the eastern external border, a singular co-patent between Romania and Moldova represents an important cross-border institutional bridge linking Chisinau to the EU innovation space.

Despite these positive linkages, the dataset highlights severe structural imbalances and an acute "innovation shadow" across the Western Balkans and Eastern peripheries. Bilateral co-patents that involve neither Germany nor Austria account for only 25 out of 542 partnerships, a mere 4.61% of the macro-regional total. This reveals that horizontal East-East and South-South research cooperation remains virtually nonexistent without a western intermediary. Even more concerning is the complete absence of patent collaboration in parts of the Western Balkans, while Moldova (1) and Ukraine (7) remain marginally integrated. This stark divide mirrors the broader macro-regional "innovation paradox," where high-tech capabilities and patenting activities are hyper-concentrated in the western core and a few capital city islands, leaving peripheral regions locked in lower value-added assembly production models.

To overcome these structural bottlenecks, transnational cooperation should prioritise the development of horizontal, multi-country research corridors such as horizontal East-East and South-South alliances, the integration of Western Balkan and Eastern candidate countries, the institutionalisation of university-industry twinning networks apart from aligning cross-border Smart Specialisation Strategies (S3).

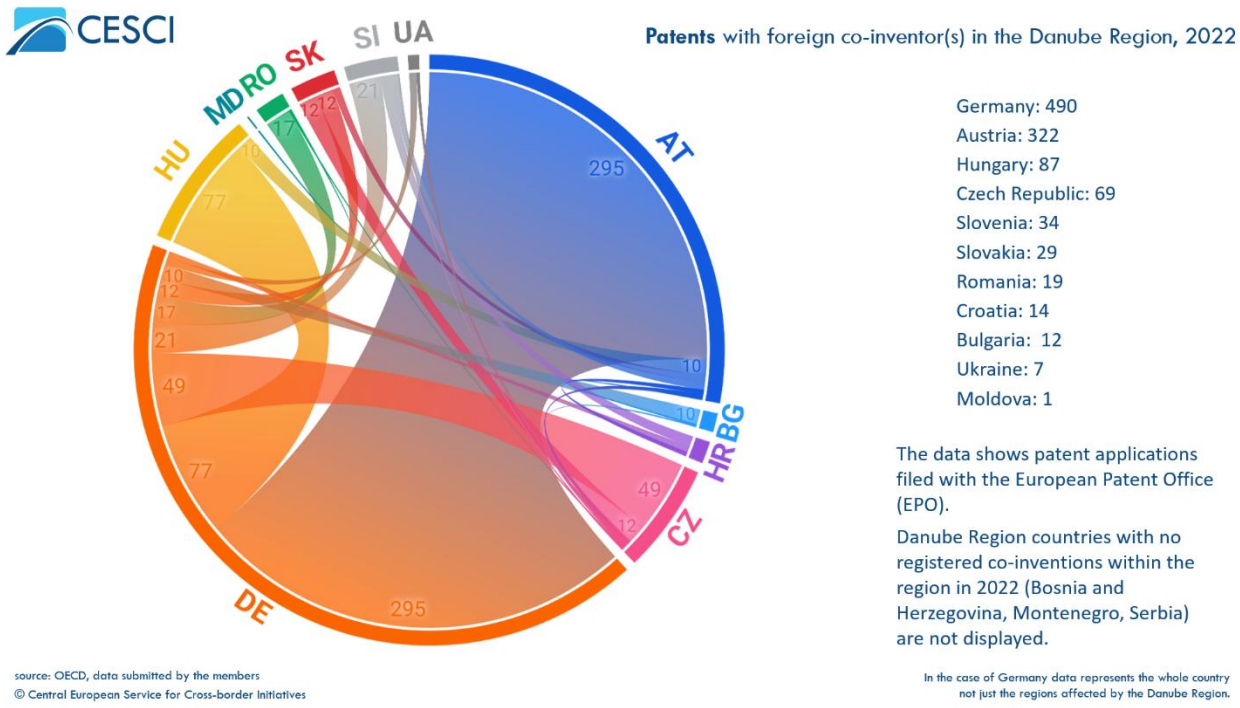


Figure 73: Patent applications to the EPO in the Danube Region, co-patent connections

NEXT STEPS IN DATA VISUALISATION

Figures to be upgraded to the final design:

Additional figures to be created:

- Patent applications to the EPO in Europe

3.2.2 The existing economic infrastructure (accessibility and energetics)

The Trans-European Transport Network (TEN-T) situated across the Danube macroregion serves as the indispensable arterial backbone of European spatial integration, establishing the physical groundwork required to operationalise the European Union's core mandate: the unhindered free movement of workforce, goods, services, and capital. By physically interconnecting national transport systems, TEN-T infrastructure drastically reduces transit times, lowers logistics costs, and integrates regional labour markets, allowing cross-border workers to commute seamlessly while enabling industrial supply chains to span multiple countries. The Danube Region occupies

a strategic position as Continental Europe's primary multimodal transport junction, bridging long-standing Western EU Member States, Central European industrial centers, the Western Balkans, and Eastern accession candidate states like Ukraine and Serbia. Upgrading and aligning these high-capacity transport links is a primary physical requirement for building a transnationally integrated, economically cohesive macroregion capable of eliminating historical core-periphery divides and unlocking shared growth.

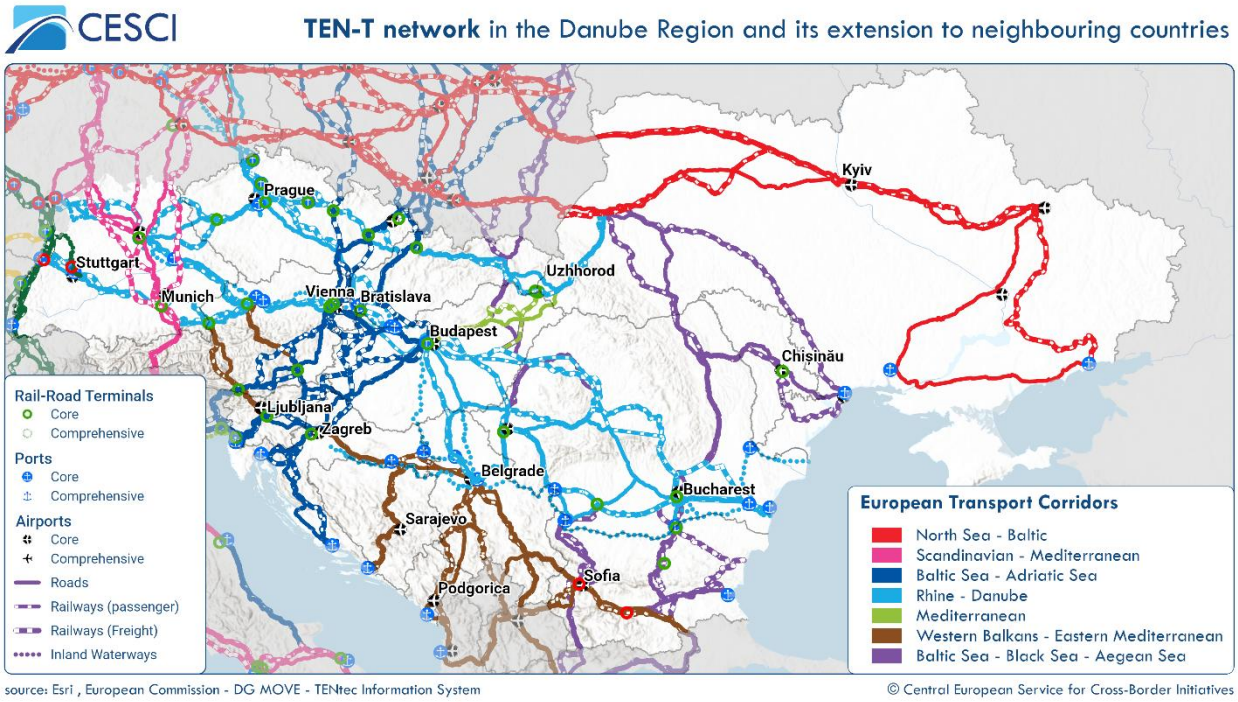


Figure 74: TEN-T network in the Danube Region and its extension to the neighbouring countries

This strategic connectivity is structured around seven primary European Transport Corridors that intersect across the Danube Basin and extend into neighbouring candidate countries. The Rhine - Danube corridor acts as the macroregion's central multimodal spine, integrating heavy rail and the primary Danube inland waterway from Southern Germany through Austria, Slovakia, Hungary, and Serbia to Romania, Moldova, and Ukraine's Black Sea ports. The Baltic Sea - Black Sea - Aegean Sea corridor establishes a vital north-south eastern trade axis running through Poland, Slovakia, Hungary, Romania, Moldova, Ukraine, and Bulgaria. The Western Balkans - Eastern Mediterranean corridor anchors Southeastern Europe by linking Austria, Slovenia, Croatia, Serbia, Bosnia and Herzegovina, Montenegro, Bulgaria, and North Macedonia to the Aegean coast. The Baltic Sea - Adriatic Sea corridor connects Central European manufacturing hubs across Czechia, Slovakia, and Austria with the Adriatic ports of Koper, Rijeka, and Trieste. The Mediterranean corridor traverses the southern flank through Slovenia, Croatia, and Hungary. The Scandinavian - Mediterranean corridor touches the upper Alpine territory. The North Sea - Baltic corridor extends high-capacity overland links eastward directly toward Kyiv.

Despite this dense network layout, the Danube macroregion faces acute joint challenges, including missing cross-border rail and road links, uncoordinated customs clearance at non-Schengen frontiers, incomplete rail electrification, aging river port equipment, and climate-driven low-water periods that disrupt seasonal river navigation. Addressing these systemic bottlenecks requires structured transnational cooperation Priority areas for joint action may include accelerating a modal shift from congested road corridors to electrified rail and inland waterways, deploying digital vessel tracking and automated border clearance platforms (SEED+) to eliminate transit delays, upgrading dual-use infrastructure, and establishing integrated cross-border public transport networks to support daily commuting and protect the „Right to Stay" in lagging border regions.

The spatial distribution of motorways in the Danube Region as captured in 2017 depicts a profound structural divide in road network density and spatial accessibility across Central and Southeastern Europe. The baseline map highlights a stark contrast between the highly mature, densely interconnected motorway systems of upper basin economies and the fragmented or virtually non-existent high-capacity road networks of the eastern and southern peripheries. In 2017, upper basin Member States such as Germany (Bavaria and Baden-Württemberg) and Austria possessed dense, polycentric motorway networks where almost the entire population resided well within a 40 km buffer zone of a major highway. Central European transition states, specifically Czechia, Slovakia, Hungary, Slovenia, and Croatia, maintained emerging, largely monocentric motorway radials centered on national capitals (such as Prague, Bratislava, Budapest, Ljubljana, and Zagreb), leaving moderate spatial gaps in interstitial rural borderlands. In sharp contrast, Southeastern Europe and the Eastern Neighborhood exhibited severe structural peripherality. In Romania, Bulgaria, Serbia, Bosnia and Herzegovina, Montenegro, Moldova, and Ukraine, motorways were confined to isolated, short segments or single primary arteries, leaving vast territorial gaps, most notably the Carpathian mountain range, the Banat and Wallachian agricultural plains, the Moldavian hinterland, and Western Ukraine, completely outside the 40 km motorway catchment area, forcing heavy freight and regional traffic onto congested, low-speed national roads.

Since 2017, intensive investments funded through EU Cohesion Policy, the Connecting Europe Facility (CEF), Recovery and Resilience Fund (RRF), national budgets, and pre-accession instruments have driven substantial motorway expansions across the macroregion, systematically closing critical spatial gaps. A landmark cross-border milestone was the completion of the M30 motorway in Hungary in 2021, which established a seamless 2x2 lane high-speed connection between Miskolc and the Slovak border at Tornyosnémeti, linking directly to Slovakia's R4 expressway toward Košice and fulfilling a core segment of the north-south Via Carpatia corridor. Important steps towards transnational connections include the linking of the Hungarian M6 to the Croatian A5 connecting Pécs and Osijek with the Bosnian

network. Hungary has further expanded its high-speed network via the M4 motorway toward the Romanian border at Nagykereki and the A3 motorway, alongside the M85-M86 expressways in the west to Austria. In Serbia, major structural bottlenecks were eliminated with the full completion of the A1 motorway through the challenging Grdelica Gorge to North Macedonia, the completion of the A4 motorway connecting Niš to the Bulgarian border at Kalotina, and the steady expansion of the A2 (Miloš Veliki) highway. In Romania, the opening of the A10 motorway between Sebeș and Turda in 2021 linked the A1 and A3 trunk lines in Transylvania, while rapid construction momentum on the A7 (Moldavia Motorway) and the A0 Bucharest Ring Motorway has begun transforming eastern connectivity. Progress along Corridor Vc has also advanced, marked by the completion of the cross-border Sava River bridge at Svilaj connecting Croatia's A5 motorway with Bosnia and Herzegovina's A1 motorway. Meanwhile, in South Bohemia, significant progress on Czechia's D3 motorway, including the opening of the České Budějovice bypass, has brought high-capacity road infrastructure closer to the Austrian state border.

Despite these substantial post-2017 advancements, severe physical bottlenecks and missing connections continue to impede seamless transboundary mobility and economic cohesion across the Danube Basin. Among cross-border links, the České Budějovice to Linz axis remains a primary European bottleneck, where Czechia's D3 motorway has yet to fully connect across the border at Dolní Dvořiště/Wullowitz with Austria's S10 Mühlviertel expressway and A7 motorway, leaving international transit dependent on two-lane regional roads. On the Romanian-Bulgarian border, cross-border road connectivity across the Danube River is constrained by a lack of bridges, leaving heavy freight dependent almost entirely on two structures at Giurgiu–Ruse and Calafat–Vidin. Domestically, one of the most critical structural bottleneck in the entire macroregion is the missing trans-Carpathian section of Romania's A1 motorway between Sibiu and Pitești. Traversing the rugged Southern Carpathians, this incomplete central segment forces heavy commercial traffic between Wallachia, including the port of Constanța and the Bucharest industrial hub, and Transylvania onto narrow, single-carriageway mountain passes, creating chronic transit delays and logistics bottlenecks. Other major domestic missing links include Romania's A8 (Unirii Motorway) planned across the Eastern Carpathians between Târgu Mureș and Iași, the incomplete northern sections of Bulgaria's A2 (Hemus) motorway, and the environmentally sensitive Kresna Gorge section of Bulgaria's A3 (Struma) motorway leading toward Greece.

Addressing these structural deficiencies is central to the ongoing reconfiguration of the European Union's Trans-European Transport Network (TEN-T) core corridors, notably the Rhine-Danube, Orient/East-Med, Baltic-Adriatic, and Western Balkans axes. Strategic priority is increasingly focused on completing macroregional corridors that transform peripheral borderlands into dynamic 360-degree functional transit spaces. The Via Carpatia axis stretching from the Baltic ports through Poland, Slovakia, Hungary, Romania, and Bulgaria to the Aegean

and Black Seas is rapidly emerging as the primary eastern highway backbone of Continental Europe, integrating isolated rural hinterlands into high-value manufacturing supply chains. Simultaneously, the complete construction of Corridor Vc (Budapest–Osijek–Sarajevo–Ploče) is critical to unlocking landlocked Bosnia and Herzegovina, establishing a direct trade conduit between Central Europe and the Adriatic Sea. In Eastern Europe, the accelerated development of Romania's A7 Moldavia motorway toward Suceava and Siret aims to extend high-speed road connectivity directly to the Ukrainian and Moldovan frontiers, providing an essential land trade channel that integrates Eastern partner states into the broader European Single Market. The completion of the Hungarian M3 to the Ukrainian border would function similarly.

Unlocking the full socio-economic potential of the Danube Region's motorway network requires tackling complex transnational challenges that extend beyond physical tarmac construction. Non-physical border friction represents a major operational bottleneck along external EU and non-Schengen borders, where uncoordinated customs clearance, rigid inspection protocols, and non-interoperable digital systems create multi-kilometer truck queues and multi-hour delays at critical border crossings such as Röszke/Horgoš (Hungary–Serbia), Calafat/Vidin (Romania–Bulgaria), Siret (Romania–Ukraine), and Reni (Ukraine–Moldova). Furthermore, Russia's war of aggression against Ukraine has fundamentally altered regional security requirements, placing unprecedented emphasis on infrastructure resilience and dual-use (civilian and military) mobility along the EU's Eastern border regions. Upgrading road weight capacities, reinforcing aging bridge infrastructure, and expanding dual-use transport links are urgent priorities. Transnational cooperation needs include harmonising border clearance through the Systematic Electronic Exchange of Data (SEED+), deploying intelligent transport systems (ITS). By aligning physical highway investments with legal and administrative convergence, the Danube states can eliminate border friction, protect the „Right to Stay" in lagging rural peripheries, and establish a fully integrated, secure road transport corridor across Europe.

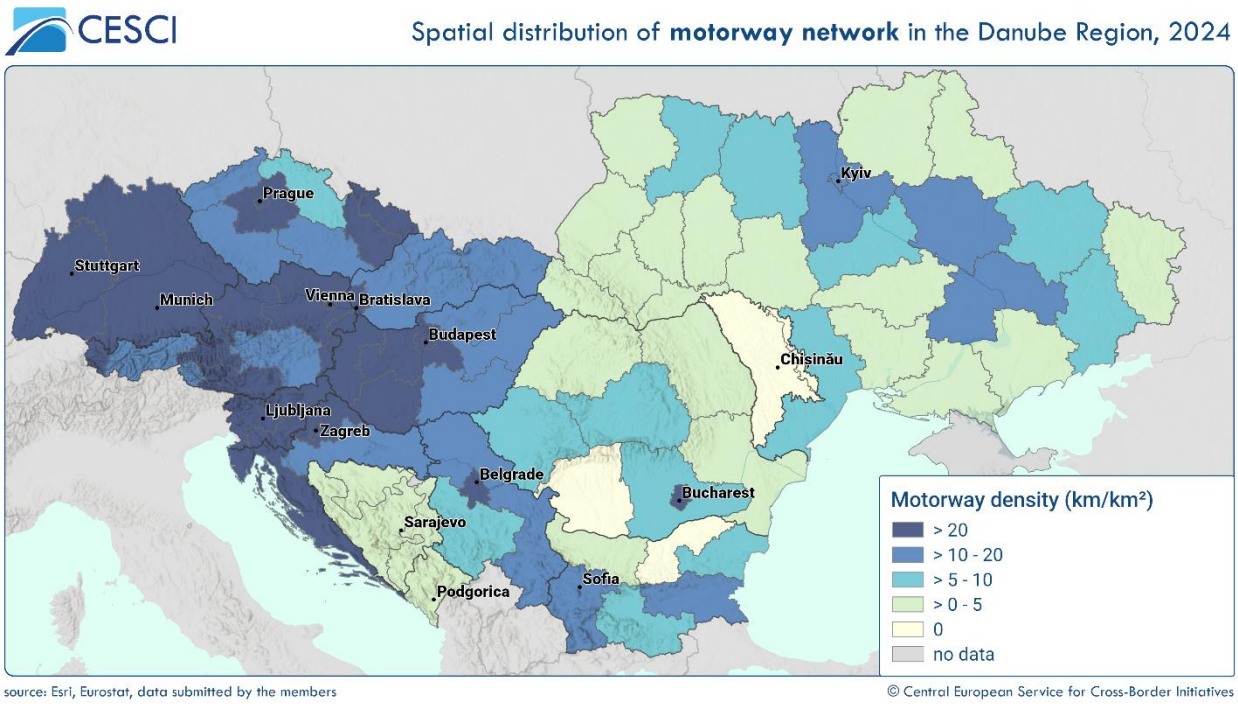


Figure 75: Spatial distribution of motorway network in the Danube Region

The 2024 spatial distribution map of motorway density across the Danube Region depicts a pronounced West-East and core-periphery structural dichotomy in European high-capacity road infrastructure. At the upper end of the spectrum, a contiguous, highly integrated cross-border zone of maximum motorway density unites Southern Germany (Baden-Württemberg and Bavaria) with Austrian, Hungarian, Slovenian and Croatian regions. These well-connected territories, alongside major Central European capital agglomerations – specifically Prague, Bratislava, Vienna, Budapest, Zagreb, Ljubljana, and Belgrade – function as dense hubs where high-speed accessibility is guarenteed.

Conversely, the map highlights an extensive, contiguous cross-border belt of severe infrastructural deficit in the eastern and southeastern parts of the macroregion. A contiguous low-to-zero density zone binds Eastern Romania, Moldova, and Western Ukraine, forming a shared peripheral frontier where high-speed road connections are almost completely absent. A bit less pronounced but still similar cross-border pattern of sparse coverage characterises the Western Balkan hinterlands, encompassing Bosnia and Herzegovina, Montenegro, Southern Serbia, and Bulgaria, where rugged Dinaric and Balkan mountain ranges combined with fiscal constraints have historically restricted highway expansion.

This uneven spatial layout presents critical transnational challenges for territorial and economic cohesion, trade integration, and the free flow of goods and labour across the macroregion. Addressing these disparities requires targeted transnational cooperation to complete key TEN-T missing links, the trans-Carpathian A1 gap in Romania, the Via Carpatia corridor, and Corridor Vc, while deploying digital customs solutions (SEED+) to reduce severe non-Schengen border

delays. Furthermore, joint interventions must focus on upgrading dual-use infrastructure along Eastern EU frontiers to support „Solidarity Lanes" and enhancing secondary road links to rural peripheries, thereby protecting the „Right to Stay" and fostering balanced polycentric growth across the entire Danube Basin.

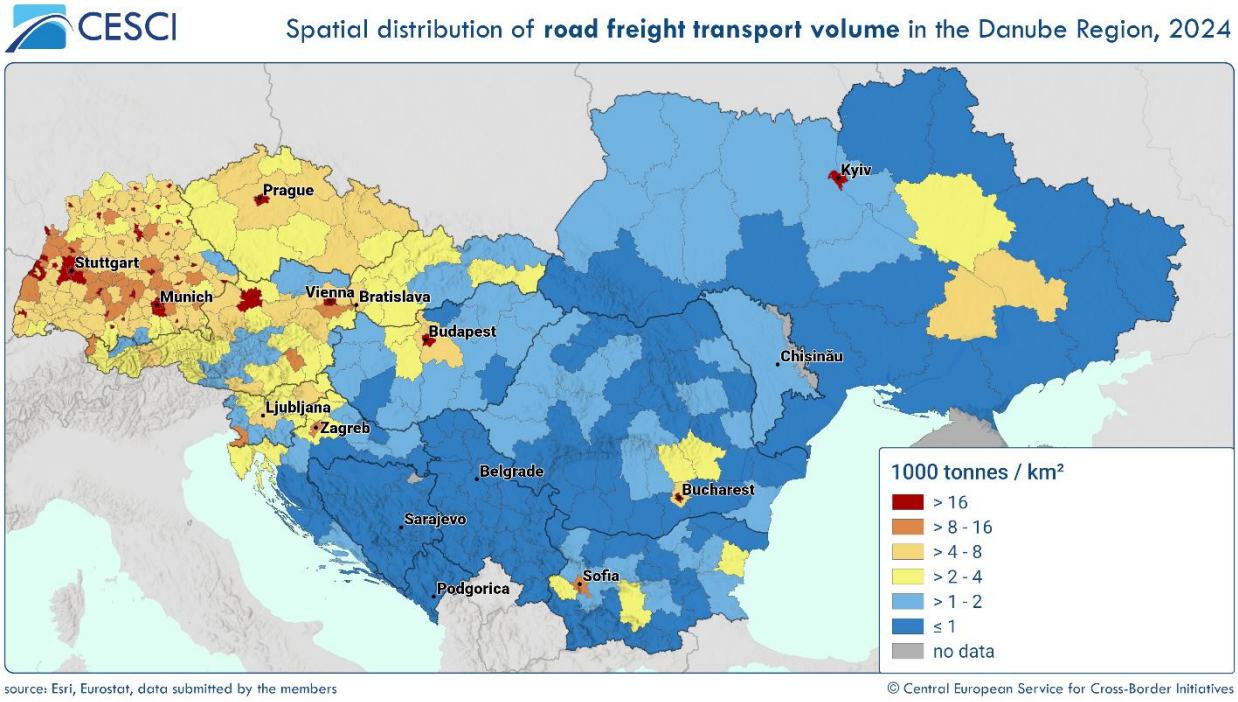


Figure 76: Spatial distribution of road freight transport volume in the Danube Region

The spatial distribution of road freight transport volume across the Danube Region highlights a stark West-East and core-periphery disparity in logistics intensity. High-density road freight flows are heavily concentrated across the upper basin's industrial core in Southern Germany (Bavaria and Baden-Württemberg surrounding Stuttgart and Munich), Austria, and Czechia. In these western territories, dense manufacturing value chains generate continuous, high-volume freight corridors that extend across entire regional networks. Outside this central core, heavy road freight volumes become almost exclusively monocentric, clustering around major capital agglomerations such as Prague, Bratislava, Budapest, Belgrade, Sofia, Bucharest, and Kyiv.

In sharp contrast, vast rural hinterlands, outer borderlands, and peripheral regions across Eastern and Southeastern Europe (including Romania, Bulgaria, Serbia, Bosnia and Herzegovina, Montenegro, Moldova, and Ukraine) exhibit very sparse road freight volumes, overwhelmingly remaining below 1 or between 1-2 thousand tonnes/km². This spatial dichotomy reflects the economic and infrastructural divide identified in macroregional diagnostics: while the western industrial core and primary TEN-T radials handle heavy freight volumes that cause corridor congestion, high carbon emissions, and road wear, eastern peripheries struggle with missing high-speed links, geographical peripherality, and severe clearance delays at non-Schengen and external EU frontiers.

These structural imbalances generate critical joint challenges for cohesion and environmental sustainability across the Danube Basin. To optimise macroregional supply chains while achieving climate targets, transnational cooperation requires a modal shift from congested road corridors toward electrified solutions, rail networks and the Danube inland waterway. Key interventions should focus on completing cross-border TEN-T multimodal missing links and EU „Solidarity Lanes", upgrading river port handling infrastructure, and deploying digital border management tools (such as SEED+ and River Information Services) to eliminate transit delays, enhance dual-use transport resilience, and better integrate peripheral economies.

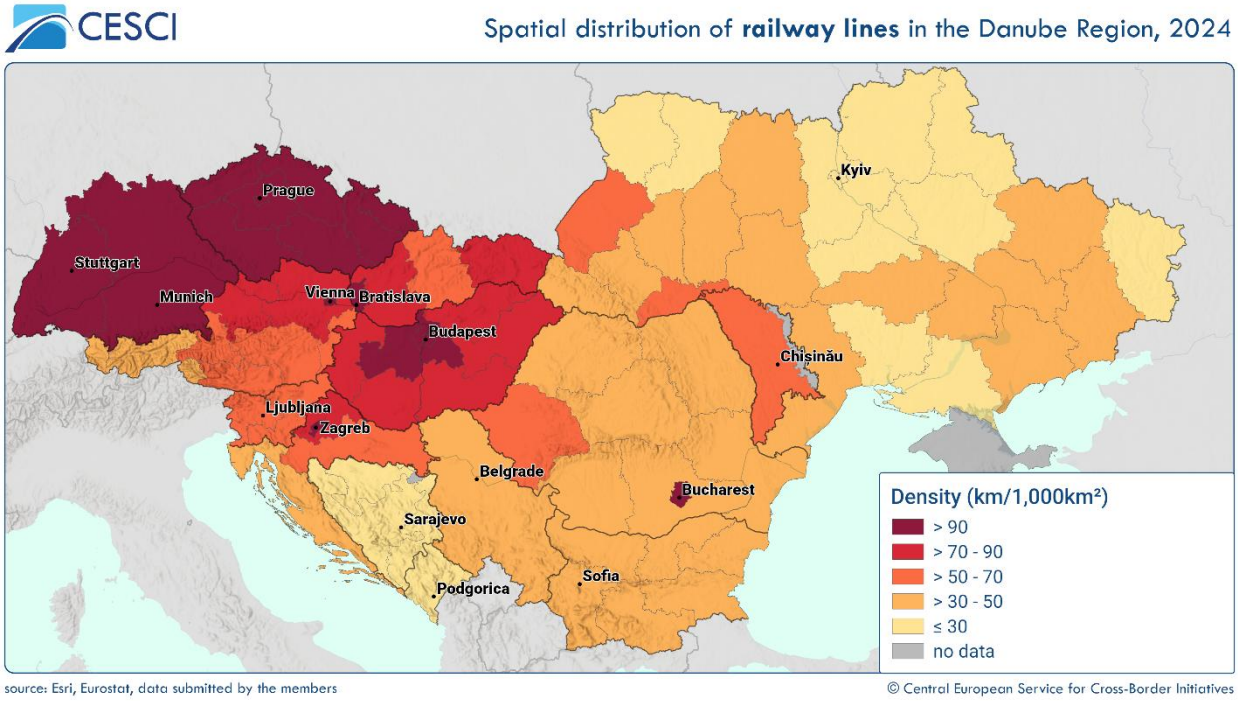


Figure 77: Spatial distribution of railway lines in the Danube Region

The distribution of railway line density across the Danube Region illustrates a deeply rooted West-East structural divide alongside notable core-periphery imbalances in European rail transport infrastructure. The primary joint characteristic across the macroregion is the radial, capital-centric architecture of rail networks, where primary metropolitan hubs such as Vienna, Bratislava, Budapest, Zagreb, Belgrade, Bucharest serve as high-density rail junctions connecting national urban systems. However, spatial density varies dramatically across sub-regions. The highest network density (exceeding 90 km/1 000 km^2 or ranging between 70 and 90 km/1 000 km^2) forms a contiguous Central European belt covering Southern Germany, Czechia, Austria, Slovakia, and Hungary. This upper basin core reflects an inherited, highly developed rail infrastructure capable of supporting high-frequency passenger mobility and heavy industrial logistics.

In contrast, the lower basin, Western Balkans, and Eastern frontiers display marked infrastructural deficits. The lowest network coverage (below 30 km/1 000 km^2) is concentrated in the

mountainous hinterlands of the Western Balkans, specifically Bosnia and Herzegovina and Montenegro, where rugged Dinaric topography and historical underinvestment have limited railway construction. Furthermore, Eastern frontier territories like Ukraine and Moldova face a major structural barrier beyond network density: the technical shift between the standard European track gauge (1 435 mm) and the broad gauge (1 520 mm), which creates severe transshipment bottlenecks along EU borders.

These spatial disparities generate critical joint challenges regarding macroregional connectivity, decarbonisation, and territorial cohesion. Overcoming these bottlenecks requires coordinated transnational cooperation, where key interventions need to prioritise completing missing cross-border TEN-T rail links along the Rhine-Danube, Baltic-Black Sea, and Orient/East-Med corridors, expanding electrification, and deploying unified European Rail Traffic Management System (ERTMS) signaling standards. Additionally, targeted planning and actual investment is needed to upgrade dual-use rail capacity along Eastern EU frontiers to strengthen EU „Solidarity Lanes", while modernising secondary regional feeder lines to improve daily cross-border commuting, promote a shift from road to rail freight, and safeguard accessibility and the „Right to Stay" across peripheral hinterlands.

Table 2: Data of the most significant ports along the Danube[7]

PORT		AREA (km²)	HANDLING FACILITIES AND DEVICES						
			Covered water transshipment	**Conveyor belt**	**Pneumatic equipment**	**Ro/Ro-ramp**	**Gantry crane**	**Mobile crane**	**Floating crane**
	Regensburg	1.85	yes	yes	no	yes	-	1	-
	Kelheim	0.8	no	yes	no	yes	5	1	-
	Straubing	0.2	no	yes	no	yes	-	-	-
	Deggendorf	0.5	no	yes	yes	yes	1	2	-
	Passau	0.25	yes	yes	no	yes	-	1	-
	Linz AG	1.35	no	no	no	no	2	1	-
	Enns	3.53	yes	yes	yes	yes	6	13	-
	Krems	0.48	no	yes	no	no	2	2	-
	Vienna	3.00	yes	yes	no	yes	3	1	-
	Bratislava	1.43	yes	yes	yes	yes	19	2	-
	Komarno	0.64	no	no	no	no	-	-	-
	Győr-Gönyű	1.1	no	yes	yes	yes	-	4	-
	Budapest (Csepel)	1.52	yes	no	yes	yes	4	-	-
	Baja	0.2	no	yes	yes	yes	1	1	-
	Novi Sad	0.024	yes	yes	yes	yes	4	1	-
	Pančevo	1.27	yes	yes	yes	yes	3	3	-

[7] source: Danube Logistics Portal, data submitted by the members

	Belgrade	1.00	yes	yes	no	yes	11	2	-
	Prahovo	0.07	yes	yes	yes	yes	6	-	-
	Smederovo	0. 43	yes	no	no	no	3	1	-
	Ruse Iztok	0.83	no	yes	yes	yes	17	-	-
	Lom	no data							
	Tulcea	0.08	no	no	no	no	8	-	-
	Brăila	0.39	yes	yes	yes	no	12	8	2
	Galaţi	0.87	no	yes	no	no	31	10	9
MD	**Giurgiulesti**	1.2	no	no	no	no	-	1	-
	Reni	0.93	no	yes	yes	yes	36	1	2
	Ust-Dunaysk	0.07	no	no	no	no	3	-	8
	Izmail	no data							

An analysis of port infrastructure across the Danube Basin reveals an interconnected inland waterway network comprising 28 major ports across 9 countries with a combined land footprint exceeding 24 km², anchored by primary logistics nodes such as Enns, Vienna, Regensburg, Budapest Csepel, Bratislava, and Giurgiulești. The network exhibits clear functional complementarities between upper/middle basin multimodal terminals and lower basin bulk transshipment hubs. Ports in the upper and middle reaches specialiae in containeriaed goods, manufacturing machinery, and weather-sensitive cargo supported by covered transshipment facilities and fixed gantry cranes, led by Bratislava with 19 gantry cranes, Belgrade with 11, and Enns with 6. Conversely, lower basin and delta ports focus on high-volume agricultural, mineral, and liquid energy bulk, featuring massive gantry configurations, such as Reni with 36 gantry cranes, Galați with 31, Ruse Iztok with 17, and Brăila with 12, alongside the exclusive basin-wide hosting of all 21 floating cranes across Romania and Ukraine for flexible offshore ship-to-barge transshipment.

With 17 Ro-Ro ramps, 19 conveyor belt systems, and 12 pneumatic handling units distributed across the basin, there is substantial technical potential for joint capacity utilisation and multimodal harmonisation. Geopolitical shocks stemming from Russia's war against Ukraine have heightened this strategic value, shifting massive trade volumes to Lower Danube ports like Reni, Izmail, Giurgiulești, Galați, and Brăila, effectively turning the river into a vital EU "Solidarity Lane". Harmonising handling equipment, aligning berth management, and integrating river barges with Black Sea deep-water terminals such as Constanța elevates the waterway into a resilient "Danube Corridor" capable of anchoring regional energy and food security.

Realising this potential requires digitalising vessel tracking and customs procedures through River Information Services (RIS) and National Access Points (NAPs) to reduce border delays at key transit stops. Furthermore, joint intergovernmental fairway maintenance and dredging under the METEET initiative are to be considered in order to maintain navigable depths during severe

low-water drought periods. Finally, establishing joint police alliances like the operational DARIF network, expanding Police and Customs Cooperation Centres (PCCCs), and de-risking infrastructure upgrades could ensure a secure, climate-resilient, and fully integrated Danube port ecosystem.

An analysis of freight and mail air transport across the Danube Region illustrates an exceptionally polarised logistics landscape, defined by the overwhelming concentration of cargo volumes in a few dominant gateways alongside widespread peripherality in regional and candidate economies. Germany represents the uncontested continental powerhouse of the macro-region, handling 4,767.35 thousand tonnes in 2025 and accounting for nearly 85% of all recorded air cargo traffic across the participating states. Beyond this German industrial core, a secondary tier of Central European multimodal gateways has consolidated, comprising Hungary (365.62 thousand tonnes), Austria (227.98 thousand tonnes), and Czechia (126.98 thousand tonnes). These primary hubs stand in stark contrast to the moderate air cargo volumes handled across Southeastern Europe – including Romania (53.98 kt), Bulgaria (22.73 kt), Bosnia and Herzegovina (21.09 kt in 2024), Serbia (19.25 kt), Slovakia (18.98 kt), Slovenia (11.90 kt), and Croatia (9.59 kt) – and the marginal throughput recorded in Eastern and Western Balkan candidate territories such as Moldova (0.90 kt) and Montenegro (0.62 kt), where direct intercontinental cargo connections remain virtually non-existent.

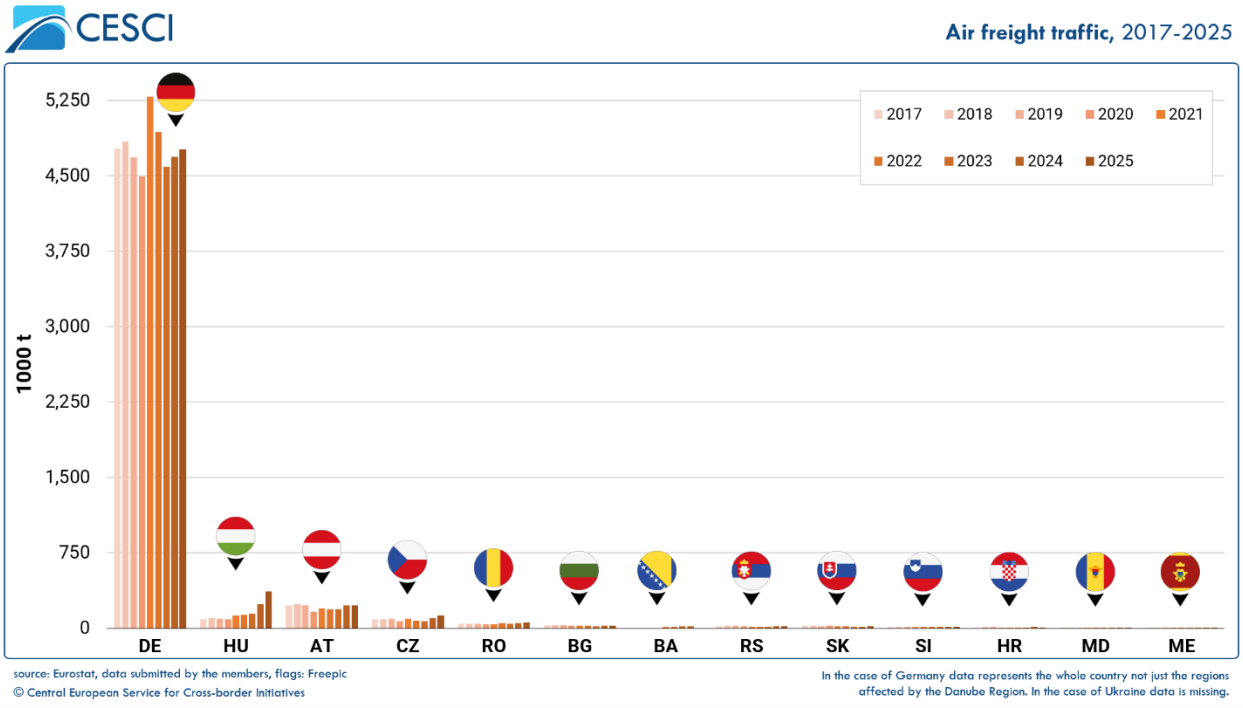


Figure 78: Air freight traffic in the Danube Region, 2017-2025

Examining dynamic developments between 2017 and 2025 reveals divergent growth trajectories, most notably the explosive expansion of Hungary as a macro-regional logistics hub. Propelled by the strategic development of Budapest's BUD Cargo City, Hungary's air cargo throughput

more than quadrupled, surging by 318.9% (an increase of 278.35 thousand tonnes) and overtaking Vienna to become the second-largest air freight terminal in the Danube Basin. Notable growth was also achieved by Czechia (+42.23%) and Romania (+29.47%), whereas mature western anchors like Austria (+0.15%) and Germany (-0.13%) returned to stable baseline volumes following severe post-pandemic supply chain fluctuations. Conversely, several smaller national airports experienced sharp contractions, led by Bulgaria (-34.70%), Slovakia (-30.20%), Montenegro (-29.16%), Moldova (-18.18%), and Serbia (-13.88%), as regional air freight traffic increasingly consolidated into primary central hubs via bonded road trucking feeder networks. This structural centralisation of air cargo underscores an urgent need for transnational cooperation to enhance air-rail multimodal connectivity and modernise customs logistics across external borders, preventing peripheral borderlands from becoming isolated from high-value supply chains.

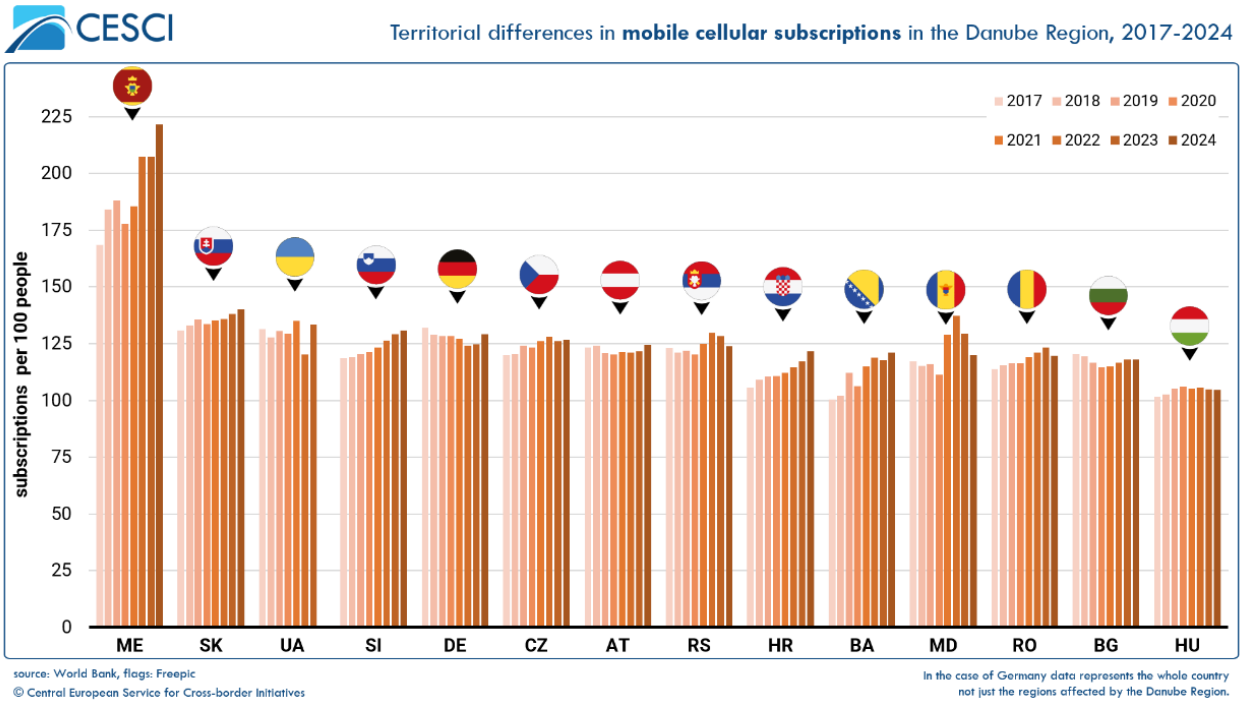


Figure 79: Mobile cellular subscriptions in the Danube Region

An analysis of mobile cellular subscriptions per 100 people across the Danube Region illustrates near-universal basic digital connectivity, with every participating country exceeding 100 subscriptions per 100 inhabitants. This demonstrates that basic mobile cellular penetration has achieved complete market saturation across the entire macroregion, spanning from Western core economies to Eastern EU Member States and Western Balkan candidate countries. Between 2017 and 2024, subscription density across the basin remained stable or expanded moderately, establishing a mature digital communications baseline across both major urban agglomerations and peripheral rural hinterlands.

Despite this universal baseline, distinct variations in subscription intensity separate participating countries. Montenegro stands out as an extreme macroregional outlier with 221.69 subscriptions per 100 people in 2024, driven by massive seasonal tourist SIM card registration, multi-device business usage, and dynamic mobile operator marketing. The remaining Danube countries operate within a tighter band ranging between 104.58 and 139.97 subscriptions per 100 inhabitants. An upper tier of high mobile SIM density is formed by Slovakia (139.97), Ukraine (133.38 in 2023), Slovenia (130.86), Germany (129.15), and Czechia (126.60). Meanwhile, a highly consistent mid-range cluster includes Austria (124.46), Serbia (123.82), Croatia (121.73), Bosnia and Herzegovina (121.23), Moldova (120.08), Romania (119.80), and Bulgaria (118.07), while Hungary records the most consolidated market baseline at 104.58 subscriptions per 100 people.

The main joint challenge facing the Danube Basin is that high mobile subscription rates do not automatically ensure high-speed 5G network coverage, gigabit fiber backhaul, or advanced digital literacy, particularly in sparsely populated rural hinterlands and mountainous borderlands where traditional service delivery costs per capita are exceptionally high. There is a transnational need for deploying cross-border 5G transport corridors, expanding e-governance, telemedicine, and digital learning hubs, and enhancing rural e-skills. These joint digital interventions are essential to eliminate service shadow zones in low-density areas, counteract youth out-migration, and safeguard long-term population retention.

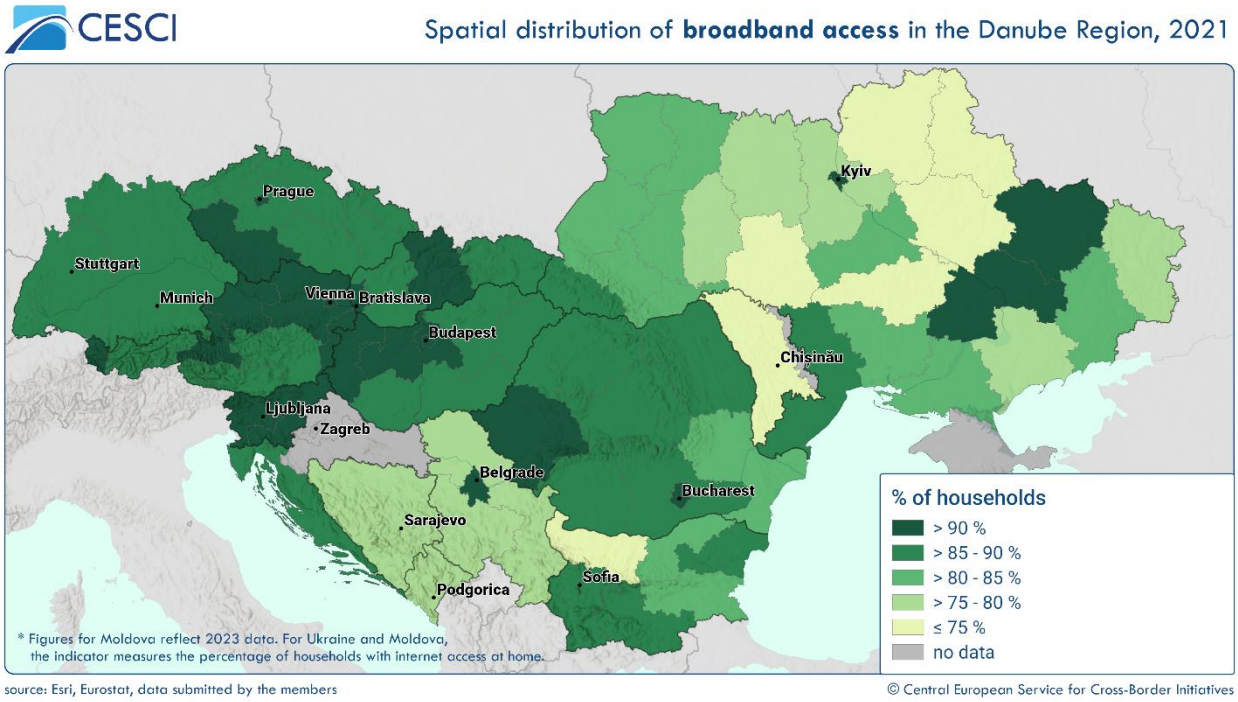


Figure 80: Spatial distribution of broadband access in the Danube Region

The spatial distribution of household broadband access across the Danube Region illustrates a mature yet geographically uneven digital landscape across the macroregion. The primary joint characteristic across the macroregion is the universal prominence of metropolitan and capital

city agglomerations such as Vienna, Prague, Bratislava, Budapest, Belgrade, Bucharest, Sofia, Kyiv, and, which consistently achieve broadband household penetration rates exceeding 90%. However, noticeable regional disparities separate Western and Central European economies from Eastern and Southeastern peripheries. In Southern Germany, Austria, Czechia, Hungary, Slovakia, and Slovenia, high broadband coverage (85% to over 90%) is territorially continuous, extending across both urban and rural provinces. In contrast, a pronounced digital gradient is evident across rural parts of Bulgaria, Bosnia and Herzegovina, Montenegro, and Ukraine, where household broadband access drops to 75-80% or below 75%.

Closing these digital divides is fundamentally important for cohesion and demographic stability across peripheral and rural hinterlands. High-speed digital accessibility serves as an indispensable lifeline for population retention, directly counteracting youth out-migration and skill-selective brain drain in depopulating borderlands. By enabling the seamless delivery of online public and commercial services such as telework, telemedicine, e-commerce webshops, and e-governance platforms, broadband infrastructure compensates for physical remoteness and shrinking physical service networks. Deploying place-based smart solutions, including „Smart Villages" and digital public service hubs, allows peripheral communities to diversify local economies, support flexible employment for high-skilled professionals, and effectively safeguard the „Right to Stay".

The main joint challenge facing the Danube states is overcoming the „last-mile" market failure in sparsely populated, mountainous, and cross-border regions where commercial telecommunication providers under-invest due to low returns on investment. Key cooperation priorities include co-financing cross-border gigabit and 5G backhaul infrastructure in underserved border corridors, harmonizing cross-border e-governance standards, and deploying shared digital literacy and e-health platforms. By fostering two-way „brain circulation" and connecting remote talent with regional value chains, these joint interventions help build resilient, digitally integrated communities across the entire Danube Region.

Energetics

An evaluation of primary energy production across the Danube Region highlights a heavily concentrated resource landscape marked by an entrenched structural divide between large industrial producers and peripheral economies. In 2024, the thirteen reporting Danube countries generated 187,208 thousand tonnes of oil equivalent (ktoe), with the nine Danube EU Member States contributing 171,703 ktoe, accounting for over 31% of the entire European Union's primary energy output (549,408 ktoe). Domestic generation remains overwhelmingly anchored in Germany, which produced 80,241 ktoe in 2024, representing nearly 43% of the macro-region's total. A secondary production tier is formed by Czechia (21,527 ktoe) and Romania (21,164 ktoe), followed by mid-sized producers such as Austria (13,993 ktoe), Hungary (11,258 ktoe), Bulgaria

(9,634 ktoe), and Serbia (9,315 ktoe). The remaining economies maintain smaller or specialised baseload outputs (Slovakia, Bosnia and Herzegovina, Croatia, and Slovenia ranging between 3,200 and 7,000 ktoe), while Montenegro and Moldova operate as marginal micro-producers with under 800 ktoe each. Ukraine historically represented the second-largest energy generator in the basin (exceeding 57,000 to 61,000 ktoe prior to 2021), though severe wartime infrastructure destruction has disrupted its statistical reporting.

Between 2016 and 2024, macro-regional primary energy production contracted by 20.1% (-47,176 ktoe, excluding Ukraine), outpacing the wider EU-wide decline of 14.5% and reflecting European decarbonisation and fossil fuel phase-out trajectories. This downward shift was primarily driven by Germany, where production dropped by 30.7% (-35,624 ktoe) due to the nuclear phase-out and reduced coal extraction, accompanied by notable contractions across coal-dependent or resource-depleting economies including Czechia (-20.4%), Romania (-14.4%), Bulgaria (-14.5%), and Serbia (-12.9%). Conversely, resilient counter-trends emerged where domestic nuclear baseloads and renewable capacities stabilised generation, visible in Austria's 11.4% expansion via Alpine hydropower and biomass, Slovakia's slight growth (+1.0%) following new nuclear capacity additions, and Hungary's virtual stability (-0.2%). To mitigate the vulnerabilities arising from shrinking domestic fossil generation and safeguard energy security across peripheral borderlands, transnational cooperation could prioritise the construction of bidirectional smart electricity interconnectors and the integration of Western Balkan and Eastern candidate countries into the European Single Energy Market. Furthermore, joint interventions should focus on unlocking the shared, deep geothermal reserves (e.g. of the Pannonian Basin) and coordinating cross-border pumped-hydro storage to balance expanding intermittent renewables across the basin.

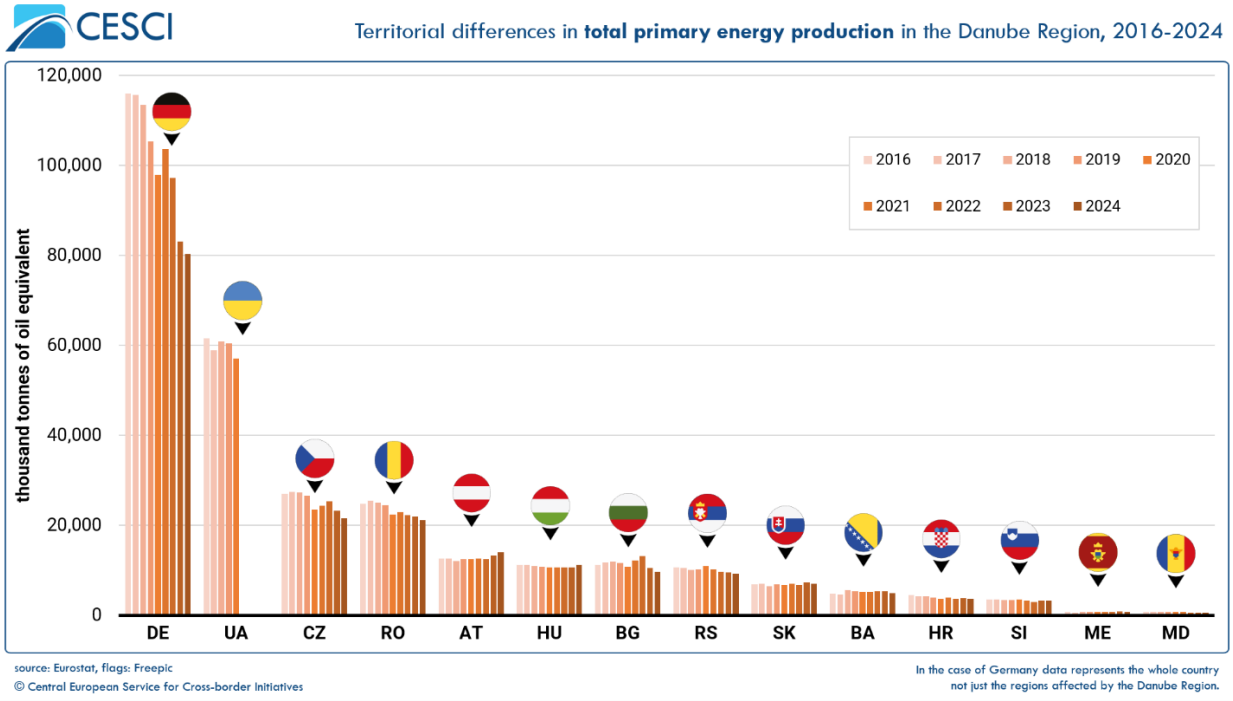


Figure 81: Territorial differences in total primary energy production in the Danube Region, 2016-2024

An evaluation of final energy consumption per capita across the Danube Region illustrates a profound territorial divide structured along an entrenched West-East and core-periphery gradient. In 2024, average final energy consumption across the European Union stood at 1,953.8 kg of oil equivalent per capita, down from 2,095.2 kg in 2016. Across the Danube Basin, participating countries diverge into three distinct consumption tiers. The upper consumption tier significantly outperforms the European benchmark, led by Austria (2,622.5 kg per capita), Slovenia (2,187.9 kg), Germany (2,129.8 kg), and Czechia (2,072.7 kg), where high living standards and energy-intensive manufacturing clusters sustain elevated per-capita demand. An intermediate convergence tier comprises Central and Southeastern European Member States operating moderately below the EU baseline, including Croatia (1,856.9 kg), Hungary (1,732.7 kg), Slovakia (1,669.3 kg), and Bulgaria (1,527.6 kg). In sharp contrast, the lowest consumption tier is concentrated across the Western Balkans and the Eastern Neighborhood, represented by Serbia (1,410.5 kg), Montenegro (1,314.7 kg), Bosnia and Herzegovina (1,273.5 kg), Romania (1,225.9 kg), and Moldova (1,006.5 kg), alongside Ukraine (which stood at 1,058.7 kg in 2020 prior to wartime reporting interruptions). This gap creates a substantial macro-regional disparity of more than 2.6 times between the highest consumer (Austria) and the lowest (Moldova), demonstrating that lower energy consumption in the eastern and southern peripheries is primarily a symptom of lower industrial output and widespread residential energy poverty rather than superior energy efficiency.

Examining dynamic developments between 2016 and 2024 reveals a polarised structural trajectory characterised by efficiency-driven contractions in mature western and northern economies alongside rapid consumption growth across catching-up peripheries. The European Union overall registered a per-capita consumption decline of 6.75% (-141.3 kg per capita), a trend mirrored and amplified by the macro-region's advanced industrial economies, led by Germany (-14.07%, shedding 348.6 kg per capita), Austria (-12.58%, shedding 377.3 kg), Slovakia (-8.36%), Slovenia (-7.90%), Czechia (-7.68%), and Hungary (-1.91%). Conversely, lower- and middle-income economies experienced substantial increases in per-capita final energy demand over the same period, led by Bosnia and Herzegovina (+26.28%, gaining 265.0 kg per capita), Serbia (+21.63%, gaining 250.8 kg), Montenegro (+18.76%), Croatia (+17.42%), Moldova (+15.71%), Bulgaria (+11.36%), and Romania (+10.44%), propelled by post-transition economic convergence, rising household appliance penetration, and expanding personal vehicle fleets. Danube Region needs to prioritise the transfer of clean energy-efficiency technologies and the mass deployment of deep residential renovation wave programs across Southeastern Europe. Furthermore, joint cross-border initiatives should focus on modernising obsolete district heating networks with local geothermal and biomass sources.

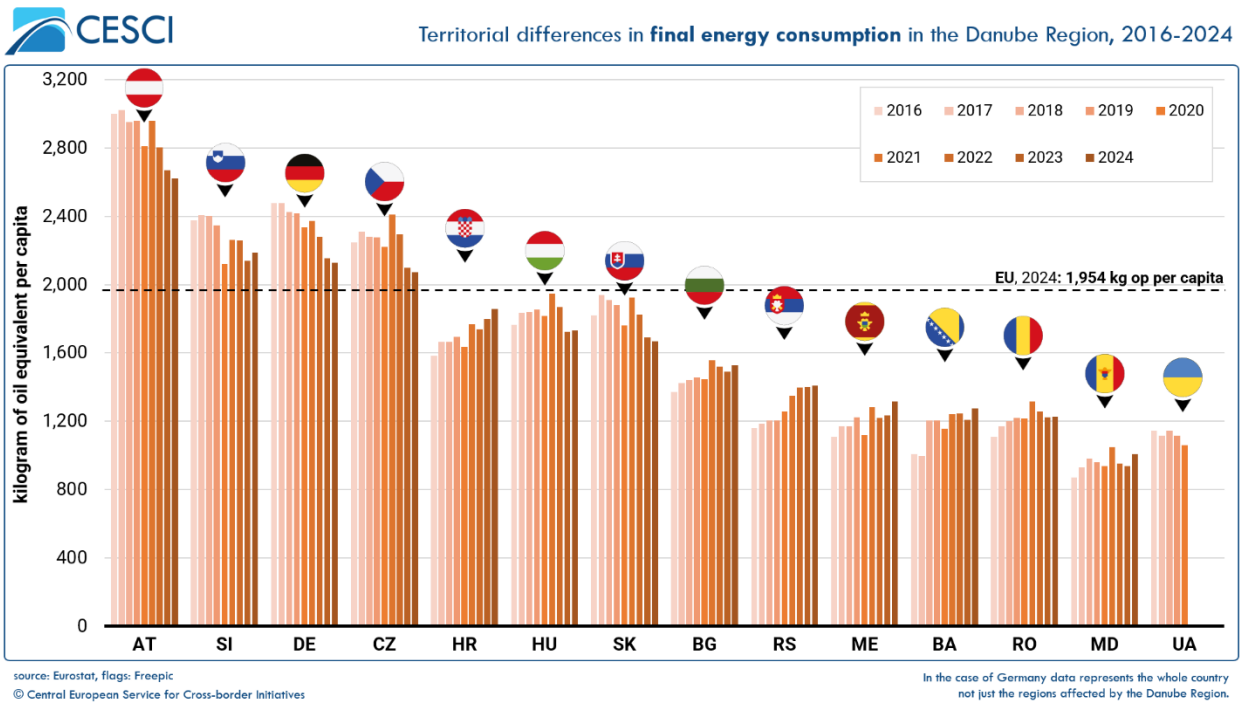


Figure 82: Territorial differences in final energy consumption in the Danube Region, 2016-2024

An evaluation of fossil fuel energy consumption as a percentage of gross inland energy consumption across the Danube Region highlights a deeply entrenched carbon dependency and marked territorial inequalities when benchmarked against European standards. In 2024, fossil fuels accounted for 66.04% of gross inland consumption across the European Union (down from 70.87% in 2015); however, eight of the thirteen reporting Danube countries continue to operate above this European threshold, yielding an unweighted macro-regional average of 67.91%. The highest levels of fossil fuel reliance are concentrated in the Western Balkans and the industrial core, led by Serbia (82.26%), Germany (77.62%), and Bosnia and Herzegovina (77.23%), where domestic lignite, coal-fired power plants, and fossil gas remain the structural backbones of national power and heating systems. A secondary tier of high fossil dependency includes Romania (69.55%), Montenegro (69.27%), Croatia (68.49%), Moldova (68.23%), and Czechia (66.71%), while Ukraine historically registered elevated levels (70.39% in 2020) prior to wartime reporting interruptions. Only five countries fall below the EU average, namely Hungary (64.05%), Bulgaria (60.69%), Austria (60.68%), Slovenia (60.32%), and Slovakia (57.71%), yet even in these best-performing states, fossil fuels still satisfy nearly six out of every ten units of energy consumed. This pervasive baseline demonstrates that despite substantial investments in renewables, the macro-region remains structurally locked into fossil fuels, exposing a systemic lag in comprehensive energy decarbonization.

Examining dynamic shifts between 2015 and 2024 reveals a slow, uneven transition that underlines the fragile energy resilience of the Danube macro-region. While most countries achieved modest percentage-point reductions, two candidate countries experienced an adverse expansion in fossil fuel reliance, namely Moldova (+4.38 pp, rising to 68.23%) and Montenegro

(+2.91 pp, climbing to 69.27%). This persistent reliance on fossil imports and carbon-intensive domestic fuels severely impairs macro-regional resilience, as demonstrated by the post-2022 energy shocks, which inflicted acute price volatility, inflation, and supply vulnerability on district heating systems, energy-intensive industries, and vulnerable rural households across the basin. To break this structural lock-in, transnational cooperation needs to accelerate coal-phase-out strategies and district heating modernisation by tapping into the deep transboundary geothermal reservoirs of the Pannonian Basin and expanding cross-border smart grid interconnections. Furthermore, joint macro-regional initiatives should focus on de-risking renewable investments, establishing cross-border renewable energy communities, and integrating Western Balkan, Moldovan, and Ukrainian energy networks into the European Single Energy Market to shield peripheral borderlands from external geopolitical supply disruptions.

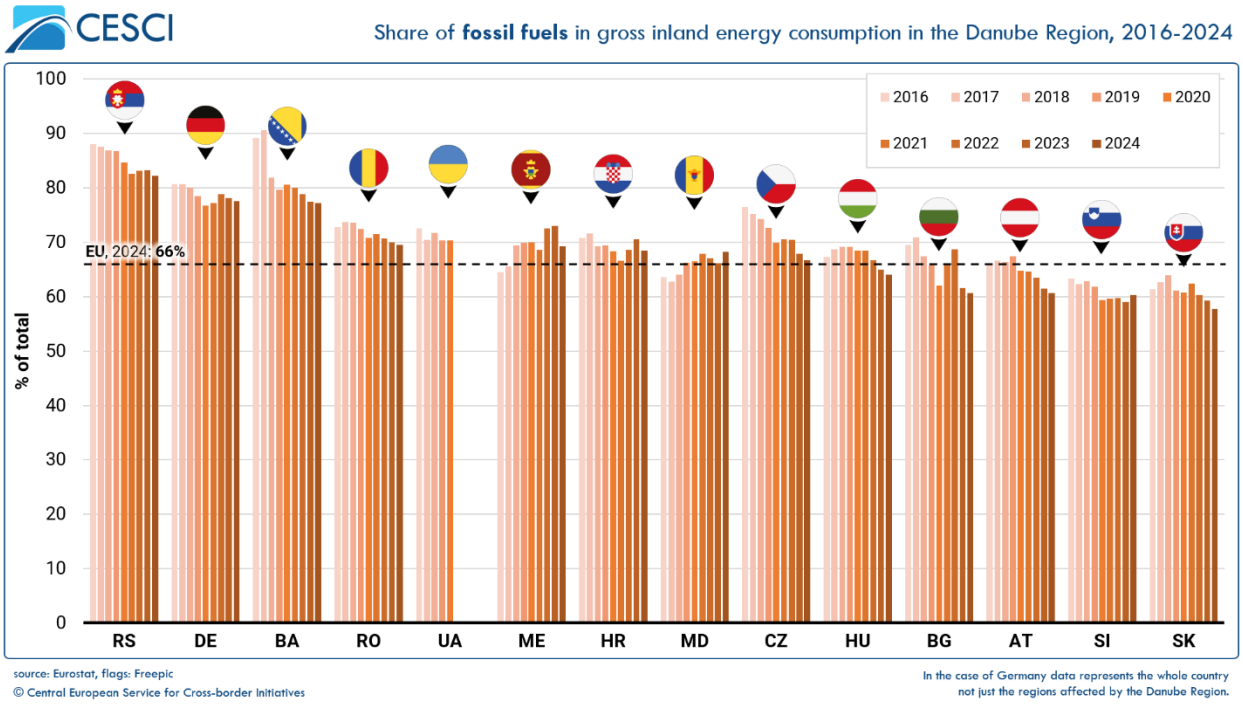


Figure 83: Share of fossil fuels in gross inland energy consumption in the Danube Region

An evaluation of the share of renewable energy in gross final energy consumption across Danube Region countries between 2017 and 2024 illustrates a highly dynamic yet structurally uneven energy transition across the macroregion. While the European Union average baseline increased steadily from 18.41% in 2017 to 25.24% in 2024, the participating states of the Danube Region display significant variation in both their starting baselines and their pace of renewable adoption. This spatial heterogeneity reflects distinct combinations of natural endowments, such as hydrogeothermal assets and forest biomass availability, alongside national regulatory frameworks, grid readiness, and investment capacities.

Based on their 2024 renewable energy shares (2021 for Ukraine), four distinct country clusters can be identified across the macroregion. The first tier consists of the high-renewable

frontrunners maintaining shares well above 35%, comprising Austria (42.95%), Montenegro (40.82%), and Bosnia and Herzegovina (38.52%), with Austria achieving a notable 9.81 percentage point gain since 2017 anchored by Alpine hydropower and district heating. The second group forms a moderate convergence tier operating near or slightly below the EU benchmark of 25.24%, including Croatia (26.48%), Serbia (25.86%), Romania (25.38%), Slovenia (25.00%), Bulgaria (23.21%), Germany (22.47%), and Moldova (20.77%), with Germany recording strong expansion (+7.00 percentage points) while Moldova experienced a contraction from its 2017 level due to severe energy crisis shocks. The third tier encompasses the catching-up Central European economies, represented by Czechia (19.21%), Hungary (18.26%), and Slovakia (18.09%), which have all achieved solid growth from lower 2017 baselines (+4.4 to +6.6 percentage points) driven primarily by rapid solar PV and heat pump adoption. Finally, Ukraine constitutes a low-baseline tier, registering a 6.60% renewable supply share in 2020 before wartime destruction shifted national focus toward emergency infrastructure reconstruction.

A key joint characteristic across the macroregion is that expanding renewable deployment is increasingly recognised as essential for reducing external fossil import dependencies and insulating regional economies from global market shocks. However, structural differences persist in the underlying technology mix. Western Balkan candidate states and Alpine nations rely heavily on traditional legacy assets like large-scale hydropower and solid biomass, leaving their renewable output vulnerable to climate-driven hydrological fluctuations during severe drought years. Conversely, Central European Member States like Germany, Austria, Hungary, Czechia, and Slovakia are driving renewable growth through technological diversification, expanding solar PV capacity, wind power, and heat pump integration, while simultaneously attempting to shift away from unsustainable primary biomass combustion.

The main joint challenges facing the Danube Basin include overcoming local transmission grid bottlenecks, balancing intermittent generation, and mitigating a multi-speed energy transition between Western Member States and non-EU candidate states. Addressing these obstacles requires robust transnational cooperation. Priority areas for joint action include scaling up cross-border smart grid interconnections (such as the ACON project), expanding cross-border renewable energy communities, and utilising Alpine and Dinaric pumped hydro storage to balance regional power markets. Furthermore, transnational cooperation must focus on unlocking deep geothermal potential across the Pannonian Basin for green district heating, harmonising guarantees of origin, and providing technical assistance to integrate candidate countries (Ukraine, Moldova, Western Balkans) into the EU energy market.

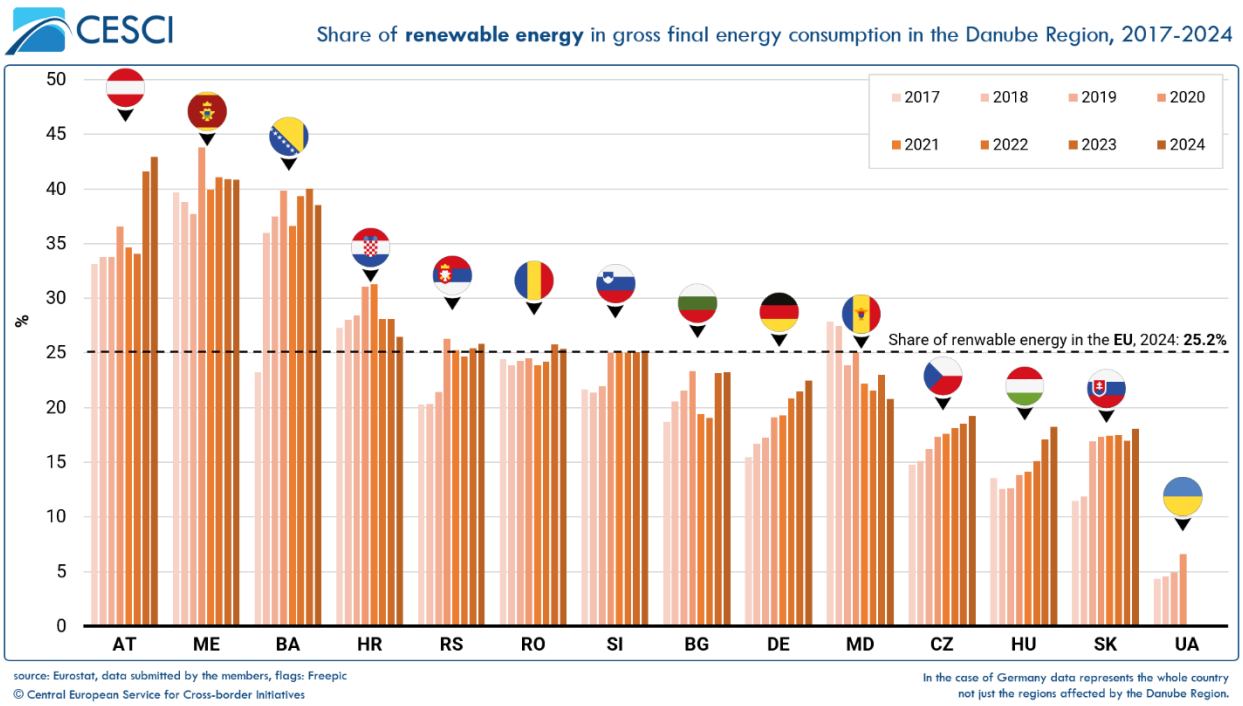


Figure 84: Share of renewable energy in gross final energy consumption

The annual primary production of renewables between 2017 and 2024 reveals a transformative shift in the energy landscape, characterized by the explosive growth of specific technologies and the emergence of a "leapfrogging" phenomenon in the eastern and southern peripheries.

Focusing on the analysis of renewable resource dynamics and trends, the macroregional energy transition is defined by several distinct sectoral trends. First, there has been a solar energy supremacy. The most significant change across the Danube space is the unparalleled expansion of solar primary production. While the EU average growth stood at a robust 126.5%, several states recorded extreme values that indicate a fundamental restructuring of their energy portfolios. Hungary (1 835.7%) and Bosnia and Herzegovina (2 761.4%) represent the peak of this trend, while absolute extremes were found in Moldova (17 076.7%) and Montenegro (5 635.1%), albeit growing from very low initial baselines.

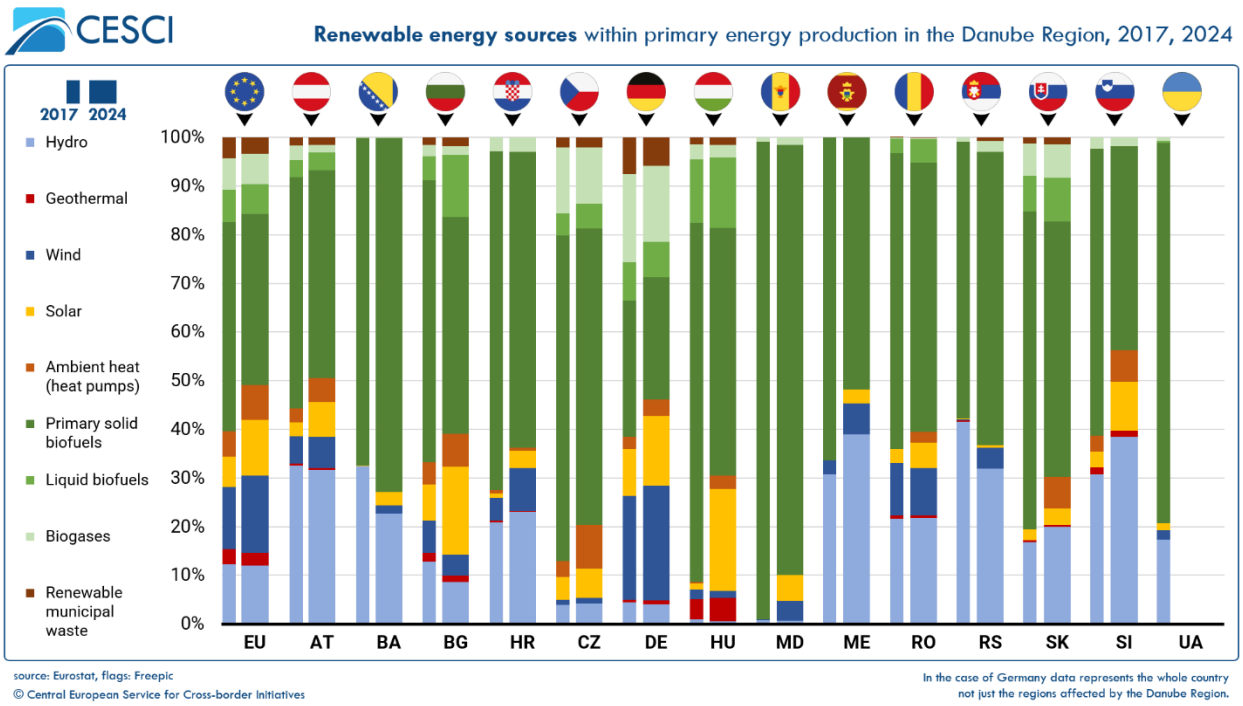


Figure 85: Renewable energy sources within primary energy production in the Danube Region

Taking into account production numbers in the wind sector, mixed trajectories can be detected. Wind energy production displays a polarised spatial pattern. While Croatia (114.0%) and the non-EU states like Serbia (2 694.1%) and Moldova (3 622.3%) saw massive increases, established Member States like Germany (31.4%) and Austria (40.9%) experienced more moderate growth. Conversely, several convergence regions, including Bulgaria (-8.4%), Hungary (-13.1%), and Slovakia (-16.7%), registered a deteriorating trend in wind production, suggesting regulatory or infrastructure bottlenecks. There have been leap-frog technologies, namely heat pumps: the adoption of ambient heat (heat pumps) serves as a vital indicator of modern residential energy systems. The Danube Region largely outperformed the EU average of 72.6%, with Hungary (1 316%) and Czechia (236.8%) acting as frontrunners in this technological shift. At last but not least another major finding is the stagnation in biofuels. Primary solid biofuels, a traditional energy source in renewables, saw marginal growth (EU 1.8%) or even significant declines in countries like Slovakia (-26.0%), Slovenia (-22.3%), and Hungary (-16.8%), reflecting a shift toward higher-efficiency renewable sources.

Based on the production data, the macroregion can be categorised into three distinct groups. The first one are the aggressive catching-up states including non-EU and new members. States. States like Moldova, Montenegro, Serbia, and Bosnia and Herzegovina are "leapfrogging" established energy models by realising massive percentage gains in solar and wind from near-zero baselines. Solar-centric transition zones are mainly Hungary, Slovenia, and Bulgaria, which countries prioritise solar and ambient heat expansion but struggle with wind energy stagnation. The third category of states can be regarded as stable diversifiers: Austria and Germany show

balanced growth across most sectors (Hydro, Wind, Solar), reflecting a more mature and integrated renewable infrastructure.

The current landscape indicates that while the green transition in renewables is accelerating in the eastern border regions, the persistence of sectoral bottlenecks in wind and primary biofuels threatens to create a "multi-speed" energy transition across the macroregion.

The following analysis examines the structural shifts in the primary production of renewable energy across the Danube Region between 2017 and 2024, focusing on the change in the share of specific energy sources measured in percentage points (pp).

The macroregion is characterised by a significant transformation of its renewable energy mix, primarily defined by the expansion of modern technologies at the expense of "traditional" biomass. The major shifts include the solar energy expansion: this is the most dominant and consistent trend across the macroregion. While the EU27 average share increased by 5.11 pp, several Danube Region countries demonstrated a much more significant shift. Hungary represents the absolute extreme with a massive 19.64 pp increase in the share of solar energy, followed by Bulgaria (+10.72 pp) and Slovenia (+6.77 pp). This indicates a rapid catching-up process in solar capacity. On the other hand there has been a decline of primary solid biofuels: reflecting a shift toward higher-value and more diverse renewable portfolios, the share of solid biofuels has dropped significantly throughout the region. The reduction in Hungary (-23.01 pp), Slovenia (-17.21 pp), and Montenegro (-14.80 pp) far exceeds the EU average decline of 7.93 pp. In contrast, Bosnia and Herzegovina (+5.34 pp) and Serbia (+3.14 pp) saw an increase in the share of solid biofuels, suggesting a continued reliance on traditional biomass in these non-Member States. Another notable change is reflected in the production from ambient heat: technological advancement is highly visible in Slovakia (+6.46 pp) and Czechia (+5.75 pp), where the share of ambient heat from heat pumps grew at nearly triple the EU average rate of 2.00 pp. This highlights a specific territorial focus on decarbonising the heating sector in Central Europe. At last but not least, wind energy and hydro energy have to be mentioned: wind energy shares showed moderate growth, with Croatia (+4.15 pp) and Serbia (+4.06 pp) leading the trend, surpassing the EU average (+3.24 pp). Hydro energy shares remained volatile due to climatic factors, showing notable growth in Slovenia (+7.88 pp) and Montenegro (+8.47 pp), but significant drops in Bosnia and Herzegovina (-9.51 pp) and Serbia (-9.50 pp).

The data reveals a highly polarised macroregion in terms of energy transition speed. Hungary serves as a dual outlier, with the highest growth in solar and the steepest decline in solid biofuels, signaling a systemic overhaul of its primary renewable production. Meanwhile, non-Member States in the Western Balkans exhibit extreme fluctuations in hydro energy and a continued (or increasing) reliance on solid biofuels, contrasting with the more balanced and technology-driven diversification seen in Germany and Austria.

The current landscape indicates that while modern renewable technologies like solar and heat pumps are rapidly diffusing through the Central European "transition zone", the structural dependence on traditional biomass and hydro-vulnerability remains acute in the southeastern peripheries. From a cohesion policy perspective, future programming could prioritise the modernisation of heating systems and the stabilisation of the renewable mix in these lagging regions to ensure a resilient and balanced macroregional energy market that minimizes the "green divide" within the Danube space.

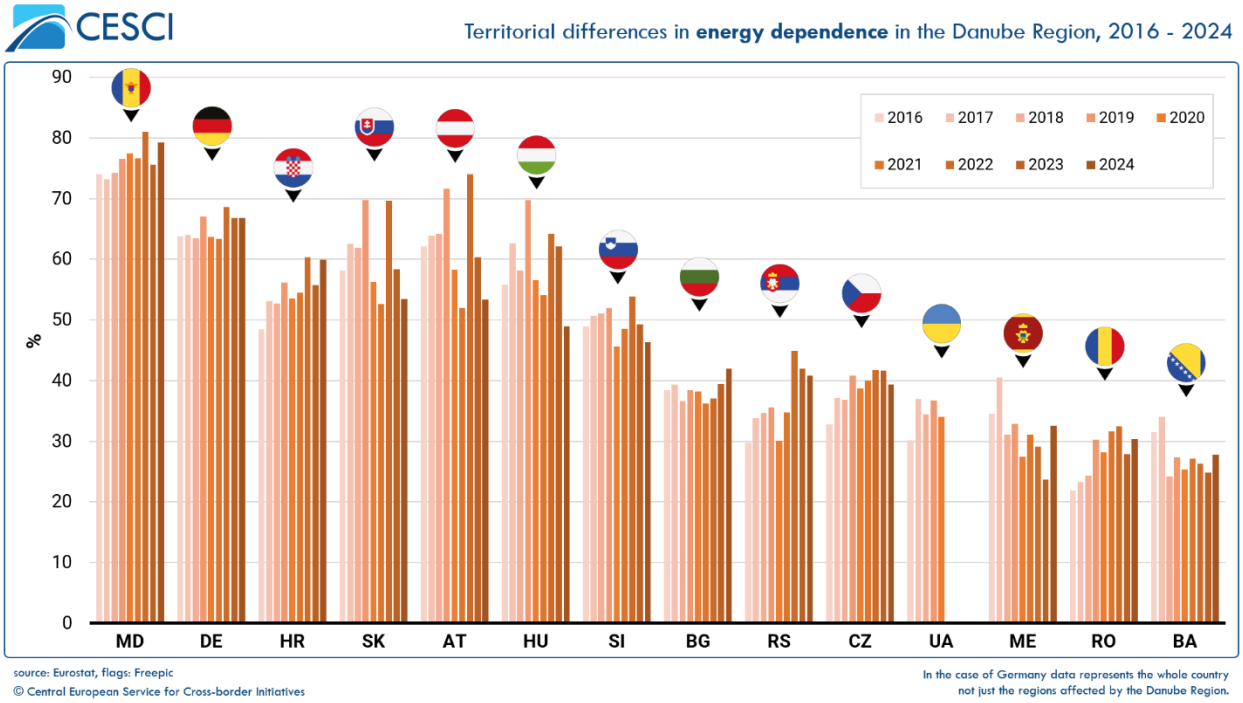


Figure 86: Territorial differences in energy dependence in the Danube Region

An analysis of energy import dependency across the Danube macroregion reveals a complex energy market and geopolitical landscape. As of 2024, the macroregion exhibits severe territorial inequalities in its energy exposure. Moldova (79.3%) remains the most vulnerable state, significantly exceeding the EU27 average of 57.3%. This high dependency reflects a precarious reliance on external supply chains that historically originated from the East. Germany (66.8%) and Croatia (59.9%) also maintain dependency levels above the European baseline, highlighting that both industrial powerhouses and coastal economies face significant structural challenges in achieving energy self-sufficiency. Conversely, the lowest dependency rates are found in Bosnia and Herzegovina (27.8%) and Romania (30.4%), states that have leveraged local resources to maintain a higher degree of insulation from global market fluctuations.

Focusing on the changes, the period between 2016 and 2024 was marked by divergent development paths. A notable "success story" in strategic decoupling is observed in Austria, which reduced its dependency by 8.8 percentage points (falling to 53.3%), and Hungary, which saw a 6.9 percentage point improvement. These shifts suggest a successful integration of

domestic production and early-stage diversification strategies. In sharp contrast, Croatia (+11.5 pp) and Serbia (+11.1 pp) experienced the most significant negative shifts, with their dependency levels surging over the eight-year period. Romania (+8.5 pp) also saw a marked increase in its external reliance, though it remains relatively low compared to the regional average. These regressions underscore a broader trend where growing industrial demand has outpaced the development of domestic energy infrastructure.

Overarching character of the macroregion is still defined by a pervasive energy dependency and a comparatively low utilisation level of local resources and renewables. Despite the commissioning of critical new interconnectors, such as those between Hungary and Slovakia or Bulgaria and Romania, the region continues to suffer from a lack of high energy safety and a fragmented network of missing links. The historical reliance of most Danube economies on uncertain fossil fuels from Russia, often transited through Ukraine, has forced a fundamental rethink of energy production, consumption, and transport paradigms. A major push towards new solutions and trans-European answers have been forced by Russia's aggression on Ukraine and the economic sanctions apart from the massive damage of critical energy infrastructure. The current data confirms that while absolute dependency levels are shifting, the transition toward a secure, integrated, and carbon-neutral energy market is proceeding at a multi-speed pace, necessitating a more coordinated macroregional approach to energy infrastructure and governance. To ensure future resilience, the following strategic priorities are essential:

- Grid modernisation: the current lack of a robust grid, particularly in eastern border regions, remains a primary bottleneck for both national security and industrial expansion.
- Renewable integration: strengthening the electricity network in the East is a critical component of European energy security; ensuring that renewable projects can be fully integrated into the market requires significant strategic grid investments.
- Market integration: the full integration of eastern border regions into the EU electricity market is necessary to harmonise the regional energy landscape.Infrastructure
- Resilience: achieving true stability requires a combination of additional gas storage, reverse-flow capacities, and the continued implementation of priority cross-border infrastructure projects, as identified in the Energy Highways of the European Grids Package.

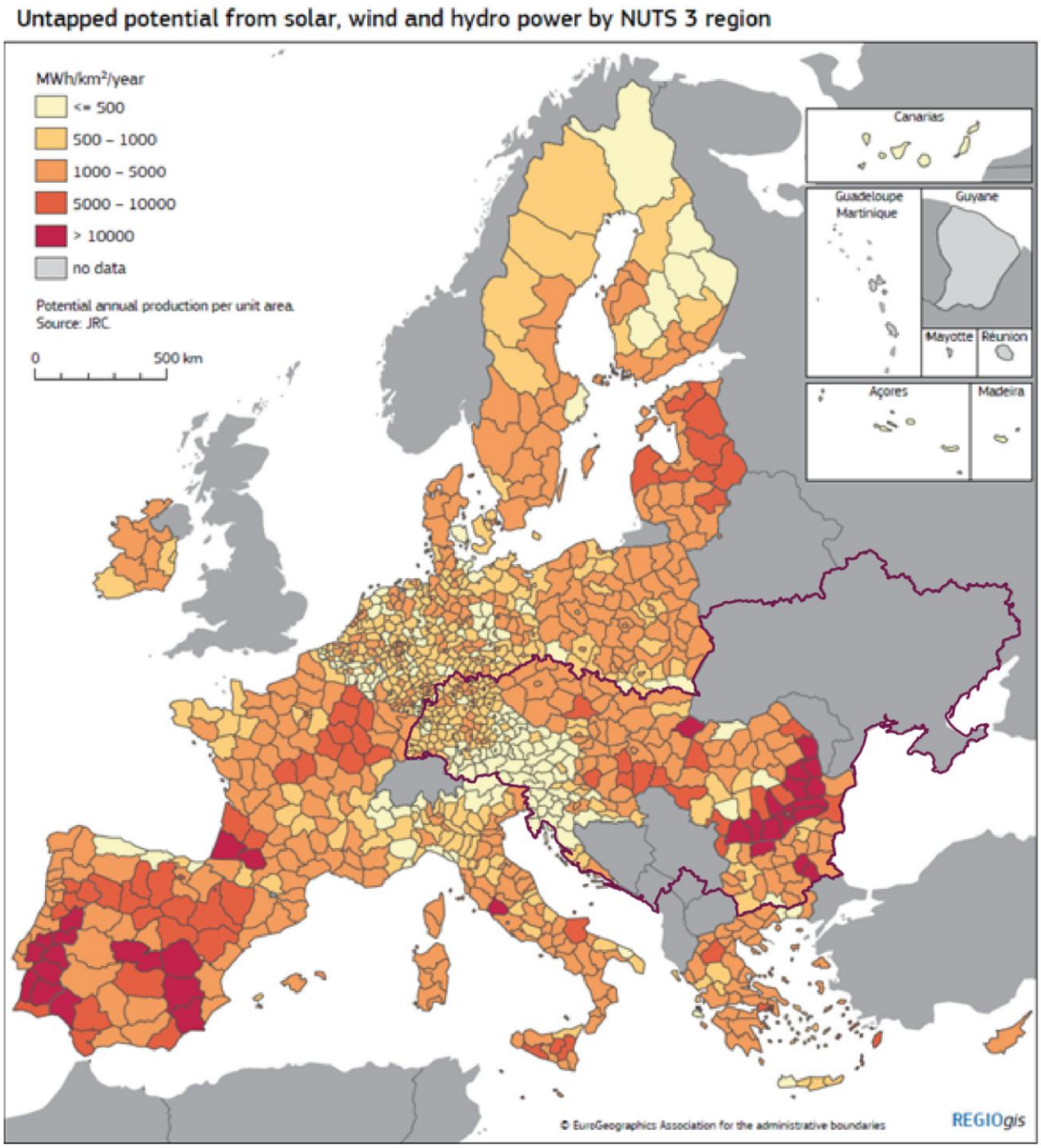


Figure 87: Untapped potential from solar, wind and hydro power by NUTS3 region, source: European Commission (2024): Ninth report on economic, social and territorial cohesion

The spatial distribution of untapped renewable energy potential combining solar, wind, and hydro power per unit area reveals that the Danube Region contains some of the highest unexploited green energy capacities in all of Europe. This immense potential is overwhelmingly concentrated across the lower Danube Basin, most notably along the Wallachian Plain, the cross-border corridor between southern Romania and northern Bulgaria, and the Dobruja plateau, where potential annual production reaches the highest European category exceeding 10,000 MWh/km²/year. The Pannonian Basin, particularly Hungary, also stands out with significant

unexploited solar and wind resources. Together, these eastern and southeastern territories form a high-capacity renewable belt that represents an indispensable asset for the European continent's clean energy transition, climate goals, and long-term energy security.

While all Danube Region countries share a joint imperative to accelerate decarbonisation and reduce dependency on external fossil fuel imports, their underlying renewable profiles exhibit distinct structural differences. In upper basin states like Southern Germany and Austria, the level of remaining untapped potential appears relatively lower primarily because their legacy assets (particularly Alpine hydropower and early-adopted solar and wind networks) are already heavily developed. Conversely, across Central, Eastern, and Southeastern Europe – including Hungary, Romania, Bulgaria, Serbia, and the Western Balkans – vast rural plains, high solar irradiance, and favourable wind corridors offer exceptional unexploited capacity for utility-scale solar PV and onshore wind generation, yet these regions face structural grid bottlenecks, financial investment gaps, and regulatory delays.

Supporting sustainable renewable energy production is a vital joint need across the Danube Basin, especially for rural, remote, and border areas that are otherwise highly exposed to national and international market volatility, fossil fuel price shocks, and supply disruptions. Local decentralised renewable energy generation provides these vulnerable peripheral communities with energy self-sufficiency, reduces energy poverty, and creates green employment opportunities that diversify local economies. Realising this potential requires coordinated transnational cooperation, wehere key policy interventions must focus on expanding cross-border smart grid interconnections, developing joint renewable energy communities in borderlands, and providing technical and financial support to integrate candidate countries.

Education

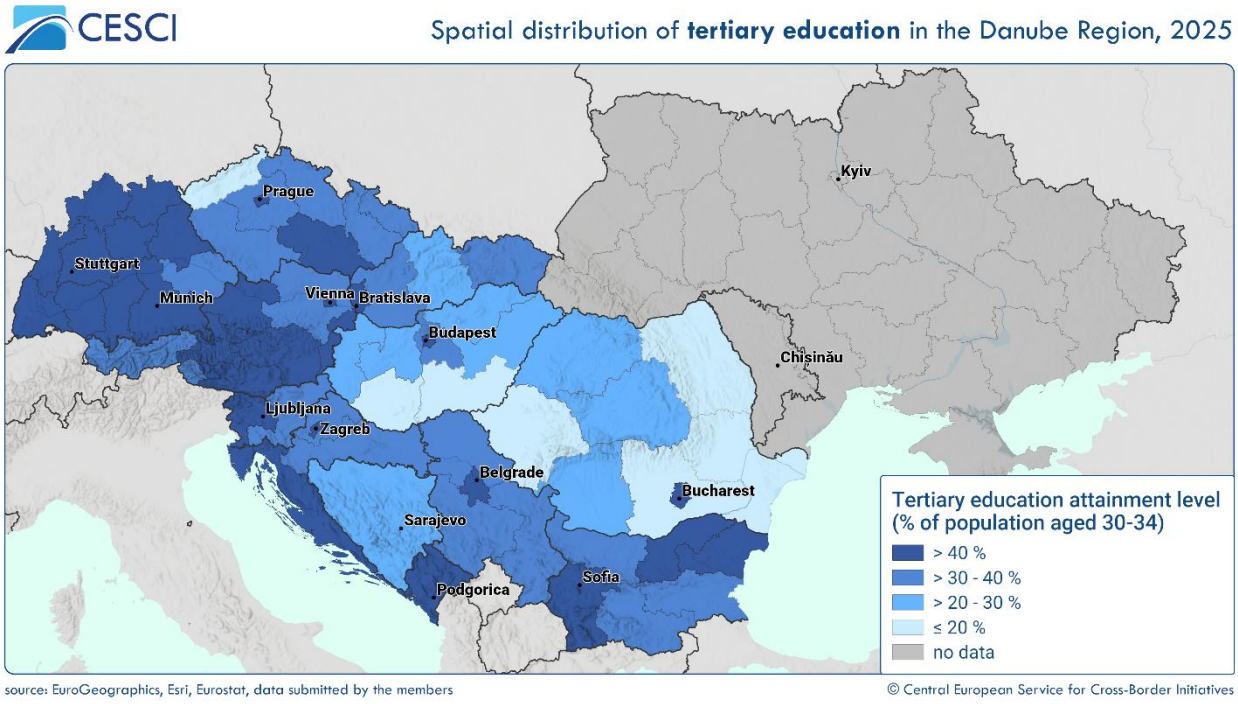


Figure 88: Spatial distribution of tertiary education in the Danube Region

An analysis of the human capital structure and tertiary educational attainment rates among the 30-34 age cohort within the Danube Region reveals a highly polarised spatial structure fractured by deep core-periphery divides. Benchmarked against the European Union average baseline of 45.7%, the internal disparities of the macroregion varies between exceptionally wide extremes, as the structural gap between the most advanced and the most lagging regions exceeds a factor of four. Within the spatial layout of the macroregion, several regional typologies can be clearly distinguished: first, the innovative zones encompassing highly educated, knowledge-based service sectors clustered in metropolitan capital agglomerations and southern German economic core areas; second, the balanced Austrian and Czech transition regions; and finally, at the opposite end of the spectrum, the structurally distressed eastern and southeastern agrarian-rural peripheries suffering from severe human capital deficits and outward migration. The territorial maximum is represented by the Czech capital, Prague (68.1%), which boasts outstanding innovation attraction, while the absolute territorial minimum is registered by the Sud-Est region in Romania (15.0%), reflecting acute peripheralisation.

The highest-performing regions – such as Prague (68.1%), Budapest (66.2%), Grad Zagreb (64.1%), Oberbayern with Munich (59.2%), the Beogradski region in Serbia (55.4%), and the Bratislavský kraj in Slovakia (55.2%) – possess an outstanding concentration of human capital, providing ideal conditions for the establishment of high value-added, knowledge-based economic structures and innovation clusters. These metropolitan growth poles and intellectual centers are highly integrated into global and transnational value chains, and through their dense

networks of universities and research and development facilities, they continuously attract highly qualified young professionals, which guarantees their sustained long-term economic dynamism.

In sharp geographical contrast stand those lagging regions, typically serving as internal or external peripheries, such as Sud-Muntenia (16.1%) and Nord-Est (17.0%) in Romania, Dél-Dunántúl (18.8%) and Dél-Alföld (19.4%) in Hungary, or the Czech Severozápad (19.7%), where the creation of a knowledge-based society and a technology-intensive modern economy faces seemingly great obstacles due to a critical shortage of appropriately qualified professionals. Owing to persistent out-migration (brain drain), the insufficient retention capacity of educational systems, and obsolete local economic structures, these territories are unable to retain young graduates, which perpetuates the dominance of low value-added sectors and long-term socio-economic marginalisation. Consequently, from a regional development and cohesion policy perspective, future interventions across the Danube Region must transcend mere physical infrastructure investments and focus on transnational cooperation of higher education and innovation networks (e.g. exchanges, co-creation, knowledge transfer and capitalisation) to prevent the intellectual hollowing-out of peripheral areas; otherwise, the internal development gap will become permanently locked into the macroregion's spatial configuration.

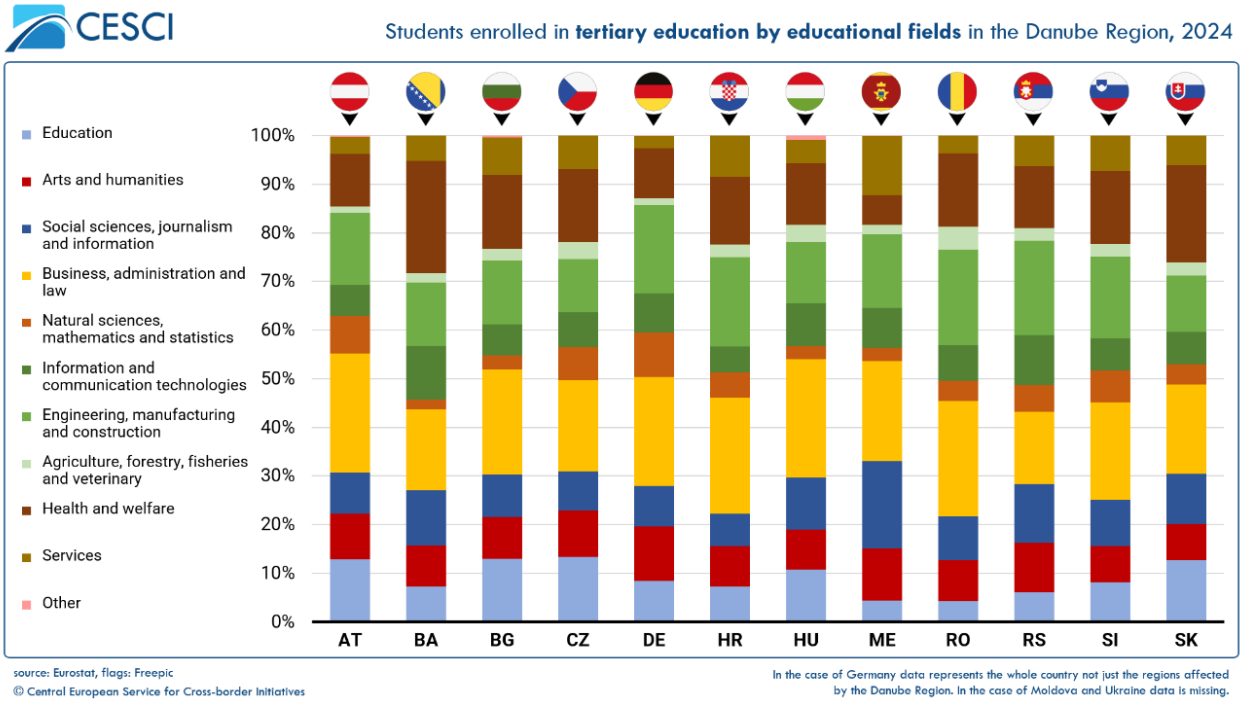


Figure 89: Students enrolled in tertiary education by educational fields in the Danube Region

An analysis of tertiary education enrollment by field of study across the Danube Region reveals important structural similarities alongside sharp regional specialisations when benchmarked against European Union averages. Across the EU-27 baseline, Business, Administration, and Law constitutes the single largest field of study at 21.86%, followed by Engineering, Manufacturing, and Construction (14.69%), Health and Welfare (14.73%), Arts and Humanities (11.06%), Social

Sciences (9.88%), Education (7.42%), Natural Sciences and Mathematics (6.71%), and Information and Communication Technologies at 5.67%. In line with this broader European trend, Business, Administration, and Law represents the dominant field of study across almost all Danube Region states, absorbing between 18% and 25% of total tertiary students in countries such as Austria (24.58%), Hungary (24.36%), Croatia (23.85%), Romania (23.74%), Germany (22.39%), Bulgaria (21.71%), and Slovenia (20.13%). A second, highly encouraging joint characteristic across the macroregion is the remarkable overperformance in Information and Communication Technologies (ICT) enrollment. Every single Danube Region state except Croatia exceeds the EU average for ICT enrolment, with particularly high concentrations observed in candidate and accession states such as Bosnia and Herzegovina (11.04%), Serbia (10.21%), Montenegro (8.22%), while Member States such as Hungary (8.73%), Germany (8.12%), and Romania (7.30%) also demonstrate a strong macroregional orientation toward digital skills and technological transition.

Beyond these joint features, significant structural differences separate the upper basin economies from Eastern, Southeastern, and Western Balkan states. Engineering, Manufacturing, and Construction enrolment is noticeably higher than the EU average regarding the tier led by Romania (19.66%), Serbia (19.44%), Croatia (18.33%), Germany (18.14%), and Slovenia (16.85%), whereas lower shares are recorded in Slovakia (11.55%) and Czechia (10.84%). Conversely, Natural Sciences, Mathematics, and Statistics exhibits a sharp West-East divide: Germany (9.13%) and Austria (7.72%) comfortably surpass the EU baseline, while Eastern European and Western Balkan states exhibit severe under-representation, dropping to 2.86% in Bulgaria, 2.75% in Hungary and Montenegro, and just 1.96% in Bosnia and Herzegovina. Health and Welfare studies display another distinct geographic concentration, absorbing over 23.11% of all tertiary students in Bosnia and Herzegovina (where it forms the single largest field of study), 19.96% in Slovakia, 15.25% in Bulgaria, and 15.20% in Romania, contrasting with much lower shares in Germany (10.31%) and Austria (10.77%). Teacher training and Education studies also show regional clustering, representing over 10–13% of tertiary students in Czechia (13.36%), Bulgaria (12.94%), Austria (12.84%), Slovakia (12.74%), and Hungary (10.81%), while remaining under 5% in Romania (4.18%) and Montenegro (4.41%).

These field-specific specialisations generate critical joint challenges and opportunities for macroregional development. While Central, Eastern, and Southeastern Danube countries generate a substantial pool of qualified engineering, ICT, and healthcare graduates, lower domestic wage levels, lower private R&D spending, and underdeveloped research infrastructure frequently trigger severe out-migration („brain drain") toward Western European hubs and metropolitan capital regions. To convert this one-way depletion into dynamic „brain circulation", transnational cooperation needs joint educational programmes, double and joint degree frameworks, and expanded university and academic exchanges. Connecting regional universities

with local innovation ecosystems and Smart Specialisation Strategies (S3) through Triple and Quadruple Helix models will help align graduate skills with regional industrial needs.

NEXT STEPS IN DATA VISUALISATION

Additional figures to be created:

- Spatial distribution of motorways in the Danube Region
- Total cargo turnover of ports along the Danube
- Number of air passengers in the Danube Region

3.3 Social cohesion

3.3.1 Demographic conditions

Spatial redistribution of population, migration

Based on the 2020 Global Human Settlement Layer population grid (GHS-POP) data, the spatial distribution of population across the Danube Region illustrates a deeply fragmented settlement pattern characterised by acute contrasts between high-density urban agglomerations and vast, demographically sparse hinterlands. The macroregion's population structure is anchored by a hyper-dense, polycentric urban network in Western Europe spanning Southern Germany (Baden-Württemberg and Bavaria) and the Upper Danube corridor, and major metropolitan capital regions such as Vienna, Prague, Bratislava, Budapest, Zagreb, Belgrade, Bucharest, and Kyiv. These urban cores act as primary demographic and economic magnets, absorbing human capital and surrounding workforce flows, which stands in sharp contrast to the extensive, low-density rural and peripheral landscapes that cover the majority of the Danube Basin.

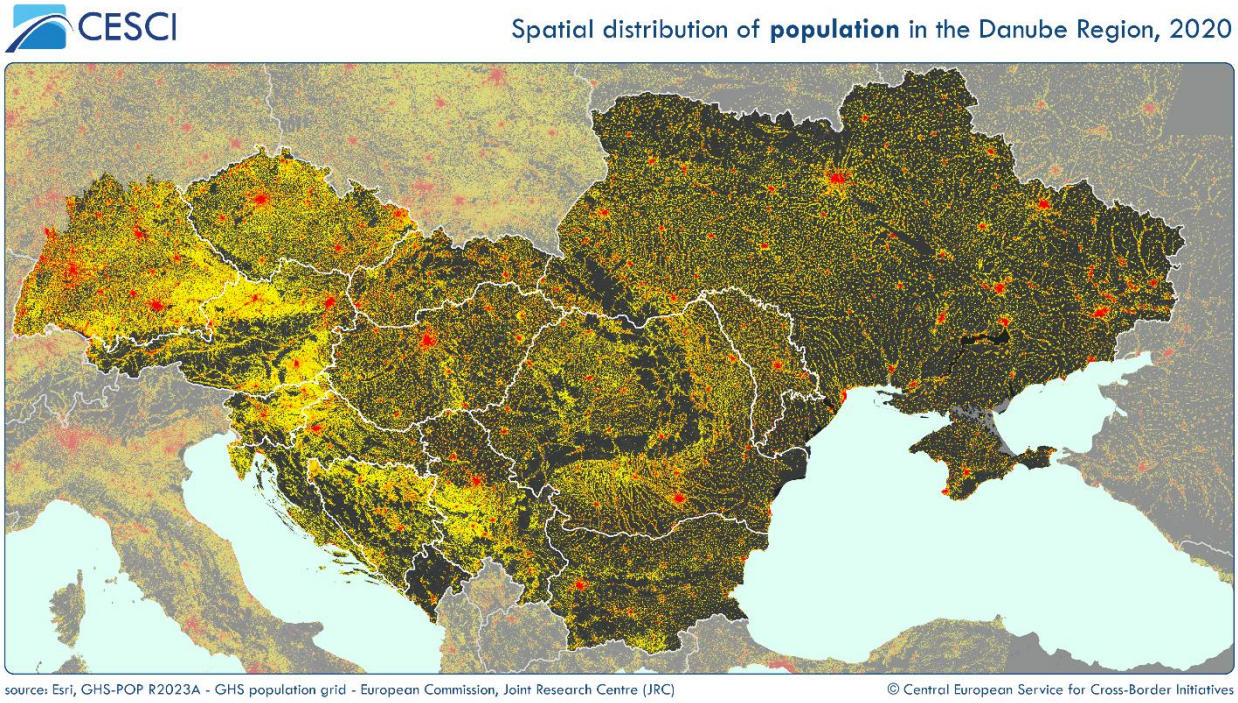


Figure 90: Spatial distribution of population in the Danube Region

A defining spatial feature of the macroregion is that low population density is heavily concentrated along state border regions, outer peripheries, and rural hinterlands, a pattern that becomes particularly pronounced across major mountain systems such as the Alps, the Carpathians, the Dinaric Alps, and the Balkan Mountains. Striking cross-border similarities emerge across these topographies. While the German-Austrian pre-Alpine border zone

maintains a relatively continuous, medium-to-high settlement density, vast transboundary mountain arcs form contiguous demographic valleys shared by neighboring countries. This is clearly visible along the Carpathian arc spanning the borderlands of Slovakia, Poland, Ukraine, and Romania; the Dinaric mountain zone linking Croatia, Bosnia and Herzegovina, Montenegro, and Serbia; and the Lower Danube and Balkan mountain frontier separating Romania and Bulgaria. In these peripheral borderlands, rugged terrain and historical peripherality reinforce low settlement density, isolating local communities from primary corridors.

These low-density spatial patterns create severe joint challenges for service delivery and territorial cohesion across the Danube Basin. In sparsely populated areas, outer peripheries, and mountainous borderlands, local municipalities lack the critical mass of citizens required to economically justify, develop, and maintain essential central urban functions, commercial activities, and public facilities like acute hospitals, secondary schools, and specialised social care. Maintaining traditional physical service infrastructure in these areas incurs an exceptionally high cost per capita, prompting service providers to consolidate or close local facilities, which in turn forms expanding inner peripheries and fuels out-migration. To counter these decline cycles and safeguard the "Right to Stay", transnational cooperation must focus on deploying flexible, remote, and e-solutions such as telemedicine, e-governance, digital education hubs, and demand-responsive public transport (DRT), to maintain service accessibility and quality without imposing unsustainable infrastructure costs. Furthermore, establishing shared cross-border public services (CBPS) along adjacent borders allows neighbouring municipalities to pool user catchments and co-finance essential utilities, ensuring long-term spatial justice and population retention across the macroregion's most vulnerable territories.

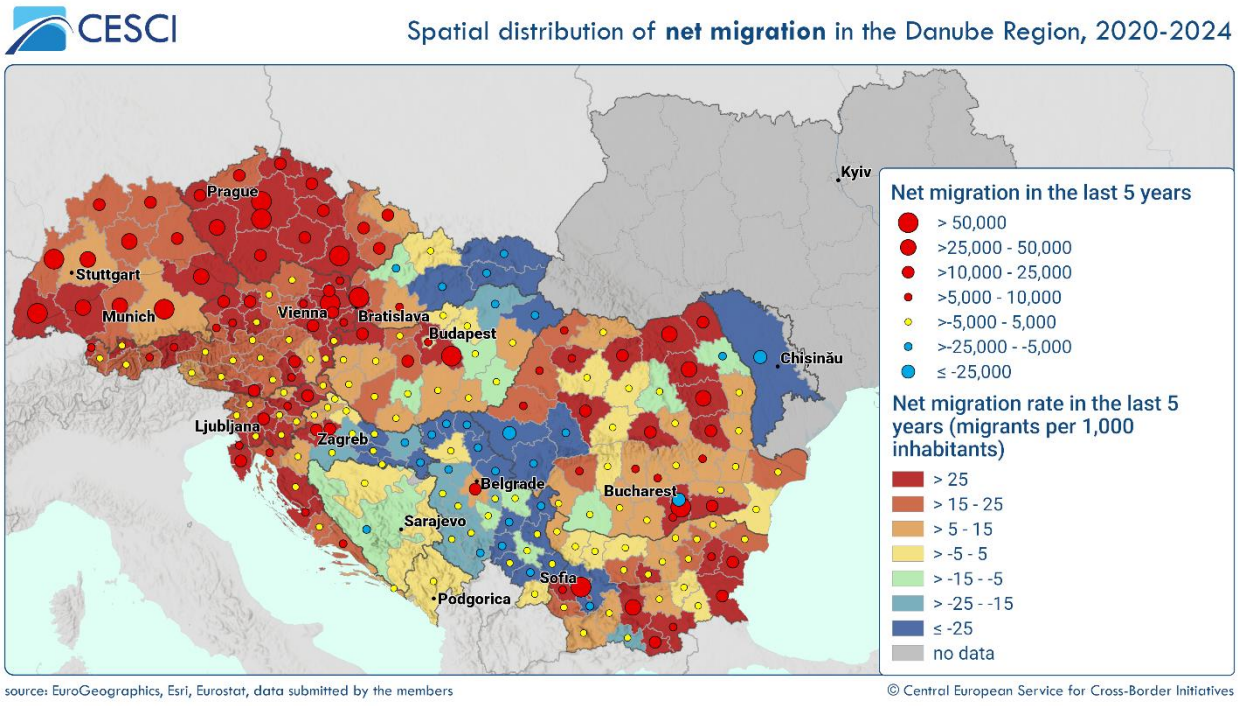


Figure 91: Spatial distribution of net migration in the Danube Region

One of the most critical challenges of the Danube Region is the profound territorial inequality embedded within its migratory landscape. An empirical evaluation of recent data reveals a highly polarised space where vast peripheral regions are undergoing continuous demographic erosion, while a select few metropolitan and core economic zones act as aggressive "collectors" of human capital. Across extensive territories, population decline is not merely a natural demographic shift but a process driven by mass out-migration, which clearly exposes a weak population retention power. This selective migration predominantly drains younger, more highly educated, and economically active cohorts. Consequently, it triggers an accelerated aging process, depletes the local human capital stock through a severe brain drain, and creates long-term structural barriers that hinder regional catching-up and territorial cohesion.

The mapping of net migration rates delineates an expansive, contiguous cross-border emigration zone stretching from Sisačko-moslavačka županija in Croatia to Hunedoara in Romania, and from the Severnobacka oblast in Serbia to the Sofia Province in Bulgaria. This broad transnational belt locks multiple countries into a shared demographic downward spiral. The most acute out-migration intensities within this crisis zone are recorded among Serbian administrative districts, with Severnobanatska oblast reaching a peak negative rate of -107.07, followed closely by the neighboring Severnobacka oblast at -82.61. This structural drain is further reinforced by Sofia Province in Bulgaria at -75.56, Srednjobanatska oblast in Serbia at -68.10, and Caraş-Severin in Romania at -65.64. The extensive outer arc of this depopulation zone includes the industrial-mining basin of Hunedoara in Romania with a rate of -29.31, alongside the structurally distressed Sisačko-moslavačka županija in Croatia at -18.67.

A separate but equally distinct transboundary source area for migration is visible along the border sections of Eastern Slovakia and Northeastern Hungary. In this peripheral cluster, the migration loss of the Slovakian Prešovský kraj at -30.77 and Košický kraj at -28.46 connects directly across the national border with the negative rates of the Hungarian counties of Szabolcs-Szatmár-Bereg at -25.13 and Borsod-Abaúj-Zemplén (HU311) at -22.49.

In sharp contrast to these lagging peripheries, the macroregion possesses highly integrated core areas that generate a substantial net migration surplus, typically forming contiguous regional clusters almost exclusively in neighbouring regions of Germany, Austria Czechia, Slovenia, Slovakia and Hungary. The highest gains are concentrated within capital city agglomerations and advanced central and western industrial nodes. The absolute peak of migration influx is recorded in Romania's Ilfov at +202.97, which represents an intense process of suburban expansion surrounding Bucharest. Strong retention and attraction capabilities are also clear in dominant urban cores like Hlavní město Praha at +105.52, the Slovakian Bratislavský kraj at +88.51, and Pest county surrounding Budapest at +48.65. Within the western core areas, Wien shows a resilient surplus of +55.09, while German NUTS 2 regions display a uniform growth profile, led by Freiburg at +32.06, Niederbayern at +25.58, and Schwaben at +24.36.

This high volume of inward migration creates a complex set of structural challenges for the host regions. The large-scale arrival of third-country nationals, international labour migrants from European countries and other continents, and waves of Ukrainian refugees under temporary protection frameworks places an immediate strain on local institutional structures. This demographic pressure affects public services, generating capacity deficits in healthcare and public education, driving up housing market prices, and demanding sophisticated integration measures to ensure effective labour market absorption and social cohesion.

The structural fragmentation of this migratory map proves that regional policy must move beyond traditional infrastructure funding and invest directly in local economic diversification and (youth) retention programs within the lagging eastern peripheries. Ultimately, the lesson for macroregional governance is that the widening socio-spatial gap between expanding metropolitan cores and hollowed-out borderlands can only be balanced by building integrated solutions across borders.

Data concerning residential mobility illustrate a profound transformation of the Danube Region into an increasingly interconnected macroregional living space. Over the past decades, the number of people residing in another Danube country has steadily increased, creating a growing population whose everyday lives transcend national borders. In 2025, approximately 3.57 million people (3,566,234) born in one Danube country were living in another country of the Danube Region. Many citizens can therefore be regarded as genuinely "Danubian" citizens, having accumulated experience through living, working, studying, conducting business, or engaging in leisure activities in one or more countries of the region. This transnational experience represents a valuable asset for regional development. The knowledge of different administrative systems, languages, cultures, labour markets and business environments can strengthen economic cooperation, social cohesion and territorial integration across the Danube Region.

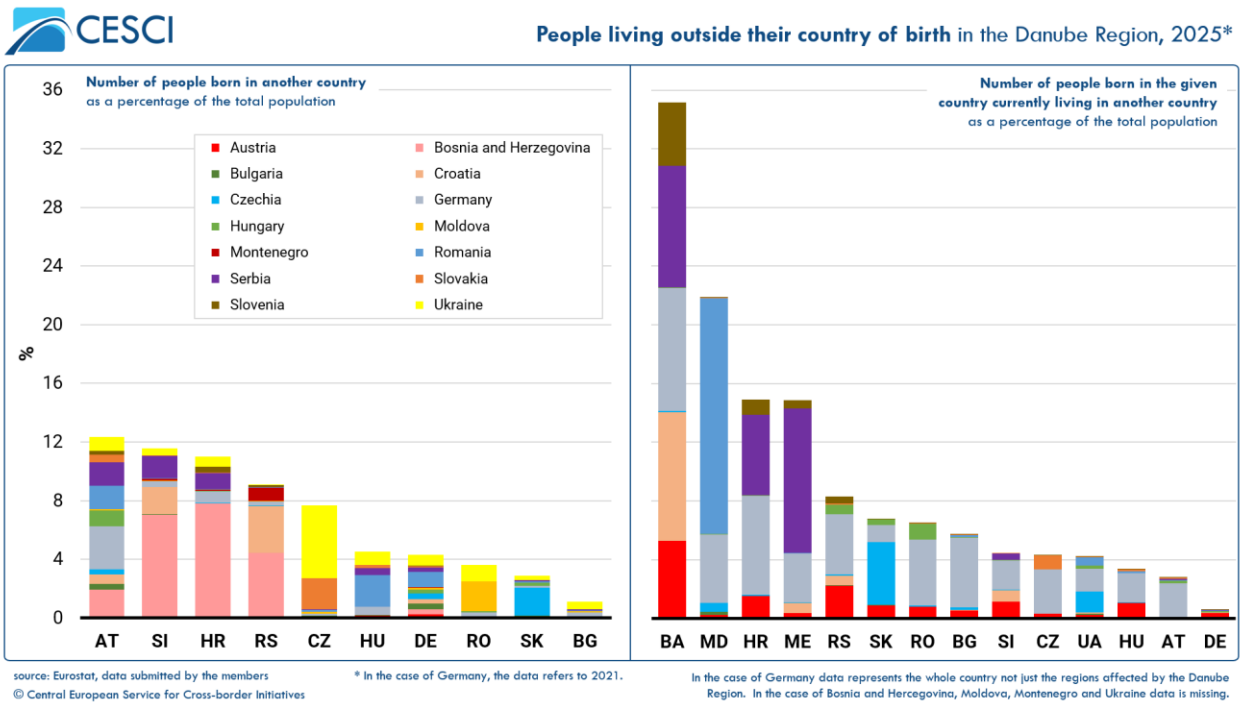


Figure 92: People living outside their country of birth in the Danube Region

The increasing intensity of cross-border movements and residential mobility creates new opportunities but also new governance challenges. Regions can capitalise on the intercultural competences, language skills, social networks and business connections of mobile citizens. At the same time, the growing number of residents, workers and entrepreneurs with cross-border lives generates rising demand for accessible and reliable information concerning residential permits, building permits, taxation, social security, employee rights, consumer protection, healthcare access, pension rights and other life and business events. The scale of this phenomenon is illustrated by several very large migration corridors, including Ukrainians living in Czechia (538 691 persons), Moldovans living in Romania (386 473 persons), Romanians living in Hungary (207 789 persons) and Slovaks living in Czechia (232 119 persons). Consequently, territorial integration increasingly requires not only physical connectivity but also administrative and legal interoperability.

In terms of volumes, Czechia accommodates large populations born in Slovakia (232 119) and Ukraine (538 691), making it one of the principal destinations for regional mobility. Slovenia, meanwhile, hosts substantial populations born in Bosnia and Herzegovina (146 808 persons), Croatia (39 365) and Serbia (32 329). Bulgaria and Montenegro show somewhat lower proportions, while Germany and Austria record relatively low percentages because of their large populations, despite hosting considerable numbers of residents born elsewhere in the Danube Region. Austria alone hosts 1 137 067 originating from Danube countries covered by the dataset, including communities from Bosnia and Herzegovina (179 761), Romania (148 602), Serbia (144 512), Hungary (98 335), Ukraine (88 682).

Several distinct territorial patterns emerge from the bilateral flows. The strongest intra-regional migration corridor is between Czechia and Ukraine, where 538 691 Ukrainian-born residents live in Czechia. Another major axis connects Romania and Moldova, where 386 473 Moldova-born residents live in Romania. Austria accommodates large communities from Bosnia and Herzegovina (179 761), Romania (148 602), Serbia (144 512), Hungary (98 335) and Ukraine (88 682). A particularly notable feature is the persistence of historically rooted migration systems. The Czechia-Slovakia relationship remains one of the most integrated two-way corridors in the region. More than 232 119 Slovak-born persons live in Czechia, while 102 473 Czech-born persons reside in Slovakia. Together, these two reciprocal flows amount to more than 334 000 people, demonstrating the enduring functional integration inherited from former Czechoslovakia. Another significant pattern is the Romania-Hungary corridor. Around 207 789 Romanian-born residents live in Hungary, whereas only 11 417 Hungary-born residents live in Romania. This clearly indicates a predominantly one-way migration pattern. A similar asymmetry characterises the aforementioned Romania-Moldova relationship, where 386 473 Moldova-born residents live in Romania, while only 608 Romania-born residents are registered in Moldova. Similarly to Austria, but on a smaller scale, Slovenia functions as a major regional hub attracting migrants from across the Western Balkans and Central Europe hosting substantial populations from Bosnia and Herzegovina (146 808 persons), Croatia (39 365) and Serbia (32 329). These flows largely reflect labour-market integration and long-standing migration traditions established during the former Yugoslav period.

Overall, the geography of mobility reveals a Danube Region structured around several overlapping migration systems. Former state formations such as Czechoslovakia and Yugoslavia continue to shape contemporary residential choices, while linguistic and cultural affinities reinforce corridors such as Romania-Moldova and Romania-Hungary. At the same time, economically stronger countries such as Austria and Czechia act as attractive destinations. The result is a dense network of interconnected territories involving more than 3.5 million residents living elsewhere within the macroregion, demonstrating that migration in the Danube Region has become increasingly intra-regional and is contributing to the emergence of a genuinely integrated Danubian socio-economic space.

The following section examines the demographic shifts resulting from Russia's war on Ukraine and the subsequent implementation of temporary protection measures across Europe. The geopolitical crisis has fundamentally altered the migratory landscape, with the Danube Region emerging as a primary destination for beneficiaries of temporary protection.

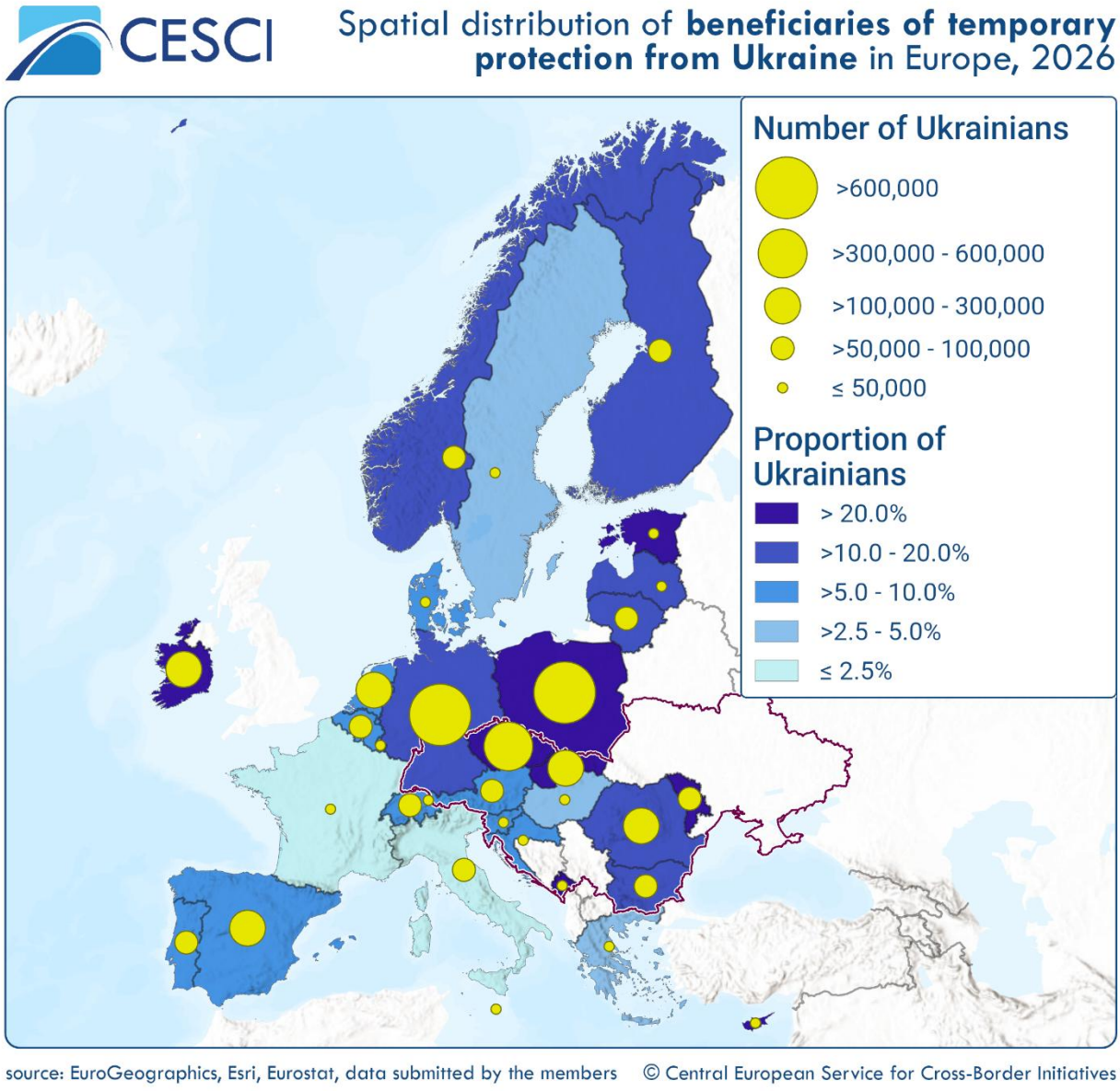


Figure 93: Spatial distribution of beneficiaries of temporary protection from Ukraine in Europe

Focusing on the pan-European level, following the onset of the conflict, the number of Ukrainian refugees and displaced persons in Europe has increased drastically, creating a unique historic situation for regional integration. Based on the statistical evidence for 2026, the total number of beneficiaries of temporary protection across the surveyed territory reached 10 985 880, representing a substantial increase from the 2023 baseline of 9 644 000.

The Danube Region countries have collectively played a decisive role in this humanitarian response. Focusing on the role of the Danube Region, the collective hosting capacity increased in nine countries (Austria, Bulgaria, Croatia, Czechia, Germany, Hungary, Romania, Slovakia, Slovenia) hosted 2 215 065 beneficiaries, up from 1 909 625 in 2023. The Danube Region's share of the total beneficiaries across the entire surveyed area increased from 19.80% to 20.16% between the two periods. Even more significant is the region's weight within the European Union. In 2023, the selected Danube Region countries hosted 50.02% of all EU-based beneficiaries; by

2026, this share rose to 51.43%, indicating that the macroregion now hosts the absolute majority of displaced Ukrainians within the EU.

Within the Danube Region, the spatial distribution of beneficiaries is characterized by extreme heterogeneity, reflecting both geographical proximity and economic pull factors. Taking into account absolute concentrations Germany remains the primary receiving country, hosting 1 224 855 individuals, followed by Czechia (396 465) and Romania (201 085). These three states alone concentrate over 80% of the total beneficiaries within the macroregion. In relation to demographic intensity (per 1 000 inhabitants), when normalised by population, the relocation of people reveals a different hierarchy. Czechia exhibits the highest intensity with 36.3 beneficiaries per 1 000 inhabitants, followed by Slovakia (25.7) and Germany (14.7). Conversely, Hungary (4.5) and Slovenia (5.2) show significantly lower relative ratios, highlighting a persisting divide in the long-term settlement patterns across the macroregion.

The magnitude of change between 2023 and 2026 highlights varying degrees of intensification across national borders. Highest relative increases can be found in relation to Romania, which recorded the most dramatic growth, with its beneficiary population in 2026 reaching 184.9% of its 2023 level. Significant surges were also witnessed in Croatia (148.2%), Hungary (146.7%), and Slovakia (145.0%). In contrast, Bulgaria saw a relative decrease in beneficiaries compared to its 2023 peak (reaching only 52.9% of that volume), while Czechia (90.2%) experienced a slight stabilisation of its protected population.

The current landscape indicates that the social integration of such a high volume of displaced persons represents a complex set of challenges, particularly in regions where the number of immigrants now exceeds the size of many indigenous national and linguistic minorities within the Danube Region. More than 2.2 million people area affected by this mass mobility flow from Ukraine, equivalent to the size of total population of Slovenia and many times higher number compared to the citizens of Montenegro. Receiving territories, most notably German, Czech, Slovak, and Romanian regions, face challenges regarding the integration of individuals and their families into the labour market, education, and healthcare systems, as well as the need for comprehensive administrative support. Given that a large proportion of (former) asylum seekers have found a living in their new places of resident, the macroregion has to be more prepared and adjusted to the long-term population surplus from neighbouring Ukraine. To ensure long-term social cohesion, future policy must prioritise the expansion of language and cultural training, legal orientation, and integrated social solutions to mitigate the relatively new social disparities emerging from Russia's aggression on Ukraine.

The evaluation of population development across the European continent underscores a deep structural divergence between core Western European growth axes and the macroregional space of Central and Eastern Europe. While the European Union as a whole experienced a slow

and steady population increase of +1.71% between 2015 and 2025, the Danube Region has been heavily impacted by profound population loss. In the aforementioned decade population decline reached a total number of 411 925 inhabitants in ten countries (excluding BA, MD, UA) and two German federal states. With millions who have left Ukraine, to external areas tot he Danube Region too, also underlines the challanges posed by massive depopulation.

Within this territory, depopulation is not a transitory crisis but an ongoing, deeply structural process that shapes the long-term socioeconomic prospects of several territories. Depopulation has emerged as one of the most persisting challenge of transnational character across the macroregion. This is underlined by that fact that in Croatia and Serbia none of the regions experienced population growth, and in Romania, Bulgaria Hungary and Slovakia only the minority of regions registered notable increase. Apart from Germany, Austria and Czechia almost exclusively dot-like areas managed to increase their population size, while extensive transboundary areas in Croatia, Serbia, Hungary, Romania and Bulgaria experienced population decrease excessing 10%.

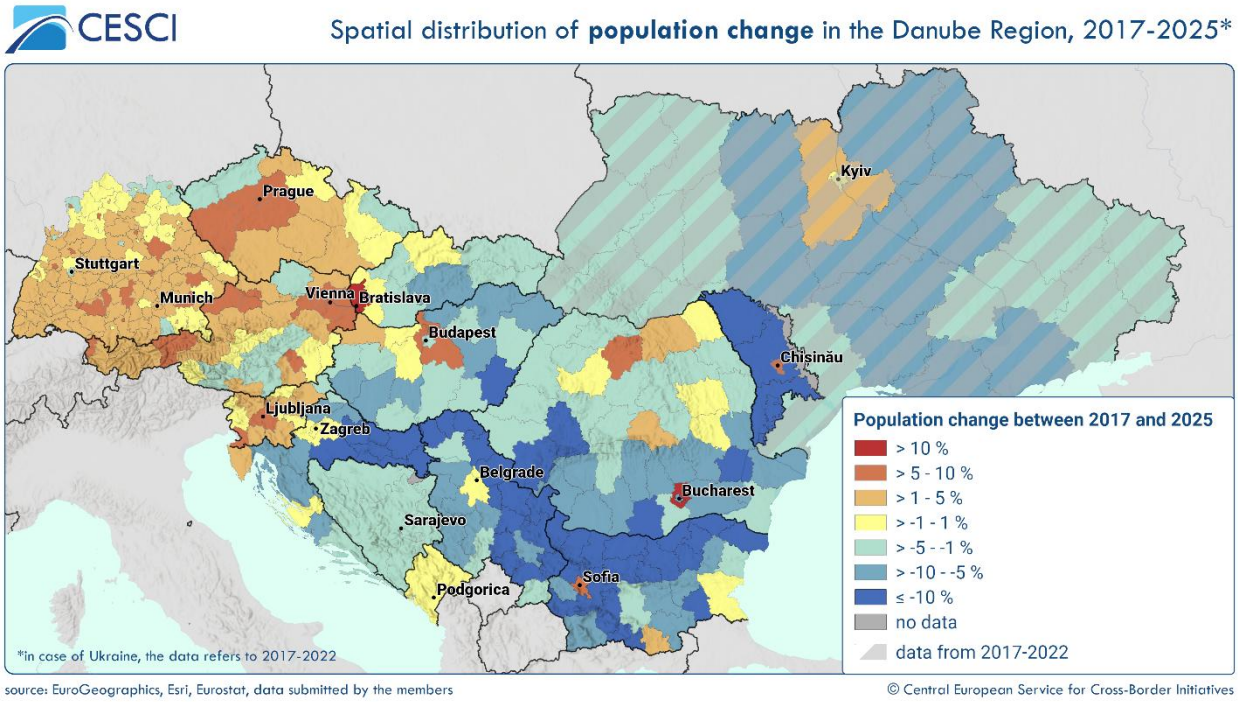


Figure 94: Spatial distribution of population change in the Danube Region

Considering key territorial inequalities there has been a core-periphery polarisation. The spatial configuration of demographic change reveals a highly polarised pattern: population growth is almost exclusively concentrated in metropolitan regions, major urban hubs, and suburban agglomerations, while rural peripheries and external border zones suffer from severe demographic decline. The most significant positive population changes are clustered within capital city regions and highly competitive industrial nodes, which function as powerful target areas. Such suburban growth engines include Ilfov in Romania, which represents the absolute

peak of population growth across the macroregion, surging by +28.71%, which highlights intense suburbanisation processes surrounding Bucharest. Capital city regions like Bratislavský kraj recorded an outstanding increase of +15.10%, while Wien grew by +11.39%. Another subcategory can be detected in the form of competitive industrial and secondary urban centres (e.g. Pforzheim, Stadtkreis: +11,58%; Graz: 10.4%), driven by robust labour markets and inward migration.

Conversely, the eastern and southernmost borderlands of the macroregion are facing an unprecedented demographic collapse, characterised by a breakdown of population retention force. The regions most severely hit by depopulation include Vidin and Montana, located in northwestern Bulgaria, with their long-term spiral of decay, shedding -28.68% and -21.50% of their populations respectively. The Pannonian parts of the Croatian border regions such as Vukovarsko-srijemska županija at -24.84%, Požeško-slavonska županija at -23.03%, and Virovitičko-podravska županija at -21.05% showcase a devastating pattern of regional abandonment. Furthermore, the Serbian border areas of Severnobanatska oblast at -20.96% and Borska oblast at -18.86% further mirror this problem.

A demographical assessment of these worst-performing regions indicates that they are trapped in a vicious, self-reinforcing downward spiral. The primary driver is a negative effect where structurally high, long-term out-migration of the young, skilled, and tertiary-educated workforce intersects with chronically low natural fertility rates and high mortality. As the demographic structure undergoes severe aging, these regions lose their internal capacity for natural reproduction. The systematic drain of working-age cohorts toward Western European core areas or national metropolitan centers leaves behind an elderly, economically inactive population. This peripheralisation transforms formerly functional rural landscapes and industrial border zones into hollowed-out spaces. The dramatic and ongoing depopulation of the southeastern peripheries threatens the long-term sustainability of basic public services, social infrastructure, and healthcare provision. Furthermore, the rapid erosion of critical human capital and the emergence of abandoned, depopulated settlements severely undermine the economic resilience of these convergence regions, necessitating a paradigm shift in cohesion policy toward targeted, „smart-shrinking" governance and regional development models that focus on cross-border public service integration.

Age structure

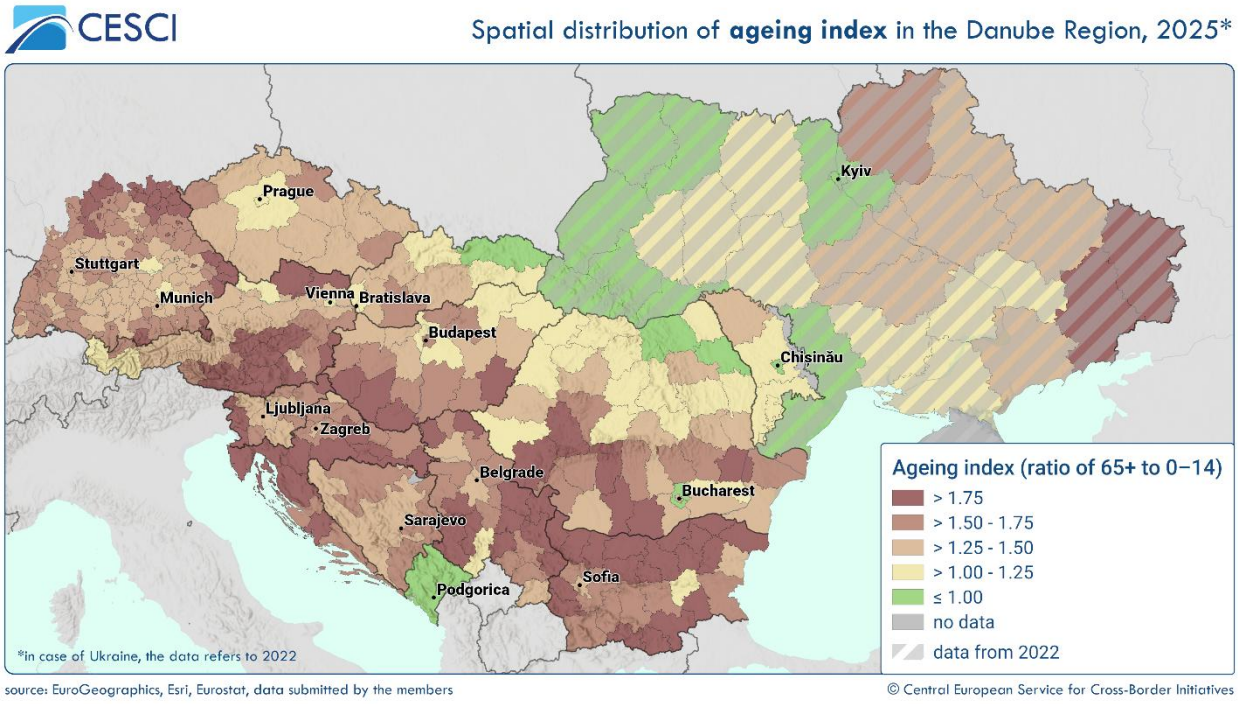


Figure 95: Spatial distribution of ageing index in the Danube Region

A demographic analysis of the Danube macroregion reveals that the geographic space is experiencing a systemic, deep-seated transformation defined by continuous and accelerating aging. The process of aging is an ongoing, structurally embedded reality that challenges the core social and economic tissue of the macroregion. A retro-prospective view indicates a profound shift over the last one and a half decade. Back in 2011, several extensive regions still maintained a favourable demographic profile where youth populations outnumbered the elderly, creating contiguous, relatively youthful territories. Regions such as the Moldavian part of Romania, Eastern Slovakia, and large sections of Bosnia and Herzegovina stood out as resilient demographic reserves with aging index scores well below the parity line.

However, contemporary shifts have almost completely erased this youthful profile across the European continent. Today, virtually almost no NUTS3 regions remain within the entire Danube macroregion where the value stays below 1.0 (indicating a surplus of children under 15 compared to seniors aged 65 and older) apart from few regions from Ukraine in particular. Reflecting this irreversible shift, states like Austria, Czechia, Hungary, and Serbia do not possess a single remaining region with a youthful indicator, signaling a comprehensive and uniform transition into an advanced stage of aging.

When benchmarked against the European Union average aging index of 1.53 (meaning roughly 153 seniors for every 100 children), the Danube macroregion exhibits sharp spatial polarisation and profound internal inequalities. Only five isolated NUTS3 regions across the analysed territory managed to keep a relative youth index below the 1.0 threshold: the suburban growth centre of

Ilfov in Romania (0.78), driven by intense suburbanisation around Bucharest, followed by the northeastern Romanian convergence poles of Iaşi (0.90) and Suceava (0.93), Prešovský kraj (0.91) in Slovakia, and Montenegro (0.95). Outside of these highly localised exceptions, the macroregion is dominated by values that vastly exceed the EU baseline, exposing a pronounced northwest-to-southeast and core-periphery divide.

The territories most critically afflicted by advanced demographic aging are concentrated along the peripheral borders of Bulgaria, Eastern Serbia, and parts of the Adriatic coast, where values often climb to double the European Union average. The most extreme aging index in descencing order are recorded in Smolyan (2.92) and Vidin (2.75) in Bulgaria, Zajecarska oblast (2.77) and Borska oblast (2.46) in Eastern Serbia, Gabrovo (2.63) and Kyustendil (2.38) also in Bulgaria, furthermore in Šibensko-kninska županija (2.27) and Primorsko-goranska županija (2.23) along the Croatian coast.

These poorly performing regions are caught in a self-reinforcing "demographic trap" This severe aging profile is driven by a cumulative long-term effect. Historically high, selective, and continuous out-migration of young, tertiary-educated cohorts towards major national capital regions or Western European labour markets has structurally drained these territories of their primary reproductive and economic base. When combined with decades of critically low fertility rates, these peripheral zones have transitioned into an era of persistent natural population decline. Consequently, areas like northwestern Bulgaria or the industrial-mining basins of Eastern Serbia have seen their demographic structures distorted to a degree where senior generations outnumber youth by nearly three to one, leaving behind an increasingly dependent, immobile local society.

The aging local societies create critical challenges for regional planning, as the rapid decrease of active-age labour forces hampers traditional economic growth and complicates the emergence of a viable, market-driven silver economy due to low localised purchasing power. Consequently, future cohesion and regional development policies must prioritise investments to transition toward senior-friendly public infrastructure and modernised social care networks, while simultaneously elevating the socio-economic framework for active senior employment and lifelong community engagement to ensure the "baseline functionality" of these ageing territories.

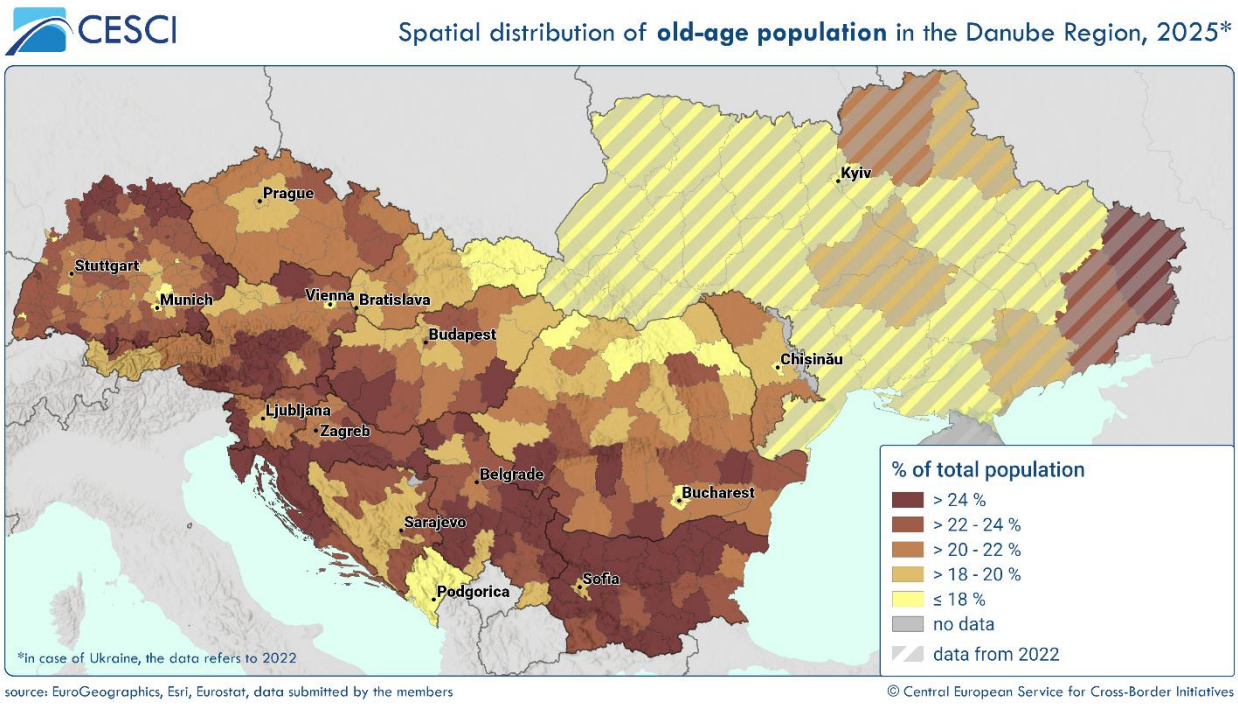


Figure 96: Spatial distribution of old-age population in the Danube Region

An evaluation of the demographic structure across the Danube Region reveals an exceptionally high proportion of the old-age population, which in numerous territories significantly exceeds the European Union benchmark of 21.96%. At the national level, countries such as Bulgaria (24.0%), Croatia (23.3%), Germany (22.7%), Serbia (22.7%), and Slovenia (22.1%) all surpass the European average, reflecting a widespread demographic shift driven by rising life expectancies, sub-replacement fertility, and the chronic out-migration of younger cohorts. This demographic transition is most acute at the sub-national level, where extensive, contiguous transboundary areas have evolved into severe demographic peripheries with extraordinarily high shares of elderly residents. Almost all countries of the macroregion have high number of regions with the old-age population exceeding the threshold of 24%. In Bulgaria and Croatia the majority of NUTS3 regions fall into the most ageing category. The most prominent aging hotspot forms a continuous cross-border belt along the Bulgarian-Serbian frontier, anchored by Bulgarian regions such as Vidin (31.4%) and Gabrovo (30.5%), alongside the neighbouring Zaječarska (30.9%) and Borska (29.1%) oblasts in Serbia. Similarly, rugged hinterlands and rural peripheries like Bulgaria's Smolyan (30.0%) and Croatia's Šibensko-kninska county (28.6%) represent territories where nearly one in three residents is over the age of 65. This profound demographic transformation necessitates a fundamental realignment of macroregional public policy and spatial planning to address the escalating needs of an aging society. To sustain territorial cohesion, there is an urgent and growing need to systematically expand specialised elderly care and integrated social services, while retrofitting public spaces and transit networks to provide accessible, pensioner-friendly infrastructure. Furthermore, adapting to this reality requires unlocking the potential of the „silver economy" by fostering accessible lifelong learning

programs, supporting flexible employment models for older adults, and developing targeted healthcare, rehabilitation, and leisure opportunities that keep the senior population active, engaged, and structurally supported within their local communities.

NEXT STEPS IN DATA VISUALISATION

Additional figures to be created:

- Spatial distribution of working-age population in the Danube Region

3.3.2 Social disparities

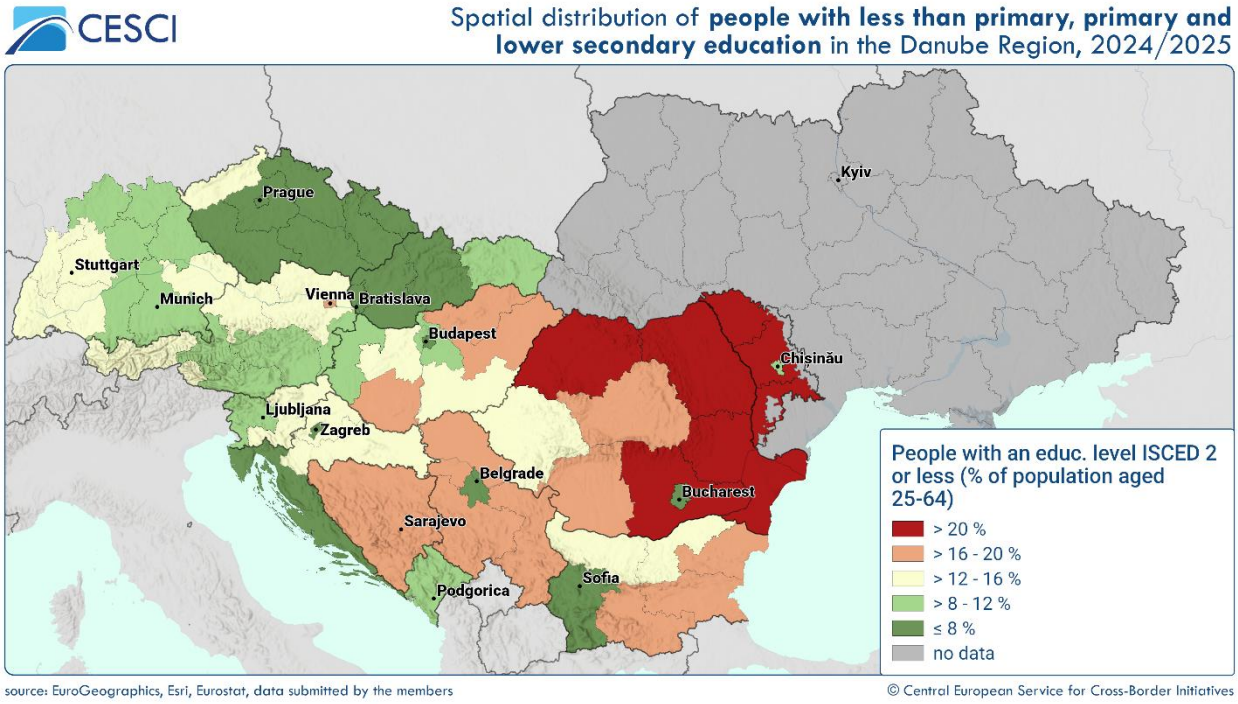


Figure 97: Spatial distribution of people with less than primary, primary and lower secondary education level in the Danube Region

Systemic inequalities can be detected in relation to the population's level of basic educational attainment. The spatial distribution of the low-educated population – defined as individuals aged 25-64 possessing at most lower secondary education (ISCED levels 0–2) – accurately reflects the enduring centre-periphery divide.

The European Union average of 18.8% constitutes a clear benchmark for assessing the internal structure of the macroregion. Based on the available data, distinct regional clusters and territorial typologies can be identified within the Danube Region. Knowledge-intensive and innovation-oriented core regions encompass the metropolitan agglomerations of Central European capitals and the advanced industrial core areas, where the proportion of low-educated individuals remains negligible and substantially below the EU average. The absolute positive outlier is Prague, with an exceptionally low rate of 1.8%, closely followed by the Bratislava Region, Zagreb, and Budapest. In these territories, the density of higher education networks, the diversified service economy, and the concentration of high value-added employment opportunities collectively ensure that the overwhelming majority of the population possesses at least upper secondary or tertiary qualifications.

On the contrary, structurally disadvantaged areas are the southern and eastern peripheries. The geographical disparity between the extremes is striking, as the macroregion's best- and worst-performing territories exhibit more than a fifteenfold social gap. This category comprises extensive rural and border regions of Romania, Bulgaria, and Serbia, where low educational

attainment constitutes a mass social phenomenon and where indicators significantly exceed the European Union average. Marginalised peripheries form an almost contiguous belt of underdevelopment across the eastern and south-eastern parts of the macroregion. The epicentre of the structural crisis is clearly located in Romania, where the Sud-Est region records the highest proportion of low-educated individuals at 27.9%, followed by Nord-Est (24.8%), Nord-Vest (21.3%), and Sud-Muntenia (20.8%). Within Hungary, Northern Hungary carries the most severe structural disadvantages with a rate of 19.3%, closely followed by the Northern Great Plain region (18.7%), while in Bulgaria the Yugoiztochen (18.5%) and Yuzhen tsentralen (17.6%) regions stand out negatively. A detailed socio-political assessment of these lagging territories demonstrates that the persistence of low educational attainment is rooted in deeply embedded institutional and social failures. In these predominantly rural, agrarian, or obsolete heavy-industrial regions, educational systems are unable to compensate for disadvantages deriving from family background, resulting in intensified educational segregation and persistently high levels of early school leaving.

The lack of quality educational infrastructure, the continuous outmigration of skilled labour (brain drain), and the low innovation capacity of local economies collectively reproduce an environment in which low-educated individuals constitute the most marginalised and socially excluded groups, remaining permanently excluded from the primary labour market. The high proportion of low-educated populations directly contributes to the persistence of poverty and the entrenchment of low-income conditions, as insufficient educational attainment systematically obstructs the social mobility of disadvantaged and marginalised groups while simultaneously excluding them from the opportunities generated by modern labour markets. At the same time, this deficit in human capital traps affected territories at a collective level, since the absence of a skilled workforce prevents local economies from transitioning beyond low value-added production modes. In the long term, this dynamic results in the entrenchment of regions within a persistent development trap, thereby reproducing territorial inequalities across generations.

An evaluation of the at-risk-of-poverty rate across the Danube Region highlights a fragmented social landscape characterised by severe territorial inequalities and a pronounced core-periphery divide. At the national level, low poverty risk in the western and northern tier – led by Czechia (9.6%), Slovakia (12.2%), Hungary (14.0%), Slovenia (14.3%), Austria (15.9%), and Germany's Danubian states (Bavaria at 12.6% and Baden-Württemberg at 13.2%) – contrasts with elevated baselines in Romania (18.4%), Croatia (19.5%), Serbia (19.6%), Montenegro (20.9%), and Bulgaria (21.2%). This national divergence is compounded by a striking „capital city island" phenomenon, where primary metropolitan hubs concentrate high-value jobs and record the macro-region's lowest poverty rates, led by Bratislavský kraj (1.4%), București-Ilfov (2.7%), Praha (6.8%), Budapest (7.2%), and Beogradski region (8.4%). Addressing whether border and peripheral regions perform worse, empirical evidence shows that non-capital, peripheral, and

border territories in Central and Southeastern Europe systematically underperform, generating immense domestic divides: poverty risk reaches 20.4% in peripheral Východné Slovensko (14.6 times higher than Bratislava), 27.8% in Romania's borderland Sud-Vest Oltenia (10.3 times higher than Bucharest), 27.7% in Southern and Eastern Serbia (3.3 times higher than Belgrade), 28.6% in Croatia's Panonska Hrvatska (the dataset peak), and over 22% to 27% in Northern Hungary and rural Danubian Bulgaria.

These peripheral deficits coalesce into contiguous transboundary poverty belts along shared borders, most prominently along the Lower Danube corridor (spanning Northern Bulgaria, Southern Romania, and Eastern Serbia) and along the EU's eastern external boundary facing Ukraine and Moldova. Because entrenched poverty in eastern and southern peripheries acts as the primary catalyst for skilled talent drain, population loss, and service depletion, targeted transnational cooperation should advance cross-border public services, „Smart Village" initiatives, and rural economic diversification to transform unilateral brain drain into balanced brain circulation and uphold the „Right to Stay" across all Danube territories.

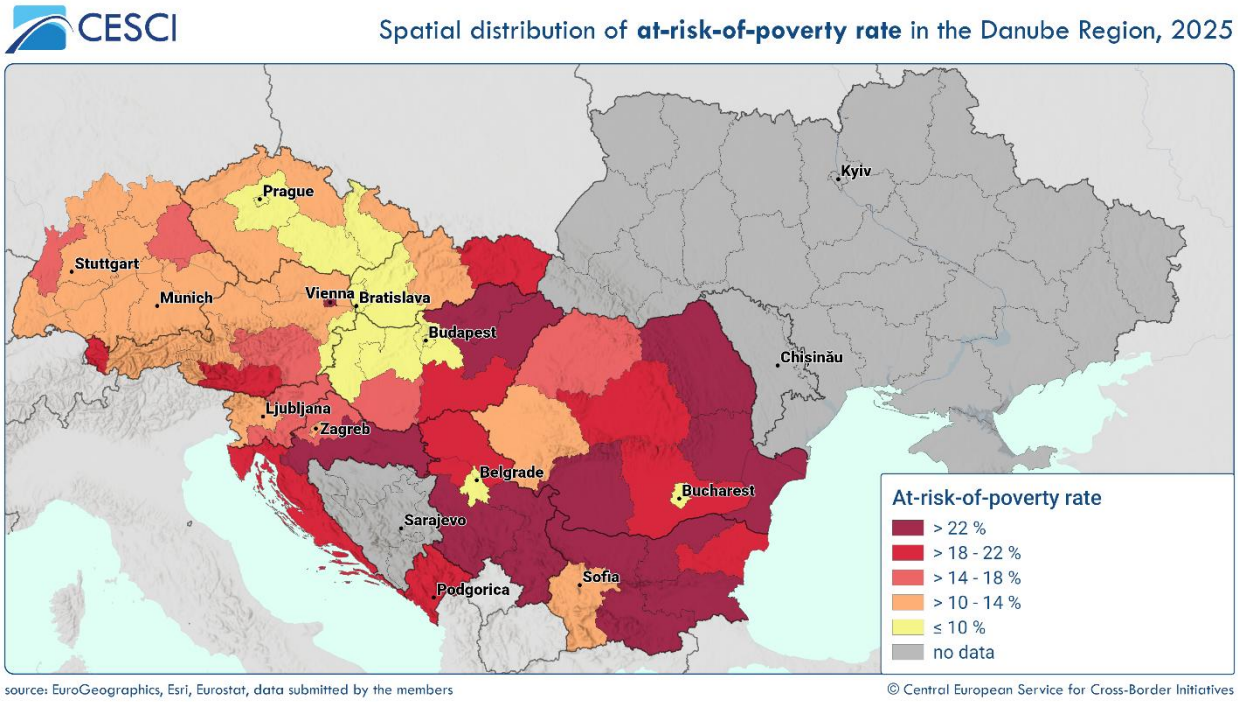


Figure 98: Spatial distribution of at-risk-of-poverty rate in the Danube Region

NEXT STEPS IN DATA VISUALISATION

Additional figures to be created:

- Spatial distribution of housing deprivation in the Danube Region

3.3.3 Labour force migration, training and employment

Characteristics of employment and educational attainment

An evaluation of unemployment rates across the Danube Region reveals a polarised labour market structured along an entrenched core-periphery and West-East divide when benchmarked against the European Union average. In 2025, the EU-27 unemployment rate stood at 6.0%, down from 7.3% in 2018. Across the Danube macroregion, participating economies diverge into three distinct performance tiers. The upper tier of high unemployment is concentrated predominantly within the Western Balkans and parts of Southeastern Europe, where structural joblessness exceeds the European baseline, led by Bosnia and Herzegovina (12.2%), Montenegro (10.7%), and Serbia (8.7%), alongside Romania (6.1%). In stark contrast, a vast cluster of Central European and Eastern economies exhibits exceptionally tight labor markets with near-full employment, led by Hungary (4.4%), Slovenia (3.9%), Germany (3.8%), Moldova (3.8%), Bulgaria (3.5%), and Czechia (2.8%). This macro-regional pattern highlights a profound structural paradox: while mature industrial and Central European export centers grapple with severe skilled labor shortages that constrain industrial output, candidate economies in the Western Balkans continue to face structural unemployment, informal employment, and the labor market exclusion of vulnerable groups, particularly in non-capital and rural peripheries.

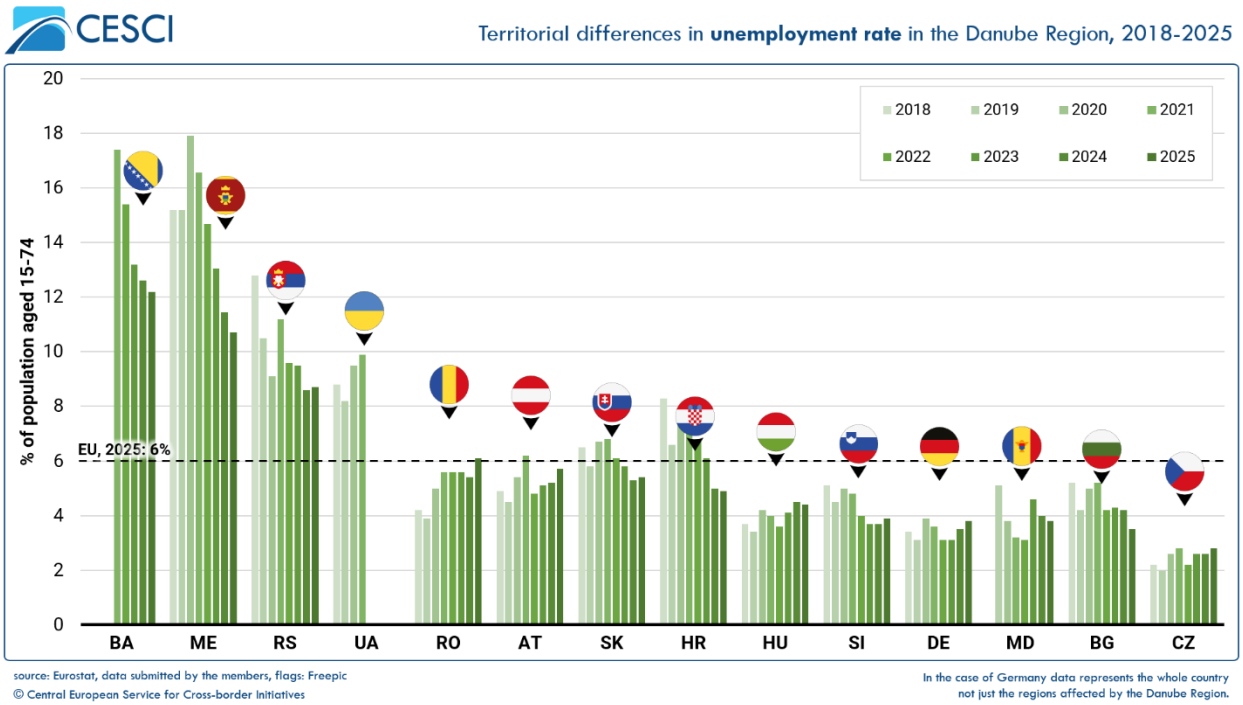


Figure 99: Territorial differences in unemployment rate in the Danube Region, 2018-2025

Examining dynamic shifts between 2018 and 2025 highlights a dual macro-regional process defined by structural convergence across catching-up candidate economies alongside mild cyclical softening in mature industrial cores. Throughout the post-pandemic recovery,

Southeastern Europe and the Western Balkans experienced significant job creation and economic formalisation, which drove down double-digit jobless rates and substantially narrowed the historical unemployment gap separating candidate countries from the European baseline. Concurrently, the macro-region's industrial engines in Central and Western Europe saw their historical unemployment lows give way to modest cyclical upticks, as elevated energy costs, sluggish export demand, and industrial restructuring muted hiring. Rather than a lack of aggregate demand, the defining structural bottleneck across Central Europe has become widespread labor scarcity and demographic shrinkage, which stands in sharp contrast to the underutilized labor reserves persisting in the Western Balkans. To reconcile these spatial imbalances and mitigate the unilateral flight of working-age talent from candidate states, transnational could prioritise the harmonisation of vocational education and dual-training systems tailored to the green and digital transitions. Furthermore, joint macro-regional initiatives should focus on removing administrative obstacles to cross-border remote work and supporting local SME ecosystems, transforming unilateral brain drain into balanced brain circulation and safeguarding the „Right to Stay" across all Danube territories.

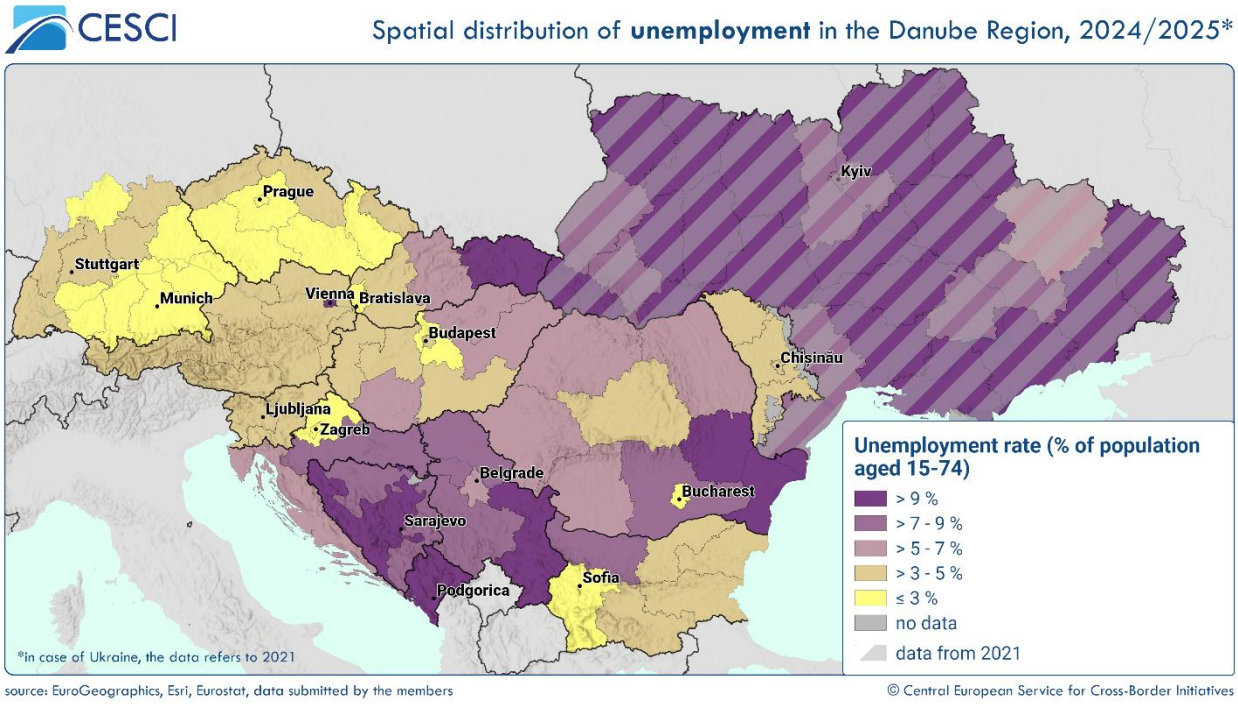


Figure 100: Spatial distribution of unemployment in the Danube Region

The 2025 unemployment across the Danube macroregion reveals a highly polarised labour market characterised by deep territorial disparities and distinct gender-based structural imbalances. When benchmarked against the European Union average unemployment rate of 6.0%, the macroregion exhibits a dual reality where localizsd economic engines operate at near-full employment, while peripheral and non-EU territories have remained trapped in chronic structural joblessness.

The territorial configuration of total unemployment highlights a sharp division between dynamic urban or capital cores and lagging borderlands. The lowest unemployment rates are heavily concentrated in the central economic hubs of Central and Eastern Europe, led by Střední Čechy at an exceptional 1.5%, followed closely by the capital regions of Bucureşti-Ilfov (1.8%), Praha (1.8%), and Bulgaria's Yugozapaden (1.9%). These regions have successfully integrated into transnational supply chains and logistical networks, showcasing an outstanding capacity for labour absorption that performs vastly better than the EU baseline. On the opposite end of the spectrum, the highest unemployment rates are clustered within non-EU macroregional partners and structurally vulnerable convergence zones. Bosnia and Herzegovina records the peak regional unemployment at 12.2%, followed closely by Serbia's Region Juzne i Istocne Srbije at 12.0%, and the Sud-Est region of Romania at 11.3%. Notably, Wien (9.9%) stands out as an urban outlier facing metropolitan frictional unemployment, while Východné Slovensko (9.5%) illustrates the persistent challenge of deep-seated geographic peripheralisation far from central growth poles.

Beneath these aggregate figures lies a highly uneven gendered landscape that reflects underlying sectoral specialisations and historical economic paths. At the macro level, the European Union baseline exhibits a higher female unemployment rate (6.2%) relative to males (5.8%). This pattern of excess female unemployment is magnified in Bosnia and Herzegovina, where female unemployment reaches a striking 16.5% compared to 9.4% for males, creating a massive 7.1 percentage point disparity. Significant female surpluses are also highly visible in Romania's Nord-Est (7.7% female vs. 4.3% male) and Sud-Muntenia (10.2% female vs. 7.5% male) regions, alongside Serbia's Region Juzne i Istocne Srbije (13.5% vs. 10.9%). These patterns typically manifest in traditional agrarian or peripheral economies where the local service sector remains underdeveloped, or where recent industrial expansions are dominated by automated, capital-intensive assembly plants that disproportionately absorb male labour force participants while structural or cultural-mental barriers limit female formal employment.

Conversely, a distinct male unemployment[8] surplus is observable in regions structurally hit by the transition or downscaling of heavy manufacturing, logistics, and primary industrial processing. At the same time oftentimes these regions are characterised by female-oriented service sectors and light industries. This friction is most prominently displayed in Romania's Sud-Est region, where male unemployment spikes to 12.4% against 9.5% for females. Similar male-dominated joblessness patterns emerge in Croatia's Grad Zagreb (4.0% male vs. 1.9% female), the Vest region of Romania (5.9% vs. 4.1%), and Bulgaria's Yuzhen tsentralen (4.0% vs. 2.3%). These specific spatial patterns align with traditional heavy industrial clusters or maritime

[8] it is crucial to highlight that for Unterfranken (DE26) in Germany, while the total and male unemployment rates stand at 3.0% and 3.8% respectively, the female unemployment rate data is completely unavailable, a statistical limitation that distorts comprehensive gendered mapping and comparative cohesion metrics within that specific sub-region.

gateways that have experienced deindustrialization, leaving a pool of blue-collar male workers who face retraining bottlenecks as the economy shifts toward tertiary activities.

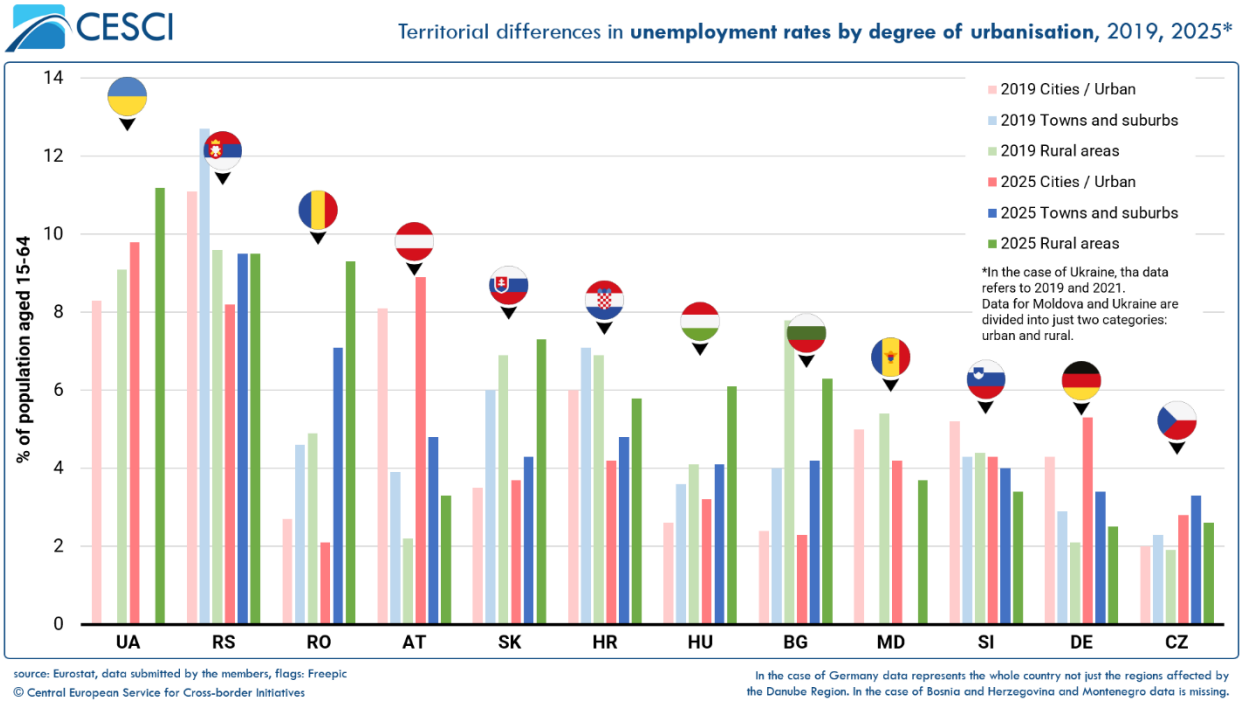


Figure 101: Territorial differences in unemployment rates by degree of urbanisation in the Danube Region

An evaluation of unemployment rates by degree of urbanisation reveals profound structural and spatial divides across the labour markets of the Danube Region. Compared to the European Union average baseline the macroregion does not follow a uniform territorial pattern. Instead, it is sharply bifurcated between two opposing labour market models: an Eastern model characterised by acute rural unemployment, and a Western model where urban areas bear the heavier joblessness burden.

In the central, eastern, and southeastern states of the Danube Basin, unemployment is overwhelmingly concentrated in rural areas and small towns, where rates are frequently two, three, or more than four times higher than in primary urban centers. The most extreme illustration of this divide is Romania, where rural unemployment reached 9.3% in 2025 compared to a mere 2.1% in cities, representing a more than 4.4-fold disparity. Similarly dramatic rural-urban splits manifest in Bulgaria (rural 6.3% vs. cities 2.3%), Slovakia (rural 7.3% vs. cities 3.7%), and Hungary (rural 6.1% vs. cities 3.2%), with Croatia (rural 5.8% vs. cities 4.2%) and Serbia (rural and towns 9.5% vs. cities 8.2%) reflecting a similar burden on non-metropolitan hinterlands. In this Eastern model, capital city regions operate as dynamic „islands of full employment" integrated into global value chains, while surrounding rural peripheries suffer from low job creation, structural deindustrialization, low educational attainment, and high early school leaving rates.

In sharp contrast stands the Western model represented by Austria and Germany, where major cities face significantly higher unemployment rates than their rural hinterlands. In Austria, urban unemployment stands at 8.9%, compared to just 3.3% in rural areas, marking a nearly 2.7-fold urban excess. Germany exhibits a similar structural profile, with city unemployment at 5.3% against 2.5% in rural regions. In these mature Western economies, rural areas possess highly competitive, diversified manufacturing and SME ecosystems, whereas metropolitan hubs absorb frictional unemployment, industrial restructuring, and the complex social integration demands of newcomer and marginaliaed populations. A third, highly balanced group comprises Czechia (cities 2.8%, rural 2.6%) and Slovenia (cities 4.3%, rural 3.4%), where unemployment remains universally low across all degrees of urbanisation.

These contrasting spatial inequalities generate compounding macroregional challenges for cohesion. Severe rural unemployment in the eastern peripheries fuels continuous youth out-migration („brain drain"), depleting local human capital and threatening the „Right to Stay", while western metropolises grapple with urban overheating and social integration pressures. Addressing these interlinked bottlenecks demands structured transnational cooperation. Key interventions could prioritise aligning active labour market policies, expanding dual vocational education (VET) networks, and executing „Smart Village" strategies that deploy digital infrastructure for remote work and local entrepreneurship. Furthermore, strengthening functional urban-rural partnerships and supporting short local value chains could help decentralise quality job creation, diversify rural economies, and restore population retention capacity across the macroregion's lagging hinterlands.

An evaluation of employment rates across the Danube Region highlights a deeply divided labour market landscape. In 2025, the EU-27 employment rate reached 71.0%, serving as a dividing line across the macro-region, which splits into three distinct performance groups. The upper tier comprises mature Western economies and industrialized Central European Member States that comfortably surpass the European benchmark, led by Germany (77.2%), Czechia (75.7%), Hungary (75.1%), Austria (74.3%), Slovenia (72.9%), and Slovakia (72.3%), with Bulgaria (70.9%) converging directly on the EU baseline. An intermediate tier of catching-up economies operates moderately below the European threshold, represented by Croatia (68.8%), Serbia (66.5%), and Romania (63.0%), alongside pre-war Ukraine (60.5% in 2021). In stark contrast, a structurally constrained lower tier persists across the Western Balkans and the Eastern Neighborhood, characterized by critically depressed employment baselines in Bosnia and Herzegovina (55.1%), Montenegro (54.2%), and Moldova (40.2%). This spatial distribution generates a vast macro-regional divide of 37.0 percentage points between the highest-performing industrial core (Germany at 77.2%) and the most distressed eastern periphery (Moldova at 40.2%), demonstrating that while Central Europe operates under severe labor market tightness and structural labor shortages, peripheral candidate territories continue to suffer from low labor force

participation, large informal economies, and limited female employment outside primary administrative centers.

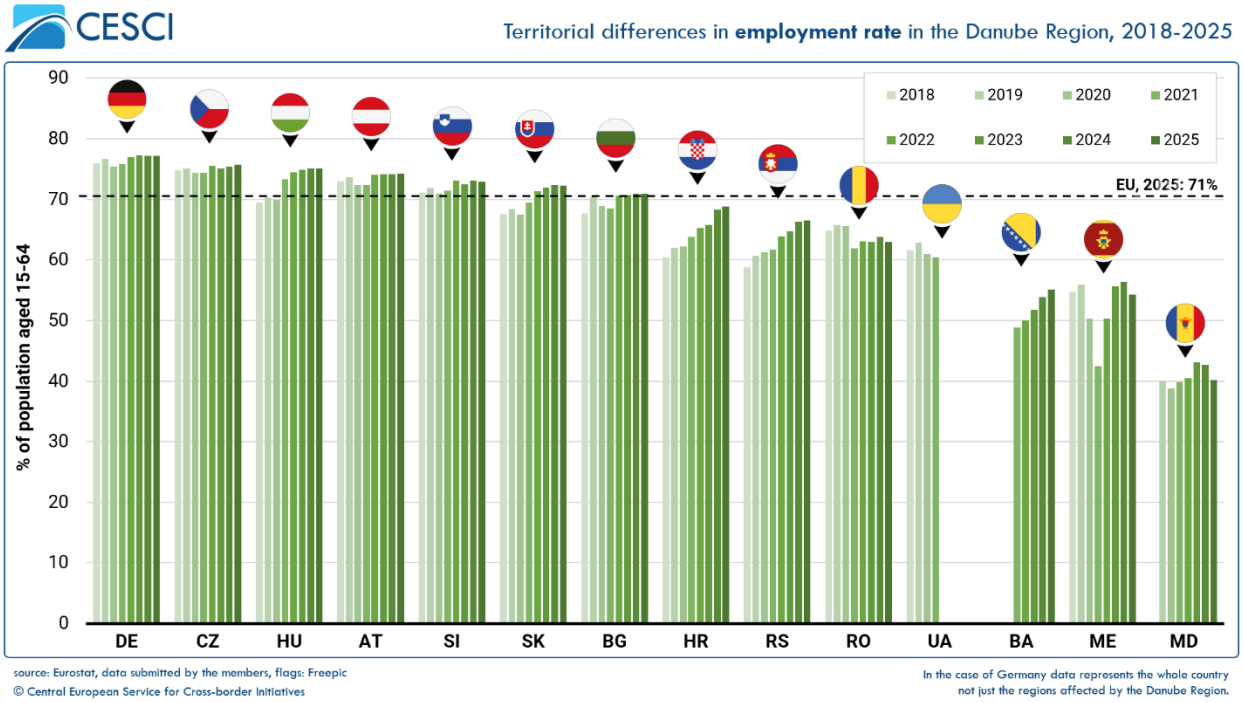


Figure 102: Territorial differences in employment rate in the Danube Region, 2018-2025

Examining dynamic shifts between 2018 and 2025 reveals an overarching catching-up process across Southeastern Europe and the Western Balkans that outpaced the European Union's baseline expansion (+3.3 percentage points, rising from 67.7% in 2018 to 71.0% in 2025). The strongest employment growth across the basin was achieved by Croatia (+8.3 percentage points, surging from 60.5% in 2018 to 68.8% in 2025), Serbia (+7.7 pp, rising from 58.8% in 2018 to 66.5% in 2025), Bosnia and Herzegovina (+6.3 pp between 2021 and 2025, expanding from 48.8% to 55.1%), Hungary (+5.7 pp, climbing from 69.4% in 2018 to 75.1% in 2025), Slovakia (+4.7 pp, from 67.6% in 2018 to 72.3% in 2025), and Bulgaria (+3.2 pp, from 67.7% in 2018 to 70.9% in 2025). Mature western anchors maintained steady, incremental gains despite broader economic headwinds, visible in Slovenia (+1.8 pp, from 71.1% in 2018 to 72.9% in 2025), Austria (+1.3 pp, from 73.0% in 2018 to 74.3% in 2025), Germany (+1.3 pp, from 75.9% in 2018 to 77.2% in 2025), and Czechia (+0.9 pp, from 74.8% in 2018 to 75.7% in 2025). Conversely, structural headwinds produced contractions or stagnation in a few territories, most notably Romania (-1.8 pp, falling from 64.8% in 2018 to 63.0% in 2025), Montenegro (-0.5 pp, declining from 54.7% in 2018 to 54.2% in 2025 following a severe pandemic slump to 42.4% in 2021), Moldova (+0.1 pp between 2019 and 2025, stalling from 40.1% to 40.2%), and Ukraine (-1.1 pp between 2018 and 2021, dropping from 61.6% to 60.5% prior to wartime statistical disruptions). To bridge these persistent employment disparities and counteract the ongoing demographic drain of active workers from candidate economies, transnational cooperation could prioritise the harmonization of dual vocational training standards and support youth entrepreneurship in rural

areas. Furthermore, joint interventions under the Danube Region Programme could foster cross-border teleworking frameworks and digital business hubs.

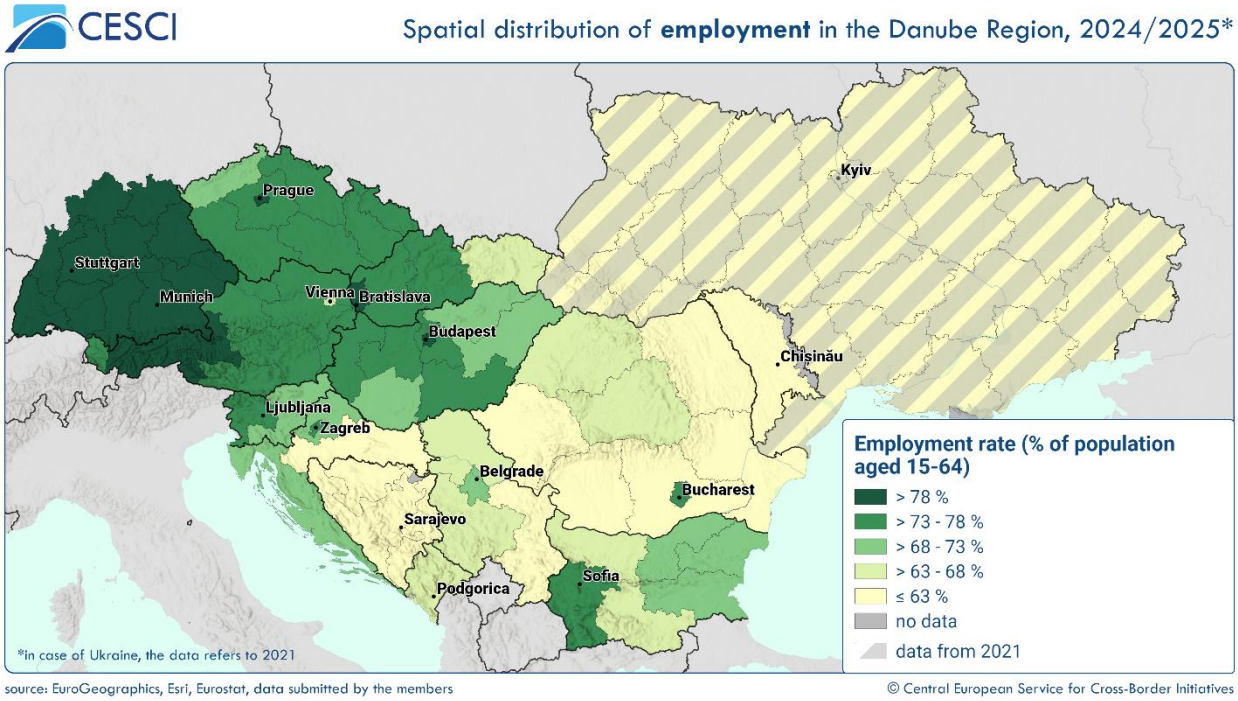


Figure 103: Spatial distribution of employment in the Danube Region

When benchmarked against the European Union average overall employment rate of 71.0%, the Danube macroregion reveals profound spatial fragmentation, characterised by an entrenched, historic East-West divide.

When it comes to categorising the regions, there is the western core, or the engines of labour absorption. The western tier of the macroregion, exclusively comprising regions in Germany and Austria, operates at a level of near-full employment that vastly exceeds the European baseline. These economies possess robust employment ecosystems. This is illustrated by the highest performing clusters in the dataset: Oberbayern (81.3%), Schwaben (81.2%), Niederbayern (81.0%), Tübingen (80.8%), and Salzburg (78.6%).

Another typical type of regions are the capital city islands within a monocentric structure in the eastern and souther part of the Danube Region. Moving eastward, the spatial pattern changes from continuous regional performance into a highly monocentric configuration. In the central and eastern Member States, the competitive capacity of the national labour market is almost entirely concentrated within metropolitan and capital city regions. These capitals stand out solely as vibrant economic islands, disconnected from their stalling national hinterlands. Such regions include Budapest (78.8%), Bratislavský kraj (78.7%), Bucureşti-Ilfov (75.0%) and Grad Zagreb (74.9%). Outside these urban cores, the surrounding provinces frequently drop below the EU average, creating severe sub-national disparities in wage earning and regional development.

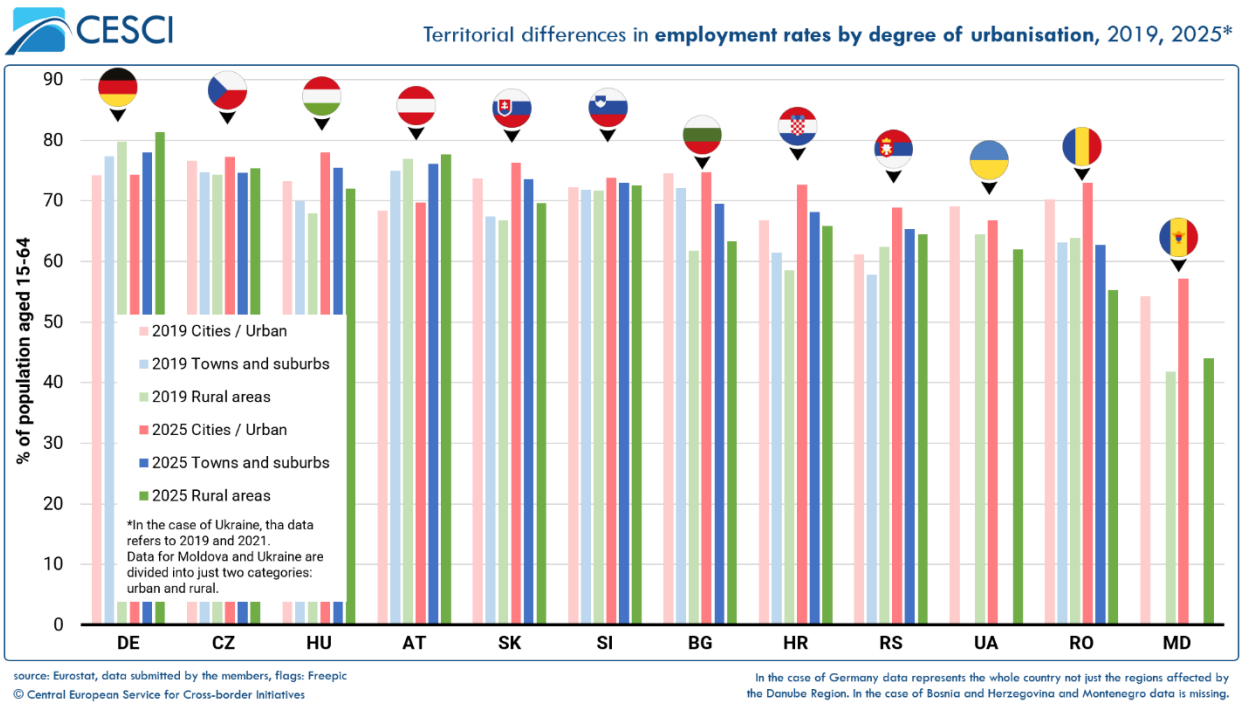


Figure 104: Territorial differences in employment rates by degree of urbanisation in the Danube Region

An evaluation of employment rates by degree of urbanisation across the Danube Region reveals stark territorial inequalities and a fundamental spatial divergence that sharply contrasts with the uniform European Union baseline. Across the EU-27, employment rates in 2025 display almost complete parity across settlement tiers, standing at 71.2% in cities, 70.9% in towns and suburbs, and 70.9% in rural areas. Within the Danube macro-region, however, territories do not conform to a single balance; rather, they are bifurcated into two diametrically opposed spatial models alongside a balanced transition tier. The Western model, embodied by Germany and Austria, is defined by an inverted urban gradient where employment rates reach their highest levels in rural hinterlands (81.3% in Germany and 77.7% in Austria) and intermediate towns and suburbs (78.0% and 76.1% respectively), while dropping to their lowest levels in primary urban centers (74.3% in Germany and 69.7% in Austria), resulting in negative urban-rural gaps of -7.0 and -8.0 percentage points. This Western pattern reflects robust, decentralised industrial Mittelstand networks and competitive rural SME clusters that absorb high volumes of labour, contrasted with metropolitan centers that handle frictional unemployment, structural service transitions, and the labor market integration of migrant populations. In sharp contrast, the Eastern and Southeastern model, encompassing Romania, Bulgaria, Moldova, Croatia, Slovakia, Hungary, Serbia, and Ukraine, is characterised by extreme monocentric polarisation where dynamic capital agglomerations and large cities function as dominant employment engines (reaching 78.0% in Hungary, 76.3% in Slovakia, 74.7% in Bulgaria, 73.0% in Romania, and 72.6% in Croatia), while rural peripheries suffer from acute job deficits (dropping to 63.3% in Bulgaria, 62.0% in Ukraine, 55.3% in Romania, and 44.0% in Moldova). In these Eastern economies, towns and suburbs occupy an intermediate buffer position, while the urban-rural employment divide reaches

dramatic extremes in Romania (a 17.7 percentage point gap), Moldova (13.2 pp), and Bulgaria (11.4 pp), reflecting deep-seated structural underemployment, high early school leaving, and the persistence of low-productivity subsistence agriculture in non-metropolitan areas. A third, highly balanced typology is visible in Czechia and Slovenia, where dense polycentric settlement structures and well-integrated regional transport corridors maintain consistently high employment rates across cities (77.2% in Czechia, 73.8% in Slovenia), intermediate towns (74.6% and 72.9%), and rural areas (75.4% and 72.5%).

Examining the dynamic shifts between 2019 and 2025 illustrates widespread employment expansion across the macro-region, though the trajectory of convergence has been highly uneven. Driven by robust post-pandemic labor absorption, several Central and Southeastern European Member States recorded significant catching-up gains across all settlement types that substantially outpaced the EU average increase of roughly 2.5 to 2.8 percentage points. Croatia achieved the most comprehensive progress, lifting employment rates across its cities (+5.8 pp), towns (+6.6 pp), and rural hinterlands (+7.3 pp to 65.8%), accompanied by strong nationwide gains in Hungary (surging to 78.0% in cities, 75.5% in towns, and 72.0% in rural areas) and Serbia (rising by +7.8 pp in cities and +7.5 pp in towns). In mature Western economies, rural and suburban areas further consolidated their structural dominance, with German rural employment climbing by 1.6 percentage points to breach the 81% mark. Conversely, profound territorial divergence emerged in Romania, where city employment expanded by 2.8 percentage points to 73.0%, while rural employment experienced a severe contraction of 8.6 percentage points (plummeting from 63.9% in 2019 to 55.3% in 2025), significantly deepening the national urban-rural divide. Ukraine also registered employment losses across both urban (-2.3 pp) and rural (-2.5 pp) spaces, reflecting severe wartime dislocations, enterprise destruction, and workforce mobilization. To counteract these widening territorial discrepancies and safeguard the „Right to Stay" across lagging non-metropolitan regions, transnational cooperation needs to prioritise the deployment of „Smart Village" frameworks, digital innovation hubs, and dual vocational education networks that stimulate high-value job creation outside primary metropolises. Concurrently, establishing cross-border labour market observatories and strengthening functional urban-rural partnerships will be essential to diversify peripheral economies, partly reverse youth out-migration, and foster balanced, polycentric employment growth across the entire Danube Region.

An evaluation of employment rates by sex across the Danube Region reveals pronounced territorial inequalities and deep structural divides in gender labour market participation when benchmarked against the European Union average. In 2025, the EU-27 employment rate stood at 80.9% for men and 71.3% for women, resulting in an average European gender employment gap of 9.6 percentage points. Across the Danube Basin, male employment rates exhibit relative stability across most Member States and candidate countries (ranging largely between 68% and

80%), whereas female employment displays extreme spatial divergence, ranging from 74.1% in Germany down to 36.5% in Moldova. The macro-region divides into four distinct gender-equality tiers. The top-performing cluster meets or closely tracks the European female benchmark, characterided by high female participation and narrow gender gaps, led by Germany (74.1% female vs. 80.2% male; a 6.1 percentage point gap), Hungary (71.3% vs. 78.8%; 7.5 pp gap), Czechia (71.2% vs. 80.2%; 9.0 pp gap), Austria (71.0% vs. 77.7%; 6.7 pp gap), and Slovenia (70.4% vs. 75.2%; 4.8 pp gap). Slovenia and Croatia share the narrowest gender employment gaps in the entire macro-region at just 4.8 percentage points. An upper-intermediate tier comprises Slovakia (68.3% female vs. 76.3% male; 8.0 pp gap), Bulgaria (67.5% vs. 74.2%; 6.7 pp gap), and Croatia (66.4% vs. 71.2%; 4.8 pp gap). A third, lower-intermediate tier encompasses territories where female employment remains constrained around the 54% to 62% range, including Montenegro (61.3% female vs. 68.8% male), Serbia (61.1% vs. 71.9%), Ukraine (55.5% vs. 65.7%), and Romania (54.4% vs. 71.4%). At the bottom extreme, acute structural deficits persist in Bosnia and Herzegovina, which records an alarming gender employment divide of 26.1 percentage points (41.9% female vs. 68.0% male), and Moldova, where economic disengagement affects both sexes but leaves female employment at a macro-regional low of 36.5% (vs. 44.5% for men; 8.0 pp gap). This spatial configuration underlines that while Central European manufacturing hubs successfully mobilise female labour, traditional care burdens, insufficient care infrastructure, and large rural informal sectors continue to exclude women from formal employment in parts of Southeastern Europe and the Western Balkans, as vividly illustrated by the wide gaps in Romania (17.0 pp) and Bosnia and Herzegovina (26.1 pp).

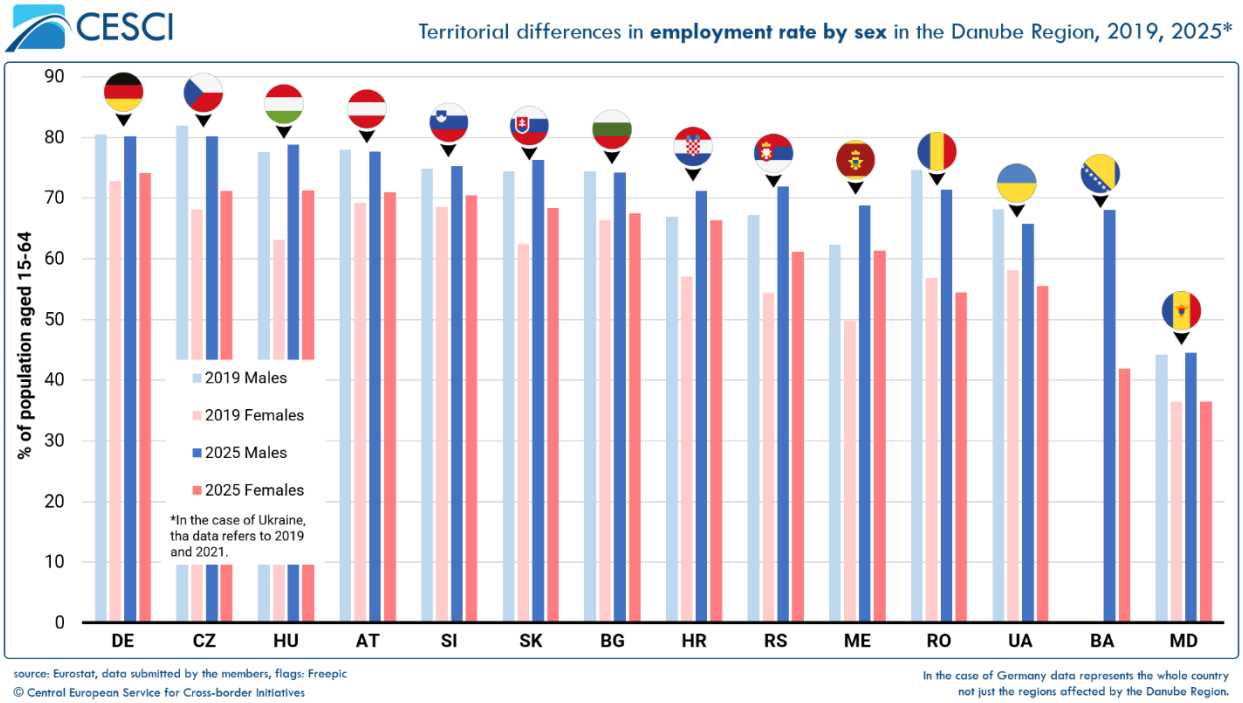


Figure 105: Territorial differences in employment rate by sex in the Danube Region

Examining dynamic developments between 2019 and 2025 highlights an overarching macro-regional convergence process driven by substantial female employment gains that significantly compressed gender gaps across Central Europe and parts of the Western Balkans. The most pronounced upward surges in female labor absorption occurred in Montenegro (+11.6 percentage points, rising from 49.7% in 2019 to 61.3% in 2025; narrowing its gender gap by 5.1 pp), Croatia (+9.3 pp, surging from 57.1% to 66.4%; cutting its gap by 5.0 pp), Hungary (+8.2 pp, climbing from 63.1% to 71.3%; reducing its gap by 6.9 pp), Serbia (+6.8 pp, expanding from 54.3% to 61.1%), and Slovakia (+5.9 pp, from 62.4% to 68.3%), far exceeding male employment increases in the same economies (+1.3 pp to +6.5 pp). In mature western anchors, male employment remained essentially flat or edged slightly downward in Germany (-0.3 pp to 80.2%), Austria (-0.3 pp to 77.7%), and Czechia (-1.7 pp to 80.2%), while female rates continued to expand (+1.1 pp to +3.1 pp), fostering steady internal gap compression. In sharp contrast, structural retrenchment and crisis-driven disruptions characterized the eastern basin: Ukraine experienced contractions for both women (-2.6 pp, falling to 55.5%) and men (-2.4 pp, dropping to 65.7%) due to wartime economic displacement; Romania recorded simultaneous declines for females (-2.4 pp to 54.4%) and males (-3.2 pp to 71.4%), leaving its wide 17.0 percentage point divide entrenched; and Moldova experienced complete female stagnation (0.0 pp change, remaining frozen at 36.5%). To dismantle these persistent gender barriers and mobilise underutilised female talent across lagging peripheries, transnational cooperation must prioritise targeted investments in affordable early childhood education, elderly care infrastructure, and digital upskilling programs in non-metropolitan areas. Furthermore, joint macro-regional initiatives should foster cross-border female entrepreneurship networks and promote flexible, remote-work frameworks that reconcile family life with high-value formal employment, thereby safeguarding the „Right to Stay" across vulnerable candidate and borderland communities.

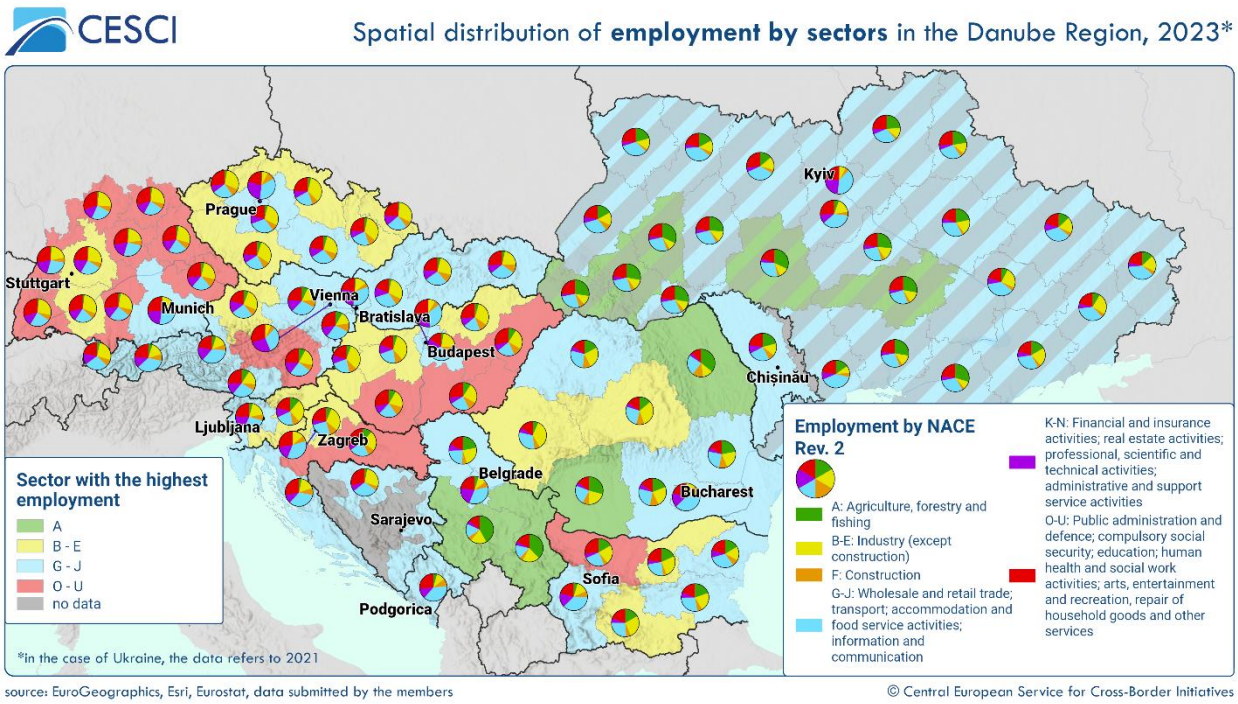


Figure 106: Spatial distribution of employment by sectors in the Danube Region

The spatial distribution of employment by sectors do not follow a uniform pattern; rather, it is sharply differentiated by profound West-East socioeconomic gradients, stark urban-rural disparities, and historical path dependencies. A classification of the regions based on their primary economic sectors creates four distinct macroregional functional typologies, which define the production profiles and socioeconomic trajectories of the regional labour markets.

The first major regional group consists of commercial, trade-dominated, and gateway hubs where NACE sections G-J (encompassing wholesale, retail trade, transport, accommodation, food services, and information and communication) represent the absolute dominant share of employment. Geographically, this cluster manifests as a series of highly competitive metropolitan capital nodes or specialized coastal tourism ribbons that capitalize on exceptional connectivity or significant natural capital. Within this commercial category, Praha stands out with a total employment pool of 1 893 504 where the trade and communication cluster captures 34.9% of the workforce, operating alongside a highly advanced professional services sector at 27.0%. A nearly identical structural configuration is visible in Budapest, which commands a total workforce of 2 750 400 with a 33.3% share in commercial services, and Grad Zagreb, where the sector utilizes 35.6% of its 952 306 workers. Bulgaria's capital region, Yugozapaden, further confirms this metropolitan trend by channeling 37.5% of its 2 215 502 employees into this bracket. Outside of capital cities, this service concentration extends to dominant tourist coastlines like Jadranska Hrvatska, which reports a 33.6% commercial share, and affluent western cores like Oberbayern (DE21), where the sector employs 28.3% of a massive 4 102 060-strong labour force while maintaining a balanced professional service infrastructure.

The second major regional typology forms the industrial and manufacturing belts of the macroregion, defined by a heavy concentration of employment in industry and energy processing under NACE sections B-E. Rather than developing in large capital city markets, these industrial centers are predominantly located in intermediate, highly specialized production zónas integrated into transnational manufacturing chains, particularly automotive and heavy mechanical engineering networks. This specialised production system is exemplified by the Czech region of Severovýchod, where industry claims 33.4% of the total 1 240 915 workers, and Střední Morava, which features a 32.8% industrial share out of 1 005 594 employees. This Central European industrial spine extends into Sjeverna Hrvatska, where manufacturing employs 29.6% of the workforce, and the Czech region of Jihozápad with a 29.1% industrial employment share. Even within the highly developed western margins, intermediate nodes like Stuttgart continue to reflect this manufacturing identity, locking in 26.7% of its 3 324 463 workers in industrial tasks. On the eastern side of the macroregion, Bulgaria's Yuzhen tsentralen acts as a mirror to this profile, anchoring 26.6% of its 1 060 400 workers within industrial production systems.

The third spatial typology is characterized by welfare-driven, institutional, and public service-centric regional economies where NACE sections O-U (covering public administration, defence, education, human health, social work, and community services) comprise the dominant employment block. This group reflects two divergent territorial realities within the Danube space: it captures well-funded, advanced public infrastructure models in Germany and Austria, while simultaneously defining structurally stagnant, peripheral convergence regions. In the highly developed German sub-regions, this institutional dominance is prominent in Unterfranken with a 29.9% share, Oberfranken at 29.5%, Freiburg at 29.4%, and Karlsruhe at 28.1% of total employment. Conversely, in structurally weaker peripheries like Panonska Hrvatska with 28.1% public service employment, and the depopulating Bulgarian region of Severozapaden with 26.3%, the public sector serves as a non-market stabilizing force. In these less competitive zones, the contraction of private corporate investment leaves state administration, schools, and hospitals as the primary avenues for formal regional employment.

The final distinct regional group consists of agrarian and primary sector-dependent peripheries, defined by a high concentration of employment in agriculture, forestry, and fishing under NACE section A. This group includes only four NUTS 2 regions, all located within the southeastern tier of the macroregion, highlighting a persistent core-periphery divide where the transition to high-value manufacturing or modern service sectors remains incomplete. The absolute peak of this primary sector reliance is found in Serbia's Region Sumadije i Zapadne Srbije, where an astonishing 42.0% of the 1 560 529 employees are tied to agricultural livelihoods. This pattern is mirrored in the neighboring Region Juzne i Istocne Srbije, where the primary sector accounts for 37.7% of the workforce. Romania exhibits a similar structural landscape in its northeastern borderlands, with Nord-Est (RO21) registering a 35.6% agricultural share out of 2 726 076

workers, while the south-central region of Sud-Vest Oltenia retains 29.1% of its 1 475 636-strong labor pool within primary sector activities.

The overarching spatial mapping of these four sectoral typologies underscores a highly uneven regional landscape within the Danube macroregion, characterized by a stark gap between advanced corporate services and traditional primary production. While core metropolitan hubs like Prague and Budapest have transitioned into high-value knowledge economies with substantial shares in professional and financial services (NACE K-N reaching 27.0% and 25.2% respectively), this transition is highly localized. The sudden drop in service intensity directly outside these capital boundaries highlights a polarized macroregional structure where capital islands absorb skilled human resources, while peripheral zones remain dependent on basic manufacturing or farming. For the four agrarian outliers, where the primary sector continues to lock in between 29% and 42% of all available labor, this lack of diversification leaves the local economy vulnerable to external shocks, climate fluctuations, and long-term depopulation. This evaluation shows that achieving real territorial convergence across the Danube space requires policy interventions to move beyond general infrastructure projects, focusing instead on targeted industrial diversification and localized service development to bridge the divide between the western core and the southeastern peripheries.

An evaluation of employment rates by educational attainment across the Danube Region on nationa level reveals a dual labour market reality characterised by broad cross-national convergence for highly educated workers alongside extreme territorial fragmentation and exclusion among lower-skilled populations. Across the macro-region, tertiary graduates (ISCED levels 5–8) enjoy consistently high employment rates that cluster tightly between 85% and 92% across almost all participating Member States and candidate countries – led by Bulgaria (91.5%), Hungary (91.1%), Romania (90.1%), Slovenia (89.5%), Slovakia (89.0%), Croatia (88.1%), Germany (87.7%), Czechia (87.5%), Serbia (85.8%), Austria (85.7%), and Bosnia and Herzegovina (82.3%)—with only Montenegro (77.5%), Moldova (63.7%), and Ukraine (63.0%) trailing behind. A secondary layer of regional cohesion appears among medium-skilled workers holding upper secondary and post-secondary non-tertiary qualifications (ISCED levels 3–4), which serve as the primary vocational backbone for Central European manufacturing economies such as Czechia (82.3%), Germany (81.8%), Hungary (79.1%), Slovakia (77.0%), Austria (75.6%), and Slovenia (74.8%), while absorbing lower shares in candidate and eastern partners like Serbia (68.0%), Montenegro (58.9%), Ukraine (51.3%), and Moldova (42.2%). In stark contrast, profound territorial divergence emerges at the low-educational attainment level (ISCED levels 0–2), separating Western economies from the rest of the macroregion. In Germany (50.3%) and Austria (49.6%), approximately half of all low-educated adults participate in the formal labor market, supported by dynamic service sectors and active integration measures. Conversely, low-educated populations face acute labour market marginalisation across Central Europe, the

Western Balkans, and the Eastern Neighborhood, with employment rates plunging to 25.3% in Czechia, 23.9% in Croatia, 20.2% in Bosnia and Herzegovina, 19.6% in Montenegro, 16.0% in Slovakia, and 14.8% in Ukraine. Consequently, the „educational employment premium" (the gap between tertiary and low-educated employment) reaches extraordinary levels in Slovakia (a 73.0 percentage point divide: 89.0% vs. 16.0%), Croatia (64.2 pp), Czechia (62.2 pp), Bosnia and Herzegovina (62.1 pp), Bulgaria (59.9 pp), Montenegro (57.9 pp), and Romania (55.2 pp), which is nearly double the more compressed gaps observed in Germany (37.4 pp) and Austria (36.1 pp).

Examining dynamic developments between 2018 and 2025 illustrates an intensifying structural polarisation, as rapid job expansion for skilled workers coincided with a generalised retrenchment of low-skilled employment outside the western core. Driven by structural modernisation and nearshoring investments, tertiary employment surged significantly across catching-up economies, led by Slovakia (+9.7 percentage points), Serbia (+8.0 pp), Croatia (+6.7 pp), Hungary (+6.1 pp), and Bulgaria (+5.4 pp) while medium-skilled employment expanded robustly in Serbia (+7.5pp), Croatia (+7.2 pp), Hungary (+5.2 pp), Slovakia (+3.0 pp), and Czechia (+2.2 pp). Crucially, however, employment among low-educated workers contracted almost universally across Central and Eastern Europe, marked by sharp drops in Romania (-7.7 pp, falling from 42.6% in 2018 to 34.9% in 2025), Montenegro (-5.8 pp, from 25.4% to 19.6%), Slovakia (-5.1 pp, from 21.1% to 16.0%), Bulgaria (-3.2 pp), Serbia (-3.2 pp), Croatia (-2.1), Hungary (-1.6 pp), and Czechia (-1.2 pp). Only Germany (+2.0 pp) and Austria (+1.4 pp) registered gains in low-skilled labour absorption, underscoring that industrial automation, technological upgrading, and structural transition in post-socialist economies are aggressively displacing low-skilled labour into inactivity. Transnational cooperation could prioritise the development of accessible lifelong learning, adult reskilling, and modernised dual vocational education adapted to the green and digital transitions. Furthermore, joint initiatives should foster transnational university-industry partnerships and localised upskilling hubs in deindustrialised and rural borderlands, transforming unilateral talent „flight" into balanced brain circulation.

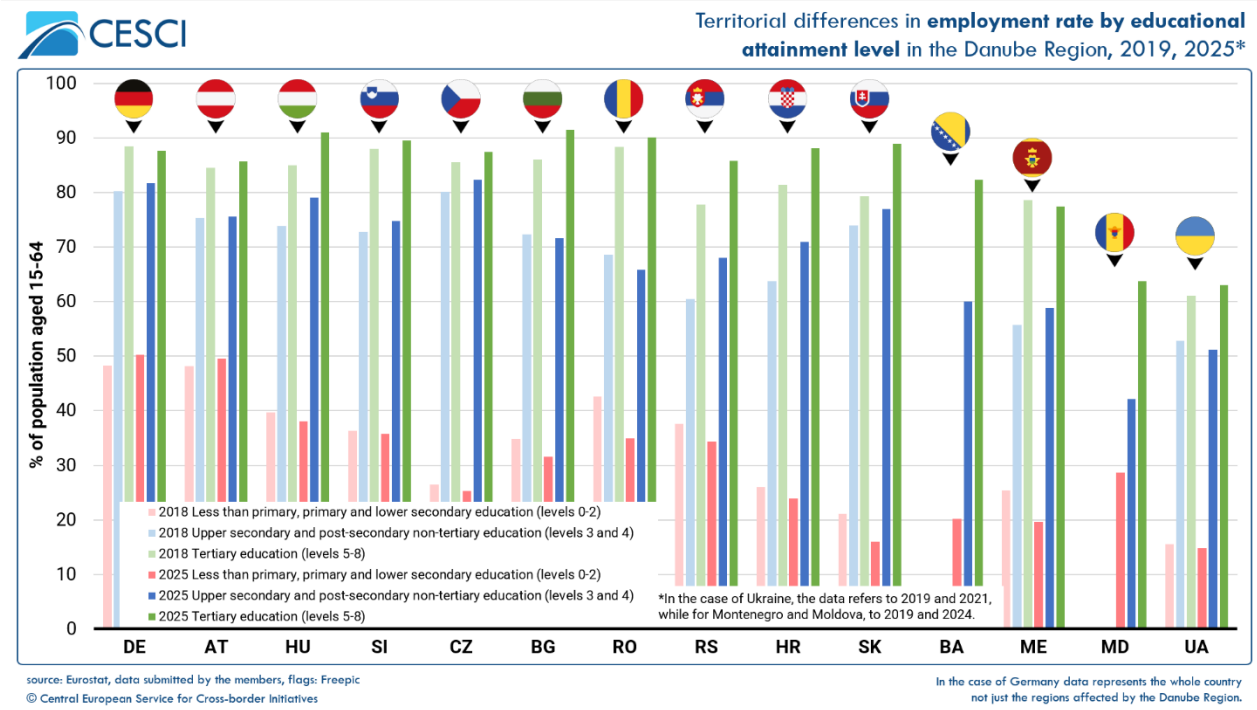


Figure 107: Territorial differences in employment rate by educational attainment level in the Danube Region

Focusing on the employment division of the macroregion based on **educational attainment levels on regional level**, the data demonstrates a robust, systemic correlation between educational attainment and employment levels. Deeper analysis reveals that low educational attainment (Levels 0-2) acts as a far more punitive barrier to employment in the eastern and southern peripheries than it does in the western core, where vocational systems offer better protection for low-skilled groups. To illustrate these structural variations, the regions of the Danube space can be classified into three distinct typologies based on their skill-specific employment profiles:

Group 1 concerns the highly integrated western industrial cores. Its characteristics are the exceptionally high overall employment, balanced by a well-preserved vocational framework that keeps low-skilled employment above or near 50%, alongside high tertiary employment (around 88-90%). These regions involve Oberbayern, Schwaben, Tübingen, and Salzburg, for instance.

Group 2 is for the knowledge-intensive capital hubs of the eastern countries. They are characterised by high total employment driven by a commanding share of high-skilled jobs (Levels 5-8 regularly exceeding 90%), but suffering from extreme polarisation, where the residual low-skilled population suffers from acute labour market exclusion. Examples are Budapest, Bratislava, Zagreb or Bucharest.

Group 3 consists of lagging and structurally distressed southeastern peripheries. These regions are known for severe aggregate underperformance (total employment rates between 56% and 65%), where low overall capacity is compounded by the structural abandonment of the lowest-educated cohorts, who are largely constrained to informal or seasonal sectors. Best examples

include Sud-Est (total: 56.5%, levels 0-2: 29.3%), Sud-Vest Oltenia (total: 56.6%, levels 0-2: 29.6%), Region Juzne i Istocne Srbije (total: 62.1%, levels 0-2: 31.5%), Panonska Hrvatska (total: 63.0%, levels 0-2: 25.2%), and Severozapaden (total: 65.7%, levels 0-2: 26.1%).

From a cohesion policy perspective, these insights confirm that supporting infrastructure alone cannot resolve the macroregion's structural imbalances. Future interventions under transnational frameworks must transition from general funding models toward targeted investments in regional human capital. In the lagging peripheries, funding could target the expansion of local vocational programs, lifelong retraining, and the decentralised development of secondary industrial nodes. Without initiatives to integrate low-skilled and medium-skilled populations into the formal economy, these peripheral regions risk staying confined in a low added-value development trap, further widening the economic divide across the Danube Region.

An evaluation of part-time employment as a share of total employment across the Danube Region reveals an extreme structural and territorial divide, demarcating two fundamentally different labor market regimes across the basin. While the European Union average for part-time work hovers around 17.0%, the Danube macro-region does not cluster around a central median; rather, it splits into an advanced Western flexicurity model on the one hand, and a rigid, full-time-dominated Eastern and Southeastern model on the other. At the upper extreme, Austria (30.06%) and Germany (29.41%) stand as major European outliers, where roughly three out of every ten workers are employed on a part-time basis. This high prevalence is overwhelmingly gendered, with nearly half of all employed women in Austria (49.23%) and Germany (48.63%) working part-time, compared to approximately 12% of men (12.60% in Austria and 12.15% in Germany), reflecting established institutional frameworks for work-life reconciliation, high female participation in service sectors, but also persistent structural shortages in full-day institutional childcare. In stark contrast, all eleven Central, Eastern, and candidate economies in the macro-region record part-time employment shares far below the European benchmark, forming a secondary transitional tier in Slovenia (8.39%) and Czechia (8.05%), and an exceptionally low-prevalence cluster across Moldova (5.36%), Serbia (5.12%), Hungary (4.66%), Slovakia (4.40%), Croatia (3.00%), Montenegro (2.70%), Romania (2.33%), Bosnia and Herzegovina (2.28%), and Bulgaria (1.73%). This generates a vast territorial disparity of more than seventeen times between Austria and Bulgaria, illustrating that part-time work in post-socialist and candidate economies is largely unviable due to lower baseline wage levels, where households cannot afford reduced hours, combined with institutional traditions favouring standard full-time contracts and limited employer offering of flexible arrangements.

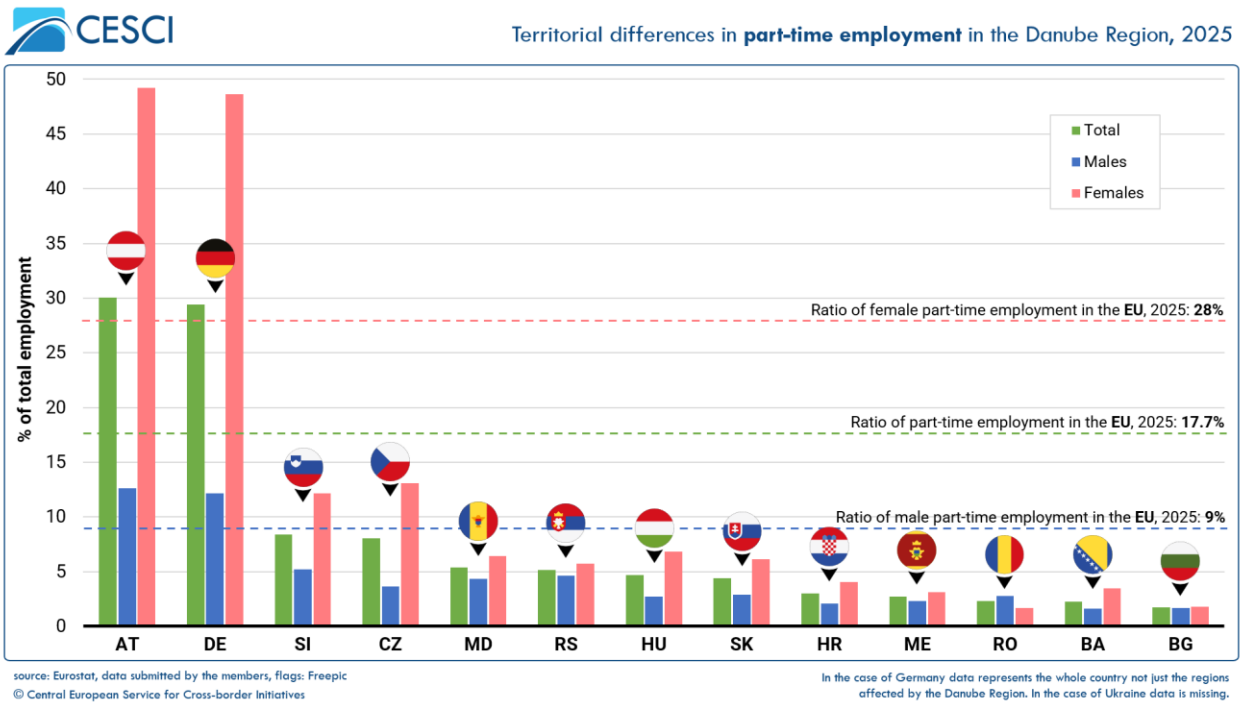


Figure 108: Territorial differences in part-time employment in the Danube Region

Examining gender-specific patterns further deepens this spatial inequality, exposing contrasting labor market dynamics across sub-regions. While Western economies exhibit massive gender part-time gaps exceeding 36 percentage points (where female part-time rates outnumber male rates by four to one), the gender gap narrows substantially in Central Europe (9.41 pp in Czechia and 6.96 pp in Slovenia) and virtually collapses across Southeastern Europe. In Serbia (5.72% for females vs. 4.61% for males; a 1.11 pp gap), Montenegro (3.10% vs. 2.30%; a 0.80 pp gap), and Bulgaria (1.78% vs. 1.69%; a 0.09 pp gap), part-time work is so marginal that gender differentiation disappears, while Romania exhibits an anomalous inverted pattern where male part-time work (2.79%) slightly exceeds female part-time work (1.70%). Rather than voluntary flexibility, the marginal part-time employment observed across the Western Balkans and Eastern peripheries often reflects underemployment, seasonal agricultural casual labor, or involuntary reduced hours due to a lack of full-time opportunities. Transnational cooperation requires the development of quality, protected flexible working regulations and the expansion of affordable early childhood care across Southeastern Europe. Furthermore, joint interventions under the Danube Region Programme should foster peer-learning between western social partners and eastern ministries to promote family-friendly workplace standards, hybrid telework frameworks, thereby supporting work-life reconciliation and protecting the „Right to Stay" across all Danube territories.

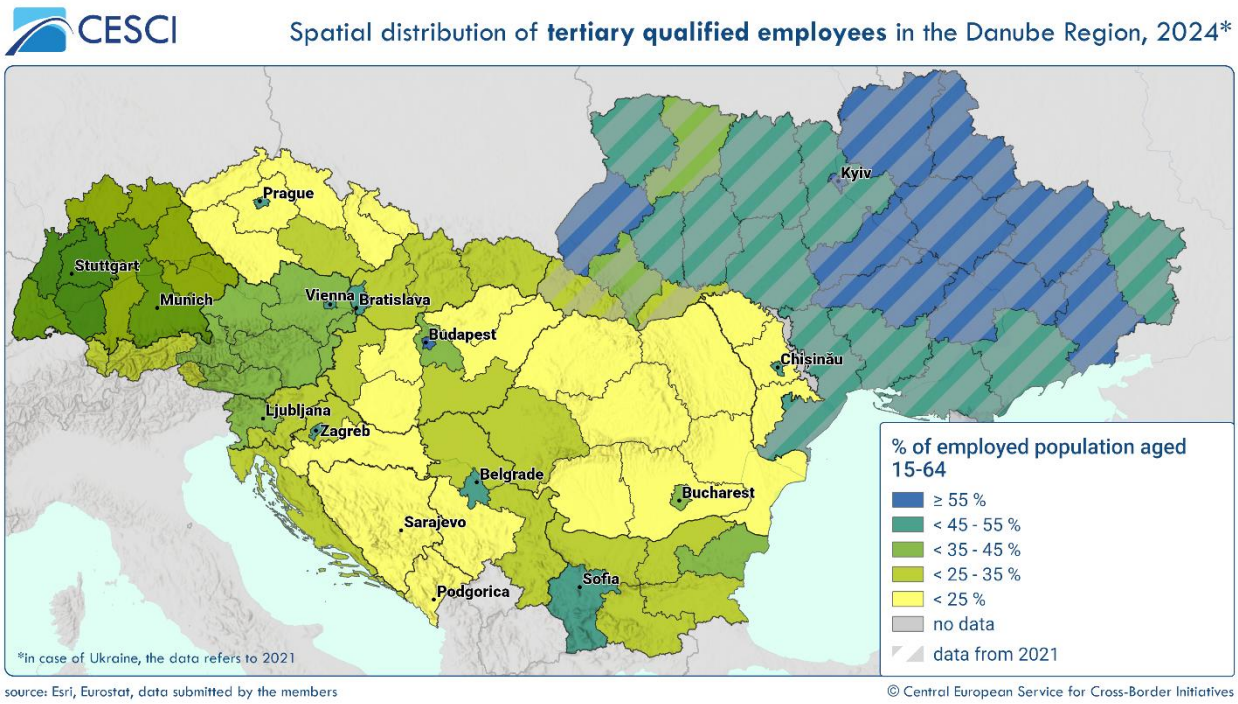


Figure 109: Spatial distribution of tertiary qualified employees in the Danube Region[9]

The 2024 spatial distribution of tertiary-qualified employees (aged 15-64) across the Danube Region illustrates a strong East-West structural dichotomy alongside an acute urban-rural polarisation. The primary joint characteristic across almost all Central, Eastern, and Southeastern European participating states is the prominent "capital city island" phenomenon, where tertiary qualification shares among the employed workforce reach their absolute regional peaks within metropolitan capital agglomerations such as Prague, Bratislava, Budapest, Zagreb, Belgrade, Sofia, Bucharest, and Chisinau. In these primary urban centers, dense university networks, public administration, corporate headquarters, and high-value service sectors concentrate the vast majority of highly educated human capital across national territories.

Beyond these capital islands, however, the macroregion exhibits starkly divergent territorial patterns that separate Western core economies from Eastern and Southeastern peripheries. In Southern Germany (Bavaria and Baden-Württemberg surrounding Munich and Stuttgart) and Austria, high tertiary qualification rates (35-55%) extend across broader regional territories, forming a contiguous, well-balanced cross-border belt of educated workforce. Conversely, across the rural hinterlands, outer borderlands, and non-capital provinces of Czechia, Hungary, Romania, Bulgaria, Serbia, and Bosnia and Herzegovina, tertiary-qualified employment drops sharply into the lowest categories, revealing an entrenched human capital divide between primary metropolises and rural peripheries. Crucially, a major methodological limitation affects the data for Ukraine, which displays exceptionally high pre-war tertiary qualification shares across almost all oblasts; however, because these figures date back to 2021, they fail to reflect the

[9] Due to slight differences in the methodology, data from Ukraine can be taken with restrictions.

severe wartime demographic disruptions, internal displacements, infrastructure destruction, and mass outward migration of over 6 million citizens (disproportionately tertiary-educated women and young adults) triggered by Russia's full-scale invasion since 2022.

These severe spatial imbalances generate critical joint challenges for macroregional cohesion, as the hyper-concentration of tertiary-qualified opportunities in Western hubs and capital cities fuels continuous, skill-selective out-migration from lagging rural peripheries, draining local human capital stocks and accelerating demographic aging. To counteract this talent depletion and safeguard the "Right to Stay" (Droit de Cité), transnational cooperation is needed.

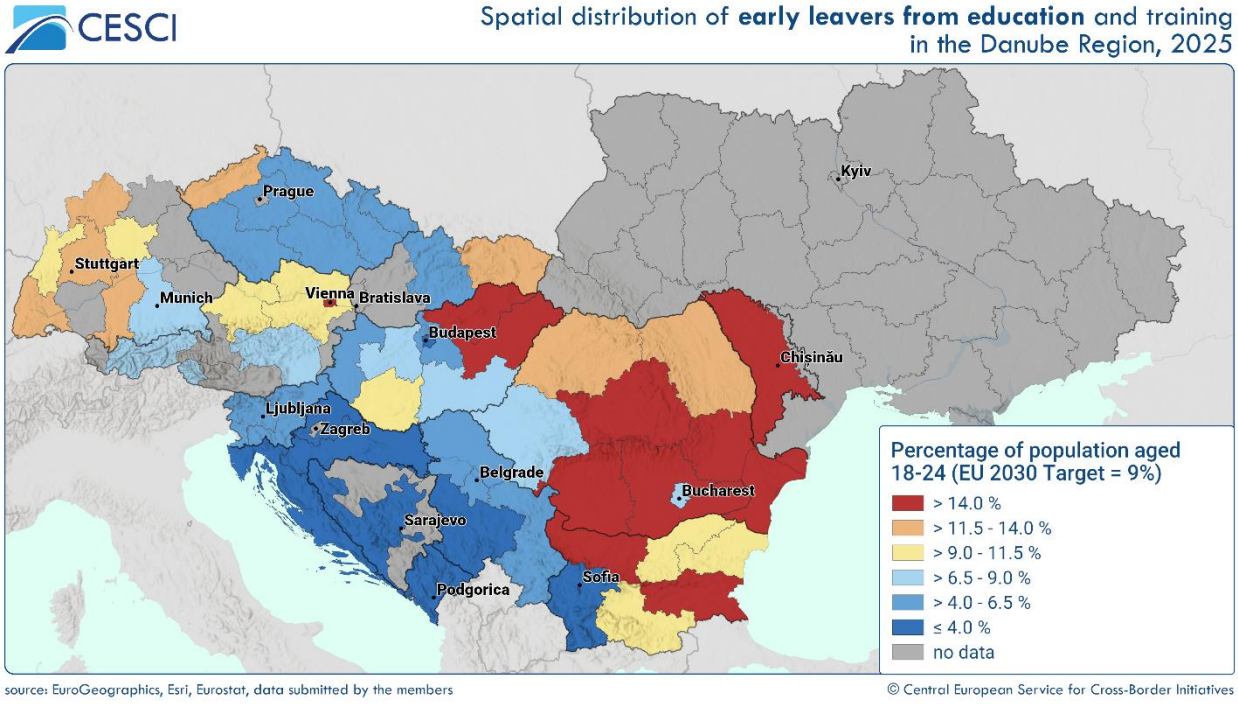


Figure 110: Spatial distribution of early leavers from education and training in the Danube Region

Educational processes within the Danube Region highlight that while certain improvements have been observed in early school leaving in recent years, territorial disparities remain deeply embedded in the region's spatial structure. It can be concluded that the eastern and southeastern peripheries of the macroregion – particularly certain Romanian, Bulgarian, Hungarian, and Slovak territories – persistently and severely underperform, lagging far behind the 9.0% European Union integration target and the 9.1% EU average.

Based on the data of 2025, the absolute worst-performing area is the Sud-Est region in Romania, where the rate of early school leavers reaches a striking 25.1%, closely followed by the Bulgarian Yugoiztochen with 18.9%, Észak-Magyarország in Hungary with 18.8%, as well as the Romanian Centru, Sud-Muntenia, and Sud-Vest Oltenia regions, each displaying a rate above 18.0%. Similarly unfavourable, systemic problems afflict the Bulgarian Severozapaden with its rate of 15.2%, Észak-Alföld with 14.7%, and Východné Slovensko, reflecting Slovakia's internal divide, which, with its index of 11.8%, falls vastly behind the performance of western core areas. A deeper

analysis of these poorly performing, peripheral regions characterised by typically rural, agrarian, or former heavy industrial structures reveals that high dropout rates are driven by complex and cumulative socio-economic determinants, such as intergenerational poverty, the social exclusion of the Roma minority, and institutionalised forms of educational segregation. The infrastructural and methodological shortcomings of the school system, the brain drain of qualified educators, and a local labour market structure built on low value-added, casual work collectively result in youth failing to see the individual return on long-term participation in education, which perpetuates local backwardness.

A sharp geographical contrast to this lagging zone is formed by the macroregion's positively outstanding, successful regions, which boast exemplary educational retention power and developed institutional backgrounds. Croatian regions demonstrate excellent demographic and educational discipline, led by the negligible rates of Jadranska Hrvatska at 2.0% and Sjeverna Hrvatska at 2.3%, but Yugozapaden, which incorporates the Bulgarian capital, also produces a highly favourable value of 2.6%. Integration is similarly successful in the Croatian Panonska Hrvatska, the Šumadija and Western Serbia region in Serbia, and in Budapest, while almost every NUTS 2 region in Czechia, such as Central Moravia or the Southeast, remains stably and uniformly below the EU target. At the same time, an interesting structural anomaly appears, as certain core areas of Austria and Germany, such as Vienna with 14.1% or Swabia with 13.1%, show higher values than the EU average; however, this phenomenon is not the result of classic „backwardness", but rather of urban dropout rates linked to migration backgrounds, as well as the statistical specificities of the dual vocational training system, which in certain cases registers the transition from training to the labour market as early school leaving.

From an educational policy and regional development perspective, the persistently high proportion of early school leavers directly contributes to the affected eastern and southern peripheral regions getting stuck in a development trap, as the lack of skilled human capital makes it virtually impossible to shift the local economic and employment structure onto modern, knowledge- and technology-intensive foundations. Desegregation and early childhood development programs targeting educational inequalities must be placed at the core of funding interventions; otherwise, social mobility in these disadvantaged areas will permanently stagnate, and socio-economic resilience will remain at a low level.

Cross-border labour (and student) mobility

In labour mobility wages, especially territorial inequalities and gaps in Europe play a crucial role. An evaluation of average monthly net earnings across the Danube Region illustrates an entrenched East-West wage disparity, where the overwhelming majority of participating countries significantly underperform European standards and remain locked in low-earning wage regimes. Against the European Union average baseline of 2,496 EUR in 2025, only Austria

(3,529 EUR) and Germany (3,045 EUR) provide earnings above the continental benchmark, while all other reporting Danube economies fall considerably below it. Even the most prosperous Central European transition state, Slovenia (2,023 EUR), lags behind the EU average, followed by Czechia (1,742 EUR), Slovakia (1,508 EUR), Croatia (1,408 EUR), and Hungary (1,286 EUR), before dropping to severely depressed baselines in Bulgaria (1,204 EUR), Romania (1,156 EUR), Montenegro (1,012 EUR), and Moldova (675 EUR). This spatial distribution creates a dramatic macro-regional wage gap of more than 5.2 times between Austria and Moldova, and a persistent 2.5- to 3-fold compensation gulf separating the German-Austrian core from Southeastern Europe. This severe income divergence serves as a primary structural driver of demographic erosion and selective „brain drain", compelling young, tertiary-educated talent and vital healthcare, engineering, and educational professionals to leave lower-income peripheral hinterlands for higher-paying metropolitan or western labour markets. The resulting outflow inflicts acute skilled labour shortages, weakens tax bases, and accelerates depopulation across source economies, while simultaneously reinforcing intense cross-border and transnational labour commuting flows along internal borders exemplified by daily workers crossing from Slovakia and Hungary into Austria. Furthermore, these persistent earning and cost-of-living differentials induce asymmetric residential mobility, whereby individuals relocate to lower-cost housing markets across adjacent borders while maintaining higher-wage employment in neighbouring states, underscoring the urgent need to accelerate regional economic convergence, and foster high-value local employment.

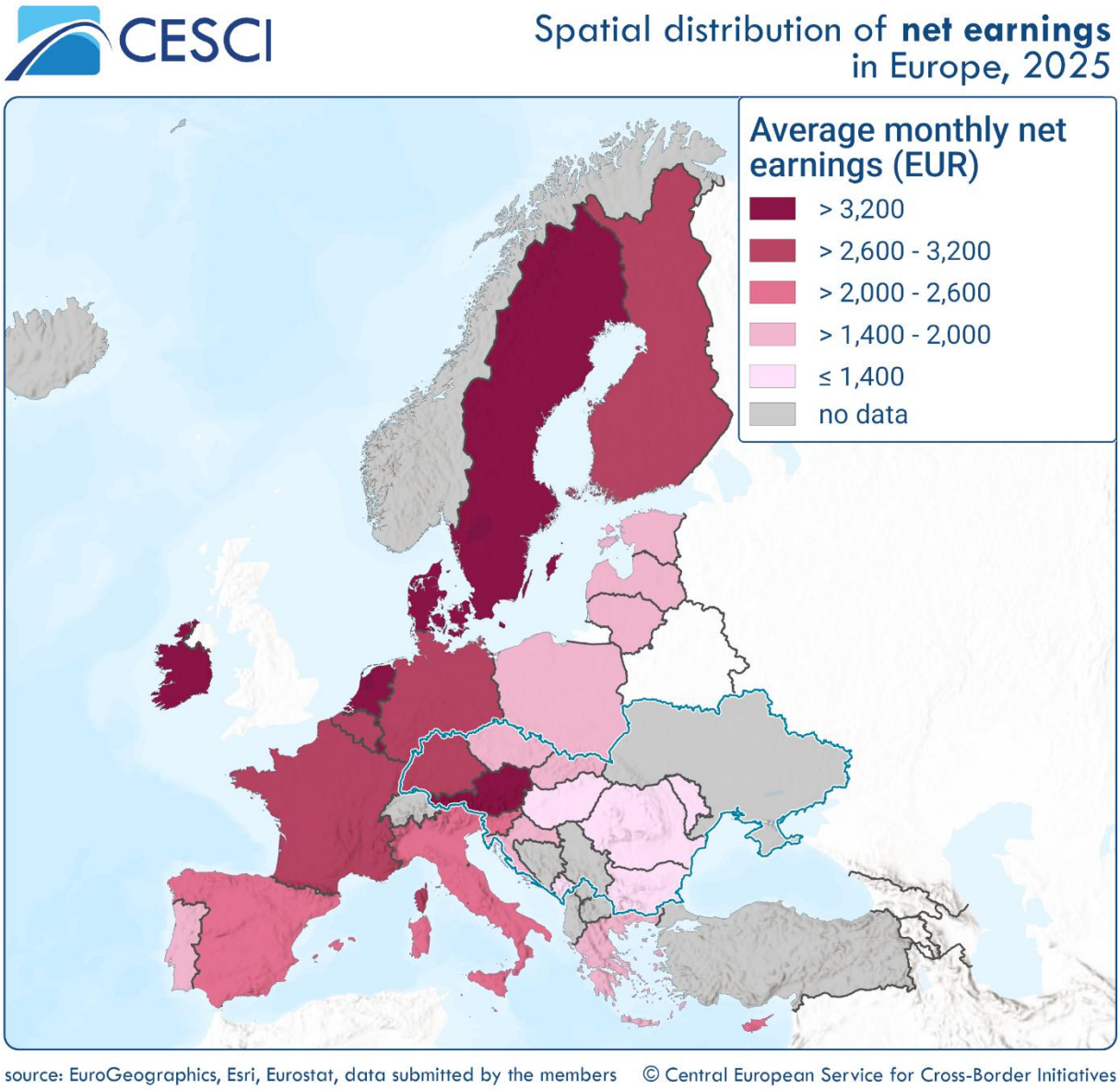


Figure 111: Spatial distribution of net earnings in Europe

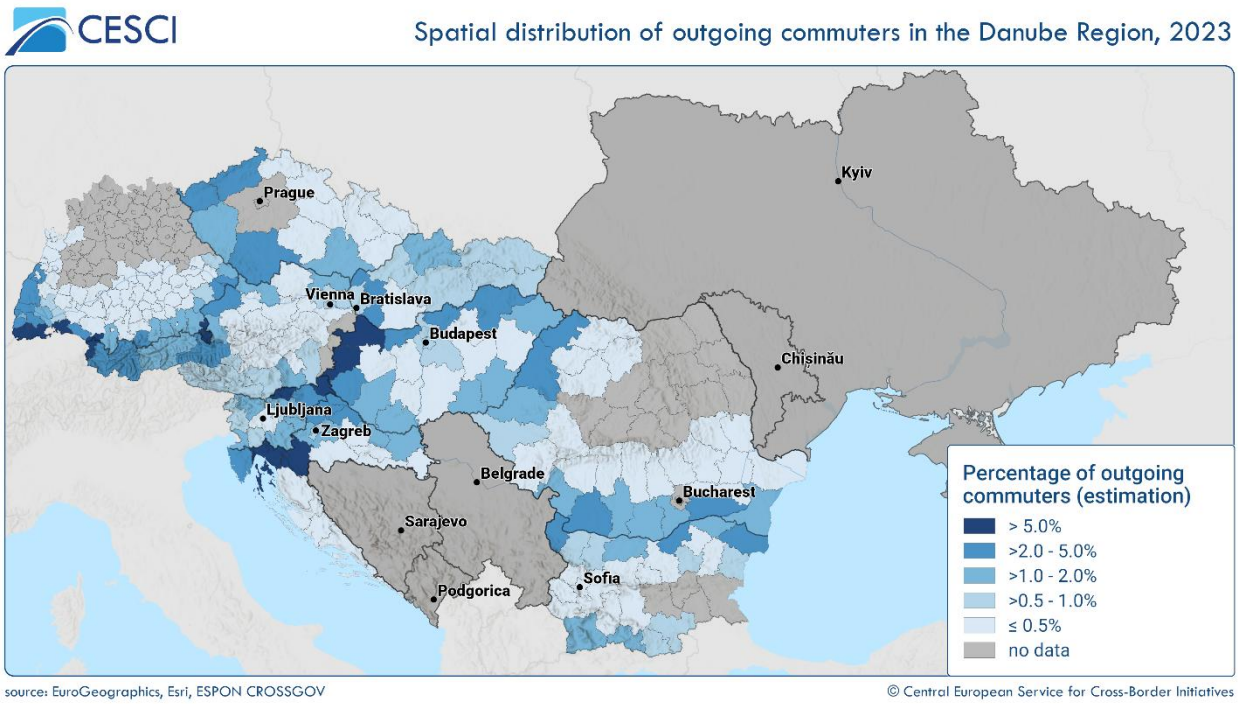


Figure 112: Spatial distribution of outgoing commuters in the Danube Region

The spatial distribution of cross-border commuters serves as a vital indicator of functional labour market integration and the degree to which administrative barriers have been mitigated. Based on the statistical evidence, the Danube Region remains a highly fragmented space, where high-intensity flows of labour are concentrated in specific border clusters, while extensive inland and peripheral areas remain isolated from transnational employment opportunities.

The data reveals profound territorial inequalities in the share of employees employed across national borders. Hotspots of high labour integration, where the highest ratios of cross-border commuters are predominantly located are situated in the western and central parts of the macroregion, particularly along the borders of Germany, Austria, Slovenia, and Hungary. Berchtesgadener Land (13.1%) and Waldshut (11.9%) represent the peak of labour mobility, benefiting from their proximity to high-wage employment centers and mature transport links in the vicinity of Switzerland (the vivid labour market destination of Basel and Zürich in particular). Similarly, Pomurska (9.6%) in Slovenia and Győr-Moson-Sopron (9.5%) in Hungary exhibit high levels of integration, likely driven by the strong manufacturing and trade ties with the German-speaking core and the overcoming of formerly strong East-West divides. Regarding functional areas, transboundary cross employment zones are also visible in the Austrian-German-Swiss border areas (Rheintal-Bodenseegebiet, 9.1%; Lörrach, 8.4%) and the northern Balkan regions (e.g. Karlovačka županija, 8.8%), where historical coexistence and linguistic proximities facilitate the development of transboundary functional urban and labour market catchment areas.

Regions in "labour shadow" represent a substantial portion of the macroregion. Many regions exhibit near-zero cross-border commuting. This includes major metropolitan hubs like Sofia

(stolitsa) and Ingolstadt, where strong internal labour markets and central settlement functions reduce the necessity for outward mobility, where there are mo major pull factors such as high wages. Furthermore, many regions in Bulgaria and Romania (e.g., Gabrovo, Dâmbovița) remain isolated from transnational labour flows also due to insufficient border crossing density and unfavorable traffic infrastructure, particularly along the southeastern border sections.

Focusing on cohesion policy implications, the current landscape demonstrates that while functional labour integration has been flourishing in distinct western clusters, the southeastern peripheries remain characterised by hard administrative and infrastructure barriers that hinder the labour market integration of communities and the flow of skilled workforce. To achieve true territorial cohesion, future policy interventions must move beyond infrastructure-led developments to prioritise the harmonisation of labour market regulations and the support of institutionalised cross-border governance solutions to tackle the legal obstacles to well-functioning integration and also to unlock the potentials of a stronger labour market integration for many border regions especially along the external border of the EU. The emergence of functional areas in employment, i.e. cross-border or trinational catchment areas put on emphasis on the need for information services and better coordination with regard to life events in connection with working abroad within the macroregion (e.g. cases of social security, assurances and taxes, acceptance of certain qualifications and diplomas).

3.3.4 Interethnic conditions and cultural relations

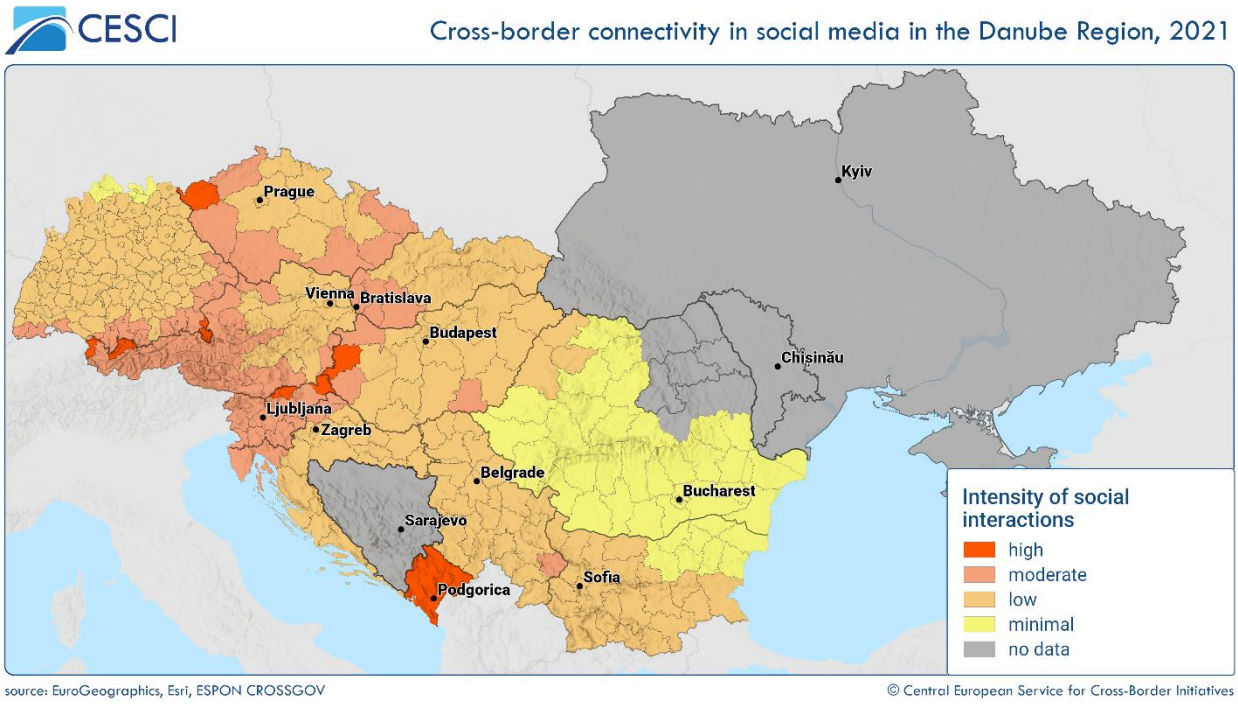


Figure 113: Cross-border connectivity in social media in the Danube Region

The assessment of social integration utilises the Social Connectedness Index (SCI), which provides an overview of the cross-border social connectedness and personal interactions of inhabitants within border areas. The data visualises the likelihood of Facebook users from one region having friend connections in the neighboring cross-border region, reflecting the intensity of interpersonal and cultural knowledge across state lines. These values are classified into four intensity levels, where minimal represents the lowest probability of cross-border connection and high stands for the highest probability of cross-border connection. While not all digital connections imply active communication – as some relate to merely "following" content– this indicator serves as a symptomatic proxy for the social media landscape and the degree of sociocultural familiarity between neighbouring populations.

Focusing on the territorial analysis, the spatial configuration of the SCI reveals profound territorial inequalities, largely mirroring the historical and political fragmentation of the Danube Region. High and moderate levels of social connectivity are predominantly concentrated in the central and western clusters of the macroregion, particularly where historical ties and integrated labour markets are strongest. Most evident examples for this include regions involving social exchanges between Germany (e.g. Berchtesgadener Land) and Austria, Austria and Hungary (e.g. Vas). High share of national territories represent at least moderate intensity in Montentegro, Slovenia, Czechia and Austria.

Conversely, a "social connectivity shadow" persists in the southeastern peripheries and along the external borders of the European Union. Excluding Montenegro with its strong ties with the Western Balkan countries social interactions represent a rather low or minimal level of intensity across the majority of regions east of the Austrian-Hungarian-Slovenian-Croatian border zone. Almost all the regions with minimal intensity can be found in Romania and Bulgaria. Regions in Romania, Bulgaria and Serbia frequently display minimal or low connectivity intensity. These low values highlight a significant lack of social integration, where administrative barriers, language differences, and the separating role of non-Schengen borders continue to hinder the flow of interpersonal and cultural knowledge. This geographical disparity underscores a macroregion where the central-western core is increasingly integrated, while the eastern borderlands remain socially isolated from their immediate neighbours.

The current landscape indicates that the digital and social divide between the western core and the eastern peripheries remains a decisive barrier to cohesion; therefore, future regional development and cohesion policy must prioritise "soft" interpersonal activities and the promotion of digital cultural exchange to build the social capital and trust necessary for functional cross-border cooperation in currently rather isolated territories.

The Danube Region represents one of the most culturally, ethnically, and confessionally multifaceted spaces on the European continent, where centuries of imperial transitions, migrations, and shifting borders have forged an intricate human mosaic. An analysis of the spatial distribution of places of worship derived from the OpenStreetMap (OSM) database vividly illustrates the physical manifestation of this pluralism, revealing how sacred architecture delineates the historical, spiritual, and civilizational intersections of the macro-region. Within this shared river basin, Western Catholicism, Eastern Orthodoxy, Protestantism, Islam, and Judaism converge, forming a complex territorial pattern that mirrors the region's diverse heritage.

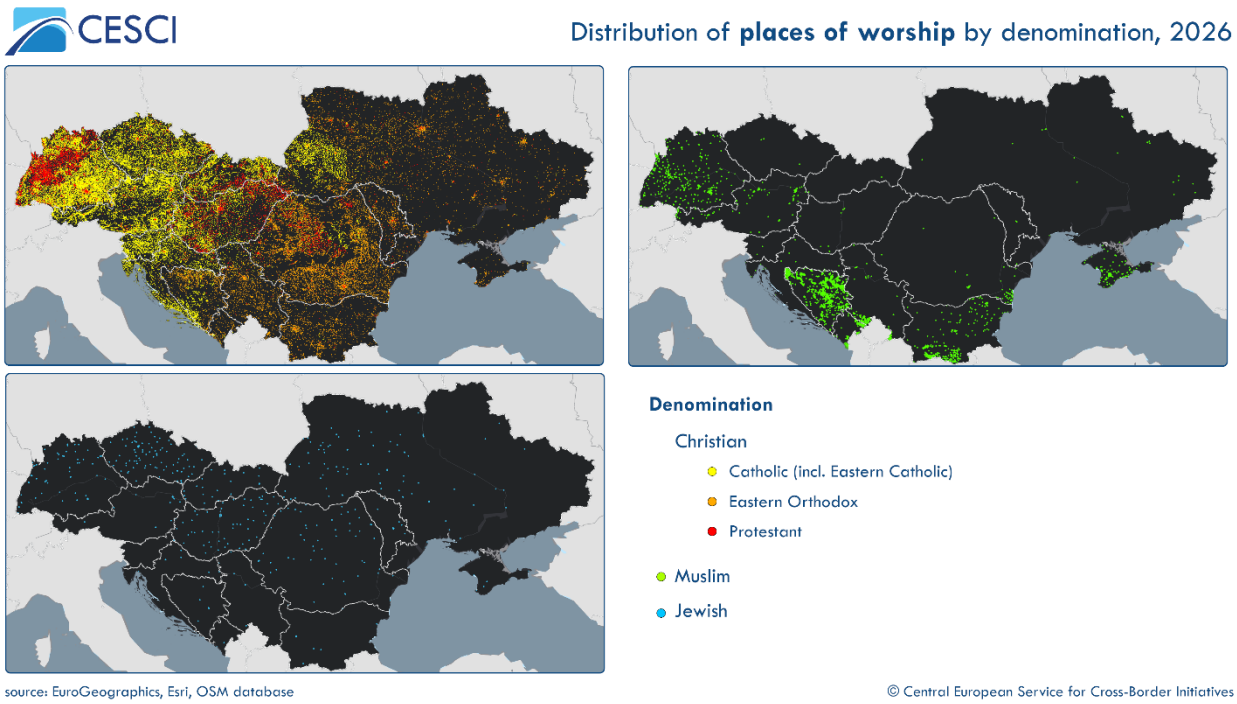


Figure 114: Distribution of places of worship in the Danube Region

The spatial configuration of Christian places of worship exhibits a clear East-West confessional division across the basin. Roman Catholicism, including Eastern Catholic rites, forms a dense, continuous web of sacred sites across the upper and central territories, dominating Southern Germany, Austria, Czechia, Slovakia, Hungary, Slovenia, and Croatia, with historic extensions reaching into Transylvania in Romania, Vojvodina in Serbia, and Western Ukraine. In contrast, Eastern Orthodoxy constitutes the predominant religious infrastructure across the eastern and southern basin, anchoring expansive networks across Romania, Bulgaria, Serbia, Montenegro, Moldova, and Ukraine, alongside substantial parts of Bosnia and Herzegovina. Interspersed within these spaces, Protestant places of worship highlight historical Reformation hubs, notably clustered in Baden-Württemberg and northern Bavaria, eastern Hungary's eastern regions, and historical enclaves in Transylvania (with comtemporary Hungarian and former Saxon population) and southern Slovakia.

Beyond Christianity, the territorial footprint of Islamic and Jewish places of worship illustrates the macro-region's profound cultural layers. Muslim sacred sites display a dense, historic concentration in the Western Balkans – most prominently throughout Bosnia and Herzegovina, southern Serbia, and Montenegro in areas such as Sandžak –but also across southern Bulgaria (Pomaks), Romanian Dobrogea, and Ukraine's Crimean peninsula (with Tatar population), while also emerging in German and Austrian urban agglomerations due to contemporary demographic mobility (including, among others Turkish and Kurdish guest workers, migrants from the Middle East and Turkey). Concurrently, Jewish places of worship, though profoundly scarred by twentieth-century tragedies, form a pan-regional constellation. Synagogues and memorial sites remain embedded across primary urban gateways like Vienna, Prague, Budapest,

Bucharest, Kyiv, and Sarajevo, as well as historic market towns throughout Central Europe, Galicia, and Bukovina.

This cultural tapestry reflects a territory marked by rich historical ties alongside deep historical grievances and war-torn legacies, from the Yugoslav conflicts to the ongoing war against Ukraine. Yet, this shared space demonstrates that diverse communities have coexisted for centuries, generating unique architectural, linguistic, and spiritual synergies. In this sensitive geopolitical landscape, European integration and the Danube Region Programme serve as vital instruments for peace, reconciliation, and cross-border cooperation. By mobilising the principle of „unity in diversity", the macro-region can transform its shared sacral and cultural heritage into a strategic driver of social well-being, utilizing joint cultural routes, heritage preservation, and intercultural dialogue to bridge past divisions and foster sustainable prosperity.

NEXT STEPS IN DATA VISUALISATION

Additional figures to be created:

- Spatial distribution of the population by citizenship in the Danube Region
- Spatial distribution of the population by spoken language in the Danube Region

IV STAKEHOLDER ANALYSIS

This chapter will be finalised after the stakeholder consultation process.

ANNEX 1 – TABLE OF FIGURES

Figure 1: Biogeographical regions in the Danube Region ... 13
Figure 2: Ecological regions in the Danube Region ... 14
Figure 3: Soil types in the Danube Region ... 15
Figure 4: Land cover in the Danube Region ... 16
Figure 5: Protected areas in the Danube Region ... 17
Figure 6: Natura 2000 and nationally designated areas in the Danube Region ... 18
Figure 7: Ratio of Natura 2000 areas in the Danube Region ... 19
Figure 8: Chemical status of the rivers in the Danube River Basin, source: ICDPR ... 22
Table 1: Transboundary water supplies ... 24
Figure 9: Chemical status of groundwater bodies of basin-wide importance in the Danube River Basin, source: ICDPR ... 26
Figure 10: Spatial distribution of large floods in the Danube Region ... 27
Figure 11: Bratislava Devín, Budapest, Smederovo – Dainly mean river discharge ... 29
Figure 12: Budapest, Bratislava Devín, Belgrade – Daily mean water level ... 30
Figure 13: Šentjakob, Jesenice na Dolenjskem, Sremska Mitrovica – Daily mean water level ... 31
Figure 14: Changes in Europe's climate types according to the Köppen-Geiger classification ... 32
Figure 15: Meteorological droughts duration in the Danube Region ... 34
Figure 16: Aridity Actual in the Danube Region ... 35
Figure 17: Spatial distribution of fire events in 2026, source: JRC, EFFIS (European Forest Fire Information System) ... 37
Figure 18: Territorial differences in biocapacity deficit in the Danube Region ... 39
Figure 19: Components of the ecological footprint in the Danube Region ... 40
Figure 20: Relation between the ecological footprint and HDI in the Danube Region ... 41
Figure 21: Greenhouse gas emissions in the Danube Region ... 43
Figure 22: Organic area share of total farmland in the Danube Region ... 44
Figure 23: Territorial differences in recycling rate of municipal waste in the Danube Region ... 45
Figure 24: Territorial differences in recycling rates for packaging waste in the Danube Region ... 46
Figure 25: Generation of waste by category in the Danube Region ... 48
Figure 26: Generation of waste by hazardousness in the Danube Region ... 49
Figure 27: Generation of waste in the Danube Region ... 51
Figure 28: Gross value added of circular economy sectors ... 52
Figure 29: Theoretical internal cross-border hinterlands of the main and subcenters of the Danube Region ... 54
Figure 30:Cross-border functional areas in Europe, source: ESPON CROSSGOV project ... 55
Figure 31: Access to elderly care facilities by car, source: ESPON DESIRE project ... 57
Figure 32: Spatial accessibility of secondary schools, source: ESPON TNCOOP project ... 58
Figure 33: Spatial accessibility of hospitals, source: ESPON TNCOOP project ... 59
Figure 34: Changes in inland house prices in the Danube Region ... 60
Figure 35: Spatial distribution of number of households by degree of urbanisation ... 61
Figure 36: Status of EU enlargement and border crossing points in the Danube Region ... 64
Figure 37: Cross-border regions and temporary border control in the Danube Programme Area ... 65
Figure 38: Trust in the European Union according to public opinion in the Danube Region ... 68
Figure 39: Territorial differences in E-Government Development Index in the Danube Region ... 70

Figure 40: Interreg cooperations in the Danube Region 71
Figure 41: Territorial differences in GDP per capita in the Danube Region on national level (2018-2025) 74
Figure 42: Territorial differences in GDP growth in the Danube Region on national level (2018-2025) 75
Figure 43: Spatial distribution of GDP in Europe on regional level 77
Figure 44: Spatial distribution of GDP per capita in Europe on regional level 78
Figure 45: Spatial distribution of GDP in the Danube Region, 2023 80
Figure 46: Spatial distribution of GDP per capita in the Danube Region 80
Figure 47: Changes (volume) in GDP per capita 81
Figure 48: Changes (%) in GDP per capita 82
Figure 49: Agriculture, value added (% of GDP), 2017-2025 84
Figure 50: Industry, value added (% of GDP), 2017-2025 85
Figure 51: Spatial distribution of industrial units in Europe 87
Figure 52: Services, value added (% of GDP), 2017-2025 89
Figure 53: Sectors, value added (% of GDP) in the Danube Region, 2017-2025 90
Figure 54: Territorial differences in HDI in the Danube Region 91
Figure 55: Spatial distribution of bed-places in the Danube Region 93
Figure 56: Spatial distribution of overnight stays in the Danube Region 94
Figure 57: Share of tourists within the macroregion coming from Danube Region countries 97
Figure 58: Changes in number of SMEs, 2021-2024 98
Figure 59: Number of SMEs as a % of total enterprises, 2021-2024 100
Figure 60: Proportion of SMEs by sector, macroregional level 101
Figure 61: Proportion of SMEs by sector, national level 102
Figure 62: Turnover of SMEs by sector, national level 103
Figure 63: Value added at factor cost of SMEs as a % of value added of enterprises in the Danube Region 105
Figure 64: Spatial distribution of RDI in GDP (%) in the Danube Region 106
Figure 65: Intramural RDI expenditure (GERD) by sectors of performance in Europe 109
Figure 66: Proportion of innovative enterprises of all enterprises in the Danube Region 110
Figure 67: Employment in information and communication in the Danube Region 112
Figure 68: Human resources in science and technology in the Danube Region 113
Figure 69: Spatial distribution of employment in high-technology sectors in the Danube Region 114
Figure 70: Spatial distribution of Thematic Smart Specialisation Partnerships in the Danube Region 116
Figure 71: Spatial distribution of cluster collaborations in the Danube Region 117
Figure 72: Composition and intensity of FDI relations within the Danube Region based on inward FDI from the countries of the microregion 120
Figure 73: Patent applications to the EPO in the Danube Region, co-patent connections 122
Figure 74: TEN-T network in the Danube Region and its extension to the neighbouring countries 123
Figure 75: Spatial distribution of motorway network in the Danube Region 127
Figure 76: Spatial distribution of road freight transport volume in the Danube Region 128
Figure 77: Spatial distribution of railway lines in the Danube Region 129
Table 2: Data of the most significant ports along the Danube 130
Figure 78: Air freight traffic in the Danube Region, 2017-2025 132
Figure 79: Mobile cellular subscriptions in the Danube Region 133
Figure 80: Spatial distribution of broadband access in the Danube Region 134
Figure 81: Territorial differences in total primary energy production in the Danube Region, 2016-2024 136
Figure 82: Territorial differences in final energy consumption in the Danube Region, 2016-2024 138
Figure 83: Share of fossil fuels in gross inland energy consumption in the Danube Region 139

Figure 84: Share of renewable energy in gross final energy consumption 141
Figure 85: Renewable energy sources within primary energy production in the Danube Region 142
Figure 86: Territorial differences in energy dependence in the Danube Region 144
Figure 87: Untapped potential from solar, wind and hydro power by NUTS3 region, source: European Commission (2024): Ninth report on economic, social and territorial cohesion 146
Figure 88: Spatial distribution of tertiary education in the Danube Region 148
Figure 89: Students enrolled in tertiary education by educational fields in the Danube Region 149
Figure 90: Spatial distribution of population in the Danube Region 152
Figure 91: Spatial distribution of net migration in the Danube Region 153
Figure 92: People living outside their country of birth in the Danube Region 156
Figure 93: Spatial distribution of beneficiaries of temporary protection from Ukraine in Europe 158
Figure 94: Spatial distribution of population change in the Danube Region 160
Figure 95: Spatial distribution of ageing index in the Danube Region 162
Figure 96: Spatial distribution of old-age population in the Danube Region 164
Figure 97: Spatial distribution of people with less than primary, primary and lower secondary education level in the Danube Region 166
Figure 98: Spatial distribution of at-risk-of-poverty rate in the Danube Region 168
Figure 99: Territorial differences in unemployment rate in the Danube Region, 2018-2025 169
Figure 100: Spatial distribution of unemployment in the Danube Region 170
Figure 101: Territorial differences in unemployment rates by degree of urbanisation in the Danube Region 172
Figure 102: Territorial differences in employment rate in the Danube Region, 2018-2025 174
Figure 103: Spatial distribution of employment in the Danube Region 175
Figure 104: Territorial differences in employment rates by degree of urbanisation in the Danube Region 176
Figure 105: Territorial differences in employment rate by sex in the Danube Region 178
Figure 106: Spatial distribution of employment by sectors in the Danube Region 180
Figure 107: Territorial differences in employment rate by educational attainment level in the Danube Region 184
Figure 108: Territorial differences in part-time employment in the Danube Region 186
Figure 109: Spatial distribution of tertiary qualified employees in the Danube Region 187
Figure 110: Spatial distribution of early leavers from education and training in the Danube Region 188
Figure 111: Spatial distribution of net earnings in Europe 191
Figure 112: Spatial distribution of outgoing commuters in the Danube Region 192
Figure 113: Cross-border connectivity in social media in the Danube Region 194
Figure 114: Distribution of places of worship in the Danube Region 196

ANNEX 2 – DOCUMENT ANALYSIS

Pálvölgyi, T. & Reich, G. – Global, European and Hungarian Water Policies

- Type: Research publication / sectoral policy paper
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 3 (Integration & Special Territorialities)

Executive summary The paper provides a strategic review of global (UN), European (EU Water Framework Directive, Floods Directive), and national (Hungarian National Water Strategy) water policy frameworks. It addresses the escalating global water crisis driven by climate change and unsustainable human activities, advocating for the systematic integration of water security, climate adaptation, and transboundary diplomacy across macro-regions.

Key findings & relevance to the Danube Region

- Climate adaptation & water scarcity (SO 2.4, SO 2.5): The study highlights critical climate vulnerabilities in the Danube and Carpathian Basin, such as severe drought exposure, groundwater table subsidence, and flood risks. It stresses a necessary shift from reactive disaster management to proactive landscape-based water retention, Nature-based Solutions (NbS), and circular water management.
- Transboundary integration & governance (SO 2.5, ISO 1.1): Highlighting the extreme hydrological exposure of downstream areas (where up to 95% of surface waters originate beyond national borders), the paper demonstrates that water issues are inherently transboundary. It emphasises the EU Strategy for the Danube Region (EUSDR Priority Areas 4 and 5) and the International Commission for the Protection of the Danube River (ICPDR) as vital cooperation frameworks for harmonised river basin management and risk prevention.
- Core implementation & governance challenges: The study identifies critical regulatory bottlenecks, particularly the WFD's narrow focus on ecological protection without integrating socio-economic sectoral needs. Operationally, the region faces severe infrastructure deficits, including aging water supply networks (>50% worn-out pipelines) and fragmented municipal governance. These are compounded by acute spatial exposure to climate risks, where massive flood hazards (e.g., 1.2 million residents at risk in the Tisza Basin) and worsening drought pressures severely threaten local resilience.
- Post-2027 strategic policy directions: Recommends aligning water-climate policies across Danube and V4/Carpathian Basin countries, integrating water security into post-2027 EU policy revisions (such as the Water Framework Directive), and strengthening cross-sectoral governance to balance socio-economic needs with aquatic ecosystem protection.

Priority Area 10 & DCSF – 12 Theses from the 12th Danube Participation Day

- Type: Policy declaration / action plan & stakeholder recommendations
- Thematic alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration - Special Territorialities)

Executive summary: This strategic document synthesises outcomes from the 12th Danube Participation Day in Sarajevo, coordinated by EUSDR Priority Area 10 and the Danube Civil Society Forum. It presents 12 actionable theses to empower local authorities, municipalities, and civil society organisations (CSOs) across the Danube Region, specifically in Western Balkan candidate countries, to actively engage in EU policy-making, cohesion implementation, and democratic transition.

Key findings & relevance to the Danube Region

- Institutional capacity & local governance (ISO 1.1, ISO 1.2): As over 70% of EU rules are implemented locally, municipal skills are vital. The document advocates establishing certified academies to train municipal staff in EU cooperation, shifting from isolated projects to programmatic strategic visions, and offering physical community spaces for local engagement.
- Strengthening the partnership principle (ISO 1.1, ISO 1.2): It emphasises structured CSOs coordination, connecting large CSOs with smaller, resource-scarce ones, to close information gaps and embed participatory practices early in EU candidate countries.
- Youth retention & „Right to Stay" (SO 4.1, ISO 1.2): Addresses acute brain drain in candidate countries by calling for direct investment in youth. Creating inclusive local spaces for young people to influence policies turns abstract EU values into visible benefits, encouraging youth to build their futures locally. To counteract severe out-migration, regional strategies must establish tangible socio-economic opportunities so young adults are not indirectly forced to relocate to major cities or abroad for a better quality of life. Furthermore, providing targeted skills development, transparent governance, and avenues for local decision-making empowers youth to actively shape their communities and curb regional brain drain.
- Core implementation & structural challenges: Highlights resource bottlenecks in small municipalities lacking EU expertise, widespread CSO burnout, fragmented execution of the Partnership Principle, and frustration over slow EU accession dynamics in the Western Balkans.
- Inclusive enlargement & peer cooperation (ISO 1.2): Urges peer-to-peer collaboration that respects candidate countries' cultural heritage without paternalism. It promotes participatory governance tools, such as participatory budgeting, to build mutual trust and accelerate European integration.

ÉMI – Danube Region Biomass Action Plan (DRBAP)

- Type: Regional strategic action plan / sectoral policy assessment
- Thematic Alignment: Pillar 1 (Water Scarcity / Resilience), Pillar 3 (Integration - Special Territorialities)

Executive summary: This action plan, commissioned under EUSDR Priority Area 2 (Sustainable Energy), provides a macro-regional assessment of biomass potential, policy frameworks, and utilisation across 14 Danube Region countries. It establishes concrete priorities and policy recommendations to expand sustainable bioenergy production, improve cross-border coordination, and align energy strategies across EU and non-EU partner states.

Key findings & relevance to the Danube Region

- Biomass dominance & supply shift (SO 2.2): Biomass constitutes over 50% of renewable energy primary production across most Danube countries. While forestry remains the main supply source (73.5% in 2010), agricultural residues and biogenic waste are projected to expand rapidly toward 2020.
- Heating sector & utilisation (SO 2.1, SO 2.2): The vast majority of bioenergy is consumed for heating (bioheat), primarily using solid biomass in local heating, district networks, and combined heat and power (CHP) installations.
- Core implementation & structural challenges: A critical lack of standardised, nationwide biomass data across the macro-region severely hinders strategic policy planning. Furthermore, transport biofuel consumption is projected to double, driving a heavy reliance on imported biofuels (rising from 13% to 40.5% by 2020).
- Strategic policy directions: Recommends prioritising high-efficiency local heating/CHP, utilising agricultural waste, establishing unified regional biomass databases, and shifting long-distance biomass logistics from road transport to the Danube waterway.

ICPDR – Danube Declaration 2022

- Type: Political declaration / Macro-regional ministerial agreement
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration - Special Territorialities)

Executive summary: Adopted at the ICPDR Ministerial Meeting in February 2022, this declaration sets a joint political vision for integrated water resource management across EU and non-EU countries in the Danube River Basin. It formally endorses the updated Danube River Basin Management Plan (DRBMP) and Danube Flood Risk Management Plan (DFRMP) Updates 2021. The declaration aligns macro-regional action with the European Green Deal and establishes binding commitments for 2022–2027 across climate adaptation, pollution control, hydromorphological restoration, and flood resilience.

Key findings & relevance to the Danube Region

- Climate adaptation & water Scarcity (SO 2.4, SO 2.5): Formally designates climate change impacts, specifically severe droughts, water scarcity, and extreme hydrological

phenomena, as a „Significant Water Management Issue" for the Danube Basin, urging immediate measures to enhance aquatic ecosystem resilience and maintain regional water balances.

- Comprehensive pollution control (SO 2.5): Reaffirms commitments to abate surface and groundwater pollution from agricultural nutrients, urban wastewater, and hazardous mining tailings. It targets emerging threats like riverine plastic litter while sustaining key technical tools such as the Danube Transnational Monitoring Network (TNMN) and Accident Emergency Warning System (AEWS).
- Ecological Connectivity & Biodiversity (SO 2.7): Mandates river restoration, habitat protection, and transboundary ecological corridors, prioritising flagship initiatives like restoring sturgeon migration passability at the Iron Gate dams. It aligns water protection with sustainable navigation (METEET initiative) and sustainable hydropower development.
- Nature-based flood resilience (SO 2.4): Prioritises natural water retention measures, floodplain restoration, warning systems, and downstream solidarity to mitigate flood risks in line with the DFRMP 2021.
- Core implementation challenges & governance (ISO 1.1): Identifies major hurdles, including securing funding for complex transboundary infrastructure, balancing competing sectoral demands (agriculture, energy, transport), and harmonising EU environmental directives across non-EU accession countries. Reaffirms close operational synergies with the EUSDR and mandates the 5th Joint Danube Survey (JDS5) for 2025.

Storno Soft Bt. / EUSDR PA4 – Water Digitalisation in the Danube Region

- Type: Regional baseline study, sectoral diagnostic & strategic roadmap
- Thematic Alignment: Pillar 1 (Water Scarcity), Pillar 3 (Integration - Special Territorialities)

Executive Summary: Commissioned by EUSDR Priority Area 4 (Water Quality) and the Hungarian Ministry of Foreign Affairs and Trade, this study evaluates the digital transformation of water management across all 14 Danube River Basin countries. It introduces the Danube Region Digital Water Management Maturity Index (DMI) and formulates a strategic roadmap to transition digitalisation from isolated, voluntary pilots into an integrated, legally mandatory compliance engine driven by the European Water Resilience Strategy, recast Urban Wastewater Treatment Directive (UWWTD), NIS2 Directive, and EU AI Act.

Key findings & thematic relevance

- Water scarcity & operational efficiency (Pillar 1 | SO 2.4, SO 2.5): Compounding hydrological extremes (severe multi-month droughts, low summer flows) are heavily aggravated by massive Non-Revenue Water (NRW) physical losses exceeding 50–60% across lower and middle basin countries (Bulgaria, Montenegro, Bosnia and Herzegovina, Serbia, Romania). This contrasts sharply with upper basin leaders like Austria (NRW 5–10%), demonstrating that expanding smart metering, IoT pressure management, and real-time leakage analytics is essential for regional water retention and drought resilience.

- Transboundary integration & upstream exposure (Pillar 3 | SO 2.5, ISO 1.1): Downstream vulnerability, exemplified by Hungary, where 94-96% of surface water originates beyond national borders, underscores acute transboundary dependencies. Basin-wide flood and drought management is severely constrained by „data debt", non-interoperable SCADA/GIS platforms, and a lack of standardized APIs across border regions.
- Heterogeneous digital maturity tiers: The DMI framework disaggregates the basin into four distinct tiers: Systemic Optimisers (Austria 4.8, Germany 4.1), Structural/Moderate Modernisers (Czechia 3.5, Hungary 3.1, Slovakia 3.3, Slovenia 3.3), Foundational Builders (Croatia 2.7, Montenegro 2.8, Serbia 2.9, Moldova 2.9, Bulgaria 2.3, BiH 2.2), and Crisis-Driven Innovators (Ukraine 3.3, leveraging 93% digital literacy and Digital Twins for war reconstruction).

Core implementation & governance challenges

- Human capital deficits: Public utilities suffer from acute workforce shortages and low digital skills (<35% basic digital literacy in Bulgaria and Romania), compounded by severe brain drain to the private tech sector.

Strategic policy directions & roadmap

- Three-phase national doundation building: Guides countries through Phase I (Capability/Systems Assessment), Phase II (Blueprint Creation with open standards like FIWARE, OGC WaterML 2.0, INSPIRE, and EIF), and Phase III (Prioritized Implementation Wave Roadmap).
- Basin-wide systemic initiatives: Recommends mandating a federated FAIR-compliant water data architecture; establishing a Danube Digital Water Competence Programme under the European Water Academy; and deploying catchment-level Digital Twins anchored to EU Destination Earth (piloting first in the Tisza Basin).
- Immediate country actions (Hungary): Recommends launching a National Water Data Harmonisation Programme (synergising with new DIMOP Plusz investments), negotiating bilateral upstream data-sharing agreements, and executing NIS2-compliant SCADA security audits.

Zavarská, Z. – Economic strategies for a thriving Danube Region

- Type: Research report / policy analysis paper
- Thematic Alignment: Pillar 2 (Right to Stay)

Executive Summary: Published by the Vienna Institute for International Economic Studies (wiiw) in November 2024, this policy report evaluates economic convergence, labour market trends, foreign direct investment (FDI), and industrial automation across all 14 Danube Region countries. It formulates policy priorities to enhance workforce readiness, foster digital skills, attract high-tech FDI, and counteract severe demographic erosion and labour market pressures across peripheral regions.

Key findings

Pillar 2

- Emigration, brain drain & labour Shortages (SO 4.1, Pillar 2): Although GDP per capita gaps between Danube countries narrowed from an 11-fold to a 5-fold difference between 2004 and 2023, severe labour shortages have emerged. Continuous out-migration and youth drain from Eastern, Southeastern, and rural peripheries toward Western hubs strip local economies of young, tertiary-educated talent, depleting human capital stocks and directly threatening the „Right to Stay".
- Digital skills divide & training deficits (SO 1.4, SO 4.2): High digital literacy in frontrunners like Czechia and Austria (~70%) contrasts sharply with Southeastern countries (Romania, Bulgaria, Bosnia and Herzegivina), where basic digital skills fall below 30%. Insufficient lifelong learning opportunities and educational mismatches leave older and rural workforces unable to adapt to technological shifts, further worsening vacancy bottlenecks.
- FDI & IT sector expansion (SO 1.3, SO 1.4): Intra-regional investment is critical, with German and Austrian FDI representing 25–33% of total FDI stocks in several CEE/SEE countries. Greenfield FDI in IT and software services has surged (led by Germany, Romania, Hungary, and Czechia), though Western Balkan candidate states lag behind.
- Industrial automation & functional traps (SO 1.1, SO 1.3): The region contains highly export-oriented manufacturing hubs with rapid robot density growth (Germany, Slovenia, Austria, Czechia, Slovakia). However, ongoing brain drain and weak local innovation ecosystems risk trapping CEE countries in a „functional middle-income trap" of lower value-added assembly rather than high-value R&D.

Strategic policy directions

Pillar 2

- Mitigating brain drain & retaining talent: Safeguard the „Right to Stay" by investing in high-quality local jobs, modern public services, and study/work schemes that convert permanent out-migration into circular talent mobility.
- Industrial innovation & upgrading: Shift from passive assembly models to active industrial policies that incentivise R&D, cluster formation, and local value-chain integration.
- Regional digital upskilling: Facilitate cross-border training exchanges, expand lifelong learning for older workers, and modernise vocational curricula.

EUSDR PA10 – Extended Steering Group Meeting: Digitalisation of Public Sector

- Type: Policy meeting summary / Institutional capacity report
- Thematic Alignment: Pillar 3 (Integration - Special Territorialities) | PO 1 (SO 1.2) & ISO 1 (ISO 1.1)

Executive Summary: Organised under EUSDR Priority Area 10 (Institutional Capacity and Cooperation), this report synthesises the October 2024 meeting on designing and enhancing digital public services across the Danube Region. It addresses eGovernment implementation, artificial intelligence adoption, data interoperability, and digital inclusion across both candidate states (Western Balkans, Moldova) and EU Member States.

Key relevant elements & findings

- Citizen- & Public-Facing eServices (SO 1.2): Showcases digital ID integration via mobile devices (Hungary's Digital Citizen Programme) and centralised eGovernment data sharing/reuse (Czechia). For public administration, it highlights in-house generative AI testing in Baden-Württemberg while evaluating data security and algorithmic outcome accountability.
- Interoperability & cross-border governance (ISO 1.1): Stresses alignment with the European Interoperability Framework (EIF), cross-agency collaboration, and transitioning from fragmented access points toward unified „One Access Point" portals for cross-border public services.
- Core challenges & governance bottlenecks:
    - Legal & structural: Fragmented responsibilities across different administrative levels, lack of multi-level governance, and inadequate consultation with local governments.
    - Process & capacity deficits: Need for end-to-end paperless workflows, digital skills training for public servants, and maintaining in-person service alternatives to guarantee digital inclusion for insecure citizens.
    - Funding & coordination: Unclear long-term funding sustainability requiring strict prioritization under resource constraints, alongside a need for stronger public-private partnerships.

Office of the Lower Austrian Provincial Government – FTI-Strategie Niederösterreich 2021–2027

- Type: Regional research, technology and innovation strategy / policy document
- Thematic alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration - Special Territorialities)

Executive summary: Adopted by the Office of the Lower Austrian Provincial Government, this strategic policy framework establishes the direction for research, technology, and innovation (RTI) in Lower Austria up to 2027. Replacing former regional RTI strategies, it aligns regional competencies with national goals, Horizon Europe, and the Smart Specialisation approach to strengthen regional competitiveness, support the green and digital transitions, and bring science closer to society.

Key findings & relevant strategic elements

- Core guiding principles (ISO 1.1): Grounded in three principles: strengthening interdisciplinary, inter-institutional, and international co-operation; enabling public participation through Open Science and Citizen Science; and increasing efficiency and transparency via competitive, call-based funding.
- Environment, climate and resources (SO 2.1, SO 2.4, SO 2.5, SO 2.6, SO 2.7): Targets the bioeconomy, circular economy, decarbonisation, clean mobility, smart farming, biodiversity, and clean drinking water protection.
- Digitalisation, intelligent production and materials (SO 1.1, SO 1.2, SO 1.3): Focuses on smart manufacturing, additive manufacturing (3D printing), surface technology, robotics, big data, cybersecurity, and space technologies.
- Health and nutrition (SO 1.1, SO 4.1): Drives medical technologies, oncology, prevention, biotechnology, food and feed safety, and responses to demographic ageing.
- Society and culture (SO 1.2, SO 4.2): Functions as a standalone field for humanities and social sciences while providing a cross-cutting dimension to address the social, economic, and historical impacts of technological transformations.

Specific RTI funding instruments & governance

- Specific Funding Mechanisms: Deploys competitive calls across six specific instruments: RTI partnerships, endowed professorships, research infrastructure, doctoral dissertations, research projects, and citizen science projects.
- Governance architecture: Managed by the RTI Steering Group (*FTI-Steuergruppe*) alongside an advisory Location Forum (*FTI-Standortforum*) and executed through a dedicated funding agency.

Global Initiative Against Transnational Organized Crime – Blue Crime on the Danube

- Type: Research report / Policy assessment paper
- Thematic Alignment: Pillar 3 (Integration - Special Territorialities) | ISO 2 (ISO 2.1)

Executive summary: published by the Global Initiative Against Transnational Organized Crime (GI-TOC) in June 2024, this research report assesses organised crime vulnerabilities along the Danube River. It reveals that whilst official seizures remain low due to intelligence gaps and limited law enforcement focus, the river serves as a permissive corridor for illicit flows that have been intensified by Russia's war against Ukraine.

Key issues & regional vulnerabilities

- Impact of the war in Ukraine: the blockade of Black Sea ports shifted massive trade volumes to lower Danube ports (such as Reni, Izmail, Giurgiulești, and Galați), leading to severe traffic congestion, increased corruption, and heightened risks of illicit trade.
- Sectoral and geographical crime dynamics:

- Upper Danube (Germany, Austria to Mohács and Vukovar): vulnerable to West-to-East trafficking of synthetic drugs and precursors, alongside document fraud on cruise ships.
- Middle Danube (Hungary, Croatia, Serbia to Brăila): characterised by fuel smuggling into Serbia and cross-border migrant smuggling across river boundaries.
- Lower Danube & tri-border region (Romania, Moldova, Ukraine): the most vulnerable area, facing high risks of cigarette smuggling, weapons proliferation, synthetic drugs, and local corruption networks.

- Security and intelligence gaps: law enforcement remains strictly national and fragmented, with minimal transboundary cooperation, a lack of dedicated patrol vessels, insufficient barge-searching equipment, and an absence of shared criminal intelligence platforms.

Strategic policy directions

- Institutional law enforcement cooperation: calls for establishing a dedicated Danube law enforcement coordination centre, expanding Police and Customs Cooperation Centres (PCCCs), and institutionalising joint operations (such as DARIF).
- EUSDR & PA11 alignment: urges active leadership from the EUSDR Priority Area 11 (Security) and the EUSDR Presidency to integrate river security into wider European border management strategies.
- Intelligence-led policing and surveillance: recommends upgrading technical river surveillance, deploying specialised barge-inspection training, and engaging private port operators to disrupt illicit supply chains.

BMASGPK – Halbjahresbericht der Spezialattachés des BMASGPK, 2026

- Type: Official government monitoring report / socio-political country diagnostic
- Thematic Alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration - Special Territorialities)

Executive summary: Published in July 2026 by the Austrian Bundesministerium für Arbeit, Soziales, Gesundheit, Pflege und Konsumentenschutz (BMASGPK), this half-yearly report provides a comprehensive socio-political diagnostic of seven EU candidate and enlargement countries in South-Eastern and Eastern Europe: Albania, Bosnia and Herzegovina, Republic of Moldova, Montenegro, North Macedonia, Serbia, and Ukraine. It tracks labour market developments, social protection, healthcare reforms, disability rights, consumer protection, and the alignment of national legislation with the EU Acquis, highlighting the strategic role of Austrian special attachés in strengthening institutional capacity and supporting European integration.

Key findings & relevant elements

- Labour Market Friction & Youth Retention (Pillar 2 | SO 4.1, SO 4.2): High youth unemployment, widespread informal work, low activity rates among women, and working poverty persist across the Western Balkans, Republic of Moldova, and Ukraine.

Continuous out-migration of skilled workers and young people creates severe labour shortages in critical sectors such as healthcare and construction, reinforcing the urgent need for local employment opportunities, active labour market measures, and the implementation of the EU Youth Guarantee.

- Inclusion of vulnerable groups & human rights (SO 4.3): Progress is being made towards de-institutionalisation for children and persons with disabilities, alongside pilot programmes for personal assistance, community-based care, and the EU Child Guarantee. However, marginalisation remains high among Roma communities, single mothers, and internally displaced persons, particularly in Ukraine due to the ongoing war.
- Institutional capacity & transnational cooperation (Pillar 3 | ISO 1.1, ISO 1.2): Austrian special attachés provide technical assistance, facilitate bilateral social security data exchanges, conduct capacity-building workshops, and support civil society organisations across Albania, Bosnia and Herzegovina, Republic of Moldova, Montenegro, North Macedonia, Serbia, and Ukraine to foster mutual trust and accelerate alignment with EU standards.

Office of the Lower Austrian Provincial Government – Hochschulstrategie Niederösterreich 2030+

- Type: Regional higher education and science strategy / policy document
- Thematic Alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration - Special Territorialities)

Executive summary: Published by the Office of the Lower Austrian Provincial Government, this strategic framework guides the long-term development of Lower Austria's higher education sector up to 2030 and beyond. Building on the successes of the 2025 strategy, it aims to enhance regional academic attractiveness, foster university-business innovation, drive international co-operation, and counteract youth drain by aligning higher education with regional economic and societal needs.

Key findings & relevant elements

- Youth retention & brain drain mitigation (Pillar 2 | SO 4.1, SO 4.2): Directly addresses demographic pressures and talent loss by expanding regional study places, improving accessibility for non-traditional students, and supporting degree completion. Providing high-quality tertiary education across 15 institutions strengthens local human capital and safeguards the „Right to Stay".
- Research, innovation & technology Transfer (SO 1.1, SO 1.4): Strengthens applied research and knowledge transfer by integrating future-oriented subjects (such as data science, artificial intelligence, healthcare, and sustainability) into curricula. It fosters direct university-business partnerships across regional Technopoles, supporting spin-offs and Christian Doppler Laboratories to boost regional competitiveness.
- Transnational integration & internationalisation (Pillar 3 | ISO 1.1): Drives cross-border academic co-operation through flagship initiatives like the proposed Europacampus

Hainburg and participation in the European Universities Initiative (such as E³UDRES² led by UAS St. Pölten). This enhances international mobility, joint degree programmes, and regional integration across borders.

- Governance architecture: Structured around six core guidelines (attractiveness, study access, internationality, research strength, business partnerships, and social responsibility) and monitored via the Lower Austrian Higher Education Conference (*Niederösterreichische Hochschulkonferenz*)

Document Summary: Ortiz, W. et al. – Perspectives of Renewable Energy in the Danube Region

- Type: Research publication / Conference proceedings
- Thematic Alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration - Special Territorialities)

Executive summary: Published by the Institute for Regional Studies (CERS HAS) and the Wuppertal Institute, this volume compiles multidisciplinary research on the post-fossil energy transition across Danube Region states. It evaluates the systemic, social, economic, and resource-specific dimensions of renewable energy sources (RES), highlighting how regional integration, grid modernisation, and market harmonisation can accelerate decarbonisation.

Key findings & relevant elements

- Centre-periphery disparities (SO 2.2): A sharp economic and energy gradient extends along the Danube River, ranging from advanced post-fossil deployment in core Western nations like Germany and Austria to early-stage adoption in peripheral Eastern and South-Eastern European states. Replicating Western support mechanisms (such as Feed-in Tariffs) in peripheral economies has frequently encountered obstacles due to economic constraints, lower energy awareness, and social resistance against rising consumer electricity prices.
- Water energy & pumped hydro storage (SO 2.1, SO 2.2): Hydropower accounts for 70% of European renewable electricity and represents the region's most cost-effective, climate-friendly, and reliable renewable technology. With a technical hydropower potential of 96 TWh/a across the Danube Basin, Alpine pumped hydro storage (PHS) in Austria (and Switzerland) provides vital large-scale energy storage, frequency regulation, and operational flexibility to balance fluctuating solar and wind power across neighbouring national grids.
- Systemic & grid constraints (SO 2.1, SO 2.2): Ageing power transmission networks, market concentration, and generation volatility present major technical barriers. Expanding cross-border grid interconnections, demand-side management (DSM), and storage technologies are essential for maintaining regional power system stability.
- Geothermal, wind & solar potentials: Deep geothermal potential remains largely untapped across the Pannonian Basin (Hungary, Romania), requiring improved reinjection practices. Wind and solar deployment faces regulatory and spatial siting

challenges, which can be mitigated through GIS-based spatial planning and joint support schemes.

Piculescu, V. & Roman, M. – Integrated Territorial Instrument of the Danube Delta (2016–2021)

- Type: Ex-post assessment report / territorial policy evaluation
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration – Special Territorialities)

Executive summary: Commissioned by the European Commission, this report evaluates the implementation, governance, and performance of the Integrated Territorial Instrument (ITI) supporting the Integrated Strategy for the Development of the Danube Delta (ISDDD) between 2016 and 2021. It assesses how €1.3 billion in European Structural and Investment Funds (ESI Funds) across eight operational programmes contributed to environmental protection, local economic development, connectivity, and public service delivery in this unique UNESCO Biosphere Reserve.

Key findings & relevant elements

- Territorial challenges (Pillar 3 | SO 5.2, SO 3.3): The Danube Delta, a UNESCO Biosphere Reserve and Ramsar site, suffers from acute geographical isolation, sparse population density, and harsh living conditions. A structural divide exists between the core biosphere reserve area (DDBRA) and neighbouring mainland urban service centres, creating socio-economic lag and requiring targeted public investments in water transport, local roads, and basic services to sustain local communities.
- Water scarcity & environmental developments (Pillar 1 | SO 2.4, SO 2.5, SO 2.7): Although conserving the delta's unique natural heritage is Strategic Objective 1, Pillar I (Environment) absorbed only 13% of contracted funds and 5% of payments. Crucial environmental measures, such as natural water flow optimisation, coastal erosion control, flood risk management, wetland restoration, and waste collection in river channels, faced severe under-implementation due to non-eligibility or lack of suitable financing streams. Furthermore, mandatory environmental impact approvals for all infrastructure in protected zones frequently protracted project timelines.
- Imbalance in investment absorption: The vast majority of funding was absorbed by large transport infrastructure (Pillar III Connectivity, including the Brăila bridge) and business competitiveness (Pillar II Economy), rather than directly addressing environmental assets or essential public services like water and wastewater treatment.

Strategic policy directions

- Prioritise core environmental assets: Ensure dedicated funding and simplified access for climate adaptation, water flow optimisation, wetland restoration, and waste management in the 2021–2027 programming period.

- Strengthen local administrative capacity: Provide targeted technical assistance to municipal beneficiaries to streamline procurement, environmental permitting, and project preparation.

M&E Factory – EUSDR Process/Implementation Evaluation

- Type: Process and implementation evaluation report
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive Summary Commissioned by the Danube Strategy Point and published in April 2025, this report evaluates the strategic dimension, governance, technical implementation, and policy impact of the EU Strategy for the Danube Region (EUSDR) between 2020 and 2024. It assesses how political commitment, funding embedding, and institutional workflows across the 12 Priority Areas address macro-regional challenges, offering recommendations to prepare the Strategy for the post-2027 Cohesion Policy framework.

Key findings & relevant elements

- Fluctuating political commitment (ISO 1.1): While political engagement has strengthened among EU candidate countries viewing the EUSDR as an accession pathway, commitment in older EU Member States has occasionally stagnated or declined due to competing national priorities.
- Operational overburden vs strategic coordination (ISO 1.1): Priority Area Coordinators (PACs) are increasingly driven by operational project management under the Interreg Danube Region Programme (DRP), which risks diluting high-level strategic policy work and cross-sectoral coordination.
- Governance and capacity deficits (ISO 1.1): Implementation across the 12 Priority Areas is hampered by staff turnover, resource constraints, and low participation from Steering Group (SG) members, alongside uncoordinated information flows with national line ministries.
- Funding & embedding gaps (PO 1, PO 2, PO 3, PO 4): Despite the development of embedding guidance tools, mainstream EU programmes (e.g. ERDF, ESF+, Horizon Europe) exhibit low awareness of EUSDR priorities, lacking formal mechanisms to fund macro-regional strategic initiatives.
- Impact of external shocks (Pillar 1, Pillar 2, Pillar 4): The COVID-19 pandemic and Russia's war of aggression against Ukraine highlighted the need for operational flexibility, transforming the EUSDR into a vital platform for solidarity, civil protection, security, and EU accession support.

Strategic policy directions & recommendations

- Re-anchoring strategic focus (ISO 1.1): Transition from isolated project implementation to mission-oriented approaches and cross-Priority Area working groups addressing key challenges like regional security, Ukraine's recovery, and post-2027 EU Cohesion Policy.

- Embedding in post-2027 frameworks (ISO 1.1): Align EUSDR priorities with the post-2027 Multiannual Financial Framework, the Western Balkans Growth Plan, and national reform agendas.
- Strengthening governance & youth integration (ISO 1.1): Simplify the EUSDR Governance Architecture Paper, establish national coordination platforms, and operationalise the Danube Youth Organisations Network (DYON) with clear roles and dedicated funding.
- Improving communication & impact measurement (ISO 1.1): Structure PAC reporting around an impact model to better demonstrate tangible territorial outcomes, while actively engaging European Commission line DGs and political decision-makers.

Ministers of Interior of the EUSDR Member States – Joint Conclusions of the Sofia Conference (2026)

- Type: Ministerial joint conclusions / policy declaration
- Thematic Alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: Adopted at the Conference of the Ministers of Interior organised under the 2026 Bulgarian Presidency of the EU Strategy for the Danube Region in Sofia, these joint conclusions mark the 15th anniversary of the Strategy. The Ministers reassert political support for internal security, addressing evolving hybrid, cyber, and radicalisation threats, while calling for the explicit prioritisation of security in the forthcoming Multiannual Financial Framework.

Key issues & relevant elements

- Dynamic security environment (ISO 2.1): The region faces an increasingly complex security environment driven by terrorism, violent extremism, radicalisation, hybrid threats, disinformation, and cyberattacks, aggravated by Russia's war of aggression against Ukraine, conflicts in the Middle East, and societal polarisation.

Strategic policy directions & recommendations

- Transboundary integration & river safety (Pillar 1, Pillar 3 | ISO 2.1): Reaffirms horizontal cooperation between Priority Area 11 (Security) and Priority Area 1a (Waterway Mobility), commending Hungary for annually organising the operational DARIF Operation to secure river transport corridors.
- Protecting quality of life (Pillar 2 | ISO 2.1): Underlines that internal security and public safety across local communities are essential prerequisites for guaranteeing citizen well-being and supporting regional population retention.
- Governance & strategic labelling (ISO 1.1): Recognises the role of Priority Area Coordinators, Steering Groups, the European Commission, and the Danube Strategy Point, while encouraging participating states to propose „Danube Flagships".

- MFF Funding prioritisation: Urges that security considerations be integrated and mainstreamed across all future EU legislation, policies, and Multiannual Financial Framework funding programmes.

SMART ERA Consortium – Submission to the European Commission Public Consultation Right to Stay Strategy: Your Region, Your Future

- Type: Position paper / policy contribution / consultation submission
- Thematic alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: Submitted in June 2026 by the Horizon Europe project SMART ERA to the European Commission public consultation on the Right to Stay Strategy: Your Region, Your Future, this document presents evidence-based policy recommendations to counteract rural depopulation, ageing, and service decline. It advocates for place-based, community-led innovation, granular local data, and multi-level policy coherence across the Common Agricultural Policy, Cohesion Policy, and macro-regional strategies such as the EU Strategy for the Danube Region.

Key findings & relevant policy elements

- Securing the „Right to Stay" (Pillar 2 | SO 4.1, SO 5.2): Rural decline stems from cumulative challenges including out-migration, service deterioration, weak connectivity, and governance fragmentation. Smart rurality addresses this by improving everyday living conditions so residents can remain in or return to rural areas.
- Place-based interventions & territorial granularity (Pillar 3 | ISO 1.1): One-size-fits-all policies fail in remote, mountainous, and sparsely populated regions. To capture local diversity, standard NUTS 2 and NUTS 3 statistics should be complemented with LAU-level (Local Administrative Unit) data and granular indicators.
- Community-led governance & local delivery (Pillar 3 | ISO 1.1): LEADER/CLLD should serve as the core delivery backbone for smart rurality, establishing structured alignment with Smart Villages, Startup Villages, Smart Specialisation Strategies (S3), and the Long-Term Vision for Rural Areas.
- Evidence-based digital transformation (PO 5 | SO 5.2): Digitalisation and remote work offer key opportunities for economic diversification, but success requires moving beyond physical infrastructure toward governance-driven digital readiness. The SESAM (SMART ERA Smartness Assessment Method) methodology enables data-driven assessments of local capacity.
- Funding accessibility & micro-grants: Administrative complexity hampers smaller municipalities. Policy frameworks should introduce one-stop-shop platforms, micro-grants, cascade funding, and earmarking mechanisms for smart rurality in post-2027 programming frameworks.
- Synergies with macro-regional strategies (EUSDR PA 10): Drawing on contributions from EUSDR Priority Area 10, the paper stresses that linking local pilot projects directly to

macro-regional strategies ensures the up-scaling, transfer, and visibility of successful local solutions across macro-regions.

Strategic policy directions & recommendations

- Mandate rural proofing: Systematically apply rural proofing and territorial impact assessments across all sectoral policies.
- Synergise research and delivery funds: Align Horizon Europe innovation initiatives with Cohesion Policy implementation to facilitate the uptake and scale-up of project results.
- Earmark post-2027 funding: Secure dedicated earmarking and targeted support for smart rurality within upcoming national regional policy plans and post-2027 cohesion frameworks.

German Federal / Interreg Perspective – Spatial Challenges in the Danube Region

- Type: Policy matrix / spatial challenge assessment table
- Thematic Alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: This policy table outlines the spatial challenges across the Danube Region from a German strategic perspective, structured around Interreg-relevant Policy Objectives and Interreg Specific Objectives. It identifies core territorial vulnerabilities, including industrial cluster restructuring, digital and energy grid bottlenecks, demographic polarisation, water availability risks, and cross-border governance deficits.

Key findings & relevant elements

- Water scarcity, climate adaptation & natural Resources (Pillar 1 | PO 2: SO 2.4, SO 2.5, SO 2.7): Highlights low water levels causing ecological and economic damage, prolonged drought periods, altered water availability, and surging agricultural irrigation demand. It also details extreme weather risks (heavy rain, flash floods, urban heat stress), forest climate degradation, biodiversity loss from habitat fragmentation, and land-use competition between peatland/wetland conservation and active land use.
- Demographic change, skilled labour & „Right to Stay" (Pillar 2 | PO 1: SO 1.4; PO 4: SO 4.1, SO 4.2, SO 4.3, SO 4.5; PO 5: SO 5.2): Addresses functional losses and building vacancies in smaller towns and rural areas alongside structural out-migration of young people. Ageing populations drive up healthcare and social care demands, while sparse settlements face severe access and staffing deficits for public services. Spatially uneven skilled labour shortages and rising housing costs in growth centres further exacerbate territorial polarisation.
- Industrial transformation, digitalisation & connectivity (Pillar 3 | PO 1: SO 1.1, SO 1.2, SO 1.3; PO 3: SO 3.2, SO 3.3): Identifies deep restructuring risks in industrial core clusters (automotive, mechanical engineering) and less diversified sub-regions. Electrification

increases pressure on energy and grid networks, while digital infrastructure bottlenecks persist in rural areas. Transport challenges include ageing bridge infrastructure, overloaded rail nodes (e.g. Munich Region), inadequate public transport in rural areas, and missing multimodal links.

- Cross-border functional spaces & governance (Pillar 3 | ISO 1, ISO 2, ISO 3): Calls for joint strategies to manage suburban sprawl and cross-border urban-rural ties, strengthen medium-sized cities, and build territorial resilience along Eastern European borderlands (e.g. Ukraine, Slovakia, Romania).

Antić, S. (HIIA) – Toward a Danube Corridor? Elevating Hungary as a Regional Resilience Anchor (2026)

- Type: Policy analysis paper / sstrategic perspective report
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration – Special Territorialities)

Executive summary: Published by the Hungarian Institute of International Affairs in April 2026, this policy paper advocates converting the Danube River into a high-capacity, low-cost „Danube Corridor" to anchor regional energy security and trade across Central and Southeastern Europe. It highlights how developing river transport can offset energy pipeline vulnerabilities and enhance regional economic resilience.

Key findings & relevant elements

- Water scarcity & climate risks (Pillar 1 | SO 2.4): Extended drought periods causing severe low water levels, combined with freezing winter temperatures, pose recurring threats to unimpeded, year-round river navigation and barge freight. Overcoming these climate impacts requires joint intergovernmental coordination for riverbed maintenance, regular dredging, and seasonal emergency response.
- Transit bottlenecks & pipeline vulnerabilities (Pillar 3 | SO 3.2): Landlocked Danube Basin economies face severe geopolitical risks, including pipeline halts (e.g., the Druzhba oil pipeline disruption) and inflated land transit tariffs.
- Port & institutional infrastructure deficits (Pillar 3 | SO 3.2): River freight efficiency is hindered by uncoordinated cross-border customs, non-integrated River Information Services, and outdated port facilities across key Danube stops (such as Baja, Mohács, Novi Sad, and Prahovo).

Strategic policy directions

- Intergovernmental river governance: Establish a joint committee to streamline customs for energy cargoes, coordinate dredging, and integrate real-time digital vessel tracking.
- Multimodal port upgrades & energy diversification: Modernise Danube ports with heavy cargo infrastructure and storage to facilitate barge shipping of oil, gas, and renewable energy tied to Black Sea ports (e.g., Constanța) and Azerbaijani supplies.

- EU & regional funding integration: Utilise EU Cohesion Policy, InvestEU, IPA III, and the Western Balkans Investment Framework to fund macro-regional waterway projects.

Jovanović, B. (wiiw) – Labour Story in Five Acts

- Type: Economic diagnostic presentation / labour market analysis
- Thematic Alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: Presented by the Vienna Institute for International Economic Studies (wiiw), this analysis evaluates labour markets, real wage erosion, emigration pressures, and structural value-chain traps across non-EU Danube Region countries and accession candidate states. It shows that wage suppression, weak labour rights, and persistent out-migration threaten the "Right to Stay," calling for a new economic model built on active industrial policy, public investment, and wage growth matched by productivity.

Key findings & recommendations

- Wage suppression & inflation erosion (Pillar 2 | SO 4.1): Resurgent consumer price inflation across Danube candidate states (reaching 3.0% in Albania, 3.8% in Serbia, 4.9% in North Macedonia, and 6.8% in Bosnia & Herzegovina and Moldova in 2026) severely erodes purchasing power. Average gross wages remain suppressed between 25% and 38% of the EU average, lagging significantly behind local labour productivity levels.
- Inadequate household income coverage (Pillar 2 | SO 4.1): Employee compensation fails to cover basic household consumption across non-EU Danube countries (covering only 43% in Albania, 54% in North Macedonia, 57% in Montenegro, 58% in Moldova, 74% in Serbia, and 77% in Bosnia & Herzegovina), compared to Austria where compensation exceeds 103% of consumption.
- Labour rights violations & brain drain (Pillar 2 | SO 4.2): Danube accession states experience systematic or regular labour rights violations according to the ITUC Global Rights Index. Even as unemployment falls, employers identify labour shortages and brain drain/emigration as their primary operational bottlenecks.
- High-skilled shortages vs. low-skilled mismatches (Pillar 2 | SO 4.1): Persistent emigration drives acute high-skilled labour shortages (data, management, development), while low-skilled job portals face structural mismatches (sales, drivers, service staff).
- Low value-added production traps (Pillar 3 | SO 1.3): Western Balkan candidate countries remain locked at the bottom of the global value-added „smile curve" (specialising in low-margin assembly and production), while Western economies like Germany hold high-margin headquarters, R&D, and support services.

Strategic policy directions

- EU accession as a convergence driver: Full EU membership accelerates GDP growth (adding an estimated 2.1 percentage points to annual growth) and historically reverses net emigration trends into positive net migration.
- New economic model for population retention: Securing the „Right to Stay" requires higher wages, stronger labour rights enforcement, active industrial policies supporting domestic firms, progressive taxation, and expanded public investment in education, healthcare, social protection, and infrastructure.

wiiw – Danube Region Monitor "People & Skills" Report 2025

- Type: Statistical monitoring report / socio-economic diagnostic
- Thematic Alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: Commissioned by EUSDR Priority Area 9 („People and skills") and published by the Vienna Institute for International Economic Studies (wiiw) in 2025, this report evaluates labour market performance, education systems, and social inclusion trends across 14 Danube Region countries. It details how severe depopulation, youth emigration, structural joblessness, and cross-border mobility dynamics threaten the „Right to Stay", providing evidence-based insights for regional convergence and human capital retention.

Key findings & recommendations

- Accelerating depopulation & emigration pressures (Pillar 2 | SO 4.1): The Danube Region suffered a cumulative loss of over 2.4 million residents between 2011 and 2024 (dropping to 109.7 million). Non-EU candidate states (BA, MD, ME, RS) and rural/eastern peripheries face intense demographic contraction driven by a combination of persistently low fertility rates and heavy outward migration.
- Brain drain & shrinking active workforce (Pillar 2 | SO 4.1, SO 4.5): Out-migration is heavily concentrated among young, tertiary-educated workers, depleting local human capital stocks, shrinking active-age labour pools, and over-burdening social and eldercare infrastructure. Root drivers include labour market fragmentation, lower relative wages, and declining public service access in peripheral areas.
- Regional demographic asymmetry (Pillar 3 | SO 5.2): A sharp regional divide exists: while candidate states and Eastern peripheries depopulate, Western/Central Danube economies (AT, DE, CZ, SK, SI) experienced modest population gains driven by net migration and refugee inflows (e.g., Germany accounted for 77% of the region's total population increase since 2021).
- Cross-border mobility & daily commuting (Pillar 2, Pillar 3 | SO 5.1, SO 5.2): Over 3.5 million citizens reside in a Danube state different from their origin alongside large daily cross-border commuting flows, requiring harmonised transboundary administrative support for taxes, pensions, and social rights. High outward labour migration (e.g., in Moldova, where remittances form a major share of GDP) distorts official domestic employment figures while draining local talent.

- Employment, NEET & social divide (SO 4.1, SO 4.2, SO 4.3): Employment in candidate states averages 63.3% (vs. 77.6% in EU Danube states), with long-term unemployment exceeding 50% of jobseekers in candidate countries (73.3% in BA, 74.5% in ME) and high youth NEET rates (18.4% average vs. 10.9% in EU Danube members). Early school leaving is highest in Moldova (17.5%) and Romania (16.8%), while risk of poverty stands at 22.0% in non-EU candidate states.

Strategic policy directions

- Safeguard the „Right to Stay": Counteract brain drain and rural depopulation by investing in attractive local employment, competitive wages, quality public services, and youth activation.
- Establish cross-border administrative support: Implement harmonised information and obstacle-management schemes for citizens living, commuting, working, or studying across macro-regional borders.
- Modernise vocational & reskilling pathways: Expand dual VET systems, early childhood education, and active labour market policies (ALMPs) to lower NEET rates and facilitate smooth school-to-work transitions.

World Bank Group – Closing the Skills Gap: Green and Digital Skills for a Competitive Europe (14th EUSDR Annual Forum)

- Type: Policy presentation / economic diagnostic report
- Thematic Alignment: Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive Summary Presented by Nathalie Lahire (Senior Economist, World Bank Group) at the 14th EUSDR Annual Forum, this presentation outlines global megatrends reshaping Danube Region and Western Balkan economies. It examines structural job displacement risks, green and digital skills gaps, and human capital strategies required to overcome the middle-income trap and foster economic competitiveness.

Key findings & strategic policy directions

- Regional megatrends & labour paradox (Pillar 2 | SO 4.1): Out-migration, brain drain, ageing populations, and rapid technological shifts create a severe regional paradox: high unemployment and low participation rates coincide with acute skill shortages in growing sectors.
- Green transition risks & digital deficits (SO 1.2, SO 4.2): High-carbon economies face significant job vulnerability during the green transition (led by Bosnia & Herzegovina at 17.8% of jobs at risk, and North Macedonia at 16.9%), while basic digital literacy remains very low across candidate states (e.g. Serbia).
- Education underperformance (SO 4.2): Foundational competencies (literacy, numeracy) and higher education performance across Western Balkan candidate states trail

substantially behind EU averages, limiting the transition toward high-value-added production models.

- Targeted retraining & education reform: Mitigating these gaps requires heavy investments in workforce reskilling (estimated at €300M in BIH), aligning university and VET curricula with EU standards, and scaling up digital education initiatives.
- Regional skills & excellence networks (Pillar 3 | ISO 1.1): Recommends building cross-border research networks, centres of excellence, and university-industry partnerships to meet advanced STEM/green job demands, meet Bologna requirements, and retain regional talent.

ESPON TNCOOP – Interreg NEXT Black Sea Basin Programme Fiche (May 2026)

- Type: Transnational territorial analysis & programme profile report (ESPON 2030)
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: Produced under the ESPON 2030 TNCOOP research framework, this report provides a comprehensive socio-economic and territorial evaluation of the Interreg NEXT Black Sea Basin (BSB) Programme area (2021-2027 and post-2027 outlook). Spanning 8 countries including EU Member States (Bulgaria, Greece, Romania) and candidate/partner countries (Armenia, Georgia, Moldova, Türkiye, and Ukraine) the BSB Programme represents a unique geopolitical bridge connecting South Eastern Europe, the Danube catchment, and the South Caucasus into an integrated EU cooperation framework. The analysis highlights key functional interdependencies, acute environmental and demographic challenges, and critical strategic synergies with the EU Strategy for the Danube Region (EUSDR) and the Danube Region Transnational Programme.

I. Territoriality and functional linkages

Key territorial and socio-economic development patterns

- Broad geographic coverage & inclusion: The BSB programme area provides a unique platform for transnational cooperation on an equal footing, notably as the sole EU cooperation instrument integrating Armenia and Georgia alongside candidate countries (Moldova, Ukraine, Türkiye) and EU Member States (Bulgaria, Greece, Romania).
- Urban-rural dualism & spatial settlement: The region is predominantly rural and sparsely populated (often fewer than 50 inhabitants/km^2 in peripheral borderlands), contrasted with massive, hyper-dense urban nodes.
- Economic sector dynamics & post-pandemic recovery: The tertiary (services) sector dominates regional employment (~50% of total jobs). Following a severe pandemic-induced contraction (-4.79% GDP drop across BSB countries) and subsequent inflation spikes driven by Russia's war of aggression against Ukraine, economic growth is

recovering, accompanied by declining unemployment in EU Member States and rising GDP per capita in major metropolitan hubs.

- Environmental investment divide: Severe national disparities exist in environmental protection spending relative to GDP: EU Member States lead (Romania ~2.5%, Bulgaria 2.0%), while non-EU candidate/partner states lag significantly (Ukraine <1.5%, Moldova <0.5%), underlining the necessity of transnational capacity building for climate resilience.
- Digital & physical connectivity convergence: Broadband household coverage reached >80% across most of the basin by 2021 (closing the gap with the broader EU), though physical transport accessibility remains highly unequal, with fewer than 20% of rural populations in Ukraine, Moldova, and north-eastern Türkiye having access to major road networks.

Functional linkages & shared systems

- Ecological and marine continuum: The semi-enclosed Black Sea constitutes a shared, highly biodiverse, yet ecologically fragile marine ecosystem. It forms an inseparable functional continuum with major inflow rivers, most notably the Danube, Dnieper, and Rioni basins, where land-based agricultural runoff, industrial waste, and coastal urbanisation dictate downstream water quality.
- Shared natural risk profiles: Climate-induced hazards affect the basin collectively. Riverine and flash flood risks are heavily concentrated in Ukrainian and Romanian NUTS 2 regions, while drought pressure on soil moisture and vegetation affects up to 8% of land in Sud-Est Romania.
- Cross-border economic links & supply chains: Agriculture remains culturally and historically significant despite long-term employment declines, while manufacturing and services rely heavily on cross-border labor availability, export logistics, and raw material flows across the sea basin.
- Crossroads logistics & TEN-T integration: The BSB functions as a strategic transit hub connecting Europe and Asia. Ongoing geopolitical disruptions have placed immense priority on developing resilient trade corridors, including the Middle Corridor, Black Sea port interconnections (e.g. Constanța, Odesa, Izmail, Prahovo), and links to TEN-T corridors via Bulgarian, Romanian, and Greek ports.

Cooperation & funding intensity

- Core partner clusters: Cooperation under Policy Objective 1 (Smarter Europe) is concentrated among a stable, highly connected network of municipal and public-private authorities from Moldova (Chisinau), Greece (Kavala), Bulgaria, and Türkiye (Uskudar).
- Environmental network cohesion: Under Policy Objective 2 (Greener Europe), a larger number of projects are funded, involving research institutes, public authorities, and NGOs (e.g., Mare Nostrum in Romania, Institute of Oceanology in Bulgaria). However, partnerships remain somewhat fragmented across isolated project clusters, indicating significant room for scaling up inter-project knowledge transfer.

1.3 Territorial challenges and opportunities

Pillar 1: Water scarcity

- Severe water quality & eutrophication pressures: The semi-enclosed Black Sea suffers from land-based pollution, agricultural nutrient runoff, untreated urban wastewater, and industrial discharges, causing widespread eutrophication and marine ecosystem degradation.
- Waste intensity & circular economy deficits: Municipal and commercial waste intensity remains markedly higher than EU averages, particularly in dense urban centers. Low municipal recycling rates and insufficient waste management capacity pose severe marine pollution risks.
- Climate-induced floods, droughts: Rising frequencies of extreme weather events cause severe river flooding in low-lying river basins (Ukraine, Romania) and agricultural drought exposure in the Pannonian and coastal margins.

Pillar 2: „Right to Stay"

- Depopulation, ageing & brain Drain: Depopulation and population ageing affect almost all regions (median age >37 years across most NUTS 2 units), driven by low birth rates and persistent outward youth migration from rural and candidate territories (Severoiztochen in Bulgaria, Moldova, Ukraine).
- Innovation & competitiveness traps: Regional competitiveness and innovation scores across the BSB remain well below EU averages. Sparse cross-border R&I funding, low private-sector R&D investment, and bureaucratic barriers prevent SMEs from transitioning to high-value-added production models.
- Social infrastructure accessibility shadow: Rural and remote areas face severe service delivery deficits. Travel times by car to the nearest hospital or secondary school routinely exceed 30 minutes in peripheral rural zones (compared to <5 minutes in İstanbul), reinforcing local social exclusion and pushing young families to emigrate.

Pillar 3: Integration, special territorialities

- Spillover effects of Russia's war of aggression against Ukraine: The war represents the most critical external shock, causing catastrophic human, infrastructural, and economic damage in Ukraine, while triggering severe regional spillovers:
    - Maritime security & trade restrictions: Unexploded ordnance, naval mines, and military threats have disrupted shipping lanes, inflated transport/insurance costs, and restricted Ukraine's agricultural export corridors.
    - Conflict-related pollution: Destruction of industrial and water infrastructure has released toxic contaminants, hazardous waste, and marine debris throughout the Black Sea basin.

- Energy & food insecurity: Interrupted transit routes and energy infrastructure attacks have amplified price volatility across the Eastern EU borderlands.

- EU accession dynamics & asymmetric governance: The region features a multi-speed political landscape (EU Members BG, GR, RO; Candidate States UA, MD, GE, TR; Applicant AM). Divergent regulatory frameworks, varying administrative capacities, and low government effectiveness index scores in certain partner territories hamper seamless cross-border governance.

3 Synergies and potentials: Black Sea Basin Programme, EUSDR, and Danube Region Programme

A major analytical strength of the report is highlighting the functional and strategic overlap between the Interreg NEXT Black Sea Basin Programme, the EU Strategy for the Danube Region (EUSDR), and the Danube Region Programme (DRP):

1. Shared geographical scope & institutional governance

- Geographical Overlap: Four key sovereign states, Bulgaria, Romania, Moldova, and Ukraine, are full participating members in both the EUSDR/DRP and the Interreg NEXT BSB Programme, forming a continuous socio-economic and environmental corridor from Central Europe to the Caucasus.

- Unified institutional anchor (shared Managing Authority): Interreg NEXT Black Sea Basin, Interreg VI-A Romania–Ukraine, and Interreg VI-A Romania–Moldova share the exact same Managing Authority within the Romanian Ministry of Development, Public Works and Administration (MDPWA). This institutional concentration provides an unprecedented operational opportunity to streamline project pipelines, prevent double funding, and align strategic calls across transnational boundaries.

2. Source-to-Sea ecological & environmental protection (Pillar 1 | PO 2)

- Joint river-sea pollution & marine litter control: Environmental pressures along the Danube River directly dictate the ecological health of the Black Sea. The BSB Programme actively complements EUSDR Priority Area 4 (Water Quality) and PA 5 (Environmental Risks). A landmark precedent was established in November 2021 with a joint EUSDR-BSB event on marine litter, establishing coordinated frameworks to trap plastic waste and agricultural contaminants upstream before entering marine ecosystems.

- Danube Delta & Wetland Conservation: The Danube Delta represents the physical hinge connecting both macro-regions. Coordinated funding between DRP, BSB, and the Integrated Territorial Investment (ITI) Danube Delta supports transboundary wetland restoration, fish migration protection, and climate adaptation in coastal river deltas.

3. Maritime connectivity, energy corridors & blue economy (Pillar 3 | PO 1, PO 3)

- Danube Waterway to Black Sea Maritime Logistics: Combining EUSDR PA 1a (Waterways Mobility) with BSB's focus on port infrastructure, digital shipping management, and the Common Maritime Agenda (CMA) strengthens multimodal transport. Integrating

Danube river barges with Black Sea deep-water ports (e.g. Constanța, Odesa) enhances the resilience of EU „Solidarity Lanes" for grain, energy, and commercial trade.

- Sustainable blue economy & small-scale Innovation: While DRP funds broad macro-regional policy frameworks, the BSB Programme allocates a high share of funding to capacity building (22.7%) and innovation (20.9%). BSB's small-scale project calls provide an ideal testing ground for community-led blue economy initiatives, eco-tourism, and circular bioeconomy pilots that can be scaled up („upstreamed") into major EUSDR strategic flagships.

4. Border security, civil protection & EU accession (Pillar 3 | ISO 1, ISO 2)

- Eastern border resilience & conflict response: In response to Russia's war against Ukraine, both programmes reinforce civil protection, emergency preparedness, and border security (EUSDR PA 11 and BSB ISO 1). Synergies focus on joint disaster management, environmental hazard monitoring (e.g., conflict-related chemical spills or marine debris), and refugee integration.
- Accelerating EU accession on equal footing: Both macro-regional frameworks act as a „laboratory for EU integration", engaging candidate countries (UA, MD, GE, TR, AM) on equal footing with EU Member States, building public administrative capacity, and harmonising environmental and economic regulations with the EU Acquis.

Interreg Transnational Programmes: needs and opportunities for the future cooperation [TNCOOP] Programme fiche Interreg Danube Region // May 2026

- Type: Transnational territorial analysis & programme strand synthesis fiche (ESPON 2030)
- Thematic Alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: This document provides a comprehensive summary of the ESPON 2030 TNCOOP European Research Project report *Programme Fiche Interreg Danube Region* (May 2026). The report presents an in-depth territorial analysis, socio-economic profile, and strategic evaluation of the 2021–2027 Interreg Danube Region Programme (DRP) area and offers evidence-based operational recommendations for transnational cooperation in the post-2027 programming period.

1. Key Findings

Water scarcity

- River basin climate vulnerabilities: The Danube River Basin faces severe, interconnected climate-driven risks across its 2,850 km length and major sub-basins (Tisza, Sava, Drava, Dniester). While extreme flood risks threaten low-lying river plains in Croatia, Serbia, Romania, and Bulgaria, as well as Danube capitals (Vienna, Bratislava, Budapest, Belgrade), multi-month drought impacts on ecosystems have intensified across both

northern and southern territories, causing severe soil moisture and vegetation deficits in Bosnia and Herzegovina, Montenegro, Slovenia, Germany, Czechia, and Romania.

- High energy dependency and fossil reliance: The macro-region exhibits low overall utilisation of renewable energy resources coupled with a high dependency on external fossil fuel imports, with net energy import ratios exceeding 60% in Moldova, Germany, Hungary, Austria, and Slovakia. This energy vulnerability was acutely exposed following Russia's war of aggression against Ukraine.
- Environmental pressures: While waste intensity has generally decreased across the basin, municipal waste management and circular economy performance remain uneven.
- Dense environmental cooperation networks: Under Policy Objective 2 (Greener Europe), the DRP exhibits its densest transnational cooperation patterns. Partnerships are heavily concentrated among universities, research institutes, and public water authorities (such as the University of Natural Resources and Life Sciences Vienna, the Technical University Munich, the Hungarian General Directorate of Water Management, and Croatian Waters) collaborating across key river basin, sediment, and water balance projects (*Danube Water Balance*, *DanubeSediment_Q2*, *Tethys*).

Right to Stay

- Demographic contraction and brain drain: The Danube Region lost over 2.4 million inhabitants between 2011 and 2024, experiencing severe demographic contraction in eastern EU areas and non-EU candidate countries (with cumulative population losses exceeding 15% in northern Bulgaria, eastern Croatia, and Moldova) driven by low fertility, rapid population ageing, and sustained outward migration of young, tertiary-educated talent.
- Labour market disparities and youth inactivity: Despite declining overall unemployment, severe structural inactivity persists. Rates of young people Not in Education, Employment, or Training (NEET) remain elevated in eastern and southern peripheries (ranging from 12% to 22.5%, peaking in Romania's South-West Oltenia and South-East regions and Bulgaria's Severozapaden), creating intergenerational poverty traps.
- Human capital disconnects: Tertiary educational attainment and high-value, technology-intensive employment are heavily concentrated in capital cities and western regions. Rural and eastern hinterlands face lower tertiary completion rates, early school leaving, and an underdeveloped services sector relative to EU averages.
- Social exclusion and service shadows: Large shares of the population remain at risk of poverty or social exclusion (AROPE rates exceeding 40% in parts of Romania and Bulgaria). Spatial accessibility to essential social infrastructure is severely constrained in rural and mountainous zones (e.g., the Carpathians and Dinaric Alps), where car travel times to the nearest hospital or secondary school routinely exceed 30 minutes.
- Targeted DRP funding allocation: To counteract these socio-economic divides, the DRP allocates 45.2% of its total planned funding to Sustainable Regional Development

(covering education, employment, and social inclusion), a share dramatically higher than the 7.2% average observed across other Interreg B programmes. High cooperation intensity under PO4 is driven by regional development agencies, universities, and SMEs in projects focusing on skills, innovation, and culture (*Culinary Trail*, *DINAMIC DANUBE*, *DanubeCrafts*).

Integration and special territorialities

- Socio-economic divides: The DRP area is divided into three distinct country groupings: older EU Member States (Germany, Austria), post-2004 EU Member States (EU-13), and non-EU candidate countries. This creates a sharp East-West divide in GDP per capita, regional competitiveness, and innovation performance, alongside a deepening urban-rural divide where capital metropolises prosper while rural hinterlands lag.
- Sub-transnational functional geographies: Transnational cohesion relies on shared natural and geographical systems, including transboundary river basins (Tisza, Sava, Drava, Dniester) and mountain ranges (Carpathians, Balkans, Alps) that require coordinated spatial governance.
- Geopolitical shocks and EU accession: Russia's war of aggression against Ukraine has profoundly altered regional trade, energy security, and demographic patterns, driving massive refugee inflows (with Germany hosting over 1.2 million refugees, and Moldova, Czechia, and Slovakia recording the highest refugee shares relative to their total populations). Concurrently, the DRP serves as a vital technical framework supporting the EU accession process for candidate countries (UA, MD, BA, ME, RS) by fostering equal-footing cooperation.
- Institutional governance engine for EUSDR: The DRP acts as the primary financial engine for the EU Strategy for the Danube Region. Under Specific Objective 4.1, the DRP directly funds the Danube Strategy Point (DSP) and the Priority Area Coordinators (PACs) across all 12 EUSDR Priority Areas, strengthening multi-level governance.

2. Strategic policy directions and recommendations

Water scarcity

- Prioritise energy resilience and low-carbon solutions: Future programming must adapt thematic priorities to tackle the region's high energy dependency by supporting diversified renewable energy production, energy efficiency, and climate-resilient energy infrastructure.
- Strengthen transnational river basin management: Interventions should continue focusing on large-scale environmental challenges that exceed national or cross-border capacities, specifically integrated flood risk management, drought adaptation, sediment monitoring, and ecological corridor protection across shared river systems.
- Promote the circular bioeconomy: Capitalise on the transition toward a circular bioeconomy as a cross-cutting driver for sustainable growth, resource efficiency, and material reuse, helping to decouple regional economic growth from waste generation.

Right to Stay

- Invest in labour market adaptation and upskilling: Implement targeted upskilling, reskilling, and lifelong learning initiatives to mitigate brain drain and address acute labour shortages caused by demographic decline. DRP should support innovative employment models, such as remote work frameworks tailored to rural contexts.
- Adopt integrated „triple-impact" policy packages: Move away from single-theme interventions toward holistic packages that link environmental, social, and economic goals. For example, leveraging natural and cultural assets for eco-tourism and agritourism can simultaneously create high-quality local jobs, stimulate rural economies, and support nature conservation.
- Targeted capacity building for rural and peripheral actors: Address the concentration of project coordination capacity in capital cities by delivering structured, localized outreach, webinars in national languages, and capacity-building toolkits (such as the OECD Beneficiary Capacity Building Toolkit) to empower rural and peripheral beneficiaries.

Integration and Special Territorialities

- Formalise full Ukrainian and Western Balkan integration: Maintain post-2027 eligibility for all regions of Ukraine to leverage their strong motivation and technical value in resilience and innovation. Utilise „associated partner" models to seamlessly integrate Western Balkan territories located outside formal programme borders.
- Implement multi-level, place-based interventions: Deploy tailored, place-based approaches that address specific territorial scales, using metropolitan hubs as drivers for R&D/technology transfer and providing targeted support to rural and border peripheries to prevent further developmental divergence.
- Strengthen strategic synergies across programmes and EUSDR: Deepen systematic operational links between DRP project outputs and EUSDR macro-regional policy processes via active Priority Area Coordinator (PAC) involvement. Strengthen horizontal synergies with overlapping transnational programmes (e.g., Interreg Central Europe) and vertical synergies with mainstream ERDF/ESF+ funds, Community-Led Local Development (CLLD), and Integrated Territorial Investments (ITIs, such as the ITI Danube Delta in Romania).
- Align with Performance-Based Governance: Prepare programme architecture, monitoring systems, and result-indicators for the post-2027 Cohesion Policy framework's shift toward performance-based governance, ensuring measurable macro-regional impacts.

Interreg Transnational Programmes: needs and opportunities for the future cooperation [TNCOOP] Strand fiche Interreg VI B Transnational Programmes // May 2026

- Type of document: Transnational territorial analysis & programme strand synthesis fiche (ESPON 2030)
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: This document presents a comprehensive summary of the ESPON 2030 TNCOOP research project's *Strand Fiche Interreg VI B Transnational Programmes* (May 2026). The fiche delivers a cross-cutting synthesis of the 13 Interreg Strand B transnational cooperation programmes operating across Europe and its immediate neighbourhood for the 2021-2027 programming period, outlining strategic perspectives for post-2027 Cohesion Policy.

1. Key findings

1.1 Water Scarcity

- Overwhelming thematic concentration on Greener Europe: Policy Objective 2 (A greener, low-carbon and resilient Europe) dominates Interreg Strand B, absorbing 54.9% of total transnational funding across Europe (ranging between 42% and 67% at individual programme level). Water management, climate adaptation, and ecosystem protection represent the most universally recognised fields of transnational collaboration.
- Systemic water risks across shared hydrographic basins: Transnational territories are united by shared river basins (e.g., Danube, Rhine) and semi-enclosed sea basins (Baltic Sea, Mediterranean, Black Sea) that face severe hydrological stresses. Prolonged multi-month droughts, severe soil moisture deficits, and heat stress increasingly impact ecosystems, forestry, and agriculture in Southern and Central Europe (Euro-MED, Sudoe, Danube Region, Alpine Space). Concurrently, catastrophic riverine and flash flooding threatens urban corridors along major river systems and coastal zones subject to sea-level rise and storm surges (North Sea, Atlantic Area, Baltic Sea).
- Transboundary marine and freshwater pollution: Water quality deterioration remains a critical cross-border challenge. High municipal and industrial waste intensity, agricultural nutrient runoff causing eutrophication, plastic pollution, and industrial/maritime chemical contamination degrade shared river basins and maritime environments.
- Cross-programme environmental synergies: The environment theme demonstrates the highest network cohesion and partner repetition across Interreg B. Strong operational synergies exist with specialized international frameworks, such as the Helsinki Commission (HELCOM) in the Baltic Sea, the Barcelona and Ramsar Conventions in the Mediterranean, the ICPDR in the Danube, and the Alpine and Carpathian Conventions. Environmental projects frequently serve as pipelines for upscaling local pilots into larger EU-funded initiatives under Horizon Europe, LIFE, and the EU Green Deal.

1.2 Right to Stay

- Demographic erosion, depopulation, and ageing: Acute demographic decline, low fertility rates, and severe population ageing affect extensive European territories, particularly rural, mountainous, and eastern peripheral regions (Central Europe, Danube Region, Sudoe, Northern Periphery and Arctic). The persistent out-migration of young, tertiary-educated individuals („brain drain") drains local human capital, weakens local labour markets, and creates severe „development traps".
- Urban-rural divide and access to social infrastructure: A sharp spatial divide persists between prosperous metropolitan hubs and lagging rural or sparsely populated hinterlands. Rural peripheries face shrinking public service provision, where car travel times to secondary schools, hospitals, and primary healthcare facilities routinely exceed acceptable thresholds. Conversely, major metropolises suffer from overheating real estate markets, housing unaffordability, and severe urban socio-economic polarisation.
- Skill mismatches and incomplete zransitions: While overall unemployment has declined across many Interreg B areas, structural inactivity and youth NEET rates (*Not in Education, Employment, or Training*) remain high in southern and eastern peripheries (IPA Adrion, NEXT MED, Danube Region). Regions undergoing industrial and green transitions struggle to align TVET and higher education outputs with emerging digital and low-carbon skill demands.
- Targeted allocation to social Europe: Interreg B allocates 9.9% of its aggregate resources to Policy Objective 4 (*A more social Europe*), with programmes like the Danube Region allocating up to 45.2% to Sustainable Regional Development (education, employment, and social inclusion). Transnational projects excel at fostering „Smart Villages", remote service delivery models (telemedicine, e-learning), and multi-stakeholder „quadruple-helix" networks that empower local communities to remain in their home territories.

1.3 Integration and special territorialities

- Multi-speed development and spatial divides: Transnational programme areas are defined by complex macro-regional disparities, including persistent East-West socio-economic gaps stemming from historical EU enlargements, and North-South gaps in innovation capacity, GDP per capita, and quality of governance. Centrality in core economic hubs (North-West Europe, Alpine Space) contrasts sharply with extreme peripherality.
- Macro-regional strategies (MRS) and Sea basin strategies (SBS) as anchors: Transnational programmes provide the essential operational and financial engine for political macro-frameworks:
    - *EUSBSR (Baltic Sea):* Aligned with Interreg Baltic Sea Region to drive water-smart and climate-neutral societies.

- *EUSDR (Danube Region):* Directly funded via DRP (SO 4.1) to support Danube Strategy Point (DSP) and Priority Area Coordinators (PACs) across 12 thematic areas.
- *EUSAIR (Adriatic-Ionian):* Integrated with IPA Adrion flagship processes.
- *EUSALP (Alpine Space):* Synchronized with Alpine Convention priorities and Alpine Youth initiatives.
- *Sea Basin Strategies:* WestMED, Atlantic Maritime Strategy, and Common Maritime Agenda (CMA) for the Black Sea structure blue growth and coastal resilience.

- Geopolitical shocks, external borders, and accession: Russia's war of aggression against Ukraine has fundamentally altered the Eastern external borders of the EU, disrupting long-established partnerships (forcing the exclusion of Russia and Belarus) while creating urgent demands for conflict resilience, civil protection, and refugee integration in Ukraine and Moldova. In the Western Balkans and Black Sea, Interreg B serves as a critical „laboratory for EU accession", allowing candidate countries to participate on equal footing with EU Member States.
- Cross-programme beneficiary networks: Overlapping geographies foster organic institutional synergies. Central Europe shares 54 recurring project beneficiaries with the Danube Region Programme, while extensive governance networks—such as the Atlantic Region Managing Authorities (ARMA) network, the Mediterranean Multi-Programme Mechanism (MMM), MedLab, and Interact's INDEX data-sharing platform—facilitate inter-programme learning.

2. Strategic policy directions and recommendations

2.1 Water Scarcity

- Establish integrated river-to-sea climate corridors: Transnational programmes must prioritise cross-border and cross-basin environmental management. Future calls should require „dual or triple impact" project designs that combine climate adaptation (flood/drought risk prevention) with Nature-based Solutions (NbS), biodiversity restoration, and local economic diversification.
- Accelerate the smart and just energy transition: Capitalise on macro-regional renewable energy potential (offshore wind, solar, biomass, green hydrogen) by funding the planning, digital grid interoperability, and governance of local energy communities. Interreg B should support preparatory and pilot actions that pave the way for large-scale infrastructure investments under mainstream Cohesion Policy, CEF, or REPowerEU.
- Scale up circular bioeconomy solutions: Foster systemic resource efficiency and waste reduction by establishing cross-programme capitalisation pipelines. Connect regions with high waste intensity with leading R&D innovation hubs to transfer circular material models in agriculture, forestry, and maritime sectors.

2.2 Right to Stay

- Support place-based smart rurality and service innovation: Post-2027 Interreg B strategies must explicitly target rural, sparsely populated, and depopulating regions. Funding should support alternative, digitalised service delivery models (e-health, mobile healthcare, digital education hubs) and remote work infrastructure to enhance local quality of life and talent retention.
- Lower entry barriers via small-scale project calls: To counteract the dominance of capital-city institutions and large universities, programmes should institutionalize simplified, lower-budget "micro-project" or „small-scale" calls. Utilizing Simplified Cost Options (SCOs), single-stage light applications, and pre-financing will enable small municipalities, local action groups (CLLD), and NGOs to lead transnational partnerships.
- Build targeted human capital and upskilling pipelines: Address structural labour market mismatches by promoting triple- and quadruple-helix cooperation between local enterprises, TVET institutions, universities, and regional authorities. Establish dedicated capacity-building calls targeting underrepresented territories and disadvantaged social groups (including youth, women, and migrants).

2.3 Integration and special territorialities

- Embed „functional geographies" beyond rigid administrative borders: Future Interreg regulations should grant expanded „variable geometry" and geographic flexibility. This allows project partnerships to extend along natural functional spaces (such as full river catchments, maritime trade corridors, or mountain ranges) even when crossing programme boundaries or involving non-EU territories.
- Deepen integration with Non-EU, candidate, and third countries: Formalise equal-footing participation and capacity building for candidate countries (Ukraine, Moldova, Western Balkans) to support public administration reform and EU Acquis alignment. Implement „associated partner" models.
- Institutionalise multi-programme synergies and capitalisation: Move from informal, ad-hoc networking to structured operational synergies:
    - *Joint Cluster Calls:* Deploy joint calls between overlapping transnational (Strand B), cross-border (Strand A), and interregional (Strand C) programmes with synchronized evaluation calendars to pool budgets around common territorial bottlenecks (e.g., TEN-T rail/port nodes, coastal erosion).
    - *Policy Uptake Frameworks:* Require mature projects to include „policy uptake plans" and capitalisation work packages that feed pilot outputs directly into mainstream ERDF/CF national programmes, Horizon Europe, or macro-regional strategy (MRS) flagships.
    - *Dedicated EU Institutional Interface:* Establish a formal representation mechanism for Strand B within EU institutions (European Commission, European Parliament,

Committee of the Regions) to ensure transnational territorial evidence directly shapes future European legislation.

- Prepare for performance-based governance with safeguards for innovation: As Cohesion Policy shifts toward performance-based budgeting, transnational programmes must balance rigid output targets with safeguards for bottom-up, experimental, and high-risk policy innovation. Implement activity location tagging to map where territorial impacts actually land, ensuring transparent, long-term monitoring of European territorial integration.

Interreg V-A Romania-Hungary Cooperation Programme

- Document Type: Official Interreg V-A Cooperation Programme Document (European Territorial Cooperation)
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: The Interreg V-A Romania-Hungary Cooperation Programme (CCI: 2014TC16RFCB049, Version 6.0) is the official European Territorial Cooperation document governing cross-border funding between Hungary and Romania for the 2014–2020 programming period (with eligibility extending through December 31, 2023). Co-financed by the European Regional Development Fund (ERDF), the programme establishes the strategic and financial framework for joint investments across eight adjacent border counties. The document outlines the territorial strategy, priority axes, and implementation arrangements designed to address shared cross-border challenges, reduce socio-economic disparities, protect natural and cultural heritage, and support the objectives of the EU Strategy for the Danube Region (EUSDR).

1. Key findings

1.1 Water scarcity

- Transboundary water basin vulnerability: The eligible border region is rich in surface and groundwater resources, featuring multiple rivers and aquifers crossing the Romania-Hungary border. Over 35% of these shared river stretches show a deteriorating ecological trend, requiring joint management.
- Severe climate change and drought vulnerability: Climate projections highlight rising summer temperatures, a reduction in frost days, and irregular precipitation patterns that increase drought frequency and soil aridity across the Pannonian basin. These climate stresses threaten agricultural productivity, groundwater tables, and food security.
- High exposure to flood and inland water risks: Flood vulnerability across the eight counties is among the highest in Europe, with 376 localities facing recurring flood and excess inland water risks.

- Anthropogenic and industrial environmental threats: Manufacturing activities involving hazardous materials and inadequate wastewater/sewerage infrastructure present continuous risks of accidental industrial river pollution, which threatens protected Natura 2000 ecosystems and drinking water supplies.
- Arsenic contamination: Certain parts of the Hungarian border area suffer from naturally high arsenic levels in well-water, requiring specialised water quality interventions.

1.2 Right to Stay

- Depopulation and negative net migration: The border area suffers from persistent demographic contraction driven by negative natural population growth and selective outward migration of the active workforce and young graduates.
- Economic lag and low income: The region qualifies as a „less developed region" under EU Cohesion Policy, producing a lower share of national GDP (11.3%) than its population share (13.1%). Six of the eight counties fall below their national average in economic productivity.
- Healthcare disparities and „healthcare migration": A stark gap in healthcare infrastructure and equipment quality exists between Hungarian and Romanian border counties. Romanian patients frequently cross into Hungary to access higher-quality curative services, creating operational and financial strains on local healthcare systems.
- Labour market fragmentation and weak SME innovation: The active population is declining, while long-term unemployment remains high. Local SMEs struggle with weak technology transfer, unused business infrastructure/incubators, and a lack of sectoral focus.
- Poverty and marginalisation: Between 15% and 25% of the population lives at risk of poverty, with severe socio-economic deprivation concentrated in rural hinterlands and segregated Roma communities.
- Skills mismatch: High early school-leaving rates and poor alignment between vocational/tertiary education and employer needs exacerbate skill shortages, despite the presence of major university hubs (Timișoara, Debrecen, Szeged, Oradea).

1.3 Integration and special territorialities

- The 450 km non-Schengen border barrier: The non-Schengen status of Romania during the programming period created physical border controls, long access times, and severe travel delays at border crossing points (BCPs).

- Transport bottlenecks: Cross-border road density is insufficient, road safety is poor, and rail connections are severely underutilized due to a lack of electrification (only the Békéscsaba–Salonta railway line is electrified). Secondary and tertiary urban nodes are poorly connected to core TEN-T corridors.
- Underdeveloped multimodal and public transport: Cross-border mobility is heavily dominated by private passenger cars and trucks, with minimal public bus routes, lack of common e-ticketing or timetables, and unexploited river navigation.
- Institutional and administrative fragmentation: Cross-border institutional cooperation is often fragmented, one-off, and project-dependent. Differences in national legal frameworks, technical standards, and language barriers hamper daily administrative collaboration.
- Strong alignment with EUSDR: The border area falls directly within the Danube Region, demonstrating functional alignment with EUSDR Pillar 1 (Connecting), Pillar 2 (Protecting Environment), Pillar 3 (Building Prosperity), and Pillar 4 (Strengthening Region).

2. Strategic policy directions and recommendations

2.1 Water scarcity

- Implement joint quality management of shared waters (SO 6/b): Allocate €50.11 million ERDF to PA 1 to fund cross-border river basin management, water quality/quantity monitoring networks, and pollution prevention systems in compliance with the Water Framework Directive (Directive 2000/60/EC).
- Integrated water retention and eco-system restoration: Fund infrastructure to collect and store excess surface water to mitigate dry periods and droughts while preventing sudden floods. Support eco-system-based water restoration, small-scale drinking water supply upgrades, and natural habitat protection.
- Strengthen disaster and emergency response (SO 5/b): Devote €11.47 million ERDF under PA 5 to building a joint cross-border risk prevention and disaster management framework. Key actions include purchasing specialised emergency vehicles, installing monitoring tools, standardising emergency protocols, and conducting joint rescue training.
- EUSDR Synergy: Align water and risk projects directly with EUSDR Priority Area 4 („Water Quality") and Priority Area 5 („Environmental Risks") to ensure macro-regional consistency.

2.2 Right to Stay

- Support endogenous employment growth (SO 8/b): Channel €33.19 million ERDF under PA 3 into integrated territorial strategies that build on local economic strengths, particularly agriculture and food processing. Key interventions include supporting local product value chains, cross-border business incubators, SME technology transfer, and joint B2B marketplaces.
- Equalise healthcare services and expand e-health (SO 9/a): Allocate €62.22 million ERDF (the largest single priority allocation, at 32.90%) to PA 4 to modernize hospital infrastructure and diagnostic equipment across the borderland. Establish telemedical infrastructure, cross-border e-health patient data exchange protocols, and joint specialist medical teams to eliminate health inequalities.
- Target vulnerable and rural populations: Expand mobile health screening, preventive care, and social service access in remote rural areas and segregated Roma communities to combat structural poverty and social marginalisation.
- Match skills and retain youth: Develop joint vocational and tertiary training programs between universities and local industries to align education with regional job opportunities, curbing youth outmigration.

2.3 Integration and special territorialities

- Connect Secondary/Tertiary Nodes to TEN-T (SO 7/b): Direct €17.21 million ERDF under PA 2 to construct and upgrade cross-border road links connecting remote border communities to TEN-T corridors, improving road safety and reducing access times.
- Promote low-carbon and multimodal transport (SO 7/c): Fund cross-border public bus transport (including low-emission vehicles and charging stations), develop common e-ticketing and integrated schedules, construct cross-border cycle paths for commuting and tourism, and fund feasibility studies for cross-border rail electrification.
- Rehabilitate common cultural and natural Heritage (SO 6/c): Fund small-scale investments (up to €5M, or €10M for UNESCO sites) to restore castles, monuments, churches, and protected natural areas, organizing them into integrated cross-border thematic tourism routes.
- Deepen institutional and civic cooperation (SO 11/b): Allocate €3.58 million ERDF under PA 6 to reduce administrative/legal barriers, harmonize public service protocols, and fund small-scale people-to-people initiatives (cultural festivals, youth exchanges) to make cooperation a permanent feature of daily life.

- Embed EUSDR macro-regional governance: Maintain the practice of awarding additional evaluation points to project proposals that directly demonstrate contribution to EUSDR objectives and Priority Areas (PAs 1B, 3, 4, 5, 9, 10).

INTERREG VI-A IPA Romania – Serbia Programme

- Document type: Official Interreg VI-A IPA Cooperation Programme Document (European Territorial Cooperation / Instrument for Pre-Accession Assistance III).
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

4 Executive Summary

The (INTERREG VI-A) IPA Romania – Serbia Programme (CCI: 2021TC16IPCB001) is the official cross-border programming document governing European Union financial support between Romania and the Republic of Serbia for the 2021-2027 period. The programme provides the structural introduction to joint cross-border interventions focusing on the green transition, healthcare and educational accessibility, cultural tourism, and EU external border management capacity, while directly contributing to the EU Strategy for the Danube Region (EUSDR) and the EU Strategy for the Adriatic and Ionian Region (EUSAIR).

- 1. Key findings

1.1 Water scarcity

- High exposure to shared basin hydrological risks: The programme area sits right at the center of the Danube macro-region, with the Danube River forming 235 km (42.8%) of the 548 km shared border. Geographical features such as the Iron Gates gorges (Porțile de Fier / Đerdap) make the border region highly vulnerable to severe flooding, landslides, and climate-induced extreme weather.
- Severe drought and aridity pressures: Rising mean temperatures and changing precipitation patterns threaten agricultural valleys and natural ecosystems in the Banat Plains, increasing soil erosion and agricultural vulnerability.
- Inadequate wastewater and water protection infrastructure: Environmental infrastructure is severely underperforming; for instance, in Serbia, only 12% of the population was connected to urban wastewater treatment in 2017, while Romania faces stark urban-rural divides in collective wastewater systems. Uncontrolled landfills and agricultural runoff further threaten river basin water quality.
- Industrial and mining contamination hotspots: The region's economic profile features extensive mining exploitations and legacy industrial sites that cause localised soil, air, and water pollution, requiring land de-contamination and environmental monitoring.

1.2 Right to Stay

- Rural depopulation and demographic decline: Both sides of the border are predominantly rural, suffering from continuous population decline caused by low birth rates, ageing, and heavy out-migration of young active adults toward metropolitan poles or EU Member States.
- Extreme health service disparities: Medical infrastructure in rural and remote areas is outdated or absent, with over 80% of all medical personnel concentrated exclusively in urban centers. Disadvantaged groups, the elderly, and remote populations face severe barriers to accessing primary, preventive, and emergency healthcare.
- Labour market dualism and youth NEET risks: High unemployment among young active populations in rural areas coexists with acute skill shortages in technical fields. Education systems suffer from a lack of practical vocational training, poor digital tools in remote schools, and high early dropout risks among vulnerable Roma communities.
- Public transport and digital isolation: Local public transit networks in rural hinterlands are poor, characterised by low road density and slow transit times. Digital broadband coverage remains uneven, isolating remote communities from modern e-services.

1.3 Integration and special territorialities

- EU external border obstacles: The 548 km border between Romania (an EU Member State) and Serbia (an EU candidate country) represents 26% of Serbia's and 17% of Romania's external border, handling over 4 million passenger and 1.5 million freight vehicle crossings annually across 8 road, 2 rail, and 1 fluvial border crossing points (BCPs).
- Transit bottlenecks and border security pressures: Long clearance times at BCPs impede economic integration. Concurrently, the region sits along the Western Balkan irregular migration route, requiring heightened border surveillance, civil protection, and cross-border police interoperability.
- Special geographic and cultural Assets: The region encompasses key sub-transnational mountain corridors (Banat, Țarcu-Godeanu, and Cernei Mountains) and major urban cultural capitals. Timișoara (Romania) and Novi Sad (Serbia) serve as central cultural hubs, offering cross-border tourism integration potentials.
- EUSDR and EUSAIR alignment: The entire territory falls within the Danube macro-region, while Serbia also participates in EUSAIR, providing an established framework for macro-regional policy embedding.

2. Strategic policy directions and recommendations

2.1 Water Scarcity

- Preserve biodiversity and reduce pollution (SO 1.1): Direct €4.31 million in IPA III grants to restore riverbanks, decontaminate industrial brownfields/landfills, expand urban green infrastructure, and deploy real-time air/water quality monitoring networks.
- Pilot local renewable energy solutions (SO 1.2): Channel €3.90 million in IPA III grants into joint pilot actions for geothermal, solar, and wind energy, supporting local energy transition while adhering to strict sustainability criteria.
- Climate adaptation and joint disaster prevention (SO 1.4): Earmark €12.22 million in IPA III grants (the largest priority allocation under Priority 1) to flood prevention along the Danube and its tributaries using Nature-based Solutions, afforestation, joint fire/storm emergency preparedness, and cross-border civil protection systems.
- EUSDR/EUSAIR Synergies: Align all water and disaster projects directly with EUSDR Priority Area 4 („Water Quality"), EUSDR Priority Area 5 („Environmental Risks"), and EUSAIR Pillar III („Environmental Quality").

2.2 Right to Stay

- Modernise inclusive education and digital skills (SO 2.1): Allocate €6.71 million in IPA III grants to renovate technical/vocational schools, equip 200+ classrooms with digital „Smartlab" technology, support lifelong learning, and align curricula with local business demands to retain youth in rural areas.
- Equalise healthcare access and strategic health investments (SO 2.2): Direct €16.49 million in IPA III grants toward modernizing rural clinics, purchasing high-tech diagnostic equipment, establishing telemedicine infrastructure, and deploying mobile health units.
- Foster sustainable eco-tourism and cultural heritage (SO 2.3): Channel €8.29 million in IPA III grants into developing sustainable eco-tourism, health/wellness spas, cycling routes, and regeneration of public spaces, leveraging the visibility of Timișoara 2023 European Capital of Culture.
- Support small-scale projects: Provide dedicated small-scale project grants ranging from €250,000 to €2,000,000 to enable smaller local municipalities, NGOs, and civil society actors to deliver community-level solutions.

2.3 Integration and special territorialities

- Enhance external border management capacity (SO 3.1 / ISO 1): Allocate €11.73 million in IPA III grants under Priority 3 exclusively to enhance the institutional capacity of public

border authorities, modernise BCP infrastructure, and deploy large-scale IT systems for border surveillance.

- Implement strategic border security operations: Implement the strategic operation of strategic importance "*Safer climate within the Romanian-Serbian border area*" (€13.8M) involving border police, gendarmerie, and police directorates to streamline cross-border emergency/security procedures.
- Streamline border clearance and green lanes: Implement state-of-the-art digital border systems to reduce waiting times, facilitate „green lanes" for freight, and combat cross-border organized crime, human trafficking, and smuggling.
- Embed macro-regional governance: Maintain systematic coordination with EUSDR Priority Area 11 („Security") and EUSAIR governance structures, utilising JeMS electronic monitoring and standard Harmonised Implementation Tools (HIT) to ensure administrative efficiency.

Impact Evaluation Report. Evaluation services regarding the implementation and impact of Interreg V-A Romania-Bulgaria Programme

- Document type: Final Impact Evaluation Report (European Territorial Cooperation / Interreg V-A Romania-Bulgaria Programme 2014–2020).
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), Pillar 3 (Integration – Special Territorialities)

Executive summary: The Impact Evaluation Report for the Interreg V-A Romania-Bulgaria Programme (October 2020) presents an independent, comprehensive evaluation of the implementation, net effects, and long-term sustainability of the cross-border cooperation programme. Prepared by SC ACZ Consulting SRL and VVA Group S.r.l. for the Romanian Ministry of Public Works, Development and Administration, the report evaluates performance across the programme's five priority axes: Transport, Environment & Heritage, Risk Management, Employment, and Institutional Capacity.

1. Key findings

Water scarcity

- Inland waterway safety & coverage: Interventions under Specific Objective 1.2 successfully reached a 100% completion rate for navigation safety improvements across the entire 470 km shared Romanian-Bulgarian Danube stretch.

- Natura 2000 & river ecosystem protection: The programme successfully supported 13 Natura 2000 sites with coordinated management tools (surpassing the target of 10) and improved conservation status across more than 27,000 hectares of natural habitats.
- Joint water & climate risk management: Specialised emergency response capabilities along the Danube basin were significantly upgraded through joint procurement of Chemical, Biological, Radiological, and Nuclear (CBRN) mobile units, rapid intervention boats, and shared risk-monitoring protocols.
- Tourism-induced ecological pressures: Unintended negative side-effects were identified regarding increased tourist visits to newly promoted natural heritage sites, which led to garbage accumulation and highlighted local waste management vulnerabilities.

Right to Stay

- Overachievement in employment & skill initiatives: Interventions under Specific Objective 4.1 significantly exceeded all 2023 output targets, with over 18,400 individuals participating in joint local employment initiatives and training schemes.
- Youth & vulnerable group retention: Targeted training and social inclusion measures successfully addressed high regional youth unemployment, early school leaving, and structural poverty in lagging border districts.
- Business incubation & local product value chains: Projects created innovative tools to support local entrepreneurship, including cross-border virtual business incubators (such as BIOVIRTINC in organic agriculture) and 34 new integrated tourism products.
- Healthcare & service accessibility: Practical interventions under institutional capacity provided critical equipment upgrades to regional hospitals and schools, directly improving quality of life in border communities.

Integration and special territorialities

- TEN-T Road Infrastructure Modernisation: More than 120 km of roads connecting peripheral border areas to TEN-T networks were modernized, benefiting over 600,000 residents and improving local mobility.
- Overcoming natural & administrative Barriers: The programme fostered cross-border institutional dialogue across the physical barrier of the Danube River, establishing 62 cross-border mechanisms and multiple inter-agency agreements.
- Macro-regional EUSDR synergy: A total of 185 funded projects directly contributed to the implementation of the EU Strategy for the Danube Region (EUSDR).

2. Strategic policy directions and recommendations

Water scarcity

- Promote modal shift to waterways: Future programming should encourage synergies between transport modes, prioritising investments that shift freight and passenger transport from congested roads to Danube inland waterways.
- Embed civic waste education: Measures addressing civic education regarding tourist-generated waste and environmental protection should be integrated into horizontal principles or required within project selection criteria.
- Expand joint water & climate adaptation tools: Continue supporting joint cross-border early-warning systems, eco-system restoration, and shared management plans across transboundary river basins and wetlands.

Right to Stay

- Align skills training with market demand: Future employment interventions should move beyond general training to focus on high-demand digital management, green economy skills, and company-level business restructuring.
- Implement long-term employment tracking: Establish post-project monitoring indicators to measure long-term job retention (e.g., tracking employment status 1-3 years post-completion) to better evaluate soft intervention impacts.
- Support local entrepreneurship & business resilience: Scale up support for cross-border business networks, vocational coaching, and digital platforms to foster sustainable self-employment and retain young talent.

Integration and special territorialities

- Maintain investment continuity & integrated approaches: Ensure continuity of successful cross-border investment priorities beyond 2020 while adopting integrated, place-based territorial strategies rather than purely sectoral approaches.
- Engage the private sector & SMEs: Actively involve SMEs, business associations, and private stakeholders in cross-border planning and governance to enhance economic spill-over effects.
- Deepen EUSDR macro-regional alignment: Strengthen thematic concentration around the EU's post-2020 Cohesion Policy objectives (Smarter, Greener, Connected, Social, and Citizen-focused Europe) to maximize macro-regional impact.

Thematic Chapter „Basic Skills and Skills Shortages"[10]

Document Summary: wiiw – Danube Region Monitor "People & Skills" (Thematic Chapter 2025)

- Type: Empirical research & policy diagnostic report (EUSDR Priority Area 9)
- Thematic Alignment: Pillar 2 (Right to Stay) | PO 4 (SO 4.1, SO 4.2)

Executive Summary Prepared by the Vienna Institute for International Economic Studies (wiiw) on behalf of EUSDR Priority Area 9 ("People and Skills"), this thematic chapter analyzes student-level PISA 2022 data across 12 Danube Region countries (Austria, Bulgaria, Croatia, Czechia, Germany, Hungary, Romania, Slovakia, Slovenia, Montenegro, Republic of Moldova, Serbia). It evaluates foundational basic skills (mathematics, reading, science, ICT competence) alongside citizenship skills (sense of belonging, growth mindset, creative thinking). The report provides empirical evidence to address critical skills shortages, reduce educational inequalities, and safeguard the "Right to Stay" by strengthening youth employability and human capital retention across the macro-region.

1. Key findings

Right to stay

- Demographic contraction & brain drain: Accelerated population ageing and heavy outward youth migration create acute labour shortages in key sectors (health, education, ICT, green technology). Weak performance in foundational literacy and numeracy increases early school leaving, structural unemployment, and social exclusion, directly driving outmigration from lagging regions.
- Persisting EU vs. candidate country skill gap: A sharp cognitive divide splits the region: Danube EU Member States cluster near the EU-27 average in mathematics, reading, and science, whereas non-EU candidate countries (ME, MD, RS) and Eastern EU states (BG, RO) lag significantly behind, threatening regional convergence.
- Digital self-confidence deficits: Self-reported ICT competence is surprisingly low across the region, with even higher-performing EU states (e.g., Austria, Germany) displaying below-average digital self-confidence among youth.
- Entrenched socio-economic inequality: Family socio-economic status (ESCS) and home resources strongly dictate cognitive achievement in most Danube countries, reinforcing intergenerational cycles of disadvantage.

[10] https://peopleandskillsmonitor.danube-region.eu/files/Danube-Region-Monitor_Thematic-Chapter_2025.pdf

- Domain-specific gender divides: Girls consistently lead in reading and creative thinking, whereas boys outperform in mathematics, growth mindset, and school belonging – limiting female participation in local STEM fields.

2. Strategic policy directions and recommendations

- Mitigate absenteeism & early dropout: Deploy early warning systems, student counselling, and targeted family support to keep vulnerable youth in education and prevent structural unemployment.
- Modernise basic & digital skills curricula: Upgrade mathematics, science, and ICT education alongside dual vocational training to match local employer demands, filling structural vacancies and enabling lifelong learning.
- Tackle socio-economic & gender inequality: Expand early childhood education and promote gender-sensitive teaching to encourage girls in STEM and boys in literacy and creative fields.
- Foster inclusive school environments: Nurture student growth mindsets and school belonging through supportive teaching practices, ensuring young people develop the resilience and adaptability needed to thrive in local labour markets.

Danube Transnational Programme 2014-2020 Evaluation of the Danube Transnational Programme Updated evaluation report

- Document Type: updated ex-post evaluation report of the Danube Transnational Programme (DTP) 2014-2020
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration – Special territorialities)

Executive summary: The Updated Evaluation of the Danube Transnational Programme 2014-2020 presents an ex-post theory-based evaluation assessing the impacts, effectiveness, and sustainability of the DTP across 14 Danube basin countries (9 EU Member States and 5 non-EU candidate/neighbouring states). Evaluating 114 regular call projects, 25 Priority Area Coordinator (PAC) projects, 19 Seed Money Facility (SMF) projects, and the Danube Strategy Point (DSP), the report measures how transnational cooperation increased regional stakeholder capacity and supported the governance of the EU Strategy for the Danube Region (EUSDR).

1. Key findings

1.1 Water scarcity

- Absorption bottlenecks in environmental risk management (SO 2.4): While transnational water management (SO 2.1) performed strongly due to mature existing networks (e.g.,

ICPDR), environmental risk management (SO 2.4) suffered from low project generation, poor budget absorption, and underperformance in reaching expected target output values.

- Gaps in integrated river basin & disaster response: Coordinated response to climate-induced hazards (multi-month droughts, flash floods, wild fires, and chemical/accidental river pollution) remains unevenly developed across borders, requiring better data-sharing protocols and real-time monitoring tools (e.g., *DAREFFORT*, *JOINTISZA*).
- Balancing navigation with ecological integrity: Integrating inland waterway transport infrastructure with river ecosystem restoration (such as sediment balance and migratory fish corridors) remains a complex, under-addressed challenge that requires multi-sectoral policy alignment.

1.2 Right to stay

- Absorption deficits in innovation and energy efficiency: Structural absorption issues emerged under SO 1.1 (innovation framework conditions) and SO 3.2 (energy security and efficiency), indicating that broad, unfocused calls struggled to generate high-impact transnational interventions.
- High barriers to private sector and SME participation: For-profit private entities and SMEs represented only a small fraction of project partners due to financial constraints.
- Translating „soft" initiatives into local economic impact: While projects successfully delivered soft learning tools and networks (e.g., *EDU-LAB*, *D-Care Labs*, *NewGenerationSkills*), converting these into long-term local employment opportunities, youth retention, and reduced brain drain in peripheral/rural areas remains an ongoing challenge.

1.3 Integration and special territorialities

- The „strategy" quality and implementation gap: Projects generating high-level "strategies" were significantly less effective and durable in increasing cooperation compared to those producing practical tools or pilot actions. Many strategies remained purely technical documents lacking clear action plans, financial roadmaps, or political commitment from national decision-makers.
- Underperformance of the Seed Money Facility (SMF): The SMF call yielded uneven, low-quality proposal outputs due to tight application timelines, low financial volume per partner, and a lack of clear guidance on how to successfully transition project ideas into mainstream EU funding streams (ERDF/IPA).

- Administrative fatigue in EUSDR governance (SO 4.2): Applying rigid, classical Interreg project management and reporting rules to Priority Area Coordinators (PACs) created excessive administrative burdens, restricting their agility to drive macro-regional policy initiatives.
- Capacity and engagement gaps in non-EU countries: Participating non-EU candidate states (Ukraine, Moldova, Montenegro, Bosnia and Herzegovina, Serbia) faced recurring institutional capacity constraints, staff turnover, and first-level control setup delays, limiting their ability to lead projects.

2. Strategic policy directions and recommendations

2.1 Water scarcity

- Revamp project generation for risk preparedness (SO 2.4): Design targeted, structured calls for environmental risk management that directly address climate adaptation, flood/drought monitoring, and disaster resilience, providing technical guidance to overcome past absorption deficits.
- Mandate water & sediment srategy implementation: Ensure that river basin management tools and sediment strategies developed under DTP are formally embedded into national river management plans and joint macro-regional frameworks.
- Incorporate multi-sector environmental pilots: Prioritise pilot actions that combine ecological corridor restoration with green transport and sustainable land use to demonstrate tangible, scalable environmental solutions.

2.2 Right to stay

- Focus on actionable social and skills innovation: Shift funding toward practical pilot actions and tangible tools that directly link TVET/higher education with regional employers, fostering youth entrepreneurship and home-care service innovation in depopulating regions.
- Mandate long-term result tracking: Introduce project indicators that measure the actual uptake and post-closure durability of tools and social services to ensure interventions deliver lasting economic benefits to local communities.

2.3 Integration and special territorialities

- Enforce quality standards for transnational strategies: Require all future strategy-oriented projects to include concrete action plans with defined timelines, identified funding sources, and mandatory involvement/endorsement from national decision-making bodies.

- Reform EUSDR governance support (SO 4.2): Replace rigid project management rules for PACs with flexible, multi-annual technical assistance frameworks, reducing administrative overhead and allowing PACs to focus on strategic policy coordination.
- Targeted capacity building for non-EU partners: Deliver specialised, hands-on administrative and public procurement training for institutions in candidate/neighbouring countries to equalise project leadership capacities across the macro-region.

OECD Development Pathways. Multi-dimensional Review of the Western Balkans. ASSESSING OPPORTUNITIES AND CONSTRAINTS

- Document type: OECD Multi-dimensional country diagnostic / regional development review
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration – Special territorialities)

Executive summary: The Multi-dimensional Review of the Western Balkans: Assessing Opportunities and Constraints (OECD, 2021) delivers a comprehensive economic, social, environmental, and institutional diagnostic across the Western Balkan economies. This summary focuses specifically on Bosnia and Herzegovina and Serbia, evaluating their development trajectories across the five pillars of the Sustainable Development Goals (People, Prosperity, Partnerships, Peace and Institutions, and Planet).

1. Key findings

1. Water scarcity

- Bosnia and Herzegovina:
    - *Severe climate vulnerability & disaster risks:* The economy is highly susceptible to climate change, experiencing severe flooding (e.g., the catastrophic 2014 floods) and droughts. Economic losses per unit of GDP due to extreme weather events are among the highest in the region.
    - *Wastewater & municipal deficits:* Freshwater resources are moderate, but water management infrastructure is severely underdeveloped: only 31% of the population is connected to public sewage systems, and only 15% of urban wastewater is treated.
    - *Coal dependency:* Coal accounts for more than 60% of domestic electricity generation, supported by large state subsidies that disincentivise clean energy transition.
- Serbia:

- *Extreme weather exposure:* Serbia faces frequent droughts and floods; the May 2014 floods affected 22% of the population across two-thirds of municipalities (€1.5 billion in damages), while the 2017 drought caused a 10% drop in agricultural output.
- *Lignite energy mix:* More than two-thirds of domestic electricity is generated from highly polluting lignite coal.
- *Drinking water quality gaps:* While freshwater resources are relatively abundant, drinking water infrastructure requires significant investment; only 37% of drinking water in rural areas meets minimum safety and quality standards.
- *Protected areas deficit:* Terrestrial protected areas cover less than 7% of total land area, well below EU (25.9%) and OECD (15.1%) averages.

2. Right to stay

- Bosnia and Herzegovina:
  - *Extreme brain drain & outward migration:* Bosnia and Herzegovina faces severe demographic contraction; 55% of its tertiary-educated population has emigrated to OECD countries, draining the domestic human capital base.
  - *Labour market inactivity & gender disparities:* Less than 35% of women participate in the paid labour force, while 21.2% of young people (aged 15-24) are classified as NEET (Not in Education, Employment, or Training).
  - *Education quality disconnect:* Favourable pupil-to-teacher ratios do not translate into strong learning outcomes; 2018 PISA scores in reading, math, and science lag far behind OECD averages.
  - *Healthcare understaffing & financial burden:* Although Bosnia and Herzegovina spends a relatively high share of GDP on health (9.2%), out-of-pocket expenses are steep, and doctor availability (2.0 per 1,000 inhabitants) is severely constrained by physician emigration.
- Serbia:
  - *Youth emigration & demographic ageing:* High-skilled professionals represent the largest share of Serbian emigrants living in OECD countries, compounding domestic population ageing and shrinking active labour pools.
  - *Regional spatial inequalities:* Living standards and poverty rates vary drastically by geography; poverty risk in Southern and Eastern Serbia (Region Južne i Istočne Srbije) is three times higher than in the Belgrade Region.

- *Youth NEETs & graduate unemployment:* High-skilled university graduates face significant unemployment upon graduation, contributing to an overall youth NEET rate of 17.5%.
- *Out-of-pocket healthcare costs:* Despite comprehensive formal health insurance coverage (covering nearly 98% of citizens), private out-of-pocket healthcare payments remain high and are rising steadily.
- *Education system performance:* Serbia leads the Western Balkans in PISA test performance, but over one-third of 15-year-olds still fail to achieve basic proficiency in reading, math, and science.

3. Integration and special territorialities

- Bosnia and Herzegovina:
  - *Complex governance:* A multi-layered institutional structure (Entities, Cantons, Brčko District) leads to policy fragmentation, overlapping jurisdictions, and high administrative costs.
  - *External financing dependency:* Low domestic savings force heavy reliance on external inflows; personal remittances account for almost 10% of GDP.
- Serbia:
  - *FDI attraction vs. domestic linkages:* Serbia has successfully attracted significant export-oriented Foreign Direct Investment (FDI) in manufacturing and automotive sectors, boosting total exports. However, limited integration between foreign investors and local domestic SMEs restricts broader productivity spillovers.
  - *Institutional & judicial challenges:* Business growth is hindered by widespread informal sector competition, inefficient commercial court contract enforcement, and weakening institutional checks on executive power.
  - *Regional trade integration:* Serbia plays a central trade role within CEFTA, with strong regional trade links to Bosnia and Herzegovina, and Montenegro.

OECD Development Pathways Multi-dimensional Review of the Western Balkans FROM ANALYSIS TO ACTION

- Document type: OECD Policy & action review
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration – Special territorialities)

Executive Summary: The second volume of the OECD Multi-dimensional Review of the Western Balkans, From Analysis to Action (2022), translates diagnostic findings into concrete policy recommendations and action plans. Based on a regional peer-learning process and technical analysis, the document sets out actionable pathways across three core priorities: boosting education and competencies, fostering social cohesion, and ensuring a green recovery.

1. Strategic policy directions and recommendations

Water scarcity

- Bosnia and Herzegovina:
    - Adopt a harmonised energy and climate strategy: Finalise the National Energy and Climate Plan (NECP) and establish a unified, entity-harmonised legal framework for a low-carbon transition.
    - Execute a just green transition: Combine coal phase-out plans with targeted social protection and re-skilling programs for miners and thermal power plant workers, redirecting their skills toward building retrofits, construction, and green infrastructure.
    - Reform renewable energy support schemes: Replace fixed feed-in tariffs with competitive, market-based auctions and feed-in premia (FiPs) for utility-scale solar and wind projects, while streamlining permitting and environmental licensing procedures.
    - Prioritise building energy efficiency: Establish dedicated, well-funded energy efficiency funds to support thermal insulation, heating replacement, and retrofits, alongside modernising multi-apartment building legislation to empower homeowners' associations.
- Serbia:
    - Establish a coal phase-out and decarbonisation strategy: Finalise the NECP and Low Carbon Development Strategy, setting explicit timelines for coal phase-out and introducing carbon regulation compatible with EU ETS principles.
    - Expand prosumers and solar PV integration: Streamline grid-connection and net-metering procedures for residential and commercial prosumers installing rooftop solar systems, supported by public awareness campaigns.
    - Accelerate energy efficiency: Expand public energy efficiency funding, leverage private Energy Service Companies (ESCOs), and transition municipal district

heating networks to renewables/biomass with mandatory consumption-based metering.

- Reform coal subsidies and utility governance: Redirect fossil fuel subsidies toward green infrastructure and just transition funds for affected mining communities, while enhancing the operational independence of energy regulator AERS.

2. Right to stay

- Bosnia and Herzegovina:
  - Deploy competence-based curricula and teacher standards: Implement system-wide teacher standards across initial teacher education (ITE) and continuous professional development (CPD), supported by a state-level competitive licensing examination and structured mentorship for novice teachers.
  - Align VET with labour market needs: Modernise vocational education and training (VET) profiles in partnership with private employers, expand work-based learning/apprenticeships, and establish flexible pathways connecting secondary VET to tertiary education.
  - Expand early childhood education and care (ECEC): Reallocate public education funding to expand municipal ECEC infrastructure in underserved rural areas and introduce financial support schemes for low-income and vulnerable families.
  - Build adult learning and digital infrastructure: Develop adult learning systems with robust skills assessment and anticipation (SAA) tools to support upskilling and reskilling, alongside expanding digital devices and pedagogical ICT training for teachers.
  - Enhance active labour market policies (ALMPs) and female employment: Expand ALMP funding, shift public employment service (PES) resources toward individualised profiling and youth guidance, and implement the action plan to increase female labour force participation through accessible childcare and flexible work models.
  - Reform social protection: improve the benefit adequacy and targeting of means-tested social assistance, and deliver community-integrated social care at the municipal level.
- Serbia:

- Execute action plan for teacher professional development: Implement standards-based teacher appraisals that link evaluation results directly to career advancement, CPD credit accumulation, and salary progression.
- Expand dual VET and industry partnerships: Strengthen dual VET frameworks in key industrial nodes and special economic zones (e.g., Smederevo, Subotica, Pirot) to match high-demand technical and digital skills.
- Leverage FDI and diaspora for skill ppillovers: Target R&D-intensive foreign direct investment (FDI), enforce investor aftercare programs that build domestic supplier capabilities, and establish professional diaspora networks for mentorship, joint research, and seed financing.
- Support labour market integration and vulnerable groups: Adjust tax progressivity on low earners, expand ALMP reach for NEET youth and the long-term unemployed, increase Financial Social Assistance (FSA) benefit levels, and equalize municipal social care access.

3. Integration and special territorialities

- Bosnia and Herzegovina:
  - Harmonise multi-level education governance: Establish coordinated policy-making mechanisms across all 12 education ministries/cantons/entities and create a unified indicator and data collection framework to track system performance consistently.
  - Empower local self-governments (LSGs): Revise municipal fiscal space, build local administrative service delivery capacities, and deploy digital e-government solutions to streamline public service delivery.
  - Advance regional energy market coupling: Strengthen cross-border interconnections, liberalise balancing markets, and integrate regional electricity trading platforms to enhance market liquidity and energy security.
- Serbia:
  - Advance regional trade and energy integration: Promote market coupling on SEEPEX, integrate cross-border balancing markets, and align domestic trade and environmental regulations with EU standards to safeguard market access.
  - Reduce municipal service disparities: Rebalance fiscal resources across local self-governments (LSGs) to ensure equitable public service, healthcare, and social care delivery in economically underdeveloped regions.

Strategy for the valorisation of natural and intangible cultural heritage in rural and less visited areas of the Danube Region

- Document type: Transnational strategy
- Thematic alignment: Pillar 2 (Right to stay), Pillar 3 (Integration – Special territorialities)

Executive summary: The Strategy for the Valorisation of Natural and Intangible Cultural Heritage in Rural and Less Visited Areas of the Danube Region is a flagship policy and operational framework developed under the Interreg Danube Region project MYSTICAL DANUBE. Designed to foster sustainable, inclusive, and resilient regional development, the Strategy establishes a coordinated transnational model for transforming mapped natural assets and associated intangible cultural heritage (legends, folklore, traditional crafts, and customs) into authentic tourism resources.

Pillar 2: Right to stay

1. Key Findings

- Depopulation and generational disconnect: Rural and peripheral areas across the Danube Region suffer from severe demographic contraction, including population ageing and the outmigration („brain drain") of young, educated workers seeking better economic opportunities elsewhere.
- Economic fragility and employment deficits: Rural hinterlands rely heavily on subsistence or seasonal agriculture and face persistent structural unemployment, low wage levels, and limited local job opportunities.
- Erosion of intangible cultural heritage: Oral traditions, local legends, traditional crafts, dialects, and customs face slow extinction due to globalisation, modernisation, and the loss of intergenerational knowledge transfer caused by youth outmigration.
- Marginalisation of vulnerable groups: Women, youth, the elderly, ethnic minorities, and persons with disabilities often lack structured platforms, skills, or financial support to participate in local economic life or decision-making processes.
- Capacity gaps in local enterprise: Micro and small enterprises (SMEs) in rural areas operate largely in lower value-added sectors, lacking the marketing, technical, and managerial skills needed to transform local heritage into viable business models.
- Community-based tourism (CBT) as an economic driver: CBT offers an innovative socio-economic model to diversify rural economies, create local jobs, generate sustainable income, and incentivise youth to remain in their home regions.

- Inclusive empowerment of vulnerable groups: Actively involving women, youth, minorities, and persons with disabilities as co-creators and service providers in tourism builds social cohesion and reduces socio-economic marginalization.
- Intergenerational knowledge transfer: Connecting older tradition-bearers with younger generations through structured mentoring revives traditional crafts, dialects, and local folklore.
- Circular local value chains: Integrating local artisans, winemakers, organic farmers, and small home-renters into short supply chains retains economic benefits within the local community.

2. Strategic policy directions and recommendations

- Activate and empower local communities (Measures 4.1 & 3.2):
    - Establish local „Heritage Labs" and participatory workshops to help residents identify, interpret, and format local stories, legends, and traditional assets for tourism.
    - Implement the „Heritage Ambassador" model to identify, train, and empower passionate local community members to serve as official interpreters, educators, and advocates for local heritage.
    - Launch local „Heritage Days" and public awareness campaigns to foster community pride and a sense of belonging among residents.
- Strengthen SMEs and short local value chains (Measures 4.3 & 3.5):
    - Provide targeted capacity-building and business mentorship for local SMEs, family farms, and artisans to help them co-design heritage-based products and services.
    - Establish short local supply chains („Meet the Master" artisan visits, local food/craft fairs) connecting small agriculture producers, artisans, and tourism operators.
    - Advocate for simplified administrative and tax regulations governing the production, certification, and sale of traditional crafts and artisanal products.
- Promote intergenerational mentorship and vulnerable group inclusion (Measures 4.1 & 3.1):
    - Develop intergenerational mentorship schemes where youth learn traditional crafts, music, oral histories, and culinary skills directly from older community members.

- Support youth-led digital storytelling projects that blend traditional folklore with modern media, increasing online destination visibility while building youth digital competencies.
- Ensure universal accessibility across tourism infrastructure and adapt interpretation formats (audio guides, tactile elements, VR/AR) for elderly visitors and persons with disabilities.

- Establish financial support and micro-incentive schemes (Measure 3.8):
  - Set up systems of micro-grants, micro-incentives, and seed-money mechanisms tailored to small community-led initiatives and heritage start-ups.
  - Promote tax incentive programs for community-based tourism enterprises and advocate for embedding CBT funding within national and future EU programming frameworks (2028–2034).

Pillar 3: Integration – special territorialities

Key findings

- Spatial disparities and tourism over-centralisation: Tourism flows across the Danube macro-region remain heavily concentrated in capital cities, coastal zones, and major hotspots, leaving rural and remote areas under-visited despite their natural and cultural richness.
- Transport and accessibility bottlenecks: Peripheral rural regions suffer from underperforming, inflexible, or non-existent public transit networks, forcing heavy reliance on private cars and restricting visitor access to remote heritage points.
- Digital infrastructure deficits: Remote heritage locations frequently lack stable internet coverage, digital signage, or unified online information systems, hindering modern interpretation and destination promotion.
- Fragmented management and governance: Heritage management across the 14 Danube countries is often ad-hoc and siloed, lacking cross-sectoral integration, cross-border coordination, or unified macro-regional destination branding.
- Transnational thematic route integration: Establishing the *Green and Mystical Danube Storytelling Route* creates an integrated, multi-country thematic itinerary connecting rural contact points across the entire Danube macro-region.
- Green and sustainable mobility networks: Expanding eco-friendly transport options, such as cycling routes (e.g., EuroVelo), hiking trails, intermodal transit hubs, electric bus connections, and EV charging stations, enhances green connectivity.

- Smart tourism and digital Innovation: Deploying open-access digital repositories (such as the *Mystical Danube Heritage Atlas*), interactive online guides/maps, QR-coded interpretative panels, AR/VR experiences, and AI-driven visitor management tools improves destination accessibility and data collection.
- Macro-Regional Policy Alignment: Strong functional alignment with the EU Strategy for the Danube Region (EUSDR), specifically Priority Area 3 (Culture & Tourism), PA1b (Mobility), PA7, PA8, PA9, and PA10, as well as EUSAIR and EUSALP frameworks.

2. Strategic policy directions and recommendations

- Develop and manage transnational cultural routes (Measures 2.3 & 6.1):
    - Operationally establish the *Green and Mystical Danube Storytelling Route*, equipping identified rural contact points with eco-friendly, accessible visitor infrastructure.
    - Establish long-term transnational management plans, common evaluation indicators, and a multi-language digital platform to track route performance and collect visitor feedback.
    - Expand the network of contact points by inviting new rural municipalities, protected area managers, and local associations to join the route network.
- Implement advanced branding and market presence (Measures 2.4 & 6.2):
    - Launch the unified „Mystical Danube" master brand and communication strategy across digital media, social networks, and international travel trade fairs.
    - Organize the annual "Mystical Danube Festival" as a rotating transnational event featuring community performances, storytelling, craft marketplaces, and cultural exchanges.
    - Partner with national tourism boards to formally integrate rural storytelling contact points into broader national and international travel itineraries.
- Enhance green mobility and regional accessibility (Measures 5.2 & 5.3):
    - Develop intermodal transport hubs in rural areas, linking public transit schedules with hiking and cycling infrastructure.
    - Construct educational eco-trails, viewpoints, and uniform waymarking signage equipped with multi-lingual QR codes leading to digital storytelling content.
- Accelerate digital transformation and smart interpretation (Measures 5.1 & 2.2)
- Establish quality certification and transnational governance (Measures 2.5 & 6.1):

- Create a transnational quality label to certify local tourism providers, small renters, and guides demonstrating sustainable, authentic, and heritage-integrated services.
- Form cross-sectoral dialogue platforms, working groups, and destination management organisation (DMO) networks across the Danube Region to align local, national, and EUSDR macro-regional heritage and tourism policies.

OECD Tourism Trends and Policies 2026

- Document type: Official OECD flagship publication (biennial policy and statistical benchmark report).
- Thematic alignment: Pillar 3 (Integration – Special territorialities)

Executive summary: The OECD Tourism Trends and Policies 2026 report is an international benchmark publication providing comprehensive data, policy analysis, and governance insights across 53 OECD member and partner countries. The document examines the sector's performance and economic footprint while highlighting the strategic policy shifts required to foster a competitive, sustainable, and resilient tourism economy. Focusing on destination management across urban, rural, and functional areas, the publication addresses critical shared challenges—including spatial and seasonal concentration, housing market pressures, digital transformation, and climate risks—while outlining strategic policy directions to optimize local socio-economic value and ensure balanced destination development.

1. Key findings

Spatial and seasonal concentration in destinations

- Tourism demand across destinations is heavily concentrated spatially, with approximately 47% of all tourist nights concentrated in just 10% of regions with available data.
- High spatial concentration in popular urban centers, historic city cores, and established coastal or nature hubs places severe strain on public transport, municipal infrastructure, utilities, housing, and local ecosystems.
- At the same time, less-visited rural, remote, and secondary functional areas frequently miss out on the economic gains and development opportunities generated by tourism.
- Seasonality remains a common structural challenge, with around 40% of tourist nights across OECD countries concentrated in the top three peak months (exceeding 50% in countries such as Slovenia).

- High seasonal and spatial pressure creates operational vulnerabilities, strains community resources during peak periods, and leads to underutilised infrastructure capacity and unstable seasonal employment during off-peak periods.

Urban vs. rural functional area dynamics

- Urban destinations generally possess stronger infrastructure, higher accommodation density, and better public transit networks to absorb visitor volumes, but face heightened risks of gentrification, rising housing costs, traffic congestion, and local resident pushback.
- Rural and remote functional areas often struggle with structural challenges, including lower economic diversification, depopulation, lower workforce competencies, and limited public transport or digital connectivity.
- Tourism presents a major opportunity for rural functional areas to diversify local economies, generate employment, attract investment, and support public amenities that benefit both residents and visitors.
- Shifts in traveller preferences toward experience-based, slow, nature-based, and off-peak travel („coolcations") offer emerging rural destinations new opportunities to capture visitor spending away from saturated urban centres.

Short-term rentals and housing pressures

- The rapid growth of short-term tourism rentals in popular urban cores and coastal destinations can exacerbate existing housing availability and affordability pressures for local residents and seasonal tourism workers.
- Unmanaged short-term rental expansion can blur the boundaries between residential neighborhoods and commercial tourism activity, fueling local social friction if community carrying capacity is exceeded.

Environmental exposures and extreme weather

- Destinations across urban, coastal, and mountainous functional areas face rising exposure to extreme weather-related events, including heatwaves, wildfires, heavy precipitation, and flooding.
- Extreme weather disruptions damage physical infrastructure, disrupt transport connectivity, compromise natural attractions (such as low snow cover in alpine zones or coastal erosion), and alter the seasonal and geographic distribution of travel demand.

2. Strategic Policy Directions and Recommendations

Co-ordinated governance and destination empowerment

- Strengthen multi-level governance: Align national tourism policies with local destination strategies through co-ordinated whole-of-government frameworks, empowering local authorities and Destination Management Organisations (DMOs) to manage visitor flows based on local carrying capacities and community needs.
- Promote participatory planning: Involve local residents, businesses, civil society, and municipal actors in destination planning and policy design to ensure tourism development reflects community values, protects local identity, and maintains resident acceptance.
- Define destination carrying capacities: Develop standardised indicators and frameworks to assess destination carrying capacity across physical, environmental, transport, and social dimensions to guide sustainable development thresholds.

Spatially and temporally balancing visitor flows

- Develop tourism corridors and thematic routes: Establish interconnected regional tourism corridors, cycling routes, cultural itineraries, and eco-trails to spread visitor demand away from congested urban/coastal hotspots into lesser-known rural and secondary functional areas.
- Incentivise off-peak and rural travel: Implement targeted marketing, digital voucher schemes, and seasonal promotional campaigns to stimulate off-season domestic and regional visitation, helping destinations achieve stable, year-round economic activity.
- Manage hotspot demand: Utilise visitor management mechanisms (such as pre-booking systems for high-demand heritage/nature sites, extended opening hours, and staggered cruise ship arrivals) to mitigate peak-period overcrowding.

Upgrading resilient and accessible destination infrastructure

- Enhance multimodal and green Mobility: Invest in public transport links, intermodal transport hubs, walking/cycling paths, and electric vehicle (EV) charging infrastructure to provide seamless, low-emission access to rural and remote destinations.
- Adapt infrastructure to extreme weather: Retrofit and upgrade municipal utilities, transport networks, and tourism facilities to withstand climate risks, incorporating nature-based solutions (such as wetland restoration, urban shading, and permeable surfaces) to strengthen destination resilience.
- Expand accessible tourism: Upgrade destination infrastructure, public amenities, and accommodation facilities to accommodate older travellers and visitors with disabilities, ensuring inclusive access across urban and rural sites.

Managing short-term rentals and local housing

- Implement targeted digital regulations: Introduce clear, data-driven regulatory frameworks for short-term rentals to protect resident housing supply while maintaining accommodation capacity.

Harnessing data, digitalisation, and AI for smart management

- Establish integrated tourism data hubs: Build centralized data systems and open-access portals that combine official statistics, administrative records, and alternative data (mobile phone location data, transaction records, digital bookings) to track visitor flows, density, and local economic impacts in real time.
- Deploy AI and digital navigation tools: Utilise AI-powered tools, digital visitor guides, and real-time crowd management apps to inform travellers, manage queue times, and dynamically redirect visitor traffic toward underutilised attractions.
- Support digital uptake among SMEs: Provide digital skills training, quick-scan diagnostics, and financial support to small tourism enterprises in rural and secondary destinations to enhance their digital visibility and operational efficiency.

Retaining tourism value in host communities

- Strengthen local enterprise and value chains: Support local micro-enterprises and SMEs through business incubation, acceleration programs, and improved access to finance, helping them professionalise and scale operations.
- Foster local sourcing: Connect tourism businesses with domestic agricultural producers, artisans, winemakers, and local service providers to build short local value chains and minimise economic leakage.

Access to Affordable and Quality Housing for All People Main Report November 2025 (HOUSE4All)[11]

- Document type: Official ESPON 2030 Research Project Report (Co-funded by the European Union)
- Thematic alignment: Pillar 2 (Right to stay), Pillar 3 (Integration – Special territorialities)

Executive summary: The ESPON HOUSE4ALL report (Access to Affordable and Quality Housing for All People, November 2025) provides a Pan-European comparative analysis of housing affordability, housing quality, and housing policy frameworks. Utilising big data generated from web-scraping over 22 million unique housing listings alongside national statistics and 10

[11] https://www.espon.eu/sites/default/files/2025-11/espon-house4all-main-report.pdf

local/regional case studies, the report maps market dynamics at the Local Administrative Unit (LAU) level across European regions.

Pillar 2 Right to stay

- Housing market barriers for newcomers: Severe affordability pressures in homeownership and private rental markets threaten residents' ability to remain in their communities. Downpayment requirements (often exceeding €20,000 to €50,000) and mortgage durations exceeding 30 years on a single average income act as major entry barriers, disproportionately affecting young adults, relocating workers, and non-homeowners.
- Energy gentrification and renovation risks: In Eastern Europe and the Baltic states, building energy retrofits significantly improve low housing quality and energy efficiency, but often trigger „energy gentrification". Rising post-renovation housing costs risk displacing low-income households and minorities, whereas secure tenure enables single elderly women to stay in upgraded homes.
- Housing quality and adequacy deficits: The „right to stay" is frequently compromised not just by price, but by poor physical habitability, structural depreciation, and low energy efficiency, most notably in Central European multi-apartment estates.
- Support for groups in vulnerable situations: Homeless populations, low-income families, single parents, youth, migrants, and Roma communities face acute market exclusion. Targeted policy instruments bridge gaps by converting private rental units into secure, affordable housing with integrated social support.

Pillar 3 Integration – special territorialities

- The East-West housing divide: Cross-country affordability variations are largely driven by national disposable income differences. Post-socialist mass privatisation created high-homeownership regimes in Central and Eastern Europe (e.g. Hungary, Slovakia, Romania), but left these regions with underdeveloped rental sectors, acute social housing deficits, and extreme mortgage-to-income burdens (frequently exceeding 30 years).
- Urban agglomerations vs. rural hinterlands: Within-country affordability variations are primarily shaped by local price dynamics. Urban agglomerations and growing metropolitan regions (e.g. Munich, Vienna) face extreme price escalation due to urban inflow, decohabitation, cheap credit, and financial speculation. Conversely, rural areas generally offer lower prices and larger dwelling space per euro, though total affordability remains constrained if local wages are low.

- Functional areas under tourist & second-home pressure: Touristic coastal zones, alpine regions, and attractive mid-sized cities suffer severe rental market distortions. The expansion of short-term rentals (STRs) and second homes crowds out local working populations and drives up rent-to-income ratios.
- Shrinking functional regions: Case studies across e.g. Romania reveal that shrinking regions offer higher spatial affordability and significant price discounts, though regional variation exists and housing stock depreciation remains high.
- Cross-border functional housing markets: High wages and housing prices in major economic hubs create severe regional spillovers.

ESCAPE European Shrinking Rural Areas: Challenges, Actions and Perspectives for Territorial Governance. Final Report12

- Document type: Official ESPON Applied Research Final Report
- Thematic alignment: Pillar 2 (Right to stay)

Executive summary: The ESPON ESCAPE project provides a comprehensive European-wide analysis of the processes, spatial patterns, and policy responses associated with rural shrinkage. Covering the ESPON space at NUTS 3 and Local Administrative Unit (LAU) levels, the report demonstrates that rural depopulation is a widespread, long-term phenomenon driven by complex interactions between demographic ageing, economic restructuring, peripherisation, and historical transitions.

1. Key findings

Scale and geography of rural depopulation

Across Europe, 687 predominantly rural and intermediate NUTS 3 regions, representing 59% of all rural or intermediate regions in the EU28, 40% of its land area, and 33% of its population, fulfill the criteria for sustained demographic shrinkage over a 40-year period spanning 1993 to 2033. Rural shrinking is especially severe and uniform across Danube Region countries. In East-Central European nations such as Bulgaria, Croatia, Hungary, Romania, and Slovakia, more than 75% of the regional population resides in local municipalities (LAUs) that are experiencing continuous population loss.

Selective out-migration and human capital depletion

Depopulation across the Danube macro-region is heavily driven by age- and skill-selective out-migration, creating a severe drain on local human capital that undermines the „Right to Stay".

[12] https://archive.espon.eu/sites/default/files/attachments/ESPON%20ESCAPE%20Main%20Final%20Report.pdf

- In Croatia's Osječko-baranjska County, a combination of post-war recovery challenges, deindustrialisation, and agricultural restructuring triggered continuous out-migration, causing a total population loss of nearly 25% since the 1990s and creating severe shortages of qualified workers alongside a sharp decline in school pupils.
- In Hungary's Szentes district, post-socialist economic transition reduced village employment to just 50% of 1990 levels, driving higher-educated youth toward larger urban centers and leaving behind a shrinking, lower-skilled workforce.

Legacy effects and vicious cycles of decline

When active out-migration persists over decades, it distorts local age structures, resulting in „legacy shrinking" where natural population decrease (deaths exceeding births) dominates.

- In Bulgaria's Lovech province (comprising Troyan, Apriltsi, and Ougarchin), post-socialist industrial closures and low local wages generated a persistent „culture of backwardness" that pushes youth to migrate abroad, weakening local schools, cultural centers, and public healthcare facilities.

Economic disparities in shrinking agricultural regions

Demographic shrinkage is closely linked to lower economic productivity and limited job diversification. In low-income agricultural shrinking regions (predominant in rural Bulgaria, Romania, Croatia, and Hungary), regional GDP per capita averages just 43% of the EU average. Although the primary sector accounts for 10% to 20% of total employment in these areas, agricultural GVA per worker averages only 78% of national levels and continues to diverge, creating ongoing income pressure on rural households.

2. Strategic policy directions and recommendations

Rebalancing policy objectives: Mitigation and „Smart Shrinking"

Policy frameworks targeting the „Right to Stay" must recognise that complete repopulation is often unviable in regions facing severe natural population decrease. Where natural decrease is entrenched, interventions must combine mitigation with „smart shrinking" (adaptation) to guarantee spatial justice and sustain the well-being of the remaining population.

Fostering local economic diversification and quality employment

To give young residents a viable reason to stay, regional strategies must diversify rural economies beyond low-productivity agriculture.

- In agricultural areas like Osječko-baranjska County, public support should target high-value food processing, organic farming, forestry, and emerging IT hubs, supported by vocational training.

- In industrial restructuring zones like Lovech, regional policy should facilitate transition toward clean manufacturing, green energy, and local craft networks to absorb displaced workers.

Safeguarding services of general interest (SGI)

Deteriorating public services accelerate out-migration. Local and regional authorities must maintain accessible SGI through flexible, cost-effective delivery models.

- In Lovech province, inter-municipal cooperation and active LEADER Local Action Groups (LAGs) demonstrate how pooling local resources across neighboring municipalities can sustain social services, schools, and cultural activities despite declining municipal tax bases.
- High-speed digital infrastructure and „Smart Village" initiatives should be deployed to support telemedicine, distance learning, and e-governance, reducing the physical isolation of remote communities.

Transitioning from short-term projects to long-term institutional support

A major weakness in current EU and national policy execution is the reliance on short-term, competitive „project-based" funding. Local stakeholders report that short project cycles create administrative burdens and „time gaps" that prevent lasting structural adjustments.

- CAP and Cohesion Policy must establish stable, multi-annual funding mechanisms dedicated explicitly to shrinking rural areas.
- Multi-level governance frameworks must resolve the structural mismatch where local municipalities have high interest in tackling shrinkage but low financial power, by granting sub-national authorities direct financial autonomy and long-term strategic guidance.

Delivery of services of general interest in lagging regions and areas with special needs. Final report (DESIRE)[13]

- Document type: Official ESPON Executive Report
- Thematic alignment: Pillar 2 (Right to stay), Pillar 3 (Integration – Special territorialities)

Executive summary: The ESPON executive report Delivery of Services of General Interest in Lagging Regions and Areas with Special Needs evaluates the spatial distribution, physical accessibility, and quality of essential public and private services across Europe. Combining GIS-

[13] https://esponegtc.sharepoint.com/sites/collaboration/Shared%20Documents/Forms/AllItems.aspx?id=%2Fsites%2Fcollaboration%2FShared%20Documents%2FWebsite%20uploads%2FDelivery%20of%20services%20of%20general%20interest%20in%20lagging%20regions%2Epdf&parent=%2Fsites%2Fcollaboration%2FShared%20Documents%2FWebsite%20uploads&p=true&ga=1

based travel-time calculations across 8 key SGI categories (childcare, elderly care, primary care doctors, hospitals, primary schools, secondary schools, passenger train stations, and retail) with regional case studies, the study delineates Inner Peripheries (IPs), areas characterized by poor relative access to services.

1. Key findings

Pillar 2 Right to stay

- **Services of General Interest (SGI) access as a prerequisite for population retention:** Inadequate access to healthcare, social care, and education in rural and lagging areas directly erodes quality of life, fueling demographic ageing, youth out-migration, and „vicious cycles" of regional decline.
- **Disparities in travel times across the Danube Region:** While upper-income EU Member States show near-universal access to basic SGIs within 30 minutes, several Danube countries exhibit significant population proportions facing extended travel times by car. E.g. Hungary: 98.47% of the population accesses SGIs within 30 minutes, 1.22% requires 30–60 minutes, and 0.19% requires 60–120 minutes, Slovakia: 96.69% (0–30 min), 3.00% (30–60 min), and 0.26% (60–120 min), Slovenia: 96.68% (0–30 min), 2.66% (30–60 min), and 0.44% (60–120 min) versus Romania: 87.99% (0–30 min), 10.79% (30–60 min), and 1.11% (60–120 min); Bosnia-Herzegovina: 85.49% (0–30 min), 11.10% (30–60 min), and 3.29% (60–120 min). Serbia: 82.93% (0–30 min), 13.89% (30–60 min), and 2.96% (60–120 min). Montenegro: 80.20% (0–30 min), 12.46% (30–60 min), and 6.99% (60–120 min).
- **SGI Overlaps with vulnerable groups:** Social exclusion and poor SGI access heavily impact disadvantaged groups. In Hungary, deep poverty and service deficits in lagging „catching-up" settlements (e.g. Arló) severely restrict education and housing opportunities for young Roma. In Romania, elderly populations in remote rural areas face severe gaps in home healthcare and social care.

Pillar 3 (Integration – Special territorialities)

- **Point-Axial vs. Fragmented SGI Networks:** In contrast to the uniform, dense SGI coverage of Western Europe, Danube countries (e.g., Czechia, Hungary, Romania, Bulgaria) exhibit point-axial patterns where service facilities are highly concentrated in major urban centers and along primary transit corridors, leaving wide interstitial rural spaces underserved.
- **Territorial extent of inner peripheries:** Areas characterised by poor relative access to SGIs cover substantial shares of national territories in the Danube Region. Slovakia: IPs cover 16.5% to 31.1% of the national territory (depending on service type), Slovenia: IPs cover 13.1% to 27.7%.

- Overlaps with lagging and special-need regions: Inner Peripheries heavily coincide with NUTS 3 lagging regions (GDP per capita < 75% EU average), mountainous zones, and border territories. In Czechia and Slovakia, lagging NUTS 3 regions suffer severe SGI deficits in childcare, elderly care, and primary healthcare. In Romania and Bulgaria, IPs strongly correlate with lower per capita GDP, high old-age dependency, and low employment rates.
- Transit deficits: Rural passenger rail station access remains severely restricted across border zones and interstitial rural areas in the Balkans, increasing forced car-dependency.

2. Strategic policy directions and recommendations

Pillar 2 Right to stay

- Tailored and equitable service delivery (Pathway 1): Protect „single point of service" facilities in demographically shrinking areas to prevent service collapse. Implement flexible, mobile, and hybrid services, such as mobile social care for the elderly, remote village caretaking (Hungary), and home nursing (Romania), to reach isolated residents.
- Strengthen community engagement and ownership (Pathway 2): Complement SGI infrastructure with active social presence (e.g., the Presence House model in Hungary's FeTe programme) to provide continuous, community-centric support for children, education, and housing in severely lagging settlements.
- Build resilient and sustainable service Models (Pathway 3): Combine physical facilities with e-health and digital tools, ensuring non-digitalised elderly or vulnerable groups receive assisted access to avoid digital exclusion

Pillar 3 (Integration – special territorialities)

- Strengthen governance through collaborative approaches (Pathway 4): Establish cross-border public services (CPS) and inter-municipal partnerships along shared national borders (e.g., Romanian-Hungarian, Romanian-Serbian, and Bulgarian-Romanian border zones) to pool user catchments and maintain facility viability.
- Data-driven spatial planning for accessibility (Pathway 5): Use high-resolution grid data and travel-time modeling to monitor SGI accessibility and identify „areas at risk" before facility closures occur. Macro-economic planning must account for the hidden costs shifted onto rural residents when facilities are closed or merged.
- Integrated urban-rural mobility: Connect Functional Urban Areas (FUAs) to peripheral rural hinterlands through Demand-Responsive Transport (DRT) solutions (e.g., Employee Mobility in Czechia, GmoaBus in Austria) to bridge spatial transport divides.

Collecting and analysing data for the post-27 INTERREG (COREIB)[14]

- Document type:
- Thematic alignment:

Executive summary:

Document Type: Official ESPON Applied Research Final Report

- Thematic Alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration – Special territorialities)

Executive Summary: The ESPON research report Core-IB: Collecting and analysing data for the post-27 INTERREG establishes a standardised, evidence-based analytical framework designed to support the upcoming programming phase for post-2027 European Territorial Cooperation (Interreg). Covering all 48 internal EU and EFTA cross-border Interreg VI-A programme areas at the NUTS 3 (2021) level, the project delivers 48 comprehensive, highly visual border profiles (~90 pages each, total ~4,300 pages) incorporating nearly 1,700 standardised maps and charts. Across the 48 programme areas, Core-IB provides a harmonised comparative positioning of border regions against European, national, and domestic border-regional averages. Within the Danube macro-region, Core-IB addresses 15 dedicated Interreg VI-A border, providing spatial evidence on labour commuting, transport quality, climate hazard risks, and multi-level governance structures.

1. Key Findings

Pillar 1 (Water scarcity)

- Harmonised climate hazard grid: Integrating a multi-hazard grid (combining riverine/coastal flooding, droughts, landslides, and seismic risks from JRC), Core-IB shows that southern and eastern Danube border regions (particularly in Romania, Bulgaria) face the highest aggregated natural hazard risks in Europe.
- Energy infrastructure and circular economy: Mapping power lines, power plants, and renewable energy sites across borders demonstrates that while hydro-power plants along shared Danube river borders act as cross-border assets, high-voltage transmission lines remain predominantly nationalised, requiring greater grid interconnection and joint waste-to-energy circular economy initiatives.

Pillar 2 (Right to Stay)

- Socio-economic disparities: Danube border regions display contrasting GDP per capita dynamics. While Austrian–German border regions sit comfortably above 100% of the

[14] https://www.espon.eu/sites/default/files/2026-04/_1.espon-core-ib_final-report.pdf

European average, several border regions in Slovakia, Hungary, Croatia, Romania, and Bulgaria sit below the 75% EU GDP threshold, resulting in lower compensation per hour worked and persistent youth out-migration.

- Housing and real estate spillovers: Incorporating web-scraped real estate sales price datasets, Core-IB illustrates that price differentials across border pairs (e.g., between Austria and Czechia/Slovakia) create cross-border residential relocation pressures, altering local housing markets in border towns.
- SGI Accessibility Deficits: Access to Services of General Interest (measured via travel-time to primary schools, secondary schools, hospitals, and general practitioners) shows that interstitial rural border areas in the Danube region face longer travel times, threatening local quality of life and population retention.

Pillar 3 (Integration – special territorialities)

- Governance asymmetries: Across the 48 border profiles, institutional governance spans 199 active cross-border cooperation formats (including EGTCs, Euroregions, and Eurocities). However, while Central European Danube borders (e.g., HU–SK, AT–CZ, AT–HU) feature dense networks of EGTCs and b-solutions obstacle filings, eastern and southern Balkan borders exhibit lower institutional density and fewer formalized advice centers.

2. Strategic policy directions and recommendations

Pillar 1 (Water scarcity)

- Implement joint disaster risk management: Establish joint cross-border emergency response protocols and natural hazard monitoring systems along shared Danube river basins to manage flood, drought, and wildfire risks collaboratively.
- Expand transboundary renewable energy networks: Coordinate investment in cross-border energy interconnectors, grid capacity, and renewable energy installations to accelerate the green transition in peripheral border areas.

Pillar 2 (Right to Stay)

- Formalise cross-border telework agreements: Implement multi-lateral telework and social security agreements for cross-border commuters to prevent double taxation and support flexible working arrangements in frontier regions.
- Safeguard SGI delivery in peripheries: Protect single-point public facilities (hospitals, schools) in rural border areas by establishing cross-border service agreements, telemedicine networks, and shared vocational training (VET) campuses.

- Monitor cross-border real estate dynamics: Track housing price spillovers and rental market pressures in border twin-cities to prevent local residential displacement and maintain regional housing affordability.

Pillar 3 (Integration – special territorialities)

- Shift from project logic to permanent operational management: Transition Interreg funding from short-term, isolated project cycles toward building permanent cross-border governance structures (such as legal EGTCs and unified spatial planning secretariats) to ensure long-term operational continuity.
- Upgrade cross-border infrastructure and multimodal quality: Address speed and quality bottlenecks along rail, road, and ferry connections across Danube borders, leveraging the space-time-lines methodology to prioritise dual-use transport links.
- Institutionalise cross-border advice centers: Expand dedicated cross-border advice centers along Central and Eastern European borders to provide workers and businesses with legal guidance on tax, social security, and employment rules.

Governance mechanisms for cross-border functional areas (CROSSGOV)[15]

- Document type: ESPON 2030 Research Project Final Synthesis and Case Study Reports
- Thematic alignment: Pillar 3 (Integration – special territorialities).

Executive summary: The ESPON CROSSGOV research project establishes a pan-European, multi-indicator methodology to delineate and analyse Cross-Border Functional Areas (CBFAs). Combining spatial, demographic, mobility, and social connectedness indicators across 85 identified CBFAs, the study examines how daily life, labour commuting, public services, and infrastructure cross national boundaries. Within the Danube macro-region, the analysis evaluates twin cities, urban-rural linkages, and border towns, highlighting key cases like Komárno–Komárom (SK/HU) and Gmünd–České Velenice (AT/CZ), and outlines governance frameworks required to transform border areas from 180° periphery zones into integrated 360° living areas.

Key findings:

Delineation of Cross-Border Functional Areas (CBFAs)

- Multi-Indicator Methodology: CBFAs represent core zones of functional integration calculated using five harmonized European datasets: population density, cross-border

[15] Final Report: https://www.espon.eu/sites/default/files/2026-03/crossgov_final-report_governance-mechanisms-for-cross-border-functional-areas.pdf Cross-cutting analysis of the case studies:

travel-time accessibility, real-time mobility catchment areas (from geolocated Twitter/X data), social media connectedness (Facebook SCI), and natural hazard risks.

- 360° Living Areas: CBFAs function as daily living basins ("bassins de vie") where economic, educational, and social activities cross borders, turning traditional 180° border peripheries into integrated 360° functional territories.

Twin cities and border towns in the Danube Region

- Komárno–Komárom (Slovakia / Hungary): Positioned on the Rhine–Danube transport corridor across the Danube River, the twin cities share strong functional integration, including labour commuting to the Komárom Industrial Park (HU), student enrollment at János Selye University in Komárno (SK), shared historical fortress systems, thermal spas, a cross-border bus line, and a public bicycle rental system. The twin cities are advancing joint spatial planning, cross-border hospital usage (e.g., accepting cross-border patients and sharing MRI equipment).
- Gmünd–České Velenice (Austria / Czechia): A linked twin-city pair where functional linkages extend up to 50 km into the surrounding rural hinterland. Key connections include cross-border healthcare at the Healthcenter Gmünd (treating both Austrian and Czech patients), Czech students attending high school in Gmünd, shared water supply infrastructure, and integrated electricity grids.
- Trieste–Kras-Carso (Italy / Slovenia): Metropolitan Trieste acts as a functional hub for Italian and Slovenian border communities, driving asymmetric labor commuting, healthcare utilisation, and joint environmental management across the shared karstic plateau and UNESCO Geopark candidacy.

Key identified Danube Region CBFAs

- CBFA #46 (Cieszyn–Ostrava–Žilina, PL/CZ/SK): Cross-border industrial and commuting node linking Polish, Czech, and Slovak municipalities.
- CBFA #53 (Bratislava–Szombathely–Wien, SK/HU/AT): High-density tri-national metropolitan functional zone anchored by two capital cities along the Danube.
- CBFA #54 (Leibnitz–Maribor–Nagykanizsa–Varaždin, AT/SI/HU/HR): Multi-lateral functional area linking Austrian, Slovenian, Hungarian, and Croatian border regions.
- CBFA #56 (Koper/Capodistria–Rijeka–Trieste, SI/HR/IT): Coastal Adriatic-Danube transit and port functional cluster.
- CBFA #57 (Krško–Zagreb, SI/HR): Energy and commuter functional corridor connecting eastern Slovenia with the Zagreb metropolitan area.

- CBFA #59 (Osijek–Pécs, HR/HU): Regional urban-rural cross-border cluster connecting Slavonia and Southern Transdanubia.
- CBFA #60 (Győr–Komárno, HU/SK): Industrial and logistics corridor spanning the Danube River.
- CBFA #66 (Debrecen–Oradea, HU/RO) & CBFA #67 (Arad–Szeged, RO/HU): Major urban twin-axis corridors driving cross-border labor, commercial, and healthcare flows.
- CBFA #68 (Calafat–Vidin, RO/BG), #69 (Pleven–Turnu Măgurele, BG/RO), #70 (Giurgiu–Ruse, RO/BG), & #71 (Călărași–Silistra, RO/BG): Key Danube River bridge and ferry transit nodes providing vital cross-border transport linkages.

Strategic policy directions and governance recommendations

- Consolidate EGTCs to overcome institutional fragility: Move away from short-term „project-based" Interreg cycles by establishing permanent legal entities like EGTCs (e.g., Pons Danubii, TRITIA) that provide dedicated staff, long-term budgets, and legal continuity.
- Harmonise legal and administrative rules (BRIDGEforEU & b-solutions): Deploy EU legal mechanisms to remove administrative bottlenecks in cross-border public services, focusing on cross-border healthcare reimbursement, emergency service protocols, and mutual recognition of diplomas.
- Align transport infrastructure with Functional Urban Areas: Invest in cross-border public transport, integrated ticketing, and river-crossing infrastructure (bridges and ferries) to alleviate peak-hour commuting bottlenecks in twin cities and logistics corridors.
- Advance joint spatial planning and environmental management: Co-ordinate land-use planning, industrial site development, and joint environmental risk management (such as flood protection and green waste processing) across Danube river basins.

Territorial Agenda 2030

- Document type: Official intergovernmental spatial planning framework / high-level EU policy declaration
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to Stay), and Pillar 3 (Integration – special territorialities).

Executive summary: the Territorial Agenda 2030: A Future for All Places (TA2030) is Europe's intergovernmental strategic spatial planning framework. Adopted in December 2020, TA2030 provides an action-oriented roadmap for embedding a place-based, territorial dimension into public policies across all governance levels, from European institutions to local municipalities. The Agenda addresses two overarching priorities, A Just Europe (focusing on spatial justice,

service access, and regional balance) and A Green Europe (focusing on climate adaptation, ecosystem restoration, and sustainable transitions), supported by six specific priorities. It serves to operationalise Article 174 of the Treaty on the Functioning of the European Union (TFEU), ensuring that all territories and communities have a sustainable development perspective.

1. Key Findings

Pillar 1 (Water Scarcity)

- Asymmetrical climate exposure: European regions face severe and unevenly distributed impacts from climate change, including extreme heatwaves, prolonged soil aridity, water stress, and catastrophic riverine and coastal flooding.
- Hydrographic and ecosystem Pressures: Shared river basins, coastal areas, and mountainous watersheds suffer from ecological degradation, biodiversity loss, and water quality risks, requiring cross-border management.
- Unequal impacts of the green transition: The transition to a climate-neutral, circular economy creates distinct territorial challenges, risking economic strain in energy-intensive or fossil-fuel-dependent regions if not supported by targeted transition policies.

Pillar 2 (Right to Stay)

- Rising spatial and social inequalities: Growing divides between prosperous urban centers and lagging territories threaten social cohesion, civic trust, and spatial justice.
- Demographic contraction and brain drain: Persistent out-migration of young, tertiary-educated talent, combined with low fertility and rapid ageing, causes severe population depletion in rural, remote, and inner peripheral areas.
- Disparities in SGI access: Disadvantaged and peripheral regions face declining access to Services of General Interest (healthcare, education, social care, transport) and high-speed digital networks, compromising local quality of life and the ability of citizens to remain in their home communities.

Pillar 3 (Integration – special territorialities)

- Core-periphery spatial polarisation: Capital and major metropolitan agglomerations continue to absorb a disproportionate share of economic growth, jobs, and investment, widening regional divides.
- Functional urban and rural disconnects: Real-world socio-economic dependencies, commuting flows, and environmental systems cross administrative boundaries, highlighting the need for functional area planning.

- Small and medium-sized towns as regional anchors: Small and medium-sized cities and towns play a critical role as local service hubs and economic anchors for surrounding rural hinterlands.
- Border and geographical obstacles: Border regions, mountain areas, island groups, and coastal territories encounter persistent legal, administrative, and physical barriers to seamless integration.

2. Strategic policy directions and recommendations

Pillar 1 (Water Scarcity)

- Implement climate-resilient spatial planning (TA2030 Priority 4): Embed risk assessments, natural flood and drought prevention, and ecosystem-based adaptation directly into local and regional spatial development strategies.
- Manage shared hydrographic and ecological Basins: Establish cross-border and macro-regional frameworks for the integrated protection and management of transboundary river catchments, coastal zones, and ecological corridors.
- Drive a Just and Circular Transition (TA2030 Priority 5): Support fossil-fuel-dependent and energy-intensive regions through place-based transition plans, scaling up circular economy models, green infrastructure, and sustainable energy systems.

Pillar 2 (Right to Stay)

- Promote spatial justice and regional balance (TA2030 Priority 1): Deploy place-based strategies that counter brain drain, activate local territorial capital, and support the socio-economic retention of youth and families in rural and inner peripheral areas.
- Guarantee universal SGI and digital access (TA2030 Priorities 1 & 6): Ensure equal access to high-quality healthcare, education, social care, and public transport across all places, supported by smart digital infrastructure and flexible service delivery models.
- Invest in community quality of life: Enhance local social infrastructure, public spaces, and civic engagement to improve well-being and local living standards.

Pillar 3 (Integration – special territorialities)

- Deploy Functional Area Governance (TA2030 Priority 2): Apply functional regional planning tools, such as Integrated Territorial Investment (ITI) and Community-Led Local Development (CLLD), to strengthen urban-rural partnerships and shared service networks.

- Advance polycentric settlement networks: Support small and medium-sized towns as regional service and economic anchors, preventing unmanaged urban sprawl in metropolitan peripheries.
- Deepen cooperation beyond borders (TA2030 Priority 3): Institutionalise cross-border, transnational, and macro-regional cooperation (via Interreg, EGTCs, and macro-regional strategies) to remove administrative and legal border obstacles.
- Execute TA2030 Pilot Actions: Encourage European, national, regional, and local authorities to implement concrete Pilot Actions to test, demonstrate, and scale innovative spatial development solutions.

European Commission Communication on the EU's Eastern Regions Bordering Russia, Belarus and Ukraine16

- Document type: Official European Commission Communication Overview / Policy Factsheet
- Thematic alignment: Pillar 2 (Right to Stay), and Pillar 3 (Integration – special territorialities).

Executive summary: The European Commission Communication EU's Eastern Regions Bordering Russia, Belarus and Ukraine: Strong regions for a safe Europe (February 2026) outlines a strategic action plan to strengthen the security, resilience, and economic vitality of the EU's eastern frontier. Covering 9 Member States, including 4 Danube Region / EUSDR countries (Slovakia, Hungary, Romania, and Bulgaria) alongside Finland, Estonia, Latvia, Lithuania, and Poland, the Communication addresses the severe geopolitical and socio-economic disruptions caused by Russia's war of aggression against Ukraine. The Commission sets out 5 priority areas for support and introduces the EastInvest Facility, aiming to deliver €28 billion in lending support by the end of 2027 to ensure eastern border communities remain secure, connected, and viable places to live and work.

1. Key Findings

Pillar 2 (Right to Stay)

- Demographic decline and workforce shortages: Eastern border communities suffer from severe emigration, population ageing, and critical shortages of workers in vital public sectors, specifically healthcare and education. These regions face some of the EU's most acute demographic pressures, with some having lost more than 17% of their population in the last decade. Overall, the population of the eastern border regions decreased by

[16] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52026DC0082

2.6% on average between 2016 and 2025, compared to 1.2% population growth in the EU as a whole.

- Municipal service strains: Local authorities in frontier regions face limited financial capacity and underfunded public services, compounded by operational pressure from displaced persons.
- Economic and real estate stagnation: Local business environments encounter reduced private investment, stagnating housing markets, and financial strain across regional supply chains and SMEs.

Pillar 3 (Integration– special territorialities)

- Rising external security and hybrid threats: External border territories face escalating, weaponised security challenges from Russia and Belarus, including hybrid attacks, disinformation, weaponised migration, and physical sabotage.
- Higher inflation rates and lower growth aspects: median harmonised index of consumer prices inflation rate in Member States along the eastern border was at least 3.7 percentage points higher than the EU average, while the annual average GDP growth in 2022–2023 was 1.9 percentage points lower than the projection for the EU. Higher energy intensity and larger dependence on Russian gas and oil amplified the shock from energy and food price spikes.
- Collapse of cross-border trade: Border communities suffer from economic disruption caused by the complete collapse of traditional cross-border trade routes and commercial ties across the external frontier.
- Dual-use infrastructure deficits: Frontier regions require urgent physical upgrades to transport networks, specifically dual-use (civilian and military) road, rail, and port infrastructure to maintain security and regional accessibility.

2. Strategic policy directions and recommendations

Pillar 2 (Right to Stay)

- Support people and public services: Direct EU support toward border municipalities to stabilise underfunded public healthcare and education systems, retain essential staff, and manage local service demands from displaced populations.
- Build on local strengths: Provide targeted financial and advisory support to relieve pressure on local SMEs, revitalise local real estate markets, and safeguard regional supply chains.

Pillar 3 (Integration– special territorialities)

- Mobilise the EastInvest Facility (€28 Billion by 2027): Deploy €28 billion in total lending support by the end of 2027 through international financing institutions and national promotional banks, providing easier access to capital and advisory support for local authorities and businesses across the 9 eastern border Member States.
- Upgrade Dual-Use Transport Infrastructure: Modernise transport networks across eastern frontier communities, funding priority dual-use road, rail, and port projects to enhance military mobility while restoring civilian economic connectivity.
- Increase Direct EU Security Funding: Earmark increased EU budget allocations for defence, border management, and internal security across the eastern border regions.
- Establish a Regional Community of Practitioners: Create a structured network among the 9 border Member States to exchange best practices, share preparedness solutions, and counter hybrid threats collaboratively.

Linii directoare privind revitalizarea urbană în Republica Moldova

- Document type: Official National Guidelines / Strategic Policy Document (Linii directoare privind revitalizarea urbană în Republica Moldova, approved by CNCDRL Decision No. 9 on 11.03.2026).
- Thematic alignment: Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary: The Guidelines on Urban Revitalisation in the Republic of Moldova establish an updated national framework for reversing the decline of degraded urban areas. Revised in 2025 and formally approved in March 2026, the document was developed by the Ministry of Infrastructure and Regional Development (MIDR) in partnership with Polish Aid, Solidarity Fund PL, and Regional Development Agencies (ADRs). The framework guides Local Public Authorities (APLs) in drafting 5-year Urban Revitalisation Programs (PRUs). For Moldova, a country within the Danube River Basin and the EU Strategy for the Danube Region (EUSDR), the Guidelines serve as a key operational tool to strengthen local socio-economic resilience, align spatial development with EU accession standards, and foster transboundary regional partnerships.

Pillar 2 (Right to Stay)

- Social crisis as the primary benchmark: A demonstrated social crisis (such as poverty, high unemployment, heavy reliance on social assistance, crime, or youth out-migration) is an indispensable prerequisite for designating a revitalization zone. Physical or technical degradation alone cannot justify selection.
- Neighborhood rehabilitation to counter depopulation: PRUs target severely degraded residential quarters to resolve spatial dysfunctions, upgrade public spaces, and rebuild

local infrastructure. This enables citizens to remain in safe, vibrant local environments rather than migrating to capital regions or across borders.

- Institutionalised civic co-governance: Community participation is mandatory across all stages. APLs must establish a local Consultative Commission (Comisia Consultativă) comprising neighborhood residents, local business owners, and NGOs to co-design, consult, and monitor revitalization activities.
- Community micro-grant activation: The framework encourages APLs to allocate municipal funds for micro-grants targeting resident groups, allowing citizens to execute small-scale improvements in their immediate living environment.

Pillar 3

- Transboundary origin & nacro-regional alignment: The revitalization system originated from international cooperation between Moldova's regional development ministry and Poland's Ministry of Investment and Development (funded by Polish Aid). The updated framework explicitly prepares Moldovan towns for the stages of European Union integration and macro-regional cohesion.
- Inter-city cooperation & sister-city networks: The Guidelines explicitly encourage APLs to establish an inter-urban "Network of Cities" (Rețea de orașe) and engage with external international partners and sister cities (orașe înfrățite). This enables transboundary knowledge exchange, shared best practices, and joint investment attraction for urban revitalisation projects.

2. Strategic policy directions and recommendations

Pillar 3

- Leverage sister-city & transboundary partnerships: APLs should actively engage with international sister cities, EUSDR platforms, and cross-border partners to import innovative urban regeneration models and co-finance revitalisation projects.

Phasing out Russian gas in the Danube Region

- Document type: Official Regional Energy Policy & Market Modelling Study / EUSDR Flagship Report (REKK / EUSDR Priority Area 2: Sustainable Energy)
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration)

Executive summary: The flagship study Phasing Out Russian Gas in the Danube Region, commissioned by the EU Strategy for the Danube Region (EUSDR) Priority Area 2 (Sustainable Energy) and conducted by the Regional Centre for Energy Policy Research (REKK), provides a comprehensive market modelling analysis across 14 Danube Region countries (Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Germany, Hungary, Moldova, Montenegro,

Romania, Serbia, Slovakia, Slovenia, and Ukraine). The report quantifies regional gas dependencies, projects short-term (2022/2023) and long-term (2030) gas demand reduction pathways, and evaluates cross-border infrastructure interconnections required to eliminate reliance on Russian gas.

The findings emphasise that the Danube Region had a 50% import dependency on Russian natural gas (compared to 30% for the EU27 overall), with several landlocked and border countries relying almost entirely (~80–100%) on Russian supply. Achieving complete phase-out and regional energy security requires an integrated dual strategy: accelerating clean energy deployment, deep building renovations, and industrial circular heat recovery, while expanding cross-border reverse-flow interconnectors, LNG import capacity, and regional solidarity mechanisms.

1. Key Findings

Pillar 1 (Water scarcity)

- Building sector dependence and heating efficiency: Space heating in buildings accounts for 38% of total gas consumption in the Danube Region. Gas reliance for residential building energy is exceptionally high in Hungary (50%), Ukraine (41%), Slovakia (39%), and Germany (37%), with high household gas connection rates in Hungary (80%), Ukraine (74%), Slovakia (72%), and Moldova (67%). Deep building retrofits can achieve up to 50% in energy savings per building, while a 1°C reduction in indoor heating temperature yields a 2.5% to 7% immediate seasonal gas reduction across the residential sector.
- Power sector decarbonisation and renewable substitution: Gas-fired power and district heating represent 16% of the region's power energy mix (and up to 91% in Moldova). Long-term European Power Market Model (EPMM) projections show that expanding variable renewables (solar PV and wind) can substitute most gas-fired power generation by 2030, driving down total power sector gas demand in the Danube Region from 193 TWh/year (2021/2022 baseline) to 34–45 TWh/year under high renewable (REPowerEU) deployment scenarios.
- Industrial decarbonisation and waste heat circularity: The industrial sector accounts for 28% of total gas use in the Danube Region. Low-temperature industrial heat constitutes 50% of total industrial process heat demand and can be decarbonised using industrial-scale heat pumps, building insulation, and industrial waste heat recovery (circular economy). High-temperature heat , which comprises 36% of industrial process demand, requires long-term substitution through electrification, green hydrogen, and e-gases.

Pillar 3

- Extreme asymmetrical regional vulnerability: The Danube Region exhibits a strong inverse relationship between gas demand intensity and infrastructure diversification. Countries with weak supply options and single-pipeline entry points, such as Moldova and Bosnia and Herzegovina, possess infrastructure adequacy indicator of 0%, indicating complete vulnerability to supply cutoffs.
- Disproportionate Price Spikes in Landlocked Border Regions: Modelling of a full Russian gas supply cut shows that landlocked Central and Eastern European (CEE) border regions (stretching from Eastern Germany, Czechia, Austria, and Slovakia to Hungary, Romania, and Ukraine) face massive wholesale price surges of +110 €/MWh to +290 €/MWh due to internal infrastructure bottlenecks that prevent coastal LNG from reaching inland markets. This increases the total Danube Region annual gas bill by 119% to 234% above the 2021 baseline.
- Critical cross-border interconnectors ("Infra 1" & "Infra 2"): Modelled short-term infrastructure projects significantly relieve regional price pressure and supply deficits:
    - *Infra 1 Projects:* Commissioning the IGB (Greece–Bulgaria interconnector), the Slovakia–Poland interconnector, and expanding the Croatia–Slovenia interconnector reduces CEE regional wholesale prices by ~38 €/MWh to 40 €/MWh.
    - *Infra 2 Projects:* Trans-Balkan (Bulgaria–Romania–Ukraine) pipelines lowers CEE regional prices by ~108 €/MWh to 220 €/MWh, bringing CEE gas prices back toward equilibrium with Western Europe.

2. Strategic policy directions and recommendations

Pillar 1 (Water Scarcity)

- Enact deep building renovation and heat pump mandates: Danube Region governments must prioritise subsidised, deep thermal building insulation programs and accelerate the phase-out of fossil-fuel boilers in favour of heat pumps, targeting a minimum 15% to 20% overall gas demand reduction across the residential building stock by 2030.
- Promote industrial waste heat circularity and electrification: Provide capital grants, energy audits, and technical assistance (reflecting the UNIDO resource efficiency model in Ukraine) to help industrial facilities capture waste heat, upgrade low-temperature processes to heat pumps, and transition high-temperature manufacturing to green hydrogen and e-gases.
- Accelerate renewable power capacity to replace peak gas: Fast-track utility-scale solar PV, wind, and battery storage integration to displace gas-fired power generation, reducing regional power sector gas demand to 34–45 TWh/year by 2030.

Pillar 3:

- Complete priority cross-border reverse-flow interconnectors: Fully operationalise and expand bi-directional capacities on critical regional transit corridors, including the Trans-Balkan pipeline (enabling reverse flows from Greece/Bulgaria to Romania, Moldova, and Ukraine), and the Croatia–Slovenia–Austria link.
- Expand regional access to coastal LNG terminals: Support the expansion of the Krk LNG terminal in Croatia and secure capacity bookings at new FSRU LNG terminals in Germany, Greece, and Poland, ensuring landlocked Danube Region countries (Austria, Czechia, Hungary, Slovakia, Serbia, and Moldova) have guaranteed access to non-Russian LNG.
- Institutionalise cross-border energy solidarity agreements: Strengthen multi-level governance frameworks within EUSDR Priority Area 2 to establish legally binding cross-border gas sharing, joint storage utilisation, and emergency supply coordination among EU Member States and Energy Community contracting parties (Moldova, Ukraine, Bosnia and Herzegovina, Serbia).

Energy Efficiency in Industry of the States in the Danube Region

- Document type: Strategic Regional Policy & Technical Analysis (Interreg Danube Region Programme / EUSDR Priority Area 2: Sustainable Energy).
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration)

Executive summary: The study Energy Efficiency in Industry of the States in the Danube Region (prepared by Gatum Group for EUSDR Priority Area 2) provides a high-level technical and policy analysis across the 14 countries of the Danube macro-region. Industry accounts for over 27% of total final energy consumption in the Danube Region (DR), making industrial energy efficiency a critical pillar for achieving EU decarbonization and climate targets. The report evaluates industrial energy intensity, sectoral energy consumption patterns, and the transposition of key EU legislative frameworks (such as the Energy Efficiency Directive 2023/1791, the Energy Efficiency First principle, and the Corporate Sustainability Reporting Directive 2023/2772). To address significant cross-country heterogeneity, the study establishes a five-tier regional classification system, identifies untapped potential in waste heat and renewable energy integration, and highlights the need for modernised cross-border energy infrastructure (Smart Grids) and inter-institutional knowledge sharing.

1. Key Findings

- Energy flow & import reliance: 60% of total energy input is imported, 36% is produced locally, and 64% undergoes transformation (where 17% is lost). Industry consumes 22% of total available energy.

- Sectoral energy drivers: Energy demand is heavily driven by the chemical/petrochemical sector (DE, HU, RO, BG), iron/steel (UA, SK, BA), machinery (CZ, HU, SI), food/tobacco (RS, ME, HU, HR), and paper/pulp (AT).
- Untapped Renewable Energy (RES): Industrial RES share is below 10% across all Danube Region (DR) states except Austria (16.5%). In Germany's DR regions, less than 5% of industrial energy use comes from RES.
- Waste heat potential: 20% to 50% of industrial energy use is lost as waste heat, with 18% to 30% being recoverable. Full EU-wide waste heat recovery could cut industrial energy use by up to 15%. Wastewater heat recovery (e.g., Tübingen, Germany) can cover up to 11% of local district heating needs.
- SME Best Practices: Hungarian, Austrian, German, and Slovenian SMEs demonstrate that combining solar PV, biogas, microwave drying, and heat pumps can reduce industrial energy use by 30% to 45% and eliminate fossil fuel dependency.

Pillar 3

- Smart Metering Deployment Gap: Smart meter rollout varies widely across the DR:
  - *Frontrunners:* Slovenia and Montenegro (91%–100%); Austria (51%–60%).
  - *Moderate:* Romania and Slovakia (21%–30%); Serbia, Croatia, and Ukraine (11%–20%).
  - *Lagging:* Germany, Czechia, Hungary, and Bulgaria (0%–10%).
- Cross-border grid integration: The EU-funded ACON Smart Grids project exemplifies cross-border operator cooperation (CZ/SK) to modernise, digitise, and interconnect distribution networks.

2. Strategic policy directions and recommendations

- Establish regional energy competence centers: Allocate public and EU Cohesion funds (such as the EU Modernisation Fund) to establish regional competence centers (modeled after Umwelttechnik BW in Germany or the Ústí Region Energy Centre in Czechia) to provide free technical audits, waste heat mapping, and project mentoring for SMEs.
- Accelerate smart grid modernisation and data infrastructure: National regulators and TSOs must fast-track smart meter rollouts (targeting >80% coverage) and deploy digital data centers to enable real-time grid monitoring, dynamic load-shifting, and demand-response aggregation for industrial facilities.
- Scale up cross-border smart grid projects: Replicate cross-border grid integration initiatives (such as ACON Smart Grids) across neighbouring border regions to resolve

local transmission bottlenecks, reduce distribution losses (currently 1% of available energy), and facilitate cross-border renewable energy trading.

- Target high-impact industrial regions: Focus macro-regional energy efficiency funding and technical support on Category 1 (Germany/Austria) and Category 3 (Czechia, Slovakia, Hungary, Romania) manufacturing hubs, where industrial energy consumption is highest and potential savings are largest.
- Optimise the EU Modernisation Fund: Beneficiary Member States (Bulgaria, Croatia, Czechia, Hungary, Romania, Slovakia, Slovenia) should align national Modernisation Fund calls directly with industrial waste heat recovery, CHP fuel switching, and grid digital management.
- Harmonise Non-EU candidate states within EUSDR PA2: Use EUSDR Priority Area 2 platforms to provide technical assistance and capacity building for candidate states (Moldova, Ukraine, Serbia, Bosnia & Herzegovina, Montenegro), supporting their alignment with EU energy efficiency directives, ESCO contracting frameworks, and clean energy finance.

ESPON NoStaGeo Territorial governance of non-standard geographies Final Report[17]

- Document type: Official ESPON 2030 Research Project Final Report (ESPON NoStaGeo — Territorial Governance of Non-Standard Geographies)
- Thematic alignment: Primary alignment with Pillar 1 (Water Scarcity) and Pillar 3 (Integration).

Executive summary: The ESPON research report Territorial Governance of Non-Standard Geographies (NoStaGeo) provides a European-wide investigation into how non-standard functional territories, spaces defined not by traditional administrative borders or standard commuting-based Functional Urban Areas (FUAs), but by hydrological systems, ecological corridors, energy networks, and industrial value chains, are governed across 41 national institutional contexts.

By analysing four core policy themes, (1) metropolitan freshwater supply, (2) ecological connectivity, (3) energy-saving strategies in buildings, and (4) brown-to-green industrial transitions, the project demonstrates that non-standard geographies are „fuzzy", multi-scalar, and co-constructed through negotiated governance. Focusing on the Danube Region and broader European contexts, NoStaGeo offers policy guidance to align formal administrative frameworks with real-world functional interdependencies.

[17] https://www.espon.eu/sites/default/files/2026-03/nostageo_final_report_v1.pdf

Pillar 1 (Water scarcity)

1. Key Findings

- Hydrological disconnects in metropolitan water supply: In Danube Region urban areas, hydrological catchment boundaries (Water Framework Directive River Basin Districts / HydroSHEDS) do not coincide with Functional Urban Areas. Metropolitan regions depend heavily on groundwater recharge.
- High Concentration of Protected Areas: Natura 2000 and national protected sites cover vast areas across Danube macro-region countries, exceeding the EU 2030 target (30%) in Bulgaria (over 40%) and Slovenia (over 40%), while covering 26% of land across the EU overall.
- Ecological connectivity & agricultural fragmentation:
    - *Czechia (South Moravia):* Intensive agricultural landscapes in South Moravia completely eroded historic agroforestry systems during the collectivist era. A local farmer cluster is currently restoring ecological connectivity by planting network corridors across private farms.
    - *Slovenia (Ljubljana):* The city of Ljubljana functions as a green city model by strategically embedding green wedges and wetland corridors that connect the urban core with 26 surrounding rural municipalities.
    - *Trilateral Alpine Corridor:* A high-density ecological network connects alpine habitats across Austria, Slovenia, and Italy, facilitating large carnivore and ungulate migration.

2. Strategic policy directions & recommendations

- Deploy multi-functional ecological Corridors: Establish farmer clusters and agroforestry incentives in high-intensity agricultural plains (e.g., South Moravia, Czechia) to connect isolated Natura 2000 patches and rebuild ecological corridors.
- Build cross-border industrial innovation clusters: Strengthen cross-border industrial and educational alliances, such as the *Silicon Alps Cluster* linking Austria and Slovenia to train and retain the specialised workforce required for green technological transitions.

Pillar 3 (Integration)

1. Key Findings

- Absence of formal metropolitan governance in Danube countries: No formal statutory metropolitan governance frameworks exist across major parts of the Danube Region, including Austria, Slovakia, Hungary, Bulgaria, Czechia, and all Western Balkan candidate

states (except Slovenia). In these contexts, urban-rural coordination relies on soft intermunicipal partnerships or EU Integrated Territorial Investment (ITI) mechanisms.

- Suburbanisation and population shifts in Cluj-Napoca (Romania): Between 2011 and 2021, the municipality of Cluj-Napoca experienced a population decrease of over 10%, accompanied by rapid suburbanisation and surface sealing across its surrounding functional metropolitan area.
- Metropolitan water governance gaps: Metropolitan areas in the Danube region lack integrated cross-jurisdictional water governance, leading to spatial equity mismatches where rural abstraction hinterlands bear ecological and land-use restrictions while urban core centers consume the bulk of treated water.

2. Strategic policy directions & recommendations

- Deploy Policy Objective 5 (PO5) and ITI Funding: Utilise Cohesion Policy tools specifically Integrated Territorial Investments (ITI) and Community-Led Local Development (CLLD) to finance integrated development strategies across non-standard functional areas that span municipal borders.
- Establish formal intermunicipal cooperation platforms: Create formal intermunicipal coordination forums in metropolitan areas lacking statutory frameworks (e.g., in Slovakia, Hungary, Bulgaria, and Romania) to manage urban sprawl, shared utilities, and regional transport spillovers.
- Develop ESPON Metropolitan and Functional Area Toolkits: Build digital spatial tools and observatories to help Danube Region municipalities map overlapping functional boundaries (water basins, energy grids, commuter sheds) and design balanced urban-rural cost-and-benefit sharing mechanisms.

Unveiling Research Synergies in the Danube Region: Exploring Potential Research Collaboration in the Context of Smart Specialisation

- Document type: Official ESPON 2030 Research Project Final Report (ESPON NoStaGeo - Territorial Governance of Non-Standard Geographies)
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration).

Document type: Official regional innovation & research policy study

Executive summary: The study Unveiling Research Synergies in the Danube Region provides an empirical analysis of research collaboration patterns across 14 Danube Region countries by mapping national/regional Smart Specialisation Strategies (S3) and analysing organization-level participation in Horizon Europe projects (2021-2024). The report identifies common S3 priority domains, applies Social Network Analysis (SNA) to evaluate institutional connectivity, and

outlines strategic policy directions to bridge regional innovation divides, retain human capital, and accelerate the macro-region's green and digital transitions.

1. Key findings

Pillar 1 (Water scarcity)

- **Prevalence of bioeconomy and climate S3 priorities:** Agri-Food, Bioeconomy & Biotechnology is the single most common S3 priority area across the Danube Region (prioritized by 11 countries), followed by Climate and Energy (9 countries).
- **Bioeconomy & freshwater sub-field activity:** In Horizon Europe projects involving Danube Region organisations, research in Agri-Food and Bioeconomy is overwhelmingly focused on ecosystems (560 projects), proteins (112 projects), genetics (78 projects), recycling (49 projects), sustainable agriculture (17 projects), and freshwater ecosystems (16 projects).
- **Climate, energy & circular economy sub-Fields:** Within the Climate and Energy domain, key research sub-fields include recycling/circular economy (311 projects), renewable energy (220 projects), ecological restoration (84 projects), wastewater treatment processes (49 projects), solar energy (40 projects), climate change adaptation (38 projects), and wind power (26 projects).

Pillar 2 (Right to Stay)

- **Severe disparities in research participation**: Participation in Horizon Europe shows an extreme divide between Western/Central Member States and non-EU/downstream Danube countries, exacerbating brain drain and the loss of scientific human capital in lagging areas.

Pillar 3 (Integration)

- Top Shared S3 Alignment Domains: S3 mapping reveals high cross-border policy convergence in *Agri-Food, Bioeconomy & Biotechnology* (11 occurrences), *ICT and Digitalisation* (10 occurrences), *Climate and Energy* (9 occurrences), and *Health and Medicine* (8 occurrences).
- Central Hub Dominance: Social Network Analysis demonstrates that research networks are dominated by a few central hubs in Germany and Austria:
    - *Fraunhofer Society (DE):* Holds the most central position across all domains (92 projects in ICT, 75 in Energy, 28 in Bioeconomy; leading betweenness centrality of 0.432 in ICT and 0.264 in Energy).
    - *Other Central Hubs:* Technical University of Munich (DE; 52 ICT / 29 Bioeconomy / 22 Energy projects), Karlsruhe Institute of Technology (DE; 30 ICT / 29 Energy

projects), AIT Austrian Institute of Technology (AT), and Max Planck Society (DE; 62 Bioeconomy projects, though with more localized partner clusters).

- Regional „Bridging" Institutions: Institutions in emerging/non-EU Member States act as crucial brokers connecting peripheral actors to central hubs. These include the *Jožef Stefan Institute* (Slovenia; betweenness centrality of 0.121 in Energy), *Ruđer Bošković Institute* (Croatia; betweenness 0.019 in Energy), *BioSense Institute* (Serbia; 9 direct connections across 5 Bioeconomy projects), and *Institute of Molecular Genetics and Genetic Engineering* (Serbia; 12 direct connections across 3 projects).

2. Strategic policy directions & recommendations

Pillar 1 (Water Scarcity)

- Target High-Impact S3 Overlaps: Direct regional R&I investments into interdisciplinary solutions combining ICT/AI with bioeconomy and climate adaptation, such as precision agriculture, digital water management grids, and circular bio-based materials.
- Expand applied circular & water research: Fund cross-border pilot projects in wastewater treatment, ecological restoration, and renewable energy storage to align macro-regional research directly with European Green Deal goals.

Pillar 2 (Right to Stay)

- Implement twinning & staff mobility schemes: Pair leading research hubs (e.g., Fraunhofer, TU Munich, AIT) with under-represented institutions in Moldova, Bosnia & Herzegovina, Ukraine, and Romania through formal twinning and researcher exchange programs to build local capacity and curb brain drain.
- Provide proposal preparation grants: Establish seed-funding and grant-writing support for researchers in non-EU/downstream countries to increase their success rates in Horizon Europe calls.

Pillar 3 (Integration)

- Institutionalise EUSDR Priority Area 7 (Knowledge Society): Formalise the PA7 Smart Specialisation Working Group into a permanent coordination platform alongside Working Groups on ERA, Higher Education, and Dragon Fly Network to facilitate cross-border matchmaking between universities, research centers, and businesses.
- Empower Regional „Bridging" Anchors: Provide dedicated financial and administrative support to high-betweenness institutions (such as Jožef Stefan Institute, Ruđer Bošković Institute, and BioSense Institute) so they can serve as macro-regional research anchors that pull peripheral Western Balkan and Eastern Danube partners into major EU consortia.

- Create a Joint PA7 Transnational Research Funding Mechanism: Advocate for a dedicated macro-regional joint funding tool managed under EUSDR PA7 to finance seed projects, early-stage cross-border research consortia, and S3 alignment across EU and non-EU Danube countries.

Evaluation of the knowledge society in the Danube region (2010-2024)

- Document type: Regional analytical evaluation report (Evaluation of the knowledge society in the Danube region (2010-2024)
- Thematic alignment: Pillar 2 (Right to stay), Pillar 3 (Integration).

Executive summary: The evaluation report Evaluation of the knowledge society in the Danube region (2010-2024) assesses the progress, performance, and structural dynamics of the knowledge economy across the 14 participating countries and regions of the EU Strategy for the Danube Region (EUSDR). Commissioned by the Slovak Ministry of Education and executed by the Slovak Centre of Scientific and Technical Information, the report measures performance along the entire R&I value chain, from financial investments and human talent to Horizon Europe participation, patent outputs, and knowledge-intensive exports. The analysis highlights severe structural divides between old EU Member States, new EU Member States, and non-EU accession/associated countries, offering strategic policy recommendations for EUSDR Priority Area 7.

1. Key findings

Pillar 2 (Right to Stay)

- Researcher density and talent retention disparities: The capacity to retain and attract scientific talent varies drastically across the macro-region, directly influencing brain drain and the „Right to Stay". Austria leads with 6,705 full-time equivalent (FTE) researchers per million inhabitants, followed by Germany (5,811) and Slovenia (5,352). Conversely, severe talent deficits exist in Bosnia and Herzegovina (535 researchers per million), Ukraine (580), and Montenegro (743). Ukraine experienced a dramatic 56.27% drop in FTE researchers between 2010 and 2023, severely compounded by military conflict.
- Tertiary education attainment and STEM pipeline: Austria records the highest proportion of tertiary graduates aged 25-34 at 43.5% (surpassing the EU average of 43.1%), whereas Romania (22.5%) and Bosnia and Herzegovina (26.6%) report the lowest rates. Doctoral graduates in STEM fields per 1,000 population aged 25–34 are highest in Germany (1.2), Czechia (0.8), Austria (0.8), and Slovenia (0.8), compared to just 0.3 in Romania and 0.4 in Serbia, Hungary, and Bulgaria.
- Gender equality in research: Eight Danube region countries meet or exceed the EU target of 40% female researchers. The highest shares of female researchers are observed in

non-EU accession and associated states, including Serbia (52.47%), Montenegro (52.08%), and Moldova (50.87%). In contrast, the lowest female researcher proportions are found in Czechia (27.69%), Hungary (28.76%), and Germany (29.36%).

- Research career support (MSCA and ERC): Under Horizon Europe, Marie Skłodowska-Curie Actions (MSCA) for researcher mobility are heavily concentrated in Germany (€372.98 million across 2,222 participations) and Austria (€84.69 million across 507 participations), while Bosnia and Herzegovina (€297,550 across 6 participations) and Montenegro (€1.03 million across 6 participations) face severe exclusion. European Research Council (ERC) grants display an even sharper divide: Germany holds 1,144 grants and Austria holds 217, whereas Serbia and Slovakia hold only 2 grants each, Bulgaria holds 1, and four regional countries hold zero.

Pillar 3 (Integration)

- European and regional innovation scoreboard divides: No Danube Region state qualifies as an „Innovation Leader" under the 2024 European Innovation Scoreboard. Germany and Austria are classified as „Strong Innovators"; Slovenia, Czechia, and Hungary as „Moderate Innovators"; while all remaining states (Slovakia, Croatia, Bulgaria, Romania, Serbia, Bosnia & Herzegovina, Montenegro, Moldova, and Ukraine) are „Emerging Innovators". On the Regional Innovation Scoreboard, German regions (Oberbayern, Karlsruhe, Tübingen, Mittelfranken) and Prague dominate, with only five non-German/Austrian regions scoring above the EU average.
- Extreme asymmetries in R&I expenditure: Total R&D investment in the Danube Region reached €161.5 billion in 2023, but Germany accounts for nearly 80% (€130 billion), followed by Austria (€15.58 billion) and Czechia (€5.82 billion). If Germany is excluded, Austria accounts for 49% of all remaining regional R&D spending. In intensity terms, Baden-Württemberg invests 5.59% of its GDP in R&D, compared to less than 1% in Serbia, Bulgaria, Romania, Moldova, Montenegro, Ukraine, and Bosnia and Herzegovina (0.19%). Business sector R&D is highest in Germany (1.93% of GDP) and lowest in Serbia (0.01%).
- Horizon Europe participation and asymmetric collaboration: In Horizon Europe, Germany (€7.3 billion secured) and Austria (€1.14 billion) absorb the vast majority of funds, while non-EU states like Montenegro (€4.45 million), Moldova (€6.48 million), and Bosnia and Herzegovina (€9.15 million) receive minimal funding. Per capita EC contributions range from €171.86 in Slovenia and €155.33 in Austria down to €1.77 in Ukraine and €2.26 in Moldova. Collaboration networks are heavily centered on Germany (e.g., 1,184 joint project participations between Germany and Austria, and 650 between Germany and Czechia), whereas inter-collaboration among non-EU Balkan and Eastern states remains extremely sparse.

- Patenting and high-tech outputs: European Patent Office (EPO) applications per million inhabitants in 2024 are dominated by Germany (297.75), Austria (235.49), and Slovenia (73.69), while six regional states (including Romania, Serbia, Ukraine, and Moldova) register under 3.5 applications per million. Knowledge-intensive service exports as a share of total exports are highest in Hungary (56.51%), Bulgaria (54.31%), and Serbia (52.03%), and lowest in Bosnia and Herzegovina (18.47%).

2. Strategic policy directions and recommendations

Pillar 2 (Right to Stay)

- Support local capacity building and research infrastructure: Invest in research infrastructure and institutional administrative capacity in lower-performing Eastern and Western Balkan states to create attractive domestic career opportunities for young scientists and mitigate brain drain.
- Promote intra-regional researcher and manager mobility: Establish dedicated EUSDR mobility schemes for researchers, PhD students, and project managers, facilitating short-term exchanges between emerging innovation nodes and central hubs to keep human capital embedded within the macro-region.

Pillar 3 (Integration)

- Institutionalise best practice transfers and twinning: Systematically transfer successful R&I governance and technology-transfer models from „Strong Innovators" (Austria, Germany, Slovenia) to „Emerging Innovator" states via structured twinning projects.
- Establish seed funding for transnational networking: Allocate targeted seed grants to fund small cross-border networking projects designed explicitly to build competitive Horizon Europe project proposals involving non-EU and new EU Member State institutions.

Extended Steering Group Meeting on Digitalisation of Public Sector, October 2024

- Document type: Meeting Summary / Event Overview (EUSDR Priority Area 10: Institutional Capacity and Cooperation)
- Thematic alignment: Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary: This document summarises the online EUSDR Priority Area 10 Extended Steering Group meeting focused on public sector digitalization in the Danube Region. It outlines current digital practices targeting both citizens and public servants, analyzes structural challenges across legal, process, interoperability, and funding frameworks, and identifies next steps for institutional capacity building.

1. Key findings

State of Play & best practices

- Regional assessment: A study by NALAS and KDZ under the BACID initiative (*Empowering Progress with Digital Transition*) evaluated digitalisation maturity across local governments in the Western Balkans and Moldova.
- Citizen-facing services: Hungary presented its Digital Citizen Programme, which enables citizens to present digital IDs via mobile phones. The Czech Republic highlighted its centralised eGovernment system, where municipalities deliver services managed by the state, prioritizing data sharing, secure channels, and in-person options for digitally insecure citizens.
- Public servant tools: The State Ministry of Baden-Württemberg introduced an in-house generative AI testing tool for public administration, raising core questions around AI accountability and data security.

2. Strategic policy directions and recommendations

- Legal framework: Addresses data protection, e-Government legislation, digital inclusion, and resolving multi-level governance gaps where different administrations control distinct processes.
- Interoperability: Emphasises national-local alignment, cross-agency collaboration, transition from decentralised access points to single access points, alignment with the European Interoperability Framework, and testing cross-border interoperability guidelines.
- Funding & sustainability: Highlights the need for sustainable grants and subsidies, as well as clear resource prioritization during financial shortfalls.

Feasibility study „Decarbonisation of heating and cooling sector - promotion of green district heating in the Danube Region"

- Document Type: Transnational Energy Feasibility Study & Policy Report
- Thematic alignment: Pillar 1 (Water Scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration).

Executive summary: The feasibility study evaluates the decarbonization of heating and cooling across six Danube Region countries, Bosnia and Herzegovina (BiH), Croatia, Romania, Serbia, Slovakia, and Slovenia, by scaling up geothermal energy and green district heating (DH). Commissioned under EUSDR Priority Area 2, the report assesses geothermal resources, district heating markets, and financing mechanisms. It aims to leverage Hungary's mature geothermal

DH sector (~180 MW capacity) to drive cross-border technology transfer and B2B commercial partnerships across target EUSDR markets.

1. Key findings

Pillar 1 (Water Scarcity)

- Underdeveloped geothermal potential: Substantial hydrogeothermal resources exist across the Pannonian and Dinaric basins (temperatures from 50°C to over 200°C), yet direct geothermal utilization for district heating remains severely underdeveloped:
    - Slovenia, Serbia, & BiH: Geothermal DH is active in only 1 location in Slovenia (Lendava) and Serbia (Bogatić), while BiH has 0 operational geothermal ditrict heating systems.
- High fossil-fuel dependency in district heating: District heating generation in target countries relies heavily on natural gas and coal:
    - *Romania:* 80.2% natural gas, 17.7% coal, and only 0.6% renewables.
    - *Serbia:* 69.2% natural gas, 9.1% oil, 7.4% coal, and 14.3% industrial waste heat.
    - *Slovakia:* 55% natural gas, 27% biomass, and 15.8% coal.
    - *Bosnia and Herzegovina:* 50% coal, 29% natural gas, and 20% wood biomass.

Pillar 2 (Right to Stay)

- Contraction of municipal district heating infrastructure: Poor maintenance and customer disconnections threaten service viability; in Romania, operating municipal DH networks collapsed from 315 cities in 1989 down to 61 in 2017.
- Building retrofits & inefficient consumption: Thermal retrofits have reduced heat demand (e.g., residential DH heat use in Slovakia dropped 26% between 2004 and 2014). In BiH, flat-rate space billing and distorted price ratios lead households to consume 100,000 MWh of electricity for space heating per season.

Pillar 3 (Integration)

- Transboundary technology transfer: The study establishes a framework to export Hungarian technical expertise, hydrogeological exploration, and well-drilling into target Danube markets.

2. Strategic policy directions and recommendations

Pillar 1 (Water scarcity)

- Expand geothermal exploration: Increase subsurface hydrogeological mapping across the Pannonian and Dinaric basins, targeting deep 50–200°C carbonate and sandstone aquifers.
- Decarbonise district heating: Reconfigure municipal DH networks by replacing aging coal and oil boilers with hybrid geothermal-biomass plants and heat pumps.

Pillar 2 (Right to stay)

- Rehabilitate distribution networks: Modernise aging distribution networks with pre-insulated piping to reduce distribution heat losses toward EU benchmark levels (8-9%).

Pillar 3 (Integration)

- Execute B2B matchmaking missions: Organise structured B2B trade missions in Zagreb (Croatia), Banja Luka/Tuzla (BiH), and Novi Sad (Serbia) to pair local utilities with experienced geothermal developers.
- Blend pre-accession and export financing: Combine Western Balkans Green Center grants, HEPA export subsidies, and EBRD facilities to de-risk early-stage exploratory drilling and network retrofits.

Handbook on Cross-border Energy Communities

- Document type: Official European Commission Policy Handbook and Practical Guide (DG REGIO, January 2025).
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration)

Executive summary: The Handbook on Cross-border Energy Communities, published by the European Commission's Directorate-General for Regional and Urban Policy (DG REGIO), provides a strategic framework and practical methodology to establish and operate Cross-Border Energy Communities (CBECs) and Quasi-CBECs (Q-CBECs) across the EU. Designed to operationalize EU legal definitions under the Renewable Energy Directive (RED II) and Internal Electricity Market Directive (IMED), the Handbook addresses systemic legal, technical, and administrative barriers along internal borders. It equips local authorities, citizens, and energy actors to leverage cross-border cooperation to build resilient, decentralized, and low-carbon regional energy systems.

Key findings

1. Pillar (Water scarcity)

- EU Green Deal & Decarbonisation objectives: CBECs directly advance the European Green Deal and the EU Energy Union by scaling up local Renewable Energy Sources

(RES), boosting energy efficiency, reducing regional carbon footprints, and lowering energy import dependencies.

- Diversified RES technologies: Identified cross-border energy initiatives utilise a broad spectrum of clean technologies, including solar PV, wind power, biomass, green hydrogen, and geothermal energy.
- Circular heat & industrial waste heat recovery: Waste heat utilization in district heating networks represents a primary circular economy application across border regions.
    - *Calorie Kehl-Strasbourg (DE-FR):* Transports industrial waste heat from a German steel plant across the Rhine to heat households in Strasbourg, France.
    - *Eneregio SOBOS (AT-DE):* A CEF-E-funded cross-border feasibility project in the Danube region evaluating hydrothermal deep geothermal energy and industrial waste heat, with a potential to supply border communities across Bavaria, Upper Austria, and Salzburg.
- Local self-sufficiency & demand reduction: Community-led generation, local storage (batteries, thermal storage), and smart-metering optimize regional load-balancing, reduce peak grid demand, and prevent energy waste.

Pillar 3: Integration

- High economic cost of border obstacles: Legal and administrative border barriers cause an estimated annual economic loss of EUR 458 billion (~8.8% of cross-border regions' GDP) and a loss of 6 million potential jobs.
- Dominance of legal barriers: Legal obstacles account for 61% of all identified cross-border energy obstacles (out of 64 mapped obstacle entries), primarily due to incomplete national transposition of RED II (Art. 22) and IMED (Art. 16) provisions regarding „cross-border participation" and energy sharing.
- Grid and physical interconnection limits: Physical energy transfers across low/medium-voltage distribution grids face strict regulatory restrictions under the Electricity Market Regulation (EMR 2019/943/EU), which limits direct cross-border lines and favors high-voltage transmission interconnectors.
- Cross-border energy preparedness index (Scores out of 10):
    - Danube Region Scores: Austria–Slovenia (4.8/10), Czechia–Germany (4.8/10), Croatia–Slovenia (4.5/10), Czechia–Austria (4.0/10), Austria–Slovakia (4.0/10), Austria–Hungary (4.0/10), Bulgaria–Greece (4.0/10), Hungary–Romania (3.7/10),

Bulgaria–Romania (3.7/10), Czechia–Slovakia (3.7/10), Croatia–Hungary (3.7/10), Czechia–Poland (3.3/10), and Hungary–Slovakia (3.5/10).

- Danube Region Governance Practices:
    - *Pannon EGTC / REHEATEAST Project (Interreg Danube Region 2021–2027):* Coordinated by Pannon EGTC (seated in Hungary), bringing together 11 partners and 27 associated partners across 11 Danube countries to decarbonize district heating systems.

2. Strategic policy directions & recommendations

Pillar 1 (Water scarcity)

- Integrate local circular & RES systems: Encourage municipalities and regional utilities to combine solar PV, wind, biomass, and industrial waste heat into integrated local energy loops, utilizing thermal storage to decouple heat production from immediate demand.
- Prioritise low-carbon mobility: Expand cross-border e-mobility networks and shared zero-emission transport systems (e.g., the Maria Valéria Bike shared e-bike system connecting Esztergom, Hungary, and Štúrovo, Slovakia across the Danube).
- Deploy digital smart energy management: Implement Virtual Power Plants (VPPs) and AI-driven smart grid tools to manage distributed energy generation, peer-to-peer (P2P) trading, and multi-asset load balancing across border regions.

Pillar 3 (Integration)

- Harmonise national enabling frameworks: Member States must explicitly transpose RED II and IMED directives to permit cross-border membership, joint support scheme access, and unhindered energy sharing across national boundaries.
- Institutionalise permanent cross-border entities: Utilise legal structures such as European Groupings of Territorial Cooperation (EGTCs), European Cooperative Societies (SCEs), or joint municipal entities (such as *Sociétés d'économie mixte* - SEM) to provide long-term administrative continuity beyond short-term Interreg project cycles.
- Utilise EU Regulatory tools and funding:
    - *b-solutions & BRIDGEforEU:* Deploy legal advisory mechanisms to resolve specific cross-border grid, tax, and licensing bottlenecks.
    - *Interreg & CEF-E Blending:* Combine Interreg Policy Objective 2 (Greener Europe) and Specific Objective 1 (Better Governance) with Connecting Europe Facility - Energy (CEF-E) funding to finance cross-border energy infrastructure and feasibility studies.

- Deploy regulatory sandboxes: Establish temporary cross-border „regulatory sandboxes" and experimental clauses to test direct-line low-voltage electricity transfers, microgrids, and local energy trading before enacting permanent statutory changes.

ESPON 2030 Digital Interactive Deliverable / Visual Discourse Analysis (Trends and Drivers of Change Infographics, ESPON NoStaGeo)

- Document type: ESPON 2030 Digital Interactive Deliverable / Visual Discourse Analysis (Trends and Drivers of Change Infographics, ESPON NoStaGeo).
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 3 (Integration)

Executive summary: The ESPON NoStaGeo Trends and Drivers of Change Infographics framework evaluates how eight global primary forces trigger local drivers of change across nine thematic fields. This interaction reconfigures traditional administrative boundaries and commuting-based Functional Urban Areas (FUAs) into dynamic, non-standard functional geographies.

Key findings

Pillar 1

- Water management (metropolitan water supply):
    - Emerging trends: Climate-driven hydrological risk management, ecosystem-based water governance, and groundwater protection against diffuse agricultural and industrial pollution.
    - Functional area shift: Delineations shift to River Basin Districts, sub-units, and HydroSHEDS catchments. Non-standard functional areas emerge around inter-basin water transfers, emergency interconnectors, and shared urban-rural resource protection zones.
- Biodiversity preservation (ecological connectivity):
    - Emerging trends: Moving beyond static protected areas (Natura 2000) toward landscape-scale ecological connectivity and Other Effective Area-based Conservation Measures (OECMs).
    - Functional area shift: Spatial boundaries expand to transboundary biosphere reserves, ecological corridors, and green/blue infrastructure linking habitat patches across agricultural and peri-urban landscapes.
- Energy transitions (building energy savings & microgrids):

- Emerging Trends: Decentralised energy loops, local energy communities, and smart-grid-enabled demand response.
- Functional Area Shift: Establishes functional energy areas governed at the community and neighborhood scale, shaped by building ownership patterns, continuous urban fabric, and commuting zones.

- Circular economy:
  - Emerging Trends: Extended Producer Responsibility (EPR), circular business models, and local circular procurement networks.
  - Functional area shift: Delineates new functional supply-chain geographies around local recycling loops, industrial waste heat recovery, and regional material reuse networks.
- Land-Sea Interactions:
  - Emerging Trends: Marine Spatial Planning (MSP), offshore renewable energy expansion, and coastal ecosystem conservation.
  - Functional area shift: Establishes integrated land-sea transition zones combining offshore industrial platforms, port logistics, and marine protected areas.

Pillar 2 (Right to Stay)

- Sustainable Mobility:
  - Emerging trends: Implementation of 15-minute cities, super-cycle lanes, and Urban Vehicle Access Regulations (UVARs).
  - Functional area shift: Shifts focus away from broad Functional Urban Areas (FUAs) toward micro-scale walkable accessibility zones and cross-border zero-emission mobility corridors to maintain local quality of life.
- Health and ageing:
  - Emerging Trends: Digital health transformation, e-health platforms, and age-friendly community infrastructure.
  - Functional area shift: Reorganises healthcare service regions around digital platforms and cross-border health access zones (e.g., French-Belgian ZOAST areas) to secure local access to essential public services.

- Migration & talent attraction:
    - Emerging trends: Remote work expansion, digital nomad mobility, and talent attraction strategies in non-metropolitan regions.
    - Functional area shift: Creates functional amenity regions and rebranded rural spaces geared toward attracting remote workers and specialised industrial talent, helping counter rural depopulation and brain drain.

Pillar 3: Integration

- Industrial transitions:
    - Emerging trends: Development of European Innovation Valleys, green industrial ecosystems, and net-zero technology clusters.
    - Functional area shift: Reconfigures economic geographies around hydrogen infrastructure corridors, renewable energy generation sites, and multi-scalar R&D and talent networks (*Euroclusters*) that transcend municipal and regional borders.
- Inadequacy of standard spatial units: Standard administrative boundaries and conventional commuting-based FUAs fail to capture non-standard functional flows like water catchments, ecological corridors, or energy loops.
- Co-construction vs. fixed boundaries: Non-standard functional areas are fuzzy, dynamic, and theme-specific. They are not statistically pre-given but co-constructed through negotiated multi-level stakeholder partnerships.
- Institutional inertia & policy alignment: Rigid statutory planning and siloed administration create resistance to non-standard functional governance, requiring flexible place-based tools (e.g., ITI, CLLD, Cohesion Policy Objective 5) to align administrative boundaries with functional realities.

CONFERENCE of the ministers of interior of the EUSDR member states 29-30 June 2026 Sofia, Bulgaria. Joint Conclusions

- Document type: Official Intergovernmental Declaration / Joint Ministerial Conclusions.
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary: The Joint Conclusions of the Ministers of Interior of the EUSDR Member States (adopted under the 2026 Bulgarian Presidency) reaffirm political support for Priority Area 11 (Security) on the 15th anniversary of the Danube Strategy. The conclusions address evolving hybrid threats, cybersecurity, terrorism, radicalisation, and foreign information manipulation stemming from Russia's war against Ukraine and Middle East conflicts. The Ministers call for

security to be explicitly prioritized in the forthcoming Multiannual Financial Framework (MFF) and integrated across all EU policies and funds.

1. Key findings

Pillar 1

- Joint waterways & mobility security (PA 1a & PA 11): Establishes horisontal alignment between environmental/waterway transport management and regional security through the Joint Expert Working Group between Priority Area 1a (Waterways Mobility) and Priority Area 11 (Security).
- Sustainable waterland operations: Focuses on maintaining safe, sustainable, and secure inland navigation along the Danube water corridor.

Pillar 2

- Citizen well-being & safety: Identifies internal security, public safety, and protection against radicalisation as fundamental requirements for regional population retention and quality of life.
- Societal resilience to hybrid threats: Addresses societal polarisation, disinformation, and foreign information manipulation to safeguard democratic trust and community stability.
- Digital resilience for public services: Focuses on protecting public administration and essential citizen services from cyberattacks and cyber-facilitated incidents.

Pillar 3

- Operational riverine border security (DARIF Operation): Highlights the annual Hungarian-led DARIF Operation as a flagship practical model for joint border control, law enforcement, and vessel monitoring along the Danube river.
- Danube Flagships & MFF earmarking: Calls for labeling key cross-border security initiatives as "Danube Flagships" and demands explicit security prioritisation in the post-2027 EU Multiannual Financial Framework (MFF).
- Cyber & cross-border hybrid Defense: Mandates structured international coordination between national security services, law enforcement, EU agencies, and the private sector to counter cross-border cyber incidents and hybrid threats.

2. Strategic Policy Recommendations

- Pillar 1: Sustain joint operational protocols between PA 1a and PA 11 to guarantee secure, environmentally sound navigation along the Danube river corridor.

- Pillar 2: Enhance local civil protection and digital literacy initiatives to insulate border communities against foreign disinformation and cyber disruptions.
- Pillar 3: Embed DARIF operational protocols across all EUSDR riverine border police, formalise Danube Flagship status for joint border networks, and secure dedicated security funding lines in the upcoming MFF.

Advocacy Guidance and Strategic Orientations on the role of EU Macro-Regional Strategies in the EU Multiannual Financial Framework 2028-2034

- Document type: Joint Macro-Regional Advocacy Guidance & Strategic Policy Orientations.
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary:The Advocacy Guidance and Strategic Orientations paper, jointly issued by the TRIO Presidencies of the four EU Macro-Regional Strategies (EUSDR, EUSBSR, EUSAIR, EUSALP), outlines a consolidated position on the role of macro-regions in the post-2027 EU Multiannual Financial Framework (MFF 2028–2034). The document calls for embedding macro-regional priorities directly into national/regional Cohesion Policy programs, Interreg, the European Competitiveness Fund (encompassing Horizon Europe and LIFE), the AgoraEU instrument, and Global Europe accession funding. It emphasizes utilising macro-regional strategies (MRS) as multi-level, place-based platforms to govern cross-border functional areas, align public-private investments, and support special territorialities across Member States, candidate countries, and coastal/riverine basins.

Key findings

Pillar 1

- Macro-regional alignment with EU Green Goals: Positions MRS frameworks as essential mechanisms to translate EU Green Deal, climate adaptation, and environmental priorities into coordinated investment pipelines across shared river basins and sea basins.

Pillar 2

- Preserving viability in sparsely populated & peripheral territories: Identifies sparsely populated areas, mountain regions, and remote border zones as territories requiring targeted place-based support to counter demographic decline, maintain essential public service delivery, and preserve local quality of life.
- Urban hubs as knowledge and social innovation engines: Recognises cities within macro-regions as transport, energy, knowledge, and social innovation hubs that act as living laboratories for testing policy solutions that benefit surrounding rural hinterlands.

- Inclusive capacity building: Calls for multi-level stakeholder engagement, knowledge exchange, and capacity building to ensure local communities and civil society actively participate in shaping regional development.

Pillar 3

- Riverine and water catchment area integration: highlights riverine catchments, coastal zones, and mountain watersheds as critical „special territorialities" requiring cross-border, ecosystem-based governance. Explicitly underscores the strategic significance of territories with specific geographical characteristics specifically riverine catchments, coastal zones, mountain ranges, border regions, and sparsely populated areas for European cohesion and territorial integration.
- Cross-border functional area governance: Serves as a proven multi-level platform to coordinate spatial planning, transport corridors, and economic value chains across functional regions that naturally transcend national and municipal borders.
- EU enlargement and pre-accession co-governance: Serves as a practical platform for co-planning, co-governance, and co-investment between EU Member States and candidate/neighbouring countries (particularly within EUSDR and EUSAIR), utilising shared technical working groups to support legal acquis alignment and practical convergence.
- MFF 2028-2034 Structural Integration: Advocates for the explicit embedding of MRS macro-regional priorities into the post-2027 ERDF, Interreg (under Articles 7(1b) and 8(1b)), national/regional Cohesion Policy programs, and the Global Europe pre-accession instrument.

2. Strategic policy recommendations

- Pillar 1: Establish mandatory thematic links between macro-regional river/sea basin strategies and centrally managed EU environmental funds (LIFE, Horizon Europe, Competitiveness Fund) to scale up clean energy and water catchment adaptation projects.
- Pillar 2: Utilise Cohesion Policy and local urban-rural partnerships to fund public service hubs and social innovation in peripheral, mountain, and sparsely populated border areas to protect the „Right to Stay".

Study on the hydrogen markets of the DRS countries

- Document type: Strategic Regional Market Study & Policy Analysis
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive Summary: The KPMG study provides a comprehensive baseline analysis of the hydrogen value chain, covering production, consumption, transportation pipelines, underground storage, national regulatory frameworks, and cross-border project synergies, across 14 Danube Region Strategy (DRS) countries (Austria, Bulgaria, Croatia, Czechia, Germany, Hungary, Romania, Slovakia, Slovenia, Bosnia & Herzegovina, Moldova, Montenegro, Serbia, and Ukraine). Designed to inform the development of a unified EUSDR Hydrogen Strategy, the report highlights the severe market asymmetries between mature EU states and non-EU candidate countries. It identifies key transnational infrastructure corridors, joint IPCEI flagships, and cross-border „Hydrogen Valleys" required to replace Russian fossil gas imports and achieve macro-regional climate neutrality.

Key findings

Pillar 1

- Fossil reforming dominance: SMR/fossil-based production accounts for 81% to 100% of hydrogen output across all DRS countries, while renewable electrolysis (green H2) represents under 1% to 4% of current production.
- Production & consumption hotspots: Germany leads with 1,983 kt/year production capacity and 1,387 kt/year demand. Actual 2023 output reached 198.1 kt in Hungary, 170.2 kt in Slovakia, 133.5 kt in Austria, 124.9 kt in Bulgaria, 105.96 kt in Czechia, 95.8 kt in Romania, 66.85 kt in Croatia, and 1.82 kt in Slovenia. Industrial use concentrates in refining and ammonia/fertiliser manufacturing.
- Underground storage (UHS): RAG Austria operates the *Underground Sun Storage* facility (4.5 GWh, 100% pure H2) with plans to reach 26,800 GWh by 2050. Slovakia is developing border storage projects (*UGS Lab*, *UGS Velke Kapusany*), and Ukraine plans 980 GWh of geological storage.

Pillar 2:

- Workforce Reskilling (*HyAcademy.EU*): The Horizon Europe *European Hydrogen Academy* (led by UCT Prague with 12 core partners across CZ, BG, DE, RO, BE, FR, IT, NL, ES) establishes a standardised training network across 100+ universities to train local workforces and address skilled labor shortages.
- Decarbonising local transport & Danube shipping: The *Ruse Project* (Bulgaria) pairs a 55 MW electrolyser with 20 fuel cell buses and retrofitted Danube River hydrogen tugboats. 2030 NECP targets include 20 refuelling stations in Hungary (~4,800 FCEVs), 20 in Bulgaria, and 15 in Croatia.

Pillar 3

- Transnational hydrogen corridors:
    - *Central European Hydrogen Corridor (CEHC):* A 1,351 km pipeline (144 GWh/day capacity) connecting Ukrainian H2 production through Slovakia and Czechia to German industrial centers.
    - *European Hydrogen Backbone (EHB):* Integrates Corridor A (North Africa/Italy/Austria/Slovenia/Hungary) and Corridor E (East/SE Europe).
    - *Planned pipeline networks:* Germany (11,500 km core network), Bulgaria (1,550 km), Slovakia (935 km), Hungary (921 km), Austria (720 km), Czechia (566 km), and Slovenia (363 km).
- Cross-Border Valleys & IPCEI Flagships:
    - *North Adriatic Hydrogen Valley (NAHV):* A multi-lateral cross-border valley spanning Slovenia, Croatia, and Italy (37 organisations, 17 pilot projects, >5,000 t/yr green H2 target).
    - *Green Hydrogen @ Blue Danube:* Led by VERBUND (Austria) across DE, RO, BG, SR, HR, HU, and SK, transporting green H2 produced in SE Europe via LOHC on Danube shipping routes.
    - *IPCEI Black Horse:* Establishes 40 electrolysis production sites across Poland, Slovakia, and Hungary.

Strategic policy directions & recommendations

- Pillar 2: Expand the *European Hydrogen Academy* across regional universities and establish joint municipal procurement for fuel-cell bus and river barge fleets.
- Pillar 3: Accelerate construction on the CEHC and EHB corridors, extend the EU *CertifHy* Guarantees of Origin system to non-EU DRS countries, and formalise a permanent EUSDR PA2 hydrogen working group to coordinate cross-border trading.

Study on Energy Crisis Management Experiences in the EUSDR Countries

- Document type: Strategic Regional Energy Market & Crisis Management Study
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive Summary: The KPMG study evaluates gas market adaptation, cross-border infrastructure shifts, and emergency regulatory responses across the 14 Danube Region Strategy (EUSDR) countries following the 2022 energy crisis and the decline of Russian pipeline gas. Regional natural gas demand contracted by 19% (from 149 bcm in 2021 to 120 bcm in 2024). The report highlights how regional supply security has been re-engineered through cross-

border reverse-flow corridors, LNG regasification, shared storage dependencies, and joint EU emergency mechanisms.

1. Key findings

Pillar 1

- **Regional gas demand contraction:** Aggregate inland gas consumption across EU EUSDR countries dropped by 19% between 2021 and 2024 (from 149 bcm to 120 bcm). Significant declines occurred in Germany (from ~90 bcm to ~75 bcm; -17%), Czechia (-28%), Austria (-25%), Hungary (-24%), Slovakia (-21%), Bulgaria (-20%), Romania (-18%), Croatia (-18%), and Moldova (-50%).
- **Integration of domestic offshore production:** Romania's *Neptun Deep* offshore Black Sea project (8 bcm/year capacity starting in 2027) and *Midia Gas Development* (1 bcm/year) will nearly double Romanian gas output, supplying domestic needs and generating regional export surpluses.

Pillar 2

- **Price Volatility & Retail Shielding:** Extreme wholesale price spikes in 2022 (peaking above 180–210 €/MWh in Germany, Austria, Czechia, Bulgaria, and Hungary) threatened industrial competitiveness and household living standards.
- **National Policy Disparities:** National interventions varied widely: Germany introduced the *Gaspreisbremse*; Czechia, Slovakia, and Slovenia set retail price caps; while Hungary maintained flat, state-regulated price caps, resulting in household prices consistently below the EU average but higher costs for un-subsidised industry.
- **Vulnerabilities in Non-EU Candidate States:** Non-EU candidate states faced severe security and affordability risks due to small market scale and single-pipeline reliance. Moldova halved its consumption due to price shocks, while Bosnia & Herzegovina and Montenegro remained fully reliant on external transit.

Pillar 3

- **The „Vertical Gas Corridor":** Links Greece, Bulgaria, Romania, Hungary, Slovakia, Moldova, and Ukraine to transport up to 10 bcm/year of Greek LNG (Alexandroupolis FSRU: 2.25–5.5 bcm/y) and Azerbaijani TAP gas northward. Key capacity expansions include the IGB Interconnector (3–5 bcm/y), the Kulata–Kresna loop (+1.3 bcm/y), and the Rupcha–Vetrino loop (+5 bcm/y).
- **TurkStream & CEE Transit Realignment:** Following the loss of Nord Stream, Yamal, and Ukrainian transit (expiring early 2025), TurkStream (31.5 bcm/y total capacity; ~15.5 bcm/y

through Strandzha 2) became the primary remaining Russian route into Europe. Bulgaria functions as a critical transit bridge sending gas westward into Serbia and Hungary.

- Krk LNG terminal & export reversals: Croatia's Krk FSRU terminal (expanding from 2.9 bcm/y to 6.1 bcm/y by 2025) shifted Croatia into a net gas exporter, supplying up to 2.9 bcm/y to Hungary and Slovenia via reverse-flow pipelines.
- Non-EU storage interdependencies: Under EU Regulation 2022/1032 (mandating 90% pre-winter storage fills), regional storage was filled to 90–100% by November 1st each year from 2022 to 2024. Non-EU states lacking domestic storage depend on neighboring networks: Moldova utilises Romanian and Ukrainian storage, while Serbia and Bosnia & Herzegovina rely on Hungarian storage facilities (such as the 6.5 bcm Hungarian storage system).

2. Strategic policy directions and recommendations

Pillar 1

- Maintain structural gas savings: Preserve structural demand reductions achieved through energy efficiency and heat pump deployment to prevent demand rebounds during severe winter cold spells.
- Connect regional offshore production: Fast-track pipeline connections (such as the Black Sea–Podișor pipeline) to integrate Romania's Neptun Deep production directly into the BRUA and Vertical Corridor networks.

Pillar 2

- Guarantee essential supply to candidate states: Extend EU energy security safeguards to Moldova, Ukraine, and Western Balkan states to protect domestic heating and public services.

Pillar 3

- Complete the Vertical Corridor Infrastructure: Fully fund and execute pipeline looping projects across Bulgaria, Romania, and Slovakia to remove physical bottlenecks along the North-South transit axis.
- Formalise cross-border storage solidarity agreements: Establish binding cross-border gas storage and balancing agreements between EU Member States and non-EU Danube partners (Moldova, Ukraine, Serbia, BiH) to ensure emergency supply access during winter peak withdrawals.

- Expand regional access to coastal LNG: Coordinate joint regional capacity bookings at Krk (Croatia) and Alexandroupolis (Greece) to ensure landlocked Danube markets maintain diversified, non-Russian supply routes.

National Energy and Climate Plans in the Danube Region - Final Report

- Document type: Strategic Regional Market Study & Policy Analysis
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive Summary: The 2020 REKK study evaluates the National Energy and Climate Plans (NECPs) of 9 EU Member States and energy strategies of 5 non-EU countries in the Danube Region to assess decarbonization, renewable energy, and market integration trajectories through 2030.

Key findings

Pillar 1:

- Solar PV and Wind Capacity Expansion: Growth in renewable electricity (RES-E) by 2030 will be overwhelmingly driven by solar PV (+79 GW in EU DR states; +490 MW in non-EU states) and onshore wind (+40 GW in EU DR states; +877 MW in non-EU states).
- Heating, cooling, and geothermal Integration: Five regional countries already report renewable heating and cooling (RES-H&C) shares at or above 40%. Strategic plans emphasise expanding low-temperature heat networks, geothermal district heating, heat pumps, and solar thermal installations.
- Biomass over-reliance: A projected 35% increase in biomass-to-heat and biomass-to-electricity generation poses severe climate risks, as EU Danube countries project a ~70% decline in their forest carbon sinks between 2018 and 2030.
- Clean hydrogen & sector coupling: Sector coupling policies focus primarily on e-mobility infrastructure and heat pump electrification, while dedicated hydrogen frameworks remain concentrated in Germany and Austria.

Pillar 2

- Energy efficiency in the building stock: All regional EU states maintain mandatory public building renovation targets (3% annual floor area under EED Article 5) and Nearly-Zero Energy Building (NZEB) standards. Planned building retrofits are projected to achieve 10–15% energy savings in Germany and Czechia, and over 20% in Hungary and Slovenia.
- Transport sector decarbonization: To meet the mandatory 14% RES-T target by 2030, EU DR countries rely on purchase subsidies, EV charging network expansion, and biofuel

blending mandates. WAM scenarios project transport GHG reductions ranging from -7% (Bulgaria) to -35% (Austria) relative to 2018.

Pillar 3

- Gas import dependency & infrastructure paradox: The Danube Region exhibits an average gas import dependency of 73% (nearing 100% in half of the countries). While regional gas demand is projected to drop by 3% (~6 bcm/year) by 2030, planned gas infrastructure investments total EUR 14.7 billion (97% in EU Member States), reflecting Russian supply diversification strategies.
- Transnational electricity market coupling: Market integration focuses on implementing day-ahead, intraday, and balancing market coupling across 4MMC countries (Czechia, Slovakia, Hungary, Romania), Bulgaria, and Serbia to address limited liquidity and high wholesale electricity prices.

NATIONAL ENERGY AND CLIMATE PLANS IN THE DANUBE REGION. Straight or winding? Policy Recommendations

- Document type: Strategic Regional Policy Recommendations
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary: The 2021 REKK report National Energy and Climate Plans in the Danube Region: Policy Recommendations provides targeted policy advice to address critical gaps in the energy and climate strategies of 14 Danube Region (DR) countries. It outlines strategic measures needed to unlock energy system transformation, align national policies with the EU's updated 55% greenhouse gas (GHG) reduction target for 2030, and achieve net-zero carbon neutrality by 2050.

Strategic policy directions and recommendations

Pillar 1

- Renewable electricity (RES-E) frameworks: Combine solar PV and wind deployment with battery storage to mitigate grid balancing pressures, and streamline authorisation and grid connection procedures.
- Heating and cooling (RES-H&C) diversification: Shift from biomass reliance toward heat pumps, geothermal energy, and low-temperature district heating systems. Increase the predictability of financial support and introduce operational support schemes to substitute fossil-fuel heating.
- Sustainable biomass and forest sequestration: Re-evaluate zero-carbon emission assumptions for biomass combustion and account for long carbon payback times. Shift

incentives toward high-efficiency heat generation rather than inefficient biomass-to-electricity, and establish policy instruments that value and reward forest carbon sequestration under LULUCF.

- Flexible sector coupling: Conduct country-specific cost-benefit assessments before regulating immature technologies. Implement flexible, tailor-made regulations for e-mobility, heat pump integration, and hydrogen without setting premature mandatory targets.

Pillar 2

- Energy Poverty: Replace general fossil fuel and energy price subsidies with targeted financial support for vulnerable, energy-poor households. Provide aid for replacing old, highly polluting household biomass stoves with modern, efficient alternatives.
- Building renovation & demand reduction: Expand large-scale building renovation programs, revise nearly-zero energy building (NZEB) standards, and implement Energy Efficiency Obligation Schemes alongside ESCO-type energy performance contracting.
- Transport decarbonization & demand management: Mandate e-charging infrastructure in dense residential areas and apartment blocks. Impose price caps on EV purchase subsidies, introduce emission-based vehicle taxes, and support advanced biofuels over first-generation blending mandates.
- Modal shift & traffic Reduction: Expand pedestrian and cycling infrastructure, promote remote work and digital administration.

Pillar 3

- Electricity market integration: Accelerate market reforms in non-EU Danube countries (unbundling, price deregulation, day-ahead/intraday market coupling) to integrate with European power exchanges. Expand transmission interconnectors to distribute intermittent RES-E across broader regional markets.
- Non-EU policy alignment & CBAM preparation: Assist non-EU accession countries in aligning with the EU ETS, establishing cap-and-trade systems (following Montenegro's floor-price model), and preparing heavy industries for the Carbon Border Adjustment Mechanism (CBAM).
- Cross-order transport cooperation: Execute the Transport Community Action Plan to eliminate physical and non-physical bottlenecks, streamline joint border operations, and establish modern, clean transit corridors across EU and non-EU Danube states

Harvesting Report on Post-2027 Interreg. Results of stakeholder, citizen and programme consultations

- Document type: Official European Commission Harvest & Consultation Report
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary: The European Commission's Harvesting Report on Post-2027 Interreg summarises the results of a comprehensive consultation process on the future of European Territorial Cooperation (ETC). Drawing from nearly 100 harvesting reports representing over 10,000 citizens, young people, and institutional stakeholders across 88 consultation processes, the report confirms that territorial cooperation provides essential added value by bridging legal/administrative systems, building cross-border trust, and delivering place-based solutions. The analysis provides detailed policy guidance to shape post-2027 Cohesion Policy legislative frameworks.

Key findings

Pillar 1

- Joint environmental & disaster management: Environmental protection, biodiversity conservation, and natural hazard/disaster risk management are among the highest citizen priorities for future cross-border cooperation. Shared ecosystems (rivers, forests, marine basins) require integrated management, as environmental risks transcend national borders.
- Clean tech & green solutions: Stakeholders emphasise utilising Interreg to pilot innovative clean technologies, green energy projects, circular economy models, and digital waste management monitoring.
- Climate resilience in border areas: Interreg projects strengthen territorial resilience against climate shocks (such as wildfires, floods, and droughts) by pooling cross-border emergency response capacity.

Pillar 2

- Addressing peripherality and the „education gap": Peripheral border areas face severe demographic decline, aging populations, and youth out-migration. Younger consultation participants highlighted barriers to the „right to stay", calling for expanded cross-border educational exchanges, vocational training, and local employment access.
- Shared cross-border public services: Border communities depend on cooperation to overcome service deficits in healthcare, emergency response, public transport, and education. Key demands include joint medical protocols, cross-border telemedicine, shared facilities, and integrated transport ticketing.

- Social cohesion & citizen engagement: Interreg plays a core role in promoting social inclusion, civic engagement, cultural exchange, and democratic values, particularly among marginalised groups and youth.

Pillar 3:

- High perception of border advantages: Between 55% and 94% of surveyed citizens and stakeholders agree that living in a border region offers advantages, notably cultural links, tourism, business connections, and wider labour market access.
- Persistent legal & administrative barriers: Diverging national tax/labour laws, different administrative cultures, linguistic barriers, and physical congestion continue to impede the European Single Market in border regions.
- Strategic value for EU enlargement & outermost regions: Interreg is vital for pre-accession candidate countries (IPA) and neighborhood regions (NEXT), preparing candidate states for EU integration by building institutional capacity and aligning standards.

2. Strategic policy directions and recommendations

Pillar 1

- Joint environmental & climate governance: Prioritise cross-border cooperation on shared ecosystems (rivers, forests, marine basins) to enhance resilience against climate risks, including wildfires, floods, and droughts.
- Clean tech & circular innovation: Allocate targeted funding to pilot clean energy technologies, green solutions, circular economy models, and digital waste management systems across border regions.

Pillar 2

- Youth empowerment & demographic retention: Counter youth out-migration in peripheral border regions by formalising youth decision-making, establishing youth councils, and incentivising project consortia that include youth organisations.
- Low-threshold funding for community services: Expand Small Project Funds (SPFs), micro-grants, and pre-financing to enable local municipalities, small NGOs, and healthcare/education providers to deliver shared public services.
- Bottom-up citizen engagement: Deploy place-based territorial instruments, such as Integrated Territorial Investments (ITI) and Community-Led Local Development (CLLD), to drive social inclusion and local citizen participation.

- Measuring qualitative & soft Impacts: Adapt indicator frameworks to capture qualitative outcomes, including trust-building, capacity development, and civic inclusion, rather than relying solely on rigid quantitative metrics.

Pillar 3

- Multi-level synergies & capitalisation: Bridge Interreg with mainstream Cohesion Policy (Investment for Jobs and Growth), national spatial planning, Macro-Regional Strategies, and centrally managed EU funds (Horizon Europe, LIFE).
- Systemic Capitalisation Mechanisms: Establish dedicated technical assistance tools and capitalisation grants to replicate, scale up, and sustain successful project results beyond individual funding cycles.

Reducing border obstacles between EU Member States and IPA beneficiary countries. Final Report

- Document type: Final Evaluation & Policy Report
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary: This study evaluates administrative, legal, and operational border obstacles hindering cross-border cooperation between EU Member States and Instrument for Pre-Accession Assistance (IPA) candidate countries, focusing specifically on external land borders in the Danube basin and Western Balkans (Croatia, Hungary, Romania, Bulgaria, Greece, Bosnia and Herzegovina, Serbia, Montenegro, North Macedonia, Albania, and Türkiye).

Pillar 1

- Cross-Border Flood Risks in Catchment Areas: Transboundary rivers require synchronised data exchange, early warning systems (EWS), and joint risk mapping because upstream actions directly impact downstream risks. Significant cross-border flood risks persist along the Croatia–Bosnia and Herzegovina, Croatia–Serbia, Hungary–Serbia, Romania–Serbia, Bulgaria–Greece–Türkiye borders.
- Administrative & financial obstacles to prevention: 13 major obstacles hinder transboundary flood management. While flood response cooperation is relatively strong, long-term flood prevention is hindered by poor coordination, lack of local authority involvement, fragmented institutional structures, and insufficient funding. For example, Croatia cannot raise embankments along the Sava River if Bosnia and Herzegovina lacks the funding to match the height on its side.
- Spatial planning & ecosystem degradation: The post-Yugoslav dismantling of spatial planning enforcement along the Danube and Drava floodplains (e.g., Kopački rit Nature

Park on the Croatia–Serbia border) resulted in informal settlements in retention zones, reversing historical flood mitigation efforts and degrading river ecosystems.

Pillar 2

- Socioeconomic impact of border delays: Protracted waiting times at Schengen BCPs (such as Horgoš–Röszke or Kakavia) cause direct financial losses for freight operators, increase travel costs, create environmental pollution from idling vehicles, and disrupt daily cross-border commuting for workers and medical travelers.
- Lack of cross-border public transport (CBPT): Border regions lack integrated public transit systems. For instance, between Timiş County (Romania) and Vojvodina (Serbia), the complete absence of cross-border bus or rail lines forces commuters, students, and tourists to rely on private vehicles or expensive taxis, leading to social exclusion, reduced access to healthcare and education, and economic stagnation.

Pillar 3

- Interreg IPA Programme Coverage: 9 Interreg IPA CBC programmes cover external EU–IPA land borders in the region. While 2021–2027 programmes extensively include climate adaptation (PO2) and transport connectivity (PO3), soft transport measures often remain underdeveloped in project applications.
- Legal asymmetries & pending agreements: Legislative differences severely restrict connectivity. Candidate countries display low levels of full EU transport acquis transposition (ranging from 2% to 26%, with Serbia highest at ~50%). Incomplete bilateral rail agreements (e.g., between Bulgaria and Serbia at Dimitrovgrad) and visa requirements further impede seamless transit.
- Top-down vs. bottom-up governance gaps: While transnational bodies like the International Commission for the Protection of the Danube River (ICPDR), the International Sava River Basin Commission (ISRBC), and the Transport Community provide strategic frameworks, they cannot address localised border-crossing or tributary bottlenecks without bottom-up regional engagement.

2. Strategic policy directions & recommendations

Pillar 1:

- Fast-track transboundary flood risk mapping: Expand national flood risk assessments across shared river borders, developing joint databases, hydrological modeling, and standardized early warning systems (EWS) (short-to-medium term).

- Execute multi-year watershed investments: Secure long-term funding for large-scale, multi-annual flood prevention programs, such as the World Bank-led *Sava and Drina* Rivers Corridors Integrated Development Programme (SDIP), and harmonise physical embankment standards (long term).

Pillar 2

- Establish cross-border public transport (CBPT) frameworks: Design, pilot, and secure legal permissions for scheduled cross-border bus and rail lines between neiughboring border regions (e.g., Romania–Serbia), incorporating integrated ticketing and synchronised timetables (medium-to-long term).
- Upgrade BCP local services & amenities: Invest in small-scale municipal infrastructure, sanitary amenities, and waiting-time predictability tools (such as the *BorderWatcher* application) at congested BCPs to protect travelers' quality of life (short term).
- Target capacity building for local authorities: Provide specialised training, peer-learning, and technical assistance to municipal staff in border regions to enable them to design, apply for, and manage joint EU-funded risk prevention and mobility projects (short term).

Pillar 3

- Deploy Digital Border Tools & SEED+: Expand the Systematic Electronic Exchange of Data (SEED+) system for pre-arrival customs information across all major EU–IPA border crossings, and implement National Access Points (NAPs) under the EU ITS Directive (short-to-medium term).
- Synchronise BCP Operations & CEFTA AEO Lanes: Conclude bilateral agreements for one-stop/coordinated border controls, extend BCP operating hours, and grant priority passage to Authorised Economic Operators (AEOs) under CEFTA (medium term).
- Utilise Interreg IPA & b-solutions tools: Utilise Interreg IPA CBC Policy Objectives 2 & 3, as well as Interreg Specific Objectives 1 (Cooperation Governance) and 2 (Safer Europe), to finance soft capacity building, and submit requests to the EU b-solutions initiative for expert legal resolutions to specific administrative barriers (short-to-medium term).

Overview of the EU Macro-Regional Strategies: Fostering smart communities and smart villages

- Document type: Comparative Policy Analysis & Horizon Europe Working Study.
- Thematic alignment: Primary alignment with Pillar 1 (Water scarcity), Pillar 2 (Right to Stay, and Pillar 3 (Macro-Regional Integration, Multi-Level Governance & Cross-MRS Synergies).

Executive summary: This study evaluates how the four European Union Macro-Regional Strategies (MRS), namely EUSBSR (Baltic Sea), EUSDR (Danube), EUSAIR (Adriatic-Ionian), and EUSALP (Alpine), integrate and promote the concepts of „Smart Villages" and „Smart Communities" (SV/SC). Designed to support Task 7.5 ("Macro-regional Networking") of the Horizon Europe *SMART ERA* project, the report investigates how MRS frameworks translate high-level EU priorities (such as the Green Deal, Digital Strategy, and the „Right to Stay") into place-based, user-centric rural development. Based on desk research, cross-macro-regional workshops, and an empirical survey of 19 Priority Area / Action Group / Pillar coordinators across the four strategies, the report evaluates SV/SC implementation across economic, social, environmental, governance, and mobility dimensions. The findings demonstrate high familiarity with SV/SC concepts (79%) and strong consensus for expanding their role (94.7%), but highlight persistent implementation barriers, including financial shortages (68.4%), governance deficits (57.9%), and fragmented inter-strategy coordination.

Key Findings

Pillar 1

- Environmental sustainability as a primary focus: Environmental sustainability emerged as the most prominent activity category among surveyed MRS coordinators (77.8%).
- Decentralizsd Clean Energy & Bioeconomy:
    - *EUSDR:* Priority Area 2 (Sustainable Energy) leads a Danube Strategy Flagship supporting citizen-driven Renewable Energy Communities.
- Climate adaptation & risk governance:
    - *EUSDR:* Priority Area 5 (Environmental Risks) coordinates climate adaptation and flood risk management (*DANURELY-WS*, Danube Flood Risk Management Plan).

Pillar 2

- Combating depopulation & securing the „Right to Stay": SV/SC concepts leverage digital tools, local culture, and community engagement to retain populations, combat brain drain, and restore vitality in rural and mountain regions.
- Community-centered public services & care:
    - *EUSDR:* Priority Area 9 (People & Skills) and PA10 (Governance) support digital care service delivery in depopulated rural areas (*D-CARE Labs*, *Caring Communities*).
- Rural mobility & accessibility:

- *EUSALP:* Action Group 5 addresses accessibility deficits in remote areas through the *Smart Alps* network; AG4 coordinates sustainable, modal-shift transport networks (*iMONITRAF!*).

Pillar 3

- High coordinator support vs. structural barriers:
  - 79% of surveyed coordinators are familiar with SV/SC concepts, and 63.2% have incorporated them into action plans.
  - 57.9% strongly agreed and 36.8% agreed that SV/SC should play a larger role in future macro-regional strategies (0% disagreed).
  - Key barriers include lack of funding (68.4%), insufficient governance (57.9%), poor physical/digital infrastructure (42.1%), and limited local awareness (42.1%).
- Frontrunner governance practices:
  - *EUSDR:* PA10 drives multi-level governance, civil society involvement (*Danube Participation Days*, *National Participation Days*), and EuroAccess funding platforms, while partnering in Horizon projects (*SmartERA*, *RurAll*).
- Institutionalised youth engagement: Youth Councils and youth participation frameworks are actively established across EUSALP to integrate youth perspectives into regional decision-making.

Strategic policy directions & recommendations

Pillar 1

- Expand local renewable energy communities: Scale up citizen-driven energy initiatives, solar PV, biomass, and geothermal district heating across rural regions by replicating the EUSDR PA2 Flagship model.
- Embed green digital solutions in risk governance: Deploy digital monitoring networks, real-time data platforms, and forest living labs to prepare smart villages for climate risks, floods, and water scarcity.
- Promote circular bioeconomy clusters: Support rural SMEs in adopting bio-based production, circular waste management, and sustainable agricultural practices by leveraging Smart Specialisation Strategies (S3).

Pillar 2

- Expand e-health, e-learning, and care services: Guarantee essential service access in remote areas by supporting mobile health units, digital care platforms (*Caring Communities*), and distance-learning infrastructure to uphold the „Right to Stay".
- Institutionalise youth participation: Mandate the inclusion of youth representatives in local decision-making bodies, Youth Councils, and co-creation „Transition Arenas" to foster local leadership and curb youth out-migration.
- Deploy smart, demand-responsive rural mobility: Implement flexible, shared transport systems (e-bikes, demand-responsive minibuses) to connect peripheral villages with core transport corridors and urban service hubs.

Pillar 3

- Explicitly Mainstream SV/SC terminology in post-2027 Action Plans: Embed formal Smart Village and Smart Community definitions, indicators, and dedicated objectives into revised MRS Action Plans and post-2027 Cohesion Policy frameworks.
- Formalise cross-macro-regional Cooperation platforms: Develop structured, inter-MRS working groups to pool expertise and launch joint calls in shared priority areas, including:
    - *Energy & Decentralised Transition:* EUSDR (PA2) + EUSALP (AG9) + EUSBSR (PA Energy) + EUSAIR (Pillar 2).
    - *Risk Governance:* EUSALP (AG8) + EUSBSR (PA Hazards) + EUSDR (PA5).
    - *Digitalisation & Connectivity:* EUSBSR (PA Innovation) + EUSALP (AG5 / CCP1) + EUSDR (PA10).

Think Piece on the need to step up cooperation for mastering future challenges in the Danube Region. Policy pointers for the post-2027 debate

- Document type: Strategic Policy Discussion
- Thematic alignment: EUSDR Post-2027 Cohesion Policy Reform, Macro-Regional Cooperation, EU Enlargement / Gradual Integration, and Multi-Level Territorial Transformations.

Executive summary: The Spatial Foresight Think Piece provides a strategic analysis of the major transformations facing the Danube Region and establishes the imperative for stepping up macro-regional cooperation in the post-2027 EU programming period. It examines five major structural shifts: industrial/economic competitiveness, climate change adaptation, evolving societal values, quality of governance, and EU enlargement (EU 27+). The report asserts that post-2027 cooperation must move beyond isolated, project-based funding toward long-term,

mission-oriented roadmaps that align Cohesion Policy, national budgets, and centrally managed EU instruments to secure regional resilience and cohesion.

Key findings

Pillar 1

- Systemic climate adaptation: Climate change impacts across the Danube basin require large-scale, systemic interventions rather than fragmented local projects. Costs and benefits of climate investments are increasingly separated by spatial and temporal lags.
- Evolving role of the Danube river: The Danube River is transitioning from a traditional transport corridor toward an essential ecological system focused on water retention, flood protection, and biodiversity preservation.
- Asymmetric ecosystem services: Environmental assets and ecosystem services are unevenly distributed across the region, creating a mismatch between areas bearing management costs and those receiving ecological benefits.

Pillar 2

- Double-lagging industrial risk: The Danube Region lags behind global and EU averages in high-tech and future-oriented industries. Less-developed subregions face a „double lagging behind challenge" in the green and digital transitions unless local SMEs are integrated into cross-border value chains.
- Demographic decline and brain drain: Accelerating population aging and youth out-migration threaten rural and peripheral viability. Reconciling the „freedom to move" with the „effective right to stay" requires cross-border labour, tax, and social security solutions.
- Capacity and trust gaps: Varying institutional quality across regional and municipal governments limits the absorption and long-term impact of public investments.

Pillar 3

- EUSDR as an enlargement laboratory: The EUSDR provides a crucial platform for gradual integration, allowing EU Member States and candidate countries (Western Balkans, Moldova, Ukraine) to collaborate on equal footing before formal accession.
- Limitations of pure project logic: Current cooperation is overly dependent on short-term Interreg project cycles, failing to build durable, multi-level policy processes or tap into non-Cohesion EU funding instruments.

Strategic policy directions and recommendations

Pillar 1

- Develop transnational transformative roadmaps: Transition from small-scale environmental projects to cross-sectoral, mission-oriented roadmaps for climate adaptation, water retention, and drought management across shared river basins.
- Reorient Danube River governance: Shift spatial and transport planning to reflect the Danube's dual function as an ecological system and a climate-impacted waterway, prioritising alternative sustainable transport corridors when seasonal water levels drop.

Pillar 2

- Protect the „Right to Stay" via flexible mobility: Establish pilot cross-border legal and administrative arrangements addressing taxation, remote working, and social security to allow citizens to stay in their home regions while working across borders or acting as digital nomads.
- Support SME-based spatially discontinuous clusters: Strengthen cross-border supplier networks and micro/additive manufacturing clusters to connect rural and lagging SMEs directly to advanced European industrial value chains.
- Mainstream administrative capacity building: Integrate systematic institutional capacity-building programs across all governance levels to ensure public authorities can effectively deliver public services and manage complex transformation projects.

Pillar 3

- Embed EUSDR priorities into Post-2027 MFF Architecture: Require Member States to anchor macro-regional priorities directly into post-2027 national/regional Cohesion Policy programs, Interreg, the proposed European Competitiveness Fund, and pre-accession instruments.
- Leverage EUSDR for gradual EU enlargement: Utilise EUSDR technical working groups as an operational testbed for candidate countries (Ukraine, Moldova, Western Balkans), engaging local authorities, civil society, and businesses in EU policy delivery prior to formal accession.
- Shift to long-term policy process financing: Establish funding frameworks that support multi-year policy coordination, multi-level governance, and strategic project preparation beyond rigid 3-year Interreg project timelines.

Trends in Higher Education in the Danube Region

- Document type: Official Regional Monitoring Report / Working Group Analysis
- Thematic alignment: Pillar 2 (Right to stay), Pillar 3 (Integration)

Executive summary: The report *Trends in Higher Education in the Danube Region* offers a comprehensive comparative evaluation of higher education and R&D landscapes across 14 Danube Region Strategy (EUSDR) countries. Prepared by EUSDR Priority Area 7 (Knowledge Society) in close collaboration with the Danube Rectors' Conference (DRC), the document evaluates national government spending on education and R&D (% of GDP), publication outputs, participation in EU Framework Programmes (Horizon Europe, ERC, MSCA), European University Alliances, and Erasmus+ mobility. It highlights the resilience of higher education institutions amidst post-pandemic recovery, geopolitical friction, and the war in Ukraine, while detailing persistent structural divides between Western/Central Member States and Eastern/non-EU candidate countries.

Key findings

Pillar 2

- Underinvestment in education and R&D:
    - *Government education spending:* Against an EU average of 4.8% of GDP, several Danube states allocate significantly lower public funding to education, including Romania (3.3%), Serbia (3.3%), Bosnia and Herzegovina (4.1%), and Croatia (4.1%). The highest allocations are observed in Moldova (6.3%), Ukraine (5.9%), and Slovenia (5.4%).
    - *R&D Expenditure:* Against an EU average of 2.27% of GDP, an extreme innovation divide exists between strong spenders, Austria (3.26%), Germany (3.14%), and Czechia (3.00%), and lagging non-EU states: Bosnia and Herzegovina (0.19%), Moldova (0.23%), Montenegro (0.36%), and Ukraine (0.38%).
- System competitiveness and university rankings:
    - According to the *Universitas 21* ranking (adjusted for GDP per capita), Serbia (#11) and Ukraine (#14) demonstrate high system efficiency relative to economic output.
    - Leading regional universities in the Academic Ranking of World Universities (ARWU 2024) include University of Munich (#43), University of Vienna (#101–150), Charles University Prague (#301–400), and University of Zagreb, University of Belgrade, and University of Ljubljana (#401–500).
- Mobility networks countering brain drain:
    - *CEEPUS & Erasmus+:* The Central European Exchange Program for University Studies (CEEPUS) facilitated over 82,000 academic mobilities between 1995 and 2023. Erasmus+ Key Action 1 mobility recovered rapidly post-lockdowns, with

Germany, Austria, Romania, and Czechia hosting and sending the largest student/staff volumes.

- *Erasmus+ Priority Alignment:* 2023 cooperation projects prioritized *Digital Transformation* (leading in Germany at 71.8% and Slovakia at 76.2%) and *Inclusion & Diversity* (leading in Austria at 79.5% and Germany at 66.4%).

- Academic solidarity with Ukraine:
  - Danube Region universities host displaced Ukrainian students and staff through fee waivers, local support grants, and MSCA4Ukraine fellowships (173 total fellows funded).
  - Ukraine's association with Horizon Europe and the inclusion of 30 Ukrainian universities as associated partners in European University Alliances by late 2024 reinforce academic integration.

Pillar 3

- European University Alliances & „Network Fatigue": Over 100 universities across 12 Danube Region countries participate in European University Alliances across three call generations (including 29 Danube Rectors' Conference member universities). However, staff and financial constraints have triggered „network fatigue", forcing smaller or resource-constrained universities to limit multi-network commitments.
- Horizon Europe and ERC Disparities:
  - *Horizon Europe Success Rates:* Most Danube states achieve strong proposal success rates (Austria 20.63%, Slovenia 20.28%, Moldova 20.12%, Czechia 19.62%, Slovakia 19.57%, Hungary 18.88%) relative to EU averages, indicating high underlying research quality hindered mainly by lower volume capacity.
  - *ERC Starting Grants (2007–2021):* Demonstrates an extreme concentration in Germany (882 grants) and Austria (166 grants). In contrast, Hungary earned 29, Czechia 26, Slovenia 6, Croatia 2, Romania 2, Serbia 2, Slovakia 1, Bulgaria 1, and zero in Bosnia and Herzegovina, Moldova, Montenegro, and Ukraine.
- Co-authorship and transnational research betworks:
  - Germany is the single most frequent collaborative publication partner for every country in the Danube Region.
  - Bilateral co-publication density is strongest among geographic neighbours, such as Czechia–Slovakia (22.76% of Slovak papers), Serbia–Bosnia and Herzegovina

(31.43% of Bosnian papers), and Romania–Moldova (26.03% of Moldovan papers).

- Governance via the Danube Rectors' Conference (DRC): The DRC serves as EUSDR PA7's primary academic governance partner, fostering institutional cooperation, organizing annual summer schools, supporting young scholars, and embedding Coalition for Advancing Research Assessment (CoARA) principles across the macro-region.

Regional and territorial trends in the Danube Region. Implications for cooperative approaches in European and national spatial and regional development policy

- Document type: Strategic Regional Economic & Spatial Development Study (*Regional and territorial trends in the Danube Region: Implications for cooperative approaches in European and national spatial and regional development policy*, December 2024).
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), and Pillar 3 (Integration).

Executive summary: The wiiw / Rosinak & Partner study provides a data-driven spatial and socio-economic analysis of the 14 countries comprising the Danube Region (spanning over 110 million residents, representing 24% of the EU27 population and €3 trillion or 18.7% of EU27 GDP in 2023). The report evaluates the long-term regional development trajectories, structural disparities, and convergence patterns across four distinct country groups: (1) Austria and Germany (Bavaria and Baden-Württemberg), (2) 2004 EU Enlargement states (Czechia, Hungary, Slovakia, Slovenia), (3) 2007/2013 EU Enlargement states (Bulgaria, Croatia, Romania), and (4) EU Accession/Candidate states (Bosnia and Herzegovina, Moldova, Montenegro, Serbia, and Western Ukraine). The analysis demonstrates that while cross-country economic convergence has progressed slowly, internal regional disparities, specifically a widening socio-economic divide between rapidly growing capital city regions and stagnating, depopulating rural hinterlands, remain a primary threat to regional cohesion. By combining empirical trends across macro-economics, trade, innovation, digital skills, energy, transport, and governance, the study establishes strategic policy directions to reshape Danube macro-regional cooperation within the post-2027 EU Cohesion Policy framework.

1. Key findings

Pillar 1

- Per capita GHG emissions & energy consumption: Per capita greenhouse gas (GHG) emissions vary significantly, from the highest values recorded in Czechia, Austria, Germany, and Slovenia down to under 6 Gigagrams in Moldova, Romania, and Croatia. Gross inland energy consumption per 1,000 inhabitants is highest in the most

industrialised states (Czechia at 3.7 toe, Austria at 3.6 toe, Germany at 3.4 toe) and lowest in Moldova (1.0 toe) and Montenegro (1.6 toe).

- Energy production & renewable disparities: In 2022, renewables and biofuels accounted for over 85% of domestic energy production in Austria and Moldova, whereas hydro, fossil, and nuclear power dominated in Ukraine, Bulgaria, Czechia, and Hungary. As a share of gross inland energy consumption (2020), renewables reached over 30% in Austria, Montenegro, Croatia, and Bosnia and Herzegovina, but remained under 15% in Hungary, Czechia, Slovakia, Bulgaria, and Ukraine.
- Freight and passenger transport modal split: Road transport continues to dominate freight transport, accounting for 77.8% of EU27 freight and up to 77.8% in Czechia and Germany. Rail freight handles a significant share in Austria (30.2%), Slovenia (32.7%), Slovakia (30.4%), and Romania (25.4%), while inland waterways move 20.5% of freight in Romania and 16.6% in Bulgaria. Between 2010 and 2022, freight modal split shifted further toward road transport across most countries. Passenger cars account for 76% to 98% of passenger transit across the region, with train usage highest in Austria (14.2%) and Germany (9.3%).
- Circular bioeconomy & waste management: Circular material use rates in 2022 were highest in Austria (13.8%), Germany (13.0%), Czechia (11.9%), and Slovenia (9.4%), compared to under 2% in Romania and under 5% in Bulgaria. Waste treatment methods reveal a stark divide: Austria, Germany, Czechia, Slovenia, and Slovakia recover or recycle the vast majority of municipal waste, whereas Romania, Montenegro, and Serbia dispose of over 90% of total waste via landfills.

Pillar 2

- Sub-national urban-rural disparities: In 2021, regional GDP per capita at Purchasing Power Standards (PPS) in urban capital regions (e.g., Prague at 180%+ of EU average, Bucharest, Budapest, Bratislava) vastly outperformed intermediate and rural regions. In EU-Enlargement 2007/2013 and Accession states, capital cities served as the primary drivers of GDP growth, while rural and peripheral regions stagnated.
- Depopulation and outward migration: Between 2010 and 2023, severe annual population loss occurred in Moldova (-2.8% per year; -31% total population), Bulgaria (-13%), Ukraine (-12%), Bosnia and Herzegovina (-11%), Croatia (-10%), Serbia (-9%), and Romania (-6%). Outward migration and low natural birth rates severely depopulated rural areas in Eastern and Balkan countries, whereas urban centers in Austria, Germany (Bavaria and Baden-Württemberg), Czechia, and capital regions experienced net population inflows.

- Labour market tightness vs. structural unemployment: Unemployment rates dropped sharply between 2011 and 2021 across Czechia (2.8%), Germany (3.1%), Hungary (4.1%), Slovenia (4.8%), and Austria (6.2%), creating severe labour and skills shortages. Conversely, high structural unemployment persisted in Bosnia and Herzegovina (17.5%), Montenegro (16.6%), and Serbia (11.1%). Poverty risk rates (2020) remained highest in Moldova (27.1%), Bulgaria (23.8%), Romania (23.4%), and Montenegro (22.6%).

Pillar 3

- Trade integration & dual economy: Exports as a share of GDP (2023) exceeded 80% in Slovakia (91.5%), Slovenia (83.3%), Hungary (81.3%), and Czechia (69.1%), driven by integration into medium-to-high-tech automotive and machinery value chains centered on Germany and Austria. Candidate states remain concentrated in medium-to-low-tech manufacturing, agriculture (Ukraine, Moldova), and raw material mining.
- Foreign Direct Investment (FDI) concentration: FDI stock as a share of GDP (2022) was highest in Montenegro (86.5%), Serbia (68.4%), Czechia (67.4%), and Bulgaria (62.6%). Austria and Germany account for 20% to 32% of total inward FDI stocks across Central and Eastern European Member States. Intra-regional FDI from 2004 Member States into Western Balkan candidate states is expanding.
- Regional R&D and patenting asymmetries: R&D expenditure in 2021 reached 3.3% of GDP in Austria, 3.1% in Germany, 3.0% in Czechia, and 2.1% in Slovenia, but remained below 1% in Slovakia, Bulgaria, Serbia, Romania, Montenegro, Moldova, and Bosnia and Herzegovina. Regional patent applications per million inhabitants (2019) exceeded 500 in Bavarian and Austrian NUTS-2 regions, but registered under 10 in eastern and candidate regions.

2. Strategic policy directions and recommendations

Pillar 1

- Shift freight transport from road to rail and waterways: Expand multimodal logistics hubs and digital traffic management tools along Danube TEN-T corridors to reverse the growth in road freight, shift heavy cargo to rail/inland waterways, and reduce transport emissions.
- Scale up underutilised renewable energy assets: Coordinate transnational investments to expand solar PV and onshore wind generation in high-potential southern and eastern regions (Bulgaria, Romania, Croatia, Western Balkans) while deploying smart grid storage to ensure power balancing.

- Modernize waste treatment in candidate countries: Transition non-EU candidate states away from landfilling by financing regional recycling infrastructure, energy recovery, and circular bioeconomy value chains in agriculture and forestry.

Pillar 2:

- Develop polycentric urban-rural partnerships: Address severe intra-national economic divides by strengthening secondary and medium-sized cities as local growth poles, investing in regional transport, and maintaining essential public services (healthcare, housing) in depopulating rural hinterlands.
- Expand digital infrastructure and e-government: Roll out high-speed broadband in peripheral regions to facilitate remote working and digital entrepreneurship, while deploying digital e-government platforms to improve public administration efficiency, transparency, and anti-corruption control.
- Mitigate brain drain through targeted skills initiatives: Establish cross-border educational partnerships and vocational training programs tailored to regional industrial needs, while scaling up social inclusion schemes for marginalised groups (such as Roma communities) to boost local labour force participation.

Pillar 3

- Transition to domestic innovation-led growth models: Support 2004/2007 EU Member States in moving beyond low-value assembly roles in foreign-owned value chains by establishing joint R&D centers, technology transfer hubs, and supplier clusters with Western European partners.
- Reshape post-2027 Cohesion Policy around macro-regional needs: Advocate for a post-2027 EU Cohesion Policy that maintains place-based regional development rather than purely top-down sectoral allocations, ensuring funds are tailored to the interlinked socio-economic challenges of the Danube basin.
- Establish EUSDR as a laboratory for EU enlargement: Utilise EUSDR governance structures as an operational testbed for candidate states (Bosnia and Herzegovina, Serbia, Montenegro, Moldova, Ukraine) to build institutional capacity, test joint cross-border projects, and achieve practical integration prior to formal EU accession.

Guidance Paper 2026 – Aligning the EU Strategy for the Danube Region with the EU Budget 2028-2034. Thematic alignment between the EUSDR Priority Area objectives and the EU Multiannual Financial Framework 2028-2034

- Document type: Official Strategic Guidance Paper and Policy Alignment Document
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), and Pillar 3 (Integration).

Executive summary: The EUSDR Guidance Paper 2026, prepared by the Bulgarian Presidency in cooperation with the Danube Strategy Point, establishes the strategic framework for aligning EUSDR Priority Area objectives with the EU Multiannual Financial Framework (MFF) 2028–2034. The European Commission's MFF proposal establishes a policy-driven, ~€2 trillion budget that consolidates 52 previous programmes into 16 streamlined instruments, centered on competitiveness, climate action, security, resilience, and enlargement. By introducing National and Regional Partnership Plans (NRPPs) to manage €865 billion in funding and maintaining Interreg at ~€10 billion, the post-2027 architecture links investments directly to national, regional, and macro-regional priorities. The Guidance Paper positions the EUSDR both as a mechanism for translating EU priorities into coordinated regional investments and as an „enlargement facility" driving policy convergence and capacity building across EU Member States and candidate countries.

Key findings

Pillar 1

- 35% climate & environment spending mandate: The MFF 2028–2034 enforces an explicit target allocating at least 35% of the total EU budget to climate and environmental objectives, governed by a uniform „do no significant harm" principle.
- Disaster preparedness & basin-wide adaptation: Environmental priorities under EUSDR Pillar 2 (Protecting the Environment) directly align with MFF instruments to fund nature-based solutions, early warning systems, and cross-border risk management for floods, droughts, and pollution events across the Danube catchment.
- Cross-border energy & transport Infrastructure: Funding under the Connecting Europe Facility (CEF) and the Interreg Danube Region Programme is targeted at resolving multimodal bottlenecks, promoting inland waterway navigation, upgrading intermodal ports, and expanding cross-border energy grids, including renewable hydrogen integration.

- Dual-use infrastructure & security resilience: Dual-use transport and energy networks are prioritised under CEF and crisis-response facilities to enhance military mobility, secure critical supply routes, and insulate energy grids against hybrid or physical disruptions.

Pillar 2

- European Competitiveness Fund Integration: EUSDR Pillar 3 (Building Prosperity) links directly to the newly created European Competitiveness Fund (€409 billion) and Horizon Europe to scale up innovation uptake, business incubators, cross-border value chains, health industries, and critical raw material supply lines.
- Human capital & skill alignment: The MFF prioritises vocational education and training (VET), basic skills, and digital/green competencies to counter labour market mismatches, brain drain, and demographic decline in peripheral regions.
- Youth governance & ownership: Intergenerational perspective and regional ownership are embedded into EUSDR post-2027 planning through the advisory roles of the Danube Youth Council (DYC) and the Danube Youth Organisation Network (DYON).
- Social inclusion & cultural platforms: Cohesion instruments and the new AgoraEU programme support civil society, media, local democratic participation, cultural heritage, and sustainable community-led tourism.

Pillar 3: Integration

- EUSDR as an accession & enlargement facility: The EUSDR bridges EU internal policies and enlargement objectives across candidate countries (Western Balkans, Moldova, Ukraine). Performance-based Reform Agendas under the €200 billion Global Europe instrument translate EUSDR strategic priorities into binding, funded reform milestones.
- Eastern border region resilience: Aligns macro-regional activities with the EU Communication on Eastern Border Regions, directing support toward civil preparedness, economic diversification, and border management in Danube sub-regions bordering Ukraine, Moldova, and the Black Sea basin.

Annex: EUSDR Priority Area thematic contributions to the EUSDR Alignment Process. List of strategic topics identified by the EUSDR Priority Areas to support the alignment with the EU Budget 2028-2034

- Document type: Official Strategic Guidance Paper and Policy Alignment Document
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), and Pillar 3 (Integration).

Executive summary: This document serves as Annex to the "Guidance Paper 2026: Aligning EUSDR with the EU Budget 2028-2034". Its contents are based on a survey conducted by the Bulgarian EUSDR Presidency in cooperation with the Danube Strategy Point (DSP) in April 2026. Priority Area Coordinators (PACs), in consultation with their Steering Groups (SGs), were invited to list up to three strategic topics that can support the alignment of EUSDR priorities with the EU Budget 2028-2034 and to reflect the future-oriented strategic topics within their Priority Area, taking into account future EU policy priorities and macro-regional added value.

Pillar 1

- Prevention and reduction of water pollution and protection of water resources: Contribute to preventing and reducing water pollution from point and diffuse sources in the Danube Region, especially related to organic substances, nutrients, hazardous and emerging substances, inter alia by enhancing wastewater treatment and by promoting best management practices; Contribute to protecting water resources and safeguarding drinking water supply; Enhance conservation measures of Danube migratory fish species; Enhance climate change adaptation measures related to water quality.
- Integrated flood risk management: This thematic contribution focuses on integrated flood risk management in the Danube Region, with particular emphasis on flood prevention and protection measures, including flash flood risk management, as well as early warning and forecasting systems. Special attention is given to improving hydrometeorological monitoring systems (DANUBE HIS: ICPDR Danube Hydrometeorological System), enhancing forecasting capacities (including flash flood prediction), and strengthening basin-wide coordination of flood risk management. A key element is the integration of nature-based solutions (NbS) and natural water retention measures (NWRM), which contribute to reducing flood peaks, increasing water retention capacity and enhancing climate resilience. The approach is aligned with river basin-level planning. Flood risks in the Danube Region are inherently transboundary, as river systems and hydrological processes extend across national borders. Effective flood risk management therefore requires coordinated action at basin level, including shared hydrological data, harmonised forecasting systems and joint early warning mechanisms.
- Strengthened disaster risk management: This thematic contribution focuses on strengthening disaster risk management (DRM) capacities across the Danube Region through a coordinated multi-hazard approach. It addresses floods, droughts, wildfires, industrial accidents and other climate-induced hazards, with particular attention to cascading and compound events. A key priority is strengthening preparedness and response capacities at all governance levels, including national authorities, regional administrations and volunteer-based emergency response organisations. Special emphasis is placed on strengthening the operational capacity, training, interoperability

and resource availability of volunteer firefighters, civil protection units and local communities. The contribution promotes joint training and exercises, interoperability of systems, improved coordination between water and disaster management actors,

- and the use of digital and innovative solutions. The objective is to enhance resilience, operational readiness and coordinated response across the Danube Region. Transnational need of the identified thematic area: Disaster risks in the Danube Region are transboundary and increasingly interconnected. Effective DRM requires interoperable systems, joint training, harmonised procedures and coordinated response mechanisms. Macro-regional cooperation enables inclusion of non-EU countries, improves coordination and ensures efficient use of resources.
- Proactive drought management: This thematic contribution focuses on proactive drought management in the Danube Region, addressing increasing water scarcity and imbalance driven by climate change. Key elements include drought monitoring and early warning systems, harmonised drought indicators, and the development of drought risk management plans at river basin level. Special emphasis is placed on nature-based solutions (NbS) and natural water retention measures (NWRM), supporting improved water retention, soil moisture conservation and ecosystem resilience. The contribution promotes the integration of water quantity management into river basin planning and supports climate-resilient agricultural practices. The objective isto shift from reactive crisis management towards preventive and adaptive drought management at macro-regional scale. Transnational need of the identified thematic area: Drought is a large-scale phenomenon affecting multiple countries simultaneously across the Danube Region. Effective management requires coordinated monitoring, harmonised indicators, data sharing and aligned national approaches. Competing water usesfurther underline the need for coordinated basin-level planning. Macro-regional cooperation enables joint methodologies, knowledge exchange and alignment with EU climate adaptation policies.
- Integration of wetlands into multifunctional agricultural landscapes: Instead of traditional land drainage, the focus shifts to smart water management through the restoration of small-scale wetlands and buffer zones within farmland. This approach improves soil fertility, supports pollinators, and provides natural irrigation reservoirs, making agriculture in the Danube region more resilient to extreme heat and water scarcity. This include transboundary biodiversity protection and urban wetland management. The thematic areas of resilient, competitive, and sustainable EU agriculture require transnational or macro-regional cooperation, as climate change, pollution, and the use of natural resource, such as water, soil, and biodiversity, are cross-border challenges that cannot be effectively addressed by individual countries alone. Agricultural practices in one country can significantly impact shared river basins, ecosystems, and air quality in neighbouring states, making coordinated action essential. A macro-regional approach

enables the exchange of best practices in agri-environmental measures and ensures the collective protection of transboundary aquifers from agricultural runoff. It also provides a stronger foundation for promoting chemical-free farming and energy-efficient cultivation methods. Establishing a unified macro-regional framework for "Wetland Cities" helps create shared standards for sustainable urban planning, encourages knowledge exchange between municipalities, and strengthens ecological corridors that connect cities across national borders.

- Nature-based solutions to increase climate resilience of waterway infrastructure on the Danube and its navigable tributaries: The topic requires transnational and macro-regional cooperation because the Danube and its navigable tributaries form a single, interconnected river basin, where hydrological, ecological, and morphological processes extend across national borders. Effective climate resilience measures therefore cannot be planned or implemented in isolation but must follow an integrated river basin management approach that considers the entire system. Cooperation is essential to align waterway management, flood protection, ecological objectives, and navigation needs across countries.
- Cultural heritage and landscapes as territorial resilience assets: Climate risks (floods, droughts, coastal erosion, wildfires) are transboundary in nature and affect cultural and natural heritage across multiple macro-regions. Only coordinated macro-regional action allows: shared risk mapping and monitoring systems, harmonised resilience standards, efficient crisis response mechanisms, prevention of asymmetric recovery across regions.
- Energy security and resilience: Energy security and resilience have emerged as critical pillars of the European Union's strategic agenda, particularly in light of recent geopolitical disruptions, climate challenges, and structural dependencies within the energy system. For the Danube Region – characterised by its geopolitical diversity, energy interdependencies, and varying levels of economic development – these issues are especially acute. First, the Danube Region remains highly exposed to external energy dependencies, particularly in natural gas and oil imports. Several countries in the Region have historically relied on a limited number of external suppliers, making them vulnerable to supply disruptions, price volatility, and geopolitical pressure. Strengthening diversification of energy sources (with a special attention on domestic and renewable resources, as well as new alternative fuels, e.g. green hydrogen), routes, and suppliers is therefore essential. The MFF should support cross-border infrastructure projects, including interconnectors, projects that aim to enhance the overall development of new clean energy technologies, e.g., the development of the hydrogen economy in the Region to enhance regional energy autonomy and solidarity. The Region facessignificant disparities in energy infrastructure and system flexibility. While some countries have advanced energy markets and renewable integration capacities, others lag behind due

to outdated infrastructure and limited investment capacity. Transnational cooperation is therefore essential to ensure system stability, optimise capacity use, and prevent bottlenecks. Joint development of interconnectors, synchronised grid management, and shared emergency response mechanisms significantly enhance collective resilience. Diversification of energy sources and routes is more effective when pursued at a regionalscale. Individual countries – especially smaller or landlocked ones – often lack the capacity or geographic advantage to secure diverse energy supplies independently. Through macro-regional cooperation, countries can pool resources, negotiate collectively, and access alternative supply corridors located in neighbouring states. This reduces dependency on single suppliers and strengthens bargaining power. Moreover, integrating higher shares of renewables requires flexible and interconnected systems, which can only be achieved through joint investments in grids, storage, and digitalisation.

Pillar 2

- Sustainable tourism, cultural routes, cultural heritage, blue economy and youth as interconnected territorial development pillars: Sustainable tourism, cultural routes, cultural heritage, blue economy and youth are interconnected territorial development pillars that function as place-based economic multipliers across the Danube Region and neighbouring regions. Cultural routes and cultural and natural heritage are positioned as strategic development infrastructure, enabling territorial connectivity, SME growth, skills development, and balanced regional development. When taking local needs into consideration, they have the potential to directly contribute to reducing territorial disparities between urban and rural areas, core and peripheral regions, and EU and enlargement countries. Thematic intervention focuses on integrated macro-regional development corridors combining sustainable tourism and blue economy systems, linking inland (Danube), coastal (Black Sea, Adriatic-Ionian) and mountain regions.
- Youth, skills and cultural and creative sectors (CCS): are positioned as structural drivers of inclusive territorial development and convergence. They enable innovation, labour market integration and demographic resilience across the Danube Region and neighbouring regions. The intervention focuses on youth mobility systems,skills development for tourism/CCS/blue economy, and integration of enlargement countries into EU value chains. It is required to: ensure convergence, reduce territorial labour market disparities, integrate enlargement countries into EU systems, strengthen innovation ecosystems across regions.

Pillar 3

- Smart territorial development: Smart Territorial Development is territorial development (e.g. urban, rural, urban-rural) that reconciles social and technological/digital innovation and participatory governance for place-based solutions that tackle challenges in

functional regions. Transnational need of the identified thematic area: Smart territorial development addresses various challenges in functional regions. Transnational or macro-regional cooperation can address dynamics of functional regions that go beyond borders. Furthermore, the overlapping of some macro-regions requires cross-macro-regional cooperation for better policy coordination across strategies and regions. In addition, transnational and macro-regional cooperation supports mutual learning and capacity building to enhance smart rural development.

- Capacity building for civic participation/multi-level governance: Apart from the aspect of mutual learning and capacity building across borders, transnational or macro-regional cooperation supports civic participation in functional areas across borders and contributes to European public participation. The mobilisation of stakeholders from all sectors and levels have been identified as a crucial facto rfor successful Enlargement.
- Enhanced cross-border mobility and corridor performance: Transport corridors function as cross-border network systems. Macro-regional coordination is required to reduce fragmentation, improve investment alignment and strengthen corridor continuity that cannot be achieved through national planning alone.
- Resilient and secure transport connectivity: Transport disruptions, border congestion and crisis events have transnational impacts on supply chains and economic stability. Macro-regional cooperation enables interoperable governance approaches, coordinated emergency response protocols and improved operational continuity of strategic transport corridors.

EU Strategy for the Danube Region (EUSDR) Action Plan[18]

- Document type: official Commission Staff Working Document issued by the European Commission
- Thematic alignment: Pillar 1 (Water scarcity), Pillar 2 (Right to stay), and Pillar 3 (Integration).

Executive summary: The EUSDR Action Plan establishes an integrated framework for transnational cooperation across the Danube River basin. The 2020 revision concentrates and updates the original 2010 Action Plan, reducing the total number of actions by 40% (from 137 to 85) while embedding new priorities such as Artificial Intelligence, climate adaptation, and smart specialisation. The plan provides a strategic framework to „embed" macro-regional priorities into MFF post-2020 funding instruments, including Cohesion Policy funds (ERDF, ESF+, Cohesion Fund), pre-accession funds (IPA III), neighbourhood funds (NDICI), Connecting Europe Facility (CEF), Horizon Europe, and LIFE.

[18] https://danube-region.eu/wp-content/uploads/2020/04/EUSDR-ACTION-PLAN-SWD202059-final-1.pdf

Document type: Official Commission Staff Working Document (*EU Strategy for the Danube Region Action Plan*, SWD(2020) 59 final, replacing SEC(2010) 1489 final, Brussels, April 6, 2020).

Executive summary: The EUSDR Action Plan establishes an integrated framework for transnational cooperation across the Danube River basin, connecting 115 million inhabitants across 14 countries: 9 EU Member States (Germany [Bavaria and Baden-Württemberg], Austria, Czechia, Slovakia, Hungary, Slovenia, Croatia, Romania, Bulgaria), 3 Candidate Countries (Serbia, Montenegro, Bosnia and Herzegovina), and 2 Neighbourhood Countries (Moldova, Ukraine).

The 2020 revision concentrates and updates the original 2010 Action Plan, reducing the total number of actions by 40% (from 137 to 85) while embedding new priorities such as Artificial Intelligence, climate adaptation, and smart specialisation. The plan provides a strategic framework to "embed" macro-regional priorities into EU MFF funding instruments—including Cohesion Policy funds (ERDF, ESF+, Cohesion Fund), pre-accession funds (IPA III), neighbourhood funds (NDICI), Connecting Europe Facility (CEF), Horizon Europe, and LIFE.

1. Key findings

Pillar 1

- Water scarcity & agricultural management (PA 4): Action 3 targets diffuse agricultural pollution and decouples agricultural development from water scarcity through smart irrigation, water reuse, nutrient retention, and Nitrates Directive compliance. Action 4 protects drinking water resources „from source to tap", establishing water-saving cultures and safeguard zones.
- Wastewater infrastructure in rural settlements (PA 4): Action 2 targets major investments in urban wastewater treatment and promotes alternative collection and treatment of wastewater in small rural settlements.
- Climate adaptation, droughts & flood risks (PA 4 & PA 5): Action 6 (PA 4) promotes climate adaptation, controlling water abstraction, groundwater overexploitation, and natural water retention measures (NWRMs). PA 5 Action 1 implements the Danube Flood Risk Management Plan (DFRMP) to reduce flood, flash flood, and drought hazards. Action 2 enhances regional forecasting (DanubeHIS, EFAS, DriDanube). Action 5 addresses local climate change impacts and small natural water retention measures.
- Biodiversity, green infrastructure & air/soil quality (PA 6): Action 1 harmonises protected area management on boundary rivers. Action 3 protects flagship species (Danube sturgeons). Action 5 anchors Green Infrastructure (GI) networks into spatial and transport planning. Action 7 maintains soil ecosystem services and harmonised soil mapping. Action 10 restores wetlands and the Danube Delta.

Pillar 2

- Addressing brain drain & demographic outmigration (PA 7 & PA 9): PA 9 addresses demographic ageing, rural-to-urban and East-to-West worker outmigration, and brain drain caused by substantial regional income disparities. PA 7 Action 4 explicitly aims to revert brain drain and foster brain circulation by making the region attractive to young and female researchers.
- Active labour policies & skills development (PA 9): Action 1 intensifies labour market cooperation, tackling youth and long-term unemployment and school-to-work transitions. Action 2 addresses workplace digitalisation. Actions 5 & 6 modernise Vocational Education and Training (VET), work-based learning, and Centres of Vocational Excellence embedded in local innovation ecosystems to align skills with rural and regional business needs. Action 7 supports learning mobility (Erasmus+) and lifelong learning.
- Vulnerable groups, NEETs & inclusion (PA 9): Action 3 integrates vulnerable groups and NEETs (young people not in education, employment, or training) into quality employment.
- Rural Enterprises, SMEs (PA 8): Action 3 enhances collaboration between cluster initiatives and regional innovation strategies, with an explicit focus on rural areas.
- Rural ecotourism & local jobs (PA 3): Actions 1, 3, and 6 promote sustainable ecotourism, cycling trails (EuroVelo), cultural routes, and quality job creation in rural, local, and less-visited areas.

Pillar 3

- Border regions & cross-border public services (PA 10): Action 1 digitalises public services (e-Government). Action 2 explicitly targets administrative cooperation in border regions, eliminating legal/administrative obstacles, and establishing cross-border public services (CBPS).
- Functional Urban Areas & secondary transport links (PA 1b & PA 10): PA 1b Action 4 focuses on sustainable metropolitan transport systems, e-mobility market deployment, and urban air quality alignment in functional urban areas. Action 5 focuses on secondary and tertiary road infrastructure, upgrading border-crossing points, and connecting remote/rural areas to the core TEN-T network. PA 10 Action 8 enhances municipal capacities for spatial planning, functional regions, and local development.
- Enlargement & integration of Western Balkans, Moldova & Ukraine (PA 10 & PA 11): Joins EU Member States with Western Balkan candidate states (Serbia, Montenegro, Bosnia and Herzegovina) and Eastern partner states (Moldova, Ukraine). Aligns macro-regional

actions with the EU Strategy for the Western Balkans, Transport Community Treaty, and MAP REA. PA 1b Actions 1 & 2 complete TEN-T core networks and extend Rail Freight Corridors into candidate and neighbouring countries.

2. Strategic policy directions & recommendations

Pillar 1

- Decouple agriculture from water scarcity: Mandate smart irrigation, water reuse to protect surface/groundwater quality and manage water scarcity.
- Implement basin-wide flood & climate adaptation plans: Execute the Danube Flood Risk Management Plan (DFRMP) across national and sub-basin borders, expanding early warning networks (DanubeHIS, DriDanube) and Natural Water Retention Measures (NWRMs).

Pillar 2

- Establish rural innovation & vocational hubs: Deploy Digital Innovation Hubs (DIHs) in rural areas and establish Centres of Vocational Excellence to train local workforces, supporting SME competitiveness and remote job creation.
- Counter brain drain via brain circulation: Develop targeted mobility, research, and Smart Specialisation (S3) frameworks that retain young talent, foster brain circulation, and encourage female entrepreneurship in peripheral areas.
- Integrate vulnerable groups & NEETs: Scale up active labour market policies, work-based VET, and social inclusion schemes targeting NEETs, long-term unemployed, and Roma communities.

Pillar 3

- Institutionalise cross-border public services (CBPS): Assist border municipalities in eliminating legal/administrative barriers to establish joint cross-border public services, secondary transport links, and shared spatial planning in functional areas.

Polizeiliche Kriminalstatistik 2025 - Ausgewählte Zahlen im Überblick

- Document type: Official German Federal Police crime statistics report
- Thematic alignment: Pillar 3 (Integration)

Executive summary: The *Polizeiliche Kriminalstatistik (PKS) 2025* provides the official national overview of recorded offenses, clearance rates, suspects, and victim statistics in Germany for the year 2025. The report places significant statistical emphasis on border management, border traffic control, and cross-border crime dynamics. Intensified physical border checks and changing migration flows led to a 28.6% drop in residence law violations (*ausländerrechtliche*

Verstöße), including a 27.5% drop in unauthorised entries (*unerlaubte Einreise*). Concurrently, offenses committed from abroad or unknown overseas locations targeting victims inside Germany (*PKS-Ausland*) rose to 661,238 cases (+3.0%). With citizens from Danube Region partner states representing a major share of non-German suspects and crime victims in Germany, the report demonstrates that effective internal security relies directly on functional border controls, streamlined border traffic management, and deep bilateral police alliances across the Danube macro-region.

1. Key findings

- High victimisation among Danube Region nationals: Out of 1 328 567 total recorded crime victims in Germany (58.0% male, 42.0% female), citizens from Danube Region countries represent a major proportion of all non-German victims: Ukraine: 26 165 victims (7.5% of non-German victims), Romania: 18,021 victims (5.2% of non-German victims), Bulgaria: 12 052 victims (3.5% of non-German victims), Serbia: 8 200 victims (2.4% of non-German victims).
- Border controls, traffic & residence law enforcement: total residence law violations (*ausländerrechtliche Verstöße*) fell by 28.6% from 287 339 cases (2024) to 205 211 cases (2025). Unauthorised border entries (*unerlaubte Einreise*) dropped by 27.5% from 90 222 to 65 453 cases. Unauthorised stays (*unerlaubter Aufenthalt*) dropped by 31.3% from 177 275 to 121 767 cases. The report attributes these reductions directly to intensified physical border control checks, enhanced border traffic monitoring, and lower global migration volume.
- Foreign-origin crime (*PKS-Ausland*): Recorded offenses executed from abroad where the criminal impact occurred inside Germany reached 661 238 cases (+3.0% vs. 642 210 in 2024). *PKS-Ausland* is heavily concentrated in cross-border fraud (549 385 cases, accounting for 83.1% of all foreign-origin offenses) and cross-border cybercrime (207 888 cases, 31.4% of foreign-origin offenses).
- Suspect breakdown for Danube Region countries: Out of 2 054 855 total suspects, 1 231 246 (59.9%) were German citizens and 823 609 (40.1%, -9.8% vs. 2024) were non-German citizens. Suspects classified as refugees or unauthorized residents (*Zuwanderer*) dropped 22.5% to 297 401. Citizens from Danube Region partner states account for a significant share of non-German suspects investigated by German law enforcement. Leading countries are Romania (65 556 suspects, 8.0% of non-German suspects), Ukraine (56 909 suspects, 6.9% of non-German suspects), Bulgaria (27 438 suspects, 3.3% of non-German suspects), Serbia (21 264 suspects, 2.6% of non-German suspects).

2. Strategic policy directions & recommendations

Pillar 3

- Modernise border infrastructure & traffic processing: Infrastructure at border crossing points (BCPs) must be upgraded with automated digital inspection tools and synchronised customs checks to maintain smooth commercial border traffic while preventing illegal entries.
- Formalise joint police alliances with Danube states: Deepen operational cooperation between the German Federal Police (*Bundespolizei*), state police forces, and interior ministries in Romania, Bulgaria, Serbia, Ukraine, Austria, and Croatia through Joint Investigation Teams (JITs) to combat mobile burglary rings, human trafficking, and vehicle theft.
- Strengthen targeted protection for migrant victims: Expand specialised, multi-lingual social support and legal counseling for vulnerable non-German crime victims, particularly Ukrainian refugees and Romanian/Bulgarian workers in Germany.
- Standardise national & cross-border data catalogs: Establish uniform recording standards across federal state police forces for weapon-related violence (*Messerangriffe*) and online fraud formats to ensure reliable, harmonised data for European security planning.

EU-SOCTA 2025: The Changing DNA of Serious and Organised Crime

- Document type: Official Strategic Threat Assessment / Executive Summary
- Thematic alignment: Pillar 3 (Integration)

Executive summary: The Europol EU-SOCTA 2025 report outlines a fundamental shift in the „blueprint" of serious and organised crime across the European Union. Organised crime is becoming increasingly destabilising, heavily nurtured online, and accelerated by artificial intelligence (AI), blockchain, and new technologies. Criminal networks operate unhindered by borders, infiltrating legal business structures, exploiting parallel digital financial systems, and collaborating with state-aligned hybrid threat actors. For border regions and the Danube macro-region these evolving dynamics create severe security, economic, and societal challenges, particularly regarding weapons flows, migrant smuggling, waste trafficking, and online youth recruitment.

1. Key findings

Pillar 1:

- Illicit waste trafficking in ecosystems: Illicit waste trafficking is a financially driven key threat that deeply intersects with the legitimate waste management sector. Organised networks employ industry experts to illegally transport, dump, or incinerate hazardous waste, causing long-term degradation to natural environments, water bodies, and public health along cross-border trade corridors.

- Exploitation of logistics infrastructure: Criminal networks systematically misuse transport logistics, ports, and river/road transport networks to move illicit waste and dangerous goods, undermining environmental regulations

Pillar 2

- Migrant smuggling & digital adaptation: Criminal networks charge extortionate fees to smuggle irregular migrants across and within borders, exhibiting total disregard for human life. These networks rely heavily on online platforms and messaging apps for recruitment, marketing, route planning, and money transfers.
- Criminal exploitation of youth: Organized crime syndicates systematically recruit and exploit young perpetrators for high-risk operational tasks and violence, shielding top-level network leaders from identification while severely damaging local social cohesion in vulnerable communities.
- Escalating violence in public spaces: Organised crime-related violence is intensifying and spilling over into public spaces, driven by lucrative, highly competitive drug markets and coordinated remotely across borders via encrypted channels.

Pillar 3

- Firearms trafficking from neighborhood conflict zones: Illicit weapons flows are heavily shaped by the availability of arms in war and post-crisis zones in the EU neighbourhood, feeding regional drug violence and security risks across border transit corridors.
- Hybrid threats & border destabilisation: Criminal networks increasingly collaborate with state-aligned hybrid threat actors, serving as proxies that blend criminal profit with geopolitical destabilisation along EU external borders.
- Instrumentalised migration: State and non-state actors actively instrumentalise migration flows to exert geopolitical pressure, creating direct operational opportunities for organised migrant smuggling networks.
- Post-war security & border landscape shifts: The Russian war of aggression against Ukraine has altered crime patterns, and any future post-war situation will trigger significant structural shifts in criminal operations and trafficking routes across Danube and Eastern EU border states.

2. Strategic policy directions & recommendations

Pillar 1:

- Establish joint cross-border inspection teams between EU Member States and candidate countries to audit commercial waste disposal and stop illegal waste trafficking along Danube land and waterway routes.

Pillar 2

- Deploy targeted digital social work and early-intervention campaigns in economically vulnerable border areas to prevent criminal networks from recruiting youth online.
- Disrupt online marketing, recruitment, and digital payment systems used by migrant smuggling syndicates along the Western Balkan and Eastern transit routes.

Pillar 3

- Deepen operational intelligence sharing between EU Member States, Western Balkan candidate countries, and Eastern partners through Europol, Eurojust, and regional law enforcement hubs.
- Establish multi-agency border monitoring mechanisms to detect and neutralise instances where state-aligned hybrid actors instrumentalise migration or utilise criminal proxies.
- Develop comprehensive cross-border firearms tracking and interdiction frameworks to prevent the leakage of weapons from neighborhood conflict zones into regional criminal markets.