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EUROPEAN RESEARCH PROJECT //

Core-IB

Collecting and analysing data for the post-27 INTERREG

Final Report

March 2026

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1 Project background

1.1 Starting points

The ESPON **Core-IB Collecting and analysing data for the post-2027 Interreg** project has developed territorial analyses for the 48 internal cross-border programmes – delivered in the format of 48 highly-visual border profiles (each consisting of approximately 90 pages). These border profiles are intended to support the upcoming steps in the Interreg post-2027 programming process. Their main purpose is to provide **a EU-wide integrated and comparable overview** of the programme areas, offering the access to recent harmonised data, at high geographical resolution (NUTS3 level or finer – for some specific cases). Meanwhile the project is built using the most **recent existing sources, available at European scale**, Member States may hold **additional or more detailed data, which can further enrich or contextualise the findings beyond the Core-IB project**. This could include a) regional, fine-scale data and b) insights from political processes related to prioritisation and objective setting.

Assessing European border regions from a data perspective is a challenging endeavour (Berzi et al. 2026). European border regions are among the most diverse territorial categories within the European Union. They cover a wide spectrum of geographical settings, ranging from metropolitan and highly accessible areas to peripheral and remote ones. Border types vary and may include mountain ranges, coastlines, rivers, and plains. Even along the same national border, economic and social disparities can be substantial, e.g., due to cross-border differentials or varying institutional proximity (Jakubowski 2020, Paul et al. 2025). Labour markets and mobility patterns may also differ significantly (Chilla & Heugel 2019, Järv et al. 2022). At the same time, political cultures, administrative systems, and governance arrangements often diverge on either side of a border (Crossey & Weber 2023, Turner et al. 2022). These contrasts result in complex multi-level governance settings, typically characterised by selective or asymmetric cross-border cooperation structures (Chilla et al. 2012).

The 9th Cohesion Report highlights the structural importance of border regions for the European Union (European Commission 2024). They account for more than 40% of the EU's territory, generate around 30% of its GDP, and are home to roughly 150 million people, almost one third of the EU population. Cross-border mobility is a defining feature of these territories and of European integration more broadly: nearly 2 million people in the Schengen area live in one country but work in another, and an estimated 3.5 million people cross one of the EU's 38 internal borders every day.

From both scientific and policy perspectives, border regions are often referred to as "laboratories of European integration" (Bertram et al. 2023a). Their diversity makes them testing grounds for cooperation, governance innovation, and policy experimentation (Chilla & Lambracht 2022, Coletti et al. 2024). Nonetheless, the functions and meanings of borders remain multifaceted. Literature suggests that borders may act as bridges, walls, tunnels, threats or resources (Topaloglou et al. 2005, Sohn 2014, van Asseldonk & van Houtum 2025). A border can therefore symbolise complex historical and contemporary power relations, as well as the evolving legitimacy of the political systems it separates (Anderson & O'Dowd 1999, O'Dowd 2002, Reitel 2007, Kolossov & Scott 2013).

Many European border regions continue to experience structural disadvantages and untapped opportunities. Challenges such as divergent spatial planning systems, language barriers, and infrastructural constraints persist (Pásztó et al. 2019, Bertram et al. 2023b). Moreover, recent crises have demonstrated the vulnerability of these areas to external shocks (Hippe et al. 2023). For example, the COVID-19 pandemic exposed the fragility of cross-border mobility and cooperation when internal borders were temporarily reinstated (Guillermo Ramírez 2020, Böhm 2021, Peyrony et al. 2021, Chilla et al. 2022, Weber 2022, Böhm et al. 2023). Similarly, discrepancies in governance systems and legal frameworks continue to complicate cross-border disaster prevention and coordinated crisis response (Evrard & Chilla 2021, Medeiros et al. 2021; Novotný 2021). These developments underline the need for continued attention to cross-border

governance, resilience, and territorial cohesion (Hippe 2024). Removing border-related obstacles remains essential to improving economic prosperity, social interaction, and political innovation (Hippe et al. 2022, Wallin Aagesen et al. 2022). A comprehensive understanding of cross-border interdependencies is therefore crucial for designing effective territorial cooperation policies.

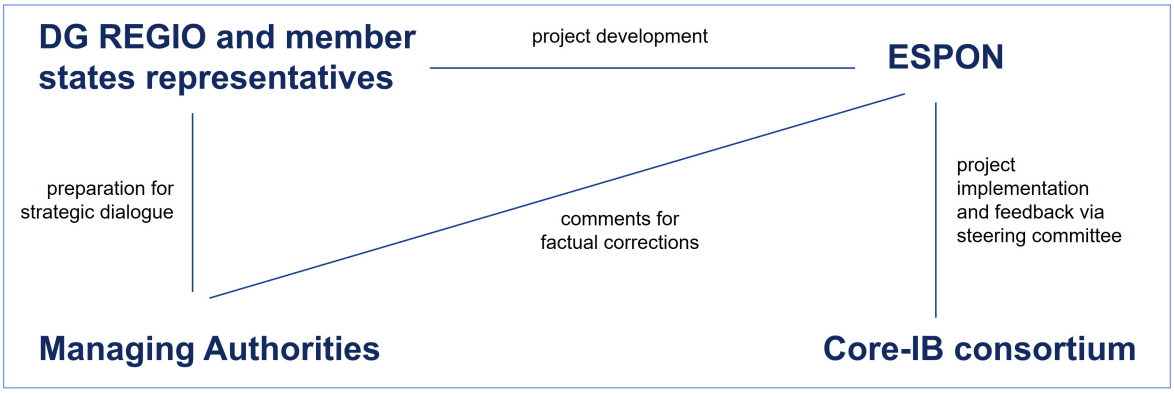
In 2023, the European Commission (DG REGIO) launched a structured debate on the future orientation of European Territorial Cooperation (Interreg) as part of the post-2027 Cohesion Policy. This dialogue emphasises the importance of strengthening the spatial evidence base and ensuring that Interreg projects target those areas where cooperation can generate the greatest European added value. Setting strategic objectives for cross-border cooperation beyond 2027 is therefore a crucial step in shaping the future of European spatial development.

1.2 The Core-IB project

The ESPON Core-IB project contributes to this policy debate, directly supporting the preparation of the next generation of Interreg programmes. The project's main objective is to **deliver evidence-based analyses on the internal cross-border areas within a harmonised knowledge framework**.

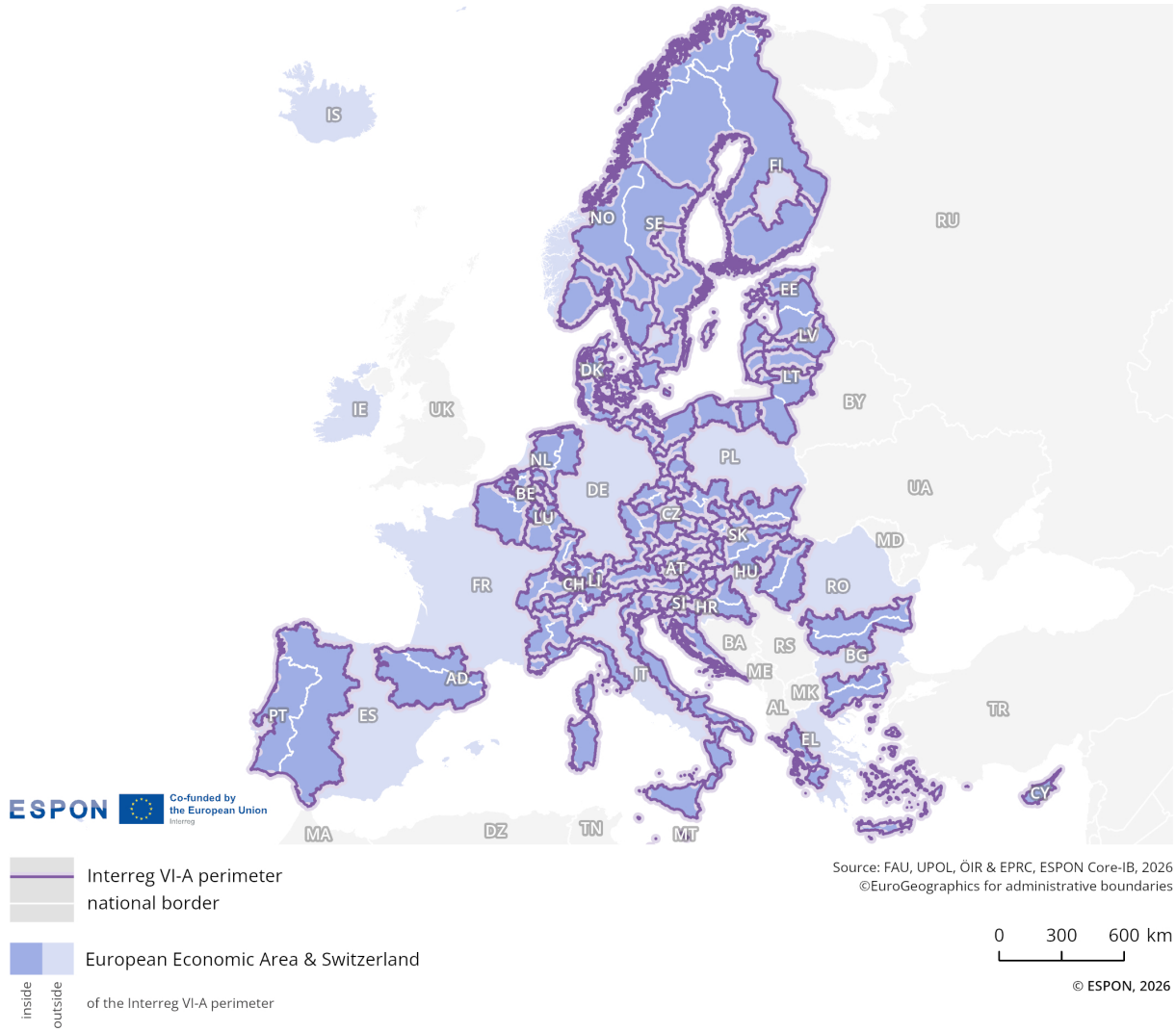
Figure 1 shows the actor setting. While the ESPON programme organised the overall process, the Core-IB project consortium was responsible to the analytical and cartographic work, i.e., the project implementation. The Steering Committee, involving national representatives and DG REGIO, provided feedback loops during the project implementation process. At a later stage, the Managing Authorities of the 48 Interreg cross-border cooperation programmes contributed through an additional feedback loop to exclude any facture mistakes. DG REGIO played a particular role in this project, as it was part of the above-mentioned Steering Committee and also accompanied the communication process with the Managing Authorities. As a result, the Core-IB project involved different governance levels, ranging from regional actors to national authorities and EU institutions.

Figure 1
The actor setting



The regional scope of the project covers the 48 internal EU and EFTA (namely Lichtenstein, Norway and Switzerland) cross-border areas corresponding to Interreg VI-A programme areas at NUTS3 (2021) level, encompassing both land and maritime borders (see Figure 2)[1]. The use of **NUTS3 (2021) geometries** is of fundamental importance, as the applied pan-European datasets, as well as the innovative, newly developed indicators in the ESPON CROSSGOV project, refer primarily to the NUTS3 level in general and to the 2021 version in particular. Methodologically, the project follows a standardised yet place-sensitive approach. It combines comparative territorial analysis with a localised perspective, visualising recent European-level data in a coherent manner.

Figure 2
The spatial framework of ESPON Core-IB



[1] As defined by Annex 1, Commission Implementing Decision (EU) 2022/74 of 17 January 2022, as amended by Commission Implementing Decision (EU) 2023/1638 of 14 August 2023 (OJ L204, 17.8.2023, p. 9): https://eur-lex.europa.eu/eli/dec_impl/2022/75/oj/eng

These include the following 48 border areas, corresponding to the programme areas (for the relevant NUTS3 2021 regions delineations from official EC documents have been used):

- Belgium-France (Wallonie-Vlaanderen-France)
- France-Belgium-Germany-Luxembourg (Grande Région/Großregion)
- Austria-Germany/Bavaria
- Germany-Austria-Switzerland-Liechtenstein (Alpenrhein-Bodensee-Hochrhein)
- France-Switzerland
- Italy-Switzerland
- Germany/Bavaria-Czechia
- Germany/Saxony-Czechia
- Poland-Germany/Saxony
- Germany/Brandenburg-Poland
- Germany/Mecklenburg-Western Pomerania/Brandenburg-Poland
- Slovenia-Austria
- Slovakia-Austria
- Austria-Hungary
- Italy-Austria
- Italy-Slovenia
- Italy-Croatia
- France-Germany-Switzerland (Upper Rhine)
- Greece-Italy
- France-Italy (ALCOTRA)
- Italy-France (Maritime)
- Italy-Malta
- Spain-France-Andorra (POCTEFA)
- Spain-Portugal (POCTEP)
- Germany-Denmark
- Sweden-Denmark-Norway (Öresund-Kattegat-Skagerrak)
- Sweden-Norway
- Sweden-Finland-Norway (AURORA)
- Finland-Estonia-Latvia-Sweden (Central Baltic)
- Poland-Denmark-Germany-Lithuania-Sweden (South Baltic)
- Germany-The Netherlands
- Belgium-The Netherlands (Vlaanderen-Nederland)
- Maas-Rijn/Meuse-Rhin/Maas-Rhein (Netherlands-Belgium-Germany)
- Romania-Bulgaria
- Greece-Bulgaria
- Greece-Cyprus
- Czechia-Poland
- Slovakia-Czechia
- Austria-Czechia
- Poland-Slovakia
- Hungary-Slovakia
- Slovenia-Hungary
- Hungary-Croatia
- Slovenia-Croatia
- Romania-Hungary
- Estonia-Latvia
- Latvia-Lithuania
- Lithuania-Poland

By improving the understanding of territorial specificities and challenges in European border regions, ESPON Core-IB strengthens the analytical foundations for effective cooperation programmes. It serves as a bridge between the growing scientific knowledge on cross-border functioning and the practical policy needs of the forthcoming funding period.

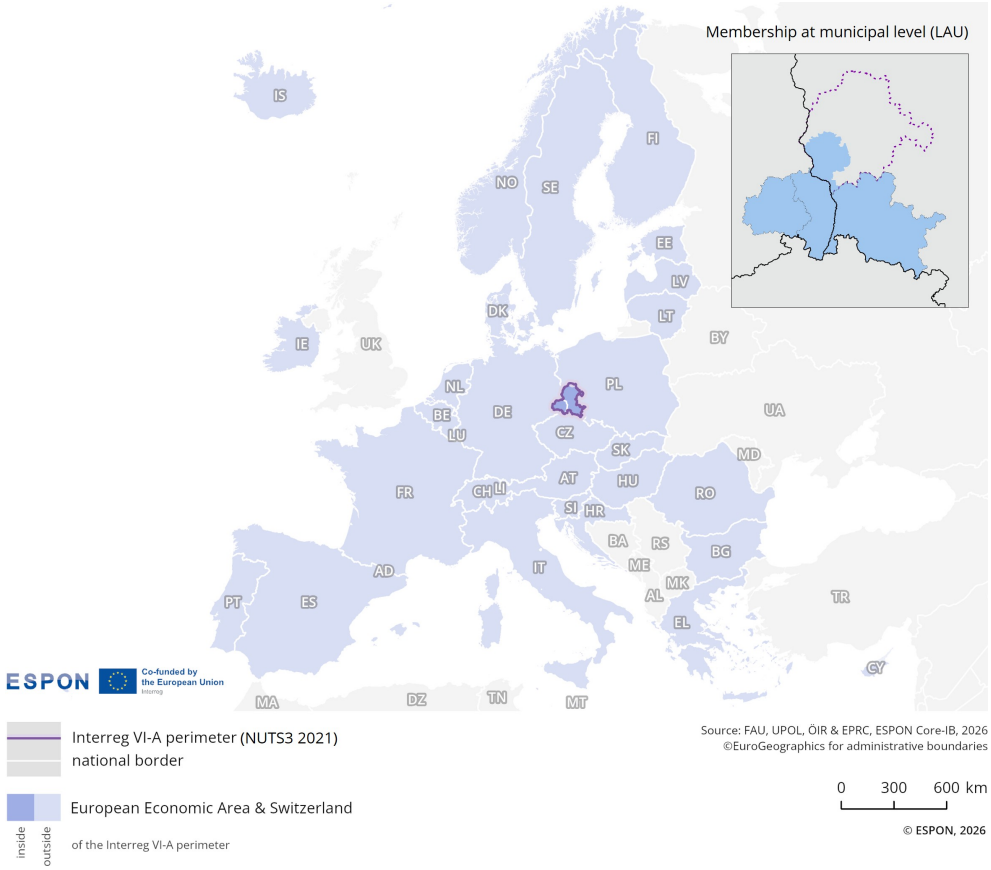
Methodological note regarding programmes geographical coverage:

The geographical areas covered by the 48 programmes are to be differentiated at **two scales**:

1. The programme areas are defined in **EU documents** at the **NUTS3 level**. In **six cases**, the municipal membership differs from this perimeter:
   i. **Poland-Germany/Saxony programme**
   ii. **Poland-Slovakia programme**
   iii. **Czechia-Poland programme**
   iv. **Sweden-Norway programme**
   v. **AURORA programme areas programme**
   vi. **Lithuania-Poland programme**

   This is due to the fact that some programme areas include, not the formal NUTS3 geometries, but only some municipalities **(LAU level geometries)**. This is the case, for example, for the **Poland-Germany/Saxony programme** that includes the NUTS3 regions for Germany - Bautzen and Görlitz, and for Poland - Jeleniogórski and Zielonogórski. The municipal membership differs from this perimeter on the Polish side (as indicated in the exemplary overview map below: where the small map in the upper right part shows dotted lines for the NUTS3 perimeter that is included in the CORE-IB analysis, and a blue colour indicating the membership at municipal level, for the specific Programme Area). More specifically, in the Polish part of the border area, only the municipality of Żarski is a member, rather than the entire NUTS3 region of Zielonogórski. Given these differences, some decisions were made in order to include the specific LAUs and thus, for the statistical analyses, the NUTS3 level is used as the reference level due to **data availability**.

Map below: overview of the Poland-Germany/ Saxony programme area, indicating the difference between the membership at LAU level (**blue fill**) and the perimeter used at NUTS3 level for statistical analysis (**dotted lines**).



This should be taken into account when **interpreting the results**. To provide a general impression for this specific case: the municipal members of this cooperation area account for approximately 1,17 million inhabitants out of 1,69 million within the NUTS3 perimeter (i.e., approximately 69%; values refer to 2023). Similar situations apply for the **Poland-Slovakia**, **Czechia-Poland**, **Sweden-Norway** and **AURORA programme areas** and are indicated in the respective border profiles.

For the **Lithuania-Poland programme** a quite specific situation is to be mentioned. Vilnius city (LAU level) is not a formal member of the programme area, even if it is included in the NUTS3 geometry of *Vilniaus apskritis*. As a result, in following the same line and providing a comprehensive overview, the NUTS3 statistical analysis included in the border profile contains the values for Vilnius city (values that could not be extracted out form the analyses due to data limitations).

2. The geographical perimeters are based on **NUTS3 geometries - 2021 version**. In some cases, these **do not fully align with newer perimeters** that rely on slightly modified **NUTS3 geometries in the 2024 version** (such as for the Latvian, Norwegian and Swedish NUTS3 regions, for example). However, these respect the current programme geometries.

   The use of 2021 NUTS3 geometries is necessary in this project, as the applied pan-European datasets, including the newly developed indicators in the ESPON CROSSGOV project, primarily refer to the NUTS3 level in the 2021 version.

   For example, this in the case of the **Sweden–Norway programme**, where the perimeter is correct from a NUTS3 (2021) perspective: the NUTS3 (2021) region Viken (NO082) has been replaced by three NUTS3 (2024) regions, of which - only two were part of the 2021 geometries (Akershus and Østfold).

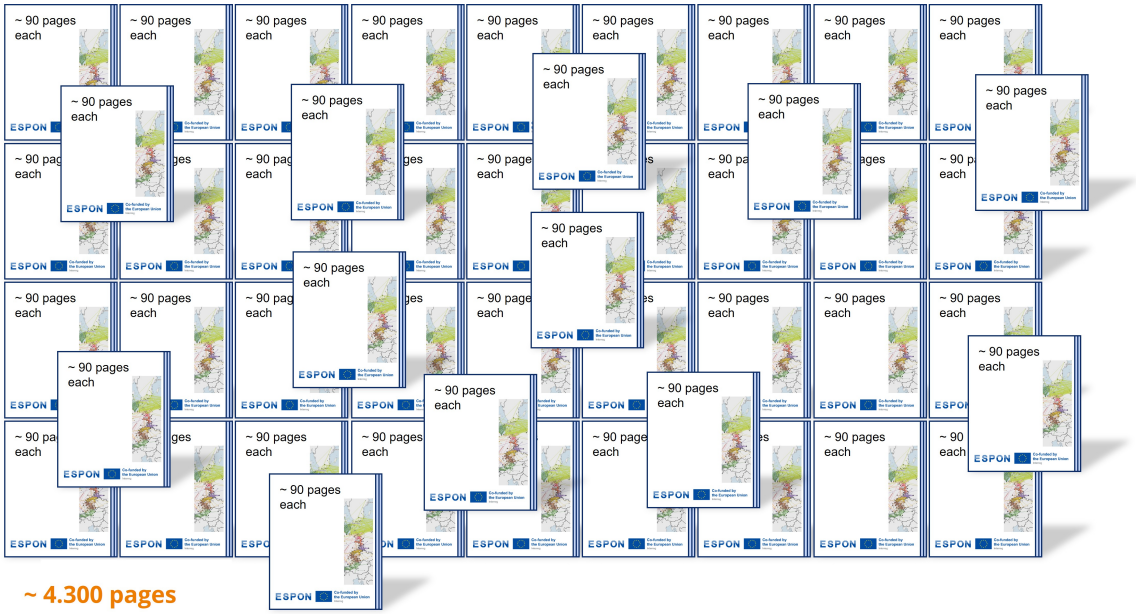
   Another example is the **France-Germany-Switzerland (Upper Rhine) programme area**, where the municipality of Moutier, which belongs to the canton of Jura since January 2026, cannot be addressed statistically with the NUTS3 (2021) geometries.

   The same applies to the Finnish NUTS3 region Pohjois-Karjala in the **AURORA programme**. In this case, the municipality of Heinävesi is a member of the programme at LAU level but is not captured in the NUTS3 (2021) geometry, as the regional boundaries changed slightly in the NUTS3 (2024) version.

1.3 The outcomes

The project's principal outcome is a comprehensive **set of 48 border profiles corresponding to the programme areas**, each approximately 90 pages in length and collectively amounting to around 4,300 pages (see Figure 3). The Core-IB border profiles compile territorial analyses based on the most recent and comparable data available at the European scale. Each document **follows a consistent structure, using the same indicators, analytical framework, and visualisation methods to ensure comparability across border areas.**

Figure 3
48 standardised border profiles as main output



The Core-IB border profiles represent a key input into the ongoing policy dialogue leading to the developing of the Interreg post-27 funding period. They are designed to provide a comprehensive analytical foundation that allows for a subsequent interpretation within regional and national policymaking contexts. These documents should be understood as **one component among several in the broader process**, leading up to the next Interreg A funding period. This process will involve a series of dialogues, participatory procedures, feedback loops, thematic orientations, and the formulation and implementation of specific objectives. In this context, regional expertise, national studies, and internal data sources might be drawn upon. Against this background, it is important to note that the **conclusions presented at the end of each border profile are intentionally kept open and are formulated as policy options**. This approach allows sufficient flexibility for subsequent concretisation and political decision-making processes at the regional and local levels.

This **Final Report** contextualises the 48 border profiles. It outlines the project logic and standardisation process framework (Section 2.1), and provides an overview of the data and indicators used (Section 2.2). Section 3 presents lessons learned from the one-year research process from three perspectives: policy, data, and science.

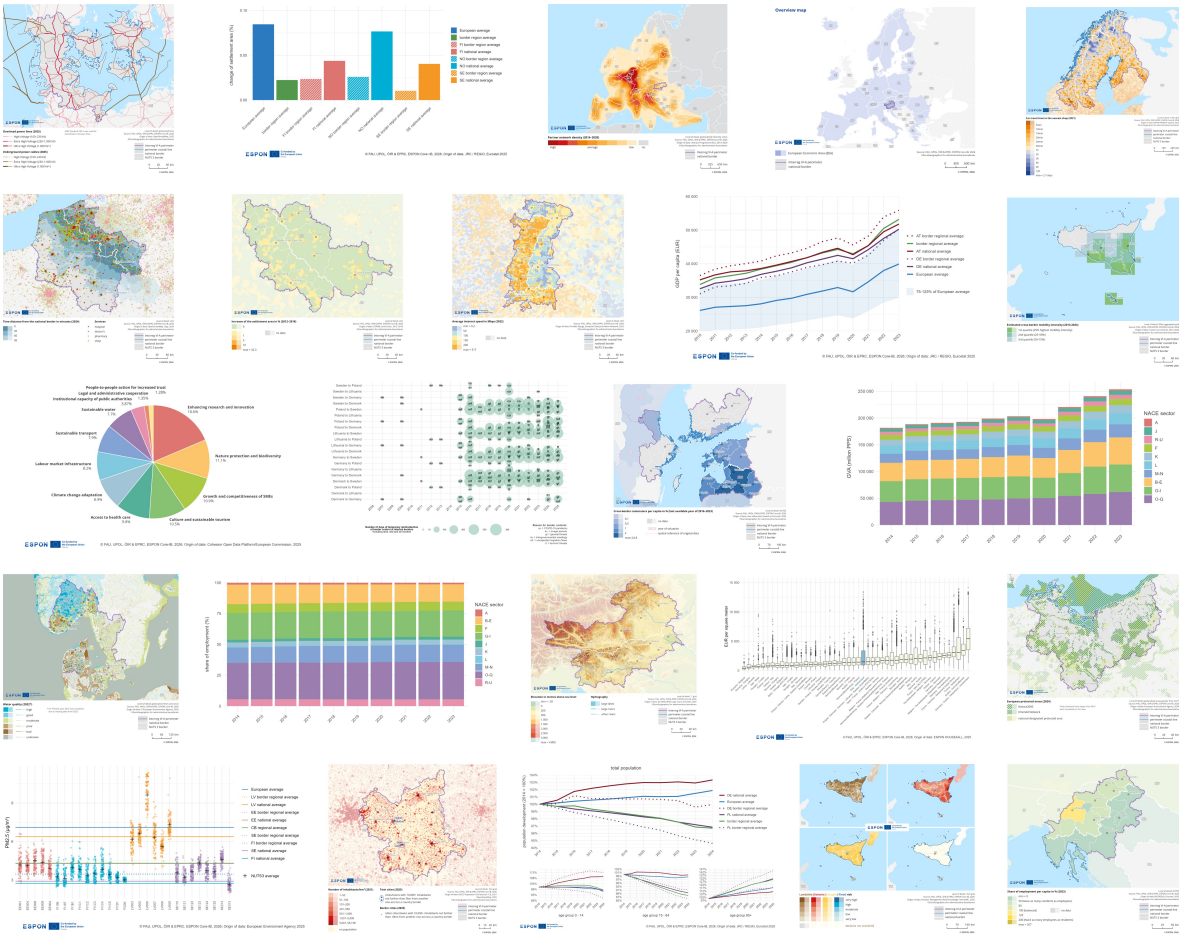
Each border profile is to be accompanied by the **Technical Annex** (“Overview of data and methods”), offering detailed descriptions of all indicators, including their temporal and spatial coverage, data sources, visualisation techniques, and interpretative guidance. This annex serves as an **essential complement to the profiles**, supporting their use and dissemination across governance levels.

2 The Core-IB logic

2.1 Overview: Horizontal and vertical process logic

The ESPON Core-IB project works with a number of existing datasets at the European level for the elaboration of 48 regionalised and institutionalised border area profiles (corresponding to Interreg VI-A perimeters). This requires balancing two seemingly contradictory logics: on the one hand, a high degree of standardisation is necessary to process, visualise, and compile a large number of comparable visuals (over 1700 in total, including approximately 1100 maps and 600 charts, see Figure 4); and on the other hand, a strong place-based analytical perspective is needed to ensure that the visual information is interpreted in a way that reflects regional and cross-border specificities.

Figure 4
Examples of the nearly 1,700 Core-IB visualisations



Combining standardisation and place-based analysis frames the methodological approach of the ESPON Core-IB project. To operationalise it, the consortium developed a structured **vertical and horizontal process logic** as shown in Figure 5. The **vertical** process is organised in four stages: (1) a pilot phase, (2) an analytical phase, (3) an interpretation phase, and (4) a fine-tuning phase.

In the **pilot phase**, the project consortium together with the Steering Committee, worked together to develop the structure of the border profiles, set the frame for the content to be implemented, and anticipate the vertical process needed to complete the 48 border profiles within 12-months period.

From the **analytical** phase on, the project consortium started to work **horizontally** and in parallel, meaning that responsibilities were distributed by indicator (for all regions). Each indicator was compiled and validated by the partner with thematic expertise in the respective topic. Several highly complex indicators were produced within the parallel **ESPON CROSSGOV[2] Governance mechanisms for cross-border functional areas project** (lifetime July 2024 to January 2026), relying on new data sources such as Twitter and META data. As both projects were implemented simultaneously within the ESPON programme, and with overlapping partner teams, the ESPON Core-IB project was able to benefit from substantial inter-project synergies.

Once the indicators were consolidated, the corresponding maps, charts, and analytical descriptions were produced. Maps and graphs were series-produced, semi-automatically, using "maps series" function in ArcGIS Pro and RStudio. This horizontal standardisation process, from indicator preparation to visualisation and description, ensured methodological consistency and enabled comparative analyses across all border profiles.

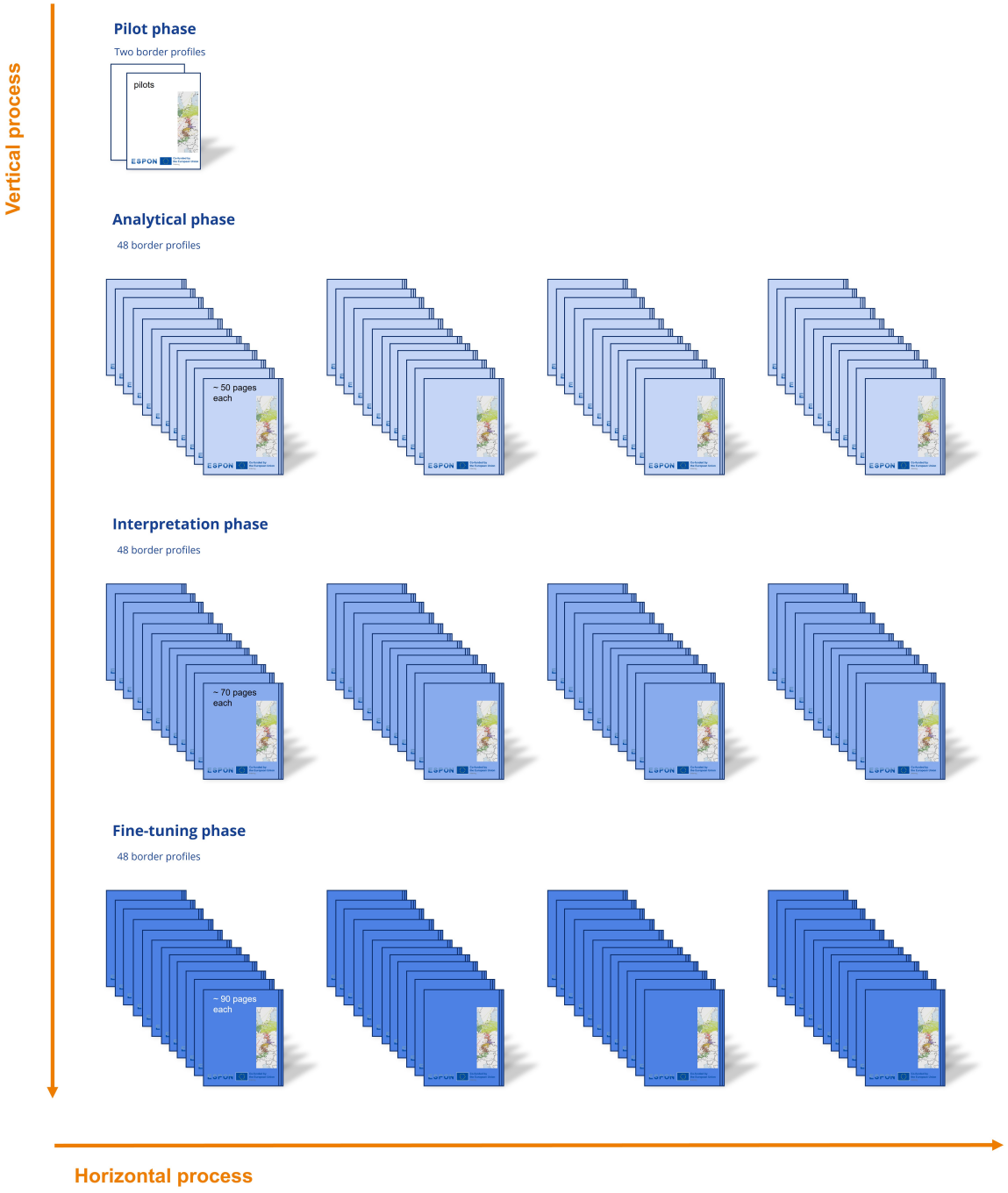
This division of labour enabled the consortium to work in parallel streams, ensuring efficiency and consistency across outputs, while still incorporating the expertise and contextual understanding of regional specialists. The process was key to completing the full set of 48 border profiles within the limited 12-month implementation period.

In the **interpretation and fine-tuning phases**, the project further evolved in a horizontal working mode, in which responsibilities were organised per border profile. After all maps, charts, and indicator descriptions had been inserted into the templates, each of the 48 profiles was assigned to the partner with the strongest regional knowledge of the respective border area. In these horizontal phases, partners were responsible for:

- validating all content produced during the analytical phase,
- interpreting the visual and textual evidence and formulating key messages for each thematic dimension,
- drafting evidence-based conclusions and cross-dimensional summaries at the end of the profile, and
- integrating feedback received through ongoing review loops.

[2] [CROSSGOV] - Governance mechanisms for cross-border functional areas | ESPON

Figure 5
The vertical and horizontal process logic of Core-IB



2.2 The process in detail

2.2.1 From indicators to standardised maps and charts

In the first analytical phase, the work was organised horizontally across thematic indicators. Each consortium partner assumed responsibility for a specific group of indicators based on their thematic expertise (e.g., accessibility, demography, economy, governance). The indicators were collected, harmonised, and validated to ensure full coverage for all 48 border regions.

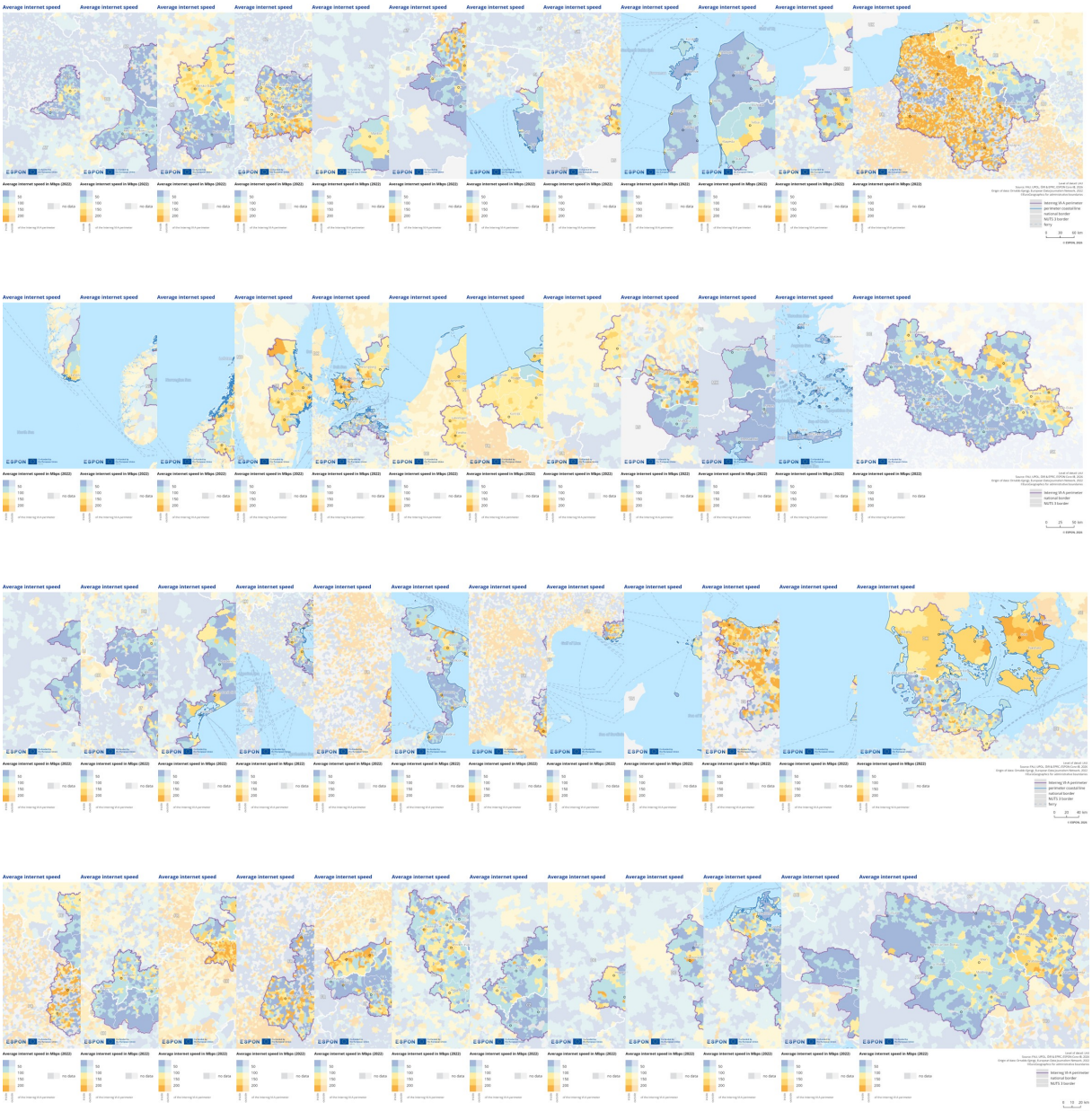
As mentioned, some indicators were generated as part of the parallel ESPON CROSSGOV project, which developed highly complex indicators using new data sources - such as social media and governance datasets. Selected datasets were imported and adapted for the Core-IB territorial analyses, ensuring methodological coherence across projects (for details see the **CROSSGOV Hub**[3]).

To manage the large volume of outputs, the project adopted a semi-automated production process for both, maps and charts. All indicator data were consolidated and transferred to two central processing nodes within the consortium: one responsible for map production (ArcGIS-based workflows), and one for chart production (R-based scripting).

Map production was carried out in ArcGIS Pro, using Python-based ArcPy scripts and Map Series functionality to semi-automate the export of hundreds of map frames. Standardised templates following ESPON standards were developed for all map layers, legends, titles, and symbology. These templates allowed for a consistent layout, font, and colour scheme across all maps, while maintaining flexibility to include regional annotations where relevant. The automation script looped through the 48 border areas, managed turning on and off respective geospatial layers (country boundaries, coastal and terrestrial region boundaries, semi-transparent masks, cities and some thematic layers) and exported high-resolution maps in batch mode (see Figure 6). **Legends were standardised per indicator, meaning that each map used the same legend scale across all regions.** As a consequence, the legend range sometimes exceeded the actual data variation visible in some regions. However, this approach was crucial to maintain full cross-border comparability.

[3] CROSSGOV_Hub_Experience

Figure 6
Batch of maps for one indicator for 48 border areas



The project applies a consistent mapping approach not only to **land borders**, but also to **maritime border areas**, using the same fine-scale datasets wherever available. Figure 7 illustrates this approach with the indicator 'change of settlement area' at municipal level, shown for two land border regions (France-Belgium-Germany-Luxembourg and Italy-Austria) and two maritime border regions (Poland-Denmark-Germany-Lithuania-Sweden and Italy-France Maritime). All four maps follow identical visualisation principles, including the same legend, symbology, and layout, ensuring full comparability across different types of border areas.

Figure 7
Mapping harmonised datasets for land and maritime border areas

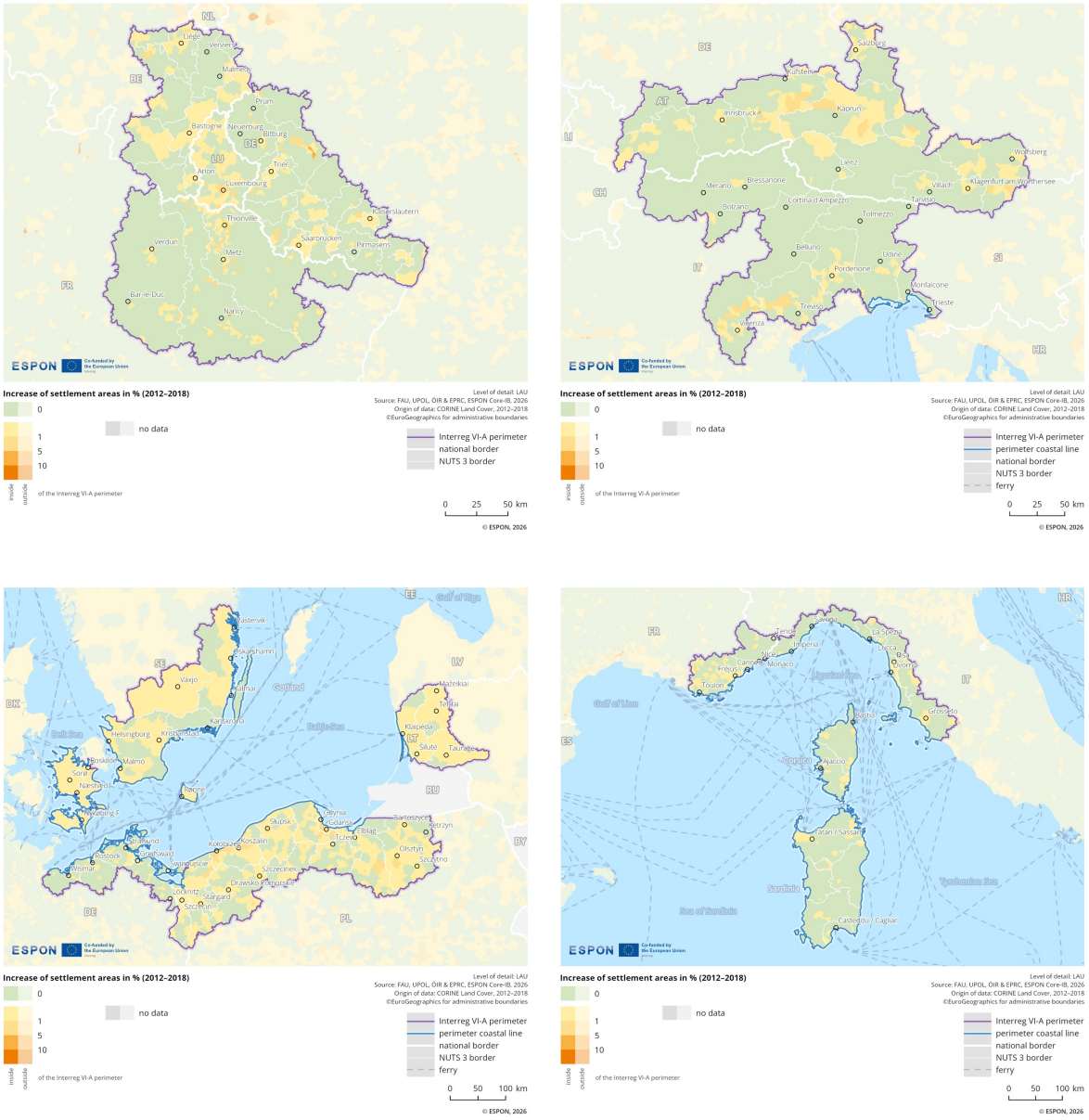
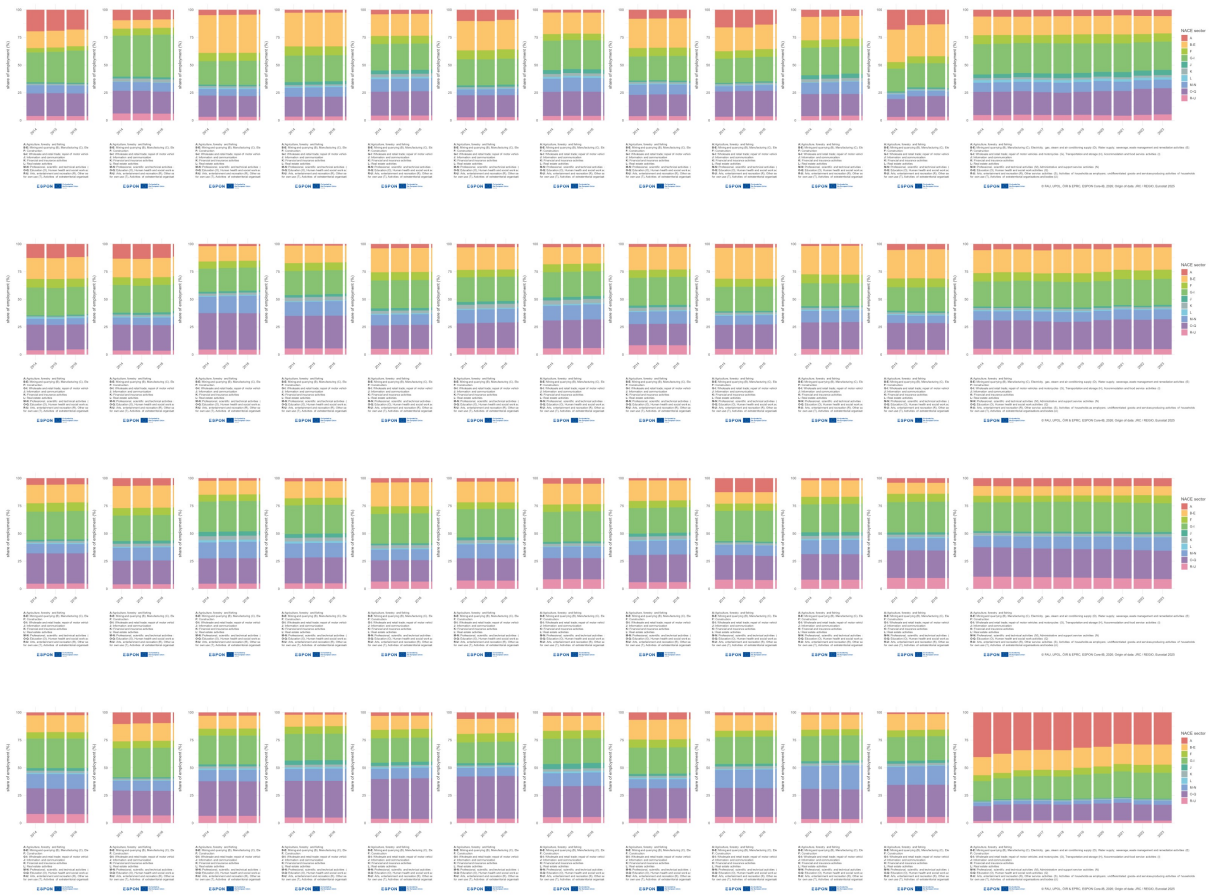


Chart production followed a similar logic, using R scripts. The consortium developed a library of standardised ***ggplot2 templates***, designed to automatically incorporate the indicator data for each border region and pre-process the data for the visualisation purposes (e.g., calculation of cross-border or national averages). These scripts produced multiple chart types (bar, line, and pie charts) with identical styling and labelling conventions. The resulting batches of charts were stored in a structured online data repository ("data box") for easy retrieval and linkage to the border profiles (see Figure 8).

Figure 8
Batch of 48 charts on the border-regional share of employment by sector

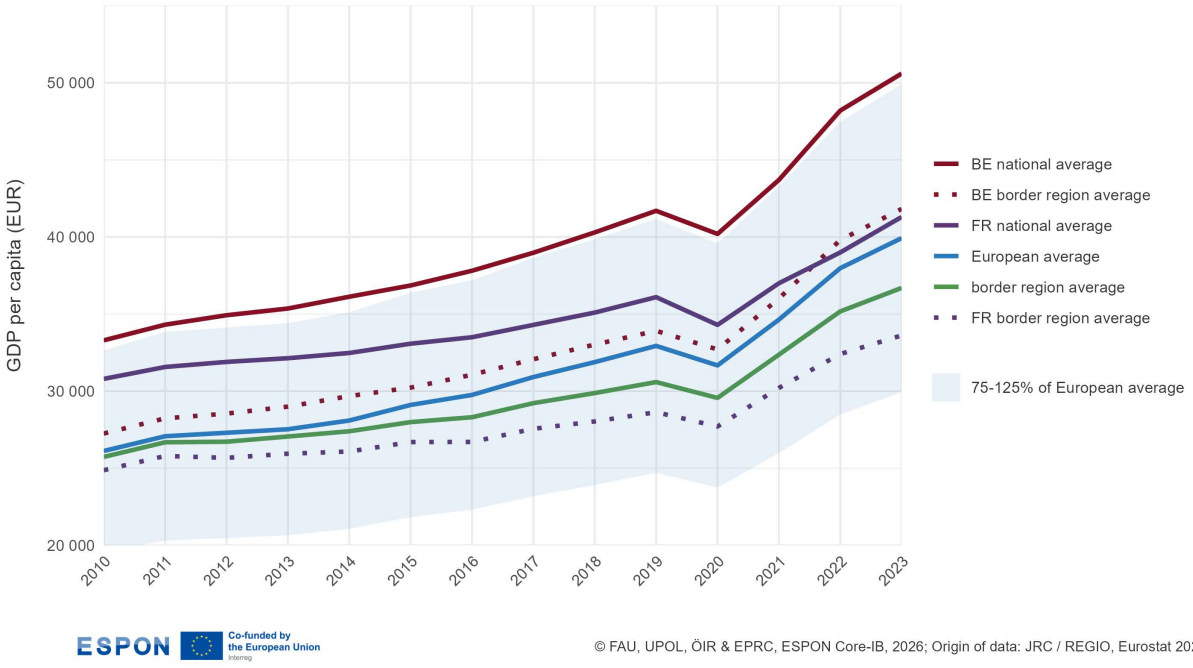


This horizontal phase resulted in a comprehensive, harmonised set of visuals and descriptions that established the basis for cross-regional comparison and border-regional positioning. To provide a comprehensive comparative positioning, the analyses apply descriptive indicator statistics and groups border regions into the following reference categories:

- European averages (defined as EU27 + Norway, Switzerland and Liechtenstein, depending on the data availability)
- National averages,
- National border regional averages, and
- Aggregated border regional averages.

Figure 9 shows an example of the reference categories for the Belgian-French border region. For the GDP per capita indicator, an additional corridor of 75-125% of the European average has also been implemented.

Figure 9
Positioning border regions across European, national and domestic border region averages



Accompanying texts for maps and charts were drafted by the responsible indicator partners, who were best informed for the interpretation. These short narratives were collected through an online shared Excel interface, which served as a collaborative editing and quality assurance tool. Cross-validation between partners was facilitated directly in the shared Excel environment. To streamline the compilation of the final border profiles, a script-based export process linked Excel cells to pre-defined fields in the Word templates. Through VBA macros and link management in Word, all text and visuals were semi-automatically updated, ensuring internal consistency across 48 documents.

2.2.2 Contextualisation and thematic synthesis

Each partner was responsible for a subset of 12 profiles, ensuring that border-regional knowledge informed the interpretation of the standardised visuals.

In this vertical interpretation phase, partners performed three key tasks:

- **Validation:** checking the correctness and internal consistency of the maps, charts, and accompanying texts produced during the horizontal phase.
- **Interpretation**: deriving place-based insights from the visual evidence, identifying patterns, asymmetries, and specific cross-border dynamics.
- **Synthesis:** formulating key messages and future oriented questions for each thematic dimension and summarising evidence-based conclusions in section 3 of each border profile.

This phase was essential to transform standardised outputs into place-based analyses that reflect the geographical, functional, and institutional specificities of each border region.

2.2.3 Ensuring consistency and coherence

A central feature of the project was its iterative and participatory feedback process, which ensured both the analytical quality and the coherence of all 48 border profiles. Each project partner acted as the lead editor for twelve border profiles and was responsible for integrating all profile-specific comments received throughout the process. This structure ensured that regional knowledge, stakeholder perspectives, and methodological improvements were incorporated consistently.

The feedback loops were organised by ESPON and addressed to the Steering Committee, which included DG REGIO, as well as members of the ESPON Monitoring Committee. An additional feedback loop addresses the INTERREG A Managing Authorities. In total, **four major feedback** rounds are implemented during the development of the border profiles (see Figure 10).

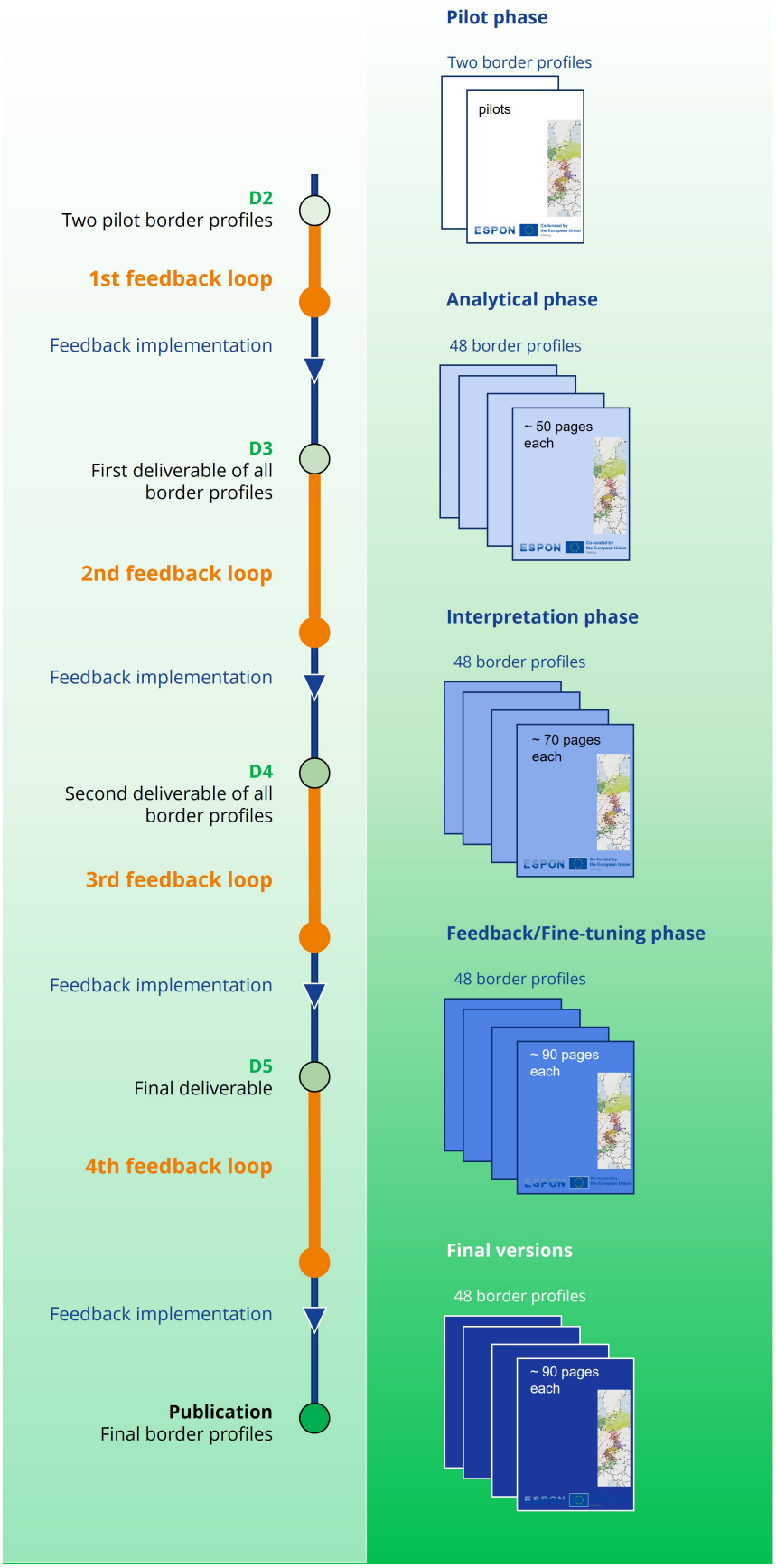
The **first feedback loop**, carried out during the pilot phase, involved a detailed review of two pilot border profiles (D2=deliverable 2). The purpose of this step was to agree on the overall structure and to define the core set of indicators that would be applied consistently across all 48 profiles. This phase was essential for establishing a common analytical foundation and a harmonised visualisation framework.

The **second feedback loop** corresponds to the first draft of all profiles (D3=deliverable 3). These drafts already contained the complete set of visualisations, around 1,100 maps and 600 charts, together with initial textual descriptions. Feedback received during this round concentrated on improving the clarity, accuracy, and consistency of both the visual elements and the accompanying analyses.

The **third feedback loop**, reflecting the first complete draft (D4=deliverable 4), introduced fully developed profiles for the first time. In this version, all key messages and summary sections had been drafted, and a comprehensive validation and cross-profile harmonisation process was undertaken. The comments in this round prompted extensive revisions, including refinements to the maps, charts, and narrative components.

The **fourth feedback loop** focuses on the final versions of fully polished and completed border profiles for all 48 regions (D5=deliverable 5). All previous comments had been incorporated, and the remaining feedback primarily aims at correcting residual errors, resolving minor inconsistencies, and finalising formatting aspects.

Figure 10
Feedback loops as key element in vertical process



Each border profile received at least one substantial set of comments in every feedback round, and often several. Table 1 provides an overview of the number of feedback documents received and incorporated in each round.

Table 1
Feedback participation in four loops

Feedback loop / response	Feedback loop 1	Feedback loop 2	Feedback loop 3	Feedback loop 4
response	**Feedback from ESPON programme and Steering committee - including ESPON MC members and DG REGIO** (containing horizontal feedback on the border profile pilots, organised in one document)	**Feedback from ESPON programme and Steering committee - including ESPON MC members and DG REGIO** (containing border profile specific and horizontal feedback, organised in 57 documents)	**Feedback from ESPON programme and Steering committee - including ESPON MC members and DG REGIO** (containing border profile specific and horizontal feedback, organised in 82 documents)	**Feedback from Managing Authorities of 48 cross-border cooperation programmes, ESPON programme and Steering committee - including ESPON MC members and DG REGIO** (containing border profile specific corrections, organised in 92 documents)

To ensure coherence across the entire set of profiles, a dual feedback mechanism was used. First, partners integrated all border-profile-specific feedback for their assigned border profiles. Second, horizontal feedback, affecting all profiles, such as layout adjustments, indicator naming conventions, or entire chapter reworks, was centralised through an online ticketing system. This allowed for the systematic and uniform implementation of cross-cutting revisions, thereby avoiding inconsistencies and redundant corrections.

2.2.4 Limitations of the standardisation approach

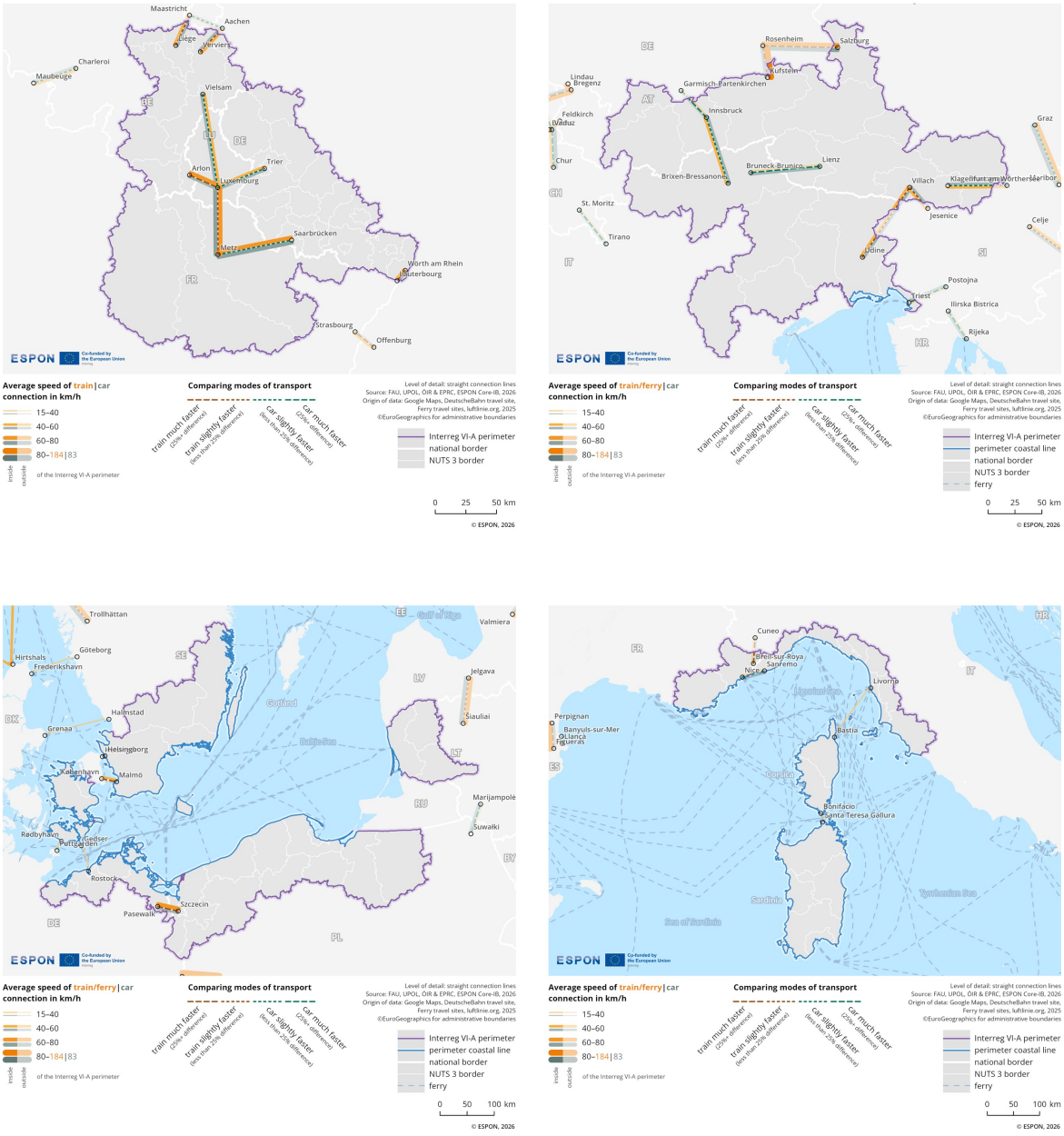
The **chosen standardisation approach was essential for ensuring comparability and efficiency across all 48 border profiles**. However, this approach also introduced three inherent limitations that must be acknowledged.

First, cross-border data availability of harmonised and fine-scaled regional statistics at the pan-European level remains challenging. Despite efforts to use the most complete datasets possible, some profiles inevitably display areas with **'no data'**. In certain cases, maps appear less detailed, particularly where fine-scale information is not available in European datasets. **These gaps highlight the constraints of using harmonised pan-European data in small, heterogeneous cross-border contexts.** Flow indicator, capturing mobility or functional linkages across borders at a fine spatial scale, are still limited at EU level, although they would further enrich the analysis. Integrating national datasets and carrying out cross-border harmonisation was beyond the scope of this project, and therefore such refinements could not be pursued within the project framework.

Second, the development of new indicators based on **pan-European thresholds** led to maps with spatial incompleteness. The ESPON Core-IB project used synergies with the parallel running ESPON CROSSGOV project, which provided newly developed pan-European datasets and an interactive platform for data exploration. While these datasets significantly strengthened the evidence base, some indicators are not equally applicable across all types of border regions, for instance, certain mobility-

related indicators cannot be completely used in maritime areas (e.g., catchment areas by car for some maritime borders). As a result, **not all indicators could be applied coherently across both land and maritime border contexts.** The 'space-time-lines' indicator, for example, highlights the quality of selected cross-border connections from a pan-European perspective (see Figure 11). When measuring the quality of selected cross-border connections, based on average speeds for car, train, and ferry links, pan-European thresholds were not always met in all maritime or sparsely populated border regions. When transferred to specific border regions, it may omit additional connections that are locally relevant, even if the travel time is very long. This occasionally resulted in seemingly incomplete representations. In these cases, **cartographic adaptations were applied to preserve contextual meaning, such as highlighting ferry lines, terminals, or additional transport nodes.**

Figure 11
Example for limitations of pan-European standardisation approach



Consequently, such indicators should not be interpreted as providing a complete representation but rather as offering a selected, comparable subset, an unavoidable trade-off when relying solely on pan-European datasets.

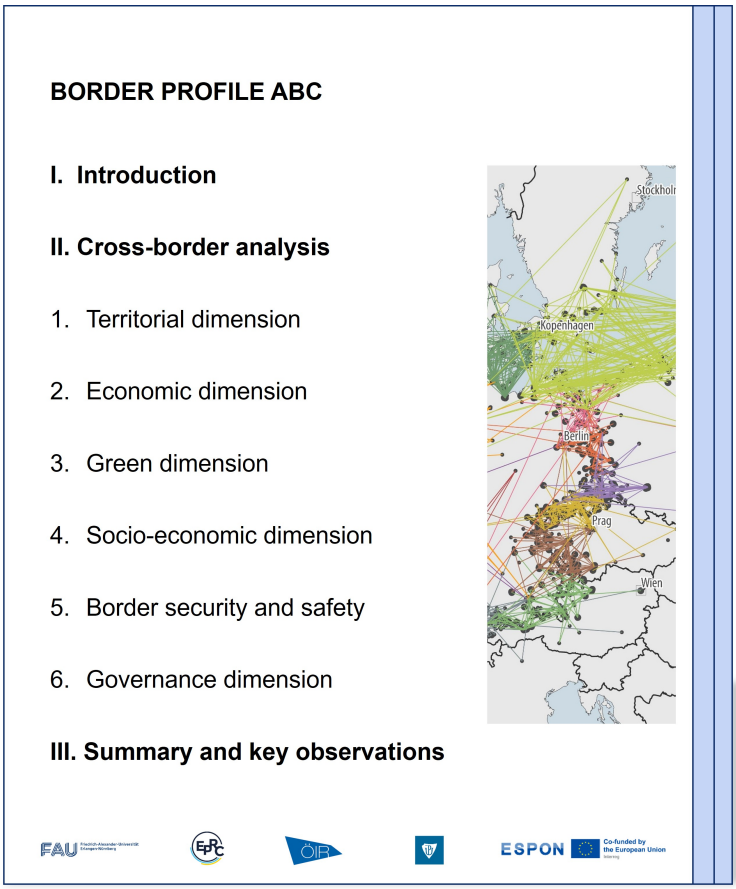
Third, the need for highly standardised map and chart production required to manage the large volume of visuals and also introduced limitations. **Uniform legends and templates** were applied across all 48 profiles. This occasionally resulted in legends that included elements not necessarily present in specific maps. Again, this reflects both the nature of the datasets and the project's commitment to comparability.

2.3 The data perspective

2.3.1 Organising border profiles in thematic dimensions

A defining feature of the Core-IB border profiles is their high degree of comparability. **All 48 profiles follow an identical structure and draw on the same set of indicators and visualisation methods** (see Figure 12). After the brief introduction (Part I), Part II presents the cross-border analysis across 6 thematic dimensions. Each dimension includes a coherent combination of maps, charts, and key messages that highlight the main findings. Part III provides a summary that cross-references the evidence-based conclusions, pinpointing to overarching insights emerging from each border profile.

Figure 12
The general structure of the Core-IB border profiles



The design of this structure drew inspiration from the well-established 'fiche' approaches developed in earlier ESPON projects, notably IRIE - Interregional relations in Europe | ESPON and ESPON CROSSGOV. Although these projects differ in scope and thematic focus, both aimed to develop a standardised template capable of capturing essential analytical dimensions in a clear and comparable format. Their methodological frameworks provided valuable reference points for developing the Core-IB profiles.

The final border profile structure is the result of testing and refining the implementation framework through **two pilot cases.** For the land-border context, the France–Germany–Switzerland (Upper Rhine) border was selected. This case includes a non-EU country and combines metropolitan and rural settings. It also benefits from a long tradition of cross-border monitoring and a well-developed knowledge base, which served as a robust reference for validating the indicator-based assessments. For the maritime context, the Italy–Croatia border was chosen as an example without any road connection. This pilot was relevant in identifying both the specific potentials and the methodological limitations of applying the framework to maritime border regions.

Both pilot applications were subjected to an iterative feedback process involving the steering committee - with representatives from ESPON, DG REGIO, and other interested stakeholders. Based on this feedback, the approach was fine-tuned, and adjustments were made where necessary. Once the revised structure was agreed upon, it was systematically applied to all 48 border regions.

Organising the border profiles around 6 thematic dimensions provides a comprehensive and comparable overview of the geographic, economic, environmental, socio-economic, border security, and governance characteristics of each border area (see Table 2). Each of these dimensions is further divided into sub-dimensions. This approach allows not only for a structured understanding of cross-border dynamics but also ensures a harmonised analytical basis across all profiles.

The **territorial dimension** captures the spatial features highlighting interactions in the border area, including settlement patterns, population density, and accessibility. The **economic dimension** explores factors influencing regional development and competitiveness, such as GDP per capita dynamics, labour market integration, including cross-border commuting, as well as infrastructure and housing considerations. The **green dimension** addresses resource management, environmental protection, and clean energy initiatives that contribute to sustainable territorial development. It includes nature protection, pollution levels, climate risks and resilience, and (renewable) energy infrastructure. The **socio-economic dimension** highlights the social and economic conditions that underpin well-being and cohesion in cross-border settings. Topics covered include social connectivity, tourism, and access to services of general interest. **Border security and safety** reflect on the temporary reintroduction of internal border controls and related issues. Finally, the **governance dimension** examines the institutional structures and processes that guide decision-making and cooperation across borders. It covers cross-border governance frameworks, the role of Interreg programmes, and the presence of territorial cooperation instruments such as European Groupings of Territorial Cooperation (EGTCs), Euroregions, treaties, and macro-regional strategies. Together, these dimensions form a coherent analytical framework that supports both comparability across border regions and a nuanced understanding of their specific characteristics and dynamics.

Table 2
Overview of thematic dimensions addressed in Core-IB border profiles

Dimension	Sub-dimensions
1. Territorial dimension	• Population and settlements • Accessibility of the border area
2. Economic dimension	• Gross Domestic Product • Labour market and commuting • Competitiveness • Infrastructure and housing
3. Green dimension	• Nature protection and pollution • Climate risks and resilience, • (Renewable) energy and energy infrastructure • Resources and circular economy
4. Socio-economic dimension	• Social integration • Tourism • Services of general interest
5. Border security and safety	• Temporary reintroduction of border controls at internal borders
6. Governance dimension	• Cross-border cooperation • Outline of Interreg activities

2.3.2 From thematic dimensions to a core set of indicators

A central component of the project involved assessing the availability and relevance of indicators across the 6 thematic dimensions and their respective sub-dimensions. The final core set of indicators was aligned with these dimensions to ensure a coherent and comprehensive basis for cross-border analysis (see Table 3). Following the project's terms of references, Core-IB had to **rely on existing European datasets, most notably Eurostat and ARDECO**. In addition, ESPON Core-IB integrated relevant results from the **ESPON CROSSGOV project as well as insights from other ongoing ESPON projects and other European sources** (e.g., European Environment Agency). The data was organised within the programme perimeters at NUTS3 level (for details see above, chapter 1.2)

The process of data monitoring and indicator selection was guided by 3 key criteria. First, indicators had to **offer European-wide coverage** and be available for all 48 border regions. Second, they needed to

represent the 6 thematic dimensions in a **balanced and sectoral comprehensive manner**. Third, the spatial resolution had to be at least at **NUTS3 level** to ensure sufficient territorial detail.

To complement the predominantly quantitative datasets, additional harmonised qualitative sources were incorporated whenever it could be applied consistently across all border profiles. These included, among others, strategic documents from the Interreg 2021–2027 programming period, the **Border Orientation Papers from the former INTERREG period**, information from the **KEEP database** on cross-border cooperation activities, data from the **Cohesion Open Data platform**, outputs from the **b-solutions initiative**, and evidence from recent ESPON projects such as **CROSSGOV, House4All, PROFECY Update, and CPS 2.0.**

Table 3
Core set of indicators for 48 cross-border profiles

Section	Topic	Indicator	Data treatment and sources
Introduction	**Location of the border region**	Interreg VI-A perimeter	Identification of Interreg VI-A perimeters via keep.eu
	Geographical characterisation	Mountain areas, lakes, seas and rivers	Processing of descriptive geodata from Eurogeographics, EuroGlobalMap, European Environment Agency
Dimension 1: **Territorial dimension**	**Population and settlements**	Population density	Processing of EUROSTAT grid data (GISCO, version 1.3)
		Population development (by age group)	Processing of EUROSTAT/ ARDECO data
		Change of settlement areas	Processing of raster data from CORINE Land cover and crossing with administrative perimeters
	Accessibility of the border area	Comparative quality of selected cross-border connections	Average number and speed of rail connections/ferries, average speed of car connections between selected cities and towns in border regions using Rail travel sites, Google Maps data
		Cross-border catchment area based on mobility flows	Twitter data about physical mobility flows is used to calculate catchment areas of different intensity

Section	Topic	Indicator	Data treatment and sources
		Cross-border travel-time accessibility	Based on the OpenStreetMap road network, areas are calculated within which you can reach border crossings below certain thresholds
Dimension 2: **Economic dimension**	**Gross domestic product**	Gross domestic product at current market prices	Processing of EUROSTAT data
	Labour market and commuting	Share of employment	Processing of EUROSTAT/ ARDECO data
		Share of working-age population	Processing and calculating of ARDECO data
		Employment by sector	Processing ARDECO data
		Outgoing cross-border commuters	EUROSTAT data on NUTS2 regionalised for NUTS3
		Cross-border telework agreements	Information about the legal framework on social security regarding cross-border telework per border pair is collected
	Competitiveness	Gross value added at basic prices by sector	Processing ARDECO data
		Nominal compensation per hour worked	Processing ARDECO data
	Infrastructure and housing	Advertised sales prices	Processed ESPON House4all data
		Average internet speed	Processing of data provided by Speedtest by Ookla Global Fixed and Mobile Network Performance Maps, based on Ookla's analysis of Speedtest Intelligence data.

Section	Topic	Indicator	Data treatment and sources
Dimension 3: **Green dimension**	**Nature protection and pollution**	Protected areas	Combination of nationally designated areas, Natura 2000 and Emerald network provided by EEA
		Air pollution	Processing and analysis of European Environment Agency data
		Water pollution	Retrieval of WISE Freshwater data of surface water bodies (European Environment Agency)
	Climate risks and resilience	Natural hazard risks	Combination of data describing the likelihood of specific natural hazard events from Disaster Management Risk Knowledge Centre/JRC
	(Renewable) energy and energy infrastructure	Power lines and energy infrastructure	OpenStreetMap data is retrieved and processed
		Power stations	OpenStreetMap data is retrieved and validated via various data sources
	Resources and circular economy	Resource productivity	Processing and calculation of EUROSTAT and ESPON CIRCTER Update data
		Generation of waste per GDP	Processing and calculation of EUROSTAT and ESPON CIRCTER Update data
Dimension 4: **Socio-economic dimension**	**Social integration**	Cross-border connectivity in social media	Processed Facebook data on existing connections across the border
		Language similarities along national borders	ESPON cross-border public services (CPS) 2.0 database along border segments

Section	Topic	Indicator	Data treatment and sources
	Tourism	Nights spent at tourist accommodation establishments	Processing of EUROSTAT data
	Services of general interest	Accessibility to services of general interest	Processing and analysis of standardized travel-time accessibility to primary schools, secondary schools, hospitals, doctors, cinemas available in the ESPON PROFECY Update (2021)
Dimension 5: **Border security and safety**	**Temporary reintroduction of border controls at internal borders**	Number of days of temporary reintroduction of border control at internal borders	Processing and analysis data of European Commission information pursuant to Article 25 and 28 et seq. of the Schengen Borders Code
Dimension 6: **Governance dimension**	**Cross-border cooperation**	Cross-border governance structures	Localisation and categorizing of cross-border cooperation formats (Eurocities, Euroregions, EGTC, cross-border associations, cross-border councils, conferences, working communities), based on desk research
		Cross-border public services	Processing of the content from ESPON cross-border public services (CPS) 2.0 database
		Perceived cross-border obstacles in b-solutions	Processing and analysis of the b-solutions initiative data
		Institutionalised advice centres for cross-border issues	Localisation, thematic priority and influence of advice centres for cross-border issues centres are identified via desk research
	Outline of Interreg activities	Interreg cooperation	Processing and analysis of the Interact Keep database

The **metadata and full list of data source**s are documented in the **Technical Annex** to this Final Report. This annex accompanies each border profile and provides detailed information on every indicator, includ-

ing its definition, temporal coverage, spatial level, source, visualisation method, and guidance on interpretation. It also outlines the processing steps and harmonisation procedures applied to ensure comparability between regions.

3 Outlook

3.1 Policy reflection

The ESPON Core-IB project provides a comprehensive set of evidence-based analyses designed to inform the development of the Interreg post-27 programmes. Through the systematic collection, harmonisation, and visualisation of territorial data, the **project provides spatial evidence on the socio-economic characteristics, environmental conditions, and governance structures that characterise cooperation across Europe's internal borders**. By doing so, it offers a consolidated and comparative knowledge base that supports strategic reflection on future cooperation priorities and helps identify shared challenges and opportunities.

The Core-IB border profiles represent **one important analytical component within a broader and multi-layered preparatory process for the forthcoming Interreg A (internal borders) funding period**. This wider process involves a series of structured dialogues, participatory procedures, thematic discussions, and iterative feedback loops, leading to the formulation of specific cooperation objectives. As this process moves forward, regional expertise, national studies, and domestic datasets, many of which might offer more granular, context-specific information, will be **essential in complementing and deepening the insights generated through the pan-European approach taken in ESPON Core-IB**.

In this context, the **evidence-based conclusions presented at the end of each border profile are intentionally kept open, non-prescriptive and formulated as policy options**. Their purpose is not to formulate concrete recommendations, but rather to highlight evidence-based tendencies and highlight potentials that can serve as an informed starting point for further political, administrative, and stakeholder involvement. This openness ensures that the findings can be adapted to the in-depth realities of border regions and aligned with ongoing national and regional policy processes.

Overall, the Core-IB border profiles are designed to **support an informed, inclusive, and coordinated decision-making process**. To fully realise their potential in shaping the post-2027 period, **a structured follow-up process is required**, one that actively builds on the spatial evidence compiled in this project. This process must bring together all actors in the multi-level cross-border governance system, from European institutions to national authorities, regional bodies, and local stakeholders. Through shared interpretation of the findings and strategic reflection can the ESPON Core-IB evidence be effectively integrated into future policymaking and contribute to robust, regionally aligned Interreg programmes.

3.2 Data reflection

The ESPON Core-IB project developed a semi-standardised approach capable of **producing a large volume of comparable analyses**, corresponding positioning, and approximately 1,700 visualisations. This represents a significant methodological advancement in cross-border territorial analysis, illustrating the potential of coordinated standardisation across heterogeneous border regions.

Despite these advances, the work also **revealed ongoing data limitations**. Several data gaps are still a serious issue – both in sectoral terms (economic, social indicators) and in types of data (in particular, flow data and fine scale data). This continues to constrain evidence-based policymaking in border areas. These gaps highlight the structural challenges of producing harmonised territorial evidence across multiple national statistical systems, and emphasise the need for continued efforts to improve the availability, comparability and spatial resolution of cross-border data. Strengthening the evidence base is therefore essential for meaningful assessments and designing targeted, forward-looking spatial development strategies.

Looking ahead, 2 areas of action in the field of territorial data emerge as particularly important for advancing cross-border evidence (very much in line with the conclusions of the ESPON CROSSGOV project):

(1) Further advancing cross-border data harmonisation

The ESPON Core-IB project highlights both the necessity and complexity of producing comparable territorial analyses across Europe's border regions. Achieving genuinely harmonised data requires sustained cooperation among institutions, as well as alignment of technical, methodological, and administrative frameworks across countries.

European initiatives such as the European Cross-Border Monitoring Network already play a valuable role in improving indicator quality. Further EU efforts provide a strong foundation for further work – including the 2017 Communication on Boosting Growth and Cohesion in EU Border Regions, the 2018 Cross-Border Data Collection project (DG REGIO) and its follow-up project on cross-border commuting in 2024.

Given that harmonisation is a long-term endeavour, efforts towards structural improvements need to be complemented by short- and medium-term actions. This includes strengthening collaboration between data providers and users, aligning statistical practices, and gradually expanding the availability of fine-resolution datasets (e.g., NUTS3, LAU, or grid-level data) to better capture the unique characteristics of cross-border areas.

(2) Exploring the potential of 'new data' sources

Beyond traditional statistical data, emerging 'new data' sources offer promising opportunities to capture real-time dynamics and functional interactions across borders. The Joint Research Centre (JRC) has recently initiated an informal network dedicated to exploring such sources, including information derived from social media, mobility applications, communication data, and other digital traces.

Some examples already demonstrate the usefulness of such approaches. For instance, the ESPON House4All project[4] used web scraping to analyse cross-border housing markets, showing that new data can provide timely insights where conventional statistics are limited. However, significant challenges remain, particularly regarding cooperation between data providers and potential users. Enhancing dialogue between statistical bodies, private-sector providers, policymakers, and research institutions will therefore be essential to unlock the full potential of new digital datasets.

3.3 Scientific reflection

The ESPON Core-IB project represents an important **initiative for large-scale and comparative data management in border studies** at a time when territorial research is being transformed by rapid 'datafication'. By systematically compiling and analysing pan-European datasets, the project demonstrates how far current data availability already allows researchers to move **towards a more consistent evidence base for all European border regions**. Its close linkage to the ESPON CROSSGOV research project further strengthened this **experimental dimension by enabling the testing of new indicators and data layers**. Together, these efforts constitute a first step towards a more comprehensive and methodologically robust understanding of Europe's heterogeneous border regions. Sustaining and expanding this level of comparable analysis will be relevant for generating new insights and supporting future strategic decisions in border regions.

[4] https://www.espon.eu/projects/access-affordable-and-quality-housing-all-people-house4all

The ESPON Core-IB project has produced a substantial body of territorial evidence, enriching the knowledge base with updated and new datasets and spatial representations of border-regional characteristics. However, the already described limitations lead to further research needs that can be categorised in three different thematic strands.

First, the ESPON Core-IB experience illustrates the **opportunities and limitations of harmonised, pan-European data sources for border-regional research**. It shows what can be achieved with existing datasets, but also where important gaps remain, especially regarding thematic depth and temporal comparability. Further elaboration on in particular pan-European flow data indicators that can be applied at border-regional level is of high interest for further territorial analyses.

Second, the collaborative set-up with CROSSGOV demonstrates the value of **integrating new data sources and experimental indicators into comparative border analysis**. Future research will need to adopt similar integrative approaches to further enhance methodological innovation. The more systematic links to already existing cross-border monitoring systems is important (see the ongoing activities of the network of 'European Cross-border Monitoring Network'[5], bringing together initiatives from various scales as for example La Mission Opérationnelle Transfrontalière[6] in France or BBSR in Germany[7] at national level, or GIS Greater Region[8] at the border-regional level).

Third, a **long-term perspective – beyond projects and initiatives** – matters. Ensuring systematic, comparative evidence is essential for analytical progress. Only through consistent data production, regular updates, and transparent methodological processes can new insights into Europe's border regions be generated.

The ESPON Core-IB project has shown that new data sources compiled at the pan-European level offer substantial potential for improving the evidence base on border areas, particularly at the regional scale. Given ongoing advances in data availability, it is reasonable to expect that this trend will continue in the coming years. To make full use of these opportunities, the process of datafication must be strategically and effectively exploited. The following areas are of particular importance from a scientific perspective:

Multi-indicator analyses: The growing number of available indicators calls for more sophisticated multi-indicator approaches. The development of Cross-Border Functional Areas (CBFAs) as developed in the ESPON CROSSGOV project illustrates this well: combining datasets requires careful methodological choices, including the design of weighting schemes and threshold definitions. The CBFA concept will likely evolve further, and similar approaches could be used to explore additional policy-relevant themes at the border-regional level. For instance, new business-related datasets and information on freight flows could enable refined analyses of economic development patterns in border regions.

Time-series analyses: Increasing dataset availability will also enable more time-series analyses. At present, studies based on official statistics have to work with large time lacks (often three years old data as most recent information). More systematic time-series data would allow researchers to test correlations and causal relationships, for example, between accessibility investments and economic development, thereby offering deeper insights into drivers of territorial change. In parallel to new

[5] https://www.bbsr.bund.de/BBSR/EN/research/specialist-articles/spatial-development/network-crossborderdata/main.html;jsessionid=BFF6FFE500201832A3B80D18B6E478EC.live21322#doc3227364bodyText3
[6] La MOT • MOT
[7] https://www.bbsr.bund.de/BBSR/DE/forschung/raumbeobachtung/ueber-raumbeobachtung/grenzueberschreitende-raumbeobachtung/grenzueberschreitende-raumbeobachtung.html
[8] GIS-GR - Geographisches Informationssystem für die Großregion

data sources, the ARDECO database is of high relevance in this regard, as it provides longer time series of regionalised statistics as for example Eurostat. ARDECO fills existing gaps in the official dataset with model-based estimates, thus enabling data to be depicted until 2024.

Pan-European comparative studies: Empirical studies on border regions typically focus on one or a small number of case studies. Improved European-wide data coverage will allow future research to adopt more systematic, comparative perspectives. This, in turn, will help reveal recurring patterns, structural drivers, and latent potentials across border regions in a more generalisable way.

To exploit these opportunities efficiently, a well-structured and coordinated research infrastructure is essential. This includes a systematic network of institutions and actors involved in border-regional analysis, data governance, data protection, and monitoring systems. Strengthening such networks will ensure that new, updated and enriched datasets are effectively integrated, methodological advances are shared, and territorial evidence continues to evolve in step with emerging policy needs.

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