

JUST TRANSITION IN EUROPEAN COAL REGIONS: COMPARATIVE ANALYSIS OF GOOD PRACTICES UNDER THE EUROPEAN GREEN DEAL

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The phase-out of coal represents a major structural transformation for coal-dependent regions in the European Union, with significant socio-economic implications for regional labour markets, economic structures, and demographic stability. This study examines the just transition process in selected European coal regions using a comparative case-study methodology. The analysis focuses on four key dimensions of transition performance: governance capacity, labour-market outcomes, economic diversification, and demographic trends. To enhance analytical consistency, the paper introduces a qualitative Just Transition Performance Index (JTPI), which integrates these dimensions into a structured comparative framework. Based on empirical evidence and index-based interpretation, the study develops a typology of coal regions, distinguishing structurally resilient regions, transitional regions with mixed outcomes, and socially vulnerable regions. The findings contribute to the understanding of regional transition dynamics and highlight the importance of institutional capacity, strategic planning, and economic diversification for achieving sustainable and socially balanced transition outcomes.

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1 Introduction

The transition towards climate neutrality represents one of the most profound structural transformations in the history of the European Union. With the adoption of the European Green Deal (EGD), the European Commission established a comprehensive growth strategy aimed at transforming the Union into a modern, resource-efficient, and competitive economy, while achieving net-zero greenhouse gas emissions by 2050. This strategic framework goes beyond environmental policy, as it fundamentally reshapes economic structures, labour markets, regional development patterns, and public finance systems across Member States.

A central pillar of the EGD is the accelerated reduction of greenhouse gas emissions, with an intermediate target of at least a 55 per cent reduction by 2030 compared to 1990 levels. Achieving these ambitious objectives requires the rapid transformation of energy systems, particularly through the gradual phase-out of coal, which remains one of the most carbon-intensive energy sources. Despite a long-term declining trend, coal has historically played a crucial role in Europe's industrial development and energy security, and in several Member States it continues to represent a significant component of electricity and heat production (Eurostat, 2024c). The structural importance of coal has resulted in strong regional dependencies. Coal mining regions have often developed highly specialised economic structures, characterised by concentrated employment, strong linkages with energy-intensive industries, and long-established social identities connected to mining activities. Consequently, the phase-out of coal does not merely constitute an energy transition, but represents a deep socio-economic transformation affecting employment, income stability, demographic trends, and long-term regional competitiveness. Without adequate policy intervention, these processes risk exacerbating regional disparities and social inequalities within the EU (European Commission (EC), 2019, 2021).

In response to these challenges, the concept of the just transition has emerged as a central normative and policy framework of the EGD. The just transition seeks to ensure that the shift towards climate neutrality is fair and inclusive, minimising adverse social impacts on workers and communities most affected by the decarbonisation process. Its core principle, often summarised by the slogan “leaving no one and no region behind”, emphasises the need to combine environmental

objectives with social cohesion, economic diversification, and active labour-market policies (ILO, 2015; McCauley & Heffron, 2018, Heffron et al., 2020).

Recognising that coal-dependent regions face significantly higher adjustment costs, the European Union has developed a targeted policy architecture to support their transformation. Within the framework of the Just Transition Platform, the Just Transition Mechanism (JTM) was introduced for the 2021–2027 programming period. The mechanism integrates multiple financial instruments, including the Just Transition Fund, a dedicated Invest-EU scheme, and a public sector loan facility supported by the European Investment Bank. Together, these instruments aim to mobilise substantial public and private investments to facilitate economic restructuring, promote innovation, support skills development, and strengthen social resilience in the most affected territories (EC, 2020, 2021). However, the implementation of the just transition remains highly uneven across the EU. Coal regions differ significantly in terms of economic structure, institutional capacity, demography, labour-market conditions, and governance arrangements. While some regions have managed to combine coal phase-out with economic diversification and social stabilisation, others continue to struggle with persistent unemployment, population decline, limited private investment, and delayed implementation of transition strategies. These differences underline the importance of analysing practical experiences and identifying transferable good practices that may inform future policy design (European Court of Auditors, 2022; OECD, 2021).

Against this background, the purpose of this chapter is to provide a comparative analysis of selected European coal regions that have already entered advanced stages of the coal phase-out process and to address the following research question: how do governance capacity, labour-market adjustment, economic diversification, and demographic trends influence the effectiveness of just transition processes in European coal regions? Focusing on regions within the European Union, the chapter examines how different policy approaches, financial instruments, and governance models have influenced socio-economic outcomes during the transition. The analysis combines a comparative case-study approach with a qualitative assessment framework to identify structural patterns and policy-relevant insights. Particular attention is devoted to the role of European structural and investment funds, national support schemes, and local stakeholder involvement in shaping regional transformation trajectories. The selected regions were chosen based on their

relevance for comparative analysis and their degree of similarity to coal-dependent regions currently undergoing transition, including the SAŠA region in Slovenia. By examining cases from Germany, Poland, the Czech Republic, Romania, Spain, and Slovakia, the chapter aims to identify common patterns, key challenges, and effective policy responses associated with the just transition process. The central objective of this chapter is therefore twofold. First, it seeks to systematise empirical evidence on socio-economic restructuring in former coal regions and evaluate the effectiveness of different transition instruments. Second, it aims to derive policy-relevant lessons that may support regions which are still at the early stages of coal phase-out. By doing so, the chapter contributes to the broader debate on the EGD as a development strategy and highlights the importance of aligning climate objectives with social cohesion and long-term regional sustainability (McCauley & Heffron, 2018). The remainder of the chapter is structured as follows. Section 2 introduces the conceptual framework of the just transition and its key socio-economic dimensions. Section 3 presents the European policy context and financial instruments supporting the transition. Section 4 outlines the methodological approach and criteria for selecting the analysed regions. Section 5 provides a comparative analysis of selected coal regions across the EU. Section 6 synthesises good practices and key lessons derived from the empirical cases. Section 7 discusses implications for coal regions currently in transition, while Section 8 concludes the chapter with final reflections and directions for future research.

2 Conceptual framework of a Just Transition

The concept of the just transition has gained increasing prominence in international climate and energy policy debates over the past two decades. Initially developed within labour movements and later adopted by international organisations, the notion of a just transition reflects the recognition that climate policies, while environmentally necessary, may generate substantial social and economic costs if not carefully designed. As such, the just transition represents an integrative framework that seeks to reconcile environmental sustainability with social justice and economic stability (McCauley & Heffron, 2018). At its core, the just transition is founded on the principle that the shift towards a low-carbon economy should not disproportionately burden specific social groups or territories. Regions highly dependent on fossil fuel extraction and carbon-intensive industries face particularly high adjustment costs, including job losses, declining regional incomes, demographic

outmigration, and erosion of local economic structures (OECD, 2021). Without targeted policy interventions, these dynamics risk deepening existing regional disparities and undermining public support for climate action. From a conceptual perspective, the just transition can be understood as a multidimensional process encompassing economic, social, institutional, and territorial dimensions.

The economic dimension relates to the restructuring and diversification of regional economies, including the development of alternative industries, support for entrepreneurship, and attraction of new investments. The social dimension focuses on employment protection, income security, skills development, and the prevention of social exclusion, particularly among workers directly affected by industrial decline. The institutional dimension emphasises governance capacity, coordination between different levels of government, and the effective use of policy instruments. Finally, the territorial dimension highlights the spatial concentration of transition impacts and the need for place-based policy responses (ILO, 2015, EC, 2019). A central element of the just transition framework is the labour-market adjustment process. Coal phase-out often results in concentrated employment shocks that cannot be absorbed through market alone. Consequently, active labour-market policies play a crucial role, including retraining and reskilling programmes, career counselling, mobility support, and targeted employment incentives. Empirical evidence suggests that early intervention, tailored training schemes, and strong cooperation with employers significantly improve re-employment outcomes for displaced workers (OECD, 2021). Beyond labour-market measures, social dialogue constitutes another foundational pillar of the just transition. The involvement of trade unions, employers' associations, local authorities, civil society organisations, and affected communities enhances the legitimacy and effectiveness of transition strategies (ILO, 2015). Inclusive governance arrangements allow for the identification of local needs, increase policy acceptance, and reduce resistance to structural change. In this regard, the just transition is not solely a technical or economic process but also a participatory one, requiring continuous engagement among stakeholders. The territorial nature of the just transition further implies that uniform policy solutions are unlikely to be effective. Coal regions differ considerably in terms of population size, industrial legacy, infrastructure quality, human capital, and innovation capacity. For this reason, the just transition is closely linked to the concept of place-based development, which emphasises tailored strategies reflecting local strengths, constraints, and development potentials. Such an approach aligns with the broader

objectives of European cohesion policy, which aims to reduce regional disparities while supporting structural transformation (OECD, 2021). Within the European Union, the just transition has been explicitly integrated into the strategic framework of the EGD. The principle of “leaving no one and no region behind” underscores the political commitment to ensuring that decarbonisation contributes to inclusive growth rather than social fragmentation. This commitment reflects the understanding that climate neutrality can only be achieved sustainably if it is socially acceptable and economically viable across all Member States (EC, 2019, 2021). Importantly, the just transition framework also entails intertemporal considerations. Transition costs are often immediate and highly visible, whereas the benefits of decarbonisation, such as environmental improvements, innovation-driven growth, and enhanced energy security, materialise gradually over time. Public policy therefore plays a critical role in smoothing adjustment processes and distributing costs more evenly across society and generations (OECD, 2017). In this context, fiscal instruments, public investment, and European solidarity mechanisms become essential tools for mitigating short-term disruption while enabling long-term structural transformation. Strategic public investment can act as a catalyst for innovation and new industrial development in transition regions (Mazzucato, 2013). Another key conceptual distinction concerns the difference between energy transition and socio-economic transition. While energy transition primarily focuses on replacing fossil fuels with renewable energy sources, the just transition adopts a broader perspective encompassing economic restructuring, social cohesion, and regional development (McCauley & Heffron, 2018). Empirical experiences from coal regions demonstrate that replacing energy sources alone does not automatically generate sufficient employment or income opportunities (EC, 2020). Successful transitions therefore require comprehensive development strategies extending beyond the energy sector, including innovation support, entrepreneurship, and human capital investment (OECD, 2021). In this sense, the just transition framework emphasises the importance of long-term strategic planning. Regions that initiated transition strategies early, invested in education and innovation, and established strong institutional coordination mechanisms have generally demonstrated greater resilience. Conversely, regions characterised by delayed planning, fragmented governance, and reliance on short-term compensatory measures have faced prolonged socio-economic difficulties.

In summary, the just transition represents a holistic policy paradigm that integrates environmental ambition with social responsibility and territorial cohesion. It provides the conceptual foundation for understanding why coal phase-out must be accompanied by targeted support mechanisms and coordinated governance structures. This framework underpins the empirical analysis presented in the subsequent sections of this chapter, which examine how different European coal regions have operationalised the principles of the just transition in practice.

3 European Green Deal and EU Financial Instruments

The European Green Deal (EGD) represents the most comprehensive policy framework adopted by the European Union in the field of climate and sustainable development. Introduced in 2019, it establishes a long-term vision of transforming the European economy into a climate-neutral, resource-efficient, and globally competitive system. Unlike earlier policy initiatives, the EGD explicitly integrates climate objectives with economic transformation, industrial development, and social cohesion. Its central goal—climate neutrality by 2050—is complemented by an intermediate target of reducing greenhouse gas emissions by at least 55 per cent by 2030 compared to 1990 levels (European Commission, 2019, 2021). Achieving these objectives requires structural changes across multiple sectors, with the energy sector playing a particularly critical role due to the high emission intensity of fossil fuels, especially coal. Coal phase-out has therefore become a key component of EU decarbonisation policy. However, the EGD recognises that the socio-economic costs of this transformation are unevenly distributed, with coal-dependent regions facing disproportionately high adjustment pressures. This asymmetry underpins the development of targeted policy instruments aimed at supporting affected regions (European Court of Auditors, 2022). To operationalise the principle of a fair transition, the European Commission established the Just Transition Platform, which provides technical assistance, facilitates knowledge exchange, and supports the preparation of Territorial Just Transition Plans. These plans play a central role in defining region-specific transition pathways and are a prerequisite for accessing dedicated financial support. Building on this framework, the Just Transition Mechanism (JTM) was introduced for the 2021–2027 programming period as a comprehensive financial architecture designed to address the socio-economic impacts of decarbonisation. The JTM combines three complementary instruments.

The first pillar of the JTM is the Just Transition Fund (JTF). The fund provides targeted grants to regions facing the most severe employment and economic challenges arising from the transition away from fossil fuels. Its primary objectives include supporting economic diversification, facilitating the creation of new sustainable jobs, financing reskilling and upskilling programmes, and promoting the rehabilitation of industrial sites. Importantly, the JTF is embedded within cohesion policy and operates under a place-based logic, allowing Member States to tailor interventions to regional characteristics. National co-financing requirements further enhance ownership and integration with broader development strategies (EC, 2021).

The second pillar consists of a dedicated Just Transition scheme under the Invest-EU programme. This component aims to leverage private investment by providing EU budget guarantees to reduce investment risk in transition regions. Through financial instruments such as loans, equity, and guarantees, the Invest-EU Just Transition scheme supports projects in areas including renewable energy, clean mobility, energy efficiency, innovation, and business development. By crowding in private capital, this pillar seeks to complement grant-based support and strengthen the long-term sustainability of regional economies (EC, 2020, 2021).

The third pillar of the mechanism is the Public Sector Loan Facility, implemented in cooperation with the EIB. This instrument combines EU grants with EIB loans to support public-sector investments that do not generate sufficient market returns but are essential for regional transformation. Typical projects include energy infrastructure, heating systems, public transport, environmental rehabilitation, and social infrastructure. By lowering borrowing costs for regional authorities, the facility enhances the capacity of public institutions to act as catalysts of transition. Together, these instruments reflect a shift from compensatory policies towards investment-driven development strategies. The mechanism represents a transition from reactive adjustment policies towards proactive transformation strategies (EC, 2021).

Despite this comprehensive financial architecture, the effectiveness of EU instruments depends critically on governance capacity at national and regional levels. Access to funding requires coherent transition planning, institutional coordination, and the ability to develop viable projects. Regions with stronger administrative capacity are therefore better positioned to utilise available resources, while weaker regions risk delays or underutilisation. Moreover, the scale of investment required

for climate neutrality exceeds the resources provided by the JTM alone. National budgets and private investment remain essential components of the overall financing framework (European Commission, 2021; OECD, 2021). In this context, EU funds act primarily as catalytic instruments that guide investment priorities and reduce transition risks, rather than as substitutes for national commitment. In summary, the EGD and its associated financial instruments constitute a multi-level governance framework aimed at aligning climate objectives with social cohesion and regional development. The extent to which this framework translates into successful regional transformation ultimately depends on institutional capacity, policy coherence, and effective implementation at national and regional levels.

4 Methodological Approach

This chapter adopts a qualitative comparative case-study approach to examine the socio-economic dimensions of the just transition in selected European coal regions. The methodological design is grounded in the recognition that coal phase-out processes are deeply embedded in regional economic structures, institutional arrangements, and historical development paths, which cannot be adequately captured through purely quantitative modelling.

A comparative case-study methodology enables an in-depth exploration of heterogeneous transition trajectories and facilitates the identification of patterns, similarities, and differences across regions. This approach is particularly suitable for analysing complex policy processes involving multiple governance levels, diverse funding instruments, and region-specific socio-economic conditions. By combining structured comparison with qualitative interpretation, the methodology provides both analytical depth and policy relevance.

4.1 Selection of Regions

The selection of regions was guided by three main criteria. First, the analysed regions have experienced significant dependence on coal mining and coal-based energy production, resulting in substantial employment and structural impacts following the decline or closure of mining activities. Second, the regions have entered advanced or completed stages of coal phase-out, enabling the assessment of observed transition outcomes rather than projected effects. Third, the regions exhibit varying

institutional, economic, and demographic characteristics, allowing for meaningful comparison across different transition models. Based on these criteria, the chapter focuses exclusively on coal regions located within EU. This limitation reflects both data availability and the intention to analyse transition processes within a common policy framework shaped by the EGD and EU cohesion policy instruments. The analysed regions include Lusatia in Germany, Malopolska and Silesia in Poland, the Moravian-Silesian Region in the Czech Republic, the Jiu Valley in Romania, Asturias and León–Palencia in Spain, and Upper Nitra in Slovakia. Special attention is devoted to the comparability of these regions with coal-dependent regions currently undergoing transition, including the SAŠA region in Slovenia. Although the regions differ in size and demographic structure, their shared dependence on coal-related economic activities provides a robust basis for comparative analysis.

4.2 Data Sources

The analysis is based on secondary data obtained from multiple European and national sources. Key quantitative indicators were drawn from Eurostat databases, including data on coal production, employment in mining activities, demographic trends, and labor-market developments (Eurostat, 2024abc). Additional information was collected from reports published by the European Commission and the Joint Research Centre, which provide detailed assessments of coal regions in transition (EC, 2020). Evaluations of EU financial instruments and implementation effectiveness were informed by reports of the European Court of Auditors (2022). Policy documents, regional development strategies, territorial just transition plans, and evaluation reports of European Structural and Investment Funds were also examined. These sources enabled an assessment of both formal policy design and practical implementation. Where available, regional-level statistics were complemented by qualitative information on governance structures, stakeholder involvement, and strategic planning processes.

4.3 Analytical Framework and Construction of JTPI

The comparative analysis is structured around four core analytical dimensions reflecting the key components of the just transition process identified in the conceptual framework like governance capacity (institutional coordination, strategic planning, implementation effectiveness), labour-market outcomes (employment

adjustment, job creation), economic diversification (innovation, investment structure, SME development) and demographic trends (migration patterns and population stability). These dimensions capture the structural and institutional determinants of transition performance and provide a consistent basis for cross-regional comparison. To support a more systematic interpretation of comparative results, a simple Just Transition Performance Index (JTPI) is constructed in section 6. The index aggregates the four analytical dimensions using a qualitative scoring approach. The index provides a synthetic measure of relative transition performance across cases. It is important to emphasise that the JTPI is not intended as a statistically rigorous composite indicator, but rather as a heuristic and interpretative tool. Its purpose is to enhance transparency, facilitate structured comparison, and support the synthesis of findings presented in the empirical analysis and complements the qualitative assessment.

4.4 Limitations of the Study

Several limitations should be acknowledged. First, the availability and comparability of regional data remain uneven, particularly regarding indirect employment effects and long-term socio-economic impacts. Second, differences in national statistical methodologies constrain direct quantitative comparison across regions. Third, the analysis focuses primarily on observable short- to medium-term outcomes, while many transition effects will materialize only over longer time horizons. Despite these limitations, the comparative case-study approach provides valuable insights into practical transition experiences and supports the identification of policy-relevant lessons. The findings should therefore be interpreted as indicative rather than deterministic, highlighting tendencies and good practices rather than universal causal relationships.

5 Comparative Analysis of Selected European Coal Regions

This section presents a comparative analysis of selected European coal regions that have entered advanced stages of the coal phase-out process. The analysis focuses on socio-economic adjustment mechanisms, governance arrangements, and the effectiveness of policy instruments applied during the transition. By examining different regional trajectories, the section aims to identify structural patterns and practical experiences that contribute to varying just transition outcomes.

To provide a structured overview of initial conditions and transition dynamics, Table 1 summarises key indicators, including demographic characteristics, coal-sector employment trends, production dynamics, and the scope of labour-market adjustment measures. The data are primarily derived from Eurostat databases and European Commission reports on coal regions in transition (EC, 2020; Eurostat, 2024a, 2024b).

Table 1: Comparative overview of selected European coal regions

Indicator	Lusatia (DE)	Małopolska (PL)	Silesia (PL)	Moravian-Silesian (CZ)	Jiu Valley (RO)	Palencia & León (ES)	Asturias (ES)
NUTS level	NUTS 3	NUTS 2–3	NUTS 2	NUTS 2	NUTS 2–3	NUTS 3	NUTS 2
Population (million)	0.6	3.4	4.5	1.2	0.1	0.6	1.0
Coal employment 2014	3,600	4,921	93,190	14,749	4,741	1,113	2,400
Coal employment 2020	3,323	3,814	71,281	6,818	3,056	0	0
Jobs lost (2014–2020)	277	1,107	21,909	7,931	1,685	1,113	2,400
Coal production (Mt)	33.0	5.0	49.4	4.5	0.7	0.5	0.3
Active mines (2022)	2	2	16	1	4	0	0
Participants in retraining programmes	1,936	65,170	12,234	6,276	1,823	884	7,990
Jobs created via ERDF	110	2,151	3,802	387	104	n.a.	668
Jobs created / jobs lost	High	Low–moderate	Moderate	Low	Very low	Low	Moderate
Migration trend (2013/20)	Positive	Negative	Slightly negative	Negative	Strongly negative	Negative	Positive
Existence of transition strategy	Yes	Yes	Yes	Yes	Yes (late)	Yes	Yes
Implementation effectiveness	High	Moderate	Moderate	Moderate	Low	Moderate	Moderate–high
Main transition focus	Innovation & R&D	Training & infrastructure	Infrastructure & transport	Environment & mobility	Social support	Clean energy	Clean energy & efficiency
Overall just transition outcome	Relatively successful	Mixed	Mixed	Mixed	Weak	Moderate	Relatively successful

Source: European Commission (Joint Research Centre), Eurostat databases, national and regional transition strategies, and authors' own elaboration.

The comparative indicators presented in Table 1 highlight substantial heterogeneity among European coal regions in terms of initial structural conditions, labour-market exposure, and transition trajectories. Although all analysed regions operate within a common European policy framework, the scale of employment losses, demographic trends, and institutional responses differs considerably.

The table illustrates that regions characterised by early strategic planning, strong administrative capacity, and diversified development priorities tend to achieve more favourable transition outcomes. Conversely, regions facing delayed policy responses, limited economic diversification, or persistent demographic decline encounter significantly greater challenges in translating financial support into sustainable socio-economic recovery (European Court of Auditors, 2022). These differences underline that the effectiveness of the just transition cannot be assessed solely through the volume of allocated funding, but must be analysed in relation to governance quality, stakeholder involvement, and the coherence between energy, labour-market, and regional development policies. The following subsections therefore examine individual regional trajectories in greater detail, with particular attention to the mechanisms that contributed to more or less successful transition outcomes.

5.1. Germany - Lusatia

Lusatia represents one of the most prominent coal regions in Germany and is historically divided between the federal states of Brandenburg and Saxony. The analysis presented here focuses on the Brandenburg part of Lusatia, which has undergone substantial structural change following the national decision to phase out coal-fired power generation by 2038.

Compared to other coal regions, Lusatia experienced a relatively limited reduction in coal-related employment between 2014 and 2020. Employment adjustments were primarily achieved through natural attrition and retirement rather than large-scale dismissals, which significantly reduced social tensions. During this period, net migration trends remained positive, indicating a comparatively stable demographic situation.

A defining feature of the Lusatian transition model has been the strong role of national financial support. The German federal government allocated approximately EUR 17 billion in structural assistance to coal regions, enabling early planning and long-term investment commitments. These resources were largely directed toward research and development, innovation infrastructure, digitalisation, and business development, with a particularly strong emphasis on strengthening regional innovation capacity.

However, the Lusatian case also illustrates the limitations of a transition strategy focused predominantly on socio-economic restructuring without a simultaneous acceleration of energy transformation. In the short term, coal production in remaining mines temporarily increased to compensate for regional energy deficits, which limited immediate reductions in carbon dioxide emissions. This highlights the distinction between socio-economic transition and energy transition, demonstrating that progress in one dimension does not automatically translate into environmental outcomes.

Overall, Lusatia can be considered an example of institutionally strong and financially well-supported transition, characterised by social stability but slower environmental transformation.

5.2. Poland – Małopolska and Silesia

Poland represents one of the most complex cases of coal transition within the European Union due to the scale of its coal sector and its continued reliance on domestic coal for energy security (EC, 2020). The regions of Małopolska and Silesia illustrate two different but interconnected transition pathways.

In Małopolska, a large number of workers participated in training and reskilling programmes between 2014 and 2020. Although participation rates were exceptionally high, the proportion of directly created jobs remained relatively limited. The region invested heavily in research, innovation, business development, and transport infrastructure, supported by both the European Regional Development Fund and the Cohesion Fund (Eurostat, 2024b).

Despite these efforts, net migration trends remained negative, suggesting that labour-market improvements were partially offset by outmigration. Furthermore, reductions in domestic coal production were partly compensated by increased coal imports, resulting in only modest environmental improvements and higher energy import dependency.

Silesia, by contrast, represents the largest coal region in the European Union in terms of employment and production volume (Eurostat, 2024a). Although coal-related employment declined significantly, overall unemployment rates decreased during the analysed period, supported by strong national labour demand and gradual workforce adjustment mechanisms. Public investments focused on transport infrastructure, environmental remediation, and energy-related projects, while the region demonstrated comparatively high effectiveness in job creation relative to the number of unemployed persons (EC, 2020).

Nevertheless, Silesia continues to face structural challenges, including limited capacity to fully replace coal-related employment through clean energy technologies and persistent environmental burdens. The Polish experience highlights the difficulty of achieving a rapid just transition in large-scale coal economies, particularly when national energy strategies continue to rely on fossil fuels

5.3. Czech Republic – Moravian-Silesian Region

The Moravian-Silesian Region represents one of the most industrialised areas in Central Europe and has experienced a pronounced decline in coal mining employment. Unlike regions where employment reduction occurred mainly through retirement, this region faced direct layoffs, increasing short-term labour-market pressures. The Czech government responded through the RE:START programme, designed to support economic diversification and improve regional competitiveness. Significant resources from European Structural and Investment Funds were allocated to environmental infrastructure, sustainable transport, and energy efficiency measures. As a result, the region achieved comparatively high energy savings, particularly in heat consumption. Despite these achievements, the environmental benefits of reduced coal production were partly offset by increased imports of fossil fuels, limiting emission reductions. Furthermore, while targeted retraining programmes demonstrated high individual employment success rates,

their overall coverage remained limited relative to the scale of employment losses. The Moravian-Silesian case underscores the importance of programme scale and timing. Effective instruments exist, but insufficient coverage may reduce their systemic impact (Eurostat, 2024b, EC, 2020, European Court of Auditors, 2022).

5.4. Romania – Jiu Valley

The Jiu Valley constitutes one of the most socio-economically vulnerable coal regions in the EU. Historically characterised by a high concentration of coal-mining employment, the region experienced severe labour-market disruption following the progressive closure of mining activities (Eurostat, 2024b). Employment losses were accompanied by long-term demographic decline and outward migration, further weakening regional development prospects. Public investment in the region initially focused predominantly on social, health, and educational infrastructure, reflecting urgent short-term stabilisation needs (EC, 2020). However, comparatively limited resources were directed toward innovation, entrepreneurship, and private-sector development, constraining long-term economic diversification. Evaluations of EU support mechanisms indicate that delays in strategy implementation and limited administrative capacity significantly reduced the effectiveness of transition instruments (European Court of Auditors, 2022). Only the most recent transition strategy, developed with broader stakeholder involvement, demonstrates stronger alignment with just transition principles.

A notable positive development has been the emergence of active civil society initiatives seeking to redefine regional identity and promote community-based development pathways (Interreg Europe, 2024). These bottom-up efforts illustrate the importance of participatory governance, particularly in regions where institutional capacity remains comparatively weak.

5.5. Spain – Asturias and León–Palencia

Spain implemented a relatively rapid coal phase-out, particularly after 2018, following national agreements on mining closures and restructuring (EC, 2020). In the regions of Asturias and León–Palencia, mine closures resulted in substantial job losses, which were initially addressed through income support schemes and early retirement arrangements. While these measures mitigated short-term social

disruption, they did not immediately generate sufficient long-term employment opportunities. Subsequent regional strategies shifted focus toward economic diversification, renewable energy deployment, and energy-efficiency investments. Asturias, in particular, increased investments in renewable energy infrastructure and achieved a comparatively higher proportion of job creation relative to coal employment losses (Eurostat, 2024b; 2024c). Nevertheless, structural labour-market rigidities and demographic challenges continued to constrain employment absorption capacity. This suggests that compensation-based approaches, although essential for social stability, must be complemented by active development policies capable of fostering sustainable private-sector growth (OECD, 2021). Overall, the Spanish case illustrates a transition pathway in which strong social protection mechanisms were gradually complemented by forward-looking investment strategies, resulting in moderate but comparatively stable transition outcomes..

5.6. Slovakia – Upper Nitra

Upper Nitra represents a coal region in which energy security considerations played a decisive role in shaping the transition pathway. The coal mine and associated power plant historically formed a significant component of regional electricity supply and district heating systems (EC, 2020). Although coal-mining employment declined steadily between 2014 and 2020, relatively few workers were expected to face abrupt unemployment due to the ageing workforce structure and decreasing interest in mining occupations among younger cohorts (Eurostat, 2024b). This gradual workforce adjustment reduced immediate labour-market pressures compared to regions experiencing sudden mine closures. At the same time, the planned closure of coal operations raised concerns regarding electricity supply stability and price volatility, highlighting the interaction between energy policy and regional development objectives. Substantial state aid supported investment projects in manufacturing and services, contributing to job creation beyond the coal sector.

Nevertheless, persistent skills mismatches and limited diversification capacity continue to pose structural challenges. As in other coal regions, the effectiveness of transition measures depends not only on financial support but also on alignment between retraining programmes and actual labour-market demand. The Upper Nitra case demonstrates the complexity of transitions in regions where employment, energy security, and territorial development objectives intersect.

Interim Analytical Insight

The comparative analysis reveals several cross-cutting patterns across the examined coal regions. First, early strategic planning and strong institutional capacity significantly reduce the intensity of social and labour-market disruption. Regions that initiated transition processes proactively and established clear governance structures demonstrated greater socio-economic stability and smoother workforce adjustment.

Second, the volume of allocated financial resources alone does not determine transition success. Although substantial EU and national funding has been directed toward coal regions, the effectiveness of these resources depends on administrative capacity, policy coordination, and the strategic alignment of investments with long-term development objectives (European Court of Auditors, 2022).

Third, labour-market instruments must be implemented at sufficient scale and in close connection with regional economic strategies. High participation rates in retraining programmes do not automatically translate into sustainable employment outcomes unless accompanied by credible job-creation pathways.

Fourth, reductions in domestic coal production do not necessarily result in proportional emission reductions when energy demand is substituted by fossil fuel imports. This finding reinforces the conceptual distinction between socio-economic transition and energy transition developed in Section 2.

Finally, stakeholder engagement and community involvement emerge as important determinants of transition legitimacy. Regions characterised by inclusive governance arrangements and active civil society participation tend to demonstrate higher levels of social acceptance and policy continuity. These cross-regional insights provide the analytical foundation for the synthesis of good practices and typological classification developed in the following section.

6 Synthesis of Good Practices and Key Lessons

The comparative analysis of European coal regions demonstrates that just transition processes are not determined by a single policy instrument or funding mechanism, but rather by a complex interaction between economic structures, institutional

capacity, governance arrangements, and strategic policy design. Although the analysed regions operate within a common European framework defined by the EGD and the JTM, their transition trajectories differ substantially, reflecting diverse historical legacies and regional development conditions. The empirical evidence summarised in Table 1 confirms that the initial structural position of coal regions significantly influences transition outcomes. Regions characterised by high employment concentration in coal mining and limited economic diversification faced more pronounced adjustment pressures, while regions with a broader industrial base exhibited greater adaptive capacity. These structural differences underline the importance of recognising heterogeneity among coal regions when designing transition strategies. *A first key lesson* concerns the importance of early and strategic planning. Regions that initiated transition strategies prior to large-scale mine closures demonstrated greater socio-economic resilience. Early planning facilitated gradual labour-market adjustment, reduced the intensity of employment shocks, and enabled the preparation of investment pipelines aligned with emerging sectors. Conversely, delayed policy responses frequently resulted in reactive strategies dominated by short-term compensation measures, which mitigated immediate social tensions but failed to generate sustainable development dynamics.

Closely related to timing is the role of institutional capacity and governance quality. Regions exhibiting strong coordination between national, regional, and local authorities achieved more effective implementation of transition measures. Stable administrative structures, clearly defined responsibilities, and continuity of leadership enhanced the absorption of European funds and improved policy coherence. In contrast, regions characterised by fragmented governance or limited administrative capacity encountered significant implementation delays, despite comparable levels of financial support. This confirms that governance quality constitutes a decisive determinant of just transition success.

Another central good practice emerging from the analysis is the diversification of regional economic structures. Regions that directed investments toward innovation, research infrastructure, clean energy technologies, and entrepreneurship demonstrated stronger long-term competitiveness. Empirical comparisons suggest that knowledge-based activities and support for small and medium-sized enterprises tend to generate more sustainable employment effects than infrastructure

investments alone. Diversification reduces vulnerability to sector-specific shocks and enhances the resilience of regional economies in the post-coal period.

Labour-market policies represent a further critical dimension of transition effectiveness. Although retraining and reskilling programmes are widely implemented across coal regions, their outcomes vary considerably. Comparative evidence indicates that high participation rates in training programmes do not automatically translate into employment creation. More favourable outcomes were observed in regions where training was closely aligned with regional investment strategies, involved employers in programme design, and was complemented by career guidance and job-matching services. Conversely, fragmented training initiatives produced limited systemic effects.

The analysis also highlights the need to balance social protection with active development measures. Income support schemes, early retirement, and compensation mechanisms play an essential role in preserving social stability during periods of structural change. However, regions that relied predominantly on passive measures exhibited weaker long-term development trajectories. More successful transition models gradually shifted from compensation-oriented approaches toward investment-driven development strategies that stimulate endogenous growth.

An additional lesson concerns the distinction between socio-economic transition and energy transition. The comparative cases demonstrate that reductions in domestic coal production do not automatically lead to proportional emission reductions, particularly when energy demand is substituted by imported fossil fuels. This underscores the necessity of integrated transition strategies that align labour-market policies, regional development objectives, and energy-system transformation. Investments in renewable energy and energy efficiency yield the greatest benefits when embedded within broader regional restructuring frameworks.

Stakeholder engagement and social dialogue emerge as critical success factors across all analysed regions. Inclusive governance arrangements involving trade unions, employers, municipalities, civil society organisations, and local communities enhance the legitimacy of transition processes and reduce resistance to structural change. In regions with strong mining identities, participatory approaches were particularly

important for rebuilding trust and facilitating acceptance of long-term transformation strategies.

Furthermore, the findings confirm the relevance of place-based approaches. Uniform policy solutions are insufficient to address the diverse challenges faced by coal regions, which differ in demographic trends, labour-market structures, and development potential. Tailored interventions reflecting regional characteristics and comparative advantages are more likely to produce durable outcomes, supporting the EU emphasis on Territorial Just Transition Plans. From a financial perspective, the synthesis demonstrates that the availability of funding alone does not guarantee successful transition outcomes. While European instruments such as the JTF, Invest-EU and cohesion policy resources play a crucial catalytic role, their effectiveness depends on the mobilisation of complementary national funding and private investment. Regions combining European support with long-term national commitment achieved more stable and predictable transformation paths.

To enhance comparative interpretation, a simple Just Transition Performance Index (JTPI) was developed as a synthetic analytical instrument. The index aggregates four core dimensions identified in the analysis—governance capacity, labour-market outcomes, economic diversification, and demographic trends—each reflecting key determinants of transition performance. The JTPI does not constitute a statistically weighted composite indicator. Rather, it serves as an interpretative framework that facilitates structured cross-regional comparison and supports the identification of broader transition patterns. The conceptual structure of the index is presented in Table 2.

Table 2: Structure of the Just Transition Performance Index (JTPI)

Dimension	Description
Governance capacity	Institutional coordination, implementation effectiveness, strategic planning
Labour-market outcomes	Employment adjustment, retraining effectiveness, job creation
Economic diversification	Investment structure, innovation, SME development
Demographic trends	Migration balance, population stability

Source: Own

Each dimension is assessed using a qualitative three-level scale, where 1 indicates low performance, 2 moderate performance, and 3 high performance. The index does not represent a statistically weighted composite measure, but serves as an interpretative framework supporting cross-regional comparison. Based on this framework, a qualitative JTPI score was calculated for each analysed region. The illustrative results are presented in Table 3.

Table 3: Illustrative Just Transition Performance Index (JTPI) by region

Region	Governance	Labour market	Diversification	Demography	JTPI (average)
Lusatia (DE)	3	3	3	2	2.75
Asturias (ES)	3	2	3	2	2.50
Silesia (PL)	2	2	2	2	2.00
Moravian-Silesian (CZ)	2	2	2	1	1.75
Jiu Valley (RO)	1	1	1	1	1.00

Note: The index represents a qualitative synthesis based on comparative indicators and expert assessment rather than a statistically weighted composite measure.

The index-based comparison reinforces the empirical patterns observed in Table 1 and facilitates the identification of distinct transition trajectories across coal regions. On the basis of the comparative analysis and JTPI results, coal regions can be grouped into three broad transition types.

Type I: Early planners and structurally resilient regions: These regions are characterised by early strategic planning, strong governance capacity, and diversified economic structures. Their transition trajectories exhibit relatively favourable labour-market outcomes and higher socio-economic resilience. Examples include Lusatia and Asturias.

Type II: Transitional regions with mixed outcomes: This group includes regions with partial diversification, improving but still constrained institutional capacity, and moderate labour-market adjustment. Transition progress is evident, yet remains uneven and sensitive to policy coordination. Examples include Silesia and the Moravian-Silesian Region.

Type III: Socially vulnerable transition regions: These regions display weak institutional capacity, high historical dependence on coal, and persistent adverse demographic trends. Transition processes are slower and more fragile, requiring sustained and targeted policy support. An illustrative case is the Jiu Valley. This typology highlights the necessity of differentiated, place-based policy responses and confirms that coal regions do not follow uniform transition pathways.

7 Implications for Coal Regions Currently in Transition

The findings of the comparative analysis presented in this chapter provide several important implications for coal-dependent regions that are currently entering or intensifying the transition process. As the EGD accelerates decarbonisation across Member States, an increasing number of regions face the complex challenge of simultaneously managing energy-system transformation, labour-market adjustment, and long-term regional development. The empirical evidence derived from the analysed coal regions offers valuable guidance for shaping effective and socially balanced transition strategies.

A first implication concerns the necessity of adopting a comprehensive and forward-looking transition vision. Regions that frame coal phase-out solely as an energy-sector issue risk underestimating its broader socio-economic consequences. In contrast, regions applying an integrated approach—linking energy policy with regional development strategies, labour-market planning, education systems, and innovation policy—demonstrate more coherent and resilient transition trajectories. Such integration reduces policy fragmentation and increases the likelihood that new economic activities will absorb displaced workers, thereby strengthening both social cohesion and long-term competitiveness.

Second, early institutional preparation is essential. Regions benefit from establishing dedicated governance structures responsible for coordinating transition-related investments and stakeholder engagement. Clear institutional leadership, stable administrative capacity, and well-defined responsibilities enhance the effective absorption of EU funding and reduce implementation delays (European Court of Auditors, 2022). Without such governance arrangements, even substantial financial allocations may fail to generate durable socio-economic transformation.

Third, labour-market implications require proactive and strategic planning. Concentrated employment shocks in coal regions cannot be absorbed through general labour-market dynamics alone. Regions achieving more favourable outcomes engaged in early workforce planning, systematic identification of skills gaps, and close cooperation with regional employers. Retraining initiatives proved most effective when aligned with concrete investment projects and realistic employment prospects, rather than implemented as isolated policy instruments. The credibility of transition strategies therefore depends heavily on the visibility of tangible job-creation pathways.

A further implication relates to economic diversification. Regions relying on a narrow set of alternative industries remain vulnerable to future economic shocks. The comparative analysis confirms that sustainable transition outcomes are more likely when diversification strategies are broad-based and supported by investments in innovation ecosystems, entrepreneurship, clean energy technologies, and small and medium-sized enterprises. Public investment should therefore aim not merely to replace lost coal-related employment but to enhance long-term regional adaptability and competitiveness. The analysis also highlights the critical role of social dialogue and stakeholder involvement. Regions currently undergoing transition benefit from inclusive governance models that actively involve workers, trade unions, municipalities, educational institutions, and civil society organisations. Participatory processes strengthen social trust, reduce resistance to structural change, and improve the quality of strategic decision-making. In regions with strong mining identities, stakeholder engagement plays a particularly important role in facilitating acceptance of long-term transformation beyond the coal legacy.

From a financial perspective, EU funds should be regarded as catalytic instruments rather than substitutes for national commitment. While mechanisms such as the JTF provide essential support, the scale of required investment exceeds EU allocations alone (EC, 2021). Regions demonstrating stable transition trajectories typically combined European resources with predictable national co-financing and long-term investment frameworks. Fiscal stability and policy continuity therefore remain indispensable preconditions for successful transformation. Transition strategies must ensure coherence between socio-economic objectives and energy-system transformation. Coal phase-out does not automatically produce proportional emission reductions if energy demand is replaced by other fossil fuels. Integrated

investment in renewable energy and low-carbon infrastructure generates the greatest benefits when embedded within broader regional development strategies.

Finally, the transition process entails significant temporal challenges. Social and employment-related costs tend to materialise rapidly, whereas the benefits of economic restructuring emerge gradually. Policymakers must therefore manage expectations, maintain long-term political commitment, and ensure transparent communication throughout the transition process. Continuous monitoring and adaptive governance mechanisms are essential for sustaining public support over time. Overall, the implications derived from this study emphasise that just transition is not a one-dimensional policy intervention but a long-term development process. Regions currently entering the transition phase face substantial risks, but also significant opportunities to modernise economic structures, improve environmental performance, and strengthen social cohesion.

8 Conclusions

The transition toward climate neutrality represents one of the most far-reaching structural transformations currently unfolding within the European Union. As demonstrated throughout this chapter, coal phase-out processes extend well beyond the energy sector and entail profound socio-economic implications for affected regions. The European Green Deal and the Just Transition Mechanism have established a comprehensive policy architecture designed to mitigate these impacts and align climate objectives with social and territorial cohesion. The comparative analysis of selected European coal regions confirms that transition outcomes are shaped by a complex interaction between initial structural conditions, governance capacity, labour-market dynamics, and the strategic orientation of public investment. Regions characterised by early planning, diversified economic structures, and strong institutional coordination demonstrate greater socio-economic resilience. Conversely, regions with delayed strategic responses, limited diversification, and weak administrative capacity face more persistent adjustment challenges. The development of the qualitative Just Transition Performance Index (JTPI) contributes to the analytical assessment of regional transition pathways by providing a structured framework for cross-regional comparison. While not intended as a statistically definitive ranking tool, the JTPI facilitates a systematic evaluation of governance performance, labour-market adjustment, economic diversification, and

demographic resilience. The resulting typology of transition regions underscores the necessity of differentiated, place-based policy approaches. The findings of this chapter highlight that financial support, although essential, is not sufficient to guarantee successful regional transformation. Institutional quality, policy coherence, and stakeholder engagement emerge as decisive determinants of long-term transition performance. Moreover, the distinction between socio-economic transition and energy-system transformation demonstrates that emission reductions and regional development objectives must be pursued in an integrated manner. Ultimately, the just transition should not be understood merely as a compensatory mechanism accompanying decarbonisation, but as a development strategy capable of fostering structural modernisation, innovation, and renewed regional competitiveness. As additional European regions enter advanced stages of coal phase-out, the lessons derived from early transition experiences provide valuable guidance for aligning climate ambition with social stability and territorial sustainability.

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