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Case study analysis of regions in transition

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Abbreviations

CG13	Coal plant Gelderland (Centrale Gelderland 13)
EBRD	European Bank of Reconstruction and Development
EC	European Commission
EDB	Ease of Doing Business
EU	European Union
ERDF	European Regional Development Fund
EU	European Union
FADE	Federación Asturiana de Empresarios (Asturian federation of businessmen)
FAEN	Fundación Asturiana de la Energía (Asturian energy foundation)
GDF	Gaz de France (gas from France)
FDI	Foreign Direct Investment
GDP	Gross domestic product
GHG	Greenhouse gases
GVA	Gross value added
GWR	Gemeinschaftsaufgabe Verbesserung der regionalen Wirtschaftsstruktur
HEC	Hunedoara Energy Complex (Complexul Energetic Hunedoara)
IDAE	Instituto para la Diversificación y Ahorro de la Energía (Institute for energy diversification and saving)
IDEPA	Instituto de Desarrollo Económico del Principado de Asturias (Economic Developoment Institute of the Principality of Asturias)
IG BCE	The Industriegewerkschaft Bergbau, Chemie, Energie (Trade Union IG Bergbau, Chemie, Energie)
IISD	International Institute for Sustainable Development
ILO	International Labour Organisation
INE	Instituto Nacional de Estadística (National Statistics Institute)
IRMC	Instituto para la Reestructuración de la Minería (Institute for mining restructuration)
JTM	Just Transition Mechanism
LNG	Liquefied natural gas
MEF	Ministry of European Funds (Ministerul Fondurilor Europene)
NECP	National Energy and Climate Plan
NRW	North Rhine-Westphalia
NUTS	Nomenclature of Territorial Units for Statistics
PCRT	Platform for Coal Regions in Transition
PLN	Polish Zloty, National Currency
PNIEC	Plan Nacional Integrado de Energía y Clima (National Energy and Climate Plan)
RCI	Regional Competitiveness Index
RD	Royal decree
RED	Renewable Energy Directive
RES	Renewable Energy Sources
RIS3	Research and Innovation Strategies for Smart Specialisation
R&D	Research and development
R&D&I	Research, development, and innovation
R&I	Research and innovation
RWE AG	Rheinisch-Westfälisches Elektrizitätswerk Aktiengesellschaft (Rhenish-Westphalian Power Plant)
RWTH Aachen University	Rheinisch-Westfälische Technische Hochschule Aachen (Rhenish-Westphalian Technical Applied Science University)
SADEI	Sociedad Asturiana de Estudios Económicos e Industriales (Asturian society of economic and industrial studies)
SER	Social and Economic Council
SME	Small and medium enterprise
START	Secretariat Technical Assistance to Regions in Transition
WGI	Worldwide Governance Indicators

1. Summary

1.1. Objectives

The aim of Subtask 6.3 is to complement the model enhancements implemented in Subtask 6.2 and to improve our understanding of the **regional impacts of the energy transition**, particularly considering aspects that are difficult to assess through quantitative modelling frameworks (e.g. regional competitiveness). The case study analysis therefore supports a more in-depth analysis of potential regional impacts by also taking into account other factors and impacts that play a role at the regional level in the energy transition. To do so, **six case studies across the Europe Union** have been carried out, focusing on regions that are in the process of/or have already undergone a major structural transformation in light of to the decarbonisation of the energy system.

1.2. Selected cases

The selected regions for the case studies are the following:

- The Jiu Valley, Romania;
- North Rhine-Westphalia, Germany;
- Silesia, Poland;
- Asturias, Spain;
- Burgenland, Austria; and,
- Nijmegen (part of the Arnhem-Nijmegen region), the Netherlands.

Each of these cases are briefly summarised below. The detailed case study findings are presented in chapter 4 to 9 of this report.

Case study 1: Jiu Valley, Romania

The Jiu Valley, located in Hunedoara County (RO423 according to the NUTS-3 nomenclature), represents one of Romania's main coal mining regions. In the early 1990s, some 15 mines were operating in the Jiu Valley; today, there are only four mining units left. The mines in the region were no longer economically efficient, lacked investments, and required important subsidies from the government to survive. This, alongside Romania's transition to a market economy and the subsequent demand shock that followed, initiated restructuring efforts in the mining sector. As a largely mono-industrial region (80% of the workforce depending on the mining industry), the closure of the mines led to severe economic and social repercussions.

In 1997-1998, over 20,000 jobs were lost. Today, the mining sector employs less than 5,000 people but remains the largest employer in the region. As a result of a lack of economic opportunities and no plans to develop new economic sectors, the region witnessed a significant demographic outflow. Unemployment figures are low, but this may be due to economic inactivity and emigration. There has been a low level of economic diversification in the region; however, some sectors such as manufacturing, wood processing, tourism, and commerce are gaining traction. The region's GDP is estimated at EUR 457mn or 15% of Hunedoara County's GDP in 2018. All in all, the region lacks competitiveness and has a hard time developing and retaining skilled labour.

Economic restructuring in the Jiu Valley has been described as weak and unjust. The lack of public policies and integrated efforts addressing economic and social challenges are apparent. More emphasis needs to be placed on education and R&D&I in order to attract investments and generate opportunities for the region. Although some positive changes are beginning to emerge, unity, community engagement, and concrete policy measures will be important in determining the successful transition of the Jiu Valley.

Case study 2: North Rhine-Westphalia, Germany

The region of North Rhine-Westphalia (NRW) (NUTS1 code: DEA) is known for its large economy in terms of GDP, which is fuelled by large manufacturing and energy-intensive industries. In 2018, the region accounted for 20% of the German GDP maintaining its status as the country's economically strongest region. NRW's long history of energy-intensive industry operations is based on the proximity of hard coal and lignite deposits in the Ruhr area and the Rhine mining region. The large coal-fired power close to these coal mines led to relatively cheap and stable electricity supply to industrial plants. Especially the Ruhr area (Ruhr metropolitan region) was famous for its hard coal mining and steel industry.

NRW, and especially the Ruhr area, employed around half a million hard coal mine workers in 1950 and 1960. However, coal mines and plants have closed due to strong foreign competition for cheap coal prices as well as increased (inter)national pressure to reach energy and climate targets. In 2018, there were no open hard coal mines in the NRW. As such, the hard coal industry has experienced a large reduction in employment over a period of around 60 years. The lignite sector has been smaller and currently employs around 9,000 workers. As per the Coal Phase-Out Act, the lignite-based power generation will stop by 2038 which means that the brown coal sector gradually needs to reduce it lignite production.

The hard coal phase-out in NRW and in particular the Ruhr area was relatively successful due to a combination of social policies addressing unemployment and policies that attract new (energy) companies and investments. Moreover, the measures that improved infrastructure, education, research facilities and soft location factors have proven to be important for restructuring the economy. However, in comparison with NRW, the Ruhr area lags behind in terms of GDP per capita, disposable income, and regional competitiveness. The case study also shows the importance of a holistic strategy to restructure the economy. The case of NRW, and particularly the Ruhr, shows that the more long-term holistic strategy of investing in research and education, infrastructure and lead markets paid off in the long run. However, this approach will not be effective if there are no concrete measures in place, such as early retirement schemes and retraining of ex-workers.

Case study 3: Silesia, Poland

The case of the Silesia region (NUTS2 code: PL22) in Poland is important due to the particularities of the region with regards to its high dependence on coal. In comparison with the majority of EU Member States, Poland has much larger reserves and generated 78.3% of its electricity with hard coal and lignite in 2018. The dependence on coal in the country's energy mix is unusually high, and the Silesia region constitutes the most coal-intensive regions in the country. The transition away from coal and towards a more diversified economic landscape has been taking place at least since the 1990s, but it is far from complete.

More recent policies, driven by the intention of the European Union to attain carbon-neutrality by 2050, promise to be ambitious. Substantial attention at both national and regional levels has been given to the transition in recent years. Important initiatives include The Government Programme for Silesia, the national strategy for the coal sector, the Silesia Regional

Transformation Action Plan, and the Technology Development Programme for Silesia. Recently, the national government has reached an important agreement with the miners' union to phase-out all coal mines by 2049. The phase-out plan is nevertheless subject to the consent from the European Commission to allow state-aid for ensuring the stability of hard-coal mining companies until the phase-out date.

The Silesia Province is among the richest regions in Poland. GDP per capita is EUR 12,600, placing the province in fourth position among all Polish provinces. Areas of active mining tend to be among the areas with highest average earnings, however, income distribution in the province remains very uneven and the average gross income of the province was slightly below the national average in 2017. Thus, many challenges remain, among these: the need for economic diversification, high levels of air and other pollution, and negative migration rates. In the case of Silesia, a key need is to diversify the local industrial base with highly efficient, low-emissions manufacturing subsectors.

Case study 4: Early retirement of Mines and Coal Subsidy Reform in northern Asturias, Spain

Asturias (NUTS2 code: ES12) had a booming coal industry (one of the major economic activities in the region), which led to several coal power plants, as well as energy-intensive industries (such as zinc and aluminium), to be developed in the region. However, over the last decades, a series of reform packages were implemented to restructure the coal mining industry in light of the energy transition, having large negative economic impacts.

One of the main impacts has been a loss of jobs, going from 100,000 employees in the coal industry in the 1950s to only 2,000 in 2019. It has also led to a reduction in economic activity in Asturias, with implications throughout the coal supply and distribution chain, including service activities, notably port infrastructure, transport and logistics. In particular, the negative impact on economic activity and lack of employment opportunities has led to an emigration of young people to other regions of Spain, with more than half of the municipalities decreasing their population size by at last 20% in the last 20 years.

The transition has been spurred by EU measures (first towards coal mining and later towards decarbonisation of the energy system), and it is only recently that Asturias decided to focus on the opportunities that the transition can present for the region. Overall, the region has a negative public perception of the transition, which is fuelled by the region's history of reduced economic activity and related employment effects. There is still a long way ahead for Asturias to balance the negative impacts and ensure that opportunities are taken advantage of.

Case study 5: Burgenland, Austria

The case of Burgenland (NUTS2 code: AT11) illustrates a successful regional roll-out of renewable energy generation. Before the energy transition started, Burgenland suffered from a lack of urban amenities and high emigration for decades. Traditionally, Burgenland's main economic sectors are agriculture and viticulture. Since 2006, clean energy is a growing sector, together with, ICTs and tourism.

In 2000, the renewable energy share was 3%. However, in 2006 regional politicians announced a target of 100% electricity self-sufficiency by 2013. This triggered the installation of 332 wind turbines with a total capacity of 755 MW. At the end of 2013, the province's electricity production exceeded its demand, reaching self-sufficiency. Moreover, up to 40% of the electricity produced within the region was exported to Vienna.

The case of Burgenland illustrates that the energy transition helped the region boost its economy while at the same time reduce poverty rates in the region. It is therefore likely that the energy transition resulted in inclusive growth, reducing income inequality. Other social impacts are a reduced unemployment rate and increased education levels of the working force. Additionally, the energy transition did not increase energy prices, nor did it jeopardise the security of energy supply. Moreover, the people of Burgenland are proud of their green electricity production and show more awareness about climate change.

Case study 6: Nijmegen, The Netherlands

The Nijmegen (NUTS3 code: NL226) case illustrates the process of an energy transition at a detailed level. It demonstrates a successful phase-out of a coal-fired plant, Centrale Gelderland 13 (CG13), as well as a successful redevelopment of the site into a clean energy hub. The plant, owned by energy giant Engie and located in the city of Nijmegen, closed officially in 2015.

Engie managed to mitigate negative effects on its employees. The closure of CG13 affected the older and lower educated workers most. Particularly workers in the 'age gap[1]' were considered vulnerable to long-term unemployment. Effective measures were able to mitigate these negative effects; ultimately, only two of its workers did not find a new job. Moreover, Engie decided to redevelop the site into an area dedicated to renewable energy production, technology development, and other activities vital to the energy transition. In 2019, 8,000 solar panels were installed at the site, and the first draft of the spatial vision was published in which many clean energy initiatives were included.

The case illustrates therefore two important elements of the clean energy transition: the phase-out of fossil fuels and the implementation of clean energy sources. However, as the redevelopment of the site has not been completed yet, only the impacts related to the closure of the plan are included in this study.

1.3. Key findings

For most case studies[2], the decline of the coal industry started before the implementation of European and national climate and energy policies. While the decline of the coal industry was due to economic and social factors, climate and energy policies contributed to the acceleration of the coal phase-out in each case study.

Below we present the main lessons learned from the case studies (for a full overview, please see the final report).

The importance of economic diversification - It is important to develop a holistic strategy to restructure the economy, so that new employment opportunities arrive, and the region can maintain or increase its economic competitiveness. The case study of NRW, particularly the Ruhr area, shows that the more long-term holistic strategy of investing in research and education, infrastructure and high-potential sectors has paid off in the long run. Moreover, structural reform should build on the regions' strengths (e.g. tourism in Jiu Valley, energy & energy-intensive industries in NRW and Asturias, and the manufacturing sector in Silesia).

[1] In short: Too young to be part of the early retirement programme, but too 'old' to have high chances on the labour market.
[2] That is the Jiu Valley in Romania, North Rhine-Westphalia in Germany, Silesia in Poland, and Asturias in Spain

The importance of social protection and inclusion - No one should be left behind – more than a slogan, this message needs to be at the core of the transition. The economic diversification away from coal should be undertaken in a way that is pragmatic but also socially just. Policy makers must acknowledge the real difficulties that citizens of the region face in relation to the transition.

The importance of European policy and funding - The European Union's policies and funds play a driving role in the acceleration of the energy transition, and at the same time can play a key role in shaping the response and economic transformation of a region. Notably, we found that EU funds targeting regional development[3] or the just transition[4] have proved to be important. They help to ease the "pain" of stakeholders that are negatively affected, and assist regions in the development and execution of structural reform plans. Similarly, for some of the regions such as Asturias, EU energy and climate policies have been the main driver for the phasing out of coal mining and coal generated power.

The importance of stakeholder engagement - Engaging with local stakeholders is key. In Asturias, the public perception of the transition is negative. To increase public support, all relevant stakeholders have been involved through social dialogue in the process aiming to reach consensus regarding the way forward. This has mainly changed the political discourse (from maintaining coal as a key element of the local economy to taking advantage of the opportunities from the energy transition), which reinforced political stability. The phase-out in the Jiu Valley, however, has been characterised as lacking engagement with local stakeholders (decisions often being taken top-down), and as 'unjust'. This has been changing, as the community of civil society organisations is very active and promotes an inclusive approach to decision-making. In each coal region, citizen support and public acceptance for the transition are vital for success.

The importance of early action - Do not hold on to old economic structures. In Asturias, the start of the transition was delayed as the region was keen on maintaining its economic structure and the related competitive edge that coal had brought. It was only when the EU policies required the phase-out of coal that they embraced the transition and its related opportunities. However, in some cases, it is beneficial to build on already existing strengths. For example, in the case of Silesia, due to the high level of specialisation in the region, developing the manufacturing sector should be a priority.

There is no one-size-fits-all - Each coal region has its own characteristics, and each phase-out takes place in a different context which means that there is no one-size-fits-all solution. For example, the hard coal phase-out in NRW took around 60 years, whereas other regions have a shorter timeframe for their phase-out. Moreover, the NRW is a relatively wealthy region and is well located. This enabled the region to invest in e.g. education and innovation and to attract many companies due to its favourable geographical location. Such characteristics highly influence the impacts observed across key indicators for each region.

[3] For instance, the European Regional Development Fund
[4] Just Transition Mechanism and the Initiative for cola regions in transition

2. Methodology

2.1. Selection of the case studies

The six cases studies are selected based on the following criteria:

1. Transformation aspect: Selected cases are regions that are in the process of/or have already undergone a major structural transformation due to the decarbonisation of the energy system. Therefore, cases will illustrate a shift away from fossil fuels or/and shift towards clean energy technology.
2. The employment aspect: Selected cases include both regions that have weathered the impact of the transition relatively well and regions that have suffered long-term economic weakness and other disadvantages. The case studies should represent the different possible impacts that the energy transition will have on jobs, whether it is successful or not.
3. The geographical aspect: Selected cases should represent a balanced geographical coverage of the European Union.

2.2. Assessment framework

Based on scientific literature[5] on the (regional labour) impacts of the energy transition and previous findings from Task 5 of this project, **seven key variables** were identified as relevant to assess in the case studies. The key variables are: (1) employment impacts; (2) income impacts; (3) economic diversification impacts; (4) innovation and education impacts; (5) institutional stability impacts; (6) demographic impacts; and (7) regional competitiveness (see Table 0-1). In the six case studies, these key variables and their indicators are investigated alongside important policy measures that have been taken.

It is important to note that for case studies 5 and 6 (Burgenland, Austria and Nijmegen, the Netherlands, respectively), different variables were used to assess the impacts of the energy transition (e.g. energy impacts and income inequality). These case studies were produced as part of Task 5, which had a different focus (i.e. the social dimension of the energy transition). As such, some variables that are included in the first four case studies (e.g. institutional stability and regional competitiveness) are not included in the final two case studies. Moreover, the impacts and results for each case study may vary as the six case studies take place in different countries, time periods and NUTS levels, meaning that there was variation in the data available for each case study.

[5] Del Río and Burguillo, 2008; Galgóczi, 2014; Caldecott et al., 2017; Fothergill, 2017; Brauers et al., 2018

Table 0-1 Impacts to be assessed

Key variable	Indicator	Sub-indicator
Employment impacts	Creation of new jobs, age by sector, gender and per geographic location	• Changes in (un)employment rate, long-term unemployment / involuntary part-time / temporary employment / unemployment rate for coal/mine workers versus general unemployment rate • Gender balance (un)employment • Geographical location of unemployment rates • The role of age (qualitative) / change in number of people that are unemployed over 50 years or under 30 years • Type of new jobs created and the required new skills / number of people with the right type of skills for RES jobs or other replacement jobs / The number of new positions that are suited for low versus high levels of education
	Destruction of existing jobs by sector, per qualification level, age, gender and per geographic location	
	Net change in the number of jobs, per qualification level, age, gender and per geographic location	Number of new jobs minus the number of destructed jobs = net change jobs
Income impacts	Income impacts for the region	Changes in GDP and GVA for the region and compared to other surrounded regions. See also GDP per capita
	Income inequality impacts	Changes disposable income per household
Economic diversification	Impact on local economy (and the different sectors)	Changes in dependency on one income source for the region /change in trends regarding the main economic sectors
	Dependency on energy sector	Import versus export of energy and changes over time
Innovation and education impacts	Impacts on technology development	Changes in technology development/patents issued/ FDI and technology transfer/ Knowledge workers / Employment in technology and knowledge-intensity (R&D)
	Impacts on education system	Changes in the education system: Employer-sponsored training, Access to learning Information, No foreign language, Higher education attainment, Early school leavers, Lower-secondary completion only
Institutional stability	Political stability	Political stability, Voice and accountability, Ease of doing business
Demographic and tourism impacts	Migration impacts	Changes in the number of people moving in or out of the region
	Tourist impacts	Changes in the number of tourists
Regional competitiveness	The ability to offer an attractive and sustainable environment for firms and residents to live and work	Regional Competitiveness Index (builds on the issues discussed above)

2.3. Data collection

For each case study, data is collected by means of **desk research** (national and regional reports, academic studies, series of socio-economic statistics, etc.) and **semi-structured interviews** with the most important stakeholders (policymakers, experts, labour unions, project developers, citizens, affected workers, etc.). The interviews were guided by a common set of questions reflecting the selected impacts and their indicators (see Annex A and Annex B for the interview guides). The interview guides also include open questions about potential other impacts of the transformation as well as questions about important policies.

2.3.1. Interviews

Below we present the list of interviewees for each case study.

Table 0-2 Overview of interviewees by case study

Case study	Name	Organisation(s)	Position(s)	Date
Jiu Valley	Adina Vințan	Valea Jiului Society	Founder and President	03/10/2020
	Alexandru Kelemen	Asociația Caritas	Programme Coordinator	30/09/2020
	Alexandru Mustață	Bankwatch Romania	Campaign Coordinator	04/09/2020
	Dana Bates	New Horizons Foundation	Executive Director and Co-founder	29/09/2020
	Eduard Edelhauser	University of Petroșani	Professor/ Researcher	16/09/2020
	Gloria Popescu	ISPE Proiectare și Consultanță	Head of Knowledge Sharing and Communication	06/10/2020
	Mihai Danciu	Polytechnic University of Timișoara, Asociația Colonia Veselă Petroșani, Asociația Comitetului de Inițiativă, Asociația Planeta Petrila, Asociația Urban Lab, Asociația De Pe Vale	Lecturer/ Researcher/ (Co-) Founder/ Representative/ Member	04/10/2020
North Rhine-Westphalia	Reiner Prigger	NRW Renewable Energies Association / part of the Coal Commission	Honorary Chairman of the Executive Board / Member	28/08/2020
	Michael Theben	Ministry for Economy, Innovation, Digitisation and Energy of the State of North Rhine-Westphalia	Head of department for climate protection	13/10/2020
	Hanna Brauers	Technical University Berlin	Researcher	03/09/2020
Silesia	Aleksander Śniegocki	WiseEuropa	Head of the Energy, Climate and Environment Programme	02/10/2020
Asturias	Antonio Crespo Campillo	HUNOSA	Corporative Director	16/09/2020
	Juan Carlos Aguilera Folgueiras	FAEN	Executive Director	05/10/2020
Burgenland		Burgenland Energy Agency (BEA)	Managing Director	02/05/2019
		Burgenland provincial government	Governor	13/05/2019
		Renewable Energy	CEO	3/06/2019

Case study	Name	Organisation(s)	Position(s)	Date
		association Austria		
		OIR, Austrian Institute for spatial planning	Chief Executive Officer	16/05/2019
		Püspök Group	Managing director	22/05/2019
		Nationalpark Neusiedlersee	Coordination, ecotourism and international cooperation	3/05/2019
Gelderland (Nijmegen)		Engie Nederland	Current employee G13 site	18/05/2019
		Engie Nederland	Former employee G13 plant	25/04/2019
		Province of Gelderland	Spatial planning manager at the province	5/06/2019
		Over Morgen	Process director	16/04/2019
		Engie Nederland	Former G13 site manager	18/04/2019
		Engie Nederland	Current G13 site manager	23/04/2019
		Neighbourhood Waterkwartier)	Citizens	08/05/2019
		Neighbourhood Weurt)	Citizens	22/05/2019
		Municipality of Nijmegen	Policy officer at the department of spatial development	18/05/2019

Note: Cells that have been highlighted indicate that the interviewee preferred to remain anonymous. Furthermore, for the Romanian case study, a total of eight interviewees participated in the study, but one interviewee did not provide their consent for sharing their name or their organisation's name. As such, the latter interviewee has been excluded from the list.

3. Case study 1: Jiu Valley, Romania

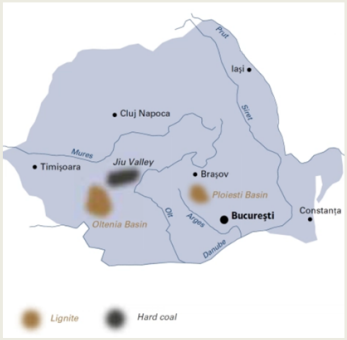
3.1. Introduction

"A remote cluster of six mining towns and surrounding villages, the Jiu Valley holds a special place in the history of coal mining in Central and Eastern Europe" (Bucata, 2020).

The **Jiu Valley** is part of the EU's Platform for Coal Regions in Transition (PCRT)[6], which assists the energy transition in Europe's coal regions (EC, 2020). The Jiu Valley has a long history of over 150 years of coal mining, which shaped it into a **mono-industrial region**. Due to deteriorated technological conditions, a lack of investment, and the type of coal that can be mined in the region, the cost of exploitation became unprofitable. This, combined with a lower demand for energy in Romania in the 1990s, led to the closure of most mines in the Jiu Valley. The most important **restructuring initiatives** began in 1997, when more than 20,000 people working in the mining industry were made redundant over a two-year period (Bankwatch, 2019). At the time, **no integrated plans** for conversion existed, leading to significant emigration from the region alongside dwindling economic and social prosperity. A recently developed strategy for the Jiu Valley, ahead of the upcoming EU funding period, as well as the new Just Transition Mechanism (JTM) bring new hopes (Bucata, 2020; PwC, 2019). Nonetheless, further efforts will be needed to raise the competitiveness of the region and generate real opportunities for the local communities. Experts agree that the potential of the Jiu Valley is vast (interview data).

General information

Country: Romania
Region: Jiu Valley (JV)
Region NUTS1 code: Macroregion 4 (RO4)
Region NUTS2 code: West (RO42)
Region NUTS3 code: Hunedoara County (RO423)
Capital of the NUTS3 region: Hunedoara
Population of the JV: 134,987
Main urban centers in the JV region (by population):
Petroșani (41,872), Vulcan (28,305), Lupeni (26,257), Petrila (24,450), Uricani (9,539), and Aninoasa (4,564)



Source: EURACOAL (2020).

Figure 0-1 General information about the Jiu Valley

Note: The Jiu Valley is a region within the NUTS-3 Hunedoara region (RO423). A lot of data in this report was only available at NUTS-2 or NUTS-3 levels, but even the latter may not be fully representative of the Jiu Valley.

Source: Own development based on data from START (2020).

[6] Now the Secretariat Technical Assistance to Regions in Transition (START).

3.2. Background information

3.2.1. Start and acceleration of the transformation

Romania possesses numerous and rich deposits of coal alongside the Carpathian mountains, containing peat, lignite, anthracite, and hard coal. The coal industry in Romania dates back to the 1840s, undergoing continuous and accentuated development until the last decade of the 20th century. Up until 1989, the industry employed some 350,000 people, while another 700,000 depended indirectly on the mines (Puterea, 2014). In the 1980s, the national production structure was skewed toward energy-intensive heavy industries, which depended on coal. In the 1990s, the industry entered a period of profound transformations and adjustments to the demands of the market economy (Jurnalul de Afaceri, 2017). The collapse of the Communist regime and the beginning of the transition to a market economy sparked an abrupt **decline in industrial production**, lowering the demand and production of coal (by about 50% within the first year). Mines began closing in the 1990s due to their **inefficiency**, **rising costs**, **lack of investments**, and **low domestic demand**. Between 1990 and 2006, the Romanian government spent approximately EUR 5.9 billion[7] subsidising the industry, but agreed with the EU to end all subsidies by the end of the decade (Puterea, 2014; World Bank, 2006). In the absence of state subsidies, the coal mines were no longer profitable (Bankwatch, 2019). Restructuring took place with the help of loans and technical assistance from the World Bank (Bruha et al., 2010). Records show that Romania received support for the closure of 29 mining sites and their environmental remediation (World Bank, 2007).

According to Romania's Energy Strategy, coal is considered an important **pillar of Romania's energy security**, representing around one-quarter of the energy mix in 2016 and up to one-third of electricity demand in times of extreme weather conditions (Ministry of Energy, 2016). At the end of 2015, the total licensed net capacity of installed generation was 20,419 MW, made up of hydro 6,339 MW (31%), coal 4,925 MW (24%), renewables 4,284 MW (21%), natural gas/fuel oil 3,571 MW (18%), and nuclear 1,300 MW (6%) (EURACOAL, 2020). Peak demand is between 8,000 MW and 8,500 MW, indicating an overcapacity in generation (EURACOAL, 2020).

The **Jiu Valley** represents one of Romania's main coal mining regions, known for its **bituminous coal** (i.e. black or hard coal). The region has been economically dependent on coal for over 150 years. The Jiu Valley, made up of six towns and municipalities (Petroșani, Vulcan, Lupeni, Petrila, Uricani, and Aninoasa), is located in Hunedoara County[8] and has a population of approximately 135,000 inhabitants (START, 2020). In the early 1990s, some 15 mines were operating in the Jiu Valley, employing over 50,000 people (Sinteza, 2016). Today, there are only four mining units left (Lupeni, Vulcan, Livezei, Lonea), operated by Hunedoara Energy Complex (HEC)[9] and employing less than 5,000 workers (albeit still the largest employer in the Jiu Valley) (PwC, 2020). Two more mines (Lonea and Lupeni) were due to close in 2018, but the sites are still running due to the potential risks associated with their closure (START, 2020). The region also operates two coal-fired power plants, with an installed capacity of 1,255 MW – the second-highest capacity in Romania. In 2017, the annual hard coal production registered was 0.8 million tonnes, covering approximately **3-5% of domestic energy production** from coal (TRACER, 2019).

[7] This figure has been converted from USD to EUR based on the average ECB exchange rate over the period 1999-2006 (https://www.ecb.europa.eu/stats/policy_and_exchange_rates/euro_reference_exchange_rates/html/eurofxref-graph-usd.en.html), i.e. a USD-EUR exchange rate of 0.9366.

[8] The county is classified as RO423 according to the NUTS-3 nomenclature.

[9] The Hunedoara Energy Complex (HEC) (Complexul Energetic Hunedoara, in Romanian) is a state-owned electricity and heat producer based in Hunedoara County. All mines operating in the Jiu Valley are under the tutelage of HEC. The company represents the largest employer in the Jiu Valley.

The mining activities within the Jiu Valley and its largely mono-industrial economy were heavily affected by the restructuring of the mining industry over the past decades (Figure 0-2) (START, 2020). As described earlier, the mines in the region were no longer economically efficient, lacked investments, and required important subsidies from the government to survive. Consequently, the drivers of the energy transition in the Jiu Valley can be summarised as follows:

- The transition to a **market economy** after the collapse of the Communist regime in 1989;
- The transition led to a **'demand shock'** due to the resulting economic turmoil, drop in industry output, and drop in demand for coal (Bruha et al., 2010);
- At the same time, the mining infrastructure was **outdated and in need of investment**;
- **Coal phase-out** also became an increasingly important agenda point for the EU, and, consequently, for Romania. In 2010, Council Decision nr. 787 restricted state aid for mines that were due to close;
- More recently, Romania's **Energy Strategy** and **National Energy Climate Plan** have reiterated the diminishing role for coal, particularly in the Jiu Valley, where investments in coal-based facilities are no longer considered relevant (Government of Romania, 2020; Ministry of Energy, 2016).
- Hard coal mining in Romania faces complex geological conditions, making it difficult for mining to be profitable (EURACOAL, 2020).

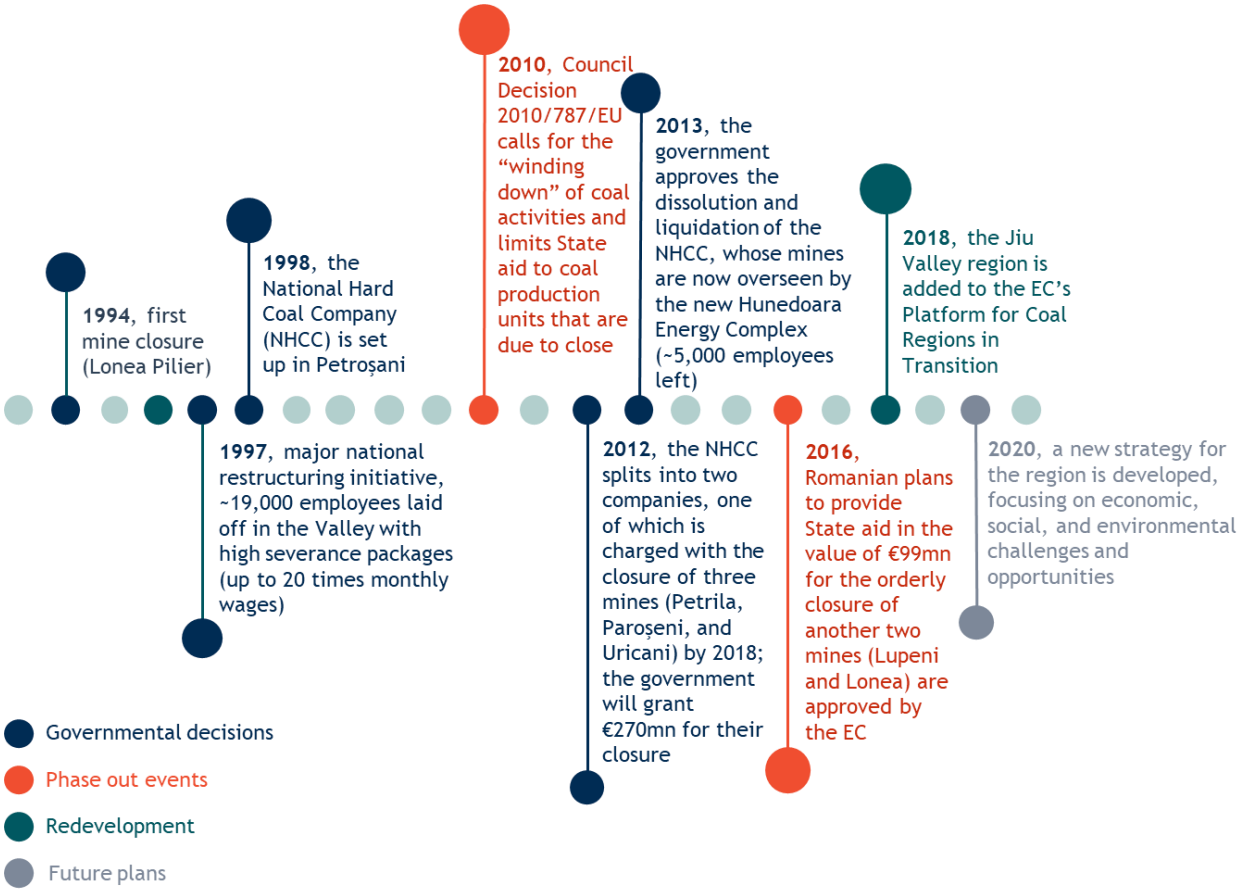


Figure 0-2 Brief timeline of the transition in the Jiu Valley

Source: Own development.

3.2.2. (Inter)national and regional policies

Romania used state aid to cover the production losses and exceptional costs resulting from the closure of several of the mines in the Jiu Valley, in line with EU state aid rules (EC, 2016). The closure of many of the mines in the region, particularly at the start of the restructuring process, was facilitated through loans and technical assistance from the World Bank (Bankwatch, 2019).[10] Besides financial support, **various policies were implemented to attract investment in the region and to re-train workers, but they were not successful**.[11] With the loans provided by the World Bank, the local community had access to microcredits for new businesses, support for consulting services, business centres, financial aid for training, support for the development of municipal infrastructure, amongst others (Bankwatch, 2019). However, none of the programmes implemented through the loans appear to have been successful. According to Bankwatch (2019), one of the more successful initiatives in the early 2000s was the Mining Community Social Development Scheme, managed by the Romanian Social Development Fund. It is reported that the scheme, which emphasised community participation, civic engagement, and community values, was more successful in promoting social capital than previous programmes. However, the scheme was discontinued due to the availability of EU funds.[12] A total of 106 projects received EU funding in Hunedoara, but only about 25% of those were implemented in the Jiu Valley.

In 2016, Romania's Energy Strategy envisaged a **slowly diminishing role for coal**, eventually replacing it with natural gas, nuclear, and renewable energy. However, the strategy emphasised its 'technology neutral' approach, stating that the importance of coal in the energy mix depended on its competitiveness and the investments needed to modernise the sector (Ministry of Energy, 2016). According to the Ministry of Energy, the country's main coal-powered energy plants, Hunedoara Energy Complex (HEC) and Oltenia Energy Complex were in critical states, with HEC being on the verge of bankruptcy.[13] Their financial situation has only worsened due to rising ETS prices and lack of support for coal (Carbon Tracker, 2017; Economica, 2019; START, 2020).[14] In the final National Energy and Climate Plan (NECP) released in 2020, efforts to decarbonise the energy sector have been reiterated (Government of Romania, 2020). Energy security will be met by **alternatives to coal** (natural gas, renewables, nuclear), investments in energy storage, and energy efficiency.[15] As coal-fired power plants are reaching the end of their lifetime, new investments in coal-based capacities are not warranted (particularly in the Jiu Valley).

The Jiu Valley has the potential to restore its economic prosperity, but it needs to account for social and environmental challenges (PwC, 2020). This is why the region fits the scope and mission of the PCRT (EC, 2017), of which it is a part of. The Platform goes hand in hand with the International Labour Organisation's (ILO) vision of a "just transition", focusing on labour rights, social dialogue, social protection and employment (ILO, 2015). As a result of the Jiu Valley's adherence to the PCRT, the Ministry of European Funds (MEF) approved a plan of measures to foster economic diversity, improvement of air quality and endowment for sustainable development through a memorandum endorsed by other relevant ministries (MEF,

[10] Ordonance nr. 11/2000 approved a loan of USD 44.5mn for the first closure programme (2000-2006) and Law nr. 167/2005 approved a loan of USD 120mn for the second closure programme (2005-2012) (Bankwatch, 2019).

[11] This was confirmed in our interviews.

[12] The Scheme was funded through loans, so it was economically more efficient to make use of EU funds.

[13] In 2011, it was reported that one tonne of coal in the Jiu Valley cost €73 to extract, but was sold at €53/tonne (Ziarul Financiar, 2011). More recently, the CE Hunedoara's production cost has been reported to amount to €110/MWh, while the electricity is sold at half the price on the market (Bucata, 2020).

[14] This was also confirmed in our interviews.

[15] The Romanian NECP established a target of 30.7% renewable energy in the energy mix by 2030 (Government of Romania, 2020).

2018). This memorandum has led to the Jiu Valley Initiative and a new strategy for the transition of the region (MEF, 2020).

Beyond the policies described above, a number of strategies have attempted to redress the economic, social, and environmental impacts of the transition in the Jiu Valley. A non-exhaustive overview of the strategies at **European**, **national**, **regional**, and **local** levels is presented below:

- **1998:** Establishment of the Romanian Social Development Fund (and the consequent Mining Community Social Development Scheme in 2004)
- **2002:** Socio-economic development strategy for the carboniferous region of the Jiu Valley
- **2007:** the first National Energy Efficiency Action Plan (followed by the second NEEAP in 2011, and the third NEEAP submitted in 2014)
- **2008:** The Strategic Plan for the Socio-Economic Development of the City of Petrila
- **2010:** Council Decision on the closure of uncompetitive coal mines (2010/787/EU)
- **2014:** Regional Development Plan for the West Region
- **2014:** The Plan for Regional Development 2014-2020 – Hunedoara County
- **2014:** The Local Development Plan of Petroșani
- **2014:** The Development Strategy of Vulcan Municipality 2014-2020
- **2014:** The Development Strategy of Lupeni Municipality 2014-2020
- **2015:** The Strategic Development Plan of the City of Uricani 2015-2020
- **2016:** Romania's National Energy Strategy 2016-2030
- **2016:** The National Strategy for Sustainable Development of Romania Horizons 2016-2020-2030
- **2018:** Energy Union Governance Regulation
- **2020:** Romania's National Energy and Climate Plan (NECP)
- **2020:** Strategy for the transition from coal of the Jiu Valley (funded by the European Commission through the Structural Reform Support Service) (still in draft stages)

Information gathered through interviews confirmed that the region is still in the early stages of a so-called 'transformation'. Although various strategies have been developed at regional and local levels, to the extent that the region has been "drowning" in strategies (as reported by one of our interviewees), progress is lacking. Interviewees suggest that concrete action and civil society engagement is needed.

3.3. Results

The following sections describe the impacts experienced in the Jiu Valley as a result of the energy transition. The impacts are also summarised in Table 0-9 below.

3.3.1. Employment impacts

In the 1990s, **80% of the regional workforce** was economically dependent on mining, and mining was what defined the identity of the region (Catu, 2018). Employment numbers in the mines dropped from approximately 50,000 in 1989 to under 5,000 today (Bankwatch, 2019). In 1997 alone 18,185 people lost their jobs, and another 2,152 the following year. The consequences were also felt at county level, particularly in the 1990s (Figure 0-3). As such, employment in the county dropped, and unemployment increased (Bankwatch, 2019).

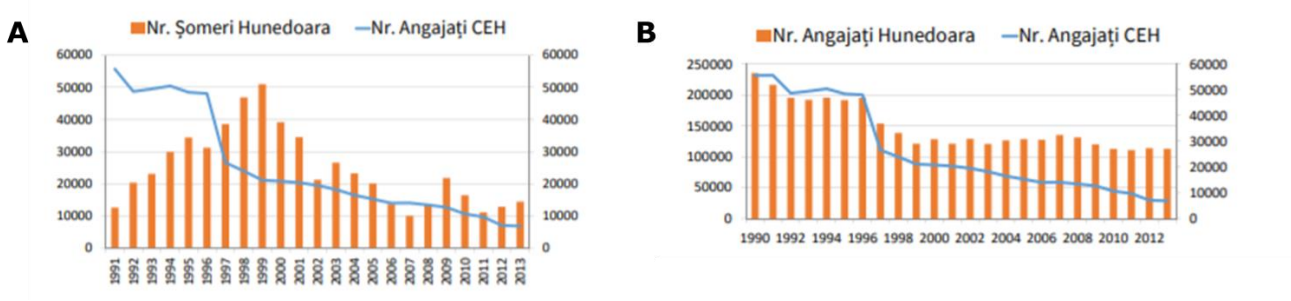


Figure 0-3 Change in employment figures in the mining company (Hunedoara Energy Complex) and at county level

Note: Graph A shows unemployment figures, while Graph B shows employment figures in Hunedoara. Both are compared to the evolution of employment within the Hunedoara Energy Complex (blue line).

Source: Bankwatch (2019).

Figures from Bankwatch and Greenpeace (2019) indicate that in 2011 **employment rates** in the Jiu Valley were lower than those of Hunedoara County (39% versus 53%, respectively). The highest employment rates were recorded in Petroșani (44%) and Uricani (40%), while the lowest were recorded in Lupeni (38%) and Aninoasa (36%). It is also reported that unemployment in the Jiu Valley and Hunedoara County has declined over the past decade (Figure 0-5), a trend that could be due to improvements in socio-economic conditions, as well as **economic inactivity** and **emigration** (PwC, 2020; START, 2020). This can be seen by the discrepancy between the population able to work and employment figures in Figure 0-4. As such, unemployment rates are relatively low in the Jiu Valley and range between 1.4% and 2.5% across the different communities (START, 2020). However, according to data gathered during our interviews, real unemployment rates could be as high as 22% in the region (as of 2018).

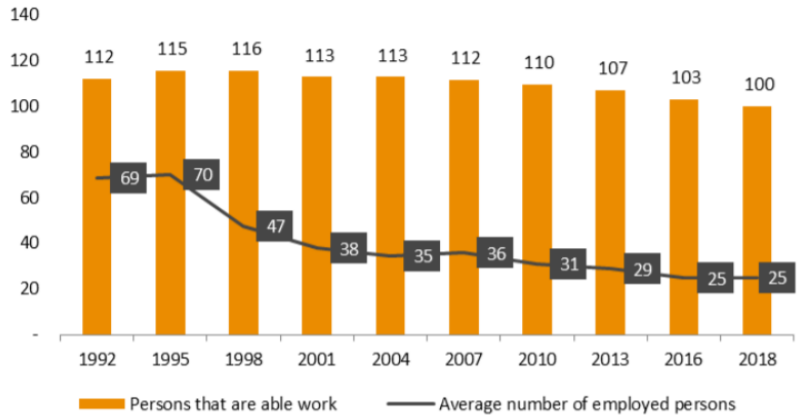


Figure 0-4 Evolution of workforce in the Jiu Valley, 1992-2018 (in thousands)

Source: PwC (2020).

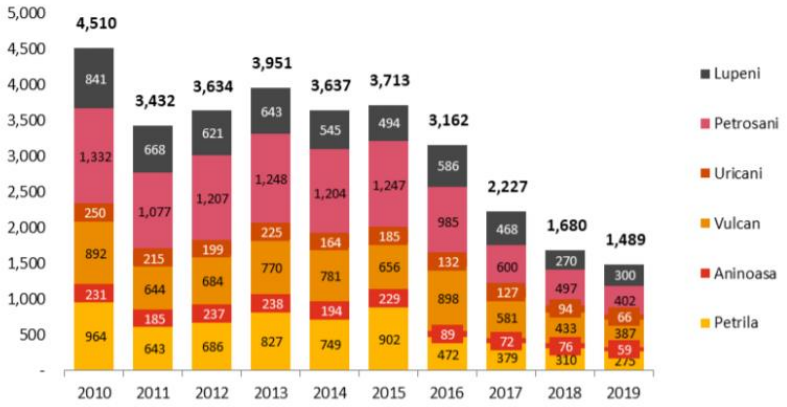


Figure 0-5 Evolution of unemployment in the Jiu Valley, 2010-2019 (number of unemployed persons)

Note: PwC (2020) notes that there is a discrepancy between the number of unemployed (as reported by the National Institute of Statistics) and those who can work but do not have a job. The unemployment situation may thus be worse than depicted in the figure above. For instance, PwC (2020) explains that, in 2018, there were 78,000 people that were able to work in the Jiu Valley, but not employed (as opposed to 1,680 officially reported as unemployed) (PwC, 2020).

Source: PwC (2020).

Although it has been more than two decades since the first wave of mine closures, economic inactivity can still be explained by the contraction of the mining industry, lack of economic opportunities, and, as explained by our interviewees, a lack of motivation from the local community (e.g. due to psychological effects of going into early retirement, lack of pride and trust in the future of the region, segregation, and poverty). Economic and social wellbeing are thus strongly linked in the region.

World Bank loans were used to fund programmes aimed at diminishing the social and economic consequences of the mine closures (in 2000-2006 and 2005-2012). The loans supported new or existing businesses, the creation of business infrastructure, training costs, social and cultural services, municipal infrastructure, and wellbeing improvements (Bankwatch, 2019). Part of the funds received by HEC during that period were used for reskilling programmes. However, there is no evidence to suggest that they were successful. Based on information collected through interviews and Bankwatch (2019), reskilling initiatives lacked integrated efforts to develop the region and did not match the needs of the local

economy. Furthermore, there were very few economic opportunities in the region, a fact that was acknowledged by local authorities (Bankwatch, 2019).

In the period 2007-2013, the first round of EU funds came in through the Regional Development Fund. The funds were used to implement 106 projects in Hunedoara County, but close to 70% were implemented in the cities of Hunedoara and Deva (and around 25% in the Jiu Valley) (Bankwatch, 2019). Most of the projects implemented in the Jiu Valley were related to urban development and social infrastructure. One example is the establishment of a new school for lifelong learning in Petroșani, specialising in tourism and food. Other funds, received through the national Mining Community Social Development Scheme, also focused on the refurbishment of buildings and roads in the Jiu Valley (Bankwatch, 2019). The latter projects placed emphasis on social capital and community values, getting the local population engaged in the development of the towns.

3.3.2. Income impacts

The **Gross Domestic Product (GDP)** of the West region (RO42) represented approximately 10% of the national GDP in 2018 (or EUR 19,207mn). It was the second-lowest GDP amongst the different NUTS-2 regions in Romania, just above neighbouring South-West Oltenia (RO41) (Eurostat, 2020a). In the same year, the GDP of the Jiu Valley was estimated at EUR 457mn or 15% of Hunedoara's GDP (PwC, 2020). The situation is reflected in the top five companies with the largest operational revenue in Hunedoara in 2018, where the **Hunedoara Energy Complex (HEC)**[16], the largest company and employer in the Jiu Valley, stands fifth (in bold in

[16] Referenced as Societatea Complexul Energetic Hunedoara S.A. in

Table 0-3 Top companies in Hunedoara County, as of 2018.

Table 0-3 Top companies in Hunedoara County, as of 2018). The top most profitable companies in 2018 are all located outside of the Jiu Valley (PwC, 2020). Meanwhile 1,988 companies in Hunedoara were unprofitable in 2018, documenting a total loss of EUR 323.9mn. The largest share of this cumulative loss was due to CE Hunedoara, which recorded a loss of EUR 267mn.

Table 0-3 Top companies in Hunedoara County, as of 2018

Rank	Top companies according to operational revenue	Top companies according to employment	Top companies according to profitability
1	SEWS ROMANIA S.R.L. (EUR 184.5MN)	SEWS ROMANIA S.R.L. (6,058 EMPLOYEES)	PHILIPS ORASTIE S.R.L. (EUR 4.6MN)
2	PHILIPS ORASTIE S.R.L. (EUR 148.4MN)	**SOCIETATEA COMPLEXUL ENERGETIC HUNEDOARA S.A. (4,288 EMPLOYEES)**	BESSER ROMANIA S.R.L. (EUR 3.6MN)
3	ARCELORMITTAL HUNEDOARA S.A. (EUR 145.7MN)	PHILIPS ORASTIE S.R.L. (1,118 EMPLOYEES)	EUROSPORT DHS S.A. (EUR 3.4MN)
4	FARMACEUTICA REMEDIA DISTRIBUTION & LOGISTICS S.R.L. (EUR 93.3MN)	APA PROD S.A. (1,023 EMPLOYEES)	SARMISMOB S.A. (EUR 3MN)
5	**SOCIETATEA COMPLEXUL ENERGETIC HUNEDOARA S.A. (EUR 87.2MN)**	ARCELORMITTAL HUNEDOARA S.A. (640 EMPLOYEES)	LANDBRUK S.R.L. (EUR 2.9M)

Note: The Hunedoara Energy Complex (Societatea Complexul Energetic Hunedoara, in Romanian), representing employment in the coal sector, is highlighted in the table above.

Source: Own development based on data from PwC (2020).

GDP/capita in the West region (RO42) increased from EUR 1,900 in 2000 to EUR 10,800 in 2018, slightly higher than the national average of EUR 10,500. Although the West region (RO42) has the second-highest GDP/capita, it is significantly lower than that of the Bucharest-Ilfov region (RO32) (EUR 24,200) (Eurostat, 2020a). In comparison, the EU27 GDP/capita was EUR 30,200 in 2018 (Eurostat, 2020a).

In terms of **Gross Value Added (GVA)**, the West region (RO42) is second-last in total GVA amongst all NUTS-2 regions in Romania (Figure 0-6) (Eurostat, 2020b). Similar to GDP, South-West Oltenia (RO41) is at the bottom, while the capital region (RO32) is at the top. Within the West region (RO42), Hunedoara County (within which the Jiu Valley is located) also has one of the lowest GVAs, after Caraș-Severin (Figure 0-7).

According to interview data, **economic discrepancies within the NUTS-2 West region** have been growing over the past years, between the counties that are close to the border (Arad and Timiș) and the counties with a deteriorating economy (Hunedoara and Caraș-Severin). Looking at sectoral data, industry (including mining and quarrying, electricity, gas, and air conditioning supply, and manufacturing) has consistently been the top GVA contributor in the West region (RO42), amounting to 32% of the total regional GVA in 2017 (or EUR 5,113mn) (Eurostat, 2020b). The total GVA of the Hunedoara County (RO423) represents 17% of the West region's total GVA in 2017 (or EUR 2,685mn) (Figure 0-7) (Eurostat, 2020b).

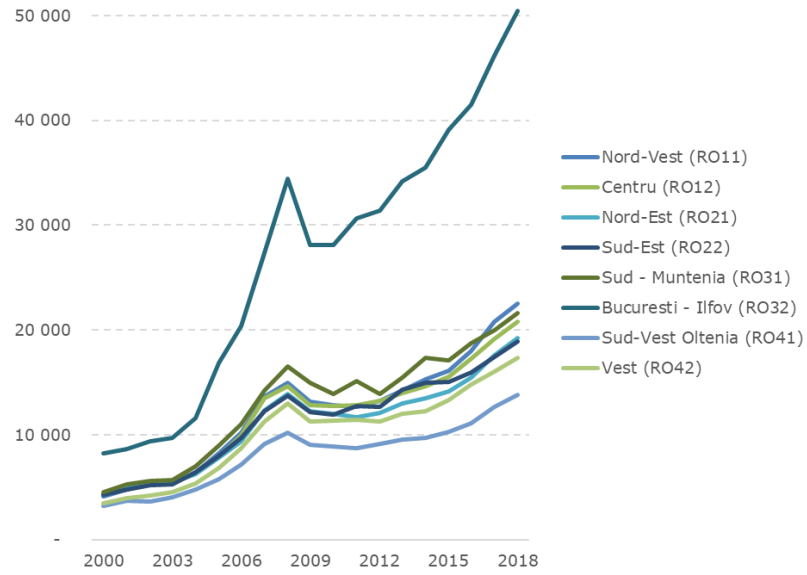


Figure 0-6 Total GVA at NUTS-2 level (all regions), in million euro

Source: Eurostat (2020b).

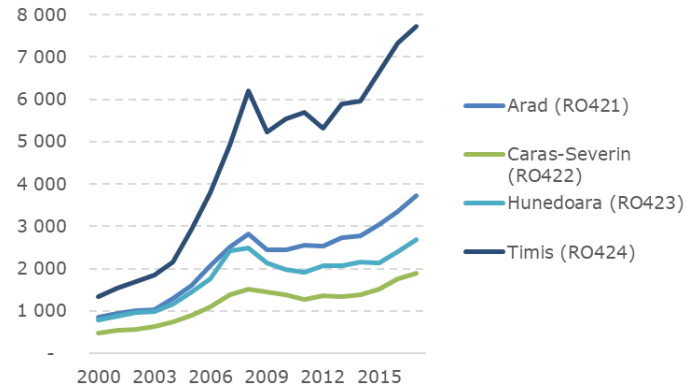


Figure 0-7 Total GVA at NUTS-3 level (within the West region RO42), in million euro

Source: Eurostat (2020b).

Along with the loss of jobs in the late 1990s came a **drop in purchasing power**, which affected other economic activities (Bankwatch, 2019; NYT, 2019). However, as can be seen in Figure 0-8, disposable income (in PPS/capita) has been increasing again since 2007.[17] The figure below shows that disposable income is increasing at different rates in the West (RO42) and capital (RO32) regions, accentuating the inequality between the regions.

[17] Earliest year available on Eurostat.

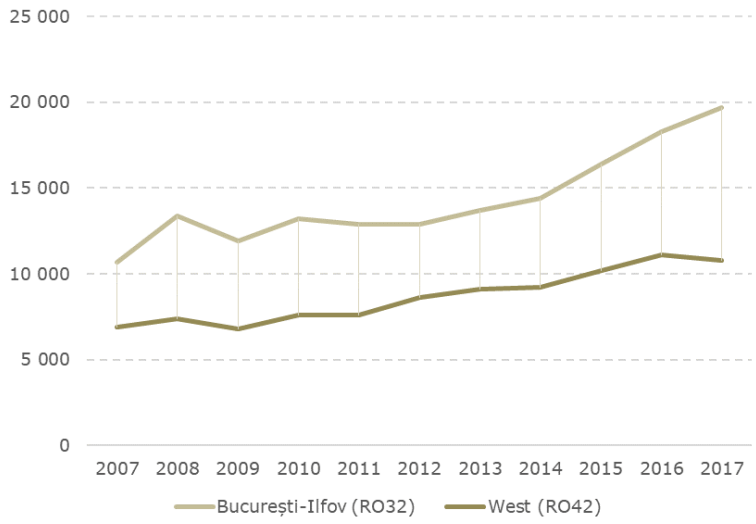


Figure 0-8 Changes in disposable income, in Purchasing Power Standard (PPS) per capita, comparison between the West (RO42) and capital (RO42) regions

Source: Eurostat (2020c).

3.3.3. Economic diversification

A degree of **economic restructuring and diversification towards manufacturing and service activities** (such as textiles and tourism) is evident in the Jiu Valley, although entrepreneurship and business start-ups are still relatively limited (Bankwatch, 2019; START, 2020). In 2018, there were 1,526 companies in the Jiu Valley, 718 of which could be found in the city of Petroșani (PwC, 2020). All localities in the Jiu Valley recorded a growing number of companies between 2012 and 2018, with Uricani experiencing the highest growth rate (89%). The range of private sector jobs available in the Jiu Valley is presented in Table 0-4 below. Economic activities in the region include electricity production, logging, manufacture of furniture, bread- and pastry-making, collection of non-hazardous waste, and more.

Table 0-4 Employment in the private sector in 2018, % of employees, per locality within the Jiu Valley

Sector	Petroșani	Lupeni	Vulcan	Petrila	Uricani	Aninoasa
Electricity production	45%	-	-	-	-	-
Retail sale in non-specialised stores	3%	11%	-	-	13%	12%
Meat processing and preservation	1%	-	-	-	-	-
Water capture, treatment and distribution	5%	-	-	-	-	-
Retail sale of second-hand goods sold through stores	3%	-	-	-	47%	
Manufacture of made-up textile articles	-	31%	-	-	-	24%
Retail sale of textiles in specialised stores	-	1%	-	-	-	-
Logging	-	11%		6%	7%	
Collection of non-hazardous waste	-	-	13%	-	-	-

Sector	Petroșani	Lupeni	Vulcan	Petrila	Uricani	Aninoasa
Activities of contracting, on a temporary basis, of personnel	-	-	5%	-	-	-
Retail sale of fresh fruits and vegetables in specialised stores	-	-	3%	-	-	-
Wholesale of beverages	-	-	5%	-	-	-
Manufacture of furniture	-	-	7%	14%	-	29%
Manufacture of milling products	-	-	-	2%	-	-
Bread-making, manufacture of fresh pastries and products	-	-	-	15%	-	-
Freight transport by road	-	-	-	6%	-	-
Data processing, web page management and related activities	-	-	-	-	0%	-
Electrical works	-	-	-	-	-	3%
Other	42%	46%	67%	58%	33%	31%
Total (#)	**9 508**	**1 483**	**1 253**	**1 226**	**731**	**446**

Note: Percentages have been rounded to the nearest whole number, meaning that the total per town/municipality may not always add up to 100%.

Source: PwC (2020).

3.3.4. Innovation and education impacts

Employment in **high-technology sectors** in the West (RO42) region is lower than in the capital region (RO32) (5.9% versus 9.3%, respectively), but higher than the national average (2.9%) in 2019 (Table 0-5). Meanwhile, the West region has a higher share of the employed population in **low and medium low-technology manufacturing** (17.1%) than both the capital region (5.6%) and the national average (12.4%) in 2019, and finds itself in a similar position to the national average when it comes to **less knowledge-intensive services** (26.5% versus 26.6%, respectively).

Table 0-5 Employment in high-technology sectors, low-technology manufacturing, and less knowledge-intensive services, comparison between the NUTS-2 West (RO42) and capital (RO32) regions, and national level (RO) (in % of employment and in thousands)

Indicator	Year	RO42 (West region)	RO32 (București-Ilfov region)	RO (National)
High-technology sectors (high-technology manufacturing and knowledge-intensive high-technology services)	2000	1.9% (17.7)	5.1% (51.0)	1.8% (190.2)
	2010	3.2% (24.8)	5.7% (60.3)	1.8% (155.1)
	2019	5.9% (42.7)	9.3% (107.4)	2.9% (249.6)
Low and medium low-technology manufacturing	2000	13.7% (125.6)	19.6% (189.4)	14.0% (1,486.4)
	2010	16.7% (127.9)	9.0% (95.6)	13.2% (1,152.8)
	2019	17.1% (124.8)	5.6% (64.3)	12.4% (1,079.5)
Less knowledge-intensive services	2000	22.2% (203.5)	37.2% (359.5)	18.7% (1,979.3)
	2010	20.3% (156.1)	36.5% (388.5)	20.9% (1,818.2)
	2019	26.5% (193.4)	37.1% (428.5)	26.6% (2,276.4)

Source: Eurostat (2020d and 2020e).

Table 0-6 below shows that there has been a rise in the share of the population aged 25-64 receiving an **upper secondary and post-secondary non-tertiary education** (up by eight percentage points since 2000) in the West region (RO42). The share of the population aged 25-64 having obtained a **tertiary education** has also increased (up by nearly six percentage points) but is significantly lower than in the more developed capital region (16% versus 40% in 2019, respectively).

Table 0-6 Levels of educational attainment, comparison between the NUTS-2 West (RO42) and capital (RO32) regions (% of age group)

Indicator	Year	RO42 (West region)	RO32 (București-Ilfov region)
Early leavers from education and training	2000	23.7%	11.6%
(18-24 years)	2010	9.8%	10.8%
[edat_lfse_16]	2019	10.3%	8.3%
Less than primary, primary and lower	2000	30.2%	16.7%
secondary education (25-64 years)	2010	23.1%	13.3%
[edat_lfse_04]	2019	16.0%	10.5%
Upper secondary and post-secondary	2000	59.3%	63.2%
non-tertiary (25-64 years)	2010	62.9%	58.4%
[edat_lfse_04]	2019	67.7%	49.3%
Tertiary educational attainment	2000	10.6%	20.1%
(25-64 years)	2010	14.0%	28.3%
[edat_lfse_04]	2019	16.3%	40.3%

Source: Eurostat (2020f and 2020g).

Tertiary education in the region is provided by the **University of Petroșani (UPET)**, which hosts over 3,000 students (UPET, n.d.).[18] The university dates back to 1948, when the Institute of Mining was established in Petroșani. Today, UPET continues to specialise in mining (to a lesser extent than in the past), and remains the only higher education institution in the country with such a profile. Several interviewees mentioned UPET as having the potential to contribute to research, development and innovation (R&D&I) in the future, but the quality of education needs to improve and align with the needs of the labour market (both secondary and tertiary).[19] One way the university could contribute to improving the competitiveness of the region is to develop clusters, together with the local administration and investors. Besides UPET, the **National Institute for Research and Development in Mine Safety and Protection to Explosion (INSEMEX)**[20] holds an important name in the region and at national level. The Institute has diversified its activity and has the potential to enhance the competitiveness and research capacity of the Jiu Valley (interview data).

[18] See https://www.upet.ro/en/.

[19] One interviewee noted that the University is re-profiling towards social sciences and humanities.

[20] See https://insemex.ro/home-en/.

3.3.5. Institutional stability

Data on **institutional and political stability** can be found at national level (World Bank, 2019). The governance scores across the different indicators in Table 0-7 have been relatively stable over the period 2009-2019 in Romania, with the exception of political stability and the rule of law, which saw a drop and an improvement, respectively, in 2014. Across the different indicators, Romania places itself between the 40th and the 70th percentile, depending on the year and the indicator. Romania has experienced political instability and has fought against corruption since the 1990s. This has led to improvements in the overall business climate, which can be seen in the evolution of the Ease of Doing Business score, going from 66 in 2010 to 73.3 in 2020 (World Bank, 2020).

Table 0-7 Worldwide Governance Indicators for Romania, 2009-2019

Indicator	Year	Governance	Percentile rank
Voice and accountability	2009	0.46	60.19
	2014	0.43	60.59
	2019	0.49	61.58
Political stability	2009	0.36	56.87
	2014	0.05	48.57
	2019	0.53	65.24
Government effectiveness	2009	-0.36	44.50
	2014	-0.03	54.81
	2019	-0.28	40.38
Regulatory quality	2009	0.60	70.81
	2014	0.58	71.63
	2019	0.46	67.31
Rule of law	2009	0.05	55.92
	2014	0.17	63.46
	2019	0.36	64.42
Control of corruption	2009	-0.26	49.76
	2014	-0.11	53.85
	2019	-0.13	51.44

Note: The governance score ranges from -2.5 to +2.5, with higher values corresponding to better governance. The percentile rank indicates the rank of the country among all countries in the world (ranging from 0 to 100, with 100 corresponding to the highest rank).

Source: World Bank (2019).

In an attempt to illustrate political stability at local level, an overview of the mayors that have been elected in the region over the past two decades is presented in Table 0-8.[21] In general, **local leaders are re-elected by the community for several mandates**, even up to 20 years in a row.

Table 0-8 Elected mayors in the Jiu Valley, 2000-2020

Elections	Petrila	Petroșani	Aninoasa	Vulcan	Lupeni	Uricani
1996	Ilie Păducel	Carol Schreter	Ilie Botgros	Vasile Giurgiulescu	Ion Napau	Gheorghe Suciu

[21] For more information on the popularity of the mayors in terms of percentage of votes, please consult PwC (2020).

2000	Ilie Păducel	Gheorghe David	Ilie Botgros	Petru Hodor	Cornel Resmeriță	Gheorghe Suciu
2004	Ilie Păducel	Carol Schreter	Ilie Botgros	Gheorghe Ilie	Cornel Resmeriță	Dănuț Buhăescu
2008	Ilie Păducel	Florin-Tiberiu Iacob-Ridzi	Ilie Botgros	Gheorghe Ilie	Cornel Resmeriță	Dănuț Buhăescu
2012	Ilie Păducel	Florin-Tiberiu Iacob-Ridzi	Nicolae Duncă	Gheorghe Ilie	Cornel Resmeriță	Dănuț Buhăescu
2016	Vasile Jurca	Florin-Tiberiu Iacob-Ridzi	Nicolae Duncă	Gheorghe Ilie	Lucian Resmeriță	Dănuț Buhăescu
2020	Vasile Jurca	Florin-Tiberiu Iacob-Ridzi	Nicolae Duncă	Cristian-Ion Merișanu	Lucian Resmeriță	Dănuț Buhăescu

Source: Own research in local media[22] and PwC (2020).

3.3.6. Demographic and tourism impacts

Altogether, as a result of the decreasing number of economic opportunities in the region, the demographic evolution of the towns and municipalities of the Jiu Valley changed for the worse. **Demographic trends in the region have been directly linked to the evolution of the mono-industrial economy** in the region (Bankwatch, 2019). According to Bankwatch and Greenpeace (2019), the population of the Jiu Valley grew from 405 in 1735 to 976 in 1750, to 4,145 in 1818. Between 1850 and 1900, the mining centres attracted a lot of workforce. The cumulative population of Petrosani, Lupeni, and Vulcan reached 22,939. The Jiu Valley's population reached a peak in 1997 (169,911), after which it started to decline. 158,678 inhabitants were registered in the region in 2002, 146,200 in 2011, and 139,718 in 2015. Right after the closure of the first mines in the late 1990s, housing complexes were emptied and anecdotal accounts suggest that people were even selling their homes in exchange for crates of beer (NYT, 2019; interview data). Migration occurred both within the country (towards other rural regions) and outside of the country (Bankwatch, 2019). The trend is that of slowly diminishing population due to migrations outside of the county, as well as an increasing death rate and a decreasing birth rate (Bankwatch, 2019; Bankwatch and Greenpeace, 2019). The share of young people is also declining, in conjunction with the proportion of active people (Bankwatch and Greenpeace, 2019).

Given its geographic location along the Carpathian mountains (in the Retezat and the Parâng mountain ranges), **the region attracts many tourists**. At county level, the number of tourists reached 168,346 in 2017 (Figure 0-9) (Hunedoara Statistical Office, 2018). The Jiu Valley alone can accommodate up to 6,000 tourists in its ski resorts (PwC, 2020). However, as identified by our interviewees, more (coordinated) investment is needed in the region for the sector to become a more viable source of revenue, while at the same time there is consensus that tourism alone cannot deliver all the benefits that are needed in the region. As reported by the NGO, New Horizons, activities in the Jiu Valley include skiing, mountain biking (including "gravity" trails and "x-country" trails), and rock climbing. The NGO also developed an online portal to spread information about tourism possibilities in the region.[23]

[22] E.g. Ziare.com (2012), Ziare.com (2020), Informația Văii Jiului (2019), adevărul.ro (2020), adevărul.ro (2017), Gazeta de Dimineață (2012), and Săptămânalul Valea Jiului (2015).

[23] See https://www.jiuvalley-adventures.ro/en/.

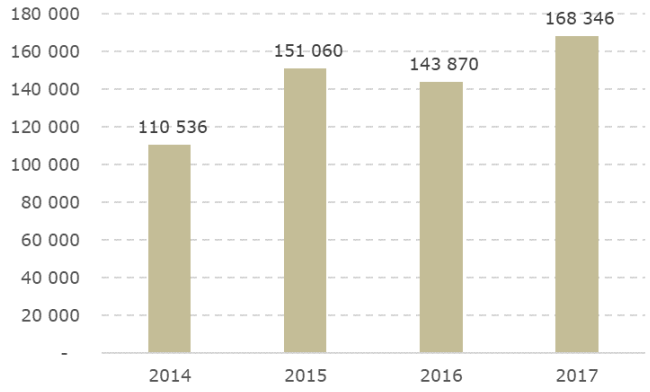


Figure 0-9 Number of tourists in Hunedoara County in 2014-2017

Source: Hunedoara Statistical Office (2018).

3.3.7. Regional competitiveness

Regional competitiveness is defined as "the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work in" (EC, 2019b, p.3). The Regional Competitiveness Index (RCI) is a measure of a region's long-term potential (at NUTS-2 level), encompassing 11 dimensions of competitiveness. With the exception of the Bucharest-Ilfov region, Romania's RCI is under -1, meaning **low competitiveness** (more than one standard deviation below the EU average). With a score of -1.04, the West (RO42) NUTS-2 region, has the second-highest RCI score in Romania (after the capital region), but remains negative in comparison to the EU average. Across the different dimensions, the region is doing relatively well when it comes to **labour market efficiency** (which may be explained by low unemployment figures), but least well when it comes to **basic education** (Figure 0-10). The education pillar represents basic skills with a direct link to labour market needs (EC, 2019b). Deteriorating services such as education and health, as well as a lack of integrated action between education and labour market needs, were reflected in our interviews. One interviewee also highlighted the importance of connectivity in the overall competitiveness of the region. While at NUTS-2 level, some counties benefit from a better connection with European corridors, others (including Hunedoara) are falling behind.

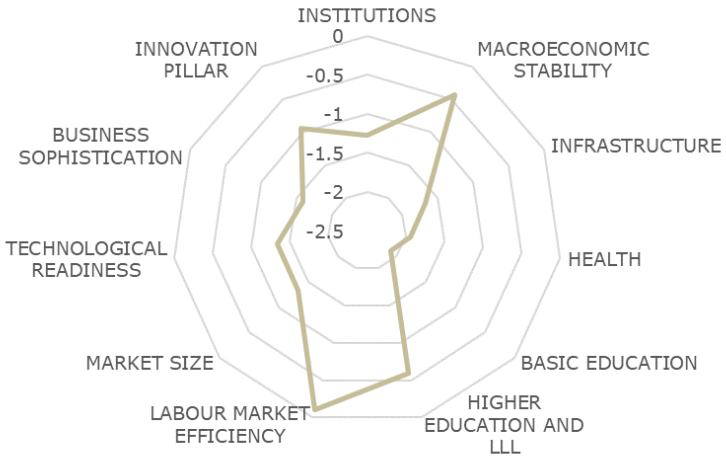


Figure 0-10 Comparison of performance across all 11 RCI pillars in the West region (RO42)

Source: EC (2019a).

3.3.8. Summary of results

The following table summarises the results described in detail above. To this end, the different indicators can score, positive, neutral, negative, or no information available.

Table 0-9 Summary of results

Key variable	Indicator	Sub-indicator	Data source	Assessment
Employment impacts (including impacts on qualifications and skills)	Creation of new jobs by sector and geographic location	Existing jobs in the private sector	PwC (2020)	Economic opportunities in the region remain limited. Private sector jobs in the Jiu Valley total 14,647 in 2018: Petroșani (9,508), Lupeni (1,483), Vulcan (1,253), Petrila (1,226), Uricani (731), and Aninoasa (446).
	Destruction of jobs	Loss of jobs	Bankwatch (2019)	Overall, negative impact in employment across the value chain due to coal phase-out. Employment numbers in the mines dropped from approximately 50,000 in 1989 to under 5,000 today. In 1997 alone, 18,185 people lost their jobs, and another 2,152 the following year.
		Changes in unemployment	Interviews	Labour force participation and employment rates are low. This can be explained by multiple factors. For example, many of the former employees of the Hunedoara Energy Complex went into early retirement and face a lack of motivation to re-join the workforce, economic opportunities remain limited, and people continue to migrate out of the region (particularly the younger population).
			PwC (2020) START (2020)	A total of 1,489 people were registered as unemployed in 2019 in the Jiu Valley, down from 4,510 in 2010. The unemployment rate remains low (between 1.4% and 2.5% across the different communities); however, this likely due to economic inactivity and emigration.
	Net change in number of jobs	Number of new jobs minus the number of destroyed jobs	Own assumptions and calculations with data from Bankwatch (2019) and PwC (2020)	Assuming that 80% of the regional workforce depended on the mining sector in 1990 and the mining company employed 55,588 people, we can assume that employment in the region amounted to approximately 69,485 people. In 2018, employment was estimated at 25,000, out of which 4,288 people were still employed by the mining sector. In total, we can assume that there has been a loss of 44,485 jobs in the region (across all sectors); however, today, only 17% of the workforce relies on the mining sector (as opposed to 80% in 1990). This means that non-mining related jobs increased by 6,815.
Income impacts	Income impacts for the region	Changes in GDP and GVA for the region, compared to other regions. See also GDP per capita	PwC (2020) Eurostat (2020a) Eurostat (2020b)	The total GDP of the West region (RO42) amounted to €19,207mn in 2018, up from €3,807mn in 2000. It is the NUTS-2 region with the second-lowest GDP, after neighbouring South-West Oltenia (RO41). The Jiu Valley share of total GDP was estimated at €457mn (2% of total GDP in the West region). GDP/capita in the West region (RO42) increased from €1,900 in 2000 to €10,800 in 2018, slightly higher than the national average of €10,500. Although the West region (RO42) has the second-highest GDP/capita, it is significantly lower than that of Bucharest-Ilfov (RO32) (€24,200). The Jiu Valley share of the GDP/capita in 2018 was estimated at €3,400 (31% of the GDP/capita in the West region). Total GVA (across all sectors) has grown from €3,438mn to €17,359mn from 2000 to 2018 in the West region (RO42). This places the region at second-last when compared to all other NUTS-2 regions in Romania.

Key variable	Indicator	Sub-indicator	Data source	Assessment
				At regional (NUTS-2) level, industry (NACE codes B to E) has consistently been the top contributor to GVA, rising from €1,015mn in 2000 to €5,113mn in 2017 (or 32% of the total regional GVA).
	Income inequality impacts	Changes disposable income (net), in Purchasing Power Standard (PPS)	Eurostat (2020c)	At regional (NUTS-2) level, disposable income (expressed in PPS) has been slowly increasing in the West region (RO42), but the gap with the capital region continues to increase. In the West region (RO42), disposable income grew from 6,900 PPS/capita in 2007 to10,800 PPS/capita in 2017. In București-Ilfov (capital region) (RO32), disposable income grew from 10,700 PPS/capita in 2007 and to 19,700 PPS/capita in 2017. As a means of comparison, disposable income in PPS/capita across all NUTS-2 regions in the EU ranged from 6,000 to 25,800 in 2017.
Economic diversification	Impact on local economy (and the different sectors)	Changes in dependency on one income source for the region/change in trends regarding the main economic sectors	Bankwatch (2019)	Part of the working population that remained in the Jiu Valley shifted to tourism, traditional agriculture, and textiles (which already existed prior to the start of the transition, employing females to a larger extent than males).
			Interviews	No specific sector has absorbed a lot of the workforce, due to a lack of economic opportunities, lack of investments, heavy migration out of the region, and early retirement for some of the former miners. Interviewees also noted the importance of services within the regional economy.
			PwC (2020)	Although mining still employs around one-third of the working population (i.e. the population that is employed) in the Jiu Valley today, other sectors (manufacturing, wood processing, tourism, and commerce) have become relatively more important than in the past (in terms of employment).
	Dependency on energy sector	Changes in dependency on the energy sector	Interviews	Under 5,000 jobs are still linked to the Hunedoara Energy Complex (HEC), but no new job opportunities have been identified in the energy sector.
Innovation and education impacts	Impacts on technology development	Employment in technology and knowledge-intensive sectors by NUTS-2 regions	Eurostat (2020d) Eurostat (2020e)	At NUTS-2 West region (RO42) level: The percentage of the employed population in high-technology sectors was 1.9% in 2000, 3.2% in 2010, and 5.9% in 2019. The percentage of the employed population in low and medium low-technology manufacturing was 13.7% in 2000, 16.7% in 2010, and 17.1% in 2019. The percentage of the employed population in less knowledge-intensive services was 22.2% in 2000, 20.3% in 2010, and 26.5% in 2019.
			Interviews	The University of Petroșani (UPET) and the National Institute for Research and Development in Mine Safety and Protection to Explosion (INSEMEX) are the main entities in the region with the potential to contribute to R&D&I.

Key variable	Indicator	Sub-indicator	Data source	Assessment
				INSEMEX has diversified its activity and continues to carry a strong reputation within the national research community, but UPET can add value by taking a more active role in R&D&I (by e.g. forming clusters with large investors).
	Impacts on education system	Changes in education system: Employer-sponsored training, access to learning information, no foreign language, higher education attainment, early school leavers, lower-secondary completion only	Eurostat (2020f) Eurostat (2020g)	At NUTS-2 West region (RO42) level: Early leavers represented 23.7% of the population aged 18-24 in 2000; 9.8% in 2010, and 10.3% in 2019. The population aged 25-64 with less than a primary or primary or lower-secondary education in 2000 was 30.2%; 23.1% in 2010, and 16% in 2019. The population aged 25-64 having a tertiary education in 2000 was 10.6%; 14% in 2010, and 16.3% in 2019.
Institutional stability	Political stability	Political stability (Worldwide Governance Indicators) and Ease of Doing Business score	World Bank (2019) World Bank (2020)	Political stability governance score at national level: 0.36 in 2009, 0.05 in 2014, and 0.53 in 2019. The World Bank's Worldwide Governance Indicators (WGI) range from -2.5 to 2.5, with the latter indicating strong governance performance. Ease of Doing Business (EDB) score (at national level): 66.0 (2010) to 73.3 (2020) (ranked 55th in the world in 2020). The EDB score ranges between 0 and 100, and helps assess the absolute level of regulatory performance over time. The change in score over time in Romania indicates that the economy is improving.
			Interviews and own analysis	At local level, there has been political stability, with many mayors being re-elected for several consecutive mandates.
Demographic and tourism impacts	Migration impacts	Changes in the number of people moving in or out of the region	Bankwatch (2019) Bankwatch and Greenpeace (2019)	As a mono-industrial region, the Jiu Valley grew in concurrence with the mining industry. The population experienced growth since the 1700s, until the 1990s, reaching a peak in 1997 (169,911). Until the mid-1970s, demographic growth was due to migratory growth, followed by natural growth. Since 1997, these trends started to regress. The population of the Jiu Valley was 158,678 in 2002; 146,200 in 2011, and 139,718 in 2015.
	Tourist impacts	Changes in the number of tourists	Hunedoara Statistical Office (2018)	The number of tourists in 2014 amounted to 110,536, 151,060 in 2015, 143, 870 in 2016, and 168,346 in 2017 (at NUTS-3 Hunedoara County (RO423) level).
			Bankwatch (2019) and interviews	Growing tourism can also be observed in the Jiu Valley; but investments are still needed to reinforce the sector, and there is a lack of coordination in this respect.
Regional competitiveness	The ability to offer an attractive and sustainable environment for	Regional Competitiveness Index (RCI)	EC (2019a)	The RCI z-score for the NUTS-2 West region (RO42) was -1.04 in 2019. This measures the relative performance of the region in relation to the EU average (set to 0); measured in terms of standard deviations from the EU RCI mean (average). The RCI in the region has improved over time, increasing from -1.25 in 2013 and -1.14 in 2016.

Key variable	Indicator	Sub-indicator	Data source	Assessment
	firms and residents to live and work		Interviews	The score indicates that the region is below the EU average in terms of competitiveness; particularly due to poor education and a mismatch between the labour market and training opportunities, which was also reflected in the interviews.

3.4. Lessons learned

The Jiu Valley was a mono-industrial region dependent on the mining industry. Since the late 1990s it lost a large share of its workforce. Employment in the region remains low due to economic inactivity and a large exodus (especially of young people) outside of the region (Bankwatch, 2019). In the absence of integrated plans for the development of the region, economic opportunities have been limited. Several mines are still due to close and the region is at the point of designating new sectors of activity and investments, while tackling social and environmental challenges.

To conclude this case study, several findings and lessons learned in relation to the just transition of the Jiu Valley can be highlighted (as discussed in either the literature or highlighted by interviewees):

- As reported by several interviewees, the Jiu Valley **did not experience any real transformation yet**. Following the closure of mines, a large share of the workforce migrated out of the region, a trend which continues today. Since then the Jiu Valley has stagnated and economic opportunities remain limited.
- In light of these findings, there is **no evidence to suggest that any particular sector has absorbed the workforce previously involved in mining**. Today, there is minimal diversification towards other sectors like manufacturing, forestry, commerce, and tourism. Although tourism is often cited as a possible avenue of future employment, it cannot bring all the benefits needed to the region on its own.
- The region continues to suffer from a **lack of public policies and integrated action**. Low quality education and a mismatch between training opportunities and labour market needs continue to be identified as challenges in the region. **More emphasis needs to be placed on education and R&D&I** to attract investors and retain qualified labour. Furthermore, **concrete actions** that can be monitored are needed.
- In thinking about future economic opportunities, one **cannot ignore the societal hurdles that persist**. Some examples include lack of unity and sense of belonging, lack of trust in the potential of the region, poverty, marginalisation, and corruption. The local administration, citizens, businesses, and all relevant stakeholders need to be more involved in the transition. Economic restructuring in the Jiu Valley has, thus, been characterised as **lacking engagement with local stakeholders** (decisions often being taken top-down), and as **'unjust'**.
- Over the past few years, some **positive changes have begun to emerge**. Interviewees have highlighted more openness to community-led actions, a new wave of hope following the involvement of the region in the Platform for Coal Regions in Transition (PCRT), and a flourishing civil society (largely motivated by local NGOs). The transition also brought about positive **environmental changes**, such as improved air quality, improved water quality, and a reduction in the region's carbon footprint.

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4. Case study 2: North Rhine-Westphalia, Germany

4.1. Introduction

The region of North Rhine-Westphalia (NRW) is known for its large economy in terms of GDP, which is fuelled by **large manufacturing** and **energy-intensive industries**. In 2018, the region accounted for 20% of Germany's GDP, maintaining its status as the country's economically strongest region (Eurostat, 2020). NRW's long history of energy-intensive industry operations is based on the proximity of hard coal and lignite deposits in the Ruhr area and the Rhine mining region. The large coal-fired power close to these coal mines led to **relatively cheap and stable electricity supply** to industrial plants (Vallentin, 2016). The Ruhr area (Ruhr metropolitan region) was especially famous for its hard coal mining and steel industry (Renn & Marschall, 2016).

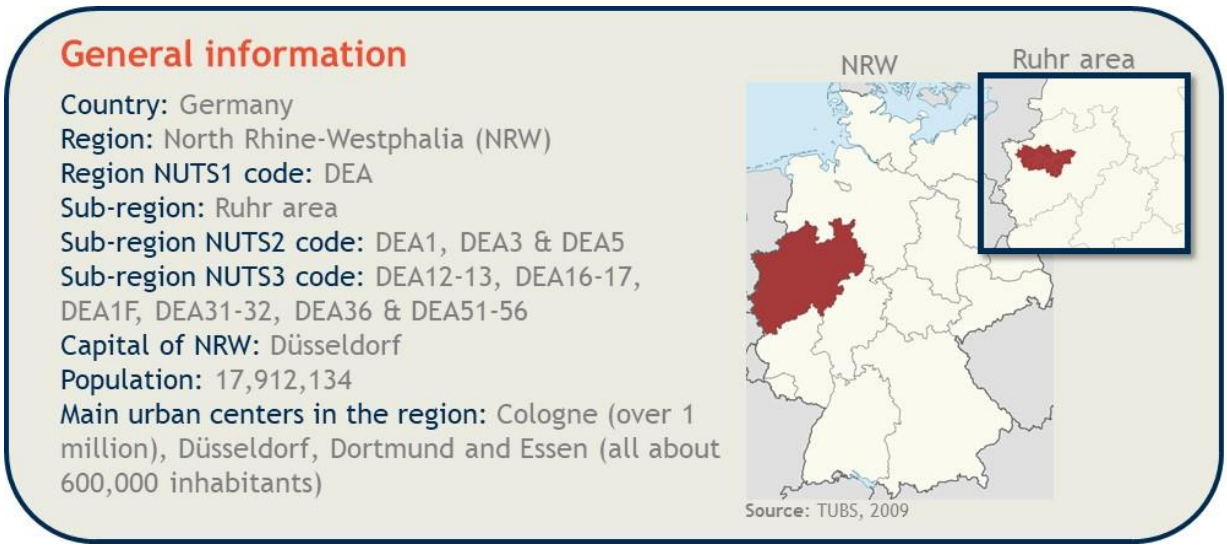

Figure 0-11 General information

Source: European Commission (n.d.)

In 1956, the mining industry in the Ruhr area reached peak when 123,000 tonnes of coal were produced that year, providing work to nearly half a million people (Oei et al., 2019). However, the situation changed with the worldwide oil crisis in 1973. Due to increasing imports of cheap coal and oil to Germany, the coal and steel industries in the State of NRW entered a crisis. As a result, many hard coal mines had to close, and the employment numbers went down significantly (from 500,000 employees directly employed in hard coal production in 1956 to zero employees in 2018). In 2018, the last hard coal mine was closed in NRW. In 2020, NRW had three active opencast lignite mines (i.e. Hambach, Garzweiler and Inden) operated by RWE Power AG (Agora Energiewende und Aurora Energy Research, 2019). Together, these mines employ 9,000 miners. The mines indirectly generate jobs for another 10,000 workers (interview data).

The region of NRW is responsible for more than a quarter of Germany's electricity generation, and around 40% of German industrial electricity is consumed in the region (Ministry for Employment, Innovation, Digitalisation and Energy, 2019).

The region has reduced its electricity generation based on hard coal throughout the years (see Figure 5-2 below). The presence of lignite in the energy mix remains at similar levels over the

presented time period. In addition, the share of renewable energy in the energy mix has increased to around 13% of generated electricity. In 2020, the lignite power plants in NRW have a net nominal capacity of 10.6 GW and hard coal power plants have a net nominal capacity of 6.6 GW (interview data). Other detailed information about NRW's energy generation statistics are presented in the textbox below.

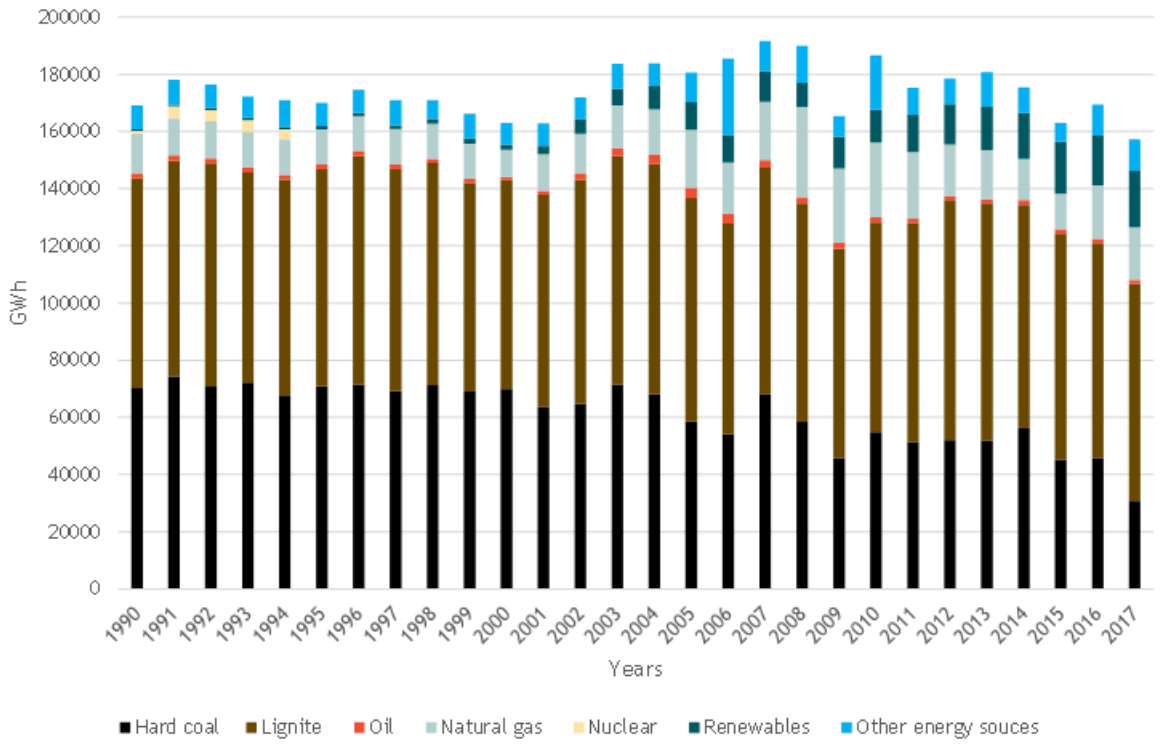

Figure 0-12 Gross electricity generation per energy source over the years (1990-2017)

Source: Own calculations based on data from LAK-Energiebilanzen (2020).

Textbox 0-1 Overview of the coal industry in North Rhine-Westphalia 2018

Table 0-10 Coal mines in NRW by NUTS-2 region

NUTS2 area	Type of coal	Production (Mt)	Productivity (tones/employee)	Depth (m)	No. mines
DEA3 Münster	Hard coal	6.7	695	800	2
DEA2 Köln	Lignite	60	13 575	NA	2
DEA1 Düsseldorf	Lignite	35	13 576	NA	1

Source: Alves Dias et al., 2018

Table 0-11 Coal-fired power plant capacity in NRW, aggregated at NUTS-2 level

NUTS area	Capacity (MW)	Average efficiency	Age in 2018 (in years)
DEA1 Düsseldorf	8 374	36%	26
DEA2 Köln	5 435	34%	38
DEA3 Münster	1 532	35%	39
DEA4 Detmold % 29	875	39	29
DEA5 Arnsberg	4 610	37%	25

Source: Alves Dias et al., 2018

The decrease in coal extraction and associated activities has led to the restructuring of the NRW's economy into a **knowledge-based economy with a focus on renewable energy and eco-industry** (Galgoczi, 2014). Due to important investments accompanying economic structural changes, the region kept its status as a competitive industrial region in Germany (European Commission, n.d.)

In this case study, we zoom in on the impacts of the coal phase-out in NRW and, in particular, the Ruhr area to draw lessons for the region and other coal regions in transition.

4.2. Background information

4.2.1. Start and acceleration of the transition

The North Rhine-Westphalia region has a long history of coal phase-out (~1960 – ongoing). In this study, we identify two stages of the phase-out, namely the **first stage** from 1958 to 2007 and the **second stage** from 2007 onward. The two stages are interlinked yet the drivers of the phases change over time.

Stage 1 (1958-2007):

- **Competition for cheap coal and oil.** Germany's mined coal can no longer compete with cheaper imported oil and coal. Around the 1970s, Germany starts to subsidise domestic coal mining, to keep the sector alive. However, the subsidies were not able to prevent the decline of national coal mining. As such, by 2001, the amount of imported coal exceeded domestic production. In 2016, 45 million tonnes were imported, mainly from Russia, North and South America (Brauers et al., 2018).

- **Liberalisation.** From the 1980s, conventional energy market moved towards a deregulated and liberalised market (Renn & Marschall, 2016).
- **Rising protest from civil society action against the coal industry.** However, they were not very successful in reducing the coal production as the coal mining workers were organised in a powerful and influential trade union called I.G. Bergbau und Chemie, which was closely affiliated with the Social Democratic Party (Renn & Marschall, 2016).
- **Falling energy demand.** Since 1990, overall primary energy demand has been gradually declining. This is due to efficiency and modernisation measures as well as the increasing use of energy sources and technologies with lower conversion losses (Agora Energiewende and Aurora Energy Research, 2019). In addition, there was a shift from the primary sector to the tertiary sector, which lowered the final demand for energy.
- **Increased use of natural gas.** Germany started to consume more natural gas, especially for heat in buildings. The use of natural gas also increased power plants, replacing coal-fired generation (Agora Energiewende and Aurora Energy Research, 2019).
- **Expansion of renewable energy.** The Renewable Energy Sources Act of 2000 (further explained below) has made a large contribution to the expansion of renewable energy, especially in the electricity sector (Agora Energiewende and Aurora Energy Research, 2019).

Stage 2 (2007-today):

- **Rising global pressure on climate-related issues**. In 2007, the German federal government decided to phase-out coal mining subsidies by 2018 (Clean Energy Wire, 2019a). Moreover, EU decisions and international events such as the Paris Agreement increased the pressure on the German government to set more ambitious climate and energy targets. The phase-out of lignite is mainly based on climate reasons (based on interview data). As lignite cannot be exported (it contains too much water which makes it expensive to be exported) the phase-out of the power plants (as part of the coal phase-out plan) also meant a phase-out of mining (based on interview data).
- **Increased political support to phase-out coal.** In 2016, the German “Climate Protection Plan 2050” (“Klimaschutzplan 2050”) was approved. This plan implied a phase-out of coal (Brauers et al., 2018). In 2019, it was announced that coal would be phased out by 2038.
- **The realisation that Germany was going to miss its 2020 climate targets.**
- **An increased pressure from civil society to phase-out coal.** This also included the mobilisation of people and capacities formerly engaged with the now decided nuclear phase-out and international level (also including people and capacities from the climate justice movement) (Brauers et al., 2018).
- **A weakening economic situation for coal power plants** due to rising renewable shares and lower wholesale electricity prices (Brauers et al., 2018).

4.2.2. (Inter)national and regional policies

Germany's political system is shaped by federalism; energy and climate legislation are planned and adopted at federal level, but **state-level governments are responsible for**

implementing federal laws. In addition, state-level governments can develop their own programmes, such as promoting renewables. As such, the most important federal climate and energy policies are discussed as they a shape the programmes and strategies of NRW.

In 2007, Germany committed for the first time to reduce the country's GHG emissions by 40 percent by 2020 compared to 1990 levels (interview data). The Climate Protection Plan 2050 (adopted in 2016) strives for near greenhouse gas neutrality by 2050. To achieve these targets, Germany needed to reduce its greenhouse gas emission by 40 percent by 2020 and by 55 percent by 2030 compared to 1990 levels (Bundesregierung, 2016).

Despite Germany's progress and plans to achieve emissions reductions in the power sector, Germany is failing to meet its climate targets in 2020 (see below).

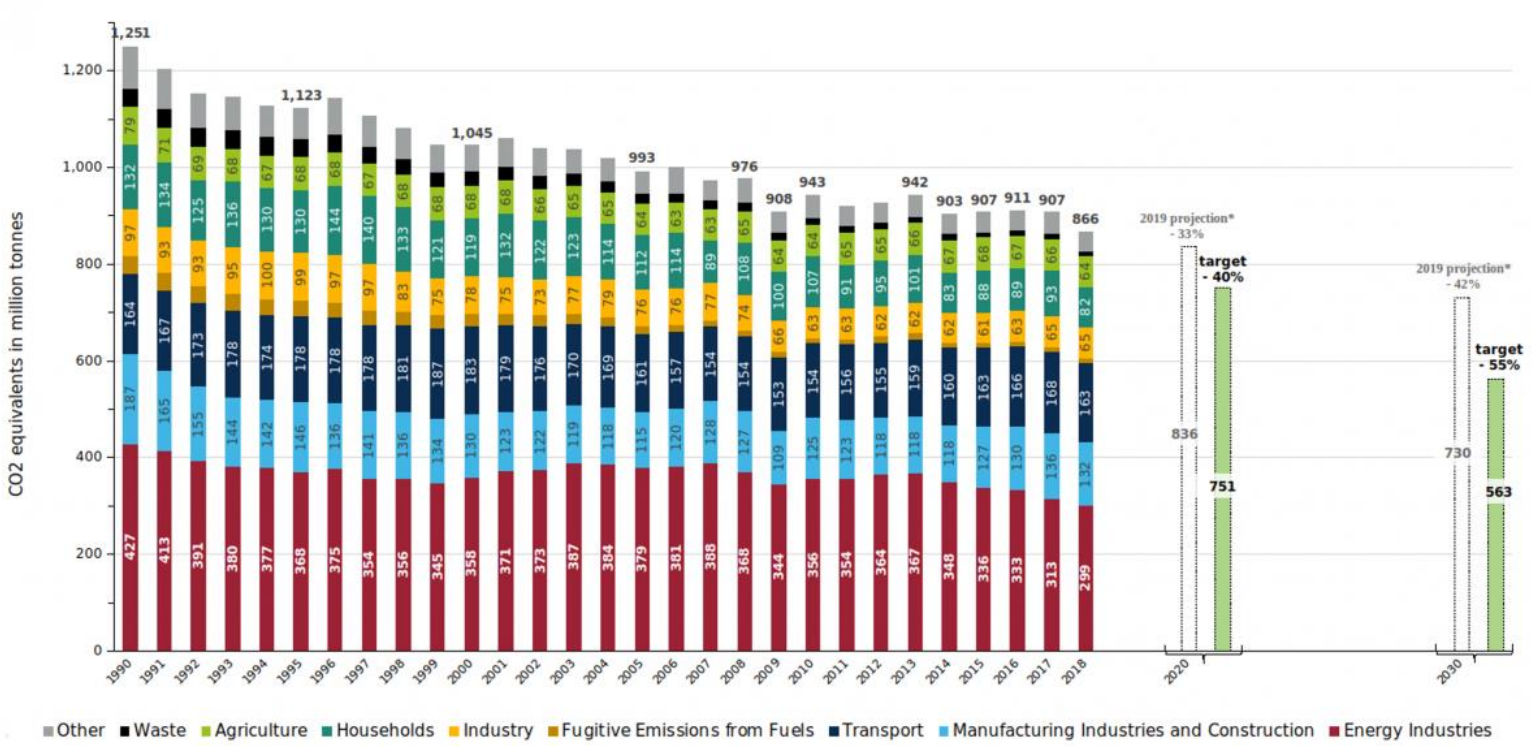

Figure 0-13 GHG emission trends in Germany by sector 1990-2018[24]

Source: Clean Energy Wire 2019b, via UBA 2019 & BMU (2019).

In 2019, Germany **committed to the phase-out of coal by 2038** (IEA, 2020). To reach this plan, the German federal government established a Commission on Growth, Structural Change and Employment ('Kommission Wachstum, Strukturwandel und Beschäftigung'), also called the Coal Commission ('Kohlekommission') in June 2018. Aside of the intermediate and end targets of the phase-out, **the commission agreed on EUR 40 billion of structural aid for the coal regions of Germany (IEA, 2020), of which EUR 14 billion is allocated to North Rhine-Westphalia** (interview data). The Coal Commission ensures the closure of coal mines and plants in the Coal Exit Act ('Strukturstärkungsgesetz Kohleregion) and the amount of

[24] Without emission from land use and land-use change and forestry.

financial aid to each state is ensured in the Structural Strengthening Act (Strukturstärkungsgesetz Kohleregionen').

Moreover, on October 9th, 2019, the German federal government passed the **Climate Action Programme 2030,** through which it intends to achieve Germany's climate goals between now and 2030. The central goal for 2030 is to reduce GHG emissions by at least 55 % by 2030 compared to the 1990 level. In addition, the aim is to align with the EU climate goal of at least 40% GHG emission by 2030 compared to 2005 levels (NECP, 2020).

At regional level, several policies were implemented to ensure a smooth phase-out process. The transition under stage 1 **was a slow transition (over 50 years),** which enabled the proper implementation of social policies such as early retirement, communication of phase-out plans, retraining, and reskilling of employees to keep unemployment rates relatively low (Brauers et al. 2018). Below we provide an overview of the energy and industry policy at regional level, including the funding and funding sources from 1968 to 2018.

Table 0-12 Overview of the energy and industry policies

Period	Policy/programme	Amount in EUR
1968 -1973	Ruhr Development Programme: Settlement of new companies without any specific sectoral specification, education (e.g. 1e university), traffic infrastructure	8.7 billion (Federal State)
1970 -1975	RNW programme (integrates Ruhr programme)	16 billion (Federal State)
1974 -1985	Technology programmes for steel coal and energy: Securing jobs and modernisation of companies	1.3 billion (Federal State)
1980 -1984	Ruhr Action Programme: Technology transfer and innovation, culture and environment, and refurbishment of old industrial sites	3.5 billion (Federal State)
1985 1988	Technology programmes	200 million (Federal State)
1987 1989	Future initiative coal and steel regions: Innovation and technology funding, education of the workers, support soft location factors	1 billion (Federal State)
1989 -1999	International Building Exhibition Emscher Park[25]: Financial support of projects, coordination & consultation	2.5 billion (Federal State)
1980 -2006 (5 periods)	European Regional Development Fund (ERDF) & public funding: Investment support and research funding, development of education and research facilities, environmental measures & creation of business centres	1.6 billion (Federal State & EU funding)
2007 -2013	ERDF& public funding: Entrepreneurship. higher living conditions & improvement of innovation	1.3 billion (Federal State & EU funding)
2014 -2020	ERDF & public funding	1.2 billion (Federal State & EU funding)
~1968 -2018	Social policies: retaining, financial ado for transfer into new employment, liberation of unemployment insurance, early retirement	18 billion (National)
1968 -2018	Subsidies for domestic coal sales	~165 billion (National)

Source: Oei et al. (2019).

In addition, the **Joint Taskforce to Improve the Regional Economic Structure** *('Gemeinschaftsaufgabe Verbesserung der regionalen Wirtschaftsstruktur'* (GRW)), has been an important funding instrument to support the Ruhr area to diversify the regional economy (interview data). Since 1969, the GRW has helped Germany foster balanced regional

[25] The International Building Exhibition Emscher Park aimed to give the Ruhr area a new impulse for an ecological, economic and cultural structural change as a response to the industrial decline of the region. For more information see https://www.internationale-bauausstellungen.de/en/history/1989-1999-iba-emscher-park-a-future-for-an-industrial-region/

development, providing funding[26] for weak regions in need of investments and attractive local jobs (Alessandrini et al., 2020).

In 2015, the state government developed a **new climate protection policy**. This policy was a new milestone after the NRW's state government had adopted a Climate Protection Act (passed in 2013), setting legally binding climate targets which meant that by 2020, GHG emissions needed to be at least 25% lower than 1990 levels and at least 80% lower by 2050 (MKULNV, 2015). The Climate Protection Plan focuses, above all, on expanding renewable energies, boosting energy and resource efficiency and lowering energy consumption, e.g. in industry, households and the building sector. It is equally important to expand combined heating and cooling systems (trigeneration) and increase the deployment of low-carbon technologies in industry (MKULNV, 2015).

At first glance, NRW's 2020 target seemed to be less ambitious than the 40% one set by the German Federal Government for the same period. However, 25% was seen as more realistic and challenging enough given the state's economic structure at the time (Vallentin, 2016). Yet, **due to efficiency gain in the industries and the closure of power plants, the State was able to achieve 38% emission reduction in 2019** (interview data).

The state government wants to make the industry part of the solution needed to comply with ambitious energy and climate policy targets (MWIDE, 2019). Moreover, the **region aims to keep its good reputation for having cheap and reliable energy which attracts the energy-intensive industries.** Consequently, it has developed the "Energy Supply Strategy NRW" which aims to balance security of energy supply, economic efficiency, and climate and environmental protection (MWIDE, 2019).

Part of this strategy is to replace coal with other energy sources, such as hydrogen, and to build on renewables (from Germany and the European market) (Interview data). In addition, extra efforts are taken to preserve the existing industries (interview data).

Due to the national coal phase-out plan, the lignite mining and plants need to be closed as well. One of the regions affected is the Rheinische Revier region. This region is at the start of the phase-out trajectory. The impacts of Rheinische Revier phase-out is not discussed in this study, however, several interesting developments were discussed in the Economic and Structural Programme for the Future of the Rhine Region 1.0 (Future Agency Rheinisches Revier, 2020), which we shortly elaborate on in the textbox below.

Textbox 0-2 Economic and Structural Programme for the Future of the Rhine Region 1.0

Economic and Structural Programme for the Future of the Rhine Region 1.0

The Rheinische Revier area has around 9000 lignite miners and 10,000 workers active in indirect jobs (interview data). The area will receive up to EUR 15 billion in the coming decades to phase-out coal and restructure their economy. The Rheinische Revier area together with NRW, developed the Economic and Structural Programme 1.0[27], which aims to turn a challenge into an opportunity. The strategy builds on the strengths of the area. One of the identified strengths is the energy industry (e.g. skilled and trained workers and existing energy infrastructure). As such, the government of the Rheinische Revier area aims to transform the region into a hydrogen valley with – among other projects - a research

[26] GRW funds support investments by trade and industry, local commerce-related infrastructure, measures to encourage networking and cooperation between local players, and measures to improve SME competitiveness (Alessandrini et al., 2020).

[27] See for more information https://www.wirtschaft.nrw/sites/default/files/asset/document/final_wsp_1_0.pdf.

centre related to hydrogen and modern innovative heat storage power plants which store renewable power as heat and later use this heat to power turbines (interview data).

The Rheinische Revier area has an innovative approach toward the coal phase-out:

1. A task force of specialists who know the region well will develop a more detailed economic and structural programme 1.1;
2. The region not only focusses on a successful phase-out (in terms of social security), but also developed its (energy) transition plan so that the coal phase-out and the energy transition take place at the same time; and
3. There is a managing and monitoring department that makes sure that funds are responsibly spent. The department is responsible for the end result (interview data).

A brief timeline of the coal phase-out and the related regional and national policies is given in the figure below.

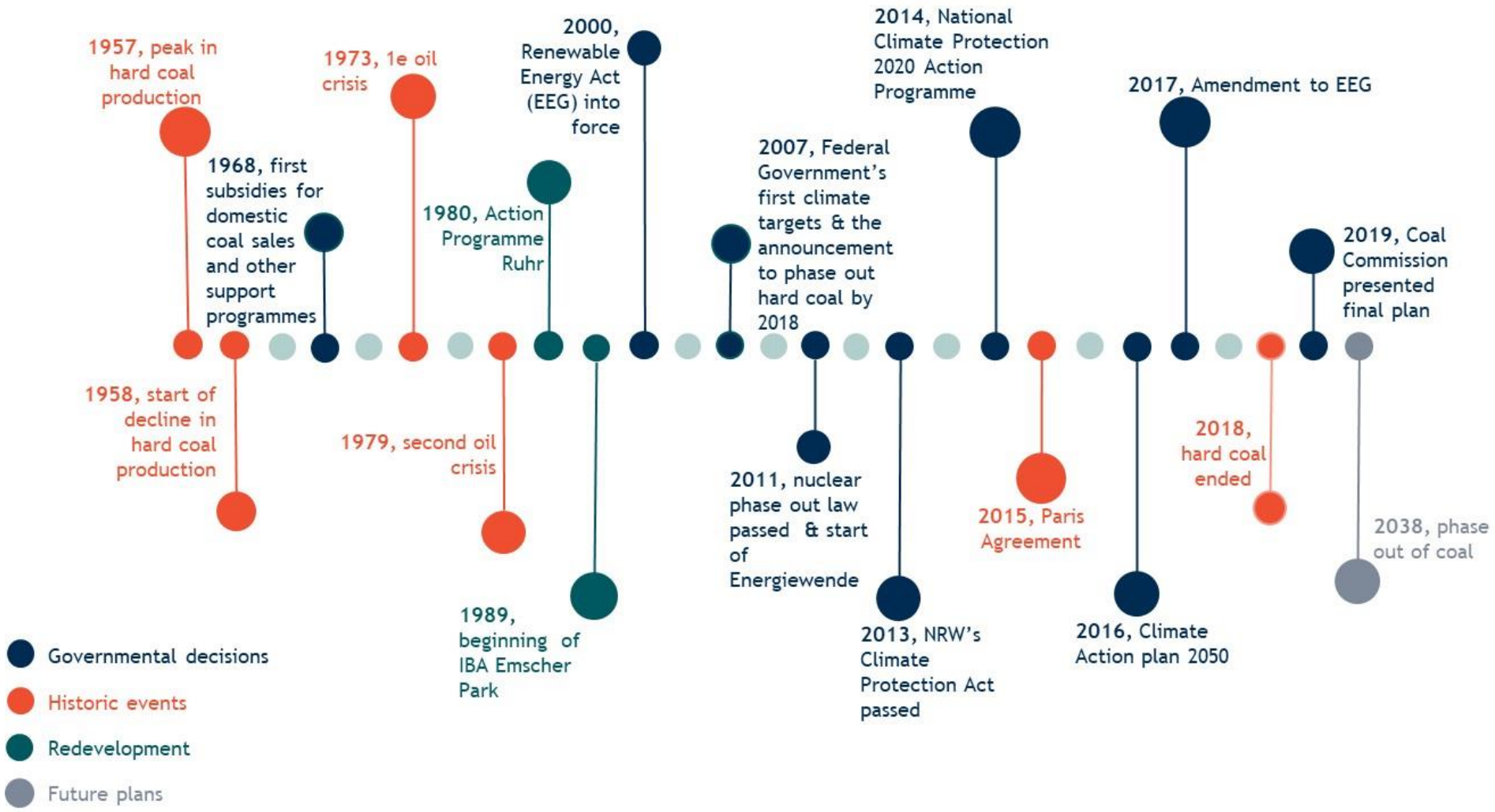

Figure 0-14 Timeline North Rhine-Westphalia

4.3. Results

4.3.1. Employment impacts

The region of NRW has a long history of coal phase-out and in particular hard coal phase-out. In the 50's and 60's there were around 500,000 miners directly employed in hard coal production in the Ruhr area and around Aachen (interview data and Figure 0-15 below). As a result of strong foreign competition, many mines had to close (see Section 5.2.1) and employment numbers went down significantly (see Figure 0-15 below).

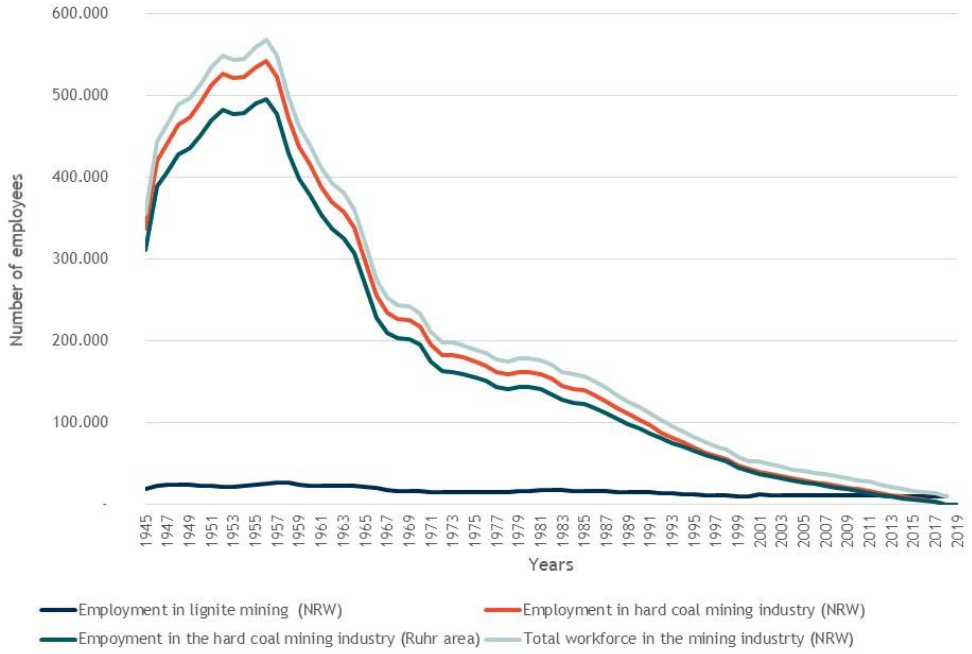

Figure 0-15 Overview of employment in the coal sector

Source: Statistik der Kohlenwirtschaft e.V. (2019).

Nonetheless, **unemployment in the mining sector barely increased due to many workers having shifted from the coal industry to other industries** (e.g. steel industry) (Oei et al., 2019). In addition, **strong social policies** were put in place, such as early retirement (at the age of 49) and retraining of (ex-)workers, to ensure that no coal miner was fired. The strong social policies were mostly the result of the strong position of the trade union, Industriegewerkschaft Bergbau, Chemie, Energie (IG BCE) in the negotiations with the government of NRW.

However, workers employed in jobs along the coal and steel value chain suffered from the crisis as they were less protected than the workers in the coal and steel industry**.** In addition, the first and second oil crisis in 1973 and 1979 respectively (see Figure 5-4), impacted the unemployment rates. **As a result, the unemployment rate grew drastically from 1970 onwards.** As illustrated in the Figure below, especially the Ruhr area experienced high unemployment rates, with a peak in 1988 of 15% unemployment.

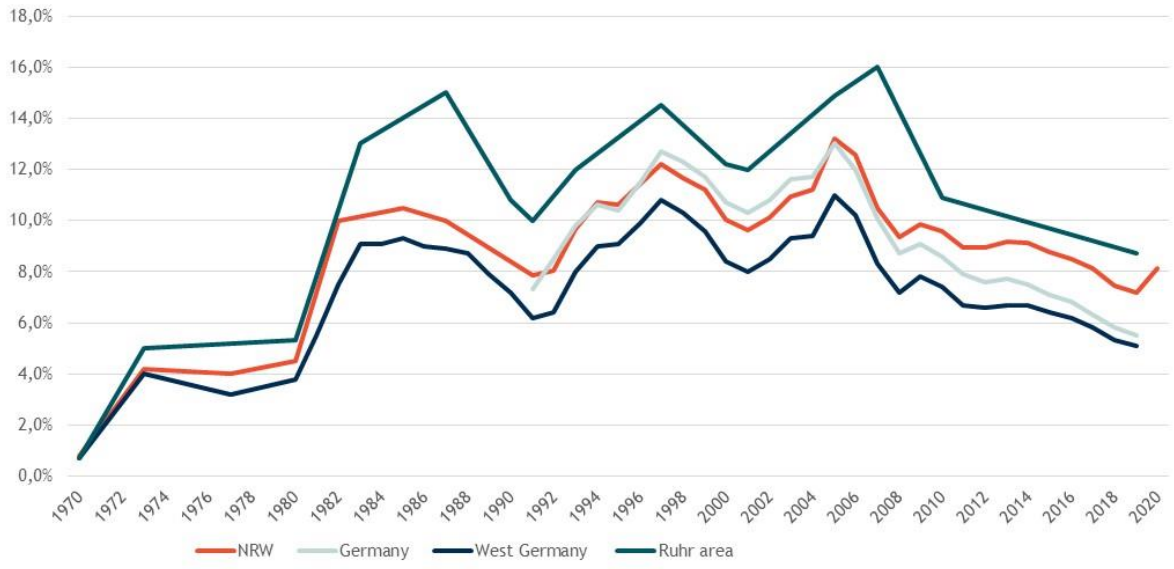

Figure 0-16 Trends in unemployment rates[28] in the Ruhr area, North Rhine-Westphalia, West Germany and Germany from 1970 to 2020

Source: Bundesagentur für Arbeit (BA) (2020) and Hospers (2004)

For a long time, the Ruhr area struggled to create new jobs. Mining and steel companies were reluctant to sell their land to companies in other sectors and domestic industries faced growing international competition as a result of globalisation (Brauers et al., 2018). Moreover, coal and steel companies as well as the government initially did not realise the true nature of the coal crises which resulted in policies (e.g. subsidies) that aimed to preserve the status quo and limited action was taken by the government to implemented structural reform measures (Oei et al., 2019).

In 2018, coal mines and power plants in NRW employed 52,341 people (see table below).

Table 0-13 Employment in coal-related activities.

NUTS area	Jobs in coal mines	Jobs in power plants	Indirect coal-related jobs (intra-regional)	Indirect coal-related jobs (inter-regional)	Total
DEA1 Düsseldorf	2 578	2 016	3227	6754	14575
DEA2 Köln	4 420	1 308	3 726	8 275	17729
DEA3 Münster	9 640	369	1 025	3 365	14399
DEA4 Detmold	0	211	125	376	712
DEA5 Arnsberg	0	1 110	1 101	2 715	4926
Total	16638	5014	9204	21485	**52341**

Source: Alves Dias et al. (2018).

The lignite sector employed around 21,000 workers in 2000 (interview data), but the number decreased to 9,000 workers in 2016 (Alessandrini, et al. 2020). Currently, an additional 10,000

[28] For Germany and NRW, there was only information from 1991 onwards. Data between 1070-190 is retrieved from Brauers et al. 2018 and O'Loughlin and Friedrichs (Eds.), 1996. For the Ruhr area there was limited data for the entire period. Data points are retrieved from RegionalverbanRurh (2020), Hospers (2004) and Brauers et al. 2018.

workers are active in indirect jobs (interview data). RWE Power AG will close the Hambach opencast mine by 2030 as the result of the National Coal Phase-out Plan and the targets set by the European Commission. This means that from 2030 onwards, only the Garzweiler opencast mine will be available to supply the remaining RWE power plants. The company anticipates that more than 3,000 jobs will be cut in the short term and, by 2030, the total will be about 6,000 (RWE, 2020).

4.3.2. Income impact

In the early 1970s, GDP in the Ruhr area declined, while GDP in NRW remained relatively stable (interview data). The figure below shows how GDP/capita evolved in Germany, NRW, and the Ruhr area between 1992 and 2017. Overall, the trend is positive, with a minor setback around the economic crisis that started in 2008. As can be seen in the figure, **GDP per capita is lower in the Ruhr area than in NRW and Germany as a whole. This gap has been widening since 2012**.

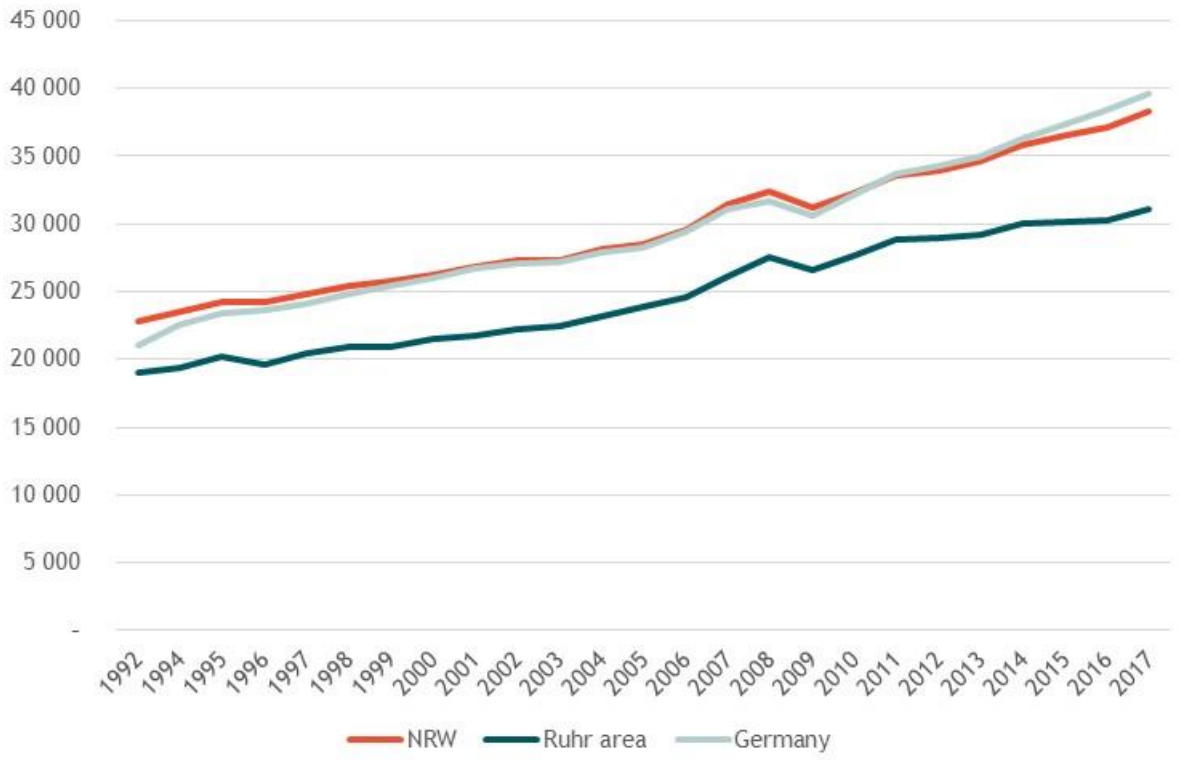

Figure 0-17 GPD per capita in euros – trends over time

Source: Own calculations based on data from Statistische Ämter des Bundes und der Länden (2019).

Figure 0-18 shows how disposable income in the Ruhr area, NRW, and Germany evolved over time. Although there was a decline in income for the coal workers due to the coal crisis in 1960 and 1970, the effect was minimal due to the strong social protection from the unions (interview data). Furthermore, the Ruhr area shows a lower disposable income per capita than NRW (illustrated in Figure 0-18).

However, one of the interviewees mentioned that losing a job as a mine worker was not only about the impact on income but also about the **ideological impact**. The industry was a male-dominated profession, and many men felt like they had lost their individual identity. Moreover,

there is a general feeling of a loss in regional identity. In some of the Structural Reform Programmes, special attention was therefore given to restoring the region's heritage.

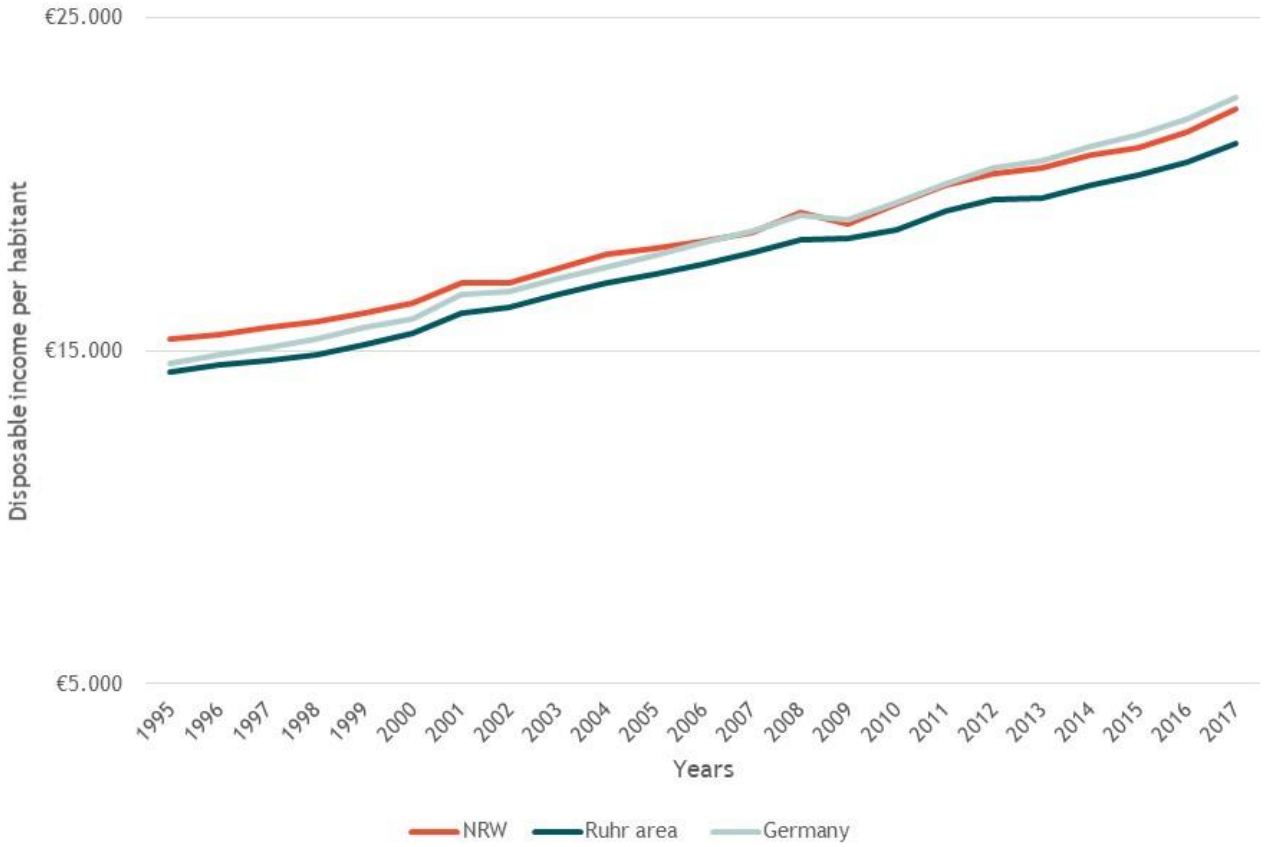

Figure 0-18 Disposable income per capita

Source: Own calculations based on data from Statistische Ämter des Bundes und der Länden (2019).

4.3.3. Economic diversification

Around the 1960s, the NRW government realised it was in a **coal lock-in** and started with the restructuring of its economy via Structural Reform Programmes (see Table 5-3 for an overview of the policies). The programmes aimed to **incentivise innovation, and especially education.** In addition, **connectivity** (i.e. improving infrastructure) was emphasised with the aim to stimulate people to work in neighbouring towns. Investments were also made in other sectors, such as the **health, media, and technology sector** (interview data).

The region aimed to become a science-oriented region and started to build several universities and research institutes;12 universities were built in less than ten years. The universities provide employment opportunities. For example, the University of Aachen produces an average of 30 new spin-offs every year, resulting in 800 jobs every year (interview data). Moreover, the Forschungszentrum Jülich Insititute (research institute) employs 6,400 workers (Forschungszentrum Jülich, 2020), of which almost 50% of staff are non-student staff, such as mechanics, electricians, and service personnel (interview data).

As such, it is evident that **NRW, and especially the Ruhr area is moving from an industry-based economy to a more service-based economy** (see Figure 5-9). The share of people

working in the secondary sectors decreased from 58% in 1976 to 26% in 2014, whereas the share in the tertiary sectors increased from 42% to 74% (Brauers et al., 2018).

In mid-2019, 76% of all employees in the Ruhr area worked in the service sector and 24% in the manufacturing sector. In NRW, excluding the Ruhr area, 72% were employed in service sector, and 28% are employed in manufacturing (Regionalverband Ruhr, 2020).

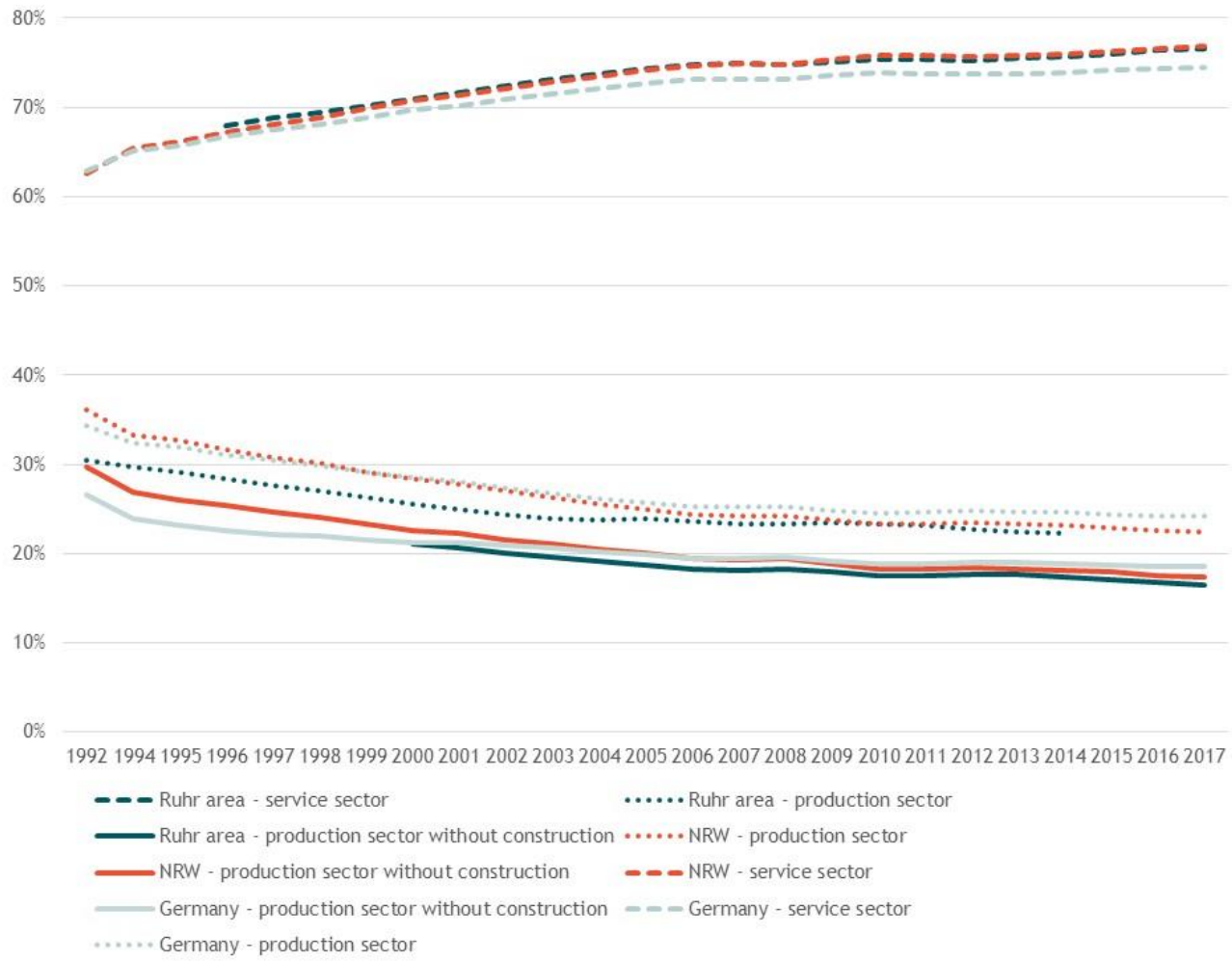

Figure 0-19 Employment in percentages per sector – trends over time[29]

Source: Own calculations based on data from Statistische Ämter des Bundes und der Länden (2019).

More specifically, in the Ruhr area, the number of jobs in the service sector increased from 1.3 million to 1.4 million in 2019. Zooming in on service sector shows that most of the new jobs are created in the "storage and provision of other transport services" sector (+ 4,793 jobs) (Regionalverband Ruhr, 2020).[30]

[29] For the Ruhr are, there was only data from 1996 onwards.

[30] Including the operation of storage facilities and traffic routes, e.g. for rail vehicles, freight forwarding and postal, courier and express services.

Other sectors which experienced an increase in employment in the Ruhr area in 2019, are the health sector with around 4,600 new jobs and social services with around 3,400 new jobs (Regionalverband Ruhr, 2020).

Employment in the manufacturing sector increased from 411,000 jobs in 2018 to 418,000 jobs (1,7%) in 2019. Within this sector, growth was largest in the construction sector (+ 3,480 jobs), the energy production sector (+ 1,097), as well as jobs related to water management, sewages and waste disposal (+ 675 positions). In contrast, the mining sector recorded many job losses (-1,236) (Regionalverband Ruhr, 2020).

The predominance of the service sector in NRW, which is a highly industrialised region, can be explained by the high amount of business-to-business service activity (European Commission, n.d.). In addition, **80% of the employment is provided by Small Medium Enterprises** (NRW Invest, 2016). Statistics show that in 2020, 711,600 small and medium-sized enterprises were registered in NRW.

Economic diversification away from manufacturing towards services is reflected in Figure 5-10. The value-added of the manufacturing sector (with and without construction) in the Ruhr area has been on the decline since 1992, while the value-added of the service sector has slowly increased. These trends are mirrored at State and national levels as well. However, the share of manufacturing in total GVA is significantly lower in the Ruhr region compared to State and national levels.

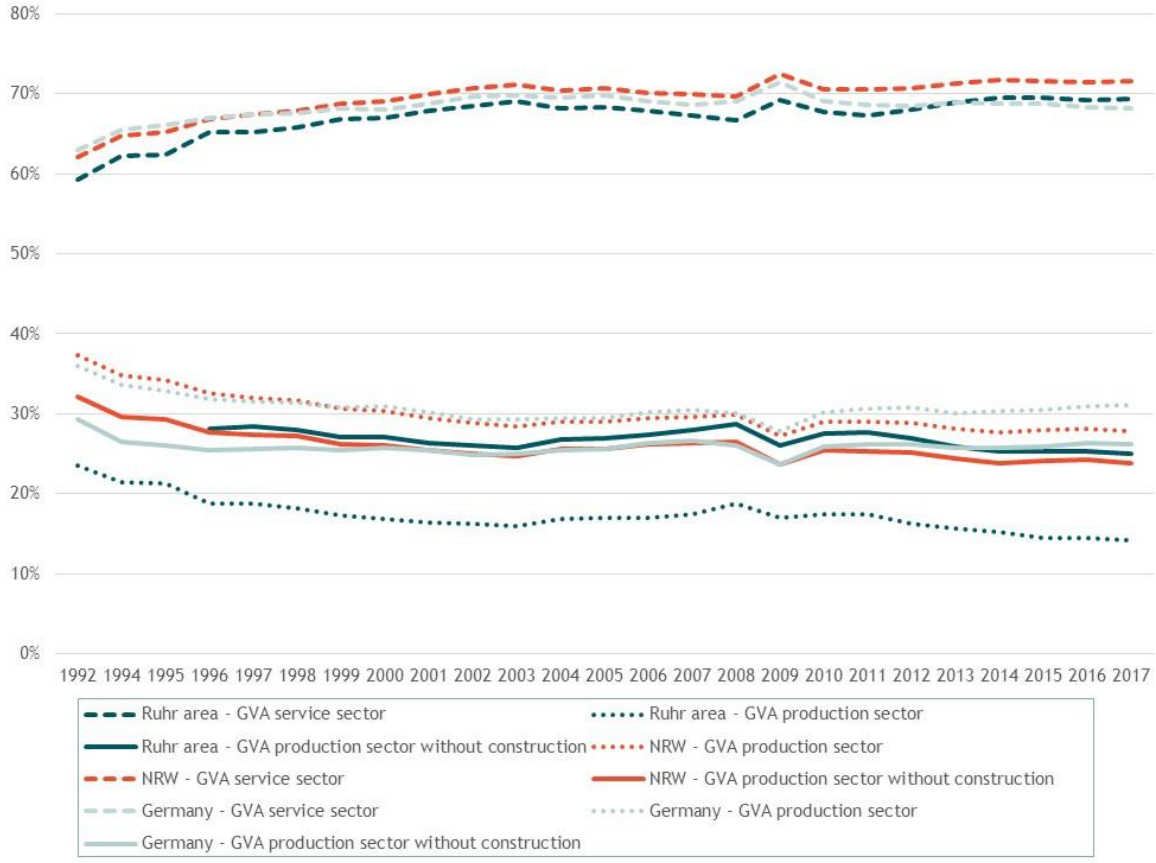

Figure 0-20 Gross Value Added (GVA) in percentages – trends over time for different sectors.

Source: Own calculations based on data from Statistische Ämter des Bundes und der Länden, 2019.

4.3.4. Innovation and education impacts

In 1965 the Ruhr area did not have any operational universities. The **opening of several new universities enhanced the attractiveness** of the region for companies as well as for citizens, constituting an important location factor. In 2020, more than 768,000 students registered at 70 universities and colleges (NRWInvest, n.d.). The University of Aachen alone has more than 50,000 students and more than 10,000 employees. However, other institutes, such as the Forschungszentrum Jülich, the German Aerospace Center, nine institutes of the Leibniz Association, 14 Fraunhofer and Max Planck Institutes as well as 56 collaborative research centres at universities contribute to the strong R&D sector in NRW (NRWInvest, n.d.). As such, NRW is seen as one of Germany's strongest science regions (interview data). Moreover, every fifth German start-up originates from NRW (NRWInvest, n.d.)

Investments in education in the Ruhr resulted in an increase of 6,6% percentage points of employees with a university degree between 2007 and 2019 (Regionalverband Ruhr, 2020). The number of employees with a university degree increased from 114,000 in 2000 to 250,000 in 2019 (Regionalverband Ruhr, 2020).

The Structural Reform Programmes induced considerable innovation in the region (interview data). Several lead sectors were selected for financial support. These include the health and mobility sector. This support expanded to resource efficiency, tourism, and digitalisation projects. As a result, an increase in the number of companies is noticeable (interview data). The Structural Reform Programme was also able to connect cities in order to generate synergies between businesses. Organisations appointed for this task helped cities get an overview of different initiatives and projects and to start cooperation projects between cities. As a result, companies and research centres started to work together (interview data). This programme responded to the need to have a distributed system with smaller companies in both the service and manufacturing sectors. Within the Ruhr area, cities are now more independent and develop their own strategies. This change was necessary to reflect the individual needs of each city (Brauers et al, 2018). However, it took time to shift policymaking from federal to regional level.

4.3.5. Institutional stability

At the beginning of the structural reform that started in the 1960s, there was some resistance from the miners (interview data). Oei et al. (2019) identifies it as cognitive lock-in: *"the belief that the crisis was cyclical, not structural, leading to persistent attempts to modernize the old structures of the Ruhr area instead of turning to new economic possibilities. Consequently, mining companies refused to sell the land they owned to new companies out of the fear that salaries would rise and employees would switch allegiances, working for new competitors"* (p.969).

Local and state politicians have always followed RWE Power AG's agenda (interview data). However, due to the EU's climate policies and national targets, local politicians are slowly changing their views towards a more climate-neutral agenda. The current phase-out plan by 2038 legally secures that anyone within the coal sector will become unemployed. This is a very important component for those affected and their families. As such, the coal phase-out has not caused political instability (interview data).

The installation of the Coal Commission to develop the coal phase-out plan has been considered a success, as it developed a plan to phase-out coal in 2038, and it included all important stakeholders (e.g. coal companies (RWE and LEAG, NGOs, regional governments and trade unions) (interview data). Forty billion Euros have been dedicated to the regions in

transition. Moreover, for LEAG[31] and RWE the outcome is considered as successful as they will be highly compensated in the next years, while trade unions have reached a good outcome for their members. The state government is overall satisfied with the results, as they will receive billions in subsidies, which enables them to further implement structural policies in the coming decades. However, the environmental associations are less pleased with the phase-out plan, as the promised expansion of renewable energies is not taking place, and power stations are being shut down less linearly than agreed (interview data). It was also mentioned in the interviews the targets of the phase-out plan are not ambitious enough to combat climate change. Moreover, the funds available for the regional restructuring of the economy is given without conditions for investments, such as to fund climate-neutral projects. In addition, the people close to the opencast mines have lost out as they are threatened by potential resettlement and have no alternative but to take their case to court (interview data).

4.3.6. Demographic and tourism impacts

Migration

At the beginning of the decline of the hard coal sector in the 1950s and 1960s there was considerable emigration due to the closing of the hard coal mines. In the Ruhr area, it was estimated that around 158,000 people migrated out of the area (Oei et al., 2019). As a reaction, two programmes were developed to restore the cultural heritage and to increase the attractiveness of the area. The programmes were the “Action Programme Ruhr” and the “International Building Exhibition Emscher Park” (see Section 5.2.2). As a result, total net migration improved, and the population rose by 247,000 people between 1987 and 1995 (Oei et al., 2019).

Tourism

The opencast mines and the fragmentation of the landscape negatively affected tourism in the region. However, an opportunity exists to build a Dutch-style cycling network around the opencast mines and thus give soft tourism a chance. In addition, the region planned to create large lakes in the next years.

4.3.7. Regional competitiveness

The region has not lost its competitiveness (interview data). Due to the restructuring of the economy, NRW attracts many companies (and especially Small-Medium Enterprises) as it has good infrastructure and a highly educated and qualified workforce. Moreover, the central location of the region (close to France, Belgium (Antwerp and Brussels), and the Netherlands) attracts many companies (interview data).

Within the region, the Ruhr area has struggled to maintain its competitiveness as its economy has historically relied on coal production. Moreover, at the start of the decline of the coal sector around 1960 and 1970, strong trade unions, together with the mining companies, aimed to keep the status quo (interview data). The incumbent regime had close political links, which resulted in policies that ensured continuity and that did not invest in support schemes and subsidies to attract new companies (Oei et al. 2019). As such, the strong trade unions acted as a barrier to the entry of new companies. According to an interviewee, the opposite happened in the textile industry in the Münster region as in this industry, the workers were

[31] LEAG is the joint brand of Lausitz Energie Bergbau AG and Lausitz Energie Kraftwerke AG.

less protected. After the manufacturing of textiles moved to Asia, the region had to welcome smaller companies in other sectors. Nowadays, the region shows higher regional competitiveness.

The European Regional Competitiveness Index (RCI)[32], which measures the major factors of competitiveness for all the NUTS-2 level, also displays strong regional competitiveness for NRW (see table below).

Table 0-14 Regional Competitiveness Index 2019

NUTS2	Score 0-100
Düsseldorf	80.17
Köln	86.57
Münster	78.47
Detmold	74.40
Arnsberg	76.53

Source: European Commission (2019).

NRW scores especially well in “market size”[33] and “macroeconomic stability”[34] with respect to its peers (see Figure 5-11). This is also reflected in the figures below which present the RCI in more detail for the NUTS2 regions that also include the Ruhr area territory. The region scores lower on “higher education and lifelong learning”. Ansberg has the lowest score of 51.7 (out of 100). However, it should be noted that these scores are still similar to peers. The region also scores lower on “business sophistication”[35] and “innovation” but is not underperforming compare to its peers (European Commission, 2019).

[32] The Index measures with more than 70 comparable indicators the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work.
[33] Based on indicators such as 1) disposable income, 2) potential market size express in GDP, 3) Potential market size expressed in population
[34] Based on indicators such as 1) general government deficit/surplus, 2) national savings, 3) government bond yields, 4) government debt, 5) net international investment position NIIP, 6 export market share and 7) private sector debt
[35] Consists of the indicators of employment (K-N sectors), GVA (K-N sectors), Innovative SMEs collaborating with others and Marketing or organisational innovators.

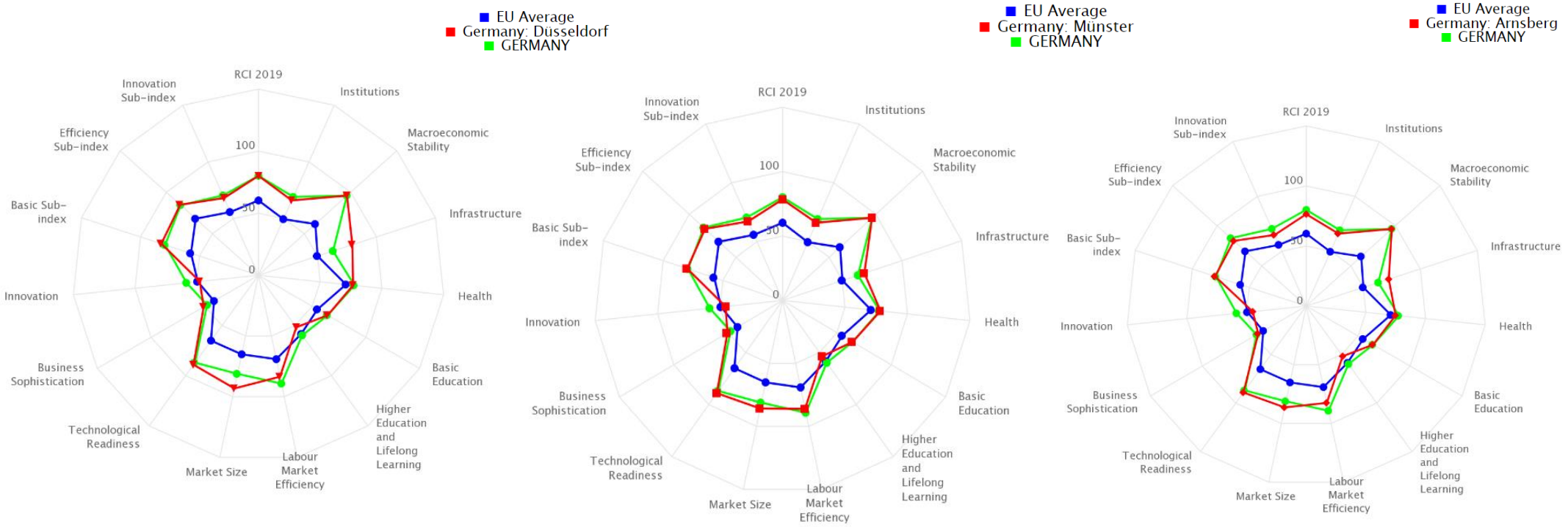

Figure 0-21 European Regional Competitiveness Index 2019 for the NUTS2 codes that are part of the Ruhr area

Source: European Commission (2019).

4.3.8. Summary of results

The table below summarises the results that are discussed in the previous sections. To this end, the different indicators can score positive, neutral, negative, or no information available.

Table 0-15 Summary of the results

Key variable	Indicator	Sub-indicator	Data source	Assessment
Employment impacts	Creation/ destruction of new jobs by sector and per geographic location	Changes in employment rate by sector	Interview data	NRW and especially the Ruhr area is moving from a manufacturing-based economy to a more service-based economy.
			Statistische Ämter des Bundes und der Länden, 2019	Figure 5-9 shows how employment in the service sector is growing (63% in 1992 to 77% in 2017), whereas employment in the manufacturing sector is shrinking over the years (36% in 1992 to 22% in 2017). Notably, the largest reduction is found for the manufacturing sector without the construction sector, meaning that the employment in the construction sector is not shrinking.
		Changes in unemployment	Interview data	Unemployment in the coal sector barely increased as many workers shifted from the coal industry to other industries or were able to enjoy early retirement arrangements.
			Bundesagentur für Arbeit, 2020	Figure 5-6 shows that the overall unemployment rate in NRW grew drastically from 1970 onwards. Since the financial crisis in 2008 the unemployment rates have been decreasing steadily for both NRW and Ruhr area.
		Geographical location of unemployment rates.	Interview data	The Ruhr area struggled for a long time to create new jobs.
			Bundesagentur für Arbeit, 2020	The Ruhr area unemployment rates are overall higher than the rates for NRW.
		Number of jobs destructed in the coal sector	Interview data	NRW, and especially the Ruhr area and Aachen, employed around half a million hard coal mine workers in the 1950s and 1960s. In 2018, there are no open hard coal mines in the NRW. As such, the hard coal industry has experienced a large reduction in employment over a period of around 70 years. The lignite sector has been smaller and currently employs around 9,000 workers.
			Statistik der Kohlenwirtschaft e.V., 2019	The trends described above are in line with the statistical data (see Figure 5-5).
Income impacts	Income impacts for the region	Changes in regional GDP compared to other surrounded regions	Interview data	At the beginning of 1970, the GDP of the Ruhr area dropped. However, as the NRW is one of the biggest states in Germany, the overall GDP did not go down drastically.
			Statistische Ämter des Bundes und der Länden, 2019	There is a small decrease in GDP in current prices of NRW compared to the GDP in current prices of Germany. In 1992 NRW represent 24% of the nation's GDP which steadily decreased to a 21% in 2017.
		Changes in regional GDP per capita	Statistische Ämter des Bundes und der Länden, 2019	There is an overall positive trend in GDP per capita, with a minor setback around the economic crisis that started in 2008 (see Figure 5-7) Overall, the GDP per capita is lower in

Key variable	Indicator	Sub-indicator	Data source	Assessment
				the Ruhr area than in NRW and Germany and the gap slowly increases from 2012 onwards
		Changes in regional GVA	Statistische Ämter des Bundes und der Länden, 2019	The manufacturing sector's value-added (with and without construction) in the Ruhr area has been on the decline since 1992, while the value-added of the service sector has slowly increased (see Figure 5-10)
	Income inequality impacts	Changes disposable income Habitant	Statistische Ämter des Bundes und der Länden, 2019	Disposable income per capita increases slowly with a disposable income of EUR 15,300 per capita in NRW in 1995 to an income of EUR 22,300 in NRW in 2017. Disposable income per capita is slightly lower for the Ruhr area with an income of EUR 14,400 in 1995 and EUR 21,200 in 2017.
Economic diversification impacts	Impact on local economy (and the different sectors)	change in trends regarding the main economic sectors	Interview data	Due to the Structural Reform Programmes, there was quite some innovation in the region. Several lead markets were selected for financial support such as the health and mobility sector. This support expanded to resource efficiency, tourism and digitalisation projects. As a result, an increase in the number of companies, especially SMEs is evident.
	Dependency on energy sector	Self-generation of energy and import of energy	Interview data	Reliable energy is pivotal for energy-intensive industry. In the past, NRW generated enough energy to also exported power, but this will change with the closure of coal plants and lignite mines. To replace the coal-fired power plants and to replace the fossil feedstock, NRW focuses on renewable energy and hydrogen.
Innovation and education impacts	Impacts on technology development	Changes in technology development / Employment in technology and knowledge-intensity (R&D)	Interview data	NRW and especially the Ruhr area is now seen as one of Germany's strongest science regions. The RWTH Aachen alone has more than 50,000 students and more than 10,000 employees.
	Impacts on education system	Number of universities	Interview data	In 1965 the Ruhr area did not have any universities; the opening of several new universities enhanced the attractiveness of the region for companies as well as for citizens, constituting an important location factor.
			NRWInvest, n.d.	768,000 students study at 70 universities and universities of applied sciences in 2018
		Higher education attainment	Regionalverband Ruhr, 2020	Investment in education in the Ruhr resulted in a rise of 6.6 percentage points of employees with an academic degree between 2007 and 2019. The numbers have doubled, from 114,000 employees with a university agree in 2000 to 250,000 employees with a university degree in 2019.
Institutional stability impacts	Political stability	Political stability	Interview data	The coal phase-out has not caused any severe political instability due to the social protection measures.
				1996 — Voice and accountability: 90[36], Political Stability and Absence of Violence/Terrorism: 92.2

[36] Percentile Rank (0-100) indicates rank of country among all countries in the world. 0 corresponds to lowest rank and 100 corresponds to highest rank.

Key variable	Indicator	Sub-indicator	Data source		Assessment
			World Bank Governance indicators		Government effectiveness: 91.8, Regulatory quality: 90.76, Rule of law: 93.97, Control of corruption: 94.09
				2019	Voice and accountability: 95.6, Political Stability and Absence of Violence/Terrorism: 66.67, Government effectiveness: 93.27, Regulatory quality: 96.15, Rule of law: 92.31, Control of corruption: 95.19
Demographic and tourism impacts	Migration impacts	Changes in the number of people moving in or out of the region	Oei, et al., 2019		At the beginning of the decline of the hard coal sector in the 1950's and 1960s there was considerable emigration due to the closing of the hard coal mines. In the Ruhr area, the total net migration from 1977 until 1986 decreased by 158,000. Total net migration turned positive with a population increase of +247,000 people between 1987 and 1995.
	Tourist impacts	Changes in the number of tourists	Interview data		The opencast mines and the fragmentation of the landscape negatively affected the tourism of the region. However, there is a great opportunity to build a Dutch-style cycling network around the opencast mines and thus give soft tourism a chance.
Regional competitiveness impacts	The ability to offer an attractive and sustainable environment for firms and residents	Changes in regional competitiveness	Interview data		The region has not lost its competitiveness. Due to the restructuring of the economy, NRW attracts many companies (and especially Small-Medium Enterprises) as it has a good infrastructure and a highly educated /qualified workforce. Moreover, the central location of the region (Close to France, Belgium (Antwerp and Brussels) and the Netherlands) attract many companies. Only the Ruhr area has struggled to become competitive as its economy relied on the coal production for decades.
			Regional Competitiveness Index 2019		Düsseldorf - 80.17, Köln - 86.57, Münster - 78.47, Detmold - 74.40, Arnsberg - 76.53

4.4. Lessons learned

The hard coal phase-out in NRW, in particular the Ruhr area, was relatively successful due to a combination of social policies addressing unemployment and policies attracting new (energy) companies and investments. Moreover, the measures that improved infrastructure, education, research facilities and soft location factors have proven to be very important to restructure the economy. However, the Ruhr area lacks behind in terms of GDP, disposable income, lower education and regional competitiveness.

To conclude this case study, several findings and lessons learned in relation to coal phase-out in NRW can be highlighted (as discussed in either the literature or highlighted by interviewees). Below we outline a few lessons which we can draw from this study:

- **The importance of a holistic strategy to restructure the economy.** In the case of the NRW and particularly the Ruhr area, it shows that the more long-term holistic strategy of investing in research and education, infrastructure and lead sectors has paid off in the long run. The Rheinische Revier Economic and Structural Programme also emphasises the importance of a holistic vision, building on the strengths of the region. However, a holistic approach will not be effective if there are no concrete measures in place, such as early retirement schemes and retraining of ex-workers. There were no layoffs during the hard coal exit which maintained the political stability in the regions.
- **Enable cooperation between regions and cities.** Part of the Structural Reform Programme was to connect cities to generate synergies. This policy has proven to be very helpful in creating opportunities for cities and villages to diversify their economies. It should also be noted that there should be some freedom for local cities to design their own tailored restructuring plans.
- **Do not hold on to old economic structures.** In the beginning, only big companies were active in the coal and mining sector in NRW. There was also resistance to welcome new companies, especially in the Ruhr area. Moreover, policies aimed to create the same kind of structure (i.e. one big company per industry). Especially in the NRW, a distributed system with smaller companies in both the service and manufacturing sector has proven to be successful.
- **The phase-out of coal should go hand in hand with the energy transition.** This is especially important for NRW which is a highly industrialised region and needs to maintain its affordable and reliable energy supply. This is also important for the maintenance of the future viability of energy firms that are affected by the exit from coal.
- **The phase-out of hard coal was a slow and therefore costly transition.** In addition, to meet the climate and energy targets, there is a need to speed up the process and to have more ambitious transition plans. As such, one should not only rely on past experiences when developing strategies for the exit of coal, but also take into account the current situation regarding global warming and the related climate and energy targets.

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5. Case study 3: Silesia, Poland

5.1. Introduction

Poland has a long history of coal mining. In comparison with the majority of EU Member States, Poland has much larger reserves and makes use of hard coal and lignite for electricity production, with a 78.3% share in 2018 (133.0 TWh). Hard coal reserves in the country amount to around 22.3 billion tonnes, mostly located in the Upper Silesian and Lublin coal basins. In the case of lignite, the reserves amount to approximately 1.0 billion tonnes with a further 23.3 billion tonnes of resources (Eurocoal, 2020).

In 2017 Poland's energy import dependency was at 38.3%. This is well below the EU's average of 55.1%. **The country's total primary energy supply in 2018 was dominated by coal (47.1%)**, with oil (28.2%) and gas (15.2%) also taking significant shares, followed by biofuels and waste (7.7%), wind (1.0%) and hydropower (0.2%). As shown in Figure 0-22, 48% of electricity production in Poland came from coal in 2018.

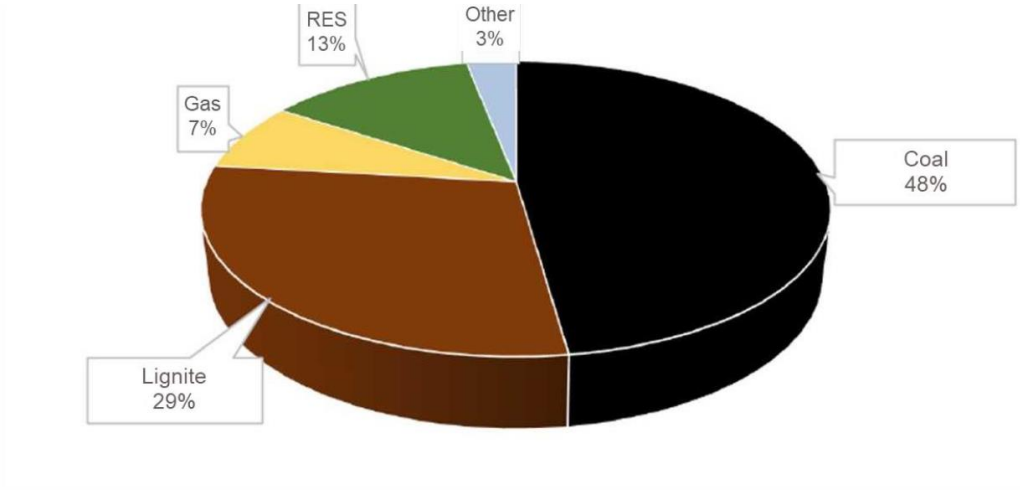


Figure 0-22 Electricity production structure by carriers in 2018

Source: National Energy and Climate Plan (2020).

Hard coal exports from Poland amounted to 3.9 million tonnes in 2018. Most of the exported coal was transported overland to neighbouring EU countries: the Czech Republic, Slovakia, Austria, and Germany; small volumes were shipped via the Baltic ports (Eurocoal, 2020). In 2018, hard coal imports to Poland were at a record high amounting to 19.7 million tonnes, including 3.5 million tonnes of coking coal, with imports predominantly coming from Russia (13.5 million tonnes or 68.5%). Smaller quantities were imported from the USA (1.5 million tonnes), Australia (1.5 million tonnes), Colombia (1.4 million tonnes), Mozambique, Kazakhstan, and the Czech Republic (Eurocoal, 2020).

In its National Energy and Climate Plan (NECP) Poland states that domestic coal production is expected to be maintained at a level capable of satisfying the demand of the energy sector. However, Poland expects a decline in the share of coal in electricity production. In 2030, the

aim is to lower the share of coal by 56-60% (compared to the current share) in order to support the clean-energy transition. The downward trend is expected to continue until 2040.[37]

Silesia (also known as Upper Silesia) is a region in the south of Poland, and it has a border with the Czech Republic. It has a population of around 4.5 million. General information on the region is summarised in the figure below.

The region is densely populated and is one of the most industrialised and urbanised areas in Poland. It is both Poland's and Europe's **largest coal mining region**, accounting for around 80% of total Polish hard coal resources of 46.9 billion tonnes (2017). In 2016, 59.2 million tonnes of coal were mined in Silesia, which equates to 89% of Poland's hard coal production. Silesia is responsible for emitting around 40% of Poland's overall emissions, both through coal-fired electricity, heat generation, and the Silesian industry (The Climate Group, 2016).

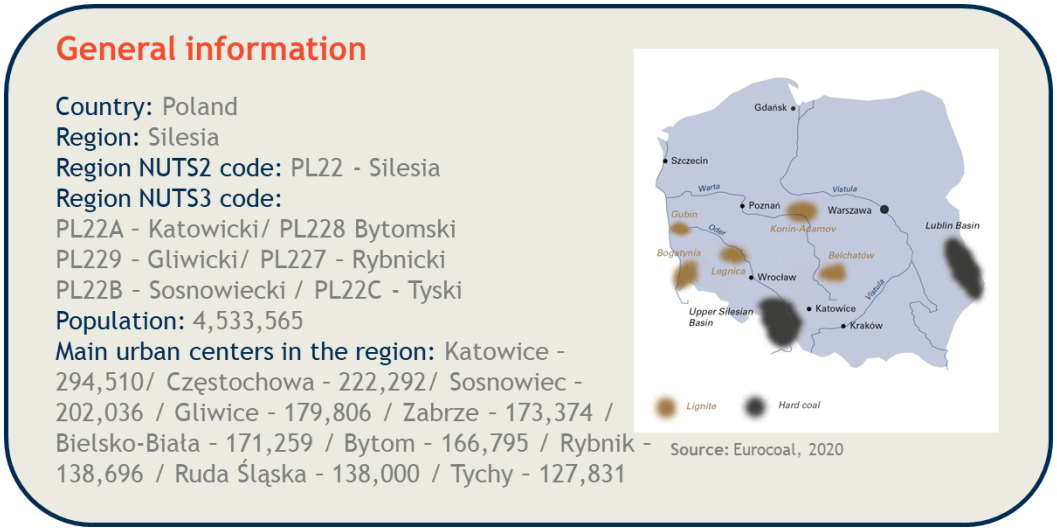


Figure 0-23 General information about Silesia

Source: Own elaboration based on regional profile of Silesia, Initiative for Coal Regions in Transition, EC (2020).

5.2. Background information

5.2.1. Start and acceleration of the transformation

The production of coal in Poland started in the 18th century in Lower and Upper Silesia. By the 19th century, coal mining became a key driver of regional growth. By the 20th century, Poland established itself as one of the most important coal-producing countries. Coal production grew steadily until the late 1970s, and in 1979 coal production peaked at 201 million tonnes. Figure 0-24 provides an overview of the key events in the trajectory of Silesia's coal phase-out, and Table 0-16 provides information on the national programmes implemented between 1993 and 2015 to restructure the hard coal mining sector in Poland.

[37] Poland, The National Energy and Climate Plan for 2021-2030, Objectives and targets, and policies and measures. Available at: https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/national-energy-and-climate-plans-necps_en.

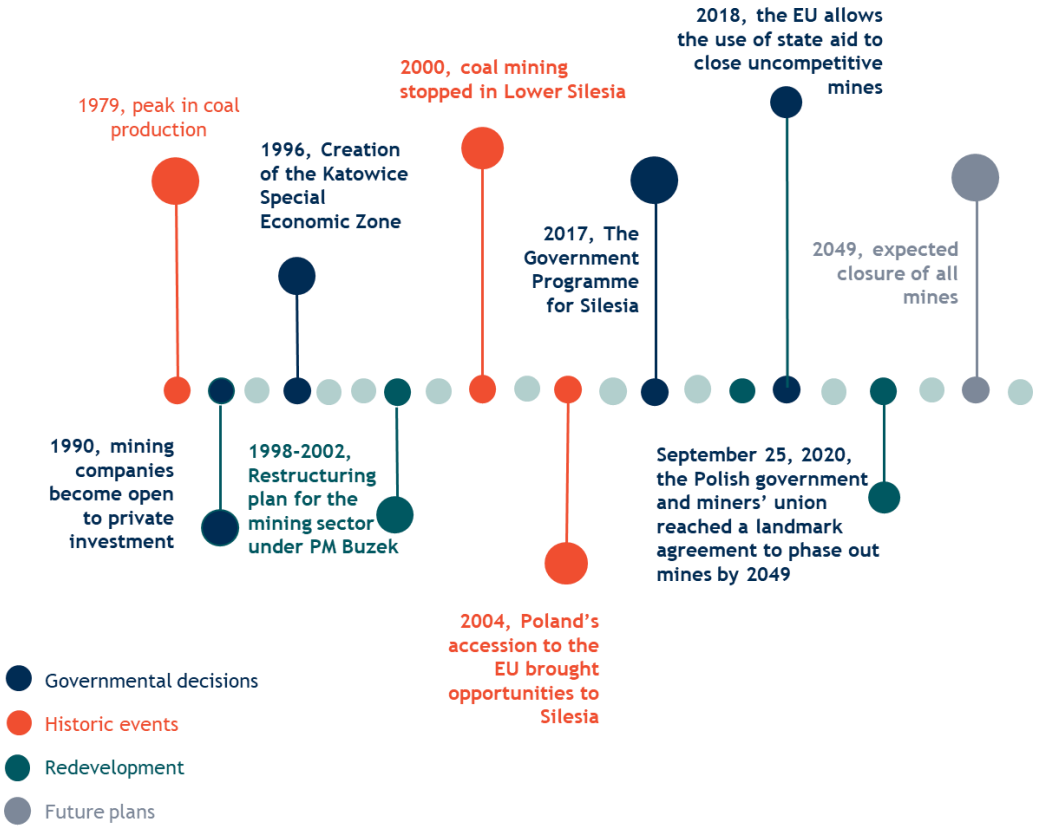


Figure 0-24 Timeline of key events in the phase-out of coal in Silesia

Source: Own development

During the Socialist era, mining companies were state-owned. The restructuring of the coal mining sector is directly linked with the general political and economic reforms that started after the fall of Socialism in Poland in 1989 (Szpor, Ziółkowska, 2018). Since the 1990s, mining companies have opened to private investments. Nonetheless, in the major mining companies today the state continues to be a key stakeholder with a large share of investments. Currently the largest coal mining company, Polska Grupa Górnicza (PGG), is state-owned and the second most important mining company, Jastrzebska Spółka Węglowa, is 56% state-owned (Wuppertal Institute, 2018).

An important early government initiative for Silesia was the creation of the **Katowice Special Economic Zone** (Katowicka Specjalna Strefa Ekonomiczna—KSSE) in 1996. The Special Economic Zone served to attract investment in the region. The KSSE continues to be one of the most important special economic zones in Poland and up until now has attracted over 390 business entities. Furthermore, it has attracted investments worth approximately 36 billion Polish Złotych (PLN) and created more than 80,000 new jobs (KSSE, 2020).[38]

Between 1998-2002, Prime Minister Jerzy Buzek introduced a restructuring plan for the mining sector. Under the plan, more than 100,000 miners voluntarily left the mines. Large parts of those workers were from the Silesia Province and had worked in the hard coal mining sector. Almost 70,000 workers took advantage of the redundancy package introduced by the government: more than half took mining leaves, and about 30,000 received one-off cash severance payments (WWF, 2018).

[38] See https://www.invest-ksse.com/ksse-1161#.

It is important to clarify that while hard coal is now only produced in the (Upper) Silesian Coal Basin, the Lower Silesian Coal Basin was also operative until 2000 (Polish Geological Institute, 2017a). Mining ceased for economic reasons and due to the difficult mining conditions. In Silesia, Poland's accession to the European Union in 2004 brought benefits to the region by offering opportunities from the incorporation into the value chain of the continental industrial centre located along the Rhine Valley. This promoted the maintenance and development of the industrial nature of the region's economy. Despite the many changes that the region has undergone, the transition that started in the 90s is not yet complete.

Table 0-16 Summary of national programmes for the restructuring of the hard coal sector

Years	Title of the document	Short description
1993	Programme for restructuring of the hard coal sector	Designed as the first of three phases of the restructuring process. Focus on sector profitability. Implementation lasted only a few months as assumptions turned out to be too optimistic.
1993-1994	Programme for staving off the bankruptcy of the hard coal sector	Correcting the previous programme. Never officially adopted by the government but laid the ground for further actions. Provided basis for creation of social protection instruments and early retirement in mining.
1994-1995	Programme for the accomplishment of the Phase II in years 1994-1995	The second phase included ecologic and social considerations. Period saw growth of wages and slower-than-expected reduction of employment. The third phase was never implemented.
1996-1998	Hard coal mining sector – Public and sector policy for the years 1996 – 2000. Programme for adaptation of the hard coal mining sector to market economy and international competition	The programme accomplished results only in the technical aspects of the restructuring process. It was not successful in the ownership, employment, finance, and organisation areas. The European Bank of Reconstruction and Development (EBRD) and the World Bank refused financial support due to an increase in production without sufficient demand and uncertainty about the closure of collieries.
1998-2002	Reform of the hard coal mining sector in Poland in the years 1998-2002	Considered to be the most ambitious programme. It extended the number of available instruments and introduced new, broader frameworks of support.
2002-2003	Programme for restructuring of the hard coal mining sector in Poland in years 2003 – 2006 with implementation of anti-crisis Acts and initiation of privatisation of certain colliers	Continued the privatisation process and implemented further reductions in the workforce.
2003-2006	Restructuring of the hard coal sector in years 2004 – 2006 and Strategy for 2007-2010	Was adopted to regulate access to coal resources and close some of the collieries.
2007-2015	Strategy for the functioning of the hard coal mining sector in Poland in years 2007 -2015	Updated in 2011 as the Programme of Mining Sector Activity in 2007-2015. The programme concentrated on ownership restructuring, R&D investments, and increasing production efficiency.

Source: International Institute for Sustainable Development, Global Subsidies Initiative (2018).

5.2.2. (Inter)national and regional policies

On an EU-level, Poland is the largest beneficiary of funding from the European Structural and Investment Funds. The country is expected to receive more than 86 billion EUR in the 2014-2020 period. About 20% of that money is directly or indirectly benefiting the region of Silesia. A large portion of the money is channelled through a series of national, operational programmes such as "Digital Poland", "Infrastructure and Environment", "Knowledge Education Growth" and "Smart Growth". In addition, regional operational programmes for the Silesian Voivodeship are also of relevance (Wuppertal Institut, 2018).

In November 2016, the European Commission (EC) reached an important decision on allowing state aid for the closure of uncompetitive mine units by 2018. The Commission found that this support would not unduly distort competition. Furthermore, on February 8th 2018, the EC allowed for the extension, until the end of 2023, of granting state aid for the further restructuring of the Polish hard coal mining sector (Eurocoal, 2020). In December 2018 during the UN climate summit (COP24) in Katowice, the Polish presidency presented the Solidarity and Just Transition Silesia Declaration, which was backed by the European Union and the representatives of 45 countries. Poland is part of the Initiative for Coal Regions in Transition (otherwise known as the Platform for Coal Regions in Transition (PCRT)).

Inter-institutional negotiations are still ongoing to finalise arrangements, but Poland is expected to be one of the largest recipients under the Just Transition Forum (JTF). The JTF is part of the Just Transition Mechanism (JTM), the European Commission's key tool to ensure that the transition towards climate-neutrality takes place in a fair way and leaves no one behind.

On a national policy scale, the government power in Poland is relatively centralised and most of the legal competencies, including in the area of mining, fall under the national level of government.

A recent initiative that should be highlighted is the creation of The Government Programme for Silesia under Prime Minister Mateusz Morawiecki, presented in December 2017. The programme is coordinated by the Ministry of Funds and Regional Policy and also includes involvement from the regional government where the Steering Committee of the Silesian Voivodship coordinates the activities (EC, 2020). This is an initiative that aims to coordinate the efforts of local, central, and European administrations to ensure the best possible synergies between previously planned investments.

The Programme's specific objectives are:

1 To increase investments in the region related to industrial innovation and development;

2 To increase professional activity and develop professional qualifications of the region's inhabitants;

3 To improve the quality of the natural environment;

4 To develop and modernise transport infrastructure;

5 To use the potential of the region to ensure energy security for Poland and innovation in the energy sector;

6 To improve the development conditions of the cities in Silesia (Government of Poland, 2020).[39]

In 2018, Poland adopted a strategy for the coal sector in Poland until 2030 with the main objective to build a more economical, effective, and modern hard coal mining sector.

Recently, **on September 25, 2020, the Polish government and miners' union reached a landmark agreement to phase-out mines by 2049**. The agreement still requires approval from the European Commission, given that it presupposes the continued financing of coal production until 2049 "in order to ensure the stability of the hard coal mining companies" – a state aid decision (Euractiv, 2020).

At regional level, it is important to highlight that Silesia dedicates 22% of its funds from the Regional Operational Programme to the development of a low-emission economy. The *Regional Transformation Action Plan*, which was adopted in 2019, has three main operational goals:

[39] See https://www.gov.pl/web/fundusze-regiony/program-dla-slaska.

1 High quality of life in the region;

2 Competitiveness of the economy based on modern environmental technologies. One of the key focus points includes counteracting the effects and limiting the negative impacts of mining on the environment and urban space;

3 Development of creative industries and free time activities (EC, 2020).

In addition, the *Technology Development Programme for Silesia for 2019-2030* was adopted in 2018 and includes plans for supporting strategic technologies in the energy sector and raw material industry among others (EC, 2020).

The region is currently preparing its *Strategy of Economic Development*, *Regional Revitalisation Policy* and *Low-carbon economy policy* (ibid.).

5.3. Results

5.3.1. Employment impacts

As seen from the figure below, the number of people employed in Poland in the hard coal sector between 1990 and 2014 has been on a decline. Like in the rest of Poland, the number of mining jobs in Silesia has been on a progressive decline from 300,000 employees in the 1990s and 130,000 in 2003 to 76,000 in 2016 (Wiatrowski, 2019). In contrast, in 2016, the number of people employed in the industrial processing sector amounted to 350,000 and that of people employed in the automotive industry to 59,000 (ibid.).

Table 0-17 provides an overview of employment numbers in the province for key sectors.

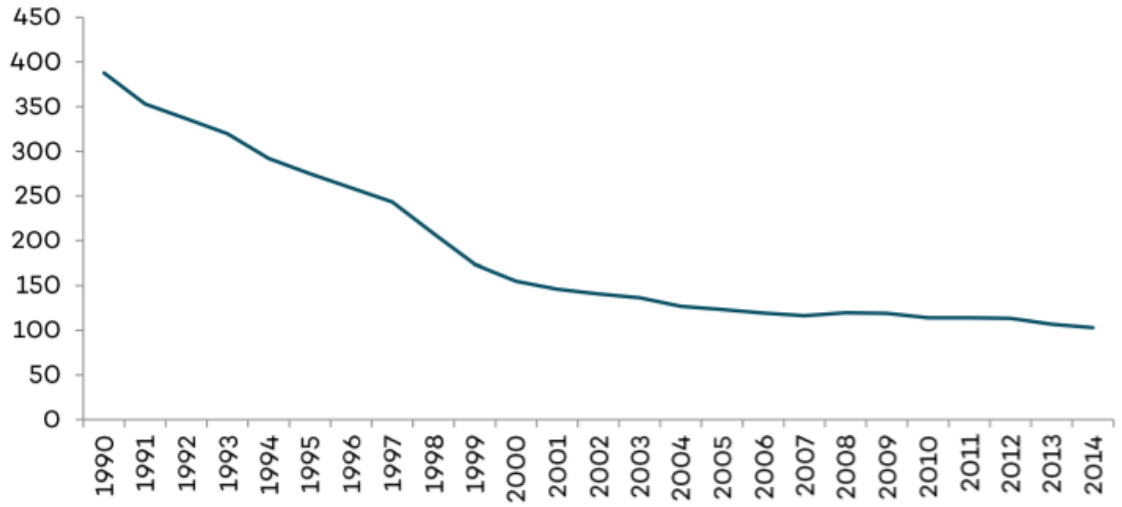


Figure 0-25 Employment in the hard coal mining sector in Poland (miners, in thousands)

Source: IISD GSI (2018).

Table 0-17 Number of employees per sector in Silesia in 2016

Sector	People employed in Silesia (2016)
Mining	76,000
Industrial processing	350,000
Automotive industry	59,000
Processing of rubber and plastic goods	31,000
Production of finished metal goods (excluding machinery and equipment)	51,000
Production of metals	23,000
Production of electrical equipment and machinery	18,000

Source: Wiatrowski (2019).

The decline in the mining industry in Silesia could be alleviated by the creation of jobs in other sectors connected to the low-emissions and clean energy sectors. As shown in Figure 0-26, it is estimated that the potential jobs in sectors related to building retrofits, energy efficiency, and energy mix diversification could amount up to 20,000 by 2030 and up to 30,000 by 2050 (WWF, 2018).

In order to better understand the job creation potential in the province, it is important to zoom out from the mining sector and consider the overall picture in the province. In 2018, Silesia had the second-lowest unemployment rate, corresponding to 4.3%, however, important differences exist in unemployment distribution across the province. For example, in 2018, unemployment rates in the cities of Bytom and Częstochowa were 9.5% and 7.3%, respectively, whereas those in Bielsko-Biała and Katowice were below 2% (Wiatrowski, 2019).

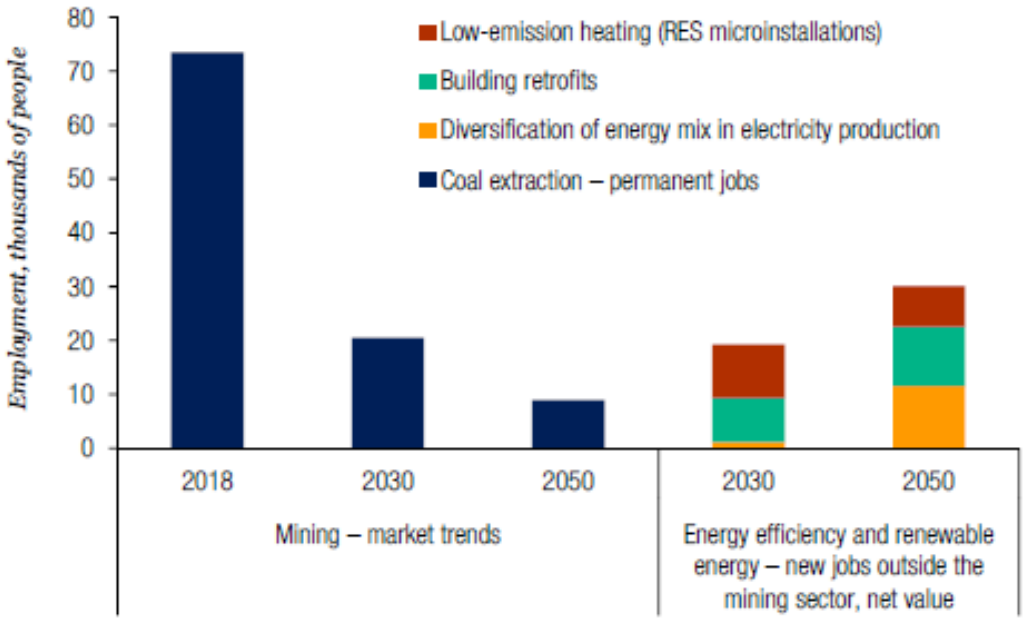


Figure 0-26 Number of employees in hard coal mining and jobs generated outside the mining sector by low-emission investments in the energy sector and buildings in the Silesian Voivodeship 2018-2050

Source: WWF (2018).

Regarding skills and qualifications in the region, Silesia's labour force is specialised in the automotive sector and, in particular, airbag and safety belt development. The region's

workforce also has the knowhow in the design of aviation engine components, manufacturing of machinery and equipment used for underground mining operations, energy industry-related engineering, and manufacturing (European Commission, 2020).

On the other hand, some of the important weaknesses reported include:

- Mismatch between the fields of study offered and the needs of employers;
- Low level of vocational training;
- Weak links between R&D development and other sectors;
- Insufficient level of enterprise innovation and low spending levels on research;
- High dependency on mining industry (European Commission, 2020).

5.3.2. Income impacts

The average gross income in Silesia in 2017 amounted to 99% of the national average. The average of the province is slightly below the national one even though the province has a higher GDP/capita and labour productivity compared to the national average. The Silesia Province is among the richest regions in Poland. GDP per capita in 2017 was EUR 12,600, placing the province in fourth position among all Polish provinces. The productivity of Silesia calculated by Gross Value Added (GVA) per employee exceeded 106% of the national average in 2016 (Wiatrowski, 2019).

As in the case of other indicators, the income rates within the province are not evenly distributed. Areas of active mining tend to be among the areas with highest average earnings. For example, in Jastrzębie Zdrój the average remunteration is 46% higher than the national average. In contrast, areas such as Czestochowa, Pszczyna, Wodzislaw, Klobuck, and Swietochlowice exhibit an average gross income that amounts to only 80% of the national average (ibid.).

According to several analyses (Wiatrowski, 2019; WWF, 2018), the **process of industrialisation in the region is crucial for achieving high levels of income.** However, this process is far from complete. For the region to achieve comparable levels of income as highly developed industrialised regions such as the south of Germany or Scandinavian industrial regions, **Silesia would have to maintain a rapid rate of industrialisation for several decades to come** (WWF, 2018).

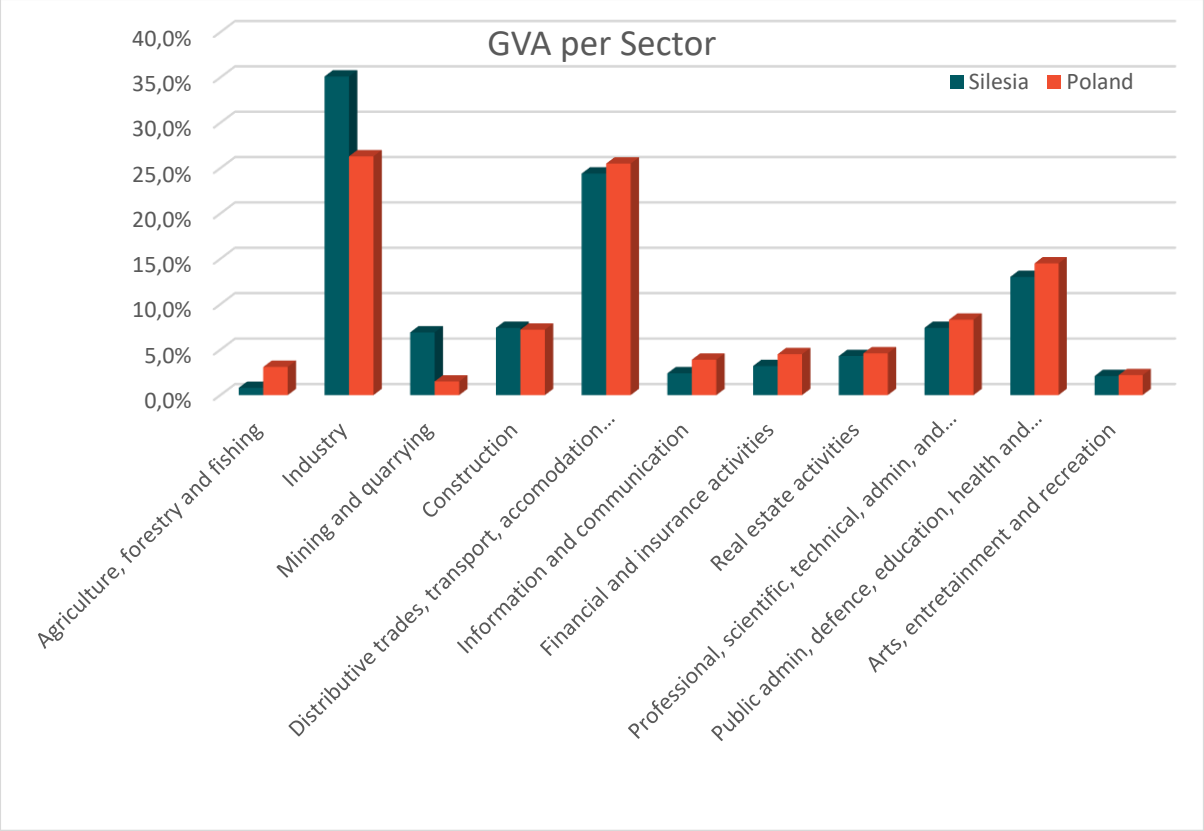


Figure 0-27 Gross Value Added (GVA) per sector for Poland and Silesia in 2017

Source: Own elaboration based on EC (2020).

5.3.3. Economic diversification

The table below provides an overview of the share of total revenues in Silesia from some of the most relevant sectors. Due to the high level of specialisation in the region, focus should be placed on developing the manufacturing sector, according to analysts (WWF, 2018). **Sectors of interest could include machinery, electrochemistry, and electronics, the chemical and pharmaceutical industries** among others. At the same time, the region could strengthen sectors already developed, such as vehicle manufacturing (ibid.).

Table 0-18 Share of total revenues in the region per sector

Sector	Share of total revenues in the region
Industrial processing	55%
Wholesale and retail trade & vehicle repair	16%
Construction	3.5%

Source: Wiatrowski, 2019

The shutdown of mining will have direct consequences on those employed in the sector, but it will also affect many other sectors that provide goods and services necessary for the functioning of mines. Estimates indicate that the number of employees related to the activities supporting the mining sector is 56,700 in all Poland. About a quarter (13.9 thousand) of them work in the industrial sector, 10.2 thousand work in transport, and another 7.6 thousand in

trade and repair sectors. Estimates based on data for the region indicate that there are about 35.4 thousand jobs related to the mining sector (IBS, 2019).

The table below provides a summary of transition opportunities for the region and an assessment of the level of interest in developing the listed activities.

Table 0-19 Evaluation of level of attractiveness for select transition opportunities

Transition opportunities in coal-related sites	High interest	Moderate interest	Minima Interest
Reconversion for renewable/clean energy			
Biomass		X	
Energy storage	X		
Gas		X	
Solar	x		
Wind		X	
Hydrogen		X	
Hydropower and pumped hydro-storage		X	
Geothermal			X
Reconversion for new economic and social activities	X		
Repurposing coal-related industrial infrastructure		x	
Heritage, culture, and tourism		x	
Low-carbon mobility and transport		x	
Diversification of coal-related supply chain and services		x	

Source: Own elaboration based on EC (2020).

5.3.4. Innovation and education impacts

Silesia has proportionally 23% fewer students compared to the average for Poland. It also has 17% fewer inhabitants with higher education compared to the whole population than the national average. However, focusing only on the age group between 25- and 64-year olds, the difference is significantly smaller—29.7% of the Silesian population have a university degree compared to 30.9% in Poland as a whole. Furthermore, within the same age group, Silesia ranks second-highest for people with at least secondary or vocational education (level III or higher in the Polish Qualifications Framework) (Wiatrowski, 2019).

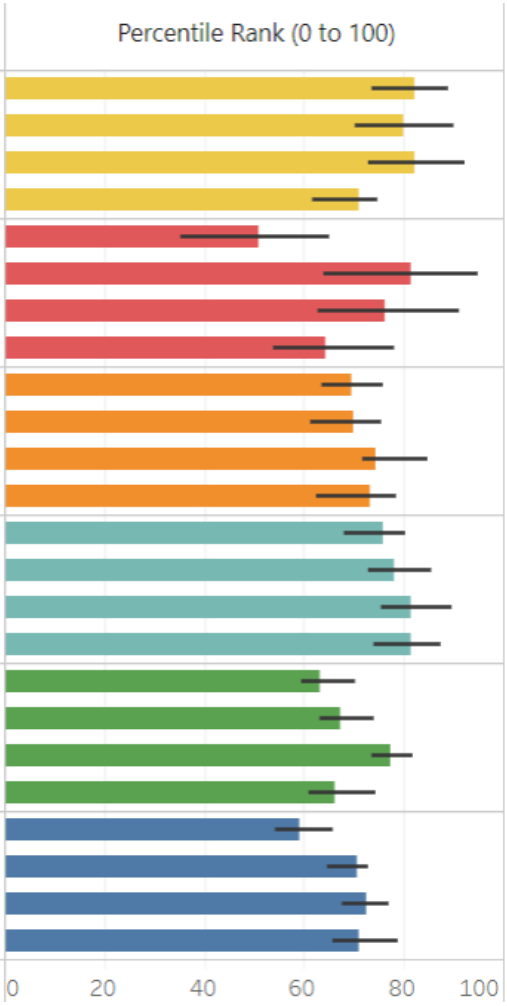
Strong academic centres in the province, including the University of Silesia and the Silesian University of Technology, are an important asset. Although R&D spending remains below the national average per capita, it increased by 27% between 2014 and 2017, indicating a positive trend likely linked to the growing skills of the labour force (ibid.).

5.3.5. Institutional stability

Data on institutional and political stability can be found at national level in the World Bank Governance Indicators data. Between 2014 and 2019 there is a notable decrease in the scoring for the indicators: “voice and accountability”, “political stability and absence of violence”, and “rule of law” (WB, 2020).

Table 0-20 Worldwide Governance Indicators for Poland 2004-2019

Indicator	Country	Year	Percentile Rank (0 to 100)
Voice and Accountability	Poland	2004	
		2009	
		2014	
		2019	
Political Stability and Absence of Violence/Terrorism	Poland	2004	
		2009	
		2014	
		2019	
Government Effectiveness	Poland	2004	
		2009	
		2014	
		2019	
Regulatory Quality	Poland	2004	
		2009	
		2014	
		2019	
Rule of Law	Poland	2004	
		2009	
		2014	
		2019	
Control of Corruption	Poland	2004	
		2009	
		2014	
		2019	



Source: World Bank (2020).

5.3.6. Demographic and tourism impacts

In terms of population age, the average inhabitant of the province is 1.5 years older than the country-wide average Polish citizen (a median of 42.1 compared to 40.6).

An important indicator to consider in providing a macroeconomic picture of the province is the age of the population active in the labour market. **Only 41% of the region's population aged over 55 are active in the labour market, which represents the lowest result in Poland** (nine percentage points below the national average). In the age range of 25–64-year olds, only 73% of the province's inhabitants are active in the labour market. This result is three percentage points below the national average (ibid.).

Another factor that represents a challenge for the province is the negative migration rate. From 2014–2015, the population of the province shrank by 3%, and in 2017, this ratio was 2% (ibid.). Furthermore, there is mark difference between expected population outflow among municipalities; in mining municipalities, a decrease in population is predicted of as much as 8.5%, and in non-mining municipalities only 2.7% (WWF, 2018).

One peculiarity of the Silesia Province is that it has the highest population density (370 people per km^2; three times higher than the average for Poland) and urbanisation rate (almost 77%) in the country (Wiatrowski, 2019).

Based on Table 0-19 heritage, culture and tourism are marked as being of moderate interest in relation to sectors being considered to diversify the economy away from coal. In the literature sources consulted, tourism was not featured prominently as an option.

5.3.7. Regional competitiveness

According to the indices available as part of the European Regional Competitiveness Index (RCI), Silesia exhibits similar strengths and weaknesses as the rest of Poland, as seen in Figure 0-28. In 2019, the province ranked slightly higher in health, labour market efficiency and efficiency. It ranked significantly higher compared to the national score in market size. The market size evaluation considers the following indicators composed of disposable income per capita, potential market size expressed in GDP and potential market size expressed in population (Annoni & Dijkstra, 2019). An analysis of the transition in the Silesian province identified the following strengths: a) economic and innovative potential, b) transitional experience, c) high population density and transport network, d) public support for the transition (Witkowski, 2019). Overall, this analysis shows **considerable opportunities for market expansion.**

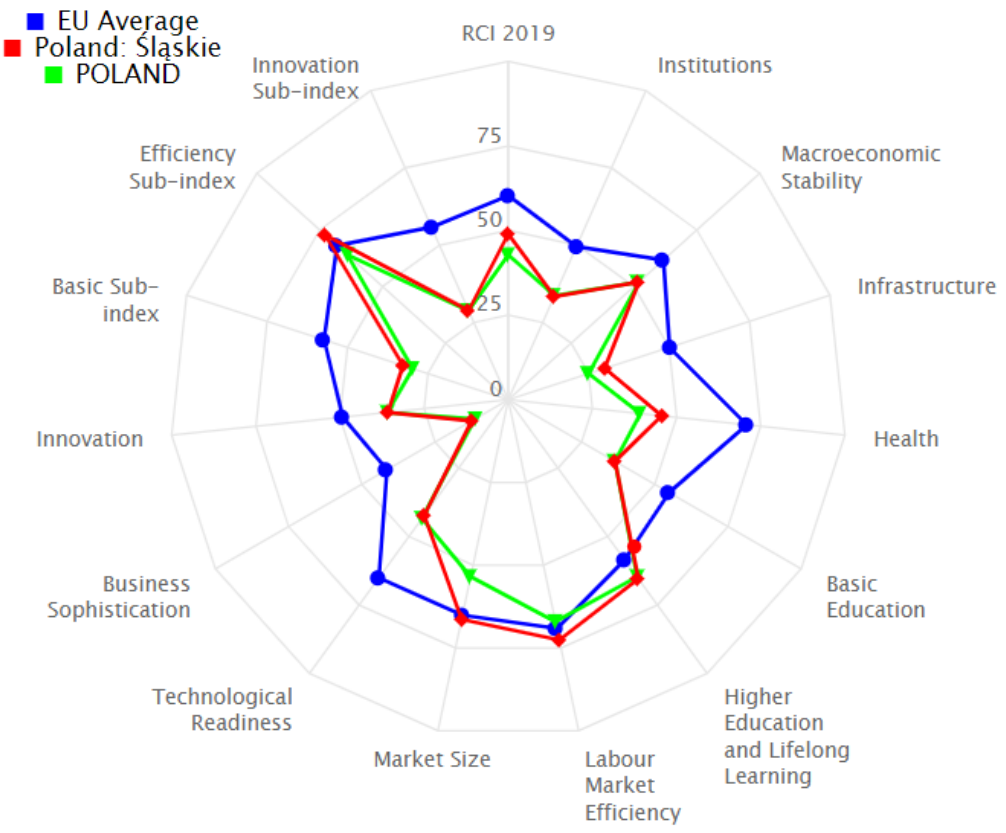


Figure 0-28 Values of the selected subindices of the European Regional Competitiveness Index 2019

Source: European Commission (2019)

5.3.8. Summary of results

The table below summarises the results that are discussed in the previous sections.

To this end, the different indicators can score, positive, neutral, negative or no information available.

Table 0-21 Summary of the Results

Key variable	Indicator	Sub-indicator	Data source (other than interviews)	Assessment
Employment impacts	Creation of new jobs	Jobs in mining compared to total jobs Unemployment rate	Tracer – Upper Silesia Region: quick data and facts	Employment figures for Silesia in the year 2017/2018 In total in the region: 1.7 mln; In industry: 0.4 mln; Mining and quarrying: 84,662. Unemployment rate in Silesia in period 2017/ 2018: 5.1% The unemployment rate in Silesia was slightly higher compared to overall unemployment in Poland (4.9%) for the period 2017/2018
	Destruction of existing jobs	Number of eliminated jobs	Government of Poland, NECP,2020	In 2018, the Polish coal mining industry employed directly approx. 135,000 people (compared to 175,000 in 2010). Employment in the Polish hard coal mining sector decreased from 407 000 in 1990s to 82 843 at the end of 2018. Silesia: early -1990s 300,000 ppl employed in mining, in 2003: 130,000, in 2016: 76,000.
Income impacts	Income impacts for the region	**Changes in GDP and GVA for the region** and compared to other surrounded regions. See also GDP per capita	Eurostat (TGS00026) nama_10r_2gdp	GDP at current market prices by NUTS 2 region (Euro per inhabitant) **2010**: 10,100 2**017**: 12,600 **2018**: 13, 400
	Income inequality impacts	**Changes in disposable income per capita** (related qualification level, but also social policies)	Wiatrowski, M. (2019) Just Transition in The Silesia Province: Opportunities and Threats	Disposable income of households by NUTS 2 region (purchasing power standards per inhabitant): • 2010: 10,700; • 2017: 13, 600. The average gross renumeration in Silesia is 99% of the national average. There are important differences in income distribution within the province. E.g. in Jastrzebie Zdroj the mean renumeration is 146% of the national average whereas in areas such as Czestochowa, Pszczyna, Wodzislaw, Klobuck and Swietocholwice it is only 80% of the national average.
Economic diversification	Impact on local economy (and the different sectors)	Share of total revenues per economic sector	Wiatrowski, M. 2019) Just Transition in The Silesia Province: Opportunities and Threats	Share of total revenues in the region per sector: • Industrial processing: 55%; • Wholesale and retail trade & vehicle repair: 16%; • Construction: 3.5%; • Other: 25.5%.
	Dependency on energy sector		European Commission, 2020 Regional Profile: Silesia	Share of coal in regional power generation mix: 85%.

Key variable	Indicator	Sub-indicator	Data source (other than interviews)	Assessment
Innovation and education impacts	Impacts on technology development	Intramural R&D expenditure as a share of GDP	Wiatrowski, M. (2019) Just Transition in The Silesia Province: Opportunities and Threats	Intramural R&D expenditure as a share of GDP in 2016: 0.53% (below national average of 0.96%).
	Impacts on education system	Share of students compared to national average Share of inhabitants with higher education degree compered to national average	Wiatrowski, M. (2019) Just Transition in The Silesia Province: Opportunities and Threats	Silesia has proportionally 23% fewer students compared to the average for Poland. It also has 17% fewer inhabitants with higher education compared to the whole population than the national average.
Institutional stability	Political stability	Political stability, Voice and accountability, Ease of doing business	World bank Worldwide Governance Indicators	Data for 2019, percentile ranking: • Voice and Accountability: 70.94; • Political Stability and Absence of Violence: 64.29; • Government effectiveness: 74.52; • Regulatory Quality: 81.25; • Rule of Law: 66.35; • Control of Corruption: 71.15. The results are comparable to those in Asturias, Spain but lower than in the case of the North Rhine-Westphalia region of Germany. Between 2014 and 2019 there is a notable decrease in the scoring for the indicators: “voice and accountability”, “political stability and absence of violence”, and “rule of law”.
Demographic and tourism impacts	Migration impacts	Changes in the number of people moving in or out of the region	Wiatrowski, M. (2019) Just Transition in The Silesia Province: Opportunities and Threats	Overall negative migration rate. From 2014–2015, the population of the province shrank by 3%, and in 2017, this ratio was 2%.
Regional competitiveness	The ability to offer an attractive and sustainable environment for firms and residents to live and work’	Regional Competitiveness Index	https://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness	EU Regional Competitiveness Index, 2019: -0.29 This translates into a score of 48.8/1000 and a rank of 170 out of 268 regions.

5.4. Lessons learned

The case of the Silesian Region in Poland illustrates several important lessons in relation to the just transition, the challenges faced by coal regions in transition and possible ways of addressing these challenges. The below highlights are based on the author's analysis of literature sources as well as discussions and information received by means of an interview.

- **Citizen support and public acceptance** for the transition **are vital for success** – without this element the transition is likely to fail. Thus, it is of upmost importance to provide clear and honest information to citizens on the reasons for the transition and the benefits but also the problems that it will entail.
- **No one should be left behind –** more than a slogan, this message needs to be at the core of the transition. The economic diversification away from coal should be undertaken in a way that is pragmatic but also socially just. Policy makers must acknowledge the real difficulties that citizens of the region face in relation to the transition.
- **Cooperation between all levels of governments** at supranational, national, and regional level – is essential to ensure the efficient utilization of resources, the development of synergies and the required consistency in planning. Regional governments have an important role to play based on their understanding of the citizen's needs, thus, they should not be left behind in the process of policy making. Furthermore, it is important to ensure that the regions have adequate resources and staff is appropriately skilled to support the transition.
- **Education, training, and requalification programmes** will play a key role in enabling the transition and attacking investment in the region. However, efforts in this direction must go **together with efforts to** attract investments that will **create jobs in the region**. To the contrary, the region runs the risk of continued negative migration rates and human capital flight.
- In the case of Silesia, a key need is to **diversify the local industrial base** with highly efficient, low-emissions manufacturing subsectors.
- **Economic development must be aligned with environmental and natural resource protection** to ensure high living standards for citizens, especially regarding air quality in the region.

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6. Case study 4: Asturias, Spain

6.1. Introduction

Asturias is a region situated on the north coast of Spain, contributing to approximately 2% of Spanish GDP. In 2016, its population was slightly above 1 million people. The unemployment rate was 14.6%, but 47% for men under 25 years old.[40] Its economy is now mainly depending on services (approximately 70% of value added) and industry (approximately16% of value added).

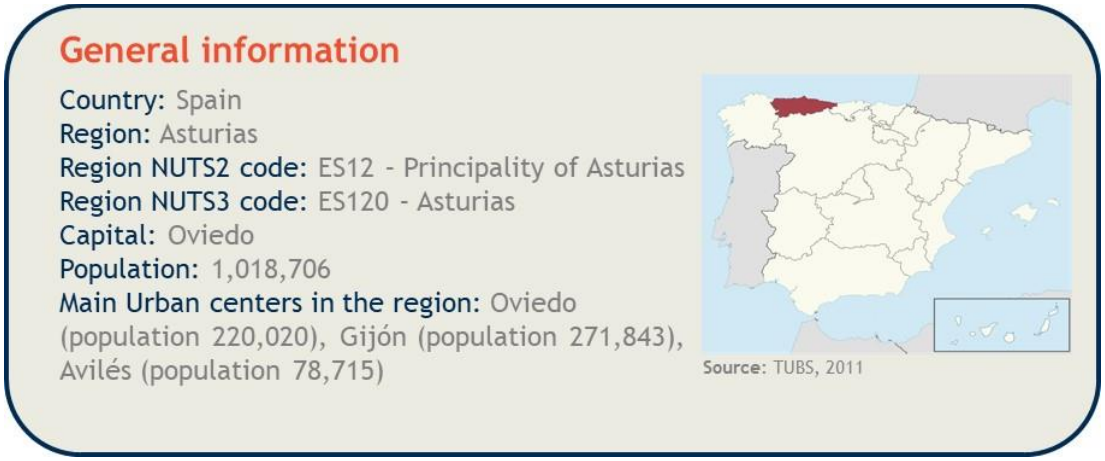

Figure 0-29 General information for Asturias

Source: Image is based on data from Coal Regions in Transition (2020).

Asturias has two coal mining basins that are a major source of jobs for the region. The coal industry employed up to 40,000 people in the early 1990s in Asturias, decreasing to only 2,000 people by 2019 (Platform for Coal Regions in Transition, 2020). The only state-owned coal mining company in the country -Hunosa- is headquartered here. In addition, there are several coal power plants[41], as well as energy-intensive industries (such as zinc and aluminium). In 2017, the extracted coal was supplied to coal-fired power generation in the region, with 75% of electricity generation in the region generated from coal compared to 17% for Spain as a whole (Platform for Coal Regions in Transition, 2020). However, over the **last decades a series of reform packages were implemented to restructure the coal mining industry in light of the energy transition**. Therefore, Asturias is one of the most affected regions by the energy transition in Spain (CCOO+ industria, 2018).

[40] See https://www.iisd.org/sites/default/files/publications/crossroads-balancing-financial-social-costs-coal-transition-china.pdf.

[41] In 2017, there were five coal power plants (2.22 MW installed capacity), and coal represented 75% of the regional power generation mix. Source: Platform for Coal Regions in Transition (2020).

6.2. Background information

6.2.1. Start and acceleration of the transformation

The decarbonisation of the Spanish economy is set within a framework of national strategies – and in particular **coal mining restructuring plans -** which refer to a phase-out of thermal coal power plants by 2030 in the electricity market and closure of the least productive coal mines by 2019. This is mainly driven by EU climate and energy policies, and as such is mostly focused on the phasing out of coal. According to an interviewee, at the Asturias level, until a few years ago, the aim was to maintain coal mining and related economic activity. Only in the last few years has there been a change with a focus on embracing the opportunities from the energy transition.

With the new emphasis of the EU's Just Transition Mechanism (JTM), additional effort is being placed in economic diversification. According to the Platform for Coal Regions in Transition (2020), the context of the transition is uncertain, in part due to the COVID-19 economic downturn, which is having an impact on energy demand which may continue in the longer term. There has also been a reduction in the coal power plant activity due to an increased share of renewable technologies in the Spanish market.

As mentioned above, **Asturias has two coal mining basins and several coal power plants and is therefore directly affected by the energy transition**. In Asturias, most coal mines ceased operations in December 2018 and only one remains open (Pozo San Nicolás), which is scheduled to close in 2021 (Platform for Coal Regions in Transition, 2020). Two coal power plants (CT Narcea and Aboño I[42]) are scheduled to close in 2020 as a consequence of the EU's Industrial Emissions Directive. A third coal plant (CT Lada-Iberdrola) has also applied for closure, though it complies with EU legislation. By 2021 there may only be 2 coal-fired generation units (available for or) in operation scheduled to close by 2030 (Aboño II and Soto-3, both from EDP), though they are already now in danger due to current market conditions. As such, the transition is in a starting phase.

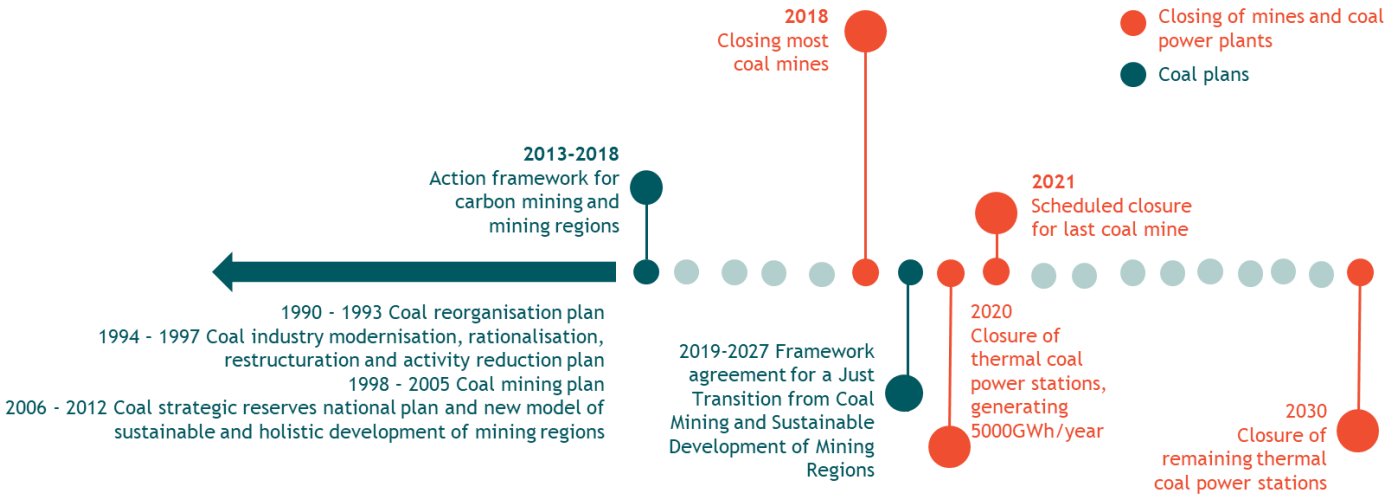

Figure 0-30 Timeline for the energy transition in Asturias2018

[42] Aboño I is reconverting from coal to burning gas from steel processes.

According to the Platform for Coal Regions in Transition (2020), Asturias is not positioned to replace its coal electricity generation capacity with renewable energy generation (e.g. wind and solar) and will switch from a net exporter to a net importer of electricity. Significant investments will be needed to maintain security of electricity supply. [43] According to the Platform for Coal Regions in Transition (2020), **57 of the 78 municipalities are severely or directly affected by coal mine closures and the phase-out of coal power plants**. The phase-out of coal and coal-fired electricity generation will also have significant implications for local industry which is electro-intensive and relies on affordable supply, as well as for coal-related supply chain and service activities.

Asturias is a particular region, in that its economy was developed on the basis of its coal mining activities, which attracted the steel industry, electricity generation and then more electricity-intensive industries. Further, according to an interviewee, the local population has a negative perception of transition processes, given the recurrent destruction of economic activity and related employment (first with the livestock sector, dairy industry, then coal mining and now energy) without the creation of new and stable economic activity and employment. This is an important barrier to the transition.

6.2.2. (Inter)national and regional policies

The following sections provide an overview of the most important (inter)national and regional policies and how they influenced the transition. The transition has been mostly led by EU and national energy and climate policy. Asturias is a recipient of the European Commission's Secretariat Technical Assistance to Regions in Transition (START) support, from the EC's initiative for coal regions in transition.[44]

The most relevant strategies and plans for economic diversification / development and decarbonisation are listed in the table below.

Table 0-22 Overview of policies

Level	Policy/ Strategy
National	**Renewable energy plans 1999-2010, 2005-2010, 2011-2020**
	Spanish Strategy for Climate Change and Clean Energy 2007-2012-2020 – focused on achieving RES and climate change commitments while improving social welfare, economic growth and environmental protection.
	Integrated National Energy and Climate Plan (PNIEC) 2021 – 2030
	Draft Bill on Climate Change and Energy Transition Law (LCCTE) – plan for decarbonisation of the Spanish economy by 2050. Under revision.
	Just Transition Strategy - foresees "just transition agreements" between government, unions and businesses in regions affected by climate transitions.
	Spain's coal mining restructuring plans 1990-1994-1998-2006-2013-2019- A series of five reform packages were implemented to restructure the industry, summarised in Table 0-23.
Regional	**Sustainable development strategy for the Principality of Asturias (2008)**
	Energy strategy of the Principality of Asturias (2008-2012)
	Industry strategy for Asturias 2013-2015
	Strategy for Asturias' smart specialisation 2014-2020 (RIS3) - Integrated agenda for regional economic transformation, prioritising sectors and technologies to promote the region's competitiveness. It focuses on reduce, reuse, recycle principles as well as circular economy, carbon capture, energy sustainability and efficiency in industry and the built environment.

[43] Imports of electricity will rely on East-West transmission (e.g. from renewable sources from Galicia) and North-South connectivity, which is constrained due to difficult topography and protected park areas. Source: Platform for Coal Regions in Transition (2020)

[44] See https://ec.europa.eu/energy/topics/oil-gas-and-coal/eu-coal-regions/secretariat-technical-assistance-regions-transition-start_en.

	Regional strategy for the sustainable use of forest biomass 2011-2020– sets targets for forestry biomass to increase renewables in the energy mix, reduce GHG emissions, incentivise job creation and sustainable development.
	Just Transition Plan for Asturias, which will cover the economic reactivation as well as energy strategy, will be published by early 2021.

Source: Based on Syndex (2015) and Platform for Coal Regions in Transition (2020).

The most relevant national policies are the coal mining restructuring plans, which aimed to transform the sector by reducing coal production and the number of employees as shown below. The plans and strategies included a number of measures to promote diversification and foster employment in the mining regions, ranging from early retirement, to grants to set up new businesses, professional training and incentives for R&D and environmental projects. According to Syndex (2015), the 2013-2018 plan aimed that only those companies which are economically viable without government support would remain open in 2019.

Table 0-23 Summary of Spain's coal mining restructuring plans

Plan	Change on number of employees	Change on production (tonnes)	Cost (M EUR)	Areas of support
Coal reorganisation plan 1990-1993	-6,169	- 900,116	4,689	- Early retirement and voluntary redundancy schemes - Compensations for reduction of coal supplies
Coal industry modernisation, rationalisation, restructuration and activity reduction plan 1994-1997	769	427,000	4,275	- Direct and indirect support to coal mining companies to improve productivity and to compensate supply loses - Early retirement and voluntary redundancy schemes
Coal mining plan 1998-2005	-16,190	- 5,675,271	9,246	- Early retirement and voluntary redundancy schemes - Compensations for reduction of coal supplies
Coal strategic reserves national plan 2006-2012 and new model of sustainable and holistic development of mining regions	-4,190	- 5,750,000	4,987	- Direct and indirect support to coal mining companies to increase productivity - Early retirement and voluntary redundancy schemes - Support to environmental and technological investment projects
Action framework for carbon mining and mining regions 2013-2018	- 2,222 (planned)	- 672,593 (planned)	400	- Direct support to compensate for production losses - Exceptional support including early retirement and voluntary redundancy schemes and mitigation of environmental impact
Framework agreement for a Just Transition from Coal Mining and Sustainable Development of Mining Regions 2019-2027	NA	NA	NA	- Support for exceptional costs (including social & employee support and mitigation of environmental impact) - Support for new business installations and expansions - Support for alternative development of mining regions - Support to new technologies

Sources: cost of plans: (Llamas, 2012); Plan 1998–2005 (Ministerio de Industrial y Energía, 1998); Plan 2006–2012 (Instituto para la Reestructuración de la Minería del Carbón, 2012); Plan 2013-2018 (Instituto para la Reestructuración de la Minería del Carbón, 2013); other: (CCOO & UGT-FITAG, 2015)

Source: Based on IISD (2017) and Gobierno de España (2018).

National and regional support

Overall, Spain is doing well with regards to the subsidy phase-out for coal mining; however, there is still work to be done with regards the subsidy phase-out for coal-fired power (ODI, 2017).[45] While Spain has adopted a framework plan to facilitate the phase-out of operational aid for coal mines and coal mining communities, in 2017 it still supported coal-fired power plants through capacity payments and environmental upgrades.

There remain several national and regional support instruments in place. However, it is important to note that most regional support follows directly from the national plans and strategies, mostly regarding Spain's coal mining restructuring plans introduced above. Previously, a large part of the support available went to the coal mines and power plants, though this has been limited in the latest plans.

Table 0-24 Overview of support

Level	Support instruments
National	Economic support for development of coal mining councils (RD 675/2014)
	Economic support for labour costs to closure of coal mines (RD 676/2014)
	Urgent measures for just transition and sustainable development in coal mining councils (RDL 25/2018)[46]
Regional	Asturias Operative programme 2014-2020 – € 254M funded by EU via the ERDF. It includes innovative actions in renewable energy, with € 19M investment through support to centralised heat production systems, energy efficiency in businesses and energy efficiency in infrastructure and public services.
	IDAE support– Support for transition regions via three main blocks: Just Transition Agreements focusing on € 300M subsidies for electric and thermal renovation. Co-financed by the ERDF. General sector block focusing on mobility. Investment block focusing on providing social capital, financing, subsidies.
	Regional incentives 2014-2020- These subsidies to business investment in Asturias aim to promote economic activity, complementing specific support to the coal sector. They cover industry (transforming industry and services to support production); tourism and exceptionally other sectors which contribute to regional development (Excluding coal and steel).
	REINDUS support to industrial investment – € 400M for financing and assistance for industry production and manufacturing projects. It aims for 20% of Spain's GDP to be industry related in 2020. Support is available for all of Spain, though there is priority for certain municipalities including those affected in Asturias. 10 year loans, with 3 year grace period, for 75% of the investment with 1% fixed interest rate will be made available.
	Just Transition Plan for Asturias (2019) includes: Urgent plan for mine restoration (IRMC)- to mitigate job loss and recuperate the environmental value of the land. The minimum budget available is € 163M and the focus is on 4 selected locations.[47] The autonomous community should provide 25%. This plan could generate 534 jobs (if implemented in one year) or 266 jobs/year or 178 jobs/year if implemented in two or three years respectively. Social plan (IRMC)– Including assistance regarding professional training and labour insertion for Asturias, Castilla y León y Aragón. The € 2.25M IRMC programme will include a minimum of 500 unemployed workers (affected by closures) over 30 months and aims for an insertion rate of 80%. There is also a Social Plan that allows early retirement.

[45] ODI (2017) further elaborates that a Framework plan for coal mines and coal mining communities has been adopted to facilitate a gradual phasing out of operational aid by the end of 2018, with social, economic and environmental transition support to mining communities and regions provided until the end of 2021. However, Spain provides subsidies to support coal-fired power plants through capacity payments and environmental upgrades, including sulfur scrubbing. No phase-out planned was available for coal fired power subsidies.
[46] Although 600 M EUR is available for urgent measures, 133 M EUR concerns funding for earlier defined projects and there is a substantial allocation for social plans. Resources available for new projects is around 150 M EUR.
[47] Cielo Abierto de Cerredo o La Granda (en el término municipal de Degaña); Pilotuerto (en el T.M. de Tineo). Subterránea; Tormaleo (en el T.M. de Ibias). Cielo Abierto; Buseiro (en el T.M. de Tineo). Cielo Abierto

Level	Support instruments
	Agreements under the 2019-2027coal restructuring plan - aim to channel IRMC subsidies towards infrastructure and restoration projects. 70 actions have been selected for Asturias with a maximum financing of € 97M (75% by IRMC and 25% by Asturias). Support to the reactivation of mining regions via business and investment projects that create jobs consist of a total € 250M for Castilla y León, Asturias, Aragón y Castilla la Mancha, for 2019-2023 (with option to extent to 2027). In 2018, Asturias obtained € 1.7M support for nine projects to generate 52 jobs, as well as € 2.6M support for 65 small projects to generate 113 jobs.

Source: Based on Ministerio para la Transición Ecológica (2020) & Gobierno de España (2019).

6.3. Results

Coal mining is one of the major economic activities in Asturias, and coal-powered electricity generation is the main generation technology. Therefore, the coal phase-out is expected to have a large negative impact. The following sections detail these impacts.

6.3.1. Employment impacts

According to the Platform for Coal Regions in Transition (2020), Asturias has a relatively low employment rate of 63.2% (in 2018), compared to the national rate (67%) and the EU average (73.2%). Unemployment rate in Asturias was 14.4% in 2019 (Q3), close to the national rate of 13.9% which is among the highest in the EU.[48] Employment and GDP related to extractive and manufacturing industries (NACE B_E) have declined (see figure). According to an interviewee, the energy transition can (negatively) impact around 15% of the region's employment (linked to mining, power generation and industry).

Industry related jobs went from representing 23% of total jobs in 1990 to 13% in 2019 (see figure below), while the total number of jobs remain somewhat stable going from 385,600 to 378,800 in the same period.

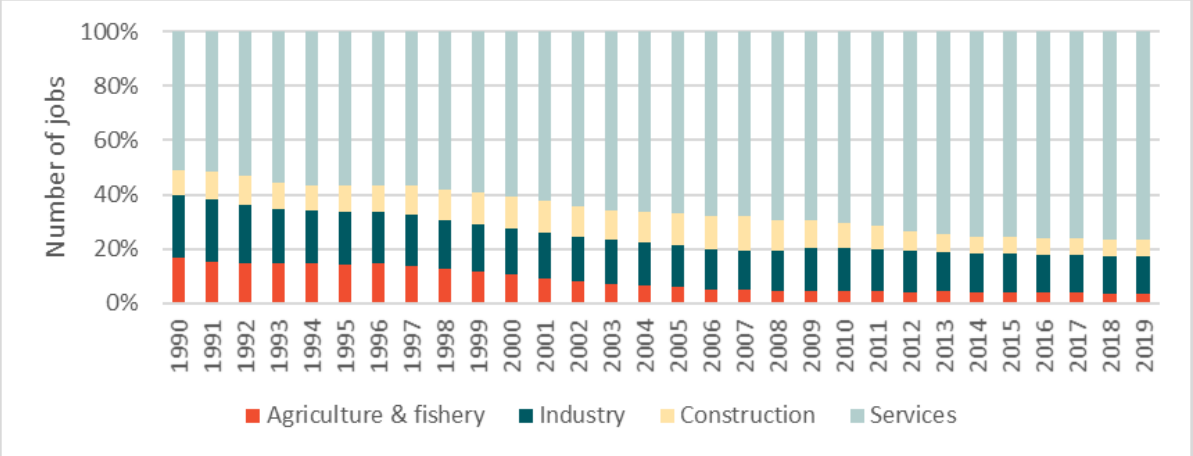

Figure 0-31 Share of employment per sector

Source: SADEI.

[48] For example, the energy sector has specialised machinery operators, electrical specialists, mechanical specialists, drill operators, mining and energy engineers, logistic coordinators, health and safety officers, or thermal power operators. Source: Platform for Coal Regions in Transition (2020).

The coal industry employed up to 100,000 people in the 1950s in Asturias. Over time, high extraction costs along with the policy framework led to a gradual closure of mines. In 2017, there were 1,468 direct jobs in coal mining; 746 in coal power plants; and 1,540 in other coal-related activities, representing 1% of the total regional employment (Platform for Coal Regions in Transition, 2020). **Employment in the coal industry had fallen to 2,000 people by 2019, and these jobs are at risk due to the planned coal phase-out** (Platform for Coal Regions in Transition, 2020).

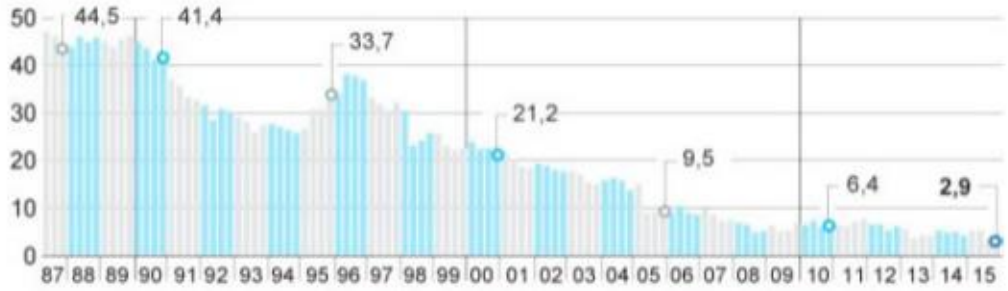

Figure 0-32 Evolution of workers in the coal mining sector, 1987 to 2015. Data in Thousands

Source: https://www.elmundo.es/economia/2016/03/20/56eaf35ae2704e78128b4607.html.

Table 0-25 Change in employment in the coal sector in Asturias and at community level

ASTURIAS	1996	2016	Variation
Extractive industries (% of total employment)	14,254 (4%)	2,961 (1%)	-79%
Total employment	334,958	365,876	+9%
Narcea	1996	2016	Variation
Extractive industries (% of total employment)	2,147 (16%)	771 (8%)	-64%
Total employment	13,267	9,351	-30%
Caudal	1996	2016	Variation
Extractive industries (% of total employment)	4,422 (24%)	776 (5%)	-82%
Total employment	18,645	14,963	-20%
Nalón	1996	2016	Variation
Extractive industries (% of total employment)	4,187 (22%)	541 (3%)	-87%
Total employment	18,936	17,709	-6%

Source: CCOO+ (2018).

According to interviewees, there was no distinction in job security or job opportunities based on age or gender; though the share of female employment has been traditionally low in the sector.

The regional labour force has a degree of specialisation linked with the main regional activities, including coal mining and coal thermal power plants.[49] According to an interviewee, no capacity

[49] For example, the energy sector has specialised machinery operators, electrical specialists, mechanical specialists, drill operators, mining and energy engineers, logistic coordinators, health and safety officers, or thermal power operators. Platform for Coal Regions in Transition (2020)

or skills constraints were identified. Unemployment is, among others, due to the lack of employment opportunities which arose from the coal phase-out. Other factors driving unemployment include the lack of dynamism of the Asturian economy, the deindustrialisation process, the under-developed economic diversification in certain areas, etc. According to another interviewee, companies facing closures often provide training for employees but those employed by intermediary companies get no benefits.

6.3.2. Income impacts

According to an interviewee, the transition affects around 15-20% of the region's GDP. 4-5% linked to the energy sector and 15% linked to the electricity-intensive industry.

At the household level, according to an interviewee, the unemployment rates show that disposable income has decreased considerably, even though collective dismissal plans included reasonable conditions. According to another interviewee, **the short-term impact on households may have been positive, due to passive income (pension). However, in the long term, unemployment may lead to significantly lower household income**.

6.3.3. Economic diversification

According to Platform for Coal Regions in Transition (2020), the coal phase-out will not only mean a substantial loss of employment opportunities, but a reduction in economic activity in Asturias: It has significant implications throughout the coal supply and distribution chain, including service activities, notably port infrastructure, transport and logistics (such as the port of Gijon[50]). Additionally, the availability of stable coal-based electricity supply in Asturias has supported the development of an important electro-intensive industry, which is expected to see a negative impact due to the coal phase-out.

According to the Asturian Industrial Production Index[51] (see figure below), the extractive industries have seen a sharp decline over time, while no other sector has seen a contrasting trend.

[50] The port of Gijon is the largest port in Spain for solid bulk cargoes, including coal and ores, and related transport and logistics services, with an estimated 100,000 annual truck movements to transport coal from ports to power plants.
[51] This index reflects the production evolution of the different industrial branches in Asturias. Its current base year is 2015 and it is disaggregated in 9 industry branches corresponding to the SADEI R28 classification.

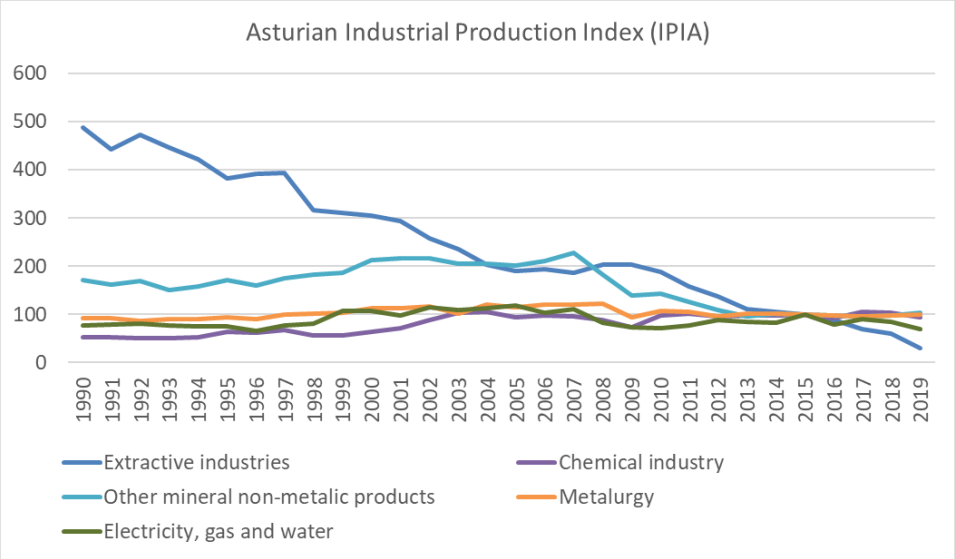

Figure 0-33 Asturian Industrial Production Index (IPIA – base year 2015) – selected sectors

Source: SADEI.

According to interviewees, the **negative economic effects of the transition are evident, while positive effects remain limited** (even though efforts towards economic diversification exist). The mining sector's GVA used to be very high, and so far there is no substitute for that loss (though some positive impacts are seen in the Aviles Port, which works with wind power machinery). According to an interviewee, the impact on electro-intensive industries, will be seen in the future and will depend on electricity tariffs.

According to the Platform for Coal Regions in Transition (2020), regarding diversification, **Asturias is not well positioned to increase its renewable energy generation significantly in the short term, thus switching from a net electricity exporter to a net importer** (though transmission lines are constrained[52]). However, there are opportunities for diversification, mostly focused on the reconversion of coal sites. The Platform for Coal Regions in Transition (2020) listed the following as opportunities where Asturias is active or where there is interest to develop activities:

- **High interest:** Biomass, energy storage, geothermal, hydro power and pumped hydro-storage, hydrogen, wind, reconversion of coal-related sites for new economic and social activities, low-carbon mobility and transport, industrial waste heat recovery.
- **Moderate interest:** Gas; repurposing of coal-related industrial infrastructure; heritage, culture and tourism.

According to an interviewee, certain sectors (like metallurgy related to thermo-solar parks and offshore wind power) have had a positive economic impact, but have limitations related to the number of projects available and the fact that investors want a share of the work to be done locally. Energy storage, hydrogen, green mobility, biomass and offshore wind were mentioned by the same interviewee as strategic sectors to be promoted during the transition.

To date, Asturias remains mostly dependent on coal for its primary energy supply (see figure), even though the region's coal production has declined from 6 million tons per year in 1990 to no production by 2019 (SADEI).

[52] Due to topography and issues to constructing transmission capacities in protected areas.

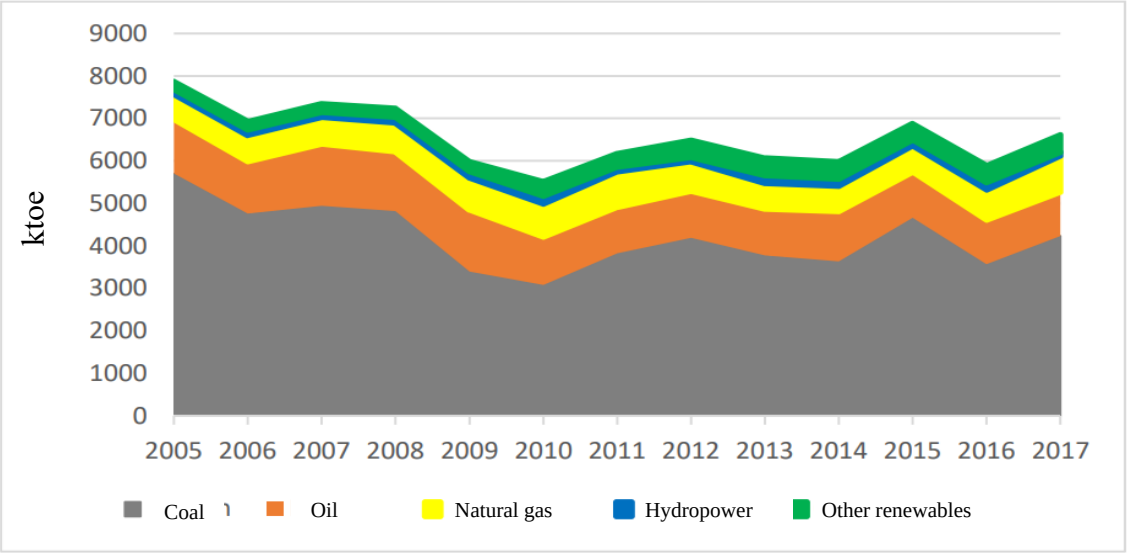

Figure 0-34 Evolution of primary energy consumption in Asturias by source

Source: COMISIÓN MIXTA PARA EVALUAR EL IMPACTO DE LA TRANSICIÓN ENERGÉTICA EN ASTURIAS (2020).

In 2017, coal represented 64% of primary energy and renewables 6% (FAEN, 2018). Energy production, on the other hand, was 39% coal, 41% biomass, and 20% wind and solar (FAEN, 2018).

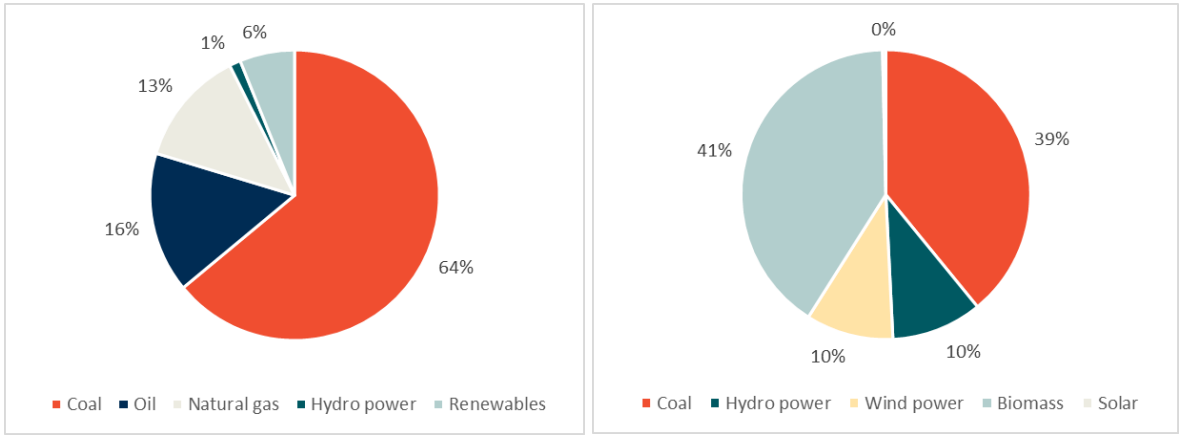

Figure 0-35 Primary energy consumption (left) and primary energy production (right) in Asturias in 2017

Source: FAEN (2018).

Additionally, there have been **a number of economic diversification projects**[53] put in place by a range of stakeholders (Platform for Coal Regions in Transition, 2020). For example, the coal mining restructuring plans, led to Hunosa transforming old mines into museums and expanding into mining related areas, such as the development of geothermal and biomass energies (IISD, 2017). An interviewee mentioned that there have been several local public

[53] Ranging from HUNOSA's mining tourism package and its heat recovery from a mine for district heating, to planned projects on energy storage (e.g. with molten salt, by reversible water pumping and mine water sewage, etc.), repurposing power plants (e.g. to burn gases from the steel process, hybridisation), mobility projects (e.g. electric buses, changing truck fleets from diesel to GNV), etc.

support programmes addressing PV and solar thermal, biomass, etc. since the end of the 90's; while in the last decade 500MW of wind power were installed (and another 15,000MW are planned). However, this remains limited compared to the 3,500MW coal power generation capacity the region had (and of which less than 1,000MW should remain in operation or available for operation by 2021 and which should be closed by 2030). The combined efforts to support the energy transition and economic diversification are significant, but the impact remains considerably limited in comparison to the negative impacts of the coal phase-out.

6.3.4. Innovation and education impacts

Interviewees mentioned that universities in Asturias (e.g. Oviedo University) have created **new requirements based on market needs, aiming to diversify and reflect the transition needs**, for example regarding green mobility. According to IDEPA (2016), the Cluster of Energy, the Environment and Climate Change at the University of Oviedo drive forward R&D&I in fields such as clean energy (generation, transport and storage) and energy efficiency.

An interviewee mentioned that the CINN.es (Centro de Nanotecnología y Nanomaterials) was established and that the 'Consejería de Innovación' promotes energy transition topics. Several projects have been funded by the EU ERDF fund including geothermal networks with water from the HUNOSA mine. Another interviewee mentioned that multinational companies which are based in the region also have research centres in Asturias (e.g. ArcelorMittal's research centres on artificial intelligence and mining, and Thyssenkrupp's research centre on mechanical walkways).

Nonetheless, the number of university students in the region has declined by around 50% since the mid-nineties. This may be linked to the emigration of the skilled youth due to high unemployment levels (see section 6.3.6).

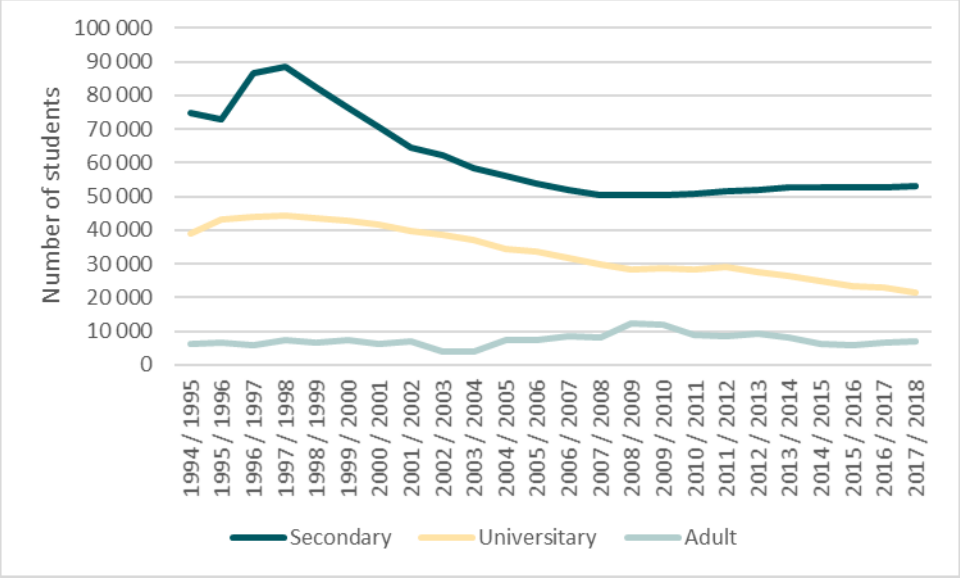

Figure 0-36 Number of students per education level

Source: SADEI.

Regarding innovation, internal expenditure in R&D has almost doubled in the last decades (See figure). The indicator includes all expenses in scientific research and technological development, both private and public funds.

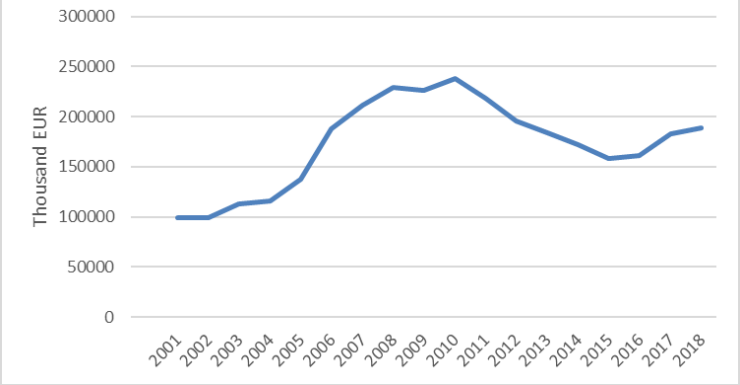

Figure 0-37 R&D internal expenditure in Asturias.

Source: SADEI

6.3.5. Institutional stability

An interviewee mentioned that the change in the political discourse (from maintaining coal as a key element of the local economy to taking advantage of the opportunities from the energy transition) has **reinforced political stability**. All stakeholders (see Annex C) have been involved through social dialogue in the process (see also Section 8.2.2) and reached consensus as much as possible regarding the way forward. At both national and regional level, there is a concern to ensure that no one is left behind. However, once funding is available the different interests may create conflicts around the allocation of these funds.

Data on institutional and political stability can be found at national level in the World Bank Governance Indicators data.[54] The governance scores across the different indicators have been relatively stable over the period 2004-2019 in Spain, with the exception of political stability, which saw a drop in 2009 followed by improvement. Across the rest of the indicators, Spain places itself above the 70th percentile showing an overall attractive business climate, which can be seen reflected in the Ease of Doing Business score of 77.9 in 2020 (WB, 2020).

[54] https://info.worldbank.org/governance/wgi/Home/Reports

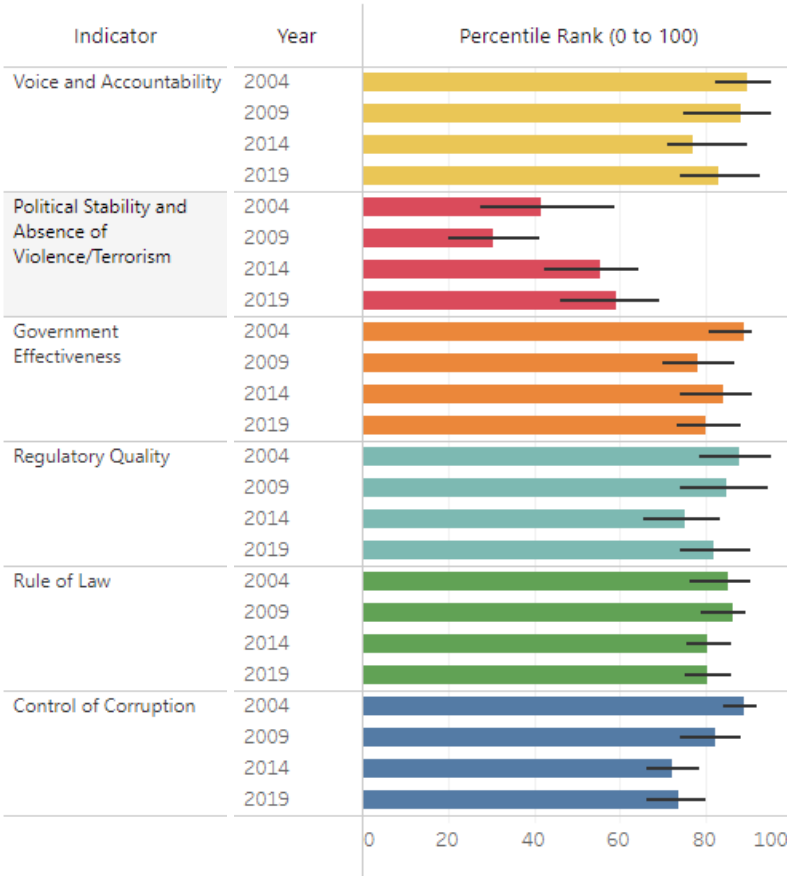

Figure 0-38 Worldwide Governance Indicators for Spain, 2004-2019

Note: The percentile rank indicates the rank of the country among all countries in the world (ranging from 0 to 100, with 100 corresponding to the highest rank).

Source: World Bank (n.d.).[55]

6.3.6. Demographic and tourism impacts

Of the 78 municipalities in Asturias, 40 saw their population decrease by at least 20% in the last 20 years (with 6 municipalities having a decrease of over 40%); while only 7 municipalities saw their population increase (where the highest increase was 21%).[56] According to an interviewee, **certain towns have seen their population reduce by half due to the coal phase-out.** According to another interviewee, unemployment has led to emigration of the skilled youth, leading to aging of the population. There are certain regions (which had mining operations) which are at risk of being deserted if economic activity is not reactivated.

[55] https://info.worldbank.org/governance/wgi/Home/Reports

[56] www.ine.es - Cifras oficiales de población resultantes de la revisión del Padrón municipal a 1 de enero. Detalle municipal.

Table 0-26 Population in Asturias and per selected municipalities.

	1999	2009	2019	Variation 20 years	Variation 10 years
33 Asturias	1 084 314	1 085 289	1 022 800	-6%	-6%
33001 Allande	2 519	2 068	1 648	-35%	-20%
33002 Aller	15 775	12 766	10 613	-33%	-17%
33003 Amieva	927	815	661	-29%	-19%
33005 Belmonte de Miranda	2 389	1 807	1 489	-38%	-18%
33007 Boal	2 608	1 979	1 505	-42%	-24%
33010 Candamo	2 629	2 180	1 947	-26%	-11%
33011 Cangas del Narcea	17 593	14 589	12 347	-30%	-15%
33015 Caso	2 070	1 869	1 507	-27%	-19%
33019 Colunga	4 571	3 878	3 257	-29%	-16%
33022 Degaña	1 564	1 233	921	-41%	-25%
33024 Gijón	267 980	277 554	271 780	1%	-2%
33027 Grandas de Salime	1 376	1 075	835	-39%	-22%
33028 Ibias	2 224	1 711	1 251	-44%	-27%
33029 Illano	646	480	346	-46%	-28%
33035 Llanera	11 798	13 776	13 702	16%	-1%
33036 Llanes	13 212	14 013	13 568	3%	-3%
33042 Noreña	4 274	5 415	5 179	21%	-4%
33044 Oviedo	200 453	224 005	219 686	10%	-2%
33046 Peñamellera Alta	742	600	514	-31%	-14%
33048 Pesoz	268	193	147	-45%	-24%
33053 Quirós	1 703	1 389	1 158	-32%	-17%
33058 Riosa	2 605	2 200	1 858	-29%	-16%
33059 Salas	7 154	5 962	4 959	-31%	-17%
33061 San Martín de Oscos	535	448	377	-30%	-16%
33063 San Tirso de Abres	667	556	410	-39%	-26%
33066 Siero	47 270	51 181	51 667	9%	1%
33068 Somiedo	1 638	1 435	1 153	-30%	-20%
33071 Taramundi	932	739	623	-33%	-16%
33072 Teverga	2 325	1 933	1 572	-32%	-19%
33073 Tineo	13 200	11 146	9 389	-29%	-16%
33034 Valdés	15 556	13 529	11 504	-26%	-15%
33075 Villanueva de Oscos	416	382	292	-30%	-24%
33076 Villaviciosa	14 348	14 775	14 439	1%	-2%
33077 Villayón	2 000	1 582	1 206	-40%	-24%
33078 Yernes y Tameza	228	185	132	-42%	-29%

Source: INE (2020).

Of the 57 mining municipalities directly or indirectly impacted by coal mining phase-out, 21 municipalities are expected to be severely and directly impacted by the energy transition (Platform for Coal Regions in Transition, 2020). In particular, the negative impact on economic activity and lack of employment opportunities has led to an emigration of young people to other regions of Spain.[57]

[57] Platform for Coal Regions in Transition (2020)

Regarding tourism, according to interviewees, the energy transition has had no significant impact.

6.3.7. Regional competitiveness

Regional competitiveness is defined as "the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work in" (p.3 EC, 2019). The Regional Competitiveness Index (RCI) measures a region's long-term potential (at NUTS-2 level). **The Principality of Asturias has an RCI score of 43.18 out of 100, and ranks 6th within Spain in terms of regional competitiveness**. However, it has seen a slight decreasing trend since 2013.

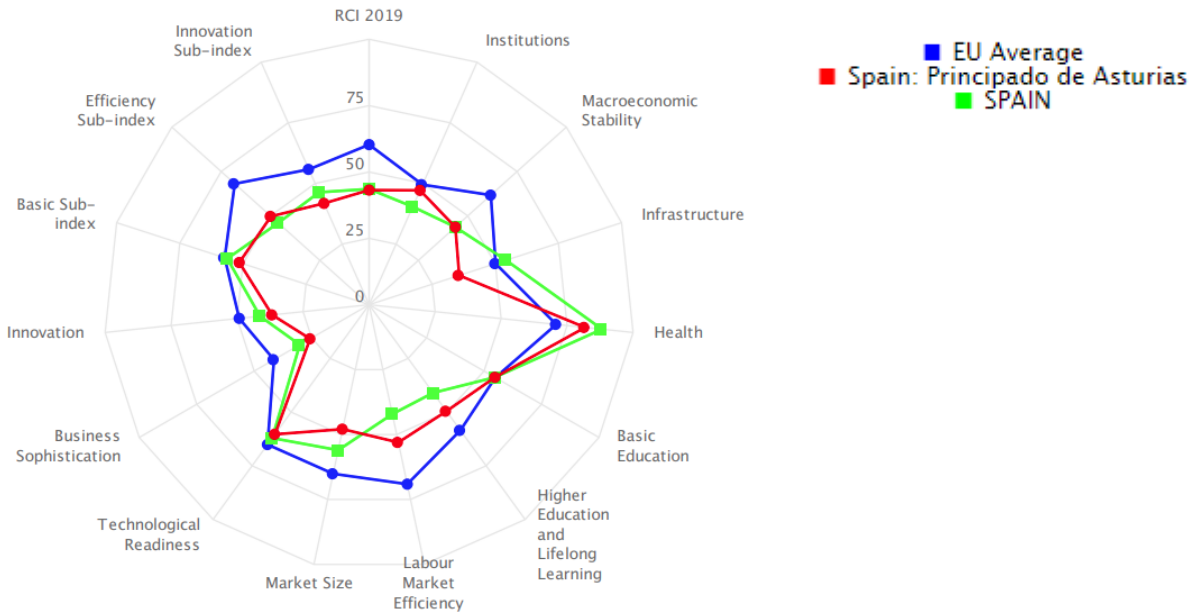

Figure 0-39 Comparison of performance across all RCI pillars for the EU, Spain and Principality of Asturias region (ES12)

Source: EU Regional Competitiveness Index (2019).[58]

Overall, there are efforts to diversify the economy in the region, but these remain limited and the employment and economic activity generated remain much lower than those generated by the coal industry. Further, Asturias has limitations given its size and limited resources. Currently, **metallurgy and manufacturing of equipment represent the most important industrial sectors of the regional economy** and the supply of a competitively priced metal is a key feature of the competitiveness of these industries (Platform for Coal Regions in Transition, 2020). However, **Asturias may lose this competitive edge with the phase-out of coal power plants if no alternative power source is identified** as this might lead to the delocalisation of the electro-intensive regional industry (especially the metal industry).

[58] https://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness

Other barriers are presented in the figure below, together with the opportunities and the drivers of the phase-out of coal.

Drivers & opportunities	Challenges
•Role of the regions, with the capacity to regulate and negotiate •Biomass potential (and other natural resources in the region) •Energy efficiency opportunities •Promote participation fora and organisations in order to improve coordination among stakeholders •Existing industrial fabric, energy resources and infrastrutcure in the region •Mainstreaming environment delegate in all companies for dialogue & follow up	•Demographic change: population ageing, outward migration •Modernisation of industry/re-industrialisation •Employment creation, reskilling •Lack of political will leading to a coherent industry and environment strategy for the long term •Regulatory uncertainty and legal instability •Lack of financing/resources and investment difficulties •ETS ineffectiveness at transforming the production model • Lack of reinforced social dialogue •Need for a training framework for emloyment following a low carbon industrial strategy •Limited awareness

Figure 0-40 Challenges and drivers to a low-carbon industry identified by stakeholders in Asturias

Adapted from: Syndex (2015) and Platform for Coal Regions in Transition (2020).

6.3.8. Summary of results

The next step is to score the cases on their performance. To this end, the different indicators can score, positive, neutral, negative, or no information available.

Table 0-27 Summary of the results

Key variable	Indicator	Sub-indicator	Data source	Assessment
Employment impacts	Creation of new jobs	• Changes in (un)employment rate • (un)employment numbers	Interview data	Negative impact in employment across the value chain due to coal phase-out.
	Destruction of existing jobs		Platform for Coal Regions in Transition (2020) & CCOO+ (2018)	Loss of 98 000 jobs in the coal industry (between 1950 and 2019). 600 jobs linked to coal power generation at risk (2018).
	Net change in number of jobs	Number of new jobs minus the number of destructed jobs = net change jobs	Interview data	Negative net impact. High unemployment, especially in mining basins.
	Nature of new skills required, per qualification level	Type of new jobs created and the required new skills	Interview data	Limited new jobs created. Qualifications & skills not an issue, given the high unemployment levels.
Income impacts	Income impacts for the region	Changes in GDP for the region	Interview data	Transition can (negatively) impact 15-20% of the region's GDP (which is linked to the energy sector and electricity-intensive industries).
	Income inequality impacts	Changes disposable income per capita (related qualification level, but also social policies)	Interview data	Increase in disposable income on the short term due to early retirement and collective dismissal plans, and risk of decrease in the long term due to unemployment.
Economic diversification	Impact on local economy (and the different sectors)	Changes in trends regarding the main economic sectors	SADEI	Extractive industries have seen a sharp decline over time, while no other sector has seen a contrasting trend.
	Dependency on energy sector		COMISIÓN MIXTA (2020)	60% of primary energy from coal in 2017.
			IDEPA (2016) & FAEN (2018) & Platform for Coal Regions in Transition (2020)	In 2015, exported 37% of its net power generation and 36% in 2017. Asturias is expected to become a net importer of electricity due to the transition.
Innovation and education impacts	Impacts on technology development	Changes in technology development	SADEI	Expenditure in R&I has almost doubled in the last decades.
	Impacts on education system	Changes in education system	SADEI	50% decrease in university students from 1995 to 2018.
Institutional stability	Political stability	Political stability, Voice and accountability, Ease of doing business	World bank Worldwide Governance Indicators	Above 70th percentile on governance indicators. Score of 77.9 on 'Ease of doing business'.
Demographic and tourism impacts	Migration impacts	Changes in the number of people moving in or out of the region	INE (2020)	71 out of 78 municipalities reduced their population in the last 20 years, with 40 seeing a reduction of over 20%.

Key variable	Indicator	Sub-indicator	Data source	Assessment
	Tourist impacts	Changes in the number of tourists	Interview data	Not applicable.
Regional competitiveness	Attractive and sustainable environment for firms and residents to live and work	Regional Competitiveness Index (builds on the issues discussed above)	EC (2019)	Slight decreasing trend since 2013.

6.4. Lessons learned

The case Asturias in Spain illustrates several important lessons in relation to the energy transition. Certain aspects of Asturias' transition, as discussed either in the literature or highlighted by interviewees, are highlighted below:

- **Asturias' history of coal mining, led to the use of coal thermal power plants for electricity generation, and a concentration of economic activity in the steel industry and electricity-intensive industry in the region.** Therefore, dependency on coal in Asturias remains high (60% of primary energy).
- **The decision to focus on the transition's opportunities for the region is recent** and follows EU level commitments. Before, Asturias focused on maintaining coal as a key economic activity. In order for the transition to be successful this trend should continue in the future.
- The region's **public perception of the transition is negative**. So far there has been a history of economic decline (livestock and dairy, then coal mining and now coal power generation) and related employment effects, with no new economic activity replacing the gaps. General perception is worsened by, for example, an increase in imports of coal-based electricity from Morocco following the closure of a local coal power plant, or competition with Chinese steel produced at much lower environmental standards. Policy makers should take this into account going forward to mitigate any negative effects.
- There are **efforts to diversify the economy, but these remain limited** and the employment and economic activity generated remain much lower than those generated by the coal industry. Further, Asturias has limitations given its size and limited resources. As mentioned before, policy makers should focus on the opportunities arising from the transition.
- The region has **no SMEs but rather multinationals and microenterprises**. This often leads to distortion in the statistics of the region. For example, in terms of investment, values are very high for Asturias as they reflect investments from large multinationals with local headquarters even though, often, the related projects do not take place inside the region. Monitoring and reporting, especially at national and EU level should be able to reflect this.

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TUBS (2011) Own work. This W3C-unspecified vector image was created with Adobe Illustrator. This file was uploaded with Commonist. This vector image includes elements that have been taken or adapted from this file: Spain location map.svg (by NordNordWest). This vector image includes elements that have been taken or adapted from this file: España-Canarias-loc.svg (by Miguillen)., CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=14520285

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7. Case study 5: Burgenland, Austria

7.1. Introduction

The case of Burgenland illustrates the successful regional roll-out of renewable energy generation. Before the energy transition started, Burgenland had a peripheral situation, with a lack of urban amenities, which resulted in the region being an emigration hotspot for decades (EC, n.d.). Traditionally, Burgenland's main economic sectors are agriculture and viticulture. Since 2006, clean energy is a growing sector, together with, ICTs and tourism (see also figure below) (EC, 2019a).

In 2000, the indigenous renewable energy share was 3% (Energy Cities, n.d.), however, in 2006 regional politicians announced the target of 100% electricity self-sufficiency by 2013. This triggered the installation of 332 wind turbines with a total capacity of 755 MW (IG Windkraft, 2013). At the end of 2013 the province's electricity production exceeded its demand, reaching self-sufficiency (COR, 2019). Moreover, up to 40% of the electricity produced within the region was exported to Vienna (Wind Europe, n.d.). Nowadays, Burgenland's renewable power mix consists mostly of wind energy, but also of biomass and solar energy (Go100%, 2019).

Figure 0-41 General information

Source: EC, 2019a; WWF, 2014

7.2. Background information

7.2.1. Start and acceleration of the energy transition

Overall, the start of the energy transition was driven by several factors (illustrated in the figure below):

- **High potential for wind, biomass and solar energy production**, especially for wind power which turned out to be 30% greater than expected;
- **Selection as Objective 1 region, part of the European Regional Development Fund (ERDF).** In 1995, Austria joined the European Union and from then on Burgenland was eligible for European Regional Development Fund (ERDF), a fund to

boost economic development in rural regions that lag economically behind (EC, n.d.). Burgenland received support from 1995 to 1999 and 2000 to 2006 (RMB, n.d.). As one of the conditions, Burgenland had to hand in a regional development plan wherein they chose to focus on two sectors—renewable energy and tourism, with a focus on synergies between these sectors;

- **Aspiration to produce an independent energy supply,** as Burgenland had only 3% indigenous renewable energy production, which made the region dependent on other states for their electricity supply;
- **Aspiration to improve their economic situation;**
- **Aspiration to reduce CO_2 emissions**;
- **Favourable changes in the national renewable energy subsidy system**. From 2002-2005 and 2010-2013, two favourable national renewable energy subsidy systems were in place which guaranteed fixed prices for 13 years. Due to these subsidies there were two wind energy installation waves;
- **The regional wind energy zoning plan**. To coordinate the first installation rush, the provincial government developed the regional zoning plan to select areas which are favourable for wind energy production (Örök, 2005);
- **The political will to achieve 100% self-sufficiency in electricity use**. After the first installation rush, the interest of the Provincial government and private companies in renewable energy grew. In 2006, experts estimated that Burgenland would be able to reach electricity self-sufficiency by 2013 (Energy Cities, n.d.). This ambitious goal was adopted by the provincial government and was supported by all political parties (WWF, 2014).

Textbox 0-3. Information on the regional wind energy zoning process.

The regional and local wind energy zoning plan:

The zoning process for the development of wind parks is split into two stages. The first one is the regional wind energy zoning process (Regionales Rahmenkonzept für Windkraftanlagen) where at provincial level the zones are determined in which it is allowed to build wind turbines. During the energy transition, several regional zoning rounds were held. At this level, experts such a spatial planners and nature conservatist are involved. Moreover, NGOs (BirdLife and WWF) and representatives of municipalities and the World Heritage Site are included in the decision-making process.

For an overview of all the stakeholders related to this case study see Annex D.

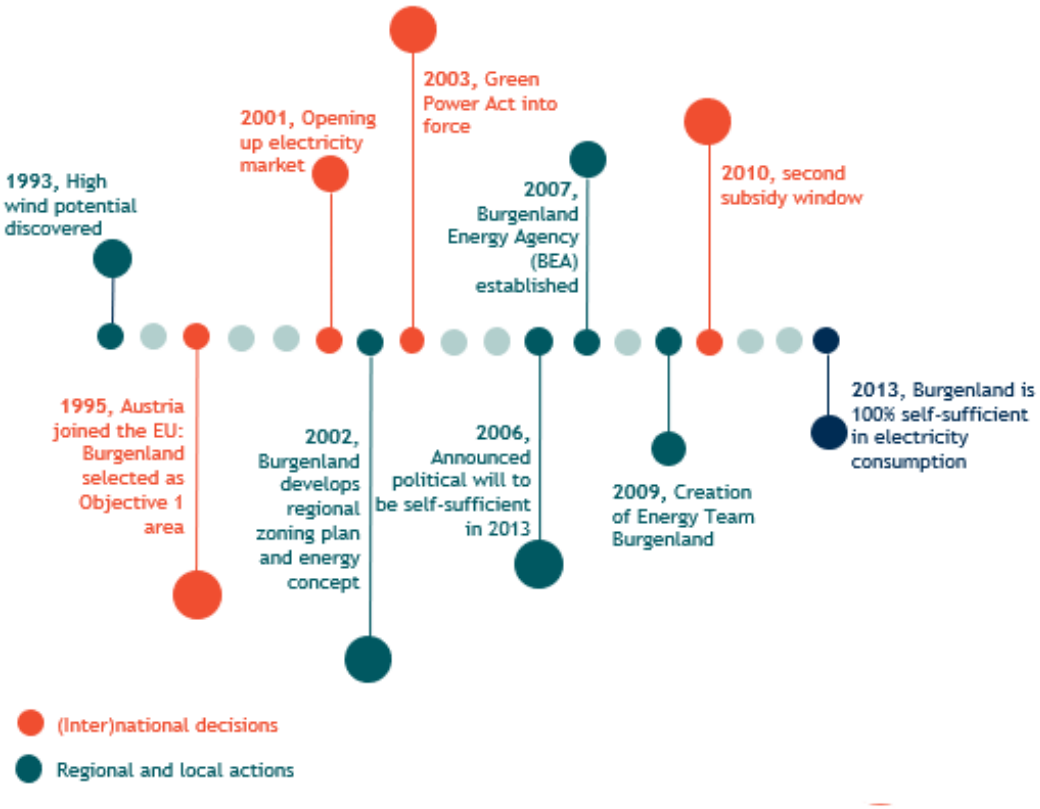

Figure 0-42 Timeline of the most important events in the case of Burgenland

7.2.2. (Inter)national and regional policies

Based on the RED I, Austria's National Renewable Energy Action Plan (NREAP) was developed. The NREAP sets the overall trajectory to meet the directive's targets. In this plan, Austria needs to increase its share of renewable energy in gross final consumption of energy to 34% by 2020 (NREAP-AT, 2010). In the 2005 base year, Austria has a renewable energy share of 24.4%. In 2014, Austria was only 1% away of meeting its 2020 target (See Figure 4-2). **Austria's trajectory by 2020 therefore clearly lies above the targets set by the directive**. The high share of renewable energy share is partly due to the large amount of hydropower (83%) in Austria, followed by solid biofuels (7.5%) and wind energy (6.1%) (Eurostat, 2017). Moreover, the Austrian Energy Strategy 2010, focuses on increasing energy efficiency, promoting and intensifying renewable energy and lastly, guaranteeing energy supply for the long term (IAE, 2010a).

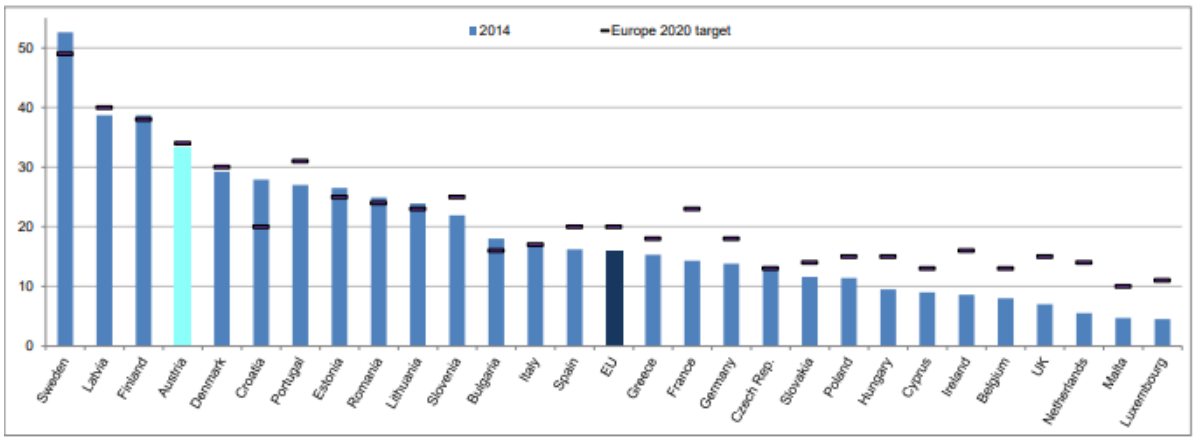

Figure 0-43 Share of energy from renewable sources in the EU Member States, 2014 (in % of gross final energy consumption)

The black bar represents each countries NREAP's target. **Source:** Eurostat (2016).

To achieve these targets, the aforementioned second subsidy system was implemented. Additionally, in Austria, the services costs to connect one's household to the grid network are relatively low (compared to Germany), which reduces the barrier for households to invest in decentralised energy.

To finance the renewable energy subsidy, Austria charges an electricity surcharge (Ökostrom Zuschlag) that households pay on top of their electricity bill. Since 2012, low-income households, pension recipients as well as students and long-term care recipients can be exempted from paying the green electricity surcharge (E-Control, 2012). Households with normal income pay yearly € 80 to € 100 (interview data).

Burgenland has specific energy policies, particularly in relation to recycled wind revenues and heat subsidies. In Burgenland**, wind energy companies must give certain financial compensation per wind turbine to the municipality as the municipality provides public roads for cables and transport.** The financial benefits from the wind energy developers are redistributed into the community by the development of new roads, kindergartens, schools, etc. (interview data).

Burgenland provides households who are at risk-of-poverty with a heat subsidy (*Heizkostenzuschuss*). The heating subsidy is granted regardless of the type of fuel used. For a low-income household with two parents and one child, the yearly amount of the heating subsidy for 2018 was € 1.497,62 (Land Burgenland, 2019a).

7.3. Results

7.3.1. Employment impacts

All interviewees indicated that the energy transition has brought an increase in both direct and indirect jobs. One renewable energy producer explained how his company grew from 2.5 full-time positions to 20 from 1995 to 2018. Also, Enercon, a wind turbine producer, located a plant in Burgenland which created 200 jobs in their most productive years. In addition to technical jobs for engineers and mechanicals, employment grew in the service sector such as restaurants and hotels, but also in research, education and agriculture sector jobs (interview data). As the transition attracted more people to Burgenland, there was higher demand for workers in supermarkets, shops, kindergartens etc. Moreover, the clean energy transition did not eliminate any jobs in Burgenland because the non-renewable energy consumed before was imported to Burgenland.

Overall, it is estimated by the interviewees that from 1995 to 2013 jobs increased by around 30%, for a total of 3,000-6,000 jobs. According to the director of Burgenland Energy Agency (BEA), this is the highest growth in jobs of all the objective 1 areas, together with an area in Poland.

Comparing these numbers with the data from the OECD (2019), the unemployment rate for the labour force over 15-64 years in Burgenland was 5% in 2001[59] which declined to 4.3% in 2013. For Austria, the rate was about 4% in 2001, and grew to 5.4% in 2013. Comparing the trend in Burgenland with the trend in Austria it seems that the energy transition had a positive impact on employment.

Taking a closer look at gender equality in employment, several interviewees emphasised that the renewable energy industry is a male dominated industry. However, some interviewees stated that there were several women working as technicians, however, most of interviewees were not aware of the issue regarding gender inequality in the working environment,

Attention is being paid to gender equality in education programmes in the region, at the university of applied sciences in Burgenland in particular. To avoid women being discouraged by the word 'technology' the university named the study programme 'Environment and Energy management' instead of 'Environment and Energy technology'.

The gender statistics reveal that the difference between the unemployment rates of men and women of working age is 0.9% in 2001 and 0.6% in 2013, which is the same as the national statistics (OECD, 2019). This implies that overall, the difference is very small and has declined over the years.

Statistical data shows that, overall, **the levels of education increased with the labour force of Burgenland.** From 2001 to 2013, the labour force with only elementary education levels lowered by 9.2 points, which is almost twice the national reduction. Thus, overall education levels of the labour force increased.

7.3.2. Income impacts

From 2001 to 2013, regional GDP per capita[60] grew in Burgenland by 46.3% (from 17,948 GDP per capita in 2001 to 26,265 in 2013) (OECD, 2019). Over the same time period national GDP grew by 39% (OECD, 2019). Other regions such as Lower Austria or Vienna have grown at lower rates (42% and 24% respectively). However, in 2013, regional GDP in Burgenland accounted for 2.3% of the Austrian GDP (OECD, 2019). As such, the province grew from a low-income region to a middle-income region (interview data). However, the growth cannot solely be contributed to the renewable energy sector as there were also many developments in other sectors such as tourism and agriculture. Lastly, as incomes grew, more tax money was collected, which increased the income for the municipalities and province (interview data).

Municipalities within the regional zoning areas especially benefited. Due to the regional wind energy zoning plan, the income impacts for the municipalities in Burgenland differ by municipality. Per wind turbines, the municipality annually receives a certain amount from the wind energy developer.

Aside of the revenues from the wind operators, the municipalities also experience a boost in the local economy as the construction phase brings in additional employment and spending. However, as not all municipalities are within these wind energy zoning areas, not all municipalities enjoy these benefits (interview data).

[59] From 2001 data is available for both national and NUTS 2 level.
[60] Purchasing power parities (PPPs) in USD.

Landowners receive a financial compensation (rent) from the wind operators for having a wind turbine or swept area of rotor blades in their fields. Wind operators pay in conformity with the market. In 2001, the compensation fees were low as people were not well informed and the market was less developed. In 2014, fees have almost doubled due to market developments, better informed landowners and the scarcity of available places.

Energie Burgenland enabled financial participation by selling shares of a few wind turbines to the general public. By becoming a shareholder, personal income increases as it receives dividend. However, this was only one event and the shares were sold out in one day (interview data).

Overall, **labour income increased as more people have highly qualified jobs with high wages.** Statistical analysis shows that households' disposable income (income after taxes and benefits) increased from 2001 to 2013 by 56.6% which is 8.4 percentage point more than the national growth rate. As such, in 2013 the Burgenland's households' disposable income was slightly higher than the national average (OECD, 2019).

While income inequality was important for the interviewees, they were not familiar with the development of this indicator in Burgenland. Although the Gini coefficient was only calculated at region level for the year 2013, an indirect indicator for income inequality is the share of people under the poverty threshold.[61] In 2005,[62] **Burgenland's poverty rate after taxes was 15.2% (nationally this share was 12.3%), which decreased in 2013 to 7.1% (nationally this share was twice as much in 2013)** (Statistics Austria, 2013). Furthermore, **in 2013, Burgenland ranked third lowest of all OECD regions, with a Gini of 0.23 whereas the national Gini coefficient was 0.28** (OECD, 2019). It is therefore likely that this steep decrease of share of people in poverty, together with a very low Gini coefficient in 2013, indicates that the overall income inequality in Burgenland has dropped from 1995 to 2013.

7.3.3. Economic diversification

Traditionally, the economy was predominantly agriculture based. Key crops being produced include fruits, root vegetables and vine crops. **In 2013, the economy significantly diversified by the growing renewable energy and tourism sector, both boosted by the Objective 1 funding** (EC, 2019). Comparing the regional gross added value of different sectors between 2004[63] and 2013, confirms that many sectors have increased their value added, while the agriculture sector has reduced it (OECD, 2019). Among them are manufacturing sectors, tourism sector, the industry sector (including energy), and scientific and technology sector (OECD, 2019).

7.3.4. Innovation and education impacts

Around 2015, six technological centres were established to boost energy technology development and other innovation. Already in 1994, the FA Burgenland - University of Applied Sciences - was established. At the university a lot of research is done on e.g. advanced research in energy and construction technologies such as improving efficiency in heat pumps and converting hydrogen power into gas (interview data). In total the university took part in over 170 projects for a total amount of over EUR 7 million (Energy Cities, n.d.). Statistical data confirms that **innovation has increased over the years as 25% of the**

[61] The poverty line is defined as 60% of median income.
[62] First year with available data
[63] Earliest data available

increase of personnel in regional industry was in the sector of science, education and technology. More specifically, the regional R&D personnel grew with a factor of 1.5 between 2002 and 2013. However, nationally, Burgenland scores the lowest of all nine states (OECD, 2013).

In relation to education impacts, the university developed a study programme focusing on renewable energy (interview data). However, looking at the trend of student enrolment at elementary and secondary level rate, it shows no increase and even a slight decrease between 2002 and 2013 (OECD, 2019).

7.3.5. Energy impacts[64]

Interviewees indicate that due to national renewable energy subsidies (up to production of 5 kWh) and high number of private-owned houses, many households installed solar PVs and heat pumps. Moreover, due to technology development the prices of solar PVs reduced over the years. **Burgenland's data shows that in 2011[65] 38.5% of its energy consumption was generated from renewable energy sources (compared to the 3% in 2000)** (Burgenland, 2013). This trend has increased towards 2013. Moreover, non-renewable sources in final consumption have reduced significantly, except for oil consumption. Notably, coal final consumption went down from 793 TJ in 1995 to 76 TJ in 2013 (Land Burgenland, 2013). Moreover, since 2013, all of Burgenland's energy production is 100% renewable (Burgenland, 2013).

The transition has a positive impact on affordability of energy. The electricity prices in Austria has always been stable and low (in comparison with Germany) (interview data). National statistics shows that energy prices for oil and gas have barely risen and electricity prices have even fallen (BMNT, 2018). Only the district network heating costs 10% more than normal heating by natural gas (interview data). In addition, renewable energy sources dampen energy prices during peaks of energy consumption.

Information on the performance of the indicator energy poverty was not available at the regional level.

Renewable energy production also **increased security in energy supply** in two ways. Firstly, for the distribution of renewable energy sources, the grid often needs to be improved to deal with the peaks in energy production. This upgrade to the grid increases the quality of the energy distribution network, which enhances the security of energy supply. Secondly, the combination of different energy sources (wind, solar, biomass and hydro energy) increases the security of energy supply as there is less dependency on one source of energy as well as on energy imports. However, it must be noted that renewable energy will always remain volatile as it depends on natural circumstances, such as wind and sun to generate electricity. Nationally, security of energy supply has increased as e.g. energy import dependency has fallen significantly from 2005- 2017 from 71.8% to 64.2% (BMNT, 2018).

[64] It is important to note that for the case study 5 (Burgenland, Austria) and 6 (Nijmegen, the Netherlands) different variables were applied (e.g. energy impacts and income inequality) due to the different focus of Task 5 (i.e. the social dimension of the energy transition).

[65] There is no aggregated data for the year 2013.

7.3.6. Demographic and tourism impacts

The economic development of the region attracted a few thousand people, especially in the main cities (interview data). However, the Burgenland statistics show that **the number of migrants and the inter-regional migration has barely increased and that the population remained stable between 2001 and 2013** (Land Burgenland, 2019).

Interviewees indicate that the **tourist sector flourished under the renewable energy transition**. The tourist office organised bike tours to visit the windmill park (interview data). From 1994 until 2014, the overnight stays in hotels and guesthouses increased by 39% (IG Windkraft, 2015). In this period 12 new hotels were built (interview data). In the figure below, the simultaneous growth in overnight stays and wind energy is illustrated. However, interviewees indicate that the increase in tourism is not solely attributed to the expansion of wind energy. The increase is the result of a combination in nature conservation and upgraded thermal pools and tourist accessible vineyards.

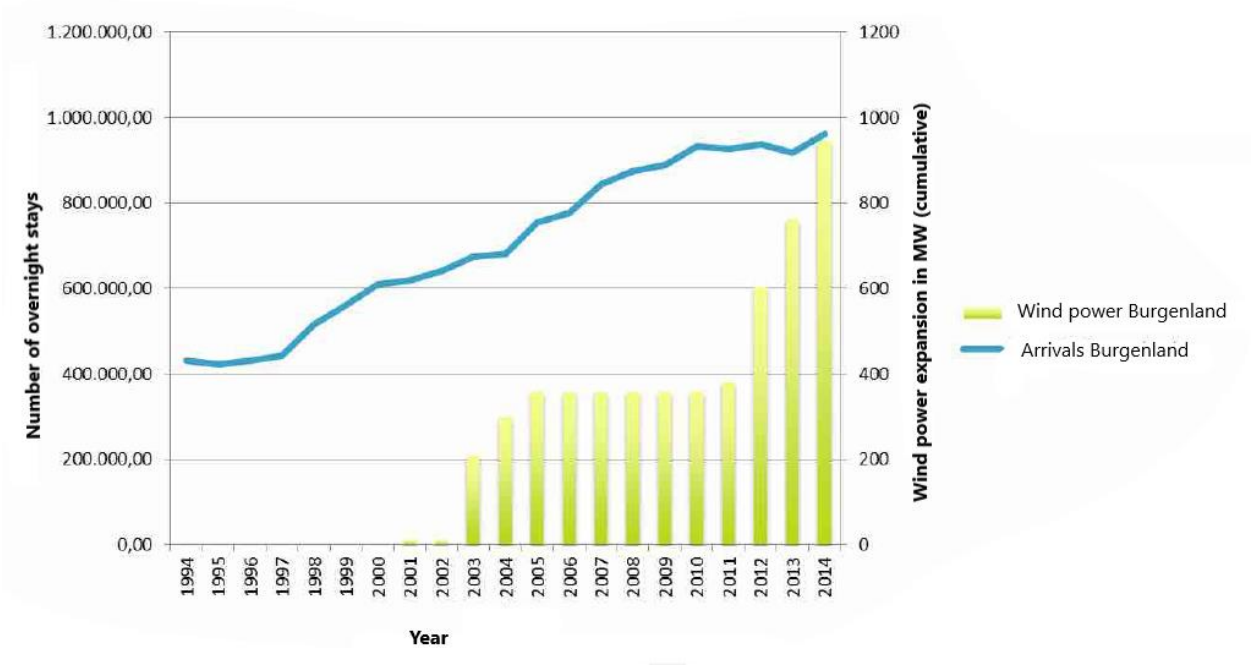

Figure 0-44 Overnight stays versus wind energy

Source: IG Windkraft (2015).

7.3.7. Summary of results

The table below summarises the results that are discussed in the previous sections. To this end, the different indicators can score, positive, neutral, negative or no information available.

Table 0-28 Overview of the scoring of the case Burgenland[66]

Key variable	Indicator	Sub-indicator	Data source	Assessment
Quantitative employment impacts	Changes in employment	The number of created or terminated jobs/ changes in employment rate	Interview data	3,000-6,000 new jobs of which (direct) green jobs (technical jobs) and (indirect) jobs (service sector & research & technology sector).
			OECD 2019	From 2001 to 2013 unemployment rate decreased by 0.7 percentage point.
Qualitative employment impacts	Gender equality: job opportunity and job security	The number of new jobs that are allocated to women versus men	Interview data:	The renewable energy industry is mostly a male dominated industry. However, there is attention for gender equality in education programmes.
			OEDC 2019	From 2001 to 2013, there is almost no difference between the unemployment rate for men and women.
	Skill- and education level: job opportunity and job security	The number of new positions that are suited for low educated versus high educated	Interview data	Mostly high-skilled and high-education jobs, some indirect jobs (hospitality and tourism sector) are suited for lower levels of education attained.
			OECD 2019	From 2001 to 2013, 25% of the new created jobs were in the scientific and technology sector and 45% of destructed jobs were in the agriculture and forestry sector. 9% of the lower educated workers acquired a higher level of education.
Income impacts	Income impacts for the region	Changes in GDP for the region	Interview data	From low to middle-income region and more revenues because of increase in tax revenues.
			OECD 2019	Regional GDP per capita grew from 2001 to 2013 by 46% (from 17,948 GDP per capita in 2001 to 26,265 in 2013). Other regions such as Lower Austria or Vienna have low increased (42% and 24%, respectively). Moreover, Austria had an average increase of 39% between 2001 and 2013.
	Income impacts for the municipality	Changes in income for the municipality	Interview data	Municipalities within the wind zoning areas receive annually a substantial amount from the wind energy operators for each erected wind turbines.
			Statistical data	No information found.
	Labour income impacts	Changes in labour income	Interview data	Higher wages because of higher skilled jobs. Jobs in other energy related sectors are barely jeopardised.
			Statistical data	No information found.
	Personal income impacts	Changes in personal income	Interview data	(Limited) option available to became shareholder of a windmill. Landowners receive rent from energy company as compensation.
			OECD 2019	From 2001 to 2013, the households' disposable income in Burgenland grew by 56.5% and was around 2013 slightly higher than national average.
	Income inequality	Changes in income inequality (as indicated by the Gini coefficient)	Interview data	No information available.
			Statistics Austria, 2013 & OECD 2019	From 2005 to 2013, the share of people in poverty has dropped by 8 percentage point and is twice as low as the national average in 2013. Moreover, in 2013 Burgenland had the third lowest Gini coefficient (0.23) of all OECD regions.

[66] It is important to note that for the case study 5 (Burgenland, Austria) and 6 (Nijmegen, the Netherlands) different variables were applied (e.g. energy impacts and income inequality) due to the different focus of Task 5 (i.e. the social dimension of the energy transition).

Economic diversification	Impact on local economy	Changes in the economics sectors of the region	Interview data	Renewable energy and tourist sector grow which diversify the economy.
			OECD 2019 and EC 2019	More diversified economy as illustrated results in an increase of added value for several economic sectors from 2004 to 2013.
	Dependency on one/energy sector	Changes in dependency on one income source for the region	Interview data	Dependency on the agriculture sector is reduced as the local economy is more diversified.
			OECD 2019 and EC 2019	Reduced added value in the agriculture sector.
Innovation and education impacts	Impacts on technology development	Changes in technology development	Interview data	Boost in research and innovation with the establishment of 6 research centres and the university.
			OECD 2019	Almost 150% increase in personnel in the R&D sector from 2002 to 2013.
	Impacts on education system	Changes in education system	Interview data	University with 1,000 students and programme on renewable energy topics.
			OECD 2019	Trend shows a slightly decrease in student enrolment.
Energy related impacts	Impact on decentralised energy production	Changes in households' self-sufficiency in energy/ changes in decentral energy production	Interview data	More houses with PVs and heat pumps due to private-owned houses, subsidies and reduced prices for PVs More awareness about energy consumption.
			Burgenland, 2013	In 2011, 38.5% of energy consumption was generated from renewable energy sources (compared to the 3% in 2000).
	Impact on affordability	Changes in energy prices for consumers	Interview data	Stable energy prices.
			BMNT, 2018	Energy prices for oil and gas have barely risen and electricity has even fallen.
		Changes in energy poverty rate	Interview data	No information available.
			Statistical data	No information available on NUTS2 level.
	Impact on energy supply security	Changes in energy supply security e.g. reduced import dependency	Interview data	Renewable energy increased energy supply by 1) improved grid, 2) less dependency on one energy source and 3) less dependency on imported energy.
			BMNT, 2018	Energy import dependency has fallen significantly from 2005- 2017 from 71.8% to 64.2%.
Demographic impacts	Migration impacts	Changes in the number of people moving in or out of the region	Interview data	No migrations impact.
			Land Burgenland 2019b	No migrations impact.
	Tourist impacts	Changes in the number of tourists	Interview data	Increase in tourism, however not only wind energy tourists but also wine-, thermal- and nature tourists.
			IG Windkraft 2015	From 1994 to 2014, the overnight stays in hotels and guesthouses increased by 39%.

7.4. Lessons learned

The case of Burgenland shows that the energy transition helped the region boost its economy and at the same time reduce poverty rates in the region. It is therefore likely that the energy transition resulted in inclusive growth, reducing income inequality. Other social impacts are the reduced unemployment rate and the increased education levels of the working force. Additionally, the energy transition did not increase energy prices, nor did it jeopardise the security of energy supply. Moreover, the people of Burgenland are proud about their green electricity production and show more awareness about climate change.

To conclude this case study, several findings and lessons learned in relation to the just energy transition can be highlighted (as discussed in either the literature or highlighted by interviewees). Below we outline a few lessons which we can draw from this study:

- **Right conditions set by the national governments**. The national governments played a crucial role in setting the right conditions for the acceleration of a just energy transition. In Burgenland, the Green Electricity Act (with subsidy windows) proved important for the expansion of wind and solar energy. Although these subsidies are paid by households (green electricity surcharges), they do not put an extra financial burden on vulnerable groups, as they are exempted from paying this tax.
- **A timely and inclusive participation process.** The most essential enabler of success was a timely and inclusive participation process. In Burgenland, the regional wind energy zoning plan was the right instrument to include all relevant stakeholders in the decision-making process. This planning started before the large expansion of wind parks which ensured no stakeholder was unheard or felt left out. Subsequently, this planning created clarity for politicians, companies and citizens so that conflicts were avoided. On the local level, wind energy developers had the responsibility to start the dialogue with the citizens to inform them about wind energy. This tradition of dialogue ensured there were zero wind energy projects stopped by citizens, and that there were not protests or civil engagement against wind energy.
- **Costs and benefits of the transition are distributed**. Energy supply. The national and regional governments took sufficient measures to share the costs of the energy transition as all electricity users pay the green electricity surcharge except for vulnerable groups who cannot afford the additional costs. Moreover, in Burgenland low-income households receive heat subsidies to make sure all households can heat their homes. The benefits of the energy transition are felt in Burgenland as they do not only enjoy the consumption of clean energy but also the financial benefits of the wind park, as they are fed back into the community (e.g. by building new soccer fields). This way all residents in the municipality can enjoy the benefits of wind energy, which increases the positive attitude toward wind energy. The sharing of the costs and benefits of the energy transition has been best practice for the case of Burgenland.

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8. Case Study 6: Gelderland coal power plant, Nijmegen, Netherlands

8.1. Introduction

The Engie case study reflects the process of the energy transition on a detailed level, as it first demonstrates the successful phase-out of the coal-fired plant, Centrale Gelderland 13 (CG13), and second the successful redevelopment of the site into a clean energy hub. The plant, owned by energy giant Engie and located in the city of Nijmegen, closed officially in 2015. Engie managed to mitigate negative effects on its employees; ultimately, only two of its workers did not find a new job. Moreover, Engie decided to redevelop the site into an area dedicated to renewable energy production, technology development and other activities vital to the energy transition (See Image 2). In 2019, 8,000 solar panels were installed at the site, and the first draft of the spatial vision was published in which many clean energy initiatives were included. The case illustrates therefore two important elements of the clean energy transition: the phase-out of fossil fuels and the implementation of clean energy sources. However, as the redevelopment of the site has not been completed yet, only distributive effects of the closure of the CG13 can be measured for this study.

Figure 0-45 The CG13 site

Source: Google Maps (2019).

Figure 0-46 The site in the concept version of the spatial vision

Source: Engie (2019).

Since 1936, the plant has been located at the Waal river and owned by Electrabel – later known as GDF (Gaz de France) Suez, which recently became Engie Nederland. While it was still in operation, the coal power plant had a production capacity of 585 MW and employed 510 workers (Electrabel, 2006). At the time of its closing, 105 workers were employed. The site covers around 30 ha and is part of Nijmegen's inner-city industrial area (Gemeente Nijmegen, 2019).

Figure 0-47 General information, Nijmegen

8.2. Background

Together with Arnhem, the capital of the province, Nijmegen represents an economic region Arnhem-Nijmegen which experienced a GDP growth of 1.3% in 2013 and 1.5% in 2015 (CBS, 2018). Growth engines were the public, health care and private services sectors (Gemeente Nijmegen, 2016). In 2015, the industry sector in Nijmegen was relatively small, supplying 12% of the available jobs in the city (Gemeente Nijmegen, 2016).

8.2.1. Start and acceleration of the energy transition

The case of Engie is split into two phases: the closing of the CG13 and the start of the redevelopment of the site. The events and policies that triggered the transition are discussed chronologically and are summarised in the Figure 9-4.

Overall, the withdrawal of coal and the redevelopment of the area was driven by:

- **The Energy Agreement:** National decision to close five coal power plants. In September 2013, the Dutch government and participants of the Social and Economic Council (SER) reached an 'energy agreement on sustainable growth' (SER, 2013). Part of this Agreement mandated the closure of five coal-fired plants built in the 1980s, which included CG13 (closed in 2015);
- **More opportunities due to the Environment and Planning Act.** After the decision was made to close the CG13 plant, the national government invited Engie and the municipality of Nijmegen to discuss the next steps (interview data). The national government granted the Engie site a special status for spatial planning (as part of the 'Crisis and Recovery Act' (Crisis- en Herstelwet) (Government of the Netherlands, 2019), which allowed Engie to have shorter procedures in permit applications and to have more flexibility in their local zoning plan (interview data). Later, this status was changed into a pilot for the Environment and Planning Act (Omgevingswet);
- **Well-located site.** In 2014, Engie realised that CG13 was very well located –close to the city and connected to the Waal river. Additionally, the energy distribution network was already in place. To this end, Engie developed the 'Green Delta Plan' in 2014. They expressed their ambition in an online video where they presented their ideas for: 4,000 (1 MW) solar panels and 2 to 4 wind turbines (10 MW); a Liquefied natural gas (LNG) gas station for trucks and an inland shipping sector; a biomass plant, the

generated heat from which would serve the heat distribution network (Engie Energie Nederland, 2016);

- **Change in Engie's strategy and ambition.** In 2015, GDF (Gaz de France) Suez announced an acceleration of its strategic shift with respect to the energy transition via a low-carbon strategy. This included the following measures; 1) no new coal-fired projects 2) close the Rugely coal-fired power plant in the UK and the Gelderland plant in the Netherlands, and 3) dispose the Group's share of coal assets in the US and Asia, thereby decreasing its coal capacity by 20%. To underline their strategy, they changed their name into Engie (Engie, 2015). This change in strategy allowed Engie Nederland to explore the location opportunities and to start with the redevelopment;
- **The government's ambition to be climate neutral and increase renewable energy production.** The province has the objective to be climate neutral by 2050 (Gelders Energieakkoord, 2016). Furthermore, the National Energy Agreement of 2013 stipulates the installation of 230.5 MW renewable capacity in the province by 2020. However, in 2014, only 36 MW wind power capacity was installed, with another 34 MW capacity in construction (Gelders Energieakkoord, 2016). Furthermore, the city of Nijmegen sets its climate targets more ambitiously by aiming to be climate neutral in 2045. Based on national, provincial and municipal renewable energy targets, there was governmental support for the closure of the CG13 and the start of the Engie project, which was essential to accelerate the redevelopment of the site.

For an overview of all the stakeholders related to this case study see Annex F.

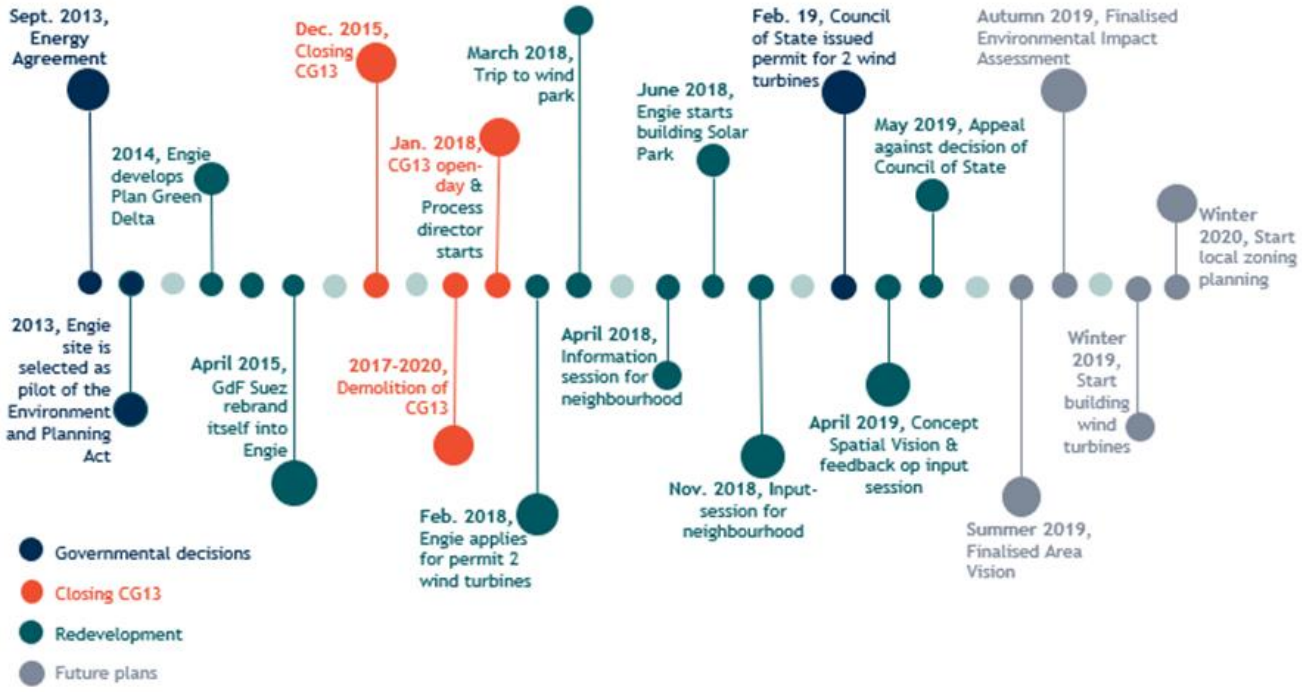

Figure 0-48 Timeline of events relevant to site redevelopment

8.2.2. (Inter)national and regional policies

Under the EU Directive 2009/28/EC, the Netherlands also established National Renewable Action Plans (NREAPs) and set its overall target for 2020 at 14.5% share of energy generated from renewable sources (with respect to gross final energy consumption) (Rijksoverheid, n.d.). In order to achieve this target, the Netherlands established a comprehensive legal and administrative framework supporting the deployment of renewables with several complementary financial, fiscal and promotional measures including feed-in premiums (IEA, 2010b). However, as illustrated in Figure 9-5, the Netherlands is lagging behind in its renewable energy production; it is ranked third lowest of all MS's in the EU. Large energy sources in the Netherlands include natural gas, oil, and coal (Rijksoverheid, n.d.).

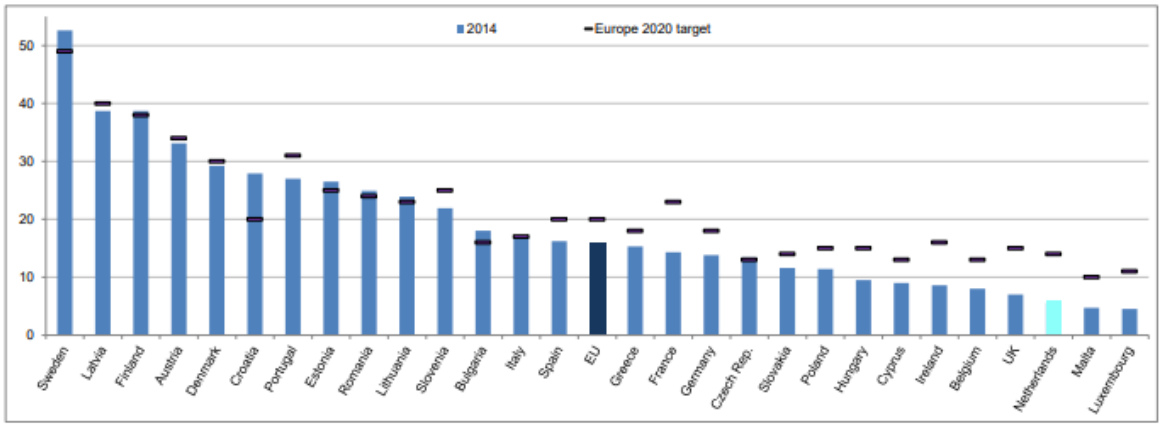

Figure 0-49 Share of energy from renewable sources in the EU Member States, 2014 (in % of gross final energy consumption

Source: Eurostat (2016).

Regional policies

Nijmegen also developed a 'Heat vision of Nijmegen'. In this vision, the avoidance of energy poverty is mentioned as one of Nijmegen's main objectives. The municipality addresses energy poverty through ambitious performance agreements with housing associations about energy savings and energy efficiency measures in social housing. In 2016, Nijmegen won the prize for the best agreement with housing associations for energy savings and energy efficiency targets (i.e., that all houses need to have energy label B by 202) (GNMF, 2016).

8.3. Results

8.3.1. Employment impacts

In the years towards the closing around 150 employees were working at the CG13 coal-fired plant. In 2013, the first round of dismissal was done, with around 40 people being laid-off (interview data). After the announcement in 2013, the remaining 100 to 110 workers were laid-off. According to interviewees, the closing had also indirect employment impacts on the suppliers from products and services such as the 'coal storage park'.

Gender and education levels attained made no difference in job security as all workers were laid-off. However, it did play a role in finding new job opportunities after the closing. According

to interviewees, the majority of the workers were low-educated, including the workers at the coal storage park (interview data). In total, Engie employed three women in part-time jobs. According to the interviewees, two of them found a new job easily and the third woman decided not to work anymore.

In order to minimise the social impacts of a coal power plant closure, Engie took several measures. First of all, enforced by law, the social plan[67] was established in which the early pension age (i.e. 57) was determined. This was important as the old workers were mostly the workers with low education backgrounds (interview data).

All interviewees state that the social plan has been very 'generous' and provided sufficient arrangements for all the workers to mitigate the negative financial impacts of losing a job.

Aside of the financial arrangements included in the social plan, Engie took several measures to support its workers in their search for a new job, also known as 'work-to-work measures'. In addition, the social plan allowed workers to find new employment on top of their early retirement. Therefore, many of the 'older' workers retrained themselves and Engie financed these trainings.

Another work-to-work measure was the possibility for workers to translate competences acquired during their career at Engie into an official certificate. Similarly, workers were exempted from certain elements of an education programme because they could show that they had acquired certain skills at the CG13 plant. This accelerated their study progress which allowed them to obtain the necessary diplomas before the plant closed. These measures improved the job prospects for many low-educated workers.

Additionally, Engie established partnerships with companies in related industries to transfer some of their workers to these partners. These partnerships were beneficial to the workers as it eased the search process, but it was also beneficial to Engie because it allowed Engie to call back their workers in case of emergencies at the power plant. Although not many workers made use of this arrangement, it did help workers to orientate themselves as many companies came to the site to present themselves (interview data). Furthermore, training was provided to improve the LinkedIn- and job application skills of the workers.

Overall, the work-to-work measures were highly effective. In the end, only two workers did not find a new job before the closure of the plant. However, Engie also employed several temporary workers, who could not benefit from any of these measures (interview data).

8.3.2. Income impacts

Income impacts for the region and municipality are limited. The closing of the coal plant influenced municipal revenues as Engie paid high taxes to the municipality (Japers, 2013). However, interviewees state that the municipality will move from centralised to decentralised energy production which will bring new kind of business into the city and will diversify revenue sources of the municipality. Moreover, the municipality is phasing out its inner-city industrial area and is replacing it with luxurious homes and new innovative businesses. This is illustrated by the closure of other industrial businesses close to the Engie site such as the slaughterhouse and meat process company closed in 2015 (350 jobs) (Back, 2016) and the Honig factory closed in 2018 (240 jobs) (Vesson, 2019). The impact on the province's income is limited (interview data).

[67] A social plan is an agreement between one or more employers and one or more trade unions which consists of rules and regulations to protect the personnel in case of a reorganisation or close down.

Labour income most likely slightly declined, except for early retired workers. The average income from labour is negatively affected as Engie paid relatively high salaries to its workers. Moreover, workers tend to stay their entire career at Engie which meant that many of them had seniority. It is likely that in many cases the new salary did not match the old salary for which Engie only compensated the first two years (interview data).

Additionally, the workers eligible for the early retirement had an income loss of 25%. However, these workers were still allowed to take on other jobs. According to interviewees, many of these workers did find new employment, either part-time or full-time and thus ended up increasing their income from labour significantly (interview data).

8.3.3. Economic diversification impacts

The closing of the plant has a limited impact on the local economy as there was no regional dependency on the energy sector for income. However, the new kind of business brought into the city will diversify the income sources of the municipality according to interviewees.

8.3.4. Innovation and education impacts

For this indicator no information was found. However, it is likely that the clean energy hub, with a technology campus will have a positive impact.

8.3.5. Energy impacts[68]

Before the closure of the CG13, Nijmegen was self-sufficient in its electricity supply (Haskoning GDHV, 2018). Therefore, the closure led to the loss of an important power supplier which needs to be replaced by (clean) an alternative energy source in order to be self-sufficient again (Haskoning GDHV, 2018). Moreover, as the electricity demand in Nijmegen is expected to increase in the future, it is a challenge for Nijmegen to meet its energy neutral target by 2049 (interview data).

However, **the closing of the CG13 plant had no impact on energy prices as the closure was foreseen and there was overcapacity on the grid so the phase-out did not result in energy scarcity which could have affected the energy prices** (interview data).

The plant closure will a positive impact on the security of energy supply as the plant ran on imported coal, making it dependant on foreign countries. Additionally, it will also have a positive impact on decentralised clean energy production as it is estimated that the clean energy hub will generate as much energy as the coal plant did by 2030 (Willems, 2019).

8.3.6. Demographic and tourism impacts

According to the interviewees there is no demographic or tourism impact in the relation with the closure of the CG13.

[68] It is important to note that for the case study 5 (Burgenland, Austria) and 6 (Nijmegen, the Netherlands) different variables were applied (e.g. energy impacts and income inequality) due to the different focus of Task 5 (i.e. the social dimension of the energy transition).

8.3.7. Summary of results

The table below summarises the results that are discussed in the previous sections. To this end, the different indicators can score, positive, neutral, negative or no information available.

Table 0-29 Overview of the results for the Engie case. Information is based on interview data

Key variable	Indicator	Sub-indicator	Data source	Assessment
Quantitative employment impacts	Changes in employment	The number of created or terminated jobs/changes in unemployment rate	Interview data	Within 5 years, 150 jobs were phased out. Also impacts on indirect jobs, e.g. coal storage park. However, only 2 workers did not find new employment.
Qualitative employment impacts	Gender equality: job opportunity and job security	The number of new jobs that are allocated to women versus men/ job tenure woman versus men.	Interview data	In total 3 women in part-time function which did not encounter differences in job security or opportunity.
	Skill- and education level: job opportunity and job security	The number of new positions that are suited for labour force with low educated versus high educated levels attained	Interview data	Many low-educated workers. No difference in job security, but difference in job opportunity.
	Age equality: job opportunity and job security	The number of people in the age gap (too old to get hired, but too young to fit in the social plan)	Interview data	A large group belonged to the age group below 57 but older than ~50.
Income impacts	Income impacts for the region	Changes in GDP for the region	Interview data	No impact was found as the case is too small to have significant impacts on the regional income.
	Income impacts for the municipality	Changes in income for the municipality	Interview data	Mixed impact as the closure will take away a revenue stream, however, the redevelopment and other new businesses in the area will bring in a new income stream.
	Income impacts for the (ex-) workers	Changes in labour income	Interview data	Workers had built-up high salaries, so likely they will not receive same salary in new jobs. Moreover, workers of 57+ lost 25% of their income. However, most of these workers filled this gap by working part-time (or even full-time) in conjunction with early retirement benefits.
	Personal income impacts	Changes in personal income	Interview data	No information available.

	Income inequality impacts	Changes in income inequality (as indicated by the Gini coefficient)	Interview data	No information available.
Economic diversification	Impact on local economy	Changes in the economics sectors of the region	Interview data	New businesses and economic sectors will diversify the income sources of the municipality.
	Dependency on energy sector	Reduced or increased dependency on the energy sector as an income source for the region	Interview data	There was no dependency on the non-renewable energy sector.
Innovation and education impacts	Impacts on technology development	Changes in technology development	Interview data	No information available.
	Impacts on education system	Changes in education system	Interview data	No information available.
Energy related impacts	Impact on self-sufficiency / decentralise energy	Changes in households' self-sufficiency in energy/changes in decentralised energy production	Haskoning GDHV (2018)	Nijmegen is not self-sufficient anymore in its electricity production. The redevelopment will make up for the losses. Some say that in 2030 the clean electricity hub will generate as much energy as the plant.
	Impact on affordability	Changes in energy prices for consumers/households are able to afford the increased prices	Interview data	No increase in energy prices because there was an overcapacity on the grid.
	Impact on energy supply security	Changes in energy supply security	Interview data	Positive impact on security of energy supply because the region stopped the import of coal.
Demographic and tourism impacts	Migration impacts	Changes in the number of people moving in or out of the region	Interview data	No information available
	Tourist impacts	Changes in the number of tourists	Interview data	No information available

8.4. Lesson learned

To conclude this case study, several findings and lessons learned in relation to the just energy transition can be highlighted (as discussed in either the literature or highlighted by interviewees). Below we outline a few lessons which we can draw from this study:

- **Mitigate the negative effects on job security.** The case of Engie illustrates best practice in reducing the negative effects for the workers of the coal plant. The most noteworthy impact of CG13's closure in relation to energy justice was that the energy transition hit older and lower educated workers the hardest. Workers in the 'age gap' were particularly vulnerable for long-term unemployment. However, good measures to protect workers proved effective in reducing the negative impacts of the energy transition. In this case, financial compensation (which included an early retirement programme) was important in mitigating negative impacts. In addition, the social plan allowed workers to find new employment on top of their early retirement. Many of the 'older' workers, retrained themselves and Engie financed these trainings. However, the work-to-work measures were equally important to support workers in the transition towards new employment. One of the measures was the possibility for workers to translate competences acquired during their career at Engie into an official certificate. Comparably, they had the opportunity to skip certain elements of an education programme because they could show that they had acquired certain skills at CG13. This accelerated their study progress which allowed them to obtain the necessary diplomas before the plant closed. These measures increased the job opportunities of many low-educated workers. Additionally, Engie established partnerships with companies in related industries to transfer some of their workers to these partners. Partnership was beneficial to the workers as it eased the searching process, but it was also beneficial to Engie because it allowed Engie to recall their workers in case of emergencies at the power plant. Although not many workers made use of this arrangement, it did help workers to orient themselves, as many companies came to the site to recruit new workers (interview data). Furthermore, training was provided to improve LinkedIn- and job application skills of the workers.
- **Have clear, honest and open communication.** As the closing of the plant brought many uncertainties for the workers, clear and open communication was pivotal to prevent unrest and protest. During the closure of the plant, Engie showed best practice in clear and open communication by organising canteen sessions every month in which they answered all the questions of the workers and could update them on the latest developments. In these sessions, workers could respond or bring in own ideas or topics to talk about. In addition, the canteen sessions were offered to inform the workers about practical issues such as the implication of the social plan. Workers could for instance invite organisations to explain the social plan.
- **Keep investing is social cohesion in the community by organising many social activities.** During the last years of the phase-out, it was difficult to safeguard social cohesion as the motivation to keep improving the plant was gone. The workers were only doing the necessary operational procedures such as superficial repairs, while the plant was slowly degrading. However, the workers at the plant together took the decision that they wanted to keep investing in the community and not forget the human aspect of such a close-down (interview data). Engie supported this decision by organising 12 social events instead of their traditional 4 social events per year. However, as some of the workers had emotional difficulties with the closing, not all workers joined this initiative.

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9. Annex A – Interview Guide A

This interview guide presents the questions that were used during the interviews for the cases of Burgenland, Austria and Nijmegen, the Netherlands in 2019

Please note that the questions below aim to guide the discussion and will be further tailored according to the interviewee's role and expertise in the case.

Introduction by the interviewer

1. Background information about the study
2. Request for consent and processing of the results

Introductory questions

1. What is/was your role/function in the case XX?
2. How do you look back on the transformation that this region has undergone/what are your first impressions of the transition this region is currently going through?
3. What are/were the main drivers of transition?

Impacts questions

1. What are according to you the consequences and impacts in terms of justice of the transition?

Follow-up questions:

    1. What were the impacts of the transition regarding employment?
    2. Where there any differences across gender or education levels?
    3. Where there any income effects (e.g. for households, the municipality, the regional GDP or ex-workers)?
    4. What are the effects in relation to energy, for instance prices, access or self-sufficiency?
    5. How did the energy transition effect social cohesion in the region?
    6. Can you recall other impacts such as demographics and/or tourisms?

2. What kind of measures were there taken by government or companies to support the negatively affected?

Finalising questions

1. What have you learned from the transition (about how the transition has gone so far and how you can apply those learnings in the future)?

2. Do you want to add something to the interview that has not been discussed before?
3. Are there any other persons I need to talk with to get a good understanding of the case?
4. For the next interviews, what should be improved to get better answers?

10. Annex B – Interview guide B

This interview guide presents the questions that were used during the interviews for the cases of Burgenland, Austria and Nijmegen, the Netherlands in 2019.

Please note that the questions below aim to guide the discussion and will be further tailored according to the interviewee's role and expertise in the case.

Introduction by the interviewer

1. Background information about the study
2. Request for consent and processing of the results

Introductory questions

1. What is/was your role/function in the case XX?
2. How do you look back on the transformation that this region has undergone/what are your first impressions of the transition this region is currently going through?
3. What are/were the main drivers of transition?

Impacts questions

1. What are according to you the regional impacts of the transition?
2. Were there any effects on the regional economy? if yes, what were these?
    - Which sectors, do you feel, are/were positively affected, and which sectors were negatively affected? What would be the overall effect according to you?
    - To what extent did the economy diversify/ move away from energy-intensive industries?
    - To what extent did the transition impact the income of the region in terms of GDP (& added value)?
    - To what extent did the transition have an impact on disposable income of households and overall income inequality – both within the region and in comparison to the rest of the country?
    - To what extent did the region improve or lose its competitiveness?
3. What are according to you the regional impacts of the transition on the employment?
    - Which sectors, do you feel, are/were positively affected, and which sectors were negatively affected? What would be the overall effect according to you?
    - To what extent was there any differences across gender, age and education levels in job security/opportunity?
    - To what extent was/is there a need for reskilling of workers due to the transition?

4. Were there any education effects (improvement of education system or the establishment of Universities in the region)? If yes, what were these?
5. Were there any innovation effects (establishment of research institute(s), investment in R&D, demonstration projects)? If yes, what were these?
6. Has the transition any effect on the political stability?
7. Can you recall other impacts such as demographics (e.g. migration) and/or tourism?

Policy questions

1. What policies were in place to push and facilitate the transition (e.g. privatisation and industry restructuring)?
    a. Were these policies developed prior or as a response to the transition?
2. What kind of (policy) measures were there taken by government or companies to ensure everyone could benefit/protect the negatively affected?

Finalising questions

1. What have you learned from the transition (about how the transition has gone so far and how you can apply those learnings in the future)?
2. Do you want to add something to the interview that has not been discussed before?
3. Are there any other persons I need to talk with to get a good understanding of the case?
4. For the next interviews, what should be improved to get better answers?

11. Annex C – Mapping of stakeholders for the case of Asturias

There are different actors involved in the development and implementation of transition strategies and plans as shown in the diagram below.

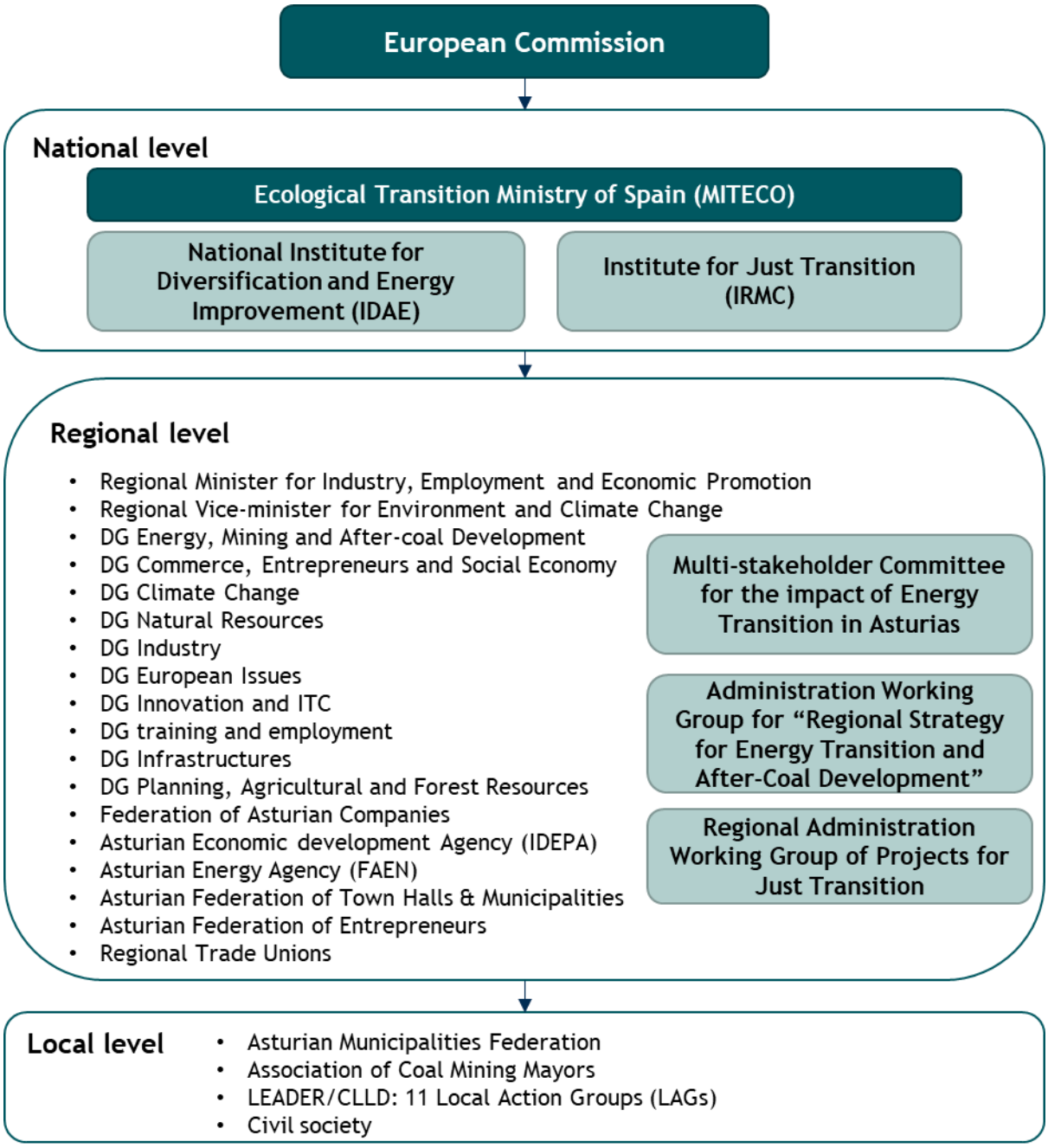

Figure 0-50 Mapping of stakeholders. Source: Based on Platform for Coal Regions in Transition (2020)

*DG: Directorate-general

12. Annex D – Stakeholder analysis – Burgenland case study

The energy transition of Burgenland involves many stakeholders. Each are discussed shortly and presented in the diagram below.

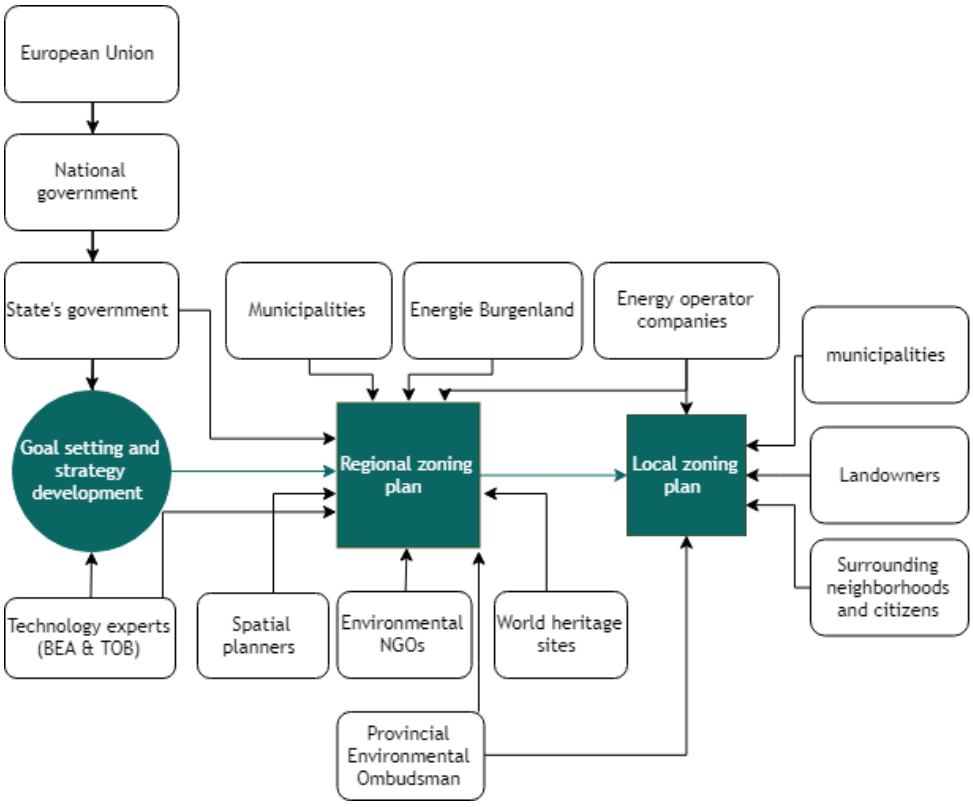

Figure 0-51 Diagram of stakeholders in the Burgenland case.

An important stakeholder is the **European Union,** as it provides the ERDF and other support to the region. The European Union also set the EU targets for renewable energy production, energy efficiency and savings and greenhouse gas reductions. The **Austrian national government** aligns its national renewable energy targets to the EU directives. Moreover, the national government set the right conditions to accelerate the energy transition, such as the Green Power Act. The **Federal State of Burgenland** streamlines its (energy) policies with national policies. However, in Austria the nine federal states are can independently develop frameworks and approaches to implement policies or to set more ambitious energy targets (interview data). The State of Burgenland is divided into 171 municipalities which have no legislative capacity (EC, 2019). The State's government is therefore the centre of all negotiations and stakeholder management during the transition.

The **Institute for Spatial Planning** (Institut für Raumplanung (ÖIR)) was contracted by the province in 2002 to help Burgenland with the first pilot of regional zoning planning.

The **Department of Spatial Planning and Nature and Environmental Protection** managed many processes, including the development of the Austrian Spatial Development Concept, where they worked closely with the ÖIR (WWF, 2014).

Burgenland Energy Agency (BEA) is a State's body responsible for the expansion and promotion of clean energy, including energy projects and strategies as well as energy consulting in Burgenland.

The **energy companies** are important stakeholders as they invest in and develop renewable energy sources. In Burgenland there are eleven companies active, including BEWAG, which later became **Energie Burgenland** (Energie Burgenland, 2013). This company acts as Burgenland's utility company and evolved into a wind energy developer over time. The company is 51% owned by the federal state (Energie Burgenland, 2013). In 2014, it was the largest (362 MW) producer of wind power in Burgenland. The largest private-owned company of Burgenland is Püspök Group which generated 212 MW in 2014. This family company was established in 1997.

In 2002, the **Provincial Environmental Ombudsman** was legally appointed to be 'the independent lawyer of nature' (interview data). Additionally, the **Nature Conservation Authority** supervises the process and provides professional competence and expertise (WWF, 2014).

There are also several **Environmental NGOs** involved, among which BirdLife and the WWF are concerned with the protection of nature, and in particular the nesting areas and emigration routes of birds. Burgenland also has some UNESCO heritage sites, such as the region around Lake Neusiedl. Therefore, representatives of World Heritage Sites are involved in the development of the regional zoning plan.

Lastly, the **citizens** of Burgenland are stakeholders as they could be negatively affected by land-changes. A majority of citizens can hinder the installation of windmills and to this end, citizens are involved in the local zoning planning (interview data). **Landowners** provide the ground for the windmills, so they have the power to stop installation.

13. Annex F – Stakeholder analysis – Nijmegen case study

As described above, the two phases of the Engie case are characterised with different stakeholders who have different roles. The national government was important as they, together with the members of SER, decided to close the CG13. The national government was also involved in the negotiations around the social plan. In addition, the national government granted the Engie site the special status which provided Engie with the needed flexibility in spatial planning to start with the redevelopment. In the diagram below, the central role of **Engie** is illustrated. The company has a leading role in both the closure and the redevelopment as they own the coal-fired plant and the ground.

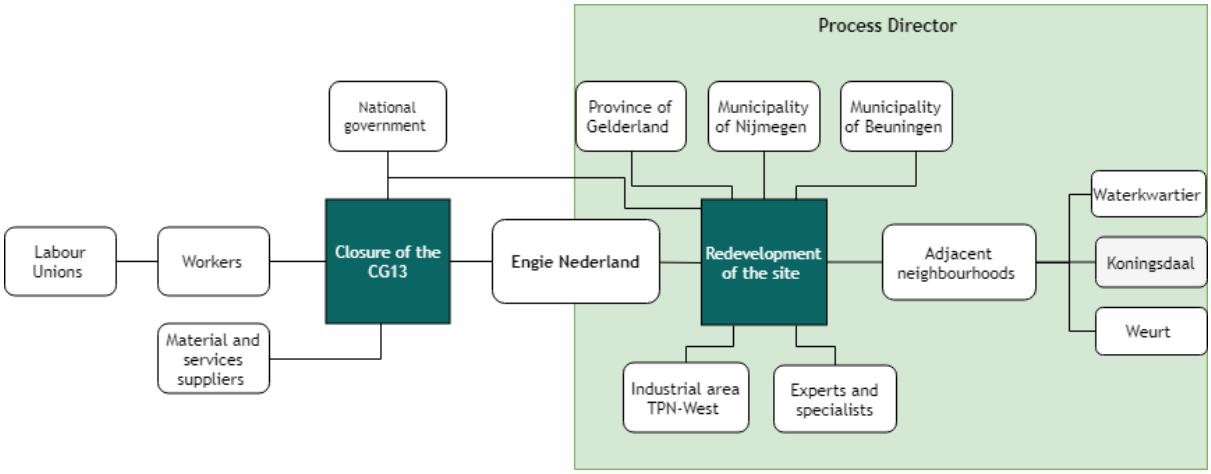

Figure 0-52 Diagram of the most important stakeholders

With the closure of CG13, the **workers** were pivotal as they were directly affected by the shut-down by losing their source of income. The **labour union** protected the workers' rights by representing the workers in negotiations around the social plan.

In the redevelopment, the **Municipality of Nijmegen** is an important stakeholder as they are the appropriate authority and therefore approves Engie's Spatial Vision. The municipality sets appropriate regulations based on their knowledge of the local situation. Moreover, the municipality closely collaborates with Engie to find the best suited opportunities for the redevelopment of the site so that it benefits the city and limits the negative impacts on the surrounding neighbourhoods.

The **Municipality of Beuningen** is as a neighbouring municipality directly involved to defend the interests of its residents (neighbourhood of Weurt) and to seize opportunities.

The **Province of Gelderland** grants the permits for the new constructions such as the windmills and solar park. Moreover, the province is closely involved with the Engie project as they want to learn from the pilot with the Environment and Planning Act. Further, the proposed plans fit within their wind energy vision and will help the province to meet their sustainability targets (interview data). They also supervise the Regional Programme Work locations (RPW), to balance the amount of office places in Nijmegen (interview datat).

The surrounding neighbourhoods (**Waterkwatier, Koningsdaal** and **Weurt**) are important stakeholders as they may experience negative externalities from for instance wind turbines. The Environment and Planning Act also requires Engie to involve the residents in the decision-

making process (interview data). Moreover, the residents have the right to request an appeal to the province against the permits of for instance the windmills.

The Engie site is also part of the **industrial park TPN-West**, which is governed by the industry association TPN-West (TPN West, 2019). As the companies are the neighbouring companies of the Engie site, they can be positively or negatively affected by the new plans of Engie. An example is the container terminal BCTN[69], which is currently renting a part of Engie's land for storage.

Involved in the redevelopment are also specialists from different institutions, such as **spatial planners, environmental experts and project developers.**

Lastly, since January 2018, a **process director,** from consultancy company Over Morgen, was installed. This director is in charge of streamlining participation process in the redevelopment of the site. This includes building an efficient and effective organisation structure which incorporates all important stakeholders.

[69] BCTN is the main inland container terminal network in the Benelux.

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