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Conservation and promotion of the Coal Mining Heritage as Europe's cultural legacy

Deliverable 2.1

Report on the coal transition strategy of the European countries.

Lead Beneficiary: Central Mining Institute – National Research Institute (GIG-PIB)

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Summary

This manuscript presents the Report on the coal transition strategy of the European countries, a part of WP 2: Status quo of coal mining heritage in Europe. Its scope includes a summary of the comparative analysis of national reports delivered by Coal Heritage project partners and best practices that provide the information about coal heritage in Europe.

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1. Introduction

The transformation of the coal mining sector in the European Union (hereinafter referred to as the EU) is one of the most important challenges of the modern economy, and at the same time determines profound changes in ecological and social spaces. This process, being a response to the needs of sustainable development and the fight against climate change, entails the need to consolidate and preserve the rich heritage of coal mining in Europe. The transformation of this economic sector in the EU is not only a technological or economic process, it is also a serious opportunity - as has been emphasized - to consolidate and preserve the heritage of coal mining. Preserving the history of mines and the hard work of miners and achievements of this economic sector is crucial not only for future generations, but also for building a new identity of local communities in mining areas. Including the heritage of coal mining in the transformation narrative is becoming an important element in shaping a new, sustainable view of the future of mining areas in the EU (Pactwa et al. 2021).

The CoalHeritage RFCS Accompanying Measure European Project has set as main goal to support coal regions in transition by making them less dependent on the mining industry through repurposing of coal mines. The general plan is to provide access to re-skilling programmes, create potential to stimulate new economic activities in these areas and develop jobs in new economic sectors, especially in relation to the coal regions in transition.

For the implementation of the project a consortium was assembled of 6 partners from 5 European Countries with specialised background in heritage and coal mine transition. The following table provides basic information regarding each partner involved in the project.

Table 1 List of project participants

#	Partner Name	Acronym	Country	Role	Logo
1	**ETHNIKO KENTRO EREVNAS KAI TECHNOLOGIKIS ANAPTYXIS**	CERTH	Greece	Coordinator	
2	**INSTYTUT TECHNIKI GORNICZEJ KOMAG**	KOMAG	Poland	Partner	
3	**PREMOGOVNIK VELENJE DOO**	PV	Slovenia	Partner	
4	**BUREAU DE RECHERCHES GEOLOGIQUES ET MINIERES**	BRGM	France	Partner	
5	**GLOWNY INSTYTUT GORNICTWA-PANSTWOWY INSTYTUT BADAWCZY**	GIG-PIB	Poland	Partner	
6	**DMT-GESELLSCHAFT FUR LEHRE UND BILDUNG MBH**	DMT-THGA	Germany	Partner	

1.1 Goal & Objectives

The main goal of Deliverable 2.1 is to help describe and understand the current state of the mining heritage in Europe. It aims at determining the transition strategy from coal mining in each of the countries (Greece, Germany, France, Poland, and Slovenia) for partners involved in the project.

Within WP 2: Status quo of coal mining heritage in Europe, project partners has to determine the processes needed to declare coal sites as national heritage areas with emphasis on legislative considerations of the coal sites and estimation of the national heritage value to explore its potential. First step has to be identification

of the transition strategy in each collaborate country and its status with transformation process analysis.

Each partner (Greece, Germany, France, Poland and Slovenia) prepared a study of their country's transition strategy from coal mining. They indicated actions taken and processes undergone until now. The partners also presented the status of coal transition in their countries. These reports are attached to this Deliverable as appendixes.

D2.1. includes a summary of the comparative analysis of national reports, delivered by Coal Heritage project partners and best practices that provided the information about coal heritage in Europe.

1.2 Contents of the reports

Each report contains information on plans to close and liquidate the mines, a description of possible ways to retrain the staff working in the mining industry and in mining-related plants in such a way as to minimize the social impacts of coal mines closure. The effect of coal heritage sites on the transition strategies and the structural changes that need to be undergone. General scope of the reports on the coal transition strategy included:

1. Goals and cause in particular country; Main objectives of the coal phase-out strategy, main political, social and economic motivations for the mining transformation;
2. Legislation, policy & regulations; Presentation of policy and regulations regarding the transformation of the mining and its support to minimize the negative socio-economic effects;
3. Transformation plan; The current situation of mining in each country, issues related to its production, employment and location of mines. Presentation of activities and solutions necessary to achieve the goals of transformation, schedule for its implementation and the identification of key stakeholders in the transformation process;
4. Socio-economic impact of coal phased-out; Analysis of the effects of transformation in the coal dependen regions; programmes and strategies for

socio-economic support, such as job creation and post-mining areas management and redevelopment;

5. Integrating coal heritage with the transition goals; Presentation of strategies and plans for the protection and re-use of coal heritage in the perspective of the transition proces; examples of successful initiatives to integrate coal heritage into other sectors of the economy, such as tourism, renewable energy, research;
6. Good practices in coal mining; Presentation of successes and case studies.

2. Motivations for the transformation of the coal mining sector in the European Union

2.1 Political motivations

As noted by the authors of individual parts of the report entitled: "Status quo of coal mining heritage in Europe" the main political, social and economic motivations for the transformation of the coal mining sector in the European Union vary depending on the specific country, its history, coal resources, and political culture. Economies considered leaders in coal production in the past are now pursuing ambitious strategies to move away from this resource in an effort to reduce greenhouse gas emissions. As part of this process, plans to close mines by 2040 at the latest and invest in renewable energy sources and energy efficiency dominate in these countries. As for countries where there is a delay in the process of phasing out coal, the key sources of this phenomenon are the strong dependence of national economies on the identified natural resource and social resistance. One of the key factors influencing the transformation policy of the coal mining sector in EU countries are natural resources, such as coal, natural gas and metal ores. Countries with large coal reserves face more complex transition challenges because they must account for complex infrastructure and employment in the coal sector. Another factor is climate goals and commitments to reduce greenhouse gas emissions. Some EU countries are already close to achieving climate neutrality, while others have higher emission levels and more ambitious goals to achieve. This significantly shapes

and influences the approach to the transformation of the coal mining sector. Equally important is the level of technological advancement and readiness for innovation in the coal mining sector. Countries that have previously invested in modern ecological technologies may be in a better position in the transformation process than those that relied on traditional methods of coal exploitation and extraction. Differences in energy policy also significantly determine the approach to the transformation of mining. Countries that focus on developing renewable energy and green technologies may be more consistent in their efforts to phase out coal and other fossil fuels.

2.2 Social motivations

In turn, social motivations are another important factor influencing the approach to moving away from coal. In countries with a long history of coal mining, mining was a traditional source of employment and an important part of the identity of local communities. Therefore, plans to close mines may be met with protests from the public. In order to minimize them, re-education programs and support for regions affected by economic transformation are created in these countries. The transformation of the coal mining sector is different in countries with strong social involvement and active social participation in decision-making processes, which are more open to changes and ready to support the transformation.

2.3 Economic motivations

There are also important differences in the economic motivation space. Financing the transformation of the coal mining sector is an important factor in this matter. Some EU countries may have more financial resources to invest in modern technologies and retrain workers - while others, especially those with fewer resources, may need support from the EU or international financial institutions depending on the country in which the transformation process is taking place. Secondly, in countries where coal mining was more expensive compared to importing it, the economic arguments for phasing out coal are stronger. Countries with opposite economic conditions remain dependent on domestic energy sources, which makes the mining transformation more costly. It is worth noting that the EU

has introduced the Just Transition Fund mechanism in this area, which is intended to help countries with higher coal dependence manage the transformation and limit the negative economic effects (EC 2021).

In the described area of political, social and economic motivations determining the transformation of the coal mining sector in the EU, it is also necessary to emphasize the importance of a given country's energy dependence on coal, the persistence of the political culture and economic programs of the ruling party at a given time, international goals, including obligations under climate agreements, such as the Paris Agreement, the history of mining in a given country, mining traditions, the level of ecological awareness and involvement in the transformation of local communities, the availability of alternative energy sources, the ability to develop new economic sectors and create jobs and international pressure related to the need to reduce emissions greenhouse gases,

3. Approach to coal phase-out strategies

Ultimately, the differences in approach to coal phase-out strategies across EU countries reflect the diversity of political, social and economic contexts. Nevertheless, the EU has ambitious targets for reducing greenhouse gas emissions and promoting sustainable energy, which requires coordination of action at national and European level. The transformation of the coal mining sector is a difficult but inevitable process in the context of global climate challenges and environmental protection. It is therefore important that EU countries continue to cooperate and strive to achieve common goals in the field of renewable energy and greenhouse gas emission reductions, while ensuring a fair sharing of the benefits and costs of the indicated transformation (Cifuentes-Faura 2022).

As has already been emphasized, the transformation of the coal mining sector in the EU is a key element of the strategy to combat climate change and strive for sustainable development. Achieving this goal requires coordinated actions and the involvement of various stakeholders (Materna et al. 2023). The following key goals dominate the strategic solutions space: reducing greenhouse gas emissions,

diversifying energy sources, transitioning to sustainable mining practices beneficial to a sustainable economy and creating new jobs and the economic transformation of mining regions. The indicated objectives are consistent with the activities and solutions undertaken and set out in the strategies, including: investments in modern technologies - including the development of methane recovery technologies, implementation of technologies for closing mining spaces remaining after the completion of mining activities, and investments in innovations related to the green digital economy. The last of the indicated investments focus on energy policies and renewable energy sources. This area focuses on supporting renewable energy projects, phasing out coal-based energy and creating a legal framework that favors sustainable energy sources. These activities and investments are supported by social policy implemented in the transformed mining areas, promoting education and retraining of employees, including assigning special importance to educational programs dedicated to employees of the hard coal mining sector, the offer of vocational training adapted to new technologies and supporting the retraining of employees towards industries related to renewable energy. These activities and initiatives are particularly strengthened by creating international cooperation aimed at sharing experiences and best practices between EU Member States, creating partnerships with non-EU countries in the field of research on new technologies related to the hard coal mining sector and joint international initiatives for sustainable development hard coal mining sector.

4. Stakeholders

The key stakeholders in the transformation of the EU coal mining sector are Member State governments, which are primarily responsible for developing and implementing national strategies for the transformation of the sector, coordinating activities at national and international level and providing financial support for transformation-related projects. An equally important stakeholder is the mining industry, which adapts its business strategy to the requirements of sustainable development of the sector, determines and develops investments in new technologies and innovations, and actively participates in dialogue with national

governments and local communities. An extremely sensitive stakeholder is the sector's employees who, or not, participate in educational programs and retraining, actively participate in the transformation process and create partnerships with enterprises and educational institutions. An equally important stakeholder are local communities living in transformed areas, for whom it is extremely important to participate in decision-making processes regarding transformation, cooperation with the government and the sector in the revitalization of mining areas and the development of local economic and social initiatives.

5. Challenges for the transformation of the coal mining sector in the EU

All of the content presented above is related - as the authors of the report particularly point out - to numerous challenges and potential conflicts accompanying the transformation of the coal mining sector in the EU. In the sphere of potential conflicts, social resistance and the attitudes and behavior of trade unions come to the fore (Herberg 2023). However, the primary challenges are the financing of the transformation and its distribution, as well as the need to simultaneously protect the environment and economic stability in the process of transformation (Gankhuyag&Gregoire 2018). The indicated challenges and potential conflicts have their significant sources, the most significant of which include;

- differences in the transformation schedules of the mining sectors of European Union countries,
- differences in natural resources,
- differences in the degree of dependence on fossil raw materials,
- differences in the availability of alternative energy sources,
- differences in the rate of reduction of greenhouse gas emissions,
- achieving climate neutrality on various dates,
- differences in the level of advancement in the field of renewable energy,
- differences in the dynamics of diversification of economies dominated by the hard coal mining sector,
- differences in the degree of dependence on mining of the economic structures of transformed mining areas,

- differences among the priorities determining the sustainable economic development of the transformed mining areas.

Other important sources are the culture of societies in the transformed areas and the level of acceptance of the transformation by these societies (Todd 2005). The indicated sources are shaped in particular by the level of social acceptance for transformation activities, mining traditions and their impact on local communities, and actions to minimize the social effects of transformation. The challenges and potential conflicts accompanying the transformation of the coal mining sector in the EU are also inextricably linked to the investments and financing that determine its course, as well as the complexity of national energy policies (Brodny &Tutak 2022). The decisive factors in these areas, as indicated by the expert opinions prepared as part of the report, are:

- financial resources available for transformation,
- investments in modern and green technologies,
- the impact of economic crises on the ability to make investments,
- priorities in the field of energy policies.
- degree of dependence on specific energy sources,
- integration of renewable energy in national energy mixes.

To conclude, the availability of natural resources, the structure of the economy, social culture, investments and energy policy are key determinants shaping the pace and direction of the transformation process of the coal mining sector in the EU. Taking into account the scale of differences between countries, it is important to develop a flexible approach that adapts to the specificity of each country to the transformation process in order to ensure an effective and sustainable transformation of the coal mining sector in the European Union. Collaboration, exchange of experiences and transparency are key elements in effectively achieving the Sustainable Development Goals.

6. Transformation effects in the coal-dependent regions

The transformation of the coal mining sector in the EU has varied effects in coal-dependent regions – impacting not only the economy, but also society and the overall landscape of coal-producing regions. As the authors of the report note, the most important factor differentiating this space is the pace of transformation (Marszowski 2010). Mining regions in the transformation process differ in terms of adapting to new socio-economic conditions. Some areas are implementing rapid reforms, accelerating the transformation process by investing in renewable energy sources and modern technologies. Others, due to specific challenges, may encounter difficulties in adapting to the new reality, which leads to various social and economic effects (European Court of Auditors 2022). In the described space, from the perspective of social effects, the following important regularities are noticed - differentiating the transformed mining regions. In areas adapting to changes determined by transformation, the dominant factors include the creation of new jobs related to ecology, innovative technologies and the specialized services sector, investing in education and training allowing employees to acquire new skills and adapting to the new realities of the labor market, and focusing on the social aspect of transformation. – including supporting local initiatives and activities aimed at minimizing its negative effects.

On the contrary, in regions struggling with the social effects of transformation, there is a predominant increase in unemployment, poverty, a decline in the quality of life, as well as challenges related to the depopulation of the transformed areas. The effects of the transformation of the coal mining sector also have serious economic implications. Particular differences can be noticed between regions achieving economic success in the process of hard coal mining transformation and those struggling with an economic crisis. In the case of the first regions, new business opportunities are emerging based on the diversification of economies and foreign investments developing economic sectors related to renewable energy, green technologies and tourism. In the case of regions affected by the crisis, there is a significant decline in income in these areas - which may affect

access to funds for transformation - and long-term adaptation to new economic realities, which makes it difficult to quickly achieve economic stability.

The regularities, differences and dependencies described above imply the need for cooperation and mutual support. In the perspective of implementing long-term transformation strategies, the need to take into account the specificity of each transformed region, as well as intergovernmental and inter-sectoral cooperation, aimed at supporting regions in difficult times, comes to the fore. From the perspective of local conditions, it seems necessary to support the local communities inhabiting them in the transformed areas, first of all through social consultations and dialogue with them in order to understand their needs and concerns, as well as the creation of aid programs that bring specific benefits to these communities. Complying with the above-described model of cooperation and mutual support in the process of transformation of the coal mining sector in the European Union has brought numerous positive effects, such as:

- developing the information technology and research sectors and investing in renewable energy sectors (Germany) (Federal Ministry for Economic Affairs and Energy, 2022),
- development of cultural tourism combined with investments in agriculture and sectors related to local production (Greece) (Terkenli&Georgoula 2022),
- investments in retraining programs for former employees of the mining sector combined with investments in modern sectors, such as green technologies (France) (PWC 2023).

The varied effects of transformation in coal-dependent regions in the European Union show that the approach to this process must be flexible and adapted to the specificity of each transformed area. It is crucial not only to achieve ecological goals, but also to take care of social and economic aspects at the same time. Support from governments, EU institutions and innovative approaches to developing local economies can help ensure that the transformation of mining sectors brings lasting benefits to all parties involved in the transformation.

7. Best practices

This chapter presents only a few examples of best practices, delivered by Coal Heritage partners in their reports on the coal transition strategy of the European countries. More best practises will be presented in the Deliverable 2.4 Successful stories of transforming coal mining sites and areas into industrial heritage objects with detailed description of examples of transformation of postindustrial sites into museums, cultural sites e.t.c.

7.1 Greece

Aliveri region

In Greece, there had been no previous history of lignite mine closures before the period of the last years of de-carbonization except for the Aliveri lignite mine. The Aliveri lignite mine, in Evvoia, was an underground mine owned by P.P.C. until 1980, when it was sealed. During the latest years, in the Amyntaio and Kardia lignite mines, part of Western Macedonia Lignite Centre, all mining operations were ceased. Ptolemaida power plant houses an informal museum of lignite, an exhibition space maintained by PPC, where tools, documents, small machines, and large machines have been gathered and stored with the hope that they will serve as the foundation for the creation of a museum deserving of the importance of the region's "black gold" in terms of electricity production and contribution to the national economy.

Figure 1: The exhibition centre of Agios Loukas in Aliveri region, at the site of the old technical school (Mavrakis et al., 2017).

7.2 Germany

Zollverein Coal Mine Industrial Complex (Essen)

This UNESCO World Heritage Site is one of the most iconic industrial heritage sites in the world. It was a large coal-mining complex that is now a museum and cultural center, which includes the former coal-mine, coking plant, and other industrial buildings.

Figure 2 Zollverein Coal Mine Industrial Complex (URL1)

7.3 France

Wendel Mine Site (Petite Roselle)

A policy to preserve mining heritage has developed in Lorraine, where several headframes have been preserved and, most notably, the Wendel Mine Site (Petite Rosselle) has been classified as a historical monument. Converted into a mining museum, which opened in June 2006, it is part of a large cross-border project developed in cooperation between the Forbach Agglomeration Community, the State of Saarland, and the city of Saarbrücken "Development Park of the Rosselle Valley".

Figure 3 *Wendel Mine Site (URL2)*

7.4 Poland

The Guido mine

The Guido mine, also known as "Zabytkowa Kopalnia Węgla Kamiennego", composed of two former mines, Guido and Queen Louise. They have been converted to underground museums join with the underground water route. It stands as a significant historic coal mine and museum in Zabrze, Silesia, Poland, also is an Anchor point on the European Route of Industrial Heritage. Guido Coal Mine hosts exhibitions about historic and modern mining technology and practice and offers sightseeing of two excellently preserved mining levels are waiting for you 170 and 320 metres below the ground.

Figure 4 *The Guido mine (URL3)*

7.5 Slovenia

Coal Mining Museum of Slovenia

The idea of the museum is to preserve customs, traditions, as well as the machinery, equipment and everything related to coalmining (est. in 1999). The museum has received numerous awards. The special award of the European Museum Forum, the Valvasor award, the Ford award for the preservation of technical heritage and others.

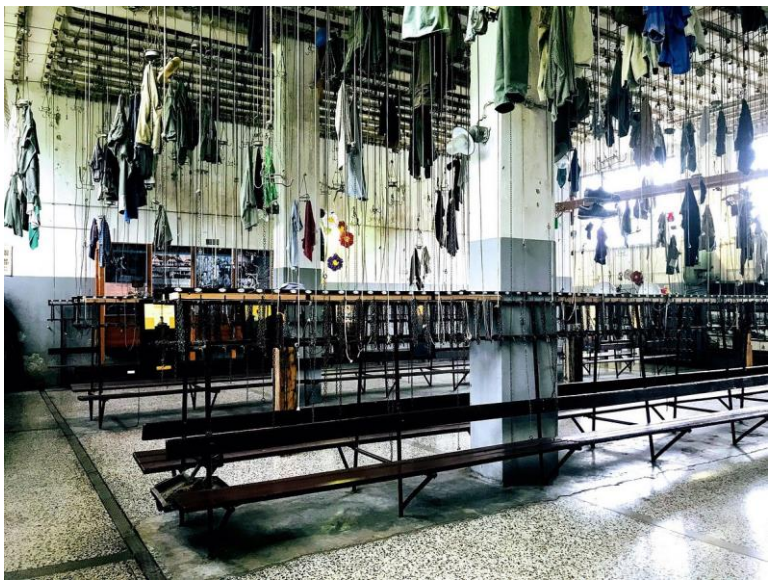

Figure 5 Coal Mining Museum of Slovenia (URL4)

8. Conclusions

Decisions leading to the reuse of coal heritage - in the opinion of the report's authors - create a unique opportunity to undertake initiatives focusing mainly on its protection, preservation and preservation. For this purpose, plans and strategies are undertaken to implement initiatives that can provide valuable tips on how to effectively manage this process. It is worth noting here, following the authors of the work titled: Research on the protection and reuse of industrial heritage from a public participation perspective - a case study of the northern mining area of Pingdingshan, China (Wu et al. 2022), that elements of the industrial system are facing obsolescence and with this process the concept of "industrial heritage" has

emerged" (Ma 2010) Industrial heritage is a special type of cultural heritage. An increasing number of people realize that closed factories, exhausted mines and abandoned railway lines have lost their original productive functions, but those on which industrial civilization is based have, over time, accumulated an industrial heritage of specific value. Industrial heritage is testimony to human civilization and historical development. Its historical and cultural values, knowledge value, scientific and technological value, economic value and artistic value have been widely recognized throughout the world.

In the light of the definition indicated above, it is worth mentioning several examples of successful strategies and initiatives - on the example of selected EU countries - that fully meet the challenge of protecting and reusing coal heritage from the perspective of public participation. The example of France focuses on the strategy of transition from coal mining to creative sectors and modern technologies - while focusing solutions on the use of mining heritage to develop cultural tourism along with the transformation of mining areas into centers of innovation and entrepreneurship (EC 2020). Using the experience of Germany, it is necessary to clearly point out retraining programs for former employees of the coal sector and the concentration of activities on the development of the educational and research sector - along with the creation of educational centers and the development of technology parks promoting innovation and entrepreneurship (EU 2021). The Polish example is the development of cultural infrastructure focused on investments in museums and heritage centers, which are crucially related to the promotion of green projects such as urban parks and recreational areas (Szubert et al. 2021). The examples of France, Germany and Poland demonstrate various strategies and initiatives for the protection and reuse of coal heritage in the transformation process. Their key aspect is sustainable development, taking into account the needs of local communities, environmental protection and the creation of modern areas that will become a source of economic and social development in the transformed areas of the EU.

In the light of the report " Report on the coal transition strategy of the European countries", it seems justified to claim that the transformation of the coal mining sector in the EU is a process that combines challenges with opportunities. In the space of challenges and opportunities, the protection, consolidation and preservation of mining heritage require not only actions for environmental protection, social growth and economic development, but also the creation of new narratives and values related to the history of mining. The transition from traditional economic sectors to modern economies and sustainable forms of development opens new prospects for mining regions, and coal heritage becomes an important element of building identity and social capital.

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URL3 https://kopalniaguido.pl

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Appendix 1 GREECE

CoalHeritage

WP2: Status quo of coal mining heritage in Europe
D2.1 – Report on the coal transition strategy of the European countries

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Greece, September 2023

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Introduction

This deliverable will be the summary of the results of the comparative analysis and best practices that will provide information about coal heritage in Europe. Western Macedonia region has served as Greece's primary energy hub for many years and has played a pivotal role in the country's energy landscape since 2019 when a government mandate led to the closure of numerous lignite-powered plants. Western Macedonia holds significant importance and necessitates the implementation of a just transition plan aimed at restructuring its industrial base. Such a plan is essential to mitigate the potential social and economic repercussions and to facilitate the attraction of fresh investments, particularly in the realm of Renewable Energy Sources (RES).

Western Macedonia holds a unique position within Greece, as it combines both industrial and agricultural activities. Its significance in the country's development escalated from the mid-1960s onwards when the abundant lignite deposits in the Regional Units of Kozani and Florina were tapped for power generation. Lignite, due to its cost-effectiveness and ease of extraction, is deemed a strategically valuable energy source and is readily available in Greece. This resource is particularly concentrated in the Western Macedonia region, encompassing a total area of 9471 km² and hosting a population of 283,689 residents (Fortsakis et al, 2016). Moreover, the Western Macedonia region stands out as the sole Greek Administrative Region lacking a coastal border while sharing land boundaries with two neighboring Balkan countries. The region is characterized by its predominantly mountainous terrain and boasts a significant share of the nation's surface water resources. It is renowned for its distinctive high-quality agricultural products, rich cultural heritage, and the presence of rare and unique ecosystems (Tranoulidis et al., 2022).

The transition away from lignite-based activities in Western Macedonia is anticipated to have a significant and concerning impact on employment in the region. Approximately 5,000 individuals are currently employed either directly or indirectly by the Public Power Corporation (PPC) in roles related to lignite. Western Macedonia is unique among Greek regions in that its Gross Value Added experienced a noteworthy decline of 8.8% between 2018 and 2019, in stark contrast to the national average change, which registered a positive growth of +2% (Hellenistic Statistical Authority, 2022).

The aim of achieving complete decarbonization in Greece by the year 2028 is clearly articulated in the provisions of the National Plan for Energy and Climate. This plan is designed to ensure the stability of Greece's power generation system and enhance energy security. It aligns with the broader European Strategy for Climate Neutrality, which is underscored in the communication released jointly by the European Parliament Commission, the European Council, the European Economic and Social Committee, and the Committee of the Regions, titled "The European Green Deal" (COM (2019) 640) (European Commission, 2019). One of the key requirements outlined in this agreement is the gradual phasing out of greenhouse gas emissions by the year 2050.

1. Goal and causes

1.1 Main objectives of the coal phase-out strategy

To face climate change, the European Union (EU) has formulated an Energy and Climate Strategy with a horizon of 2050, setting some interim targets for 2030, which aims to achieve zero greenhouse gas emissions in the EU by 2050 (Government Committee, 2020). In 2019, the legislative package Clean Energy for all Europeans was completed, which seeks to facilitate the transition to an energy system that will not

depend on fossil fuels and will have limited to zero greenhouse gas emissions. The legislative package includes the following (European Commission, 2019, Government Committee, 2020):

- At least a 40% reduction of greenhouse gas emissions by 2030
- At least a 32% participation of renewable energy sources in the total energy consumption in the EU. by 2030, according to the revised Renewable Energy Sources Directive (2018/2001/EU)
- At least a 32.5% improvement of energy efficiency by 2030 according to EU Directive 2018/844
- The new Regulation EU/2018/1999 on the governance of the Energy Union and Climate Action, to ensure the achievement of the objectives, the cooperation of the member states, the long-term predictability of the policy, etc.
- The obligation of EU member states to submit National Energy and Climate Plans for the period 2021-2030 describing how they will achieve the goals for renewable energy sources and energy efficiency

In the case of Greece, the main directions of the EU's energy and climate policy have been incorporated into the National Energy and Climate Plan (NECP), which is the main tool for achieving the objectives of the period 2021-2030. The National Energy and Climate Plan provides (Government Committee, 2020):

- At least a 42% reduction of greenhouse gas emissions by 2030
- At least a 35% increase of the renewable energy sources' share of RES of total energy consumption by 2030
- At least a 61% increase in renewable energy sources' share in electricity generation by 2030
- At least a 38% improvement in Energy Efficiency by 2030
- Zero dependence on lignite by 2028

1.2 Social and economic motivations for the mining transformation

Social and economic incentives for decarbonization and restoration of the mines include the following (Government Committee, 2021):

- Exploitation of the advantages of the affected areas
- Development opportunities in the affected areas

1.2.1 Exploitation of the advantages

The exploitation of the advantages of the affected areas will be based on the implementation of actions, that are in harmony with the European and national vision regarding the economic diversification of the areas (Government Committee, 2021). Specifically, the regional units of Kozani and Florina can utilize their advantages, which are (Government Committee, 2021):

- Promotion of the natural environment: Promotion of the mountainous landscape of Western Macedonia, as well as the abundance of forests, lakes, and rivers, as well as the promotion of the areas, which have been characterized as NATURA, to develop forms of alternative tourism
- Exploitation of the region's mineral wealth (quartz deposits, chromite, etc.), which will attract industries that use these materials and will contribute to strengthening the area's industrial sector
- Utilization of the existing workforce
- Development of the primary sector, by exploiting the stock of animal production through further development and upgrade of the livestock sector by incorporating advanced technologies
- Promotion of the region's cultural heritage, to strengthen the tourism sector
- Upgrade of the infrastructure and networks (maintenance and further development of the railway network, upgrading of Kozani airport, etc.), to increase connectivity with neighboring regions and also with neighboring countries to strengthen the trade and tourism sectors

1.2.2 Development opportunities

The restoration of the mines as well as the areas where the power plants are located will allow the creation of suitable spaces for attracting and developing new business activities, livestock and agricultural zones, promotion of alternative forms of tourism, and actions to protect and highlight the natural environment (Government Committee, 2021). The exploitation of the region's advantages can contribute to reducing the effects of decarbonization. Specifically, the development opportunities that exist for the region are reflected in the following key pillars (Government Committee, 2021):

- Clean energy: Development of clean energy production units
- Industry, craft, and trade: Development of innovative enterprises, as well as business and technology parks
- Smart agricultural production: Development of modern production and processing units of agricultural products, development of smart livestock units, and development of animal feed units
- Sustainable tourism: Development of entertainment and sports infrastructure and development and promotion of cultural and creative industries
- Technology and education: Upgrade of human resources, strengthening of social infrastructure, and development and implementation of training/retraining programs

2. Legislation, policy & regulations

2.1 Coordination and monitoring body/bodies

2.1.1 Establishment of an inter-ministerial Committee

By article 1 of the Act of the Cabinet of the Ministers no 52/23.12.2019 on December 24, 2019, the Hellenic Republic announced the establishment of an Inter-ministerial Committee for the Plan for a Just Development Transition (PJDT) to the post-lignite era of the Region of Western Macedonia and the Municipality of Megalopolis of the Region of Peloponnese.

The inter-ministerial Committee consists of:

- the Minister of Environment and Energy, who acts as the chairman of the committee
- the Deputy Minister of Environment and Energy, responsible for Energy and Mineral Raw Materials
- the Minister of Finance
- the Minister of Development and Investments
- the Deputy Minister of Development and Investments, responsible for Public Investments and the NSRF
- the Minister of the Interior
- the Minister of Rural Development and Food

According to article 2 of the Act of the Cabinet of the Ministers no 52/23.12.2019, the Commission's work is:

- the approval and monitoring of the implementation of the PJDT. The PJDT is an integrated multidimensional development roadmap for the Region of Western Macedonia and the Municipality of Megalopolis and includes a set of measures, such as investment and tax incentives, new infrastructure, utilization of local natural resources, retraining of employees, support of agricultural production and tourism, to regenerate the local economy, securing jobs and creating new ones, through a flexible development transformation, utilizing the existing human resources, after examining proposals that will be submitted by the PPC S.A. in the context of Corporate Social Responsibility and its business activity, as well as by the local government in the affected areas

- the coordination of the public consultation with the competent local authorities and local societies, joint representatives of private entities and chambers, along with the rendering of directions during the preparation and materialization of the PJDT
- The coordination of the exploitation of funding sources. The funding sources are divided into a) National (Regular Budget, Public Investment Program, National Just Transition Fund), b) European (the European Just Transition Fund, the Cohesion Fund, the European Social Fund, the European Regional Development Fund, the European Investment Bank) and c) Private

The Steering Committee has the following responsibilities:

- the preparation and materialization of the PJDT
- the proposal of the agenda for the Inter-ministerial Committee's meetings

The Steering Committee consists of:

- a well-known personality, who acts as Coordinator of the PJDT and President of the Steering Committee, and is appointed by the Inter-ministerial Committee
- the General Secretary of Economic Policy
- the General Secretary of Public Investments
- the General Secretary of Energy and Minerals
- the Regional Governor of Western Macedonia
- the Regional Governor of Peloponnese
- the Director of the PPC S.A.

According to the article 104 par.4 No 4685/2020, the President of the Steering Committee may recommend and set up working groups or committees. Members of these working groups or committees are appointed scientists or experts with experience or special knowledge related to the above topics.

2.1.1.1 Transition Program 2020-2021

On 18/3/2020, the Government committee approved the Operational Program for Just Development Transition 2021-2027, which resources will be transferred from the National Strategic Reference Framework of the period 2021-2027. The planning of the Just Development Transition Operational Program begins with the materialization of a Transition Program for the period 2020-2021, which includes the following priority actions:

- Introduction of natural gas to the affected municipalities, with co-funding from community funds and the Public Investment Program
- Programs to support employment and entrepreneurship
- Photovoltaic Station Development Program by PPC, private investors, and the local community
- Preparation of basic infrastructure

2.1.2 Establishment of Technical Secretariat

By article 104 par.5 No 4685/2020 In May 2020, a Technical Secretariat of the Steering Committee was established. The responsibilities of the Technical Secretariat are the support of the Steering Committee in the preparation and materialization of the PJDT and the Territorial Just Development Transition Plans, as well as the other responsibilities of the Steering Committee. The above was done based on the model followed in the case of the Czech Republic, in which external experts provided support to the operation of the Czech Steering Committee.

2.2 Territorial Just Transition Plan for Western Macedonia

Below are key chapters of the Territorial Just Plan for Western Macedonia, regarding the needs that exist in this region arising in various sectors related to lignite mining and the goals that have been set as well as the transformation process of the lignite mines.

The primary goal of the Government is the definitive reduction of lignite in electricity production by 2028, with the parallel replacement of lignite power generation units with clean and renewable energy production infrastructures.

The individual stages and supporting actions to achieve both decarbonization and the Just Transition were designed based on the materialization of the environmental and energy framework set by the National Energy and Climate Plan.

2.2.1 Stages and actions of the transition process

The existence as well as development of appropriate financial mechanisms will contribute to the materialization of the transition process, which consists of the following individual stages, where each stage is accompanied by the implementation of individual actions to achieve the country's transition to a climate-neutral economy:

- Closing of lignite units and lignite mines: This stage is accompanied by: a) the closing of lignite units and the closing of lignite mines, b) the monitoring of the progress of the procedures of the closing and c) informing local communities involved.
- Land allocation: This stage is accompanied by: a) the preparation of the required administrative acts and b) the launching of administrative decisions and procedures
- Land restoration process within the cores of decarbonization zones: This stage is accompanied by: a) the determination of the required interventions and works, b) the estimation of restoration costs, and c) the works of restoration and preparation of land for new uses
- Supporting actions: This stage is accompanied by: a) the planning and establishment of incentives and b) the attraction and implementation of investments

2.2.2 Transition stages

For the implementation of the transition process, a basic condition is the definition of the concessionaire, to whom the PPC assets will be transferred and restored so that the restoration procedures and the adjustments of their use can proceed quickly. In addition, appropriate spatial planning is required to capture land uses and their positioning scenarios, in the context of which they are required to be further specialized and institutionalized with the approval of the prescribed tools of the regulatory urban plan, by No 4447/2016, as it applies today and specifically with No 4759/2020.

Therefore, the Special Urban Plans (art. 8, No 4447/2016, Art 11, No 4759/2020) were recognized as the most suitable tool for shaping the uses in the areas of interest, which are owned by PPC. Each Special Urban Plan can modify the spatial arrangements of approved Urban Plans, to prepare an area to receive a specific investment project, which requires special development conditions. At the same time, to ensure the Just Development Transition of the affected areas, it is considered necessary to implement actions that will include the assurance of energy supply, the implementation of physical and digital infrastructures, and the retraining of human resources.

2.2.3 Needs and Development Goals for the Region of Western Macedonia

The compensation of the effects resulting from the closing of the lignite units highlights certain needs, and the materialization of these presupposes the determination of objectives and expected results for the development of the region of Western Macedonia. The following table (Table 1) lists the needs that exist in the sectors: a) employment, b) economy and business activity, c) energy supply, d) environment, and e) health, as well as the goals that exist for each sector, the expected results and possible funding mechanisms.

Table 1: The needs, goals, expected results and possible funding mechanism that exist in the sectors of the employment, the economy and business activity, the energy supply, the environment, and the health

Factor	Needs	Goals	Expected results	Possible funding mechanisms
Employment	• Upgrading the skills of the workforce through the support of competent training • Connecting academic research with the economy • Retrain the local workforce in new skills in areas such as environmental remediation and waste management as well as industrial specialties depending on the new investments expected to take place	• Creation of new jobs in new specialties with a positive impact on income APA • Creation of highly skilled jobs	• Reduction of unemployment • Work integration of vulnerable groups and promotion of social cohesion	• European Structural and Investment funds • Public Sector funds • Private funds • Borrowed funds • National Resources
Economy and business activity	• Strengthening and diversifying the local economy by exploiting its inherent advantages • Strengthening research, technological development and innovation • Digital transformation • Development of transport and storage infrastructure • Improvement of interregional and intraregional road and rail connections	• Transformation of local finances • Internationalization of business activity • Transfer and integration of advanced technologies • Attracting new businesses, including through the creation of industrial zones and business parks	• Improving the economy, competitiveness, productivity and extroversion • Improving the efficiency and quality of the services and products provided • Support existing businesses • Boost Income and HR • Strengthening the mobility of goods and people and the supply chain in general	• European Structural and Investment Funds • InvestEU • Recovery Fund • Private funds • Borrowed funds • National resources
Energy supply	• Transformation of the energy mix through the promotion of environmentally friendly forms of energy	• Preservation and protection of the environment • Promotion of green growth and adaptation to climate change	• Conversion to clean, low-carbon forms of energy • Improvement of energy efficiency in final energy	• European Structural and Investment Funds • InvestEU • Public Sector Loan Facility • Recovery Fund

	• Development and modernization of energy infrastructures and networks • Development of a circular economy • Development of natural gas network • Promotion of Renewable energy systems to cover energy needs • Increase in recycled waste	• Promoting the efficient use of resources	consumption • Energy saving • Improvement of living conditions in buildings	• Private funds • Borrowed funds • National resources
Environment	• Regeneration and decontamination of lands • Redefining land uses	• Restoration of natural environment • Soil and ecosystem protection	• Highlighting natural wealth	• European Structural and Investment Funds and Cohesion Fund • Recovery Fund • InvestEU • Public Sector Loan Facility • Private funds • Borrowed funds • National resources
Health	• Rehabilitation and ensuring the good health of citizens	• Development of social and health infrastructure	• Improving access to social services, better care • Upgrade of the provided services	• European Structural and Investment Funds • InvestEU • Public Sector Loan Facility • Private funds • Borrowed funds • National resources

2.2.4 Land restoration process within the cores of the Decarbonization Zones in the region of Western Macedonia

According to the Territorial Just Plan for Western Macedonia, the implementation of the restoration works of the lands within the cores of the Decarbonization Zones will be carried out with the funding of the responsible implementing body and through the assignment of the relevant works to a contractor. The financing of the restoration work will be carried out with resources drawn from the Recovery and Resilience Facility (RRF) as well as through co-funding with the Just Transition Fund. The timetable of the restoration works will be based on the timetable of the closing of the lignite units and lignite mines. However, in cases where it is deemed feasible, some preliminary restoration work will be carried out immediately.

2.2.4.1 Determination of required interventions/works and cost estimation

After the end of the mining, it is necessary to carry out restoration work based on No 274/76, No 669/77, and 1428/1984. The conditions that will be created after the end of the mining will highlight the potential of land uses, aiming to attract and develop new business activities.

The lands, within the cores of the Decarbonization zones, are divided into:

- lands, in which restoration has been completed,
- lands, in which restoration is in progress
- lands that will be restored in the future

In any case, the restoration may differ from that required for the lands to be considered suitable for the development and implementation of investments based on the land uses sought to be institutionalized for the post-lignite period. Based on this, taking into account the special soil conditions of the individual areas of the cores of the decarbonization zones, the corresponding restoration cost will be estimated.

2.2.4.2 Announcement of a restoration competition and initiation of procedures for announcing contractors

A competition must be held for the restoration work to a contractor. The following must be described in the notice:

- the requested contractor profiles,
- the minimum participation requirements,
- the evaluation criteria

Moreover, the announcement should contain information and instructions on how to apply to participate in the competition. The competition is concluded with the announcement of the contractor and the signing of the required documents.

2.2.4.3 Land restoration works

The type of restoration work is determined by the applicable environmental project approval decisions. Additional preparatory work for post-lignite uses will be determined based on the proposed land uses and will include:

- Artificial plantations of forest species
- Fields

- Lakes
- Lands for general purposes (offices, building complexes housing business activities, business parks, etc.)

In addition, restoration work includes:

- Smoothing of the surfaces
- Ensuring the stability of inclined surfaces
- Investigating for any corrosion of the surfaces
- Control of soil fertility by taking relevant samples and carrying out laboratory analyses
- Replanting of specific species based on the soil and climatic conditions of each area
- Creation of water supply infrastructure, irrigation, drainage, energy, accessibility projects, etc.

2.2.5 Transition Process Prerequisites

For the implementation of the transition process, a basic condition is the definition of the entity responsible for the mine restoration as well as the appropriate spatial planning through the development of a digital map, the preparation of proposals for the location of proposed land uses, the institutionalization of Decarbonization zones and the preparation of Special Urban Plans.

2.2.5.1 Land, mine and unit restoration body

According to No 4014/2011, every business entity can develop an activity, the operation of which will take place by the environmental project approval decisions that are issued, either after the preparation and approval of the relevant Environmental Impact Study or after defining Standard Environmental Commitments. According to Greek legislation, PPC S.A. owns ~95% of the total areas where the lignite mining activity is developed and each mine is required to operate based on the following:

- Approval of Environmental Conditions for the project of exploiting lignite deposits and the necessary projects for its implementation, in the area of Ptolemaida by PPC SA
- Approval of Environmental Conditions for the exploitation of the Amyntaio mine of PPC SA. located in the area of Kozani and Florina
- Approval of Environmental Conditions for the exploitation of lignite deposits, of the Kleidi mine located in the areas of the Municipalities of Florina and Amyntaio, by PPC S.A., and its amendments

According to the above, PPC S.A. is obligated both during the operation of the mine, to carry out specific restoration works, both for the areas of the internal deposits and for the areas of the external deposits.
The gradual and, as the case may be, the permanent shutdown of the mines and the change of land uses create new data and new requirements.
For the transition to a climate-neutral economy, which dictates the withdrawal of all lignite units and lignite mines, it is recommended to establish a Special Purpose Vehicle (SPV) for PPC S.A. to transfer the necessary lands, for the beginning of the restoration works. The purpose of the special purpose vehicle is the restoration, the readjustment of the uses, the preparation of the

development of the lands, and the optimal management of the lands of the cores of the Decarbonization zones, in which PPC S.A. operates.

2.2.5.2 Spatial planning

To ensure the materialization of the transition plan for the post-lignite era and the objective, certain spatial and urban planning have been deemed necessary. For this reason, data has been analyzed, which are related to existing and institutionalized land uses, geological, hydrological, data, the concentration of facilities/infrastructure, etc. for the affected areas, but also with the existing institutional framework and spatial development policies and the possibilities of activating spatial mechanisms.

2.2.5.3 Development of a digital map

According to No 4759/2020, the Regional Units of Kozani and Florina of the Region of Western Macedonia have been designated as Decarbonization zones. Within the Decarbonization zones actions and programs have been planned and executed; interventions have been implemented to serve the purposes of the Jut Development Transition of the affected areas. In particular, in the Decarbonization zones of Kozani and Florina, a spatial and socio-economic Just Transition Plan has been created, which has the following objectives:

- The restoration of productive energy activity and the restructuring and redesign of the business development prospects
- Addressing the environmental degradation of the area from the effects of lignite mining and the operation of Steam Power Stations, both in its natural and man-made systems and in the landscape
- Harmonization with the general energy policy and climate change policy of the EU and Greece
- The effective management and treatment of the socio-economic effects of Decarbonization in the affected areas

2.2.5.4 Development of positioning proposals for the proposed land uses on the digital map

For the development of positioning proposals for the proposed land uses, the following have been followed:

- Study and analysis of existing land uses
- Identifying restricted areas
- Analysis of existing transportation network and energy transmission network
- Registration and study of statutory land uses
- Application of spatial rules: a. rational spatial analysis, b. utilization of existing uses (economically rational transition), c. minimal environmental footprint, d. sustainable development

2.2.5.5 Strategic Spatial Planning: revision of the Regional Framework for Spatial Planning and Sustainable Development

Spatial planning can be practiced at national, regional, and local levels:

- Spatial planning, which includes the Special and Regional Spatial Frameworks and reflects the domestic strategy regarding spatial planning. The Special Spatial Frameworks define

strategic directions, at the national level, for the spatial structure of sectors of productive activities, the protection of the cultural and natural landscape, and the spatial development, while the Regional Spatial Frameworks provide directions for spatial development in regional level, which include the highlighting and utilization of the development and spatial characteristics of each region, the spatial structure of the main productive sectors, the residential development and reconstruction of the urban space and the protection of the natural and cultural heritage, as well as the residential and architectural environment.

- Urban planning provides regulations regarding domestic spatial planning and includes the Local Urban Plans, which regulate the sustainable spatial development and organization of territorial regions, and the Special Urban Plans.

According to article 8 No 4447/2016, for spatial development, which can function as receivers of plans, projects, and programs of strategic importance and require special regulation of land uses and other conditions of their development, Special Urban Plans have been created. The Special Urban Plans will define, among other things, in a set of texts, maps and diagrams, the following:

- the pattern of spatial development
- land uses
- construction conditions and restrictions
- the important urban planning interventions
- the zones of special urban planning incentives
- the basic/main road network
- the other transport, technical, and environmental networks and infrastructures
- climate change adaptation measures
- any other measure, condition, or restriction required to make the area suitable for the creation of organized activity receptors

The approval of the Special Urban Plans makes it possible to license and install the investments and create business parks. In this way, the affected areas will be able to become suitable, either for the creation of organized activities and the establishment of businesses or for the implementation of other programs of regeneration and landscape/environment restoration interventions. A necessary condition for the approval of Special Urban Plans is the preparation and submission of:

- Strategic Environmental Impact Study
- Geological Survey
- Stream delineation study

2.2.6 METAVASI S.A

It has been proposed, that a Société Anonyme (SA) be established, excluded from the public sector, functioning under the rules of the private economy, and governed by the legislation on SA and its proper law. The purpose of S.A. will be to assist lignite-dependent regions in managing a Just Development Transition. Thus, by article 15 No 4872/2021, a legal entity under private law was established in the form of a Société Anonyme (S.A.) with the name "Hellenic Company of

Just Development Transition S.A." and distinguishing title METAVASI S.A. All works performed by METAVASI S.A. have direct priority over any other work performed by public companies or organizations.
Also, all competent services and organizations of the State and the wider public sector are obliged to provide METAVASI S.A. priority, assistance, information, and facilitation for the materialization of its goal.
The goal of the Company is the diversification of the production base of the areas of Just Development Transition, the utilization of the lands included in the Decarbonization zones, the attraction, support, and promotion of investments and investment partnerships in the areas of Just Development transition as well as the execution and management of infrastructure and development projects in these areas.
The goals of METAVASI SA are the following:

- The implementation of the "Operational Program for Just Development Transition 2021-2027"
- The support of beneficiaries within the Operational Program for Just Development Transition 2021-2027
- Attract investments.
- Monitoring the implementation of the Plan for a Just Development Transition and the Territorial Just Plan.

By par. 7 of article 16 No 4872/2021, Evaluation Committees for the Plan for a Just Development Transition have been established, with main responsibility the evaluation of the projects, investments, and development plans, upon request of their entities, evaluation of the requests to lease public properties, properties belonging to the company METAVASI S.A. and real estate of Local Government Organizations and the relevant recommendation to the competent Minister for issues of Just Development Transition.

According to No 4956/2022, where the Programming Agreement of par.4 article 155 No 4759/2020 between the Greek State, METAVASI S.A., and PPC S.A., is confirmed, among others have been confirmed:

1. The signing of the present contract between the Ministry of Development and Investments, the company "METAVASI S.A." and PPC S.A., which the assignment to PPC S.A. can be made. the implementation of new land uses and the upgrade of the lands that had come under the ownership or use of PPC S.A. for the production of electricity and were included in the Decarbonization zones of Kozani, Florina, and Megalopolis, the terms and conditions for the upgrading of the areas of the topographical diagrams attached by PPC S.A., the obligations, the monitoring of execution of the Contract, the method of covering the costs of the actions and the related financial tools, the method of calculating the management costs of PPC S.A. and their coverage, as well as the method of transferring ownership of the underlying lands owned by PPC S.A., as well as any other right or obligation that concerns them and any other matter for serving the purpose of the contract, and is regulated every further detail regarding the transfer, use, and disposal of the above lands, and
2. the 100% transfer of the shares of PPC's subsidiary company Metalignitiki S.A to the company METAVASI S.A.

According to articles 27 and 28, No 4872/2021 PPC S.A. will transfer the entire decarbonization zone metallurgical exploitation activity of the company including:

- all kinds of rights on the properties included in the lands of the Amyntaio mine
- all kinds of rights on the properties included in the lands of the Kleidi mine
- all kinds of rights on the properties included in the lands of the Ptolemaida mines
- all kinds of rights on the properties included in the lands of the Megalopolis mines
- all kinds of rights on the building facilities of Megalopolis

3. Transformation plan

In this chapter, the lignite mining current situation in Greece is described. Moreover, issues related to the production, employment, and location of mines are analyzed and the activities and solutions necessary to achieve the goals of transformation are presented.

3.1 The Lignite Industry in Western Macedonia

3.1.1 Current situation

Western Macedonia is a region in northwestern Greece with a population of 290,000 people. Its economy is mostly based on lignite mining and lignite-fired power stations. Since 2010, there has been a steady decline in the number of lignite-fired power plants, with the four oldest power plants ceasing operations, which has increased since 2019 (Ziouzios et al.,2021). To meet its international commitments to climate action and sustainable development, Greece must restructure its energy system and transition to a low-carbon economy (Ziouzios et al.,2021). The Greek Government announced the objective of retiring all lignite plants by 2028, with the four power plants retiring by 2023 and just one plant remaining active - the Ptolemaida V power plant (Ziouzios et al.,2021). Western Macedonia produces over 70% of Greece's lignite; as a result, this region will face significant challenges as well as opportunities to transform the local economy and society (Pavloudakis et al.,2020; Ziouzios et al.,2021).

Location and ownerships of mines

Coal mines located in Western Macedonia are:

- Kardia coal mine (Fig.1), which is located approximately 20 km southeast of the city of Ptolemaida and it is property of PPC S.A
- South field coal mine (Fig.1), which is the largest coal mine and it is located inside of the Ptolemaida lignite basin (Chalastra et al,2004). Ptolemaida coal mine is the property of PPC S.A.
- Main field coal mine which contains the Mavropigi coal mine (Fig.1) and the Komanos coal mine and is located 10 km southeast of the city of Ptolemaida (PPC,2007). The main field coal mine is the property of PPC S.A. (Fig.1)
- Amyntaio coal mine (Fig.2), which is located inside of the Amyntaio lignite basin and is approximately 30 km northwest of the Kardia coal mine. It is the property of PPC S.A.

- Klidi coal mine Fig.3, which is located in the eastern-southeastern boundary of the entire Florina mining area, approximately 22 km east–southeast of the city of Florina (Louloudis et al., 2019). It is the property of PPC S.A

- Achlada coal mine (Fig. 4), which is located inside the Florina lignite basin and is approximately 40 km north of the Amyntaio coal mine property of ACHLADA COAL MINES S.A

- Servia coal mine which is located 12 km south of the town of Servia and 30 km south-east of the town of Kozani, in the Kozani Prefecture. Servia coal mine is property of LARCO S.A (Kapageridis et al., 2020)

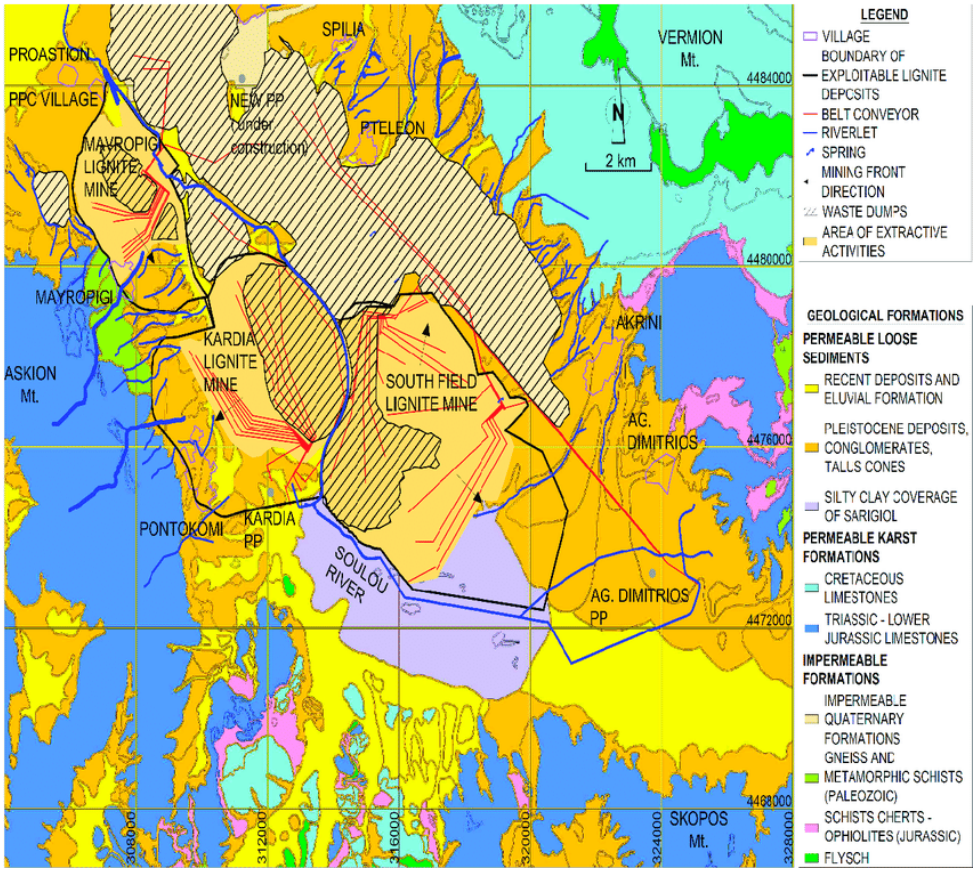

Figure 1: Geological map of the western Macedonia Lignite Centre (Ptolemaida mines) (Pavloudakis, F.; Roumpos, C.; Karlopoulos, E.; Koukouzas, 2020).

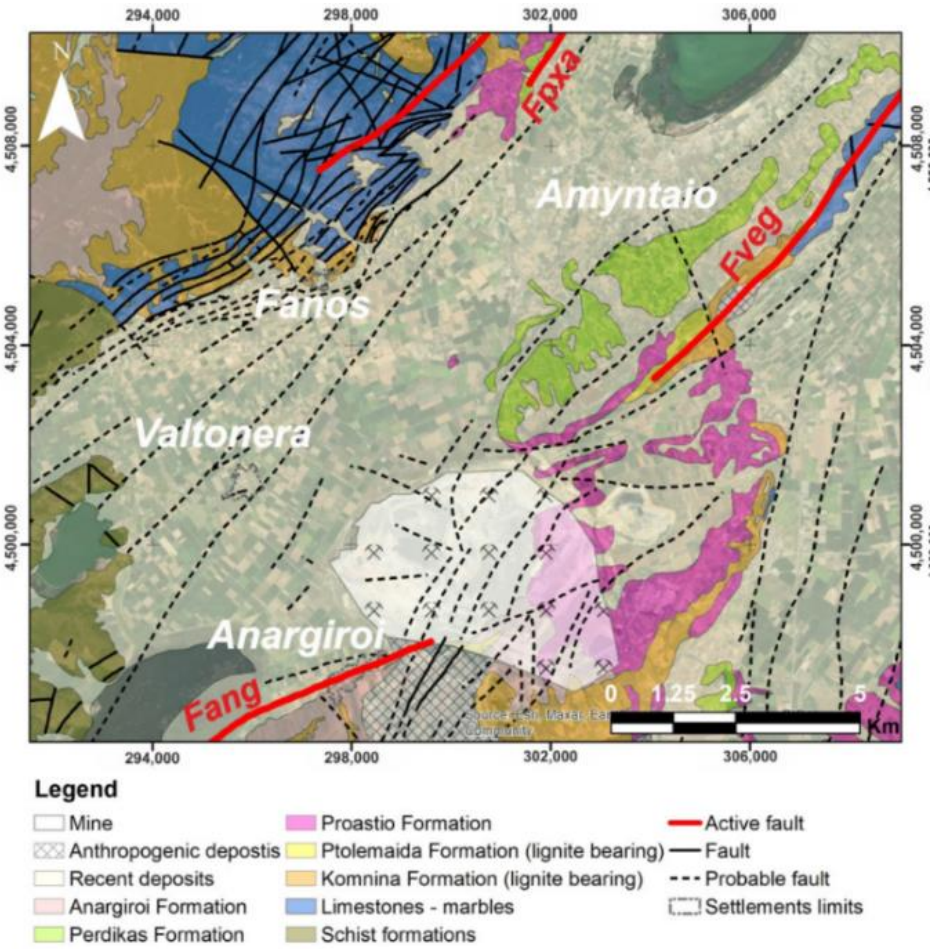

Figure 2:Geological map of the Amyntaio basin (Tzampoglou and Loupasakis,2023).

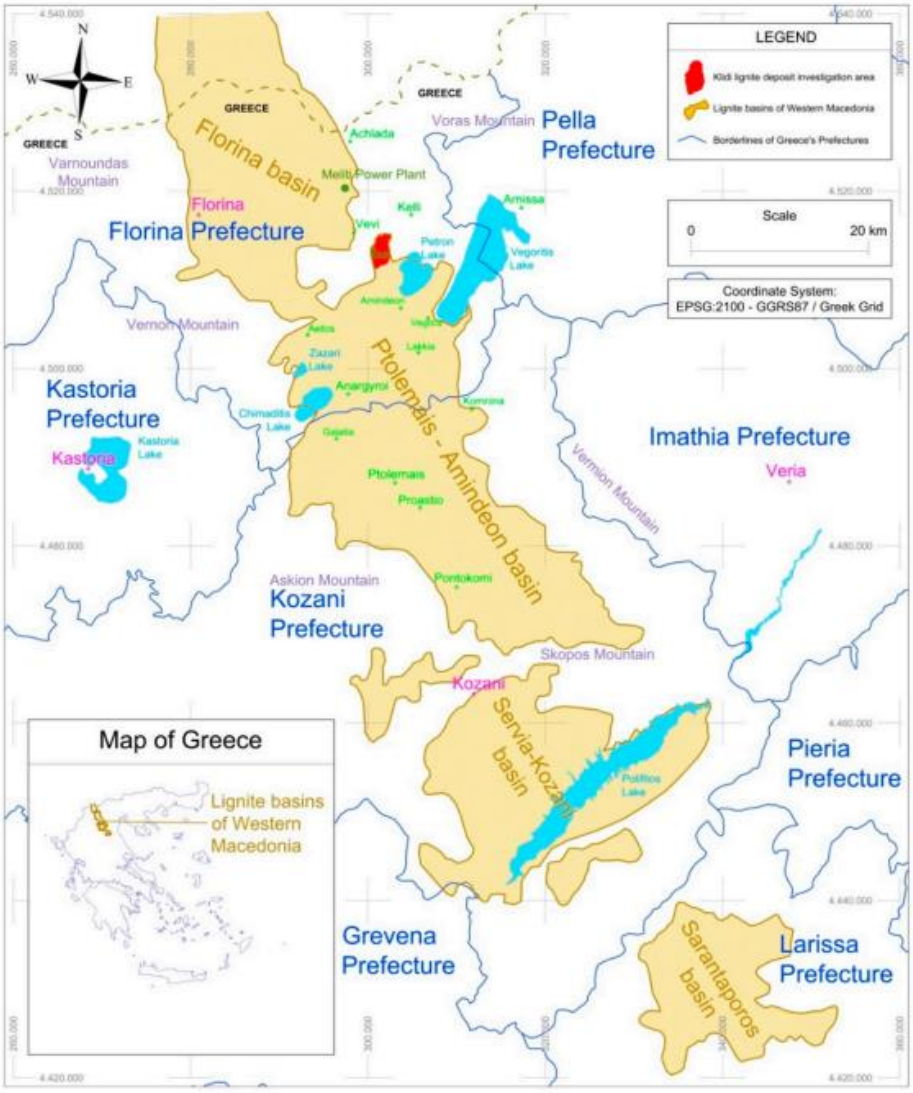

Figure 3:Simplified map of the tectonic basin that extends along the axis Florina–Ptolemais—-Kozani and the study area (Louloudis et al., 2019).

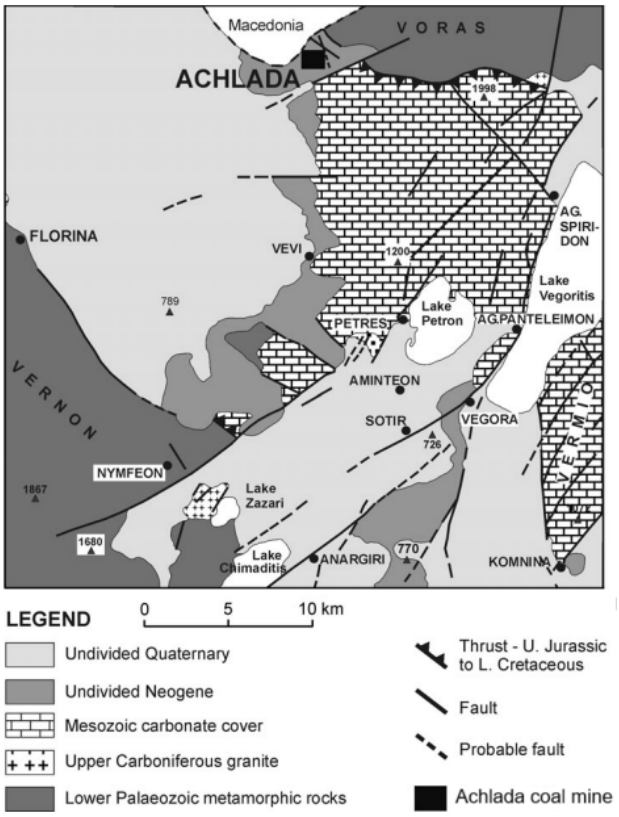

Figure 4: Geological map of the Florina Basin (Oikonomopoulos et al, 2008)

3.1.2 Production

The intensive exploitation of lignite deposits in the region of Western Macedonia, began in 1956 and continues to this day. At the peak of lignite activity, between the years 2001–2004, lignite production in Western Macedonia exceeded 55 million tons per year (Fig.5), while in the period 2005–2015, it was followed by a decline to the levels of 30–45 million tons per decade (Ziouzios et al. 2021). Since lignite activity will end in 2028, it is estimated that lignite extraction in the period 1956–2028 represents 1792 million tons of lignite (Ziouzios et al. 2021).

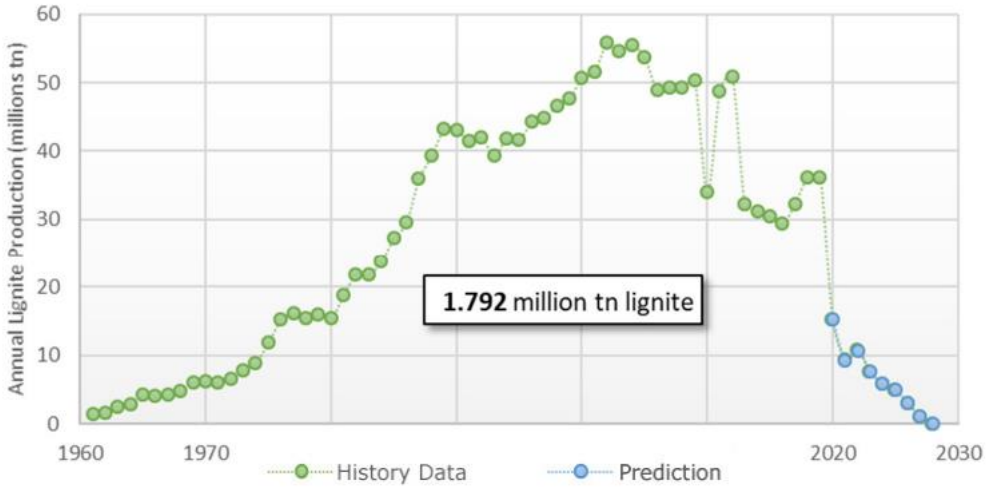

Figure 5: Lignite production in the Mines of Public Power Corporation (PPC) SA in the region of Western Macedonia (Sotiropoulos et al., 2020)

Western Macedonia's Gross Domestic Product (GDP) increased as a result of mining activity, powered by lignite-producing operations that provided jobs and money in the region (Ziouzios et al.2021). The regional GDP peaked at 5.04 billion Euros in 2009, before plummeting to 3.92 billion Euros in 2016 as a result of a fall in lignite output mixed with the commencement of Greece's economic crisis (Ziouzios et al. 2021).

3.1.3 Employment

The main part of Western Macedonia's employment is concentrated in sectors directly or indirectly related to the use of its natural resources (Fig.6) (Christiaensen and Ferré, 2020). Agriculture, forestry, and fishing constitute the largest sector of employment with a percentage of 21%. Specifically for the agricultural sector, the cultivation of non-perennial crops covers more than 10,000 jobs (12% of total employment in the region). Agriculture, forestry and fishing are followed by transport and storage with 14% of total employment and public administration with 11%. Regionally, mining and power generation each account for 5 % of available jobs (Christiaensen and Ferré, 2020).

However, the same authors refer that most of the region's Gross Value Added (GVA) comes from the industrial sectors (mining, electricity generation and water supply). Also, 50% of Western Macedonia's GVA comes from the traditional industrial sectors, highlighting the preeminence of this sector. In particular, in the regional units of Kozani and Florina, the industrial sector is particularly important, because it represents 60 and 49 % of the GDP respectively (Fig 6). Public administration represents the second largest sector in Western Macedonia (16% of regional GPA). Finally, wholesale and retail trade, tourism, and transport come in third place (11% of regional GNP).

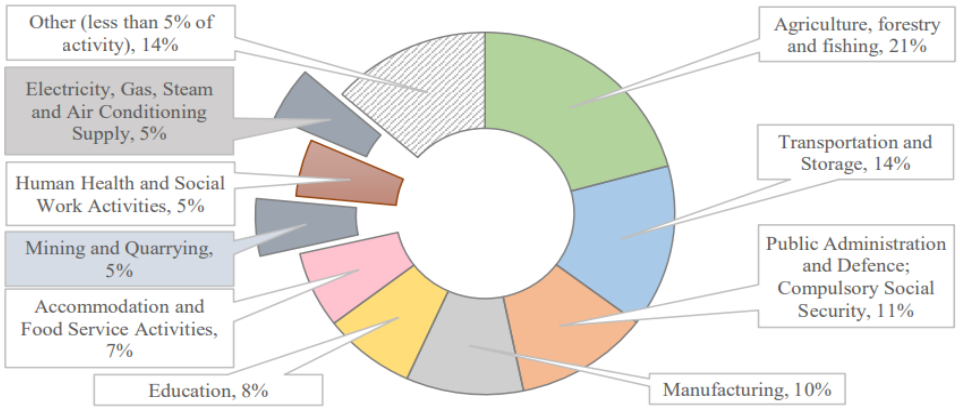

Figure 6: Employment in Western Macedonia (Christiaensen and Ferré, 2020)

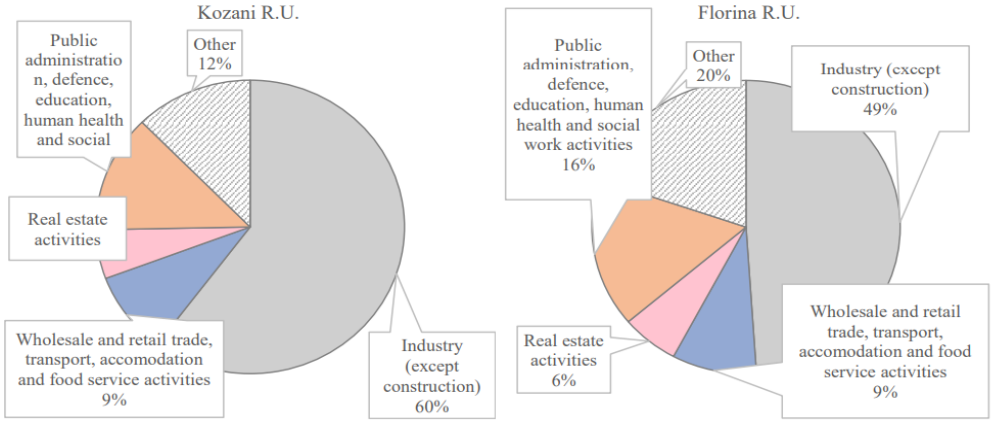

Figure 7: GVA in regional units of Kozani and Florina (Christiaensen and Ferré, 2020)

Until the September of 2020, approximately 3,200 people were employed at the Lignite Center of Western Macedonia, while approximately 2,000 jobs are maintained by the satellite companies that operate in the region and cover the ongoing needs of PPC SA. Based on these data and the decarbonization era, Western Macedonia faces high threats and the region will be asked to redefine and adapt its production model and create a new and productive environment with a focus on the development of new activities (Vlassopoulos, 2020, Ziouzios, 2021).

Western Macedonia faces decarbonization, which creates socio-economic challenges, as lignite-related activities account for 34% of regional GDP, as well as structural weaknesses because unemployment rates in the region are already high, there is low diversification in the productive model as well as limited innovation possibilities (TRACER, 2019 and Ziouzios et al., 2021). The decarbonization in Western Macedonia is expected to lead to a large reduction in regional GDP and the loss of 21,000 jobs. The region's long-term dependence on lignite activities has created structural economic problems as well as structural socio-economic conditions, which cannot be addressed only by short-term interventions but require a restructuring of production policies (Ziouzios et al. 2021).

3.2 Activities and solutions to achieve decarbonization

In order to address the socio-economic impacts of decarbonization, the Greek government announced a Master Plan for the Just Development Transition (JDTP) (see section 2). The Master Plan for the Just Transition for Western Macedonia is based on five main development pillars (Government Committee SDAM, 2020):

- Development of clean energy
- Smart agricultural production
- Research, innovation, technology and education
- Industry manufacturing activities and trade
- Sustainable tourism

Additional proposed actions that have been made in order to achieve decarbonization, include the construction of an e-mobility industrial park, a battery production facility and a 1.5 GW hydrogen production facility, the construction costs of which amount to €5 billion (Ziouzios et al,2021).

According to the master plan, the new jobs estimated to be created by 2028 amount to 6000 (Government Committee SDAM, 2020). These jobs may replace the lost jobs related to the mining and use of lignite, but also be filled by the long-term unemployed of the region which will lead to the influx of new highly skilled labor, combined with the absorption of the affected human potential in the affected areas (World Bank, 2020).

In the beginning, most of the new jobs will be in the restoration of mine lands and the development of clean energy projects. The construction phase of the investments will absorb the lost jobs of the technical staff of Western Macedonia, as it requires similar skills and qualifications (Government Committee SDAM, 2020). After the phase of the construction, the demand for professional skills may change. The creation and operation of new companies in the area will increase the demand for skilled personnel, while the further diversification of economic activities will create a demand for the skills of agriculturists, winemakers, farmers, tourism professionals, and administrative employees (Government Committee SDAM, 2020). It has been estimated that around 50% of the PPC workforce and the short-term local unemployed may need reskilling to be absorbed into new jobs, so the combination of employment programs with reskilling is a good solution and will allow workers to be quickly absorbed into the labor market and contribute in attracting new investments (Government Committee SDAM, 2020, DeCarb, 2021, Ziouzios et al., 2021).

4. Socio-Economic Impact of Coal Phased-Out

4.1 Methods and Programs transforming the mining industry

- **Economic Diversification:** Implement policies to foster the diversification of local economies in coal-dependent areas. To compensate for the loss of coal-related jobs, encourage the growth of new industries such as renewable energy, technology, and tourism.

- **Skills Training and Education:** Encourage funding for training initiatives to aid coal miners in making the shift to different sectors. This can entail getting retrained in industries like advanced manufacturing, renewable energy, or other related ones. Many factory workers specialize in one thing that is difficult to address in other jobs, so giving them the opportunity to be trained in another field also supports them psychologically and gives them hope for the future.
- **Support for Small Businesses:** Highlight the importance of providing financial support and incentives for small businesses to grow and create jobs, especially in regions where the coal industry once dominated. Small businesses are the key to success in such rural areas.
- **Technology Adoption:** Encourage the use of automation and cutting-edge mining technology to boost productivity, lessen the impact on the environment, and guarantee worker safety.
- **Research and Development:** Stress the need for research and development funds to investigate environmentally friendly mining methods, mineral recycling strategies, and creative resource extraction methods.

4.2 Effects of Transformation in Coal-Dependent Regions

- **Community Resilience:** Encourage community participation in transformation-related decision-making processes. Strong community involvement helps mitigate the psychological and social effects of economic change.
- **Health and Well-being:** Suggest studies on the health effects of transitioning away from coal, both positive (reduced pollution-related health issues) and negative (potential job loss-related stress).

4.3 Programs and Strategies for Socio-Economic Support

- **Job Creation:** Encourage the implementation of job-creation initiatives like funding for infrastructure improvement, environmental restoration, and renewable energy projects.
- **Regional Redevelopment Plans:** Encourage the creation of detailed strategies for reusing post-mining regions. This might entail converting abandoned mine sites into parks, gardens, or even renewable energy farms. Many ideas will be implemented through the CoalHeritage project.
- **Entrepreneurship Support:** Highlight the importance of supporting local entrepreneurs and startups in coal-affected regions, providing them with resources and mentoring to help diversify the local economy.
- **Education and Training Centers:** Establishing training facilities or institutions that emphasize imparting knowledge of skills necessary for the changing labor market and assisting people in adjusting to new opportunities.

5. Integrating coal heritage with the transition goals

In Western Macedonia, there are a few successful initiatives and strategies for the protection and re-use of coal heritage in the respective of the transition process. In this section examples

of these initiatives to integrate coal heritage into sectors such as tourism and culture are being presented.

5.1 Museums

5.1.1 An exhibition space by PPC

A building inside the inactive Ptolemaida power plant houses an informal museum of lignite, an exhibition space maintained by PPC, where tools, documents, small machines, and large machines have been gathered and stored with the hope that they will serve as the foundation for the creation of a museum deserving of the importance of the region's "black gold" in terms of electricity production and contribution to the national economy.

There are a ton of artifacts that the workers have amassed since the first power plant was inaugurated on October 28, 1959, according to PPC official officers in charge of the preparation and decommissioning sector of the Ptolemaida-LITOL power plant, including, among other things, the first carpenter's bench with all the tools, breathing apparatus with helmets, tools, bags, the opening flags, and tableware with the Company's logo. The first 109 employees' personal cards, as well as the handwritten organizational chart with their names and specialties, file with that information, attire, shoes, and a large number of photos, have all been preserved. Despite the efforts to collect them all, the variety of items and equipment is endless.

5.1.2 Paleontological Museum of Ptolemaida

The Historical-Paleontological Museum of Ptolemaida is another one of Western Macedonia's most distinctive institutions. The preservation and transmission of the area's history and prehistory serve as the museum's primary focus of action and operation. Paleontological artifacts from the Western Macedonia region and the basin of the Eordaia, dating from a few hundred to a few million years ago, are displayed in the museum's permanent exhibition. Visitors can find out how the prehistoric forests in the area gave rise to the lignite deposits of Ptolemaida and hear about the tales of the tusks, bones, and teeth of the animals that lived in Eordaia during the ice age once told. The skeleton of the Amyntaio's mammoth, a woodland mammoth that stood over three and a half meters tall, is one of the museum's most stunning exhibits. The history of the evolution of life on Earth is covered in great detail in the paleontological display. It contains fossils that date back to the planet's earliest signs of life, which are billions of years old and come from all across the world. Fossils of representative animals and plants, dating from the time of the dinosaurs to the most recent geological period, are also on show. The museum holds transient exhibitions all year long that focus on regional history, the visual arts, or natural history. Music or other events can be held in the museum's covered atrium.

5.2 Books

The economic and social history of Western Macedonia is significant since it relates to the nation's overall economic growth and its 20th-century energy independence. In what is now the

Kozani region, where the majority of Greece's lignite deposit is concentrated, energy played a vital role for 60 years.

There are books (Lambrou Nikos, 2010) where the complete history of the discovery and methodical exploitation of this natural wealth is presented in detail. This history was connected to the aspirations and desires of the local populace, and it determined all the changes that marked Kozani and Ptolemaida.

Furthermore, the PPC had the idea of a book about lignite aimed at children. This proposal was developed by Alexis Kyritsopoulos, who designed, wrote, and illustrated the publication (Kyritsopoulos Alexis, 2000). The book is available in the elementary school libraries in Greece. Additionally, every year, educational field trips are planned for students to visit power plants where they can observe and learn about all the steps involved in producing electricity.

Pavlidou's recent work emphasizes the struggle of the refugees from Eordaia for survival, development, advancement, and contribution—nearly 100 years after the discovery of lignite in Western Macedonia. It also emphasizes the history and significance of the surrounding area through documentation and rich photographic material (Pavlidou Miranda, 2023).

5.3 Memorial Park and Events

In Ptolemaida, there is a park at the northern entrance of the city that was created in honor and as a memorial of all the workers who lost their lives for the production of electricity, whether they were workers in the mines or power stations. In the park, certain events are organized from time to time, the most important being the "Lignite Memories" road race.

Every year on October 1, the “Lignite Memories” are organized by the PPC "Spartacus" power generation association. This is a national race co-organized with PPC. While it started as a simple sporting event, it has become an institution known and recognized in the Panhellenic. The organizers aim to establish “Lignite Memories” as an event that will honor the lignite miners. Those who sacrificed their lives on the altar of duty for the production of electricity. The event is dedicated to all mine workers who work under harsh, adverse, unpredictable, and dangerous conditions with zeal, self-denial, and consistency.

Figure 8: Lignite mines in the Eordaia basin (E. Giouvanidis, personal archive, 2014)

6. Best practices

In Greece, there had been no previous history of lignite mine closures before the period of the last years of de-carbonization except for the Aliveri lignite mine. The Aliveri lignite mine, in Evvoia, was an underground mine owned by P.P.C. until 1980, when it was sealed. During the latest years, in the Amyntaio and Kardia lignite mines, part of Western Macedonia Lignite Centre, all mining operations were ceased. Ptolemaida power plant houses an informal museum of lignite, an exhibition space maintained by PPC, where tools, documents, small machines, and large machines have been gathered and stored with the hope that they will serve as the foundation for the creation of a museum deserving of the importance of the region's "black gold" in terms of electricity production and contribution to the national economy.

6.1 Drivers of change and their relationship to coal mine closure according to the World Bank

Mine closure creates disruptions with social and labor impacts which, if anticipated, can be effectively mitigated. In most of the countries examined by the World Bank, the closure creates rapid disruption in the coal mining sector (World Bank,2018). Based on these, it is observed that if a country has a large population of coal workers, especially in labor-intensive and inefficient mines, then the divestment of labor in the coal industry will suddenly release huge numbers of people into social welfare services, straining and possibly overwhelming the system (World Bank, 2018). For example, Russia, Ukraine, Poland, and Romania where employment losses close to 2 million in a decade, falling from 2.7 million workers in 1990 to less than 1 million in 2001 (World Bank,2018). More recently, employment in the coal industry in China has declined by over 2 million workers from over 5 million coal workers in 2013 to less than 3 million workers in 2018 (World Bank,2018). Governments can predict the progression of mine closures by understanding the following drivers of change and their impacts (World Bank, 2018):

- Mine mechanization: Technical improvements in coal mining continue to be introduced in response to macroeconomic and business pressures. The result is the consolidation of operations by shifting production from less efficient mines to more efficient mechanized operations. The result is the loss of job positions (World Bank, 2018). Mechanization causes employment to be displaced from mines, which helps create economic resilience by increasing productivity (World Bank, 2018).
- Clean energy policies: Includes local and regional air pollution prevention programs, low-carbon and clean energy development agendas, and worker and community safety initiatives (World Bank, 2018). Progressive government policy interventions in favor of

alternative energy sources over the past fifty years include the following (World Bank, 2018):
    - policies to reduce air pollution
    - policies and programs that address climate change, including an energy transition favoring lower-carbon energy sources
- Innovations in the energy market, which has two aspects (World Bank, 2018). First, the slowdown in coal demand, driven by energy efficiency measures, allowed global energy intensity to fall by 2.8 percent in 2015 and 2 percent in 2016. Government energy efficiency policies and regulations have supported this transition. through standards, building plans, public financing, and tradable energy certificates, resulting in a large increase in the absorption of energy efficiency investments (World Bank, 2018). The second aspect is a broad change in energy supply with reduced costs and increased availability of alternative fuels such as renewable energy and natural gas (World Bank, 2018).

United Kingdom, Russia, and the United States show strikingly different driver output results. Employment in coal mining has fallen significantly in all three countries. The production results for each country are analyzed below (World Bank, 2018).

6.2 Russia

In the late 1980s and early 1990s, Russia was led to adjust its coal sector as part of broader macroeconomic reforms. As the economy minimized, demand for coal fell, and the government initially tried to support the coal industry with subsidies to cover losses, rather than closing mines, making layoffs, and cutting losses (World Bank,2018). However, the subsidies became unmanageable and reached more than 1 percent of GDP in the early 1990s. From 1990 to 1998, coal production fell by just over 40 percent, while employment fell by 60 percent. From 1999 to 2001 the coal industry was privatized (World Bank,2018). The overall impact has been a significant recovery in coal production since 2000: well over 350 million tonnes of production in 2016. Even as production increased, the industry continued to lose employment (World Bank,2018). Due to long delays in the payment of wages and a lack of income support, during the 1990s hundreds of thousands of miners left their jobs. As the crisis deepened, the government designed and implemented a program of sectoral reform that included the provision of resources for a social protection response in the form of back wages and severance payments (World Bank,2018).

6.3 United States

The two main drivers of change in previous decades were, first, economic growth, which led to a steady increase in demand for electricity, and, second, mechanization, which led to increased productivity and declining employment during the 1980s (World Bank, 2018). Clean air policies led to new emission standards in the 1990s, which further disadvantaged coal production with higher sulfur content compared to coal production with lower sulfur content (World Bank,2018). Employment also fell sharply during the 1990s. However, after several decades of steady growth, coal production and consumption fell sharply from 2006 to 2015 due to competition from shale gas and renewable energy (World Bank, 2018). Coal's share of electricity generation fell from 40

to 33 %, while gas-fired electricity generation increased from 22 to 34 % and electricity generated from renewable sources increased from 8 to 15 % from 2006 to 2015 (World Bank,2008). In the United States, social distress has been building steadily since the 1980s and has only received significant attention in the last decade. Even so, there is significant poverty in coal-producing regions, particularly in Appalachia (World Bank, 2018).

6.4 United Kingdom

The initial driver of change was clean energy policies as the government sought to reduce air pollution. The government then turned to clean energy as competitive pricing and availability of oil and natural gas increased alternative energy sources (World Bank,2018). The less efficient mines closed first and in the 1960s employment fell by 52 % while coal production fell by 26 %. In 2016, coal production fell to 4 million tonnes while employment fell by 1,000 workers (World Bank,2018).

During the closure of the mines social distress was minimized with the following policies (World Bank,2018):

- Provision of pensions to the workers of the closed mines
- Transfer of workers to still-operating mines

With the passage of time and the closure of more mines social conflicts increased. During the 1970s and 1980s social conflicts peaked, creating a complex political economy for government reforms (World Bank, 2018).

6.5 Examples of areas where mining activities have been closed

Below are the best practices of rehabilitation and economic restructuring carried out in areas where coal was the main mining material.

6.5.1 The Northumberlandia Restoration Project, England

The Northumberlandia Restoration Project is a prime example of the possibility of combining mining activities and public land use. It was completed in 2012 in the Cramlington area, Northumberland in Northern England, and is considered to be the first example of restoration carried out while mining activities were still operating (WWF,2016). A part of the restored area was turned into a public park and the cost of the project reached £3 million (approx. €3.5 million) (WWF,2016). Both the creation and maintenance of the park are financed by the Mining Group and Blagdon Estates banks (WWF,2016). The park is open to the public and consists of four miles of trails on an area of 47000 m^2(WWF,2016).

6.5.2 Municipality of Zeitz, Germany

The municipality of Zeitz is part of the Saxony-Anhalt region in East Germany, south of Leipzig. In the past, the Zeitz was characterized by intense mining activity, with over 20 mines and many power plants. Today only a few mines remain, which supply the two remaining power plants (WWF,2016, Avramopoulou,2022,). After German reunification, the new Federal Republic of Germany decided to restore all closed mines. For this reason, the creation of 21 artificial lakes was carried out for the restoration of the affected areas, with a typical example being Lake

Geiseltalsee 86. The implementation of the transition program was carried out by LMBV87 which was established after the dissolution of the mining company MIBRAG (Avramopoulou, 2022).

The municipalities have approved a special plan for land restoration. A separate fund was created for rehabilitation purposes, using mining revenues. The fund was managed by local authorities, while companies were asked to commit to rehabilitation works to get permission for mining activities in new areas (Avramopoulou, 2022). Large investments were also made in the area in the field of waste management (WWF, 2016, Avramopoulou, 2022).

6.5.3 Ruhrgebiet, Germany

Ruhrgebiet is located in the federal state of North Rhine-Westphalia, Germany. From the late 50s, the Ruhrgebiet gradually began to move towards deindustrialization, as a result of increased mining costs and the progressive substitution of coal for oil, natural gas, nuclear power, and cheaper imported coal. This required a long and progressive restructuring of the local economy (WWF,2016, Avramopoulou,2022). As governments realized the magnitude and difficulties of this transition, they undertook important initiatives as early as the 60s to address the potential impact on the local economy, implementing development programs aimed at addressing structural weaknesses in the labor market, the retraining and diversification of the workforce towards new activities, the promotion of technological innovation and the redesign of residential areas (WWF,2016, Avramopoulou,2022).

The interventions were designed at a local scale and required the collaboration of local authorities with chambers, local businesses, banks, and coal industry unions. Networks were also created between the communities and the 32 regional authorities of the mining areas, to protect and characterize industries and cultural heritage as part of promoting tourism development (WWF,2016, Avramopoulou,2022).

Today, the Ruhrgebiet region has managed to develop new sectors of economic activity, mainly oriented towards information technology, biomedicine, environmental protection, technologies, and others. The region has created one of the densest networks of academic institutions in Germany (5 universities and 8 technical schools) and technology centers and is home to over 600 companies (WWF,2016, Avramopoulou,2022).

6.5.4 Loos-En-Gohelle, France

Loos-en-Gohelle is a commune of 7000 people in the Pas-de-Calais department of the Hauts-de-France region of France. Since 1850, Loos-en-Gohele has had coal mines. With the gradual cessation of mining activity, the area faced an uncertain future, with the possibility of a local economic collapse and major environmental difficulties. Avramopoulou et al., 2022). Sustainable development strategies, based on the active participation of citizens, were established by the municipal council in 1997. The following were the key policies undertaken in Loos-en-Gohelle (Avramopoulou, 2022):

- Extensive energy-saving measures in existing municipal buildings and former workers housing

- Exploitation of clean forms of energy by installing photovoltaic plants in the restored mines and the deposit areas and planning the future exploitation of wind energy through the construction of 6 wind turbines.
- Creation of a research center to test 24 solar technologies in collaboration with engineering research schools
- Creation of a support and development center for more than 600 "green businesses"

Finally, in 2012, the Nord-Pas-de-Calais mining region, and its related facilities, were designated as a UNESCO World Heritage Site (WWF, 2016).

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Appendix 2 GERMANY

Research & Innovation
Research Fund for Coal and Steel

Conservation and Promotion of the Coal Mining Heritage as Europe's Cultural Legacy, grant agreement No. 101112138

Work Package 2 - Deliverable 2.1

Report on the Coal Transition Strategy of the Partners Project Countries - Germany

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2.1 Introduction - Coal Extraction Background

For over two centuries, coal played a crucial role in fostering Germany's economic and industrial progress. The contemporary issues related to the gradual abandonment of coal due to environmental concerns, along with the ongoing political discussions on this matter, needs to consider the historical significance of coal and its gradual decline in recent decades.

After World War II, Germany divided into West and East Germany. The primary underground hard coal mining operations mainly located towards West Germany, while in East Germany, hard coal extraction was limited in scale and ceased by 1978. Regarding West Germany, domestic hard coal reserves held a significance that extended beyond their role as an energy source. They played a pivotal role in the country's post-war industrial reconstruction, contributing to what became today as the "economic miracle". The importance of these coal reserves, reaching beyond Germany, was exemplified by the establishment of the European Coal and Steel Community (ECSC) in 1951 (see Figure 1), which included Italy, Belgium, France, Luxembourg, and the Netherlands. Over time, the ECSC evolved into the predecessor of the European Union (EU) (Herpich et al., 2018).

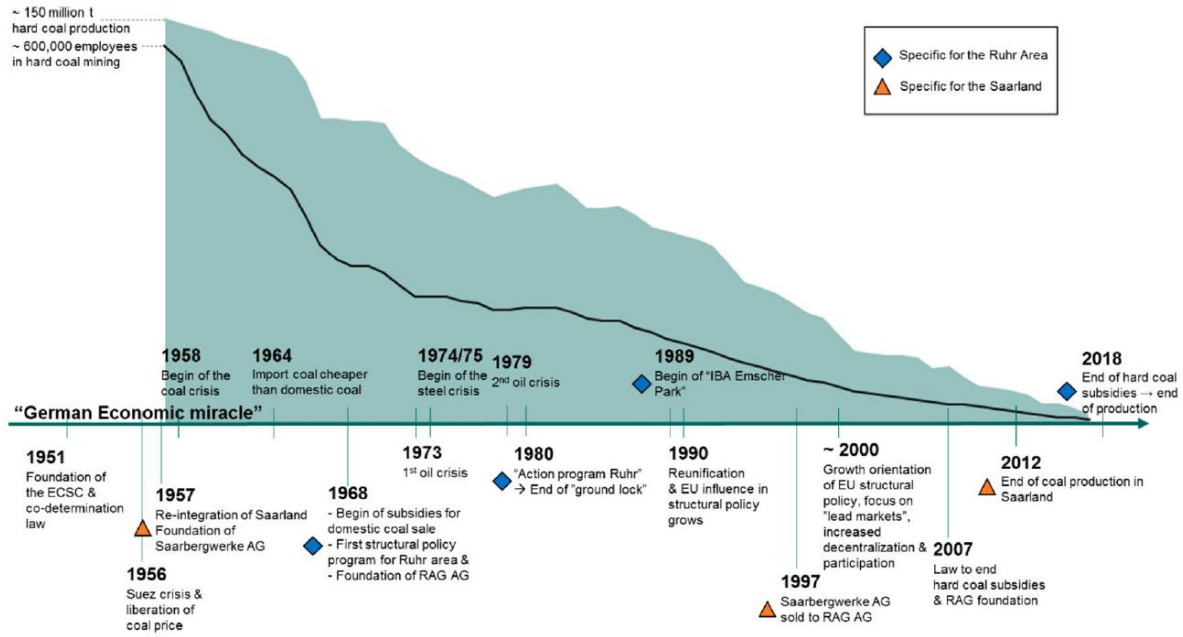

Figure 1. History of hard coal production in Germany and structural policy programs in the Ruhr area and Saarland from 1951-2018 (Modified from Oei et al., 2020).

Lignite mining took place in both West and East Germany; however, the eastern region primarily served as the key energy source. This was due to the socialist countries reduced to rely on fuel imports. By the middle of the last century, Germany was the second largest coal producer in Europe (second to the UK). Mining activities were heavily concentrated in the Ruhr Area, which accounted for over 80% of Germany's hard coal production. By 1957, employment in this sector reached its zenith, with more than 600.000 individuals employed. Approximately 500.000 of these jobs were directly related to coal mining in the Ruhr Region. Coal served multiple purposes, not only as a source of power and heating but also as a crucial component in steel manufacturing. Consequently, the Ruhr Area retained its status as the industrial hub of Germany (Herpich et al., 2018).

Lignite-fired power plants and lignite opencast mines in Germany are primarily clustered in the Rhineland, Lusatian, and Central German coal regions. In contrast, hard coal-fired power plants are distributed more evenly throughout the country, with a significant concentration in the Federal States

of the former Western Germany. The economically unviable hard coal mines that remained in operation were shut down in December 2018 (see Figure 1) due to European regulations that prohibited previous subsidies.

The shift away from coal is not solely a matter of structural change, involving technological and economic transitions. It also carries significant cultural and emotional weight. In many coal regions across the globe, mining holds a central place in the regional identity. This might be truer for underground hard coal mining compared to open pit lignite mining, because the risks of working underground have formed a strong sense of comradeship in mining communities (Dudău et al., 2019). RAG has been a key institution helping to govern the phasedown, and eventually phase-out of coal mining (see Figure 1). With the formation of RAG in 1998 , all separate coal-mining companies merged into one (private) corporation. In doing so, it was possible to manage the transition more efficiently (close down those mines first, which were economically least competitive), and at the same time provide solutions for laid-off workers (they could more easily transfer to another mine as it was now one big company).

In this chapter, the current situation of closed hard coal mines, executed plans, created legislation frameworks and social-economic impacts will be covered to describe the transition strategies and the coal and industrial heritage preservation achieved so far during the coal phased-out era in Germany.

2.2 Legislation, Policy and Regulations

Since there is no specific legislation exclusively dedicated to mine closure in Germany, the applicable laws, regulations, and guidelines concerning mine closure and post-mining activities within the European Union, Germany, and the state of North Rhine-Westphalia (NRW) are summarized in Table 1.

Table 1 Legislation framework for post-mining (European Commision, 2021; European Commission, 2019; Tracer, 2023; Plinke and Wildhage, 2003).

Scope	Regulation Name
EU guidelines	• Extractive Waste Directive 20062 1/EC. • Water Framework Directive 2000/60/EC • Environmental Impact Assessment (ELA) Directive 2014/52/EU • Groundwater Directive (GWD) 2006/118/EC • Integrated Pollution. Prevention and Control (IPPC) Directive 2008/1/EC • Environmental Liability Directive 2004/35/EC • Fauna Flora Habitat Directive (FFH Directive or Habitat Directive) 92/43/EEC
German Acts	• Federal Mining Act (BBergG) • Federal Soil Protection Act (BBodSchG) • Federal Soil Protection and Contaminated Sites Ordinance (BBodSchV) • Federal Water Act (WHG) ature Conservation and Landscape Management Act (BNatSchG) • Federal Forest Act (BWaldG) • Prevention and Remediation of Environmental Damage Act (USchadG) • Federal Spatial Planning Act (ROG) • Circular Economy Act (KrWG)
NRW Acts	• Law for the implementation and supplementation of the BBodSchG in NRW • State Soil Protection Act (LbodSchG NRW) • State Water Act (LWG NRW)

	• State Spatial Planning Act (LPIG NRW) • Federal / State Working Group on Water (LAWA) • State Working Group on Waste (LAGA)

The European Union (EU) is a unique entity that does not fit the traditional mold of an international organization or a federal state. Instead, it functions as a supranational organization comprising twenty-seven member states, each with its own legal order. This arrangement serves as an integrated legal system, where Member States collaborate with the EU to ensure the effective and proper enforcement of EU laws. The EU has the power to enact legislation binding on all Member States and the authority to enter into international agreements. A Directive is a type of legislation that has to be implemented in the national legal orders of Member States in a manner as to guarantee that the objectives prescribed in it are attained in that State. Member States have a choice or discretion as to how this is ensured (European Commision, 2021; European Commision, 2019; Tracer, 2023).

The German Federal Mining Act (Bundesberggesetz-BBergG) is the basis for all national directives and administrative acts applying to the mining industry. It covers all mining activities from the exploration phase to the production and processing of mineral resources up to the after-care phase and the reutilization process for abandoned areas. The clear advantage of having a single authority responsible for granting permissions in the mining industry lies in its familiarity with the sector's dynamics and site-specific conditions. This mining authority is exclusively authorized to approve all framework plans, contingent upon ensuring that environmental impact remains minimal and that any inevitable disruptions associated with mining are strictly limited to what is necessary. This has to be stated by the environmental impact assessment study as the most important part of the framework plan (Plinke and Wildhage, 2003). Since Germany is a federal republic, the states are entitled to define the general terms of the federal legislation. The mining authorities control will only end when no more dangers from the decommissioned mine can reasonably be expected. Once it is assured that the former mining site presents no hazard to the environment and the public, the mining authority will release the site from its surveillance. This, however, only means that as of this date the general supervising authority, the regional department for mining and energy will now control the site. This authority will then oversee all legal requirements, taking over from the previous responsibility of the mining authorities. If problems should arise, the offender - that is the former owner of the mine or the person that committed the acts leading to the pollution - will be held responsible for securing or safeguarding measures. If an offender is no longer in existence or cannot be identified, the state will have to step in, which the state tries to avoid or at least postpone for as long as possible because of financial reasons. For example, in NRW, for the surface openings (shaft and adit entrance), which do not have any legal succession, Arnsberg Regional Government`s Department of Mining and Energy is responsible (Bezirksregierung Arnsberg, 2023).

2.3 Hard-Coal Mines Closure and Transformation Plan

In the Federal Republic of Germany, the last hard coal mine in the Saar Region was closed in 2012, and then the last two remaining hard coal mines in Northrhine-Westpalia, Prosper-Haniel in Bottrop (Ruhr Area) and Ibbenbüren (Osnabrück Region), at the end of 2018, as shown in Figure 2. On 7 February 2007, the Federal Government, the State Governments of North Rhine-Westphalia and Saarland as well as the German Hard Coal Corporation (RAG Corporation) and the Trade Union for Mining, Chemical and Energy (IG BCE) reached an agreement on the socially acceptable phasing out of subsidies for hard coal in Germany by the end of 2018. Based on this agreement the RAG Foundation was established on June 26, 2007 in order to liquidate the German hard coal industry in a socially acceptable way and to finance the perpetual tasks of hard coal mining (RAG-Stiftung, 2023a). This closure process is regulated by a corresponding framework agreement concluded on 14 August 2007 between the Federal Government, the coal-mining states and the RAG Corporation, and by the Hard

Coal Funding Act, which came into force in December 2007. The Act amending the Hard Coal Funding Act, which entered into force in July 2011, repealed the original provision for a review by the German Bundestag of the decision to phase out subsidies.

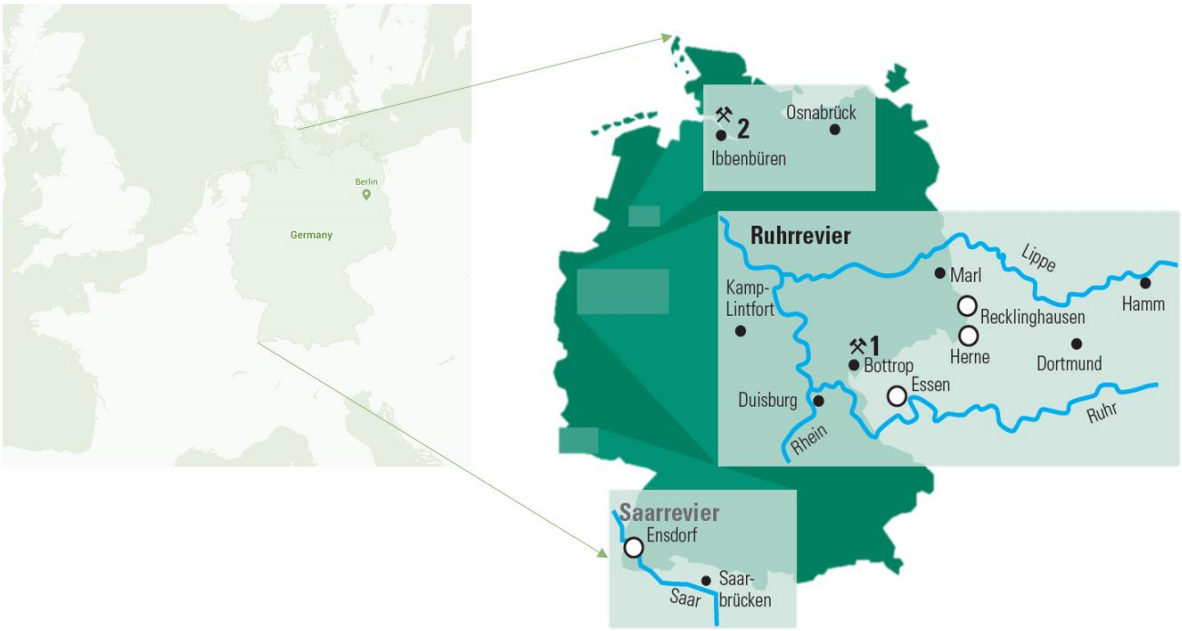

Figure 2. Location of hard coal mines in Germany (GvSt, 2017).

Following the end of hard coal mining, three enduring responsibilities persist: managing pit water, implementing polder measures, and purifying groundwater. These essential water management tasks, as depicted in Figure 3, demand sustained commitment, potentially extending indefinitely. The RAG-Foundation bears the financial responsibility for such perpetual responsibilities. In addition, it funds projects in the fields of education, science and culture in the former mining regions along the Ruhr and Saar Rivers as well as in Ibbenbüren, a smaller mining area included into RAG (RAG-Stiftung, 2022a).

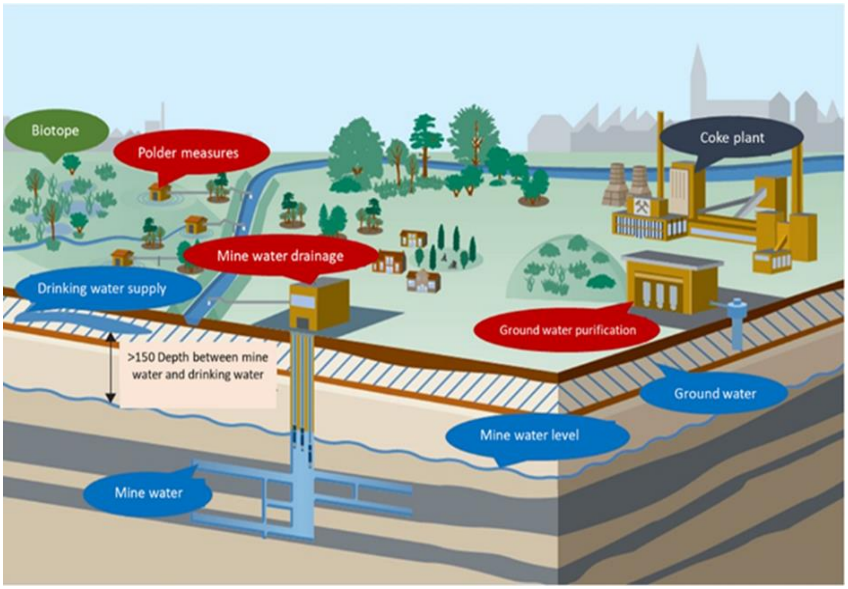

Figure 3. Eternal tasks of the former hard coal mining in the Ruhr area (Modified from RAG Aktiengesellschaft, 2023a).

Such foundation model works with a mix of diversified capital investments with a broad risk diversification including shareholdings, government and corporate bonds, managed funds and equity investments in medium-sized enterprises and real estate companies. However, the foundation generates most of its regular income with the help of its strategic equity investments in Evonik Industries AG, VIVAWEST Wohnen GmbH and its holding company RSBG SE as shown in Figure 4 (RAG-Stiftung, 2023b).

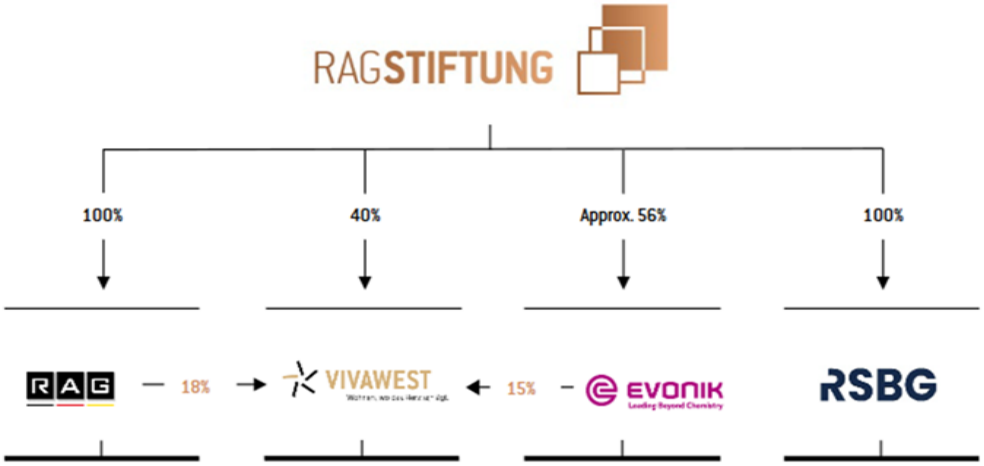

Figure 4. Organizational structure of RAG-Foundation and associated institutions (RAG-Stiftung, 2022b).

Hard-coal mine closures and post-mining activities have followed a more or less regular path, with RAG and mentioned affiliates being the primarily responsible for proper closure and management of perpetual tasks. Each of the three main hard-coal mining areas in West Germany have developed different measures and different structural changes due to the intrinsic conditions of each and the number of mine sites, therefore the history, time-evolution, policies and plans executed for each area might differ and are discussed in particular in the following section.

2.3.1 Saar Area

Hard coal mining has shaped the Saarland for over 260 years. The coal and structural crises that began in 1959 had changed the situation in coal industry. In 1960, there were still almost 53.000 employees in the Saar Area; 10 years later, there were not even 27.000. In 1998, Saarbergwerke AG was taken over by RAG AG, thus the entire German coal industry was collected under the umbrella of RAG. An earthquake caused by mining activities in 2008 had accelerated the end of mining in the Saarland and in 2012 the last operating Saar mine in Ensdorf was closed. (RAG Aktiengesellschaft, 2023b). In this region, RAG AG is the legal responsible institution for taking care of contaminated sites and eternal tasks, which includes the long-term optimization of mine water drainage. The RAG Montan Immobilien GmbH is responsible for the profitable rehabilitation of industrial brownfield sites using the complete real estate value chain. Furthermore, the RAG-Foundation is taking over the financing of the perpetual tasks of the RAG coal industry's as well as promoting education, science and culture insofar as these are related to the German coal industry (RAG Aktiengesellschaft, 2023c).

2.3.2 Ibbenbüren Area

The hard-coal mining in the Osnabrück Region has experienced a long history of more than 500 years. Ibbenbüren Colliery was the most northern colliery in Germany and one of the last two mines where hard-coal extraction was ceased in 2018. Mining took place in the East (closed in 2018) and West (closed in 1979) fields. While the East field is currently being flooded, the mine water from the West

field comes out from the Dickenberger adit without pumping, flows to the Gravenhorst treatment plant and is then discharged into Ems (Melchers et al. 2020; RAG Aktiengesellschaft, 2023d). After the completion of the closure plan, the former shafts constructions as well as dump areas will open up a wide range of options. The I-NOVA Park will be created in Ibbenbüren and in the scope of the project; freed areas could be transformed into an innovative commercial and industrial park. The dump areas will be built for a tourism purposes such as hiking, local recreation and leisure activities (RAG Aktiengesellschaft, 2023e).

2.3.3 Ruhr Area

The Ruhr Area accommodates a population of over 5 million residents within a land area of 4.000 square kilometers. The structure of the cities in this region were highly influenced by the operational needs of past coal mining and steel industrial activities. The transition process in the late 1950s, with the initial closures of coal mines. This decommissioning marked the end of a history that has significantly shaped the Ruhr area over centuries (Moellerherm et al., 2022). Prosper Haniel came to end in December 2018 and was the last colliery in the Ruhr Area. This decommissioning marked the end of a history that has significantly shaped the Ruhr Area over centuries. In the 1950s, the peak of German hard coal mining, more than 600,000 people were employed and worked in 173 collieries in the Ruhr Area, as seen in Table 2. Since the completed retreat from the open mine workings, which finalized the closure of hard-coal mining in the Ruhr mining region, the most extensive mine water rebound has been carried out in a European hard-coal mining region (Melchers et al. 2020).

Table 2 Socially acceptable adjustment of the hard coal industry in the Ruhr Area, Germany (Teichert, 2023).

	1957	**1968**	**2018**	**2022**
Employees	607000	254000	4124	650
Collieries	173	69	2	0
Production	150 MT [Coal]	112 MT [Coal]	2.6 MT [Coal]	100 million m^3 [Water]

As shown in Table 2, coal production decreased after the progressive cessation of hard coal mine operations, but water production related to mine water rebound incremented and is up today one of the perpetual tasks that the RAG Foundation and related qualified employees must take care of. Since the Ruhr Area is the biggest hard coal region, the challenges on successful transform the former mining region still exists. Therefore, the cities and districts in the Ruhr area concluded jointly to cooperate and to initiate an intercommunal decision matching and dialogue process.

2.4 Socio-economic Impacts and Hard Coal Phased-out Structural Change

Converting old coal mining and industrial sites for new economic activities presents several challenges. Firstly, the remnants of prior use, such as soil and water pollution, mining shafts, and outdated infrastructure, necessitate substantial investments in site conversion. Consequently, incumbent entities like mining companies often refrain from selling unused land to delay or avoid these restoration costs. Additionally, they are disinclined to provide land, fearing that new companies in the region may intensify competition for affordable and skilled labor. These factors, particularly the "ground lock," posed a significant obstacle in the Ruhr Valley. Despite substantial public support

programs aimed at economic diversification, only a limited number of new enterprises initially established themselves in the Ruhr Area.

During the last three decades, it has become a common practice incitement of socio- economic transition in the old industrialized locations, in the context of urban renewal, the development of new forms of urban tourism based on culture and events. Additional attempt represents the conversion of closed factories in places of heritage in order to increase the attractiveness of the destination and to create new opportunities for entrepreneurial activities in the field of tourism and services (Hospers, 2004).

As an answer to these challenges, new public institutions were set up. A property fund Ruhr and the "State development society" ("Landesentwicklungsgesellschaft"), which bought and restored former industrial sites, led to an end of the so-called "ground lock" (Metropoleruhr, 2010). This was only possible through a high level of engagement of local and regional governments with the private sector. Besides, policies that supported new industries, regional coordination of efforts was crucial to their success.

Germany has put efforts on create frameworks that combine state support, progressive region development and environmental awareness (Marot and Harfst, 2012). Any utilization of mining and post-mining potentials requires cooperation and coordination of several actors in order to establish good and coherent projects (Fischer and Stranz, 2011). Along with the entire phase-out process, a notable aspect was the absence of unemployment among mining workers, since approved economical decisions considered miners interests. The co-determination law in 1951 smoothed the transition, but only partly to coal and steel sectors, leaving uncovered the down- and upstream industries. These related industries experienced high unemployment rates, surpassing 15% (Figure 5).

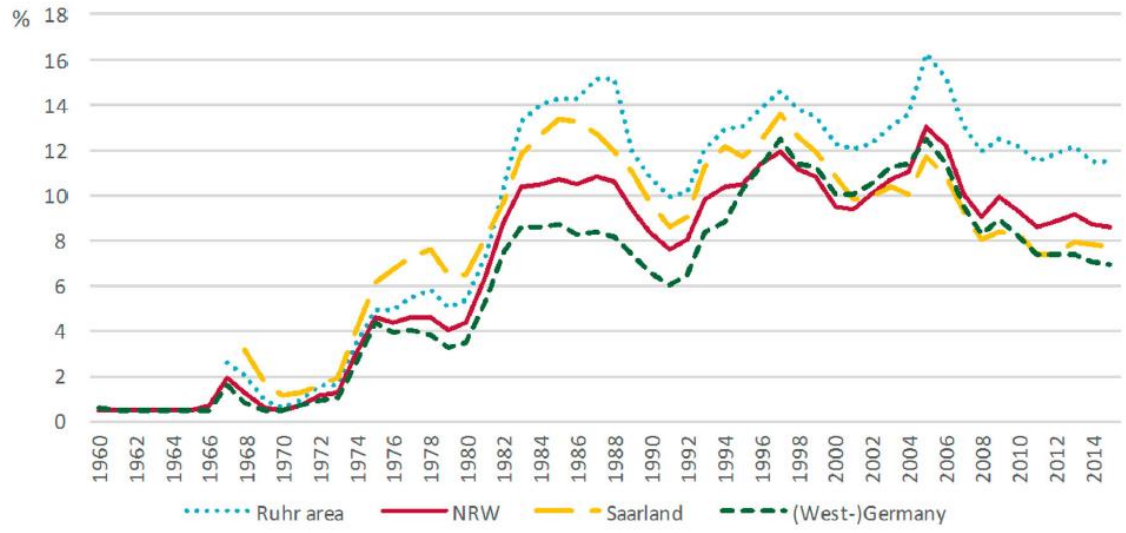

Figure 5. T*rends in unemployment rates in the Ruhr area, North Rhine-Westphalia, Saarland and (West) Germany from 1960 to 2015 (Modified from Oei et al., 2020).*

In April 2023, unemployment rates in the Ruhr region were 9.7% (Regionalstatistik Ruhr), similar to other coal regions, being considerably higher than the federal average. Being poverty and relative poverty amongst the highest in Germany. The employment situation is different along the Ruhr Area, the southern Ruhr Area present low unemployment rates as most of the Universities are found since middle 20s century. However, towards the social equator in the Ruhr Area unemployment rates are high and social problems are substantially larger. This outcome can be attributed to the earlier structural transformation in the southern regions, where many coal deposits had already been mined out, while new mining opportunities were being developed in the northern areas. This led to the

northern parts' longer reliance on coal as an important economic factor dragging out the structural transformation resulting in this lack of economic power and therefore missing jobs and subsequent social problems.
As a result, the region embarked on efforts to diversify their economies. Initial structural programs aimed at enhancing the connectivity of mining areas with nearby cities. This involved investments in modern transportation infrastructure, which not only increased the mobility of former coal miners, allowing them to commute between their residences and potential new jobs beyond the mining sector but also made the region more appealing to new businesses (Dudău et al., 2019)
The structural politics began to change in the late 1980s where ecological aspects were integrated for the first time. Additionally, the importance of new technologies and the transfer of those into the economy was emphasized in order to facilitate the founding of new industrial companies and to create jobs in other industrial sectors. In the early 2000's Infrastructure in education and transportation were made out to be key factors in the structural transformation of the Ruhr Region. To be specific eight key markets were the center of investments and development (UBA, 2021):

- Education and knowledge
- Digital communication
- Leisure time activities and events
- Health
- Mobility
- Sustainable consumption
- Resource efficiency
- Urban living and development
- The innovative industrial core

The amount of jobs in the tertiary sector grew substantially and only went down slightly in the secondary sector even though many jobs were lost in the mining industry (see Figure 6).

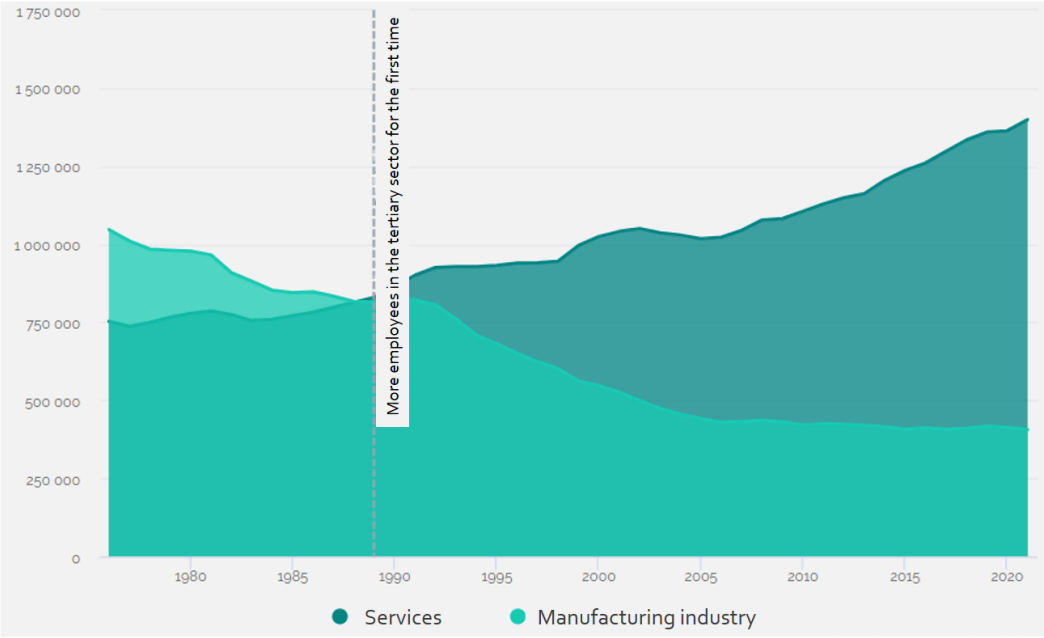

Figure 6. Employees subject to social security contributions by economic sector in the Metropole Ruhr 1976 to 2021 (Regionalstatistik Ruhr, 2023).

After the definitive end to hard-coal mining in 2018, the challenge of preventing unemployment in the mining sector was addressed. Between 1998 and 2018, the RAG workforce shrank by about 80000

people, about half going into retirement and half into other jobs. The RAG AG has been the only employer in the hard coal mining industry since then. Finding new employment for former staff was a complex task, as there was no universally applicable approach due to the diverse range of skills possessed by workers of mining sector. The RAG AG helped the staff to find new work, they had a system in place consisting of coaches and people searching for job openings to offer to the workforce. There were opportunities for retraining and acquiring additional qualifications, including college degrees. Former miners and mining staff transitioned into a wide array of professions, such as firefighters, nurses, bus drivers, engineers, and more. These new opportunities were part of the broader structural transformation occurring in the Ruhr area, and they were not specific roles created exclusively for them in a successor industry to hard coal mining.

Another important strategy to smooth the hard-coal transition was the possibility for many employees in the coal and steel industry to enter Retirement early with little to no reduction in pension payments. This was mainly financed through Germany's social system and therefore being a collective direct subsidy for the Region. Miners in particular were able to enter retirement very early, if the circumstances such as a long employment underground and no availability of a suitable alternative job were considered for a retirement with 50 years old (UBA, 2021). This strategy of closing down the industry with the retirement of its workforce succeeded because of the long duration and therefore gradual decline of hard coal mining.

Among other factors, the beginning of Ruhr University Bochum in 1965, has allowed structural transformation by increasing skilled workforce for the region. Today, the region host five universities, 15 technical colleges, and 49 research institutes, collectively employing more than 31,000 individuals dedicated to education and knowledge advancement, thus increasing the innovation and competitiveness (Prognos, et al., 2015). The Ruhr Valley was also home to some of Europe's earliest technology parks, fostering collaboration between research institutes, companies, and startups. For instance, the Technologiepark Dortmund, established in 1984, now accommodates approximately 300 companies with 8,500 employees (TZDO, 2019). While the development of a robust research and education landscape undoubtedly facilitated the process of structural transformation, it can be challenging to pinpoint precisely which activities were directly related to structural policies and which were part of the broader trend of increased academic training and research activities that have unfolded throughout Germany in recent decades.

The structural transformation is an ongoing process, and its completion remains pending. However, the overall trend towards a shortage of employees may potentially alleviate some of the economic stress. Whether the current projects will prove sufficient can only be determined in the future. In conclusion, the most significant strategies for mitigating the social impact of mine closures included the broad structural development of the Ruhr region, enabling coal mining industry workers to secure employment in different sectors, along with the provision of early and subsidized retirement options for the staff.

2.5 Integrating Coal Heritage with the Transition Goals

As previously described, integrating new sustainable and economically viable standards for the transition goals in the coal mining German regions has been a complex and multifaceted process. The history and industrial powerhouse of the Ruhr Region has impulse the integration of coal mining heritage as a key fundamental factor for transitioning away from mining and heavy industry based economy toward a more sustainable and diversified economy.

Based on the previous described urban development policies, the so-called "concept Ruhr" took up the future challenges and turned into operation in regional development concepts and master plans. These concepts and plans were also the base for applying and receiving EU regional development funding. One important topic is that the "concept Ruhr" state is "site precaution" in the frame of the coal reduction in order to minimize effects of mine closures. Besides actual mine closures, long-term future closures were considered. In total, 15 mine sites in the region were included in the "concept

Ruhr" and this perspective were the basic strategies during 2008-2018 phase-out process. A second important step was the signing of the coal brownfield agreement in 2014. This document was signed by different stakeholders such as: the regional association Ruhr (RVR) (consisting of Ruhr cities), the Ministry of Economics NRW and the coal mining company RAG and its subsidiary RAG Montan Immobilien (the Real Estate company). The main purpose of this agreement is to safeguard and to develop post-mining areas in a sustainable way. The focus was on coordinated research and technology valorization. Throughout a steering committee the progress is assessed by reports and comparing the outcomes with the annual land use evaluations. By establishing the coal brownfield agreement and based on the long-lasting trustful informal collaboration, the municipalities in the Ruhr area obtained a formal framework.
The regional association Ruhr is coordinating the collaboration and is offering exchange platforms for the town councils. Since 1920, the RVR has been supporting the development of the Ruhr area from a state in the midst of an unregulated industrial boom to a modern industrial location with quality of life. Consequently, the RVR has been shaping the transformation of the Ruhr area, today former sites of the steel and mining industries have become locations for new companies, cultural events and leisure experiences (RVR, 2023).

The **Industrial Heritage Trail** (in German “Route der Industriekultur”), part of the European Route of Industrial Heritage, is one of the transformation strategies for the region, linking tourist attractions related to the industrial heritage in the Ruhr area in Germany (Figure 7). This initiative has been developed and established by a collaborative effort involving various regional and local institutions, authorities, and organizations. It is not attributed to a single individual or organization but rather the result of a collective endeavor to celebrate and preserve the 150 years industrial heritage of the region.

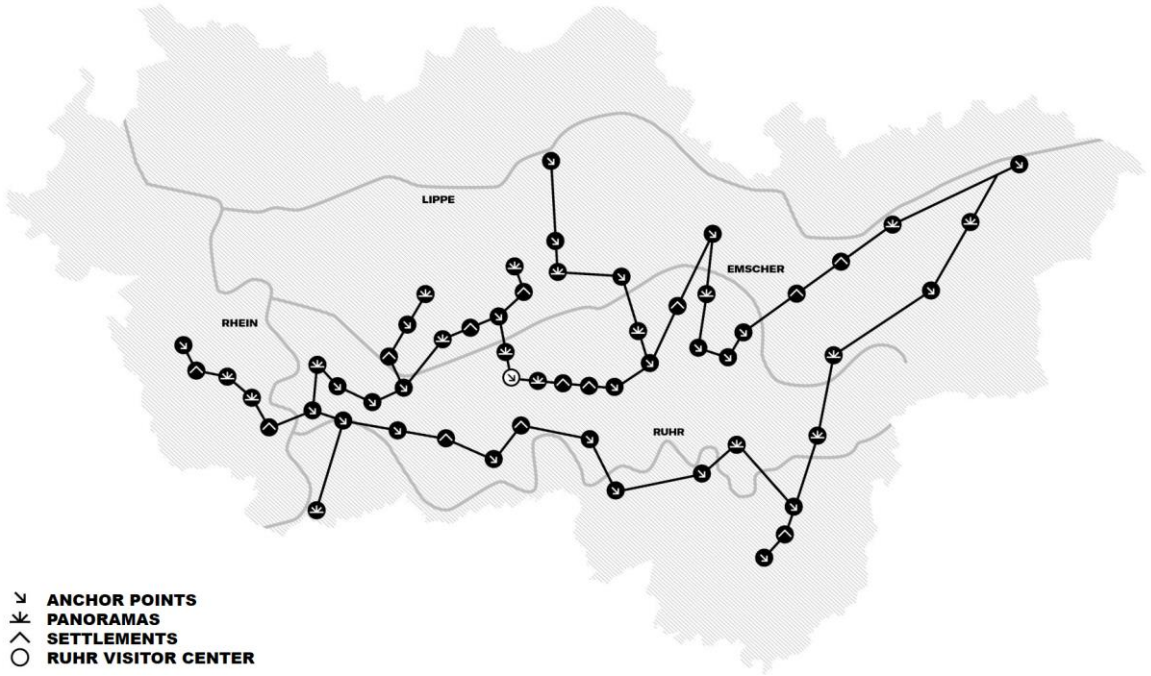

Figure 7. Map of Industrial Heritage Trail “Route der Industriekultur” in the Ruhr Region of Germany (Modified from Route der Industriekultur, 2023).

Over a distance of 400 kilometers the tourist themed route connects the most important and tourist-attractive industrial monuments in the Ruhr area. The “Route” consists of a network of industrial heritage sites and themed routes that allows visualizing the history of coal mining, steel production, and industrialization in the Ruhr Area. The route network provide visitors with a unique heritage of the

Ruhr metropolis to explore, including the Ruhr area's only UNESCO World Heritage Site, Zollverein in Essen, and 27 anchor points, locations with particular historical significance and tourist appeal. In addition, 17 viewpoints, 13 settlements and numerous themed routes are part of the Industrial Heritage route. These sites include former coal mines, steel mills, museums, and other industrial landmarks, and they are connected by a system of signage and information to create a comprehensive experience for visitors interested in the region's industrial history.

The development and promotion of the Industrial Heritage Trail have involved the cooperation of local municipalities, cultural institutions, heritage preservation agencies, and tourism boards, among others. This collaborative approach underscores the significance of industrial heritage to the identity and cultural landscape of the Ruhr Area. Such touristic approach has allowed the attraction over eight million visitors to the region each year, started in 1999 and is a project of the RVR. To boost the business creation in the region, the RVR established the subsidiary known as Business Metropole Ruhr (BMR). It triggers the business interests of the region's 53 towns and cities, promotes the competitiveness of the region and develops the high-performance and innovative image of the new Ruhr area both nationally and internationally (RVR, 2023).

When discussing the transformations brought by the development and operation of tourism in a specific area, it is important to recognize that these changes extend beyond just the physical space. Tourism has multifaceted impacts, encompassing environmental, socio-cultural, and economic effects. Identifying tourism potentials is often a collaborative effort involving local stakeholders, sometimes in conjunction with regional initiatives and European funding. Mining activities have the potential to impact and change tourism prospects, with effects can involve technological heritage, infrastructure, production facilities, and housing (Marot and Harfst, 2012).

2.5.1 Environmental Impacts

The primary drivers of success for any region hinge on the establishment of favorable social and economic conditions (Đukičin et al., 2014). The mining industry, spanning all stages of technological extraction and processing, exerts a substantial impact on the environment (Fodor, 2010). Notably, industrial heritage tourism can play a constructive role in both preserving and enhancing the environment. The growth of this tourism sector has catalyzed public sector investments in urban areas and the reclamation of contaminated and abandoned land in former industrial zones (Lane et al., 2013).

Examples of environmental effects in the Ruhr Region include the aforementioned cleansing of the Emscher River, the introduction of green spaces within industrial complexes (gardens), and the creation of artificial hills or "tips." These initiatives have fostered the development of new ecosystems in areas that previously lacked natural surroundings.

2.5.2 Economic Impacts

Tourist destinations with industrial heritage, much like others, generate a significant portion of their revenue from ticket sales, which can be regarded as their primary income source. Additional revenue streams include the sale of food, beverages, travel expenses, and accommodations (Lane et al., 2013). The engagement of local residents and their active participation in the tourism industry have a notable economic impact. Many communities in the Ruhr Region have benefited from the growth of the tourism sector, particularly in terms of increased employment opportunities. This was particularly crucial for a region that had been grappling with the decline of traditional industries and rising unemployment since the 1950s.

The effects of industrial heritage tourism in the Ruhr Region are evident in the substantial increase in overnight stays, which surged by 60.6% between 1990 and 2009. Certain cities such as Bottrop, Dortmund, and Essen witnessed growth rates exceeding 50%. This underscores the transformation of relatively unremarkable industrial cities with limited tourism offerings into attractive destinations for tourists, resulting in significantly increased tourism-related revenue.

2.5.3 Socio-Cultural Impacts

Industrial areas often derive several socio-cultural advantages from tourism, one of which is the recognition and celebration of the past. This process imparts meaning to the lives and memories of older residents, forging connections between their experiences, the present, and the future. The heightened sense of local pride stemming from this recognition has a notable impact on fostering a deeper attachment to the region and strengthening local identity (Lane et al., 2013).

Another vital cultural benefit stemming from the development of industrial heritage tourism in the Ruhr Region is the promotion of creativity through various modern art forms, such as installations and exhibitions. It is worth emphasizing that without the growth of tourism, the preservation of industrial heritage would be at risk of fading into obscurity and succumbing to the ravages of time.

2.6 Examples and Successful Coal Heritage Landmarks

In the context of this project, the coal mining sites that have become heritage are mainly located in the Ruhr and Saarland area; in this section, some of these tourist attractions will be presented.

Zollverein Coal Mine Industrial Complex (Essen): This UNESCO World Heritage Site is one of the most iconic industrial heritage sites in the world. It was a large coal-mining complex that is now a museum and cultural center as seen in Figure 8. The site includes the former coal-mine, coking plant, and other industrial buildings.

Figure 8. Zollverein Coal Mine Industrial Complex.

Duisburg-Nord Landscape Park (Duisburg): This former ironworks and steel mill has been transformed into a public park. It features illuminated blast furnaces, industrial installations, and green spaces, making it a unique blend of industrial heritage and modern recreation as given in Figure 9. The Duisburg-Nord Landscape Park is an anchor point on the European Route of Industrial Heritage as well as the Route of Industrial Culture.

Figure 9 Duisburg-Nord Landscape Park (Route der Industriekultur, 2023).

Zollern Colliery (Dortmund): This well-preserved colliery complex (Figure 10) offers insight into the coal mining industry and the lives of miners. The site's striking architecture makes it a significant industrial heritage landmark.

Figure 10. Zollern Colliery complex in Dortmund (Route der Industriekultur, 2023).

Hansa Coking Plant (Dortmund): The coking plant (Figure 11) has been registered in the monuments list of the city of Dortmund since 1998. It played a critical role in the production of coke, which was essential for steelmaking. The coking plant is a significant industrial heritage site that highlights the technology and processes involved in coking, a crucial step in converting coal into coke for use in steel production.

Figure 11. Hansa Coking Plant (Indistrie Denkmal Stiftung, 2023).

LWL Museum Nightingale Colliery (Witten): This former coal mine is now a museum that illustrates the history of coal mining in the Ruhr Area. It includes preserved buildings (Figure 12), mining equipment, and exhibitions on the life of miners.

Figure 12. Museum Nightingale Colliery (LWL, 2023).

Colliery Ewald (Herten): Colliery Ewald (in German Zeche Ewald) is a significant coal mining complex (Figure 13) located in Herten, a town in the Ruhr Area of Germany. Like many other coal mining sites in the Ruhr region, Colliery Ewald played a vital role in the industrial history of the area.

Figure 13. Colliery Ewald Complex (Route der Industriekultur, 2023).

Friedrich Heinrich Colliery Park (Kamp-Lintfort): The Friedrich Heinrich Colliery, or Zeche Friedrich Heinrich in German, was a coal mine that operated in the region. It played a significant role in the coal mining industry of the Ruhr Area during the 19th and 20th centuries. Within the park (Figure 14), it is possible to find remnants of the former coal mining operations, including preserved buildings, machinery, and industrial infrastructure. These elements provide a glimpse into the industrial past of the region.

Figure 14. Friedrich Heinrich Colliery Park (Route der Industriekultur, 2023).

North Star Park (Gelsenkirchen): It is located on the compound of former mine of Zeche Nordstern. After the closure of the mine in 1993 the area was redeveloped (Figure 15). An amphitheater is located near the canal of Rhein-Herne-Kanal, where music festivals and other cultural events are taking place, among them the annual Rock Hard Festival.

Figure 15. North Star Park (Route der Industriekultur, 2023).

Maximilian Park (Hamm): Maximilian Park was originally an industrial site that was transformed into a park. It was once home to the Maximilian coal mine, which operated from the late 19th century until the mid-20th century. The park (Figure 16) boasts extensive green areas, gardens, and walking paths, making it a popular destination for leisurely walks, picnics, and outdoor activities. The landscape design integrates both natural and cultivated elements.

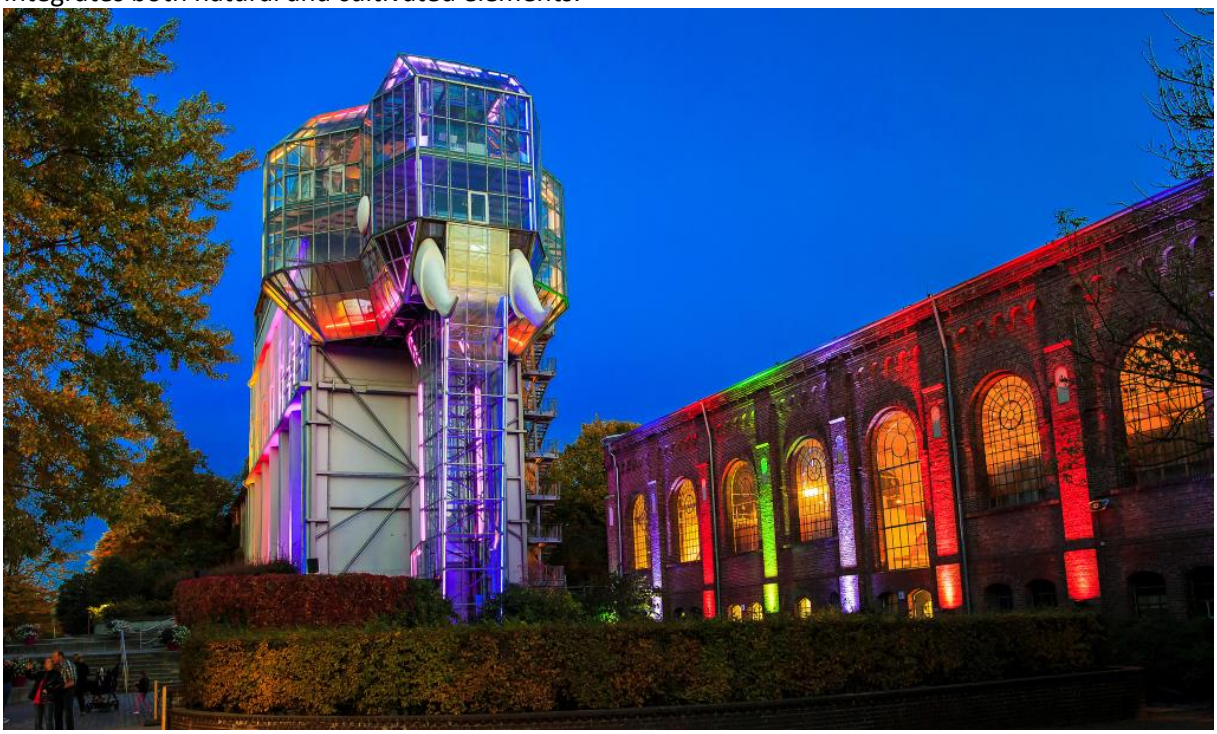

Figure 16. Maximiliam Park (Stadt Hamm, 2023).

Völklinger Hütte (Völklingen, Saarland): Another UNESCO World Heritage Site, Völklingen Hütte is a preserved ironworks that offers insight into the iron and steel industry. Visitors can explore the blast furnaces, production halls, and exhibitions on site (see Figure 17).

Figure 17. Völklinger Hütte in Saarland (WVH, 2023).

2.7 Lignite Mining Transformation Plans and Coal Heritage Perspective

In contrast to hard coal mining, there are regions in Germany with active lignite mining to this day. Lignite mining is set to stop in Germany no later than 2038 (Kohleausstieg) as mandated by the German Federal Government to accomplish the reduction in greenhouse gas emissions agreed to in the Paris Climate Agreement. The phase is set to be completed in different stages with the lignite extraction sites and power plants in North Rhine Westphalia in order to cease operations as early as 2030. The whole process is accompanied by structural development of the regions and a transition to renewable energies and carbon-neutral industries. However, this transition will leave behind a plethora of mines, power plants, and lignite processing plants. These along with the people working there are the core of the industrial heritage of the lignite mining regions.

Eastern Germany relies more heavily on its lignite industry for power production and as a significant economic factor. Still structurally weakened in the aftermath of the collapse of heavy industries following German reunification, the lignite industry remains dominant, and suitable replacements have not yet reached a comparable level, as seen in North Rhine-Westphalia. Once the necessary structural development has commenced, particularly the scaling up of renewable energy sources to an adequate extent, all Eastern German mines could be closed.

A shift away from the lignite industries seems inevitable: “What is immediately apparent is that new mine reuse projects practically never entail a return to heavy industry, which means that any new value and job creation will mainly be of a low order of magnitude.” (Van de Loo, 2021). However, the different mining districts deal differently with their heritage as mentioned below:

The **Rhenish district** is located in the western part of North Rhine Westphalia, roughly between Cologne and Aachen. Although being featured on the European Route of Industrial Heritage, old mines have primarily been repurposed and old industrial buildings have been abandoned or demolished, seemingly because the people are not being too keen to remember and embrace their lignite-fueled past and present. It is fitting that the Rhenish lignite district is the first of the three still active ones to

end lignite production in 2030, even though it is the most productive one being the origin of almost 50% of all domestically sourced lignite (Wirschaft NRW, 2023).
While RWE, the company behind all lignite mining operations in the Rhenish district, does offer guided tours through active and renatured mines and runs several small information centers regarding their mines and power plants there are no large-scale industrial heritage sites. The focus of their efforts is informing about their repurposing, renaturation, and dismantling of open pit mines and lignite-fired power plants (RWE AG). It is unclear if this is subject to change, but seems unlikely as the remaining three open pit mines are set to be partially re-natured, reused as agricultural land or forestry and the rest of the pits flooded creating a touristic and local recreational area (LANUV, 2023).
A very notable example of repurposing an old mine is the “Phantasia-Land”, it is the most visited theme-park in all of Europe and the oldest in Germany. It is located on the old grounds of an open pit mine near the city of Brühl. Furthermore, the much more culturally significant hard coal mines of the Ruhr Region are within 100 km of the Rhenish district making the need for industrial heritage sites in such a scarcely populated area questionable.
The **Lusatian lignite district** is the second largest operational lignite district in Germany accounting for 35% of German lignite production. It is located in Saxony and Brandenburg Many former mines and industrial sites followed a similar path to the ones in the Rhenish district, most of the mines are in the process of being renatured, reused, and flooded, or are finished with new landscape. The otherwise structurally relatively weak region is shifting to being a touristic region, utilizing the newly formed Lusatian Lakeland, a large and partially connected lake area as the main attraction. Most importantly, the region embraces its tradition in the lignite industry. The official touristic website for the Lusatian Lakeland lists the “Energy-Route Lusatian Industrial Heritage” as a touristic factor in the Region. This Energy-Route encompasses old and active lignite mines, former factory housing, and former lignite briquette factories and museums about the old industrial sites (Lausitzer Seenland, 2023a). These places are tourist attractions, a reminder of their heritage and often a place of work for former employees.
The F-60 visitor colliery, also known as the "Berzdorf Shaft" or "Förderbrücke F-60," is a massive and historic piece of mining equipment located in the Lusatian region. It is one of the most significant pieces of industrial heritage in Germany and is now a popular tourist attraction. The F-60 was a large mining conveyor bridge, also known as an overburden conveyor bridge, used in the lignite (brown coal) mining industry (Besucherbergwerk F60, 2023).
The **central German lignite district** is located in Saxony and Saxony-Anhalt, there are 3 active lignite mines which will end mining activities until 2038, and just like the other districts there are plenty of already closed mines and lignite processing plants, some being sites of the European Route of Industrial Heritage. One of these is the “Brikettfabrik Herrmannsschacht” Lignite Briquette Factory. The factory was opened in 1889 and closed in 1959 and was put under a preservation order only 3 years later in 1961 (Recarbo Erlebnisregion, 2023).
The “Bergbau-Technik-Park”, another site of the European Route of Industrial Heritage, is an open-air museum for mining technologies located on a waste area of the “Espenhain” mine Großpösna in Saxony. It exhibits a bucket wheel excavator, conveyor bridges, freight trains and other mining machinery used in the former open pit mine (Bergbautechnikpark, 2023). Similar mining technology is present at “Ferropolis” in Gräfenhainichen in Saxony-Anhalt. The so-called “Iron Town” is located on a small peninsula on Lake Gremmlin, the lake that formed after flooding the open pit mine Golpa-Nord. The old central power station is the heart of the site housing a small museum about the local mining history, mining equipment, miniature models of excavators, and historic pictures of the open pit mine and the villages it destroyed.
The **Hessian lignite district** is the smallest one with an Industrial heritage site on the European Route of Industrial Heritage, the “Hessisches Braunkohle Museum”, is a museum about Lignite in Hessia. It is located in Borken and is made up of three different parts. Another example is the theme park

"Coal&Energy" located at Lake Borken, a former open pit lignite mine. The facility shows most important steps of lignite mining by displaying the equipment and relevant information on signs.
The main learnings are that preservation of Industrial Heritage works best when the historic infrastructure is preserved right after work at the site stops and the local communities and former workers are incorporated into the heritage sites. The combination of community and culture and nature conservation as well as non-intensive recreational use with the lignite heritage sites are most prevalent, as with the re-use of old mining sites all over the world (Van de Loo, 2021).

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Appendix 3 FRANCE

Choisissez un élément.

D2.1 Report on the coal transition strategy of the partners project countries- FRANCE

[provisional / final]

[N° de produit]

Final version - 4 octobre 2023

Choisissez un élément.

Bazargan-Sabet Behrooz

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Introduction

France has experienced strong mining activity for many decades, particularly in coal mining regions. However, with the gradual depletion of deposits, international competition, falling demand and high costs associated with its exploitation, the coal mining industry has gradually declined. Faced with this challenge, the French State has put in place various aids and measures to support the reconversion of coal mining regions.

Coal mining regions in France are mainly located in the north and east of the country. The most famous of these are Nord-Pas-de-Calais, Lorraine and the Auvergne-Rhône-Alpes regions. For decades, coal has played a crucial role in the economy of these regions, providing employment for many people and contributing to local economic development. The reconversion of coal mining regions has become a necessity to ensure their economic survival and the maintenance of the quality of life of their inhabitants.

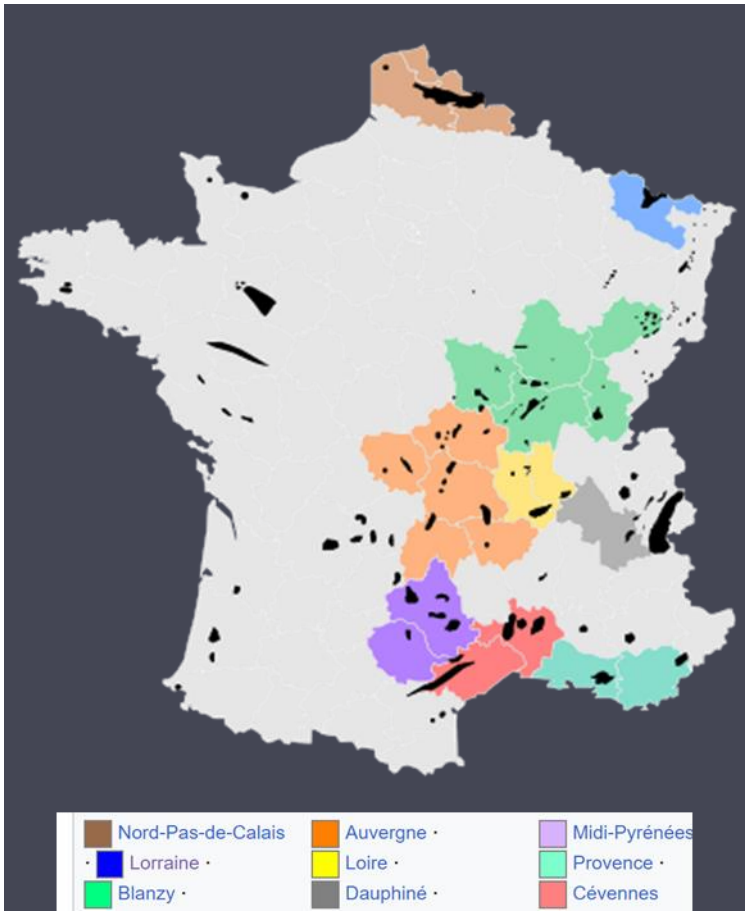

Figure 1- Maps of French coalfields (modified from URL1).

The region of Nord-Pas-de-Calais has successfully reconverted itself thanks to significant investments, particularly in renewable energies. Wind farms have been built on former mining sites, which has created new jobs in the clean energy sector.

In Lorraine, the former Moselle coal basin has been transformed into a technological park specializing in high-tech industries and innovation. Technological companies have established

themselves on this former mining site, thus creating numerous jobs in fields such as robotics, biotechnology, and advanced materials.

In the Auvergne-Rhône-Alpes region, reconversion initiatives focused on tourism have been implemented. Mining sites have been rehabilitated and transformed into tourist attractions, offering visitors the opportunity to discover the history and mining culture of the region.

The reconversion of coal regions has also included environmental rehabilitation projects. Former mining sites have been cleaned and restored in order to preserve the environment and promote biodiversity. Some of these sites have then been transformed into natural parks, providing leisure and recreational spaces for local residents.

Government programs have played a crucial role in the reconversion of these regions. Since 1960, successive governments have implemented various initiatives aimed at supporting economic and social transition. Firstly, specific funds have been created to finance reconversion projects. Subsidies have been granted to companies and to local authorities to stimulate investment in new sectors of activity. Additionally, measures have been taken to promote vocational training and the reintegration of miners. Reconversion programs have been developed to enable miners to train for new professions and find employment opportunities in other sectors.

More recently, the government has encouraged and continues to encourage the development of renewable energies in coal regions. Financial incentives have been put in place for the installation of wind turbines, solar panels, and other sources of green energy. Finally, efforts have been made to promote tourism and showcase the cultural heritage of these regions. Industrial sites have been rehabilitated and transformed into museums or recreational spaces.

However, despite these ambitious programs that play a crucial role in the future of mining regions, reconversion remains a complex process. Challenges and difficulties persist, particularly concerning:

- Job loss: The closure of mines necessarily involved the net loss of jobs in the regions, not only for miners but also in all related economic activities. While reconversion programs have allowed for the creation of new activities, a portion of jobs has been permanently lost, which has had a significant impact on the local economy.
- Resistance to change: Residents of coal regions are often attached to the history and mining culture of their region, making radical reconversions difficult to accept.
- Need for significant investments: Reconversion generally requires significant and sustained investments over the long term to replace old infrastructure and develop new ones.
- Diversity of regions: Each coal region has its own economic, social, and geographic characteristics, making it impossible to develop a single blueprint for reconversion.
- Lack of skills: Reconversion often involves a transition to new sectors that require different skills from those needed in the mining industry. The lack of appropriate skills and training limits employment opportunities in these new industries for the local population.

In summary, the decline of the coal mining industry in France has had economic, social, demographic, and environmental impacts on mining regions and their inhabitants. It is important to implement support and assistance measures to mitigate these impacts and facilitate the transition to new industries. Overcoming these challenges and achieving socio-economic transformation requires coordination and collaboration among local stakeholders, businesses, governments, and communities.

This report examines the various actions and initiatives implemented by the French government to support regions affected by the closure of coal mines in their transition to new sectors of activity.

Historical context of the coal mining industry in France

The industrial exploitation of coal in France spans nearly three centuries. Between the first well dug at Fresnes, in the North in 1720 and the closure of the last well at La Houve in the Lorraine basin in April 2004, the life cycle of French coal can be subdivided into four phases: launch, growth, maturity and decline.

The launch phase of the coal cycle, characterized by a moderate expansion of outlets, took place until the beginning of the 1820s. The “Compagnie des Mines d'Anzin” was one of the first large European companies, which exploited nearly 1/ 4 of national production and employs 4,000 miners. The law of April 1810 lays down the legal foundations which will govern all mining activities until 1946. The State assumes responsibility for the allocation and possible withdrawal of perpetual concessions, independently of land ownership so as to ensure the sustainability of concessionaires’ rights to undertake long-term investment. Through the involvement of department prefect and the mining engineers, the State controls all production techniques. Through the proportional royalty of 5% on profits, the State has a tool for controlling the management of mining operations and, through its customs officers, it holds the keys to the coal market.

The launch phase is followed by the growth phase, a period of sharp increase in consumption, which lasts until the First World War. Between 1893 and 1913 coal consumption in France increased from 40 to 63 million tons. These first two phases are marked by the integration of the potential of scientific and technological progress such as the development of steam engines and pumps, to achieve increasingly high levels of productivity.

In the interwar period, corresponding to the maturity phase of the life cycle, competition with other energy sources (oil but also hydraulic electricity) resulted in a relative stagnation in coal consumption. However, coal still covered 76% of energy needs in 1935.

From 1945, coal entered the decline phase of its life cycle, characterized by a continual decline in consumption, both in absolute and relative value. Furthermore, faced with the depletion of easily exploitable resources, it was necessary to dig deeper and deeper, which significantly increased operating costs. The evolution of consumption is accompanied by a transformation of the capital/labor relationship. We are in fact moving from the valorization of capital as the sole indicator of operating efficiency to the integration of all employees at the heart of the dynamics of the productive system. Training, safety and health conditions are all generated by technical progress and are now elements of the system effectiveness.

Paradoxically, in the last phase of its life cycle, far from presenting the image of an obsolete productive system, the coal mines in France demonstrated some dynamism, materialized by high productive performance and constant improvement in safety and health conditions. However, technological advances have not overcome market constraints and have not led to set up new organization for the exploitation of deposits.

In 1946 the public establishment Charbonnages de France (CdF) was created by the nationalization of the coal mines. In 1951, CdF experienced its first deficit. Between 1946 and 1959, the share of coal in French energy demand fell from 80 to 56%, while maximum production was reached in 1958 with nearly 60 million tons produced, almost half of which in the North. Pas-de-Calais.

In 1960, coal stocks reached their highest level at 14 million tonnes. The decline in sales further exacerbated the difficulties of the French coal industry. In response to this situation, the French government adopted the Jeanneney plan, which included:

- A reduction in production of one million tonnes per year, to be reduced to 53 million tonnes by 1965.

- Reduction in investments in extraction.

- Shift from a production logic based on consumption to a cost-based logic using imported foreign coal prices and other fuels.

Despite these measures, which were strongly opposed by the miners' unions through numerous strikes, the deficit continued to increase and exceeded the equivalent of 150 million euros in 1966. A new plan was adopted in 1968, further reducing production and planning the closure of the Nord-Pas-de-Calais coal basin between 1983 and 1985.

In 1968, the assets of the different coal mines were transferred to three public establishments, which became subsidiaries of CdF. The assets in the central and southern parts of France (Auvergne, Loire, Provence, Dauphiné, Blanzy, Cévennes, and Aquitaine) were transferred to the Houillères du Bassin du Centre et du Midi (HBCM). The assets in the North were transferred to the Houillères de Bassin Nord-Pas-de-Calais (HBNPC), and those in the East were transferred to the Houillères de Lorraine (HBL).

For a period of time, the energy crisis of 1973 led to the belief that coal production could be revived as a replacement for the increasingly expensive oil. Similarly, the arrival of the left-wing government in 1981 allowed for a small revival, but financial constraints quickly took over. After the closure of the last mine in the North in 1990 and a social plan costing 1.88 billion euros, the HBNPC (Houillères de Bassin Nord-Pas-de-Calais) were dissolved in 1992. At the height of their activities, the mines in the North employed up to 220,000 people. Ultimately, after numerous social movements, a coal pact was signed in 1994 between the State and the trade unions, which provided for the definitive closure of all coal mines throughout the country by no later than 2005.

The history of coal mining in France has undergone several twists and turns and different developments, but even at the peak of their production, all coal mines were unable to ensure the country's self-sufficiency. That is why France has always been obliged to import a portion of its coal needs. The cessation of coal mining in France is primarily based on economic reasons. The mines were closed gradually because they were no longer profitable, especially in comparison to the price of imported coal on the market. From 1999 to 2004, French coal was sold at a price lower than its extraction cost. For example, in 2002, when production was still significant (1.6 million tons per year), the selling price was 49.8 €/t while the production cost had reached 222.8 €/t. In Provence, HBCM (Houillères du Bassin du Centre et du Midi) had been selling extracted coal at a loss since 1996. The selling price was on average four times lower than the operating cost during the last three years of operation before permanent closure. Between 1990 and 2007, the State provided 20 billion euros in aid to CdF and ultimately had to pay off a debt of 2.9 billion euros in principal and interest before its liquidation.

Concept of conversion

The term "conversion" initially referred to the measures implemented by the government to mitigate the effects of workforce reduction or the closure of establishments, by promoting the development of new activities. However, in mining areas facing decline, the government quickly realized that touching upon the activity meant the collapse of an entire system. As a result, conversion policies have undergone significant transformations over the past forty years, shifting from policies focused on activity substitution to more comprehensive policies for the redevelopment of territories. The phenomenon of conversion now refers to the questioning of an economic, social, cultural, and spatial system under the pressure of a new system involving competing activities and spaces (Daviet, 1990).

It denotes a reorganization process that affects individuals, companies, and space, and is often synonymous with crisis: employment crisis, sometimes demographic crisis, crisis of trust and identity. Conversion thus encompasses multiple dimensions that can be grouped into three closely interconnected aspects:

- Diversification of activities and new forms of development;
- Institutional conversion and the reconfiguration of territories;
- Building a new identity.

DIVERSIFICATION OF ACTIVITIES

While in many mining regions around the world, areas to be converted are characterized by declining poles, marked by rising unemployment, the closure of shops and services, the emigration of young workers, falling property prices, impoverishment of populations, and a sense of despair, the situation in French coal basins is specific. The status of the miner has almost always prevented layoffs, and conversion measures, in the broader sense, have been implemented over long periods prior to closures, often preventing extreme situations.

The reduction in mining workforce was achieved through three main types of measures: firstly, social measures such as early retirement, particularly through the CCFC (charcoal end-of-career leave), a flagship measure that allows miners with 25 years of seniority to cease their activity while receiving 80% of their net salary, remaining on the payroll and retaining their rights. Secondly, personnel relocation measures to other sectors of activity dependent on the State, such as Électricité de France (EDF), which may involve interregional mobility if necessary. Finally, diversification measures of activities that may or may not benefit the mining population, depending on the profile of the jobs concerned.

The diversification of activities has experienced different temporalities and rhythms, depending on the basins and periods. Depending on the basins, closures have been staggered from the 1960s to the present day, based on their competitiveness. Depending on the periods, as the coal market evolved, coal policy also changed. The major recession of the 1960s marked the first foundational phase. Activity zones were set aside and the economic climate was still favorable. In 1967, the SOFIREM (Financial Company for the Conversion of Mining Regions) was created to "take minority stakes in companies that facilitate the hiring of miners who are leaving their jobs." The second phase began with the oil crisis of the 1970s, which was less conducive to diversification. On one hand, the stabilization or even revival of coal production generally led to a suspension of conversion programs. On the other hand, the overall economic context became unfavorable for employment in an increasing number of sectors, such as the automobile industry. Nevertheless, the structural works done during this period laid the groundwork for a significant new fabric of activities.

Since the end of the coal revival, the last one being in 1981-1983, a third phase of reactivation and intensification of conversion has begun, which unfolds in two stages. Firstly, in 1984, all hiring in CdF was definitively halted. Industrialization funds were created, while internal personnel relocation operations accelerated from Nord-Pas-de-Calais to the most competitive headquarters in Lorraine and Provence. In 1994, the prospect of definitive closure of the last headquarters was announced. The signing of the Coal Pact then accelerated the flow of personnel departures. Diversification initiatives had increased resources with the addition of European structural funds to French state investment, but they took place in a European market where territorial competition had intensified and in a more globalized economy. Over these four decades, the diversification of activities has progressed while encountering two main types of difficulties. Firstly, it has been marked by development models that have become obsolete and had to evolve as the structure of the global

economy changed and society became more sensitive to the environment and quality of life, including the development of tourism and leisure. Secondly, it has been limited by the structural legacy of a low-skilled labor industry and an outdated training system. The need quickly arose to work not only on the conversion of miners themselves but also, increasingly, on the children of miners, taking into account the factor of time and the evolution of training systems at least on a generational scale.

In this context, priority has long been given to industry as a driver of development before the reorganization of productive systems shifted towards the tertiary sector. This priority is also linked to the identity of the actors involved in conversion. Industrial groups, particularly CdF, were associated with the conversion process and became its main driving force. SOFIREM, a conversion company that helped 28,000 jobs creation in the North until it was replaced in 1984 by Finorpa, which plays a similar role, served as a model for other similar companies (particularly in the steel industry), while industrialization services prospect and provide support for implementation projects. It is worth noting the importance that actors place on exogenous development and projects with visibility. In addition to the CdF, the actions of public companies have involved new establishments such as the National Printing Office in Douai or the Renault factory, also in Douai. Starting from 1969, the government has also provided means for granting "bonuses," which are subsidies for business installation, and direct assistance for the establishment of activities, for example, in connection with automobile manufacturers. The factors highlighted to attract foreign investment themselves evolve. In addition to the 3 P's logic (Place, Personnel, Premium), other parameters are added, such as market development prospects, shared services, targeted management, etc. The business environment in terms of training and research has nurtured an increasingly comprehensive approach to the conditions of activity and development. While in the 1980s, the discourse and efforts focused more on endogenous development, emphasizing the creation of businesses and SMEs, the strategies and measures that followed reflect a greater variety of approaches, combining the attraction of major emblematic projects and the establishment of a network of local businesses. Ultimately, the policies for the conversion of mining regions gradually lost their specificity due to internal and external reasons: internally, their mono-industry character diminished; externally, they increasingly faced the same global development logics as other regions.

But beyond these common trends, the results of the efforts made have been different depending on the regions, based on four major essential criteria: i) the size of the basins, ii) the geographical location, iii) the relative weight of the mine in the local economy of origin, and iv) the nature of the new activities in relation or in break with the mining professions. For example, the differences are evident between:

- a Lorraine coal basin which had 25,000 miners in 1984 and a Provencal basin which had 2,000 miners at the same date;
- a region in northeastern France that has experienced a negative net migration since the 1970s and a Provencal region that has benefited from a sun-belt effect;
- a border basin distant from its regional metropolis (Metz) and another located in the heart of a metropolitan area (Marseille) with over one million inhabitants.

In fact, Lorraine is less attractive than Provence, despite advantages such as the the neighborhood with Germany and the bilingualism of its population. The importance of the mining population led the industrialization services to prospect with sectoral strategies guaranteeing the sustainability of jobs but also their compatibility with the level of qualification of the regional workforce.

In Lorraine, the established business fabric covers various sectors dominated, like in Nord-Pas-de-Calais, by plastics and automotive industry. After Continental, General Motors, Textar, and Girling in

the 1970s and 1980s, the most emblematic establishment of the 1990s is the assembly plants of the Smart car and the Integrated Suppliers Park in the Hambach area (2,500 jobs). 20% of employees are women, which is a significant novelty in a region where the employment structure has remained predominantly male. The job creation since 1984 would compensate for the approximately 20,000 positions eliminated. Conversion has mainly benefited the renewal of a more diversified industrial function, but services are still underdeveloped and the level of qualification of the workforce is insufficient. The 1988 plan aimed at making Moselle-Est a center of excellence for Franco-German exchanges did not lead to concrete achievements, except for the development of a logistics activity that does not provide many jobs.

Located between Aix and Marseille and benefiting from excellent highway access, the Provence basin has been undergoing intense peri-urbanization since the 1970s (Ferreira, 1988). Microelectronics is the main sector that has developed there since 1979, particularly in the municipality of Rousset where the two contractors STMicroelectronics and Atmel are located (Daviet, 2002). Microelectronics represents 80% of assisted employment since 1994.

This high-tech industry, originating from outside the region, has found its own dynamic for development in situ, extending well beyond the limits of the basin. The 6,000 jobs created in the assisted area over the past 10 years significantly offset the loss of 2,000 mining jobs in terms of volume. However, the new companies are regularly threatened with relocation, despite significant public investments. On the other hand, this new activity corresponds to technical and social logics that are completely different from the world of mining (Rychen, 2000) and has mostly benefited highly qualified non-local populations. The reconversion of the miners themselves, who were few in number, was not a priority objective in Provence, unlike in Lorraine. Furthermore, the reconversion of active miners in the Gardanne Basin only concerned about a hundred people (Chelu, 2003). Peri-urbanization and industrialization of the area have combined to generate land and real estate pressures that are a source of tensions. Beyond these specificities, the new establishments have often been located on the outskirts of the basins in both Provence and Lorraine, creating significant disparities with the heart of the mining areas where the landscape and social legacies of mining activity are concentrated. These disparities generate territorial and institutional recompositions that constitute the field of local geopolitics.

INSTITUTIONAL RECONVERSION AND TERRITORIAL RECOMPOSITION

During the peak of mining activity, the recruitment area for miners extended to peripheral rural municipalities, constituting an employment basin that exceeded the mining area. Around Gardanne, a group of 17 municipalities, totaling approximately 100,000 people, are affected. In the Lorraine Basin, the mining zone centered on Forbach includes a recruitment basin that extends to approximately 250 municipalities, totaling about 350,000 inhabitants. At the beginning of the reconversion process, the assisted areas were legitimately defined as the entire mining employment basins. Therefore, it was logical for the first activity zones to be created in the peripheries offering available space and good accessibility. The success of these zones has profoundly changed the geography of employment and wealth production within the basins.

The central municipalities appear to be the losers of the reconversion, losing the benefit of the mining royalties after closure and bearing the cost of landscape rehabilitation. Taking this evolution into account should normally lead to allocating a larger share of aid to the central municipalities. However, in reality, this is not the case. Intermunicipal rivalries raise the question of the role of actors and the competition between territories within the basins, with the role of actors being an integral part of the reconversion process itself. The absence of intermunicipal cooperation has often been a handicap at a time when local authorities have been increasingly encouraged to participate in the evolution of the economic fabric. However, the emergence of communal power has a specific

characteristic in mining basins because industrial power has long replaced traditional communal power. The mine was the master of the land, the owner of housing and facilities, the organizer of associative and cultural life, political life, and even trade union life. It shaped the material infrastructure and mental superstructures of the population. The internalization of planning power by the company has in some way supplemented the urban function. The dissolution of the company today results in the externalization of its social functions to various actors. These transfers characterize the reconversion situation as a complex system of not only economic and social but also political and institutional changes.

Since 1966, the State has created OREAMs (Organizations for the Study and Development of Metropolitan Assistance) responsible for establishing the regional development master plan, which was adopted in 1971. This plan transfers a portion of the enormous assets of the Coal Mines to the municipalities. In Nord Pas de Calais, the HBPNC managed 113,000 homes, 1,100 km of roads, 22,000 hectares of land, 55 churches, schools, hospitals, community halls, as well as sports and cultural facilities. The State committed to financing the renovation of housing and the maintenance of infrastructure (roads, water facilities, etc.) parallel to their transfer to the municipalities. These municipalities are often too poor and too small to assume this task. It is their responsibility to take over the public service missions previously carried out by the Coal Mines. The management of housing is soon entrusted to a dedicated company created in 1986, Soginorpa (Real Estate Management Company of Nord-Pas-de-Calais). In parallel, the municipalities also seek to attract businesses by developing their own industrial zones.

The decentralization laws of 1982 strengthened local authorities, which then had more substantial means of intervention. Thus, the regional authority attempted to compensate for the disengagement of the central government from 1984 through targeted subsidies. Since 1998, the Mining Basin Mission has been established to assist local authorities in managing urban planning and development issues. All these actors focus their actions on creating new jobs, which is at the heart of the reconversion policy in Nord-Pas-de-Calais.

In the Lorraine Basin, an association was created in 1989, initiated by the sub-prefecture and the HBL, anticipating the transition towards new entities. "Actipromo" then brings together elected officials, union activists, and various partners from the local community. It coordinates several operations related to development and promotion of the basin, which is now renamed "Moselle-Est". However, Actipromo did not gain the support of all 250 municipalities and some did not join. The evolution towards a new institutional entity struggles to emerge, reflecting the persistence of urban rivalries and antagonisms between an urban basin and a rural periphery. In 2003, AGEME (Agency for the Expansion of Moselle-Est) was formed, bringing together most of the inter-municipal communities within the original "basin" area. This agency is intended to "take over from the Industrialization Mission of the Lorraine Basin Coal Mines by expanding its missions. Above all, it aims to broaden its scope, transitioning from being the responsibility of a single company - even if it is public - to the responsibility of all actors in the territory: local authorities, territorial authorities, businesses, training and development organizations, financial institutions, unions, etc."

In Provence, there is no equivalent structure that brings together the 17 municipalities of the former mining basin. The old solidarities were not able to endure in the face of the magnitude of the changes that took place. The boundaries of intermunicipal communities have evolved significantly in recent years. Nine municipalities have joined the Community of Agglomeration of Pays d'Aix (CAPA); seven others form a community of municipalities, while Gardanne, the main mining site, finds itself isolated.

There is therefore a significant divergence between basins that have maintained a relative cohesion within their previous limits, while working towards renewing their identity, and a deeply fragmented

Provençal basin whose symbolic representation tends to be reduced to the political and social island of the municipality of Gardanne. This divergence leads to questioning the strengths and weaknesses of identity mechanisms in the reconversion of territories.

CONSTRUCTION OF NEW IDENTITY

The reconversion situation results from a political will and requires an agreement on the actions to be undertaken and coordinated within a perimeter that often exceeds municipal boundaries, hence the importance of an intermunicipal logic. It also requires a certain consensus among political and union forces and more generally among social actors. The reconversion situation is therefore not an objective fact but rather a process of social construction. According to Grossetti (1998), it involves a process of "mourning" that occurs after the final cessation of all operations, during which the end of the mine is gradually accepted.

There are many examples of refusal to accept this state, which often lead to conflicts. In the Lorraine Basin, while the end of exploitation had not yet begun, the announcement of the recession plan in 1984 sparked violent reactions. There was no talk yet of giving up coal. The following years were ones of doubt and confusion. Then, the notion of conversion gradually gained ground. With the implementation of the Chérèque Plan and the encouraging results of industrialization, the year 1988 marked (temporarily) the return of social peace. (Daviet, 1990).

Acceptance of recession, closure, and reconversion is conditioned by the balance of power between political and union forces within the labor movement. The necessary process of mourning does not happen automatically but requires support for the population in what is disappearing and what is being built. It therefore has a dual dimension: the recognition of what has existed and the construction of a new identity. The recognition of what has existed gives full meaning to the maintenance of memory and the preservation of heritage. This memory is the legacy of previous actions that societies must take into account because signs of the past testify to our identity. Not everything can be preserved, but it is also not possible to "start with a clean slate" without questioning collective identity.

The territory is the space that supports this collective identity. It testifies to an appropriation by groups that give themselves a representation of themselves, their history, their singularity (Di Méo, 1998). Lived space is thus the foundation of a sensitive and cultural relationship to the territory (Daviet, 2005). It is not only a matter of preserving symbols but also of valuing the past, as it is easier to rebuild from a heritage that would make sense and have value. Scientific and cultural actions that contribute to valuing the past are part of the mourning process and constitute a step towards envisioning the future.

The construction of a new identity takes time. It requires not only the existence of new jobs but also the population's understanding of what these jobs represent. It requires an appropriation of these new territories of activity. The Lorraine Coal Basin has undertaken to create a new image for itself and has adopted the new name of "Moselle-Est". This evolution is the result of a voluntary and structured approach that began with the birth of Actipromo in 1989. Its promotion and communication actions began with a traveling exhibition of local industrial products on a train that traveled to the main cities in the region throughout 1990. A range of 70 companies was represented. The National Education system participated in the operation, allowing groups of high school students to visit the train, which received a total of approximately 42,000 visitors. The aim was to restore confidence to a population that still identified with the mine and did not perceive the reality of the new industrial fabric or its future prospects.

In the Provence Basin, the development of microelectronics is visible and massive but has not been embraced by everyone. Communication events around this sector were delayed. Only the

inauguration of the STMicroelectronics plant in 2000 had a significant impact with the presence of Prime Minister Lionel Jospin, announcing the creation of a new engineering school in Gardanne. However, for rural communities that were the first to benefit from the new installations, the issue is different due to the real estate and land pressure they experience, which are negative effects of the conversion dynamic. The arrival of a new population and the wealth effects caused by the increase in land prices have been real economic and social shocks for the local population. We are witnessing another form of rejection of industrialization in these areas, based on the defense of a rural identity against an increasingly dominant industry. This situation argues for a more balanced vision of planning and development actions.

Policies of conversion in France

Three types of deep motivations have chronologically characterized conversion policies: i) first, the desire for an economic treatment of the crisis, based on the creation of new jobs, ii) then a more social management of this crisis, including the search for reclassification of personnel, and iii) more recently, the objective of requalifying territories.

Until the early 1980s, conversion policy was exclusively the responsibility of the State, the sole actor responsible for preserving major threatened industrial sectors. Initially, from the post-war period to the 1960s, the State intervened in the name of the general interest, as illustrated by the support given to the coal mines after World War II. Then, in the 1970s, its action was justified by the need to limit regional inequalities and control social unrest. These action logics, aimed at the economic treatment of the crisis, were materialized by the implementation of large industrial programs (such as the establishment of the automobile industry in the Nord region), resulting in the creation of several thousand jobs. The State is thus omnipresent, both as decision-maker, operator, and sometimes even the sole client. Such intervention logics reached their limits in the 1970s with the gradual establishment of globalization. Crises became long-lasting and structural (Grosdidier, 1996). In the 1980s, there was a progressive broadening of conversion logics, particularly with the increased participation of regional actors supported by decentralization laws and European aid, such as the European Regional Development Fund (ERDF). The importance of the territorial dimension also becomes evident, with a more comprehensive and qualitative approach, such as the emergence of quality of life criteria. This new approach to conversion is sometimes referred to as "economic and territorial redevelopment". Concrete efforts are made through the establishment of conversion poles and the planning of actions within the framework of State/Region planning contracts.

Conversion logics have therefore changed over time, with:

- more participatory representation of the State rather than omnipotent,
- increased involvement of regional actors (local authorities, chambers of commerce, decentralized state bodies, local banks and industries, etc.),
- more comprehensive view of conversion both in terms of time and in terms of space, with the aim of a sustainable requalification of the entire territory.

Conversion policies also specifically target SMEs, considered to be more job creators than large companies do and more conducive to the economic resilience of the productive fabric. Financial support is provided to them, while at the same time exceptional financial resources are allocated for the improvement of infrastructure, industrial landscape planning, training, and research.

The Nord-Pas-de-Calais region is probably the best example to illustrate this evolution of conversion policy, as State intervention was effective there as early as the 1950s.

Faced with the beginnings of the decline of coal in the Nord region, CdF (Charbonnages de France) implemented an initial conversion program under the impetus of the central government. Throughout the 1960s and 1970s, it attempted to develop a chemical hub in which activities were consolidated into an autonomous company, CdF-Chimie, in 1967. In terms of employment, the results were mediocre because CdF-Chimie had to eliminate positions, especially among its blue-collar workers, while only the number of engineers, managers, and supervisors increased. Some choices proved disastrous, such as the construction of a large petrochemical platform in Dunkirk during the oil crisis, in association with capital from the Emirate of Qatar in 1974. An expensive project, with minimal job creation and virtually no regional impact.

The programs implemented in the 1980s can illustrate the second evolution of conversion policy. An example of the significant participation of regional actors alongside the state is FINORPA (Financière du Nord-Pas-de-Calais), which succeeded in creating numerous jobs in sectors such as construction materials, fine chemicals, plastics, and agri-food. As part of territorial development, the state made every effort to attract automobile construction firms to the mining basin, both national companies like Renault in Douai and foreign companies like Toyota in Onnaing, near Valenciennes. Thanks to these establishments, Nord-Pas-de-Calais became the second region in France, after the Parisian region, in terms of the number of jobs in the automotive industry. Simultaneously, significant efforts were made to develop the tertiary sector. Thus, as early as the 1980s, the number of tertiary jobs surpassed the number of secondary sector jobs in Nord-Pas-de-Calais. This trend reflects an alignment of regional economic structures with those of the rest of the country.

Finally, the third evolution is marked by massive efforts in favor of technical and higher education. Today, Nord-Pas-de-Calais has seven universities (including the Catholic University of Lille), one of which, in Valenciennes, has deliberately focused on scientific and technical education since its establishment. Thanks to conversion, many young people who would never have had access to higher education now benefit from it. Combined with recent efforts to establish renewable energy production in rehabilitated mining wastelands, the current policy of the Nord-Pas-de-Calais region aligns with the concept of "sustainable conversion," representing a significant new sequence in the development of conversion policies that goes beyond the scope of the mining basin.

Lorraine was not directly affected by the first stage of conversion, probably because the quality of its coal ensuring its survival during the crisis of the 1950s-1960s. However, the industrial crisis of the 1970s in the steel, iron ore, and textile sectors, which resulted in the loss of 120,000 industrial jobs in five years, led to the implementation of a conversion policy solely aimed at reducing mass unemployment among low-skilled workers. Public policies therefore aimed to attract low-value-added activities to Lorraine through the costly establishment of "screwdriver factories" (e.g. Daewo, JVC, Scholtès), which themselves relocated only a few years later, in the context of globalization.

The conversion of the coal industry began in 1984, taking into account lessons learned from the past, first and foremost by spreading out the necessary actions over time. Conversion now relies on a state-regional partnership with the assistance of the private sector, which jointly commits to the economic and social development of the region. In parallel, the growing presence of higher education in the two regional hubs of Nancy and Metz ensures the availability of qualified personnel. Today, most of the industrial wastelands have been reclaimed, and new companies have been created, especially in the tertiary and new technology sectors, but also in the industrial sector, such as Mécanica near Thionville, the Smart manufacturing site in Hambach, or the plastic industry hub in Saint-Avold.

However, if the unemployment rate in Lorraine is now in line with the national average, it is likely due in large part to the development of cross-border projects. Located at the crossroads of Luxembourg, Germany, and Belgium, Lorraine has benefited from international cooperation,

particularly with the creation of the Saar-Lor-Lux great region or the QuattroPole Luxembourg, Metz, Saarbrücken, Trier. It is worth noting in this context the "Eurozone Saarbrücken-Forbach-Nord" initiative, a bilateral collaboration that establishes a genuine common policy for the valorization of mining wastelands, capitalizing on their economic, urban, cultural, and landscape potential. This commitment is reflected in the establishment of the cross-border program "Parc de Développement de la Vallée de la Rosselle". This program aims to rehabilitate six vestige wastelands of coal mining, which are connected by the green axis of the Rosselle and carry strong historical, cultural, and landscape values, as well as challenges for economic and urban recomposition.

Mining legacy

As the spatial consequences of three centuries of industrialization, the transformations undergone by the landscape are particularly visible in the coal mining areas, where abandoned spaces, left behind by the decline of traditional mining activities, have multiplied. However, the future of these downgraded and degraded spaces, structured by an industrial system completely disappeared, is a major challenge for the future of territories. Rehabilitating these degraded spaces means adapting them to the new economic system and giving them a new purpose by redesigning and converting them. This rehabilitation is one of the conditions that allow for the economic conversion of the territory and leads to a change in the image of the coal mining basin.

The image of the "black country," with a more or less highly degraded natural, economic, and social environment, often constitutes a significant obstacle to the arrival of new activities. One of the options available is to redesign this degraded landscape, considered valueless, by erasing as much as possible the traces of the mining past. This was the solution that was chosen for a long time, starting in the 1960s. The decline of mining operations and the closure of mining sites led to the complete destruction of mine buildings and headframes, while some degraded workers' housing estates suffered the same fate. Just a few years after the closure of the mines, the mining landscape consisted only of a slag heap, when it wasn't exploited itself for its earthmoving materials. Rehabilitation, therefore, initially meant the more or less complete destruction of the heritage of mining operations.

From the 1970s onwards, this trend gradually evolved towards at least partial preservation of what is now considered as legacy to be valued within the framework of the conversion process. Long treated with disdain, destroyed or in ruins, industrial buildings became the subject of a new academic discipline called "industrial archaeology" and were recognized, like ancient monuments, as historical testimonies that needed to be preserved. But it was only gradually that industrial archaeology began to take an interest in the entire landscape of regions marked by mining operations. This broadening of perspective also influenced the conception of legacy, which now encompasses not only a specific site but also an entire landscape.

In France, awareness of the value of mining heritage and the emergence of a policy to preserve certain elements of it appeared relatively late and unevenly across different mining regions, depending on the dynamics of local actors.

The desire to preserve and enhance mining heritage is very limited and lacks resources in the Midi basins (Alès, Carmaux, or Decazeville), which seem to have definitively turned the painful page of coal mining. The main mining rehabilitation project consists on the development of the Cap Découverte multi-leisure center near Carmaux, located in the former open-pit coal mine and features a synthetic ski slope, a swimming pool, and a lake. However, the complex, which opened in 2003, has not achieved the expected success and is struggling with significant financial difficulties.

A policy to preserve mining heritage has developed in Lorraine, where several headframes have been preserved and, most notably, the Wendel Mine Site (Petite Rosselle) has been classified as a historical monument. Converted into a mining museum, which opened in June 2006, it is part of a large cross-border project developed in cooperation between the Forbach Agglomeration Community, the State of Saarland, and the city of Saarbrücken. This project, called the "Development Park of the Rosselle Valley," aims to rehabilitate, enhance, and convert the mining and industrial heritage of the Saar-Lor-Lux coal basin. It also aims to promote the establishment of new economic activities, particularly within the framework of the first cross-border technopole between France and Germany, where PeMtech, the first high-tech company, established itself in 2003.

Figure 2– Wendel Mine Site (Deshaies, M. (2006), private collection of M. Deshaies)

The conservation and protection of mining heritage have developed significantly in the Nord-Pas-de-Calais coal basin, where the Lewarde Mining History Center was created even before the closure of the last coal mine in 1990. Since then, its success has been evident, as it receives an average of more than 130,000 visitors per year. There are also several other mining museums in places like Anzin, Noeux-les-Mines, or Bruay Labuissières, as well as mine sites arranged for visits, such as in Oignies. All of these sites have been preserved and classified as historical monuments.

The enhancement of mining heritage is not simply a matter of preserving memory but also aims to create new activities. The 11/19 mine site in Loos-en-Gohelle, at the foot of the emblematic twin slag heaps, has been redeveloped into an eco-park featuring a sustainable development resource center, an eco-business creation center, and cultural activities. A local initiative led to the creation of an association called "la chaîne des terrils" (the slag heap chain) in 1988. Its main goal is to highlight around forty slag heaps out of the total 232 in the entire coal basin. The primary objective of this association is to "preserve the memory, enhance, and let people discover these heritage monuments that are the slag heaps". Some of the slag heaps, reclaimed by original flora, have been arranged for walking paths and serve as recreational spaces for the residents of the surrounding urban region.

One of the slag heaps in Nœux-les-Mines has been equipped with a synthetic ski slope. It is the centerpiece of a leisure complex (Loisinord Park) that includes a lake and a golf course.

Figure 3 – Dry ski slope on a slag heap in Nœux-les-Mines, Pas-de-Calais, France (URL2)

With its listing in 2012 as a UNESCO World Heritage site under the category of "evolving and living cultural landscape," the dynamics at work in the Nord-Pas-de-Calais mining basin demonstrate that heritage recognition can be the starting point for a change in perspective and become a force of resilience.

The 120,000 hectares of the site consist of 109 individual assets, which can include pits, headframes, slag heaps, some of which cover 90 hectares and exceed 140 meters in height, infrastructure, religious buildings, executive housing and leadership castles, town halls, etc. The site testifies to the model of the workers' city, from the mid-19th century to the 1960s, and illustrates a significant period in the history of industrial Europe. It provides information on the living conditions of miners and worker solidarity.

Beyond the potential economic benefits, the goal is also to regain pride for inhabitants in being part of this territory.

The large-scale expansion of the heritage field and the inclusion of inhabited and lived-in built structures in particular have led to going beyond heritage as a tool for simple preservation of the past and turning it into a resource for the ongoing territorial transition, oriented towards the future.

Figure 4– Rehabilitation of the Cité des Électriciens (included in the UNESCO site) in Bruay-la-Buissière (62), a former mining village located 8 km southwest of Béthune. It is the oldest mining community (built between 1856 and 1861) and its rehabilitation was completed in 2019, now offering modern housing (URL3)

Valorization of post-mining resources

Although effective solutions are usually site dependent, restoring landscape alone is generally insufficient to taking off again the economic engine. Taking steps beyond the environmental reclamation of mine sites is mandatory when new developments involving the creation of job opportunities, diversification of the local economy, and the creation of community assets are targeted. Among the available instruments for this purpose, the one that inspires the least resistance and rejection among the local population is the valorization of post-mining resources, which involves the reintegration of depleted mines into economic activity. Indeed, after closure, mined areas left behand remarkable potentials and resources that could be favourably exploited. In other words "*It's Not Over when It's Over! ".* In addition, unlike the commodity working, the use of these new resources is environmental friendly and consistent with the sustainable development. Here are some examples of such potential resources:

Geothermal energy: At the end of deep underground mining operations, the galleries and voids left in place by the old workings gradually fill with water. Due to the geothermal gradient, this water heats up when it comes into contact with the mine walls and after a few years becomes a reservoir of hot water of considerable volume, sometimes several million cubic meters. This hot water can be exploited using heat pumps to produce clean thermal energy without any environmental impact, as after use, the water returns to the mine, ensuring hydraulic balance.

Several cities in Europe use mine water as an energy carrier. In France, the city of Gardanne manages to harness the 35 million m^3 of warm water present in the mine at nearly 30°C. Thanks to geothermal energy from mine water, supported by a network of solar panels (2,200m^2), an entire eco-district in Gardanne, covering nearly 14 hectares, now benefits from renewable and decarbonized energy for over 80% of its needs.

***Clean energy production*:** Mine gas, or firedamp, consisting mainly of methane, is an integral part of coal, at a rate of 2 to 10 cubic meters per ton of coal. After mining, mine gas continues to migrate

from the coal, filling the galleries and voids left in place and then escapes through fractures to the surface. It is therefore necessary to continue to capture and, if possible, to value it. One technique used, especially in Germany, involves capturing the gas through a converter and then sending it - before it spreads into the air and pollutes - into a powerful engine, which then transforms it into electricity. Very efficient and considered environmentally friendly, this process generates more energy than wind turbines. In France, in the Nord-Pas-de-Calais mining basin, Gazonor, a subsidiary of La Française de l'Énergie, has installed the first site for the generation of so-called "green" electricity, enough to supply electricity to 9,000 people per year. Three other sites in the region are being studied for rapid implementation. Ultimately, Gazonor estimates a production of nine megawatts per year, enabling to serve 40,000 consumers.

Conclusion

The unavoidable decline of the coal industry is the reason behind the policy of conversion. This policy is implemented by very proactive French authorities and involves establishing new economic activities to create jobs, in order to compensate for the decrease in employment in the coal mines. It puts the adaptability of the population in mining areas to the test, as it has caused major socio-economic and cultural disruptions. Conversion meant a complete change in lifestyle for the population in mining areas. It involved abandoning a secure profession that provided jobs for the entire family, as well as housing, heating, education, and numerous services. Those who did not work in the coal mines benefited from their economic impact. Psychologically, the change was abrupt. After the Liberation, coal miners were nationally celebrated since the country's reconstruction depended largely on coal. Just a decade later, they became outdated. This abrupt rupture explains the repeated social movements.

While there are still socio-economic difficulties inherited from the mining period that remain burdensome, the population in mining areas has shown great adaptability and resilience. The traditional strengths of these regions are now reinforced through efforts focused on heritage and the image of the territory, an essential tool for marketing communication.

Trade unions have intelligently supported the miners because at least some of them were already aware in the 1960s of the dead end of coal and the imminent end of full employment. Achieving the agreement on "zero layoffs" and the agreement on "early retirement" with the preservation of 80% of salary and all social rights is an unprecedented achievement in union struggle.

The authorities have also learned from successive crises and failed conversions, the need for:

- anticipation through a clear timetable compatible with commitment fulfilment,
- shared vision of the territory between public and economic actors,
- social dialogue so that the acceptability of conversion is achieved through the full involvement of all stakeholders in discussions and decision-making,
- financial guarantee, to ensure that all financially dependent conversion support measures are honoured.

Ultimately, the conversion of the coal mining industry in France, which began as early as the 1960s, was a multifaceted process, encompassing economic, social, and cultural dimensions. Faced with the magnitude of the shocks caused by the disappearance of coal activities as well as recurrent economic crises, the conversion process can be considered as a relative success.

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Appendix 4 POLAND

Research Fund for Coal and Steel

Conservation and Promotion of the Coal Mining Heritage as Europe's Cultural Legacy, grant agreement No. 101112138

WP2: Status quo of coal mining heritage in Europe

D2.1 – Report on the coal transition strategy in Poland

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1. Goals and causes

The global energy and environmental context has changed dramatically in recent years. As awareness of coal's impact on climate change has grown, more and more countries, including Poland, are seeking to develop and implement strategies to move away from coal. These strategies aim to reduce greenhouse gas emissions, protect the environment and resources, and diversify energy.

1.1 Reducing greenhouse gas emissions

One of the main objectives of the strategy to move away from coal is to reduce greenhouse gas emissions, especially carbon dioxide. Coal is one of the main sources of CO2 emissions worldwide. Switching to more sustainable energy sources, such as renewable energy, helps to reduce the energy sector's impact on climate change. In this perspective, climate change is one of the most serious challenges facing humanity. Scientific evidence indicates that the increase in global temperature is mainly the result of greenhouse gas emissions from human activities, in particular the burning of fossil fuels. The impacts of this climate change are increasingly visible, including extreme weather events, rising sea levels, melting glaciers and much more. Decarbonisation strategies are based on replacing traditional energy sources, such as coal burning, with greener alternatives such as RES. The key ways adopted in de-carbonisation strategies contributing to the reduction of greenhouse gas emissions are mainly investments in renewable energy sources, which allow energy to be produced without emitting CO2. Solar panels, wind turbines and hydroelectric power plants represent an increasing share of the global energy mix. Another example is the reduction of energy consumption through the use of efficient technologies and practices, which contributes to the reduction of greenhouse gas emissions. This includes insulation of buildings, more energy-efficient vehicles and the development of smart grids. It is important to develop public transport, electromobility and other low-carbon modes of transport, which contributes to reducing greenhouse gas emissions from the transport sector, which is one of the main sources of emissions. Public education and awareness is a very important factor in these perspectives. Shaping public and business attitudes towards sustainable and greener lifestyles is key. Improving public awareness can reduce energy consumption and promote sustainable practices (Koncelaria Senatu RP 2020).

1.2 Environmental protection

Coal mining determines serious negative impacts on the environment. Coal mining is associated with surface degradation, water and air pollution, and urban degradation. The transformation of coal mining can help to protect valuable ecosystems and biodiversity. Reducing air pollution from coal combustion helps to improve human health by reducing the risk of respiratory diseases and other health problems. As a result, coal mining transformation opens the door to sustainable development, creating jobs in sectors with lower environmental impacts, can contribute to the development of new economic sectors and promote more sustainable development (PEP 2030). In order to achieve the environmental goal in strategies to move away from coal, various actions and measures are being taken, including:

- investments in renewable energy sources, such as solar and wind power, help to replace coal as the main source of electricity,
- improving energy efficiency in buildings, industry and transport helps reduce energy consumption and greenhouse gas emissions.
- restoring land after mining operations to rebalance ecosystems,
- raising public awareness of the importance of environmental protection.

1.3 Energy diversification

Basing energy security on coal as the main energy source carries the risk of energy homogeneity, which can lead to instability of supply and higher energy prices. Diversification of energy sources, including investment in renewables, provides greater energy independence and stability of energy supply. Coal has traditionally been one of the world's main sources of energy, particularly in the power sector. However, its combustion is associated with numerous negative impacts, such as the aforementioned greenhouse gas emissions, air pollution and environmental degradation. Diversification of energy sources makes it possible to replace traditional sources, such as coal, with cleaner alternatives, including RES and nuclear power. It also reduces dependence on a single raw material or energy supplier. This increases a country's energy independence and ensures stability of energy supply in the event of energy market disruptions. In order to achieve the goal of diversifying energy sources, particular actions are required, examples of which are:

- investment in renewable energy sources,
- promotion of energy efficiency,
- support for research and development,
- promotion of environmental policies.

Diversification of energy sources is one of the key objectives of the strategy to move away from coal. The energy transition aims to reduce greenhouse gas emissions, increase energy independence, protect the environment and public health, and stimulate innovation and the economy.
In view of the above strategic goals of moving away from coal, the political motivations determining the transformation of mining are also important. One of the first motivations is international commitments. Under the Paris Agreement, countries have committed to limit global warming below 2 degrees Celsius. In order to achieve this goal, greenhouse gas emissions need to be drastically reduced, which requires a shift away from fossil fuels. Another factor is social pressure. As public awareness of climate change and the impact of coal on public health grows, so does public pressure on governments to take action to move away from coal. The most important motivations for social pressure are:

- Public health. The coal industry is often associated with serious health problems for residents in mining areas, such as asthma, respiratory diseases and cancer. Switching to cleaner energy sources aims to improve people's quality of life and reduce the negative impact on public health.
- Job creation. The transformation of mining can be an opportunity to create new jobs in sectors related to renewable energy, technology and innovation. This can contribute to economic growth and reduce unemployment in mining areas.
- Long-term savings. Investment in renewable energy sources can lead to long-term savings. Renewable energy sources have lower operating costs and do not require constant access to raw materials such as coal.
- New business opportunities. The transformation of mining opens the door to new business opportunities related to renewable energy, energy storage technology and energy efficiency. Companies that get involved early in these areas can benefit from the growing market (Marszowski 2021).

As the world moves towards a sustainable future, the transformation of coal mining is becoming an inevitable step towards a greener and more sustainable society. But at the same time, a shift away from coal in Poland could lead to job losses and changes in the country's economic structure. This poses a political challenge, as politicians must face public resistance, including from numerous mining-related professional groups, in seeking sustainable transition plans for these communities to

other economic sectors and to use existing mining infrastructure for new purposes. Introducing effective transition policies and strategies can help manage this challenge to achieve sustainable development goals (WsieEuropa 2023).

2. Legislation, policy & regulations

As the world moves towards sustainable and greener development, the transformation of the mining sector is becoming an unavoidable challenge. One of the key aspects of this process is the development of policies and regulations to minimise negative socio-economic impacts, the most significant of which are the following (UM 2022):

- Loss of workplaces. The shift from traditional mining to other economic sectors can lead to a loss of jobs, which can pose important challenges for local communities.
- The need to retrain workers. Workers in mining and coal-related industries need to retrain to work in new sectors, requiring investment in education and training.
- Impact on regional economies. In some mining regions, the transition can have a serious impact on the local economy, which can lead to social and political problems.
- Investment costs. Investment in new technology and infrastructure can be costly, posing challenges for governments and businesses.
- Social and political issues. The transformation of the mining sector is often accompanied by protests and social tensions over concerns about jobs and the livelihoods of traditional mining communities.
- Social equity. There is a risk that some social groups may suffer more than others during the transition, which may increase social inequality.

Properly managing these challenges is key to ensuring that the transformation of the mining sector delivers long-term social and economic benefits, while minimising its negative impacts on local communities and mining workers. A just transition involves reducing pressures and ensuring environmental security by choosing optimal pathways for the transformation of the national economy towards a cost-effective and low-carbon economy, and defining a new state industrial policy, as well as a new economic development policy for regions particularly at risk of this transition, i.e. coal regions.

2.1 European policy

Policy plays a key role in planning the transformation of mining. The solutions and strategies developed should take into account sustainable development objectives, in particular the reduction of greenhouse gas emissions and the minimisation of environmental degradation. The following are documents that have a significant impact on these activities.

WHITE PAPER Adapting to climate change: Towards a European framework for action
WHITE PAPER Adapting to climate change: Towards a European framework for action (KE 2009), is a 2009 document that sets out a framework for reducing the EU's vulnerability to the impacts of climate change. Climate change adaptation is one of the strategies to be undertaken to reduce the economic, social and environmental impacts of climate change.

European Parliament resolution on a resource-efficient Europe European Parliament resolution on a resource-efficient Europe (EP 2012) of 2012 is a document that primarily refers to actions that should be taken in the field of a resource-efficient economy. The demands formulated in the document point to the need to improve productivity and ensure sustainable growth while reducing resource consumption and safe access to resources, as well as tackling climate change and environmental

impacts. Transformation of the economy and socially responsible use of resources is an important issue underlined in this paper.

GREEN PAPER A 2030 framework for climate and energy policies GREEN PAPER
A 2030 framework for climate and energy policies of 2013 sets out a framework for climate and energy policy up to 2030 (EC 2013). Regulation of the European Parliament and of the Council on establishing a framework for achieving climate neutrality (...) - European climate law. The regulation is intended to pave the way for Europe (EU) to become the first climate-neutral continent.

2030 Agenda for Sustainable Development
2030 Agenda for Sustainable Development (UN 2015), adopted in 2015 by the UN sets out 17 Sustainable Development Goals (The Sustainable Development Goals, SDGs) and the associated 169 targets to be achieved by the world by 2030. They relate to five areas, the so-called 5xPs: people, planet, prosperity, peace, partnership, and the achievement of the SDGs is monitored through relevant indicators. Among these are those related to climate and energy: (7) ensuring affordable access to sources of stable, sustainable and modern energy for all, and (13) urgent action to address climate change and its impacts.

Paris Agreement
Paris Agreement (UN 2015) is a legally binding international climate change treaty adopted in 2015 by 196 parties at the UN Climate Change Conference (COP21). It obliges all countries to present long-term scenarios for reducing greenhouse gas emissions in line with the methodology adopted by the IPCC. The EU has presented a long-term emissions reduction strategy and updated climate plans. In them, it pledged to reduce EU emissions by at least 55% by 2030 compared to 1990 levels.

The European Green Deal
of 2019 is a key document and a package of policy initiatives that aims to put the EU on the path to a green transition and ultimately achieve climate neutrality by 2050. It supports the transformation of the EU into a just and prosperous society with a modern and competitive economy. The aim is to transform Europe into a modern, resource-efficient and competitive economy, characterised by:

- zero net greenhouse gas emissions in 2050,
- decoupling economic growth from resource consumption,
- an equal standard of living in all regions.

Actions primarily include a blueprint for building a sustainable economy, halting climate change, resource efficiency, transitioning to a clean, closed-loop economy, tackling biodiversity loss and reducing emissions. The Green Deal recognises the need for additional investment and a just transition mechanism, and the Just Transition Fund is to be one of the instruments to support these goals.

Regulation of the European Parliament and of the Council establishing the Just Transition Fund
Regulation of the European Parliament and of the Council establishing the Just Transition Fund (EC 2021) of 2021 specifies that the JTF is a component of the Fair Transition Mechanism, which also includes a special scheme under InvestEU and a public sector lending facility set up jointly with the EIB Group to mobilise additional investment in transition-affected regions. JTF is mainly used to provide grants for projects related to the achievement of the fund's objective. The regulation provides guidelines for the development of Territorial Just Transformation Plans.
In the perspective of the above-mentioned documents, the green economy, which is defined as an economy that improves people's well-being and enhances social justice, while reducing environmental risks and the consumption of natural resources, takes on particular importance (EEA

2012). In other terms, the green economy is a low-carbon, resource-efficient and socially inclusive economy (UNEP 2012). The importance and relevance of actions developing the green economy is underlined by European Union and national policies, including Poland's, which have some of the world's strictest environmental standards. The EU and national governments have set clear targets to shape European environmental policy in line with these by 2020 and in the longer term by 2050.These targets are (EU 2022):

- to protect, preserve and enhance the EU's natural capital,
- to transform the EU economy into a resource-efficient, green and competitive low-carbon economy,
- to protect Europeans from environment-related pressures and risks to health and well-being.

2.2 Polish regulations

This section presents national documents that set out medium- and long-term goals and targets for the energy transition.

National Recovery and Resilience Plan

National Recovery and Resilience Plan is the 2021 programme, which consists of 54 investments and 48 reforms to strengthen the Polish economy. In line with EU targets, a significant part of the budget will be allocated to climate objectives (42.7%) and digital transformation (21.3%). In the section on green energy and reducing energy intensity, a key objective is clean air, a goal to be achieved through, among other things (KPO 2021):

- faster replacement of old coal-fired cookers with more environmentally friendly ones,
- the purchase of photovoltaic panels and solar collectors,
- wind farms in the Baltic Sea,
- smart grids,
- hydrogen technology,
- green cities.

Strategy for Responsible Development

Strategy for Responsible Development (SRD 2017)), the document adopted in 2017, specifies the objectives and directions of the country's development until 2030 in the social, economic and spatial areas. The SRD proposes a sustainable development model, based on territorial potential, investment, innovation, development, exports and advanced products. The new strategy focuses on strategic sectors instead of all industries. The strategy assumes that the transformation of the Polish economy towards a low-carbon economy will require a complete re-evaluation and new market models allowing for, inter alia, characteristics such as capacity, availability, generator location, customer location, demand characteristics, etc. However, due to the nature of energy services, changes must be evolutionary and it is necessary to reconcile a sufficiently strong base of conventional, large-scale generation in the professional power sector with distributed sources functioning as a complement for medium-sized agglomerations and clusters, energy cooperatives, etc. with a significant level of autonomy.

National Strategy for Regional Development 2030

National Strategy for Regional Development 2030 (NSRD 2019) is one of nine sectoral strategies detailing, at national level, the assumptions of the Strategy for Responsible Development, the main objective of which is to detail actions in the field of regional policy understood as coordinated actions of all entities (including the government, local governments at all levels and socio-economic partners) for the development of individual regions. The NSRD specifies the scope of measures aimed

at the implementation of one of the pillars of the SRD, i.e. socially sensitive and territorially sustainable development, thus defining a new paradigm of the Polish regional policy. According to the NSRD, the main objective of the regional policy is the effective use of endogenous potentials of territories and their specialisations for the achievement of a sustainable development of the country, which will create conditions for an increase in the income of the inhabitants of Poland, while achieving cohesion in the social, economic, environmental and spatial dimension.

Poland's Energy Policy

Poland's Energy Policy by 2040 (PEP 2030) is a 2021 document that sets the framework for the energy transition in Poland. The document envisages a gradual transition away from carbon-intensive coal-fired generation while developing low- and zero-carbon sources. Implementation of PEP2040, which is part of the European Union's energy policy, is to lead to the achievement by Poland of the objectives resulting from the accepted international obligations related to the reduction of CO2 emissions. One of the primary objectives is to ensure that, for social, economic and environmental reasons, the ongoing transformation of the coal regions will ensure that a fair energy transition leads to economic strengthening, leaving no one behind and serving future generations. This process is to be supported by financial instruments under the EU's Fair Transition Mechanism. The details of this are primarily covered in the national and territorial Fair Transition Plans. One element of the transformation will be a reduction in hard coal production, concentrated mainly in Upper Silesia Region.

National Environmental Policy 2030

National Environmental Policy 2030– development strategy for environment and water management (PŚP2030) is a document adopted by the Council of Ministers in 2019 to support transformational activities in the environmental dimension. The action plan set out in the National Environmental Policy to 2030 includes a wide range of intervention directions that focus on accelerating the energy transition process in regions that have so far relied on coal and conventional energy sources. It is worth emphasising that these intervention directions do not only cover areas related to environmental protection, but also provide a stable framework for change processes. The priority objective is to achieve coherence between the transformations underway and the defined objectives of PEP2030, with a particular focus on diversifying the activities of companies operating in historically coal-based sectors and dynamically developing sectors associated with a modern, green economy. These sectors include areas such as renewable energy sources, energy-efficient materials, developing a closed-loop economy, revitalising brownfield sites and implementing innovative solutions in the transport sector. All these aspects are key pillars in the process of moving away from traditional, non-environmental energy sources.

National Plan for a Just Transition (NPJT)

National Plan for a Just Transition (NPJT 2021) is a document approved in 2022 by the European Commission that outlines the goals and directions for the transformation of coal regions in Poland towards a zero-carbon economy. The NPJT focuses on sectors with strong links to coal extraction and combustion, such as hard coal and lignite mining, electricity generation and coal-based heating. It considers the transformation of sectors with high emissions, such as metallurgy, minerals, ceramics, paper, wood and chemicals. The document allows for financial support from the JTF. It complements the Territorial Fair Transformation Plans developed by the provincial governments. Of particular concern in this document are the so-called SIA (Strategic Intervention Areas), which include, among others, municipalities threatened by permanent marginalisation, medium-sized towns losing socio-economic functions, Silesia and Eastern Poland. The designation of Silesia stems primarily from the challenges faced by this region in connection with the transformation.

2.3 Regional policy

Development Strategy of the Silesian Voivodeship Green Silesia 2030

At the regional level, the key strategic document in the space of transformation processes is the Development Strategy of the Silesian Voivodeship Green Silesia 2030 (Zielone Śląskie 2030), adopted by the Board of the Silesian Voivodeship in 2020. This document clearly states that from the point of view of the Silesian Voivodeship, it will be important to implement the Programme for Silesia, which aims to change the economic profile of the region, gradually replacing traditional sectors of the economy, such as mining and metallurgy, with new ventures in more productive, innovative and technologically advanced sectors. It is envisaged that the implementation of this programme, coordinated with the government's restructuring initiatives, will be supported by the development of transport infrastructure, the implementation of an integrated urban, industrial and innovation policy.

Regional Innovation Strategy of the Silesian Voivodeship 2030

Regional Innovation Strategy of the Silesian Voivodeship 2030 points to the particularly important role of regional smart specialisations and specialisations in supporting the smart transformation process of the region. Key in the case of both documents is building an innovation ecosystem and support for R&D sectors and entrepreneurs, especially SMEs, development of new ventures, research activities, transfer of advanced technologies and projects related to renewable energy, energy efficiency, digitisation, green economy and medicine. The Strategy indicates that in the coming years, entities from the Silesian Voivodeship will be beneficiaries of a specific European Union instrument supporting green transformation, the JTF. This support will enable: productive investment in SMEs, leading to economic diversification and restructuring; investment in the creation of new enterprises; investment in research and innovation activities and support for the transfer of advanced technologies; investment in the deployment of technologies and infrastructures for affordable clean energy, in the reduction of greenhouse gas emissions, energy efficiency and renewable energy; investment in digitisation and digital connectivity; investment in land regeneration, decontamination and rehabilitation and land use change projects; investment in strengthening the circular economy; up-skilling and re-skilling of workers. The allocation of funds will be guided by the Territorial Just Transformation Plan (RIS 2021).

Territorial Just Transformation Plan of the Silesian Voivodeship 2030

Terytorialny Plan Sprawiedliwej Transformacji (TJTP 2022), adopted in 2022, represents a key operational action plan in the area of transformation. It covers 7 sub-regions of the province: Katowice, Bytom, Sosnowiec, Gliwice, Tychy, Rybnik and Bielsko-Biała. The TJTP emphasises the need to change the manufacturing structure and develop the energy sector in the region and to support the labour market. Mitigating the social, economic
and environmental impacts associated with the transition towards climate neutrality are the most important objectives of the Plan. The implementation of the TJTP will be ensured by a dedicated funding source included in the European Funds for Silesia 2021-2027 and other funding sources. The Plan is consistent with EU, national policies and other regional, sectoral strategic documents such as:

- Low emission economy policy for the Silesian Voivodeship. Regional Energy Policy until 2030,
- Regional Innovation Strategy of the Silesian Voivodeship 2030,
- Social Policy Strategy of the Silesian Voivodeship for 2020-2030,
- Regional Urban Policy of the Silesian Voivodeship,
- Regional Revitalisation Policy of the Silesia Voivodeship.

3. Transformation plan

Hard coal mining in Poland is of vital importance for the country's energy security. Hard coal is the basic energy carrier ensuring Poland, together with lignite, a very high degree of energy independence, understood as independence from fuel imports. The largest amount of primary energy consumed comes from hard coal (in 2022 over 36%) (Rynek energii 2022). However, the decarbonisation policy, the development of renewable energy sources and the rising price of CO2 emission allowances are causing the share of hard coal in the balance of primary energy consumption to gradually decrease. Total hard coal consumption in Poland in 2022 was approximately 66 million tonnes, 5.9% lower than in 2021 and 14.3% lower than in 2018 (Dusiło 2023).

The changes taking place in the mining environment mean that the Programme for the hard coal mining sector in Poland, which has been implemented in stages since 1998, requires changes - both fundamental and structural. It is necessary to redefine the main objective of the programme with specific objectives, taking into account the Energy Policy of Poland until 2040 and the Social Agreement and the resulting new support system for production companies, which is to guide the sector through the process of gradual liquidation and mitigate its effects on both the industry and its environment, being an alternative to uncontrolled bankruptcy.

Size and structure of hard coal reserves in Poland

Hard coal deposits in Poland are found in three basins. Hard coal mining is currently carried out in two of them: Upper Silesian Coal Basin (USCB) and Lublin Coal Basin (LCB). In the third one (Lower Silesian Coal Basin - LSCB), mining was discontinued in 2000 due to unprofitable mining resulting from difficult geological and mining conditions (ME 2018). A map of the location of hard coal basins in Poland is shown in Figure 1.

Figure 1 Hard coal areas in Poland (Ministerstwo Energii, 2018)

From the balance resources, industrial (to be mined) and non-industrial resources are separated on the basis of economic criteria, current technological exploitation possibilities and other modifying indicators. For the industrial resources, mining schedules, utilisation factors of the deposit are developed and losses are calculated. The estimated amount of coal that can be extracted from the longwall is referred to as the operable resources. The category of operable resources is defined for the purposes of operational planning of mining companies and in statistical surveys of public statistics.
The balance sheet resources of all domestic hard coal deposits as at 31.12.2021 amounted to 64.7 billion tonnes. The resources of developed deposits accounted for 43.4 per cent of the balance sheet resources and amounted to 28.1 billion tonnes. Industrial resources in developed deposits, which are mainly recorded in deposits of active plants, amounted to 4.27 billion tonnes. In the national mineral balance at the end of 2021, there were 163 proven deposits, including 47 developed and 59 undeveloped. In addition, 57 deposits were abandoned. The volume of on-balance-sheet coal resources in undeveloped deposits as at 31.12.2021 was 30.9 billion tonnes, including 20.4 billion tonnes in UPCB and 10.3 billion tonnes in LCB (Szuflicki 2022).

Actions and solutions needed to achieve transformational goals
The transformation of Poland's economy, implemented since 1989, entailed the need for deep structural changes, including in the hard coal sector. The restructuring of the sector was implemented through successive government programmes. As a result of the implementation of the first of these, entitled "Restructuring of hard coal mining in Poland" (1993-1995), employment in the mining sector fell from over 415,000 in 1989 to 268,000 in 1995 (Tkocz 2006). This change was mainly due to natural departures (retirements, pensions) and the dismissal of bi-professionals, overseas, as well as workers employed on the surface of the mines linked to the non-production function of the workplaces. The second restructuring programme “Coal Mining, State and Sector Policy for 1996-2000”, which was adopted for implementation in 1996, resulted in a relatively slight decrease in employment - to 245,000 people in 1997.
In 1998, the most significant restructuring programme for changing the size and structure of employment "Reform of hard coal mining in Poland in 1998 -2002" was adopted. Between 1998 and 2000, 80,000 people left the mining industry and employment levels reached 155,000. Eventually, as a result of the measures taken, employment fell by 102,000 people to 140,000 by 2002. The restructuring carried out - in addition to a radical drop in the number of employees also resulted in changes in the employment structure. The share of employees in blue-collar jobs at the bottom fell by 2% and on the surface by 0.4%. The largest number of people who left the mining industry at that time took advantage of the protective instrument called the Mining Social Package (67 026 people, of whom 36 826 opted for mining leave, 419 for social benefits, 29 475 for one-off unconditional cash severance payments). A total of 23 097 people retired (Guminski et al. 2008).
Since 2004, the 'Coal Mining Restructuring Programme 2004-2006 and Strategy for 2007-2010' has been implemented. As a result of its implementation, employment in hard coal mining decreased by a further 17.1 thousand people between 2004 and 2006. The reduction in employment occurred mainly as a result of employees retiring and taking advantage of mining benefits and accounted for further changes in the employment structure - there was a decrease in the share of employees in blue-collar jobs at the bottom (by 0.7%) and on the surface (by 0.6%), as well as a decrease in the share of administrative and office employees (by 0.1%). On the other hand, the share of engineering and technical employees increased at the bottom (by 0.8%) and on the surface (by 0.7%) (MG 2007). As a result, at the end of 2021, 75,500 people were employed in the Polish coal mining industry, 77.5% of whom were underground workers (ARP 2021). Thus, between 1989 and 2021, 339,500 people left the coal mining industry.

The social contract

In order to minimise the negative socio-economic impact of the transformation of the hard coal mining sector, a social agreement was concluded on 28 May 2021 between trade unions, mining companies and the Polish government (MAP 2021). The social contract sets out objectives for the transformation of the coal mining sector, including:

- reducing greenhouse gas emissions by phasing out coal-fired power generation and improving energy efficiency, as well as introducing other sources of renewable energy such as solar, wind and geothermal,
- reducing energy dependency, which aims to reduce the country's dependence on a single energy resource by diversifying energy sources, increasing the use of renewable energy and introducing new technologies and innovative solutions,
- retraining workers in the hard coal mining sector to ensure that they are able to take up employment in other sectors of the economy,
- ensuring the safety of workers, ensuring health and safety at work and protecting the health and lives of workers in the hard coal mining sector,
- regional development, through investment in infrastructure, job creation and the development of entrepreneurship.

The social contract stipulates that all coal mines in Poland will be closed by 2049, and the timetable is as follows:

- Merger of Wujek Mine with Murcki-Staszic Mine (occurred in 2021),
- Mine RUDA Ruch Pokój ended its operation in 2021,
- Mine RUDA Ruch Bielszowice and Mine RUDA Ruch Halemba will continue mining until 2034,
- Mine Bolesław Śmiały will end exploitation in 2028,
- Mine Sośnica will cease operations in 2029,
- Piast Mine - Ziemowit Ruch Piast will cease operation in 2035,
- Piast - Ziemowit Ruch Piast Mine will cease operations in 2037,
- Murcki-Staszic Mine will cease operations in 2039,
- Bobrek-Piekary Mine will cease operations in 2040,
- Mine Brzeszcze will cease operation in 2040,
- Mine Mysłowice-Wesoła will cease operation in 2041,
- Mine ROW Ruch Rydułtowy will cease operation in 2043, Mine ROW Ruch Marcel zakończy eksploatację w 2048 r.,
- Mine ROW Ruch Chwałowice and Ruch Jankowice will end mining in 2049,
- Mine Sobieski and Mine Janina will end exploitation in 2049,
- Mine Bogdanka will cease exploitation in 2049.

Employees of the companies PGG S.A., Tauron Wydobycie S.A. and Węglokoks S.A. will participate in the system of allocation (transfer of an employee to another unit) and training, which will ensure obtaining new qualifications giving the possibility to find a job outside the hard coal mining sector. In addition, an employee without pension rights will be able to benefit from a system of social protection - either a mining holiday or a one-off cash severance payment.

4. Socio-economic impact of coal phased-out

Today, Poland and Upper Silesia is the last large hard coal basin in the European Union. Like other European industrial regions in the past, it faces economic, environmental and social problems associated with the restructuring of the coal industry. One of the key challenges for the region is the loss of competitiveness of mining, the mainstay of the local economy until the end of the 20th century. Despite a several-fold decline in employment in the industry over the past three decades,

more than 74,000 people still work in Silesian coal mining (ARP 2022). The reduction of mining or the closure of coal deposits may be associated with negative social consequences. Measures are therefore necessary not only to rehabilitate mining areas, but also to promote socio-economic transformation.
Transformation processes, including those related to the domestic coal mining sector, will, inter alia, in the area of mining regions, affect the transformation of labour markets and the associated significantly emphasised in the just transition process - the quality of life. As noted in the just transition process, particular attention will be paid to the availability of health care, cultural participation, public transport, schools and universities with attractive educational offerings, rental housing, senior services, sports facilities and recreational areas (PZS 2017). The process of just transformation and its effects in the local environment of decommissioned mines will reveal the social and economic impacts generated in transformed areas. Key ones are outlined below.

Labour market
The main concern is the threats posed by the possibility of job losses due to the closure of mines and mining-related companies and the associated possibility of increased unemployment in the region. The number of workers directly and indirectly linked to the mining industry is currently estimated at up to 400,000 people (GIPH 2021). The projected decline in employment in the peri-mine companies is linked to the opinion of representatives of these companies, who do not see the possibility of a simple change in the profile of operations, objectives and strategy, and their employees are afraid of change and are attached to their jobs. In the event of mine closures, the basic problem will be to provide mining and mining-related jobs for employees at a similar financial level. New jobs need to be created in new sectors, such as renewables, energy efficiency and new technologies, but also sectors based on changing the function of the mining infrastructure and the use of the industrial mining heritage.

Depopulation
The Silesian Voivodeship is currently characterised by a negative phenomenon of depopulation. According to forecasts by the Central Statistical Office, by 2030 the proportion of people of working age (15-64) in Silesia will still fall to 62% (GUS 2017). Increased depopulation is directly linked to the loss of jobs and the impossibility of replacing it in the current place of residence. The socio-economic situation of the Silesian Voivodeship shows that the region is potentially less resilient to economic crises. This lower resilience is due to the growing problem of an ageing population, which may reduce economic attractiveness more quickly than in other regions. Weakness is also due to the still relatively high wage stratification between the traditionally strong industrial sector and the service sector. Decreasing interest in living and investing in the Silesian Voivodship due to the low level of development of post-mining areas may contribute to further depopulation of the region. Migration for work, will cause negative changes in the social structure, especially of small mining municipalities.

Increasing areas of social exclusion
The challenges faced by mining regions include not only internal and foreign migration, demographic changes associated with an ageing population, the relocation of the urban population to the suburban zone, the dying out of city centres, the degradation of public spaces, the burden and congestion of technical and transport infrastructure, the presence of large areas of degraded and post-industrial character, but also poverty and social exclusion in specific neighbourhoods and areas where mines used to operate. Lack of work and simple poverty causes pathological patterns to spread. The increase in unemployment and social exclusion, moreover, leads not only to a decline in consumption, but also to an increase in social costs for protective measures for marginalised groups.

Decline in GDP

The Silesian Voivodeship is the most urbanised and second most populous region in Poland. In 2019, the region was inhabited by 4.5 million people (12% of Poland's population), with the sub-regions of Katowice, Sosnowiec, Bielsko-Biała and Rybnik having the largest population (over 600,000 people). The region's economy is still one of the best developed in Poland. In 2017, the Silesian Voivodeship ranked second in terms of the volume of gross domestic product produced and fourth in terms of its volume per capita. However, it should be noted that the region's growth rate and share of GDP are decreasing. Industry in the Silesian Voivodeship generates a significant share (42%) of added value and has a stronger position than in other regions. However, the decrease in the rate of economic development and the exodus of a part of the skilled workforce, associated with the closure of mines and mining-related plants, will definitely weaken this position.

Decrease in revenue of mining municipalities

The transformation and closure of mines will have a significant impact on the financial health of mining municipalities, associated with a decline in tax revenues in mining municipalities. On a national scale, the decrease in public and legal payments resulting from the downsizing of the mining industry may amount to a total of PLN 3.1 billion between 2021 and 2030 and approximately PLN 19 billion between 2031 and 2040. In turn, the total decrease in mining transformation municipalities' income from participation in personal income tax (PIT-37) may amount to as much as PLN 328 million per year, which means on average for a municipality a decrease in this income of more than 10% (TPST 2022). A decrease in the income of local governments of mining municipalities and the impoverishment of mining regions, will result in a lower quality of social services and an adverse impact on local communities. This means considerably fewer opportunities to use the budget not only for the so-called own tasks of the municipality, but also for purposes related to minimising the effects of mining activities in the form of the need to revitalise post-mining areas. Remediation and reclamation of post-industrial sites, including post-mining areas, which will increase the area available for reuse, e.g. for tourism and recreational purposes. This is a necessary measure to increase the attractiveness of the Silesian Voivodeship for tourists and investors who may be interested in developing environmentally friendly technologies and industries. Delays in the development of new industries and businesses may in turn lead to increased environmental pollution.

5. Integrating Coal Heritage with the transition goals

The integration of mining heritage objectives is inextricably linked to the transformation objectives enshrined in both the National and Territorial Just Transition Plan. Out of TPST's 10 operational objectives, two concern the preservation of coal heritage as a key area of intervention. These are:

- *Strong entrepreneurship of mining subregions*. This objective assumes that in order to maintain existing jobs and create new ones, priority will be given to supporting the development potential and competitiveness of micro, small and medium-sized enterprises. In order to develop and diversify the economic ecosystems of the mining subregions, it is also planned to implement strategic projects supporting the creation of new investments, using hubs and other instruments as hubs conducive to new, creative job places.

  An example of project following this objective is investment is the **Katowice Gaming and Technology HUB** in the historic district of Nikiszowiec. Nikiszowiec Industrial District in Katowice is the former mining workers' quarter, with a highly unique architecture, as well as an excellent modern art gallery (Wilson Schaft Gallery), a magnificent church and a few additional offbeat attractions, i.e. Industrial Ethnography Museum. Residential complex of house of the mineres has been built between 1908 and 1912 in the backyard of their place of employment, Wieczorek Coal

Mine (formerly „Giesche"), closed in 2018. City marketers have also recognised the district's uniqueness with increasing efforts to draw tourist attention to the area and a long campaign afoot to fasten Nikiszowiec to the UNESCO Heritage List. Another unusual placed in the district is Centrum Zimbardo, part of the FIL Association (Stowarzyszenie Fabryka Inicjatyw Lokalnych), a NGO founded in 2009 by a group of local friends who wanted to improve things in Nikiszowiec, all borne of a passion for their district, Silesian culture, history and traditions.
By using the facilities of the former Wieczorek mine, Nikiszowiec is going to become a driving force for the development of digital industry, especially producers of computer games, as well as the e-sports community, deals with the organization of games, tournaments and broadcasts. This can be helped by the international recognition by the Intel Extreme Masters esports world championship organized in Katowice. Municipal authorities find this project as a trigger to cooperation of gaming between business and science. The Hub should enable joint implementations, e.g. the development of new model of education, helping school and university graduates working at junior positions in e-games and IT companies.

Figure 2 Old Nikiszowiec district in Katowice (Jarosławska S. (2023), private collection of personal archives S.Jarosławska)

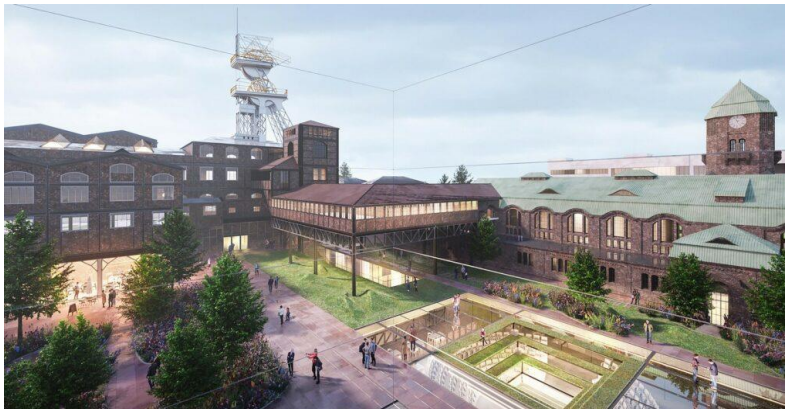

Figure 3 Vision of Katowice Gaming and Technology HUB, Nikiszowiec, city of Katowice (URL1)

– *A comprehensive system of social support activating the inhabitants of mining subregions.* This TPST objective assumes that an essential element of the just transition process is support the families of employees of the mining industry and employees of mining-related enterprises, as well as local communities most affected by the transformation process. It assumes that comprehensive actions will be taken to improve the quality of life and increase the social,

professional and civic activity of the communities involved in the transition process. The support will focus on the implementation of social integration programmes, local just transition arrangements for the inhabitants of mining regions, including bottom-up initiatives of the local community aimed at building the capacity of all stakeholders with preservation of regional identity and industrial heritage while respecting the traditions of mining subregions.

According to the representatives of the local government of the Silesian Voivodeship, the desired directions of changes related to the creation of a green economy should be related m.in. with the reclamation and diversified development of brownfield areas, reducing the effects of water and soil pollution with simultaneous prevention and reclamation activities, transforming brownfield areas located in the vicinity of industrial zones for economic purposes in compliance with zeroemission standards and with the transformation of post-industrial areas and post-mining facilities of high value into new, diversified socio-economic functions while preserving cultural heritage. The strategic recommendations for programming the Just Transition Process of coal regions also assume development of human and social capital, active and entrepreneurial society, based on the preservation of the cultural heritage and identity of the subregion (Drobniak A., 2022).

An example of successful project in this area may be the New Gliwice district, the Silesian Technology Park, Golf Club in Bytom or Leisure Centre in Sosnowiec.
New Gliwice is a revitalized complex of buildings of the former Gliwice Coal Mine, where mine facilties has been transformed into an education and business zone, especially for IT purposes.
Silesian Industrial and Technological Park in Ruda Śląska is the area of the former Wawel Coal Mine with space for small and medium-sized companies (SME). Many IT companies, architecture, geodesy and environmental protection industries operate here.
In both cases, not only the location potential was used, but also the symbolic potential of these places.

Figure 4 New Gliwice, Gliwice city (URL2)

Figure 5 Silesian Industrial and Technological Park, Ruda Śląska (URL3)

Another example of favourable transition is the former Szombierki Coal Mine in Bytom. In this case a private investor Armada Golf Club set up Golf Club at post mining area and use energy from mine waters as a source of heat for its facilities.
In Sosnowiec, on the site of the former Sosnowiec Coal Mine, the complex of modern industrial plants and the Leisure Centre was built and restored by a private investor.

In these cases, the areas of the former mines were mainly dedicated to economic activity, because in addition to reclamation the post-mining areas, the economic potential of these places must be maintained.

Figure 6 Armada Golf Club (Jarosławska S. (2023), private collection of personal archives S.Jarosławska)

Figure 7 Leisure centre in Sosnowiec (Jarosławska S. (2023), private collection of personal archives S.Jarosławska)

5.1 Economic Impacts

The transformation process by 2050 will require the creation of a significant number of new jobs due to the liquidation of the mining sector. Another problem is change in education profiles to retrain thousands of workers, fill the competence gap and stop the outflow of educated residents with a high creativity potential. It will generate the need for changes in traditional sectors undergoing transformation, which currently employ approx. 79 000 people (KPST 2021). Projects in the scope of tourism, cultural, creative sectors and cultural heritage are expected as a contribution to the generation of new, sustainable jobs. It cover all activities for the preservation of the identity and cultural heritage of the mining region, m.in. for the commercial development of unique industrial heritage resources, supporting diversification towards creative industries.

Another area of considerable economic importance is tourism. In 2022, more than 5 million domestic tourists in the Silesian Voivodeship took advantage of it, spending 5.5 billion PLN in the region and this numbers are growing every year (GUS 2023). Tourists have at their disposal thematic trails, one of the most famous is the Industrial Monuments Route of the Silesian Voivodeship inscribed in the European Route of Industrial Heritage, i.e. with a silver, lead and zinc ore mine in Tarnowskie Góry enlisted within the UNESCO World Heritage List.

Silesian Industrial Monuments Route (Szlak Zabytków Techniki Województwa Śląskiego)

It is a thematic tourist trail officially opened in 2006, including 40 objects related to the industrial heritage of the Silesian Voivodeship, focused on the tradition of mining, metallurgy and energy. Today, it is the most interesting industrial tourism route in the country and as one of the main branded tourist products of the Silesian Voivodeship. In 2010, the Industrial Monuments Route joined the European Route of Industrial Heritage network (ERIH – European Route of Industrial Heritage). Since 2010 Industriada, industrial monuments route festival, has been held annually in June. Various cultural and entertainment events take place in the industrial facilities located along the trail and in the so-called associated facilities: performances, concerts, multimedia shows, workshops, sightseeing. Industriada is the only event of its kind in Central and Eastern Europe, the second largest industrial festival in Europe.

Figure 8 ***Industriada 2023, Rybnik (URL4)***

5.2 Environmental Impacts

Moving away from mining is primarily a necessity to solve the problem of post-mining and post-industrial areas, those that already exist and those that will appear as a result of the liquidation of subsequent mines. Currently the number of post-industrial areas in the Silesian Voivodeship is over 600 and it represents a huge potential for development. It is possible to use post-mining areas not only for the purposes of green infrastructure, but also for the needs of a zero-emission economy, e.g. RES, energy storage, water pumping stations, CO2 storage, cybersecurity or server rooms. Therefore, the strategic objectives of the Silesian Voivodeship TPST in the spatial dimension includes mainly the identification of post-industrial areas of strategic importance for the development of local governments in coal regions. It is necessary to indicate areas and objects of strategic importance from the point of view of its industrial heritage, significance in the urban layouts of municipalities, strategic projects, i.e. cultural zones, technology hubs, districts of new technologies, demonstrators of low-carbon economy and proximity to residential areas or recreational areas, including green and blue infrastructure.

The challenge is to ensure an appropriate quality of life in the post-mining region, not only in terms of providing attractive jobs, but also in terms of improving the quality of the environment and setting new directions for development, while preserving heritage and cultural identity, which will allow current and future residents to look into the future with hope (TPST 2022).

The vision of using industrial heritage resources mainly includes public spaces with green economy infrastructure, i.e. bicycle paths, pedestrian paths, linear parks and other recreational post-mining areas attractive to the leisure industry. Another area is new, zero-emission and revitalized old housing complexes, including those of high cultural heritage value. These activities are in line with the main objectives of the Silesian TPST, such as improving the quality of life of the inhabitants of mining regions. The second objective is a comprehensive social support system activating the inhabitants of mining regions aimed to increase the level of activity of communities participating in the just transition process.

5.3 Socio-cultural impacts

Social and cultural impact is primarily associated with intangible assets of mining industry, like knowledge skills, historical charity activity of the mining companies, customs and rituals of local communities of mining fraternity and special mining ethos of hard and collective work. The new use of these resources brings knowledge in the form of socio-cultural values related to building local identity, historical and anthropological knowledge and creating a community based on these values.

Low level of social capital is often a real challenge for coal societies in terms of building cultural identity and industrial heritage while respecting the region's traditions. Therefore, in 2023 new opportunities have emerged as part of the European Funds for the Silesian Voivodeship. It should for the implementation of grassroots initiatives of local communities, aimed at preserving regional identity and industrial heritage while respecting the traditions of mining silesian subregions, with particular attention to their tangible and intangible mining heritage. Non-negligible is also a new image of Silesia and its effect for the region. Its change in the use of industrial heritage for new purposes will be value added. Therefore, it is assumed that the TPST will also support investments contributing to the change of the image of the subregions from traditional industrial character to the tourists attractive, based on the use of industrial heritage.

6. Best practises

The process of preserving coal heritage has begun in Poland on a large scale after 1989 and the transition to a market economy. The transition from a planned economy to a free market economy and the ongoing reforms, including successive reforms of hard coal mining, left behind many redundant industrial infrastructure objects, such as buildings or mine shafts, often of historical value. This part presents best practices for the use of mining facilities as coal heritage. Most of them are placed in the region of Upper Silesia.

6.1. Upper Silesia

Coal Mining Museum in Zabrze

It composed of two former mines, Guido and Queen Louise. They have been converted to underground museums join with the underground water route.

Guido Coal Mine hosts exhibitions about historic and modern mining technology and practice. Guido Coal Mine offers sightseeing of two excellently preserved mining levels are waiting for you 170 and 320 metres below the ground. The oldest available regions at the 170 level tells about the toil of work from the beginning of the 20th century which was the time of mechanization, technological progress but also the cult of St. Barbara in Silesian coal mining. St. Barbara's chapel also the main point of this level. It catches attention thanks to the architectural qualities: raw brick, steel constructions and industrial climate are mixed with monumentality which is well-known from neo-gothic brick churches so often appearing in Silesia. The biggest attractions of the 320 level are the large scale mining machines presented in operation and the ride in suspended electric rail. The experience at 320 level is mostly connected with exploring the development of mining technology from the end of the 19th century up to modern times. A part of the route at 320 level is covered with suspended electric rail. It is the only rail of this type in the world that has been made available for the tourists. The tour of Guido Coal Mine ends in the deepest located pub in Europe, in the Pump Hall. It offers specialty of the house, "Guido" beer and Silesian kitchen.

Figure 9 Guido Coal Mine, Zabrze (URL5)

Queen Louise Adit (Sztolnia Królowa Luiza)

The Queen Louise Mine sightseeing starts off at ground level where tourists find chunky pieces of machinery, pistons, dials, pipes, photo displays and other industrial detritus clustered around the old 'Karnall' shaft. The underground sections are split into three levels for visitors, the first of which is a boat trip along an underground river spanning 1130m, while a guide explains the history and culture of the mine. The 2nd level 40m below ground shown the technologies used for mining over the last 200 years, right up to the huge machinery of the 21st century. The third level is family orientated, specifically for kids, with multimedia elements teaching the history of the mine and the people who worked there. The Museum also offers a unique space for rent, 320 meters underground, for conference and cultural events.

One of the most unique offers is the Water Route in Queen Louise Adit, hidden under the streets of the Zabrze city. A fragment of underground excavations are on foot here, and 1,100 meters is a unique, underground rafting by boat, meeting the legendary Treasurer or Utopka of Upper Silesia. There are also underground ports, passing places, sounds of dripping water and unique chiaroscuro prevailing in the entire underground. This trip has been awarded by the European Commission with the European Heritage Award/Europa Nostra Award 2019 and with the Tourist Facility of the year 2019 by Polish Chamber of Tourism.

Figure 10 Water Route in Queen Louise Adit, Zabrze (URL6)

Water tower in Zabrze (Wieża Ciśnień)

Built in 1909, the water tower in Zabrze is no ordinary structure, combining a technical building with residential and office space. As a result of the revitalization works, the tower became a facility for social, educational, scientific and cultural activities. In 2022, an interactive exhibition was opened here. CARBONEUM – the coal knowledge centre is a modern exhibition that combines the functions of a science centre and a classic educational exhibition.

Figure 11 Carboneum exhibition, Zabrze (URL7)

Maciej Shaft /Zabrze

Maciej Shaft (Szyb Maciej) the part of the former Concordia Coal Mine, is the most modern of Zabrze's industrial heritage sites. It gives an untouched air of authenticity with a possibility to taste the local cuisine in restaurant, which is placed in the Silesian Tastes Gastronomic Route and relax during summer chillout weekends. The primary sights are the hoist tower with the original twin-drum hoisting machine by Siemens-Schuckertwerke which visitors have the opportunity to steer themselves.

Figure 12 Maciej Shaft, Zabrze (URL8)

Cultural Zone in Katowice

One of the most spectacular transformation of the city centre in Poland, multiple awarded for the unique design. The territory of the former Katowice Coal Mine has been drastically rejuvenated and

redeveloped as part of the city's official Cultural Zone (Strefa Kultury). It consists of four core venues: the city centre's iconic Spodek arena with the International Congress Centre, the NOSPR Music Hall - home to the Polish National Radio Symphony Orchestra, as well as one of the best concert halls in Europe in terms of acoustic quality, and the Silesian Museum situated 13m underground in the former Katowice Coal Mine. The addition of these buildings has not only visually and architecturally enriched a once potholed moonscape, but filled the cultural calendar with high-calibre events attended by thousands throughout the year, like the Tauron New Music Festival each summer. Muzeum Slaskie comprises a building complex erected at the site of the former mine and represents a perfect combination of the region's identity with state-of-the-art architectural solutions. Such result was achieved thanks to the maximum use of underground space, and therefore relatively low interference with the local, post-industrial landscape. Impressive spaces are vast and modern and at the same time maintain the memory of place, which closely corresponds with the Museum's cultural policy. The building of Muzeum Slaskie, raised as a result of the local inhabitants' needs and brave visions, has quickly become the crucial cultural centre of the region, a remarkably important Silesian social life and event hub and a significant contributor on the cultural map of Poland.

Figure 13 The Silesian Museum, Cultural Zone, Katowice (URL9)

Figure 14 The NOSPR Music Hall, Cultural Zone, Katowice (URL10)

Nikiszowiec district in Katowice

Wilson Shaft Gallery

Wilson Shaft Gallery is located in the pithead building and bathhouse of the old Wilson shaft of the Wieczorek mine. Taken over by the private company and adapted into exhibition and office spaces, the area around the Wilson shaft is now filled with brightly-painted outdoor sculptures in sharp contrast to the industrial surroundings, as well as a muraled entrance wall full of colourful pop culture icons. The gallery itself comprises an impressive 2,500 square metres divided into three halls, the largest of which wouldn't look dissimilar to a gymnasium if the installation art - high quality sculpture, graphic and installation art by both local and international artists.

Industrial Ethnography Museum

Located in Nikiszowiec, his branch of the Katowice Historical Museum. is unique in its emphasis on ethnography and folk culture, illustrates the everyday lives of the region's miners and other blue-collar folks through a series of ethnographic exhibits. They also have three permanent exhibitions on display. The first is devoted to the Janowska Group. Another exhibit is a replication of a typical Nikiszowiec worker's house. The museum includes also an interesting gallery of painting by Nikiszowiec's renowned Janowska Group with a collection of Nikiszowiec miners including Teofil Ociepka, Paweł Wróbel, Erwin Sówka and Ewald Gawlik, who gained renown for their „naive" painting.

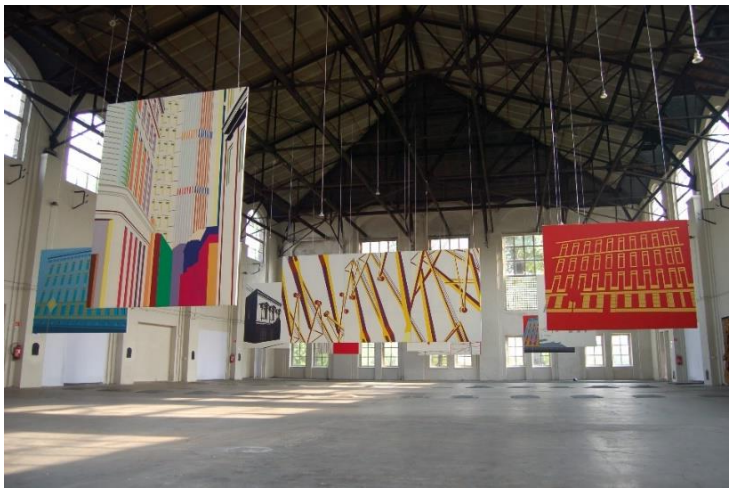

Figure 15 Wilson Shaft Gallery, Katowice (URL11)

Figure 16 Katowice Historical Museum (URL12)

6.2 Lower Silesia

Former Mine Science and Art Centre (Centrum Nauki i Sztuki Stara Kopalnia), Wałbrzych

In Wałbrzych the biggest post-industrial tourist attraction is located on the former Julia Coal Mine premises. Currently it covers the area of 4.5 hectares of historic post-industrial objects with authentic equipment, such as a machine park which has been secured and made accessible for visitors. All visitors can not only see the enormous scale of mine infrastructure, but also learn about the character of the dangerous and demanding work of a miner. This perfectly preserved post-industrial complex is a source of knowledge on the history and culture of coal mining, as well as about ceramic industry in Lower Silesia. The structures of Stara Kopalnia include Museum of Industry nad Technology, contemporary art gallery, exhibition of mining paraphernalia, Unique Ceramic Centre, restored structures including a machine room, underground adit, headframe, workshop, also quest rooms and a cafe. In 2015 Stara Kopalnia was awarded a prestigious title of “Zabytek zadbany” (en. a well-kept monument) granted by the National Heritage Board of Poland, which additionally emphasized the unique character and the scale of revitalization works conducted in the whole object.

Figure 17 Former Mine, Wałbrzych (URL13)

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Appendix 5 SLOVENIA

Research Fund for Coal and Steel

Conservation and Promotion of the Coal Mining Heritage as Europe's Cultural Legacy, grant agreement No. 101112138

WP2: Status quo of coal mining heritage in Europe

D2.1 – Report on the coal transition strategy

SLOVENIA

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1 Introduction

Climate change and the need to reduce CO_2 emissions have subsequently led to the development of strategies for the decarbonisation of the energy sector by the EU, aiming for reductions of at least 53 % by 2030 and 93 % by 2050, rendering the transition out of coal for coal-intensive countries and regions inevitable. With the transition, after the coal production stopes in Velenje Coal Mine (CMV)[1], arises the issue of the management of these regions in general, including the mines, buildings, and equipment (movable and immovable), in particular. Although this can be a very challenging task, it is also an opportunity to showcase the importance of these mining/industrial sites by converting and promoting them as sites of cultural heritage, and in particular coal and industrial heritage. An aspect to ensure the successful conversion is the engagement of the local (primary) stakeholders (including the public).

2 Current situation in SAŠA and Zasavje region

Figure 1 Map of Slovenian coal mines – SAŠA and Zasavje region [URL1]

With the first mining activities at the end of the 19th century, the SAŠA region has a nearly 150-year-long mining tradition, which in 2023 is still deeply involved in all socio-economic aspects of the region. In addition to the direct economic dependence on the coal industry, which was built around the largest Slovenian coal deposit and one of the thickest layers of coal in the world, more than 100 years ago another coal-related industry found its home in the Šaleška valley – electricity generation.

[1] Slo: Premogovnik Velenje (PV)

Today, the latter is located in the town of Šoštanj and provides approximately 30 % (in certain periods even up to 60 %) of domestic electricity production in Slovenia.

While electricity production based on thermal technology in the Šaleška valley plays an important role in the national energy mix an even greater significant coal-related dependency can be determined within the local economy. Today, this industry directly employs around 2,000 residents of the Šaleška valley (municipalities Velenje, Šmartno ob Paki, and Šoštanj) which is almost 10 % of the total working population and annually generates almost 30 % (500 million €) of all revenue generated in these municipalities. This includes revenue of Šoštanj Thermal power plant (TEŠ), CMV Group and direct transactions made by those two entities to local subcontractors and suppliers. On the other hand, when excluding revenues of Šoštanj Thermal power plant and CMV, approximately 10 % of the local economy directly relies on revenues generated from the local coal industry. These numbers can further indicate that another 10 % of the active workforce or between 1,500 and 2,000 residents of Šaleška valley is also indirectly employed through coal-related business activities.

These numbers combined with the information on greenhouse gas emission intensity provide a clear argument for the need to start the transition process early. Despite its small size (slightly more than 45 000 inhabitants in the narrow area of influence), the region is at the forefront when it comes to greenhouse gas emissions in a national comparative perspective. The regional total verified emissions in the Emissions Trading System (ETS) in 2019 amount to 3,8 million tonnes of CO2 equivalent (while for Zasavje region: 132,402 tonnes of CO2 equivalent; and total Slovenian verified emissions: 6,3 million tonnes CO2 equivalent). All emissions are from ETS installation Termoelektrarna Šoštanj, d. o. o. (Šoštanj Thermal Power Plant or TEŠ). The national decarbonisation ambitions are bound to form a disproportionate pressure on the region due to the specificity of the situation.

While the exit from coal in Zasavje region, respectively Zagorje has started in 1999 when referendum results did not support the construction of the third unit of Trbovlje Thermal Power Plant (hereafter: TET). As the business logic of the near-by Trbovlje-Hrastnik coal mine (hereafter: RTH) was closely connected with TET, the decision to close the mine was made. At the request of the Government of the Republic of Slovenia, the leadership of RTH published a study, which estimated the costs of closing the RTH by the end of 2015. In 2000, the Act of Regulating Gradual Closure of Trbovlje-Hrastnik Mine and Economic Restructuring of the Region was adopted (and later amended). In 2005, the closure works started and in 2013, the mining activities stopped. Shortly after, the TET closed as well. Till 2020, all necessary closure and rehabilitation works were carried out. Due to a larger than foreseen scope of works and costs in the medium-term program, some less-necessary closure and rehabilitation works have remained - mainly in the field of infrastructure renovation.

3 Goals and causes

The extensive research (the Report on Analysis of Key Opportunities and Challenges made in the process of the preparation of national strategy and action plans for transition from coal of Slovenian coal regions in 2020) showed that the transition towards a climate-neutral economy in the region should focus on socio-economic development, which would positively influence the GDP and employment rate. To holistically address the development needs was accepted the National Strategy for Transition from Coal of Slovenian Coal Regions. It sets five strategic objectives, which need to be achieved by 2050. Based on those broad objectives, the objectives for the Territorial Just Transition Plan were developed. Moreover, the resolution on Slovenia's long-term climate strategy until 2050 (DPS 2050) places the coal phase-out and other fossil fuels as one of the key sectors for decarbonising the energy supply sector, which also supports the decarbonisation of other sectors. According to the National Energy and Climate Plan (NECP), the DPS 2050 envisages that the use of

coal will be reduced by up to 30 % by 2030 compared to 2005, after which coal will be exploited at only one location in Slovenia.

0bjectives: actively addressing the brain drain through scholarship schemes linking students and major regional employers; invest in supporting “mind-set change” activities, which improve entrepreneurial skills and mind-set, and affection to life-long learning and changes; establishment of a network of regional promoters; caring for vulnerable groups and reducing social inequalities related to the challenges of coal mining and helping them develop a fitting skillset; introduction of circular content into the system of formal and non-formal education; revitalization of the coal-related technical heritage; sustainable growth of local large, small, medium, and micro enterprises in key sectors; dissemination of sustainable and circular business models and solutions at all levels and in all segments of enterprises; highly developed RDI and start-up ecosystem; investments in the Digitization of the Economy and Industry 4.0; adapting to climate change in agriculture and industry; maximizing the use of solar potential that supplies both industry and households and preparing the site for the continuation of energy activity (change of use); promoting energy efficiency and improving the energy and emission intensity of industry; incentives for pilot projects to produce synthetic methane and hydrogen for industrial use, including in conjunction with the local system; improving intra-regional connectivity with sustainable transport solutions.

4 Legislation, policy & regulations

The legal framework for closure of the Velenje mine and the economic and social restructuring of the Savinjsko-Šaleška region should be based and aligned with the applicable legislative framework. To ensure compliance of the Mine Closure Act with the existing national and European legislation, in Report on Analysis of Key Opportunities and Challenges was prepared a review of relevant legislation, which is directly or indirectly related to mine closure as well as other national and international non-legislative documents dealing with mine closures and other closely related topics (i.e. environmental issues, construction, special planning, etc.). Moreover, as the content of the Mine Closure Act will have to be aligned with national strategies, national programs, community guidelines and other long-term development programs and policies in that Report is also prepared a review of relevant strategic documentation that could directly or indirectly effect the planning and implementation of the Velenje mine closure.

The Act on Gradual Closure of Velenje Coal Mine must also be adopted as quickly as possible, with which Coal Mine will receive the necessary funds for all measures related to gradual closure, which includes mine closure, surface rehabilitation, personnel issues, etc. Adoption of the SAŠA Region Restructuring Act will enable funds to be drawn up for restructuring, investments and new projects. The establishment of the Just Transition Fund is of key importance for the Savinjska-Šaleška region, as this will enable us to stimulate the circular economy, introduce new technologies and preserve the energy location of the Šaleška Valley. The projects identified within the Velenje Coal Mine Group pursue our key strategic goals and are primarily aimed at a gradual transition to a carbon-free society while creating new market opportunities, creating new jobs with higher added value outside the PV Group, optimizing existing programs with the aim of ensuring greater competitiveness and reducing dependence on Velenje Coal Mine.

Adequacy of mining legislation for the coal phase-out process governed by the Strategy: It would be necessary to ensure that the solutions and guidelines proposed by the strategy are properly resolved at the level of newly adopted legislation, which would have to be in accordance with other applicable laws (e.g. Mining Act, Environmental Protection Act, etc.).

Requirements of the extended concession for mining as well as alternative uses of mining infrastructure – regulation of this area together with the future Act on closure of CMV. The proposed

solutions in the Strategy should comply with the provisions of the Slovene Mining Act in respect of the concession for the exploitation of mineral resources and necessary elements in case of continued use of mining infrastructure (e.g. use of tunnels for underground flow power plant for energy storage).

5 Transformation plan

Given the strong coal-dependency of the local socio-economic environment, thoughtful transition steps need to be taken while being comprehensively aligned with both local and national contexts. To achieve that, a comprehensive and focused set of operations is provided to outline the region's transition steps through all aspects of the transition. When it comes to environmental challenges, operations that are addressing surface remediation, decommissioning of coal-related infrastructure, and repurposing of coal-related infrastructure should be addressed as early in the process as possible. This will provide new investment opportunities and can be recognized not only as a foundation for a future quality living environment but also for the economic and social transition of the region. Repurposed facilities will provide conditions where new social programs could take place, offering employees in the coal-mining industry and other region's residents re-skilling, training, and other career-related services. On the other hand, with a highly skilled labour force available, new investment areas and incentives for economic development in place, the region will be able to attract important greenfield and brownfield investments. In addition, the region's energy transition should also be addressed at this point of time, namely through initial efforts related to the sustainable transition of district heating system (from fossil to renewable generation) and R & D activities related to e-mobility and alternative sources of energy (e.g., solar, green hydrogen, biomass linked to new sustainability criteria which are expected to be further defined with the recast of RES Directive). The region's energy transition should also be addressed through the revision of NECP, planned to be adopted in 2024 at the latest.

Firstly, a regional centre for just transition providing a knowledge base for a focused and evidence-based transition process needs to be established. The regional centre will support the local communities in their efforts to provide just transition for all segments of the affected society. It will also provide project-related support in all phases of the project cycle thus facilitating the implementation of the plan and ensuring adequate maturity and quality of projects/operations.

Regarding economic development, it is important to address as early as possible the challenges on all identified levels, including the attraction of direct investments, construction of start-up infrastructure and R & D activities within the production sector.

When it comes to social challenges, the development of the entrepreneurial mind-set and initial efforts toward the development of employment possibilities and reskilling/training programs should also be addressed earlier in the process.

In parallel, the conditions for further decarbonisation, development and transition of industries related to energy generation, focus foremost on the energy transition of the region itself. The possible measure to achieve this is upgrading of the district heating infrastructure through high voltage boilers and alternative sources of energy for district heating system, as well as pilot project related to green hydrogen technologies and e-mobility.

In the mid-term developed social programs should be implemented, providing enough time to start preventively and systematically addressing social challenges before they will even occur significantly.

The exit from coal was already completed in the Zasavje region. Lex specialis was established to provide the foundations of the phase-out process but so far, the transition has not performed in line with the just transition principles. The activities were focused narrowly on the mine closure

procedures and mitigating the challenges related to the social status of redundant workers. In doing so, the socio-economic aspects of the transition remained unresolved. This situation calls for a specific approach focusing on specific elements of just transition.

6 Socio-economic impact of coal phased-out

The area of influence in the SAŠA coal region consists of ten municipalities from the Upper Savinja and Šaleška valley.

Figure 2: SAŠA region with municipalities (Research agency SAŠA, 2021)

To clearly understand the current situation and the area, which will be exposed to the greatest socio-economic pressures and environmental challenges in the next steps of the transition, a clear distinction is needed between the narrower and the wider area of influence. The data on environmental impacts, employment structure and indirect connection of economic entities (businesses) with coal mining and energy, show that the narrower area of influence is formed by three municipalities. Those are from the so-called Šaleška Valley, which includes Velenje, Šoštanj, and Šmartno ob Paki. In 2019, 33,506 people lived in the Municipality of Velenje, 8,735 in the Municipality of Šoštanj, and 3,271 in the Municipality of Šmartno ob Paki. The inhabitants of these municipalities represent 78 % of all directly employed in the local coal industry (by the companies TEŠ and the Coal Mine Velenje (CMV).

With key impact area positioned around Velenje, Šoštanj, and Šmartno ob Paki, the direct economic impact includes jobs of approximately 1800 of the region's residents that are directly employed by CMV and TEŠ and an additional 1500 to 2000 jobs created within the region's economy through support services and other procurement activities of the coal industry. As data indicates we can conclude that today roughly 20 % of jobs in the region are directly dependent on the coal industry. However, this does not include any job multiplication effects that those jobs further have on the local economy and the whole business ecosystem in the region.

In addition to the key impact area, an extended impact area can also be identified, providing a foundation to comprehensively address the just transition challenges within the complete administrative unit of the SAŠA region. The region represents a rounded entity of 10 municipalities with strong historical, economic, and cultural ties that interact daily on multiple levels of the public

and private sector (Municipalities Gornji Grad, Ljubno, Luče, Mozirje, Nazarje, Rečica ob Savinji, Solčava, Šmartno ob Paki, Šoštanj, and City Municipality Velenje).

While addressing the challenges of the coal phase-out, it is crucial to understand that the impacts of coal are rapidly declining with a geographical distance (from the area of coal mining and coal burning). Therefore, the key strategic goals and further measures of just transition must be primarily aimed at creating positive impacts on the narrower area of influence. However, these impacts can also be achieved by implementing measures within the entire SAŠA region. Therefore, operations from the extended impact area can be undertaken if their positive contribution to the narrower impact area is proven.

The region Zagorje is still profoundly shaped by its mining tradition that less than two decades ago, in 2002, still directly employed approx. 1350 workers which represented 14 % of the region's working population. In 2019, 41,630 people were living in the narrow area (Trbovlje, Zagorje ob Savi and Hrastnik). In total these numbers are even higher since by some estimations throughout the process of coal phase-out approximately 5.000 jobs were lost in the region. The loss of these jobs represented a big challenge for local communities and forced the region into an ongoing socio-economic transition. The decline of the energy sector, on the other hand, resulted in growing economic reliance on the rich technical knowledge of the past.

In the past, the inhabitants and the environment of the Šaleška Valley have already paid a considerable price because of production of electricity, as the valley was heavily polluted. It would be unfair that, due to the policy of global pollution, the inhabitants of the Šaleška Valley should once again bear the burden of restructuring the industry that serves the whole of Slovenia. For this reason, at Premogovnik Velenje we are particularly striving for a just, economic and social transition, which will of course require funds, which Premogovnik itself will not be able to provide. We are already rehabilitating degraded areas with our own funds, without state aid. The state must as soon as possible adopt the Act on the closure of the Velenje Coal Mine, which will determine until when it will operate, and provide funding sources, and the law on the restructuring of the region, which will ensure a fair transition for the Šaleška region in the coming decades and will bring growth, development and create new jobs, while at the same time maintaining an adequate level of reliability of electricity supply in Slovenia.

7 Integrating coal heritage with the transition goals

Transition towards a climate-neutral economy in the region should focus on all areas of just transition: social-economic development, which would enable GDP and employment rate to remain the same (or even increase), environmental transition, including a revitalization of degraded areas, and energy transition, in order to enable stable and "green" energy supply in the country. However, the most important aspect of transition will be oriented towards efforts (directly or indirectly) related to socio-economic transition challenges.

Based on the identified needs, strategic objectives until 2050 were set and described in the National Strategy for Transition from Coal of Slovenian Coal Regions. Those five strategic objectives (hereafter: SO) and operational objectives are expected to be achieved through implementing the operations in territorial just transition plans. As this document predicts a shorter period (until 2030 with an outlook until 2040), all objectives set in the Strategy are not equally addressed.

Goals: rehabilitation and exploitation of the potential of degraded industrial areas, both for residential and industrial purposes as well as for tourism and recreation; support for the development of tourism, especially in the field of integrated regional tourism products; a start-up company specializing in outdoor sports activities used RDP support to purchase equipment and

respond to increasing demand for adventure tourism. Harness the full range of natural and historical heritage assets' potential; industrial boutique tourism in the way of preserving industrial heritage).

Figure 3 Recreational and sports area near Velenje lake on previous coalmining degraded area. (URL2)

8 Best practices

In case of the Zasavje Coal Region, which is one of the two regions affected by National Strategy for Transition from Coal of Slovenian Coal Regions, the principles of a just transition were not consistently followed. In the case of the Savinjsko-Šaleška coal region, the opportunity for a structured and controlled process of just transition is still available. The strategy sensibly takes into account the historical experience and circumstances in abandoning coal and establishes adapted conditions for the development of the two regions, which today stands at different points in this process.

PV has already carried out some transitional activities in the past regarding the company strategy at that time. Some of these strategies are shown on next figure.

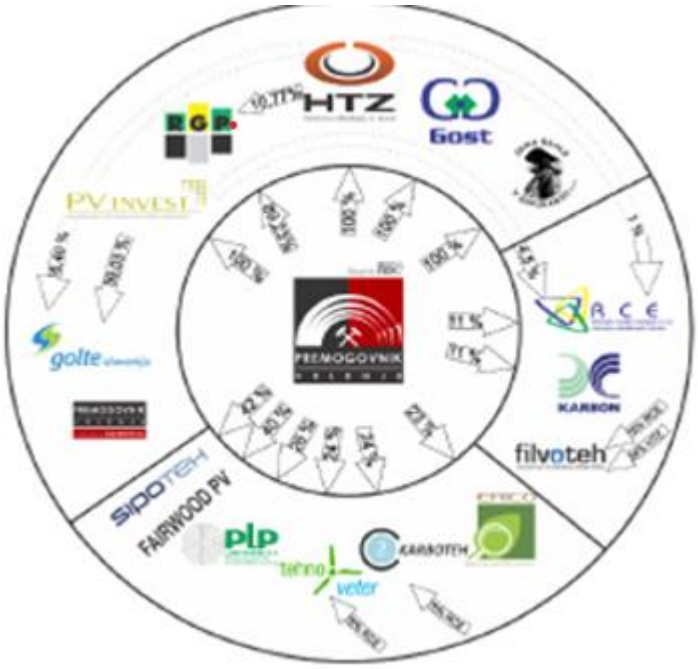

Figure 4 Strategic period 1990–2004, PV

In that period, the company performed optimization of basic processes whereby a number of affiliated and independent companies were established with the goal to become successful on the external market outside PV. At the same time, the new companies still had some support from the mother company. The companies to be highlighted from the pictures above:

- RGP – tunnelling, civil construction and geotechnical services; still a successful company today.
- HTZ – repair and haulage of mining equipment; has some smaller business and programmes outside PV; the majority of its business is continuing to be support to PV.
- PLP – wood processing industry; the majority of its business continues to be support to PV.
- SIPOTEH – production of heavy machinery (e.g. mining, mechanical parts, etc.); the majority of its business is continuing to be support to PV.
- Tourism:
    - GOLTE – ski resort.
    - GOST – restaurants, catering and seaside hotels.
    - Coal mining museum of Slovenia.
- PV invest – investment company.
- Research companies (smaller):
    - RCE (versus projects from the OVE, energy efficiency, CO2 lowering, etc.).
    - Karbon (waste management).
    - ERICO (environmental survey, analyses, etc.).

The main goal was to restructure and clean up the main process, that is coal production, which at that time was cca 4 mio t/a, and to gradually reduce the number of employees. It could be said that this was already preparation to the to the plans in place at that time to close the mine in 2028.
The strategy changed as substitute Block 6 was built in 2015 and the initial closure time was but back to 2054. Nevertheless, PV is continuing its business optimization and restructuring. With the green deal and EU goals, the plan is now to cease coal mine production sooner than initially planned, i.e., in 2033 and represents the strategic period 2022–2033. Today, the PV business group is presented by next figure.

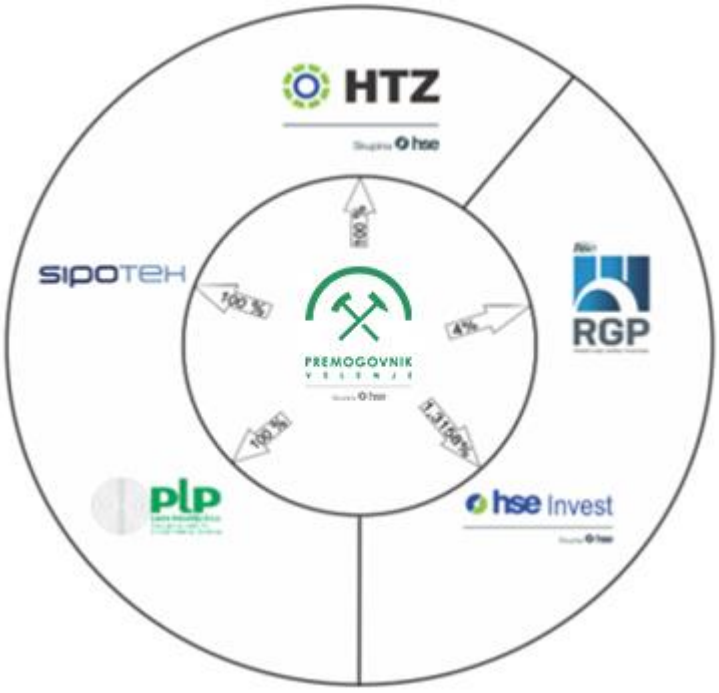

Figure 5 The PV business group, PV

As can be seen, the main companies dependent on the PV are HTZ, SIPOTEH and PLP. The transition from the phasing out of coal will therefore also affect them.

8.1 Coal Mining Museum of Slovenia

At the Velenje Coal Mine, we wanted to preserve our customs, traditions, as well as the machinery, equipment and everything related to coalmining. It was 1999, when the abandoned Škale mineshaft near Velenje was brought back to life with the establishment of the Coal Mining Museum of Slovenia.

Figure 6: The Coal mining museum of Slovenia (URL3)

Visitors to the Museum, which is considered a centre of industrial art, enter it accompanied by guides in exactly the same way as miners did in the last century. Dressed in miner's clothes and a topcoat, with a helmet on their head and a miner's lunch in their pocket, they descend into the depths through the Stari jašek, a shaft from 1888. In the underground tunnels, they experience a picturesque presentation of how the miners' work was done in the past and what it is like today, and learn about the mining equipment from the last decades of the Coal Mine's development. The story is told by 18 scenes and 15 miner puppets, which come to life through modern audio-visual equipment. An antique underground train takes the visitors from the past back to the present. Also on display are a collection depicting the development of coal mining in Slovenia, a miner's apartment from 1930, the history of jumping over the skin and exhibitions of renowned artists.

In the deepest-lying underground cafeteria, visitors can enjoy a five-star experience, Velenje Underground – Štajgerjeva južna, prepared by award-winning chefs, original dishes inspired by local ingredients and mining tradition, and select wines with musical animation. With respect for the past and in cooperation with the Šalek Valley Tourism Institute (Zavod za turizem Šaleške doline), the tourist product Mysteries of Submerged Villages was created, which begins in the depths of the Museum and ends with a virtual dive in Lake Velenje and a superb culinary experience. The product is an example of sustainable development of a destination through the digitization of industrial and cultural heritage. We should point out the various record-breaking achievements, such as the descent into the depths with the oldest functioning elevator in Slovenia, a walk along the thickest layer of coal in the world and a miner's lunch in the deepest-lying cafeteria 160 metres below the surface. In the last decade, the coalmine hosted a concert by the world-famous Laibach 160 m below the ground, an extreme PokerStars poker tournament in Ligi's salon, a culinary experience with the world-class chef Ana Roš, and many more.

Figure 7: Miner's lunch at the Coal mining museum of Slovenia (source: Internal PV material)

The only underground museum in Slovenia has already been visited by more than 500,000 people from around the world, as the museum's multimedia story is also available in English, German, Italian and Croatian, and it is accessible to disabled, visually impaired and hard of hearing people.

The museum has received numerous awards. The special award of the European Museum Forum, the Valvasor award, the Ford award for the preservation of technical heritage, the Chamber of Commerce and Industry of Slovenia award for the contribution to the preservation and marketing of cultural heritage, and others were joined in 2023 by the Slovenia Unique Experience quality mark and the international Big see tourism design award 2022. The story of the Mysteries of Submerged Villages was featured in the Green Destinations Top 100 Stories list of one hundred best sustainable practices in the world.

8.2 The Zagorje Mining Museum

The Zagorje Mining Museum first opened its doors on 17 November 1995 to commemorate 240 years of mining in the Zagorje Valley. The Municipality of Zagorje ob Savi is in charge of the preservation of mining heritage, and in 2015, it completed its project of renovation and rejuvenation of the Mining Museum. Since September 2015, the museum boasts new additional interactive content that attracts visitors from all over Slovenia and abroad.

Figure 8: The Zagorje Mining Museum (URL4)

The museum's mining heritage collection includes a large number of photographs showing the development of mining in the valley. The museum also houses a collection of tools, rocks and mining equipment that miners used in their work. Right next to the museum there is a collection of heavy mining machinery (locomotive, mining carts etc.) which illustrates the rapid progress of coal mining techniques. A great attraction is the simulated tunnel, which displays the development of the shaft supports and the coal mining technique. Visitors can also view a multimedia projection about mining in the Zagorje Valley.

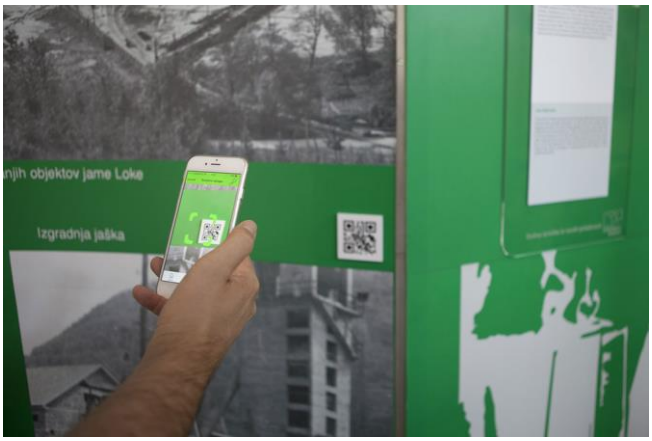

Figure 9 interactive interference with smart phones at Zagorje mining muzeum (URL4).

This is the first museum in Slovenia that is designed interactively, meaning that the visitors can view it on their own with the help of smart phones.

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