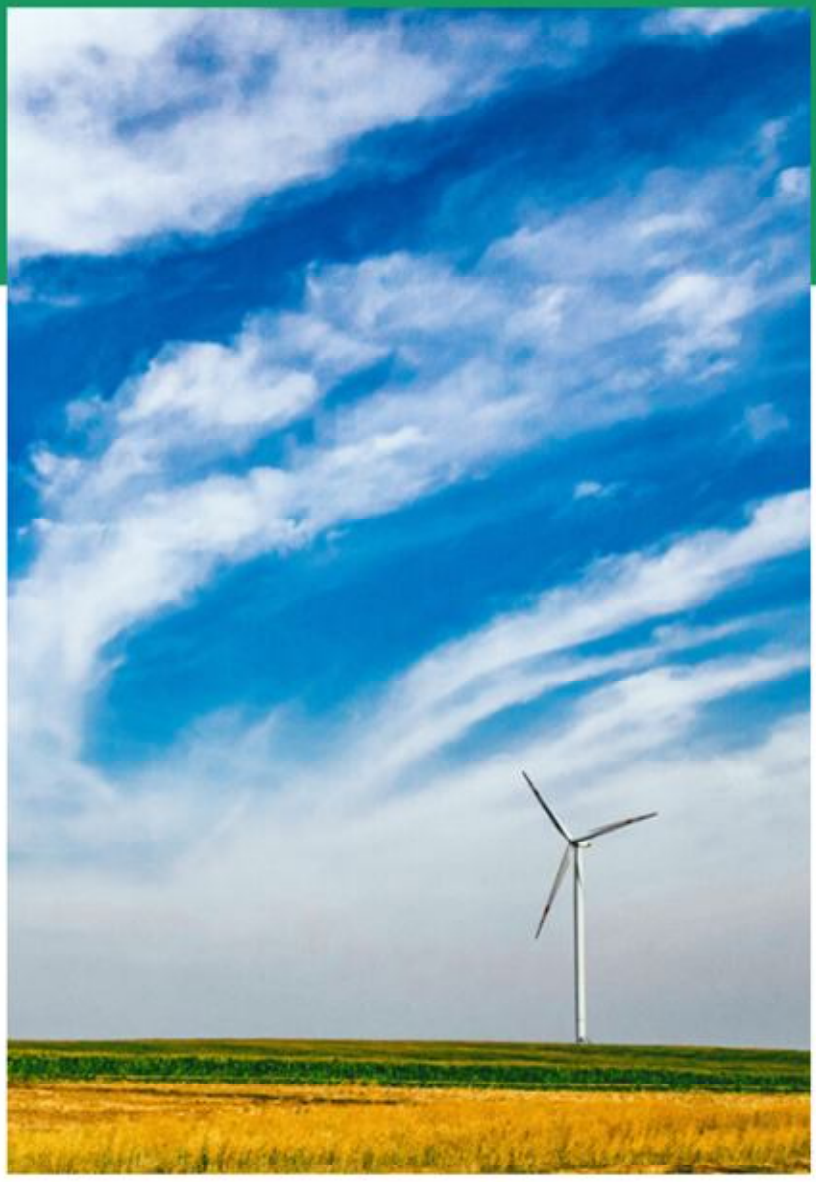
OCTOBER 2019

DeCarb
Interreg Europe

NEEDS ANALYSIS REPORT ON ENVIRONMENTAL RESTITUTION & LAND RESTORATION IN DECARB REGIONS

DECARB A1.4



PREPARED BY

Ministry for Economic Affairs and Energy, State of Brandenburg

LAND BRANDENBURG
Ministerium für Wirtschaft und Energie

1 INTRODUCTION

Fossil fuels (solid fuels and natural gas) continue to supply most of energy demand in the EU-28. In 2018, the share of solid fossil fuels (coal and solid products derived from coal) in EU primary energy consumption (availability) was estimated at 14.5%. Coal is the third largest contributing source to energy production in the EU-28 (after renewables and nuclear power), accounting for almost a quarter of the total electricity generation (Eurostat 2019). However, the share of coal in the energy production mix varies considerably between Member States. For instance, the contribution of coal is particularly high in Poland (79%) and Greece (61%) while a number of countries such as Malta, Latvia and Cyprus do not produce any coal based energy.

Coal is currently mined in 41 regions across 12 EU countries. In the EU-28, there are currently 128 operating coal mines with combined annual production of over 500 million tonnes; and 207 coal stations (or coal-fired power plants) in 21 Member States with a total capacity of almost 150 GW. In DeCarb territories, there are 19 operating coal mines with an annual production of 183.2 million tonnes (36.8% of the total EU production) and 17 coal fired power plants with a total capacity of 21 GW, which make up about 2.1% of the total European power generation capacity. It is estimated that the coal industry directly employs 48,450 people in DeCarb territories.

Recently, a series of factors such as restrictions on coal use, the new standards for industrial emissions, the decreasing profitability of coal mines, and most importantly the Union's commitment to phase out coal for electricity generation, has gradually led to the shutdown or limitation of coal driven activities in a number of regions across Europe. In 2014-2015, 58 mines were closed in Germany, Poland, Slovenia and Spain while a first massive wave of coal-fired power plant decommissioning is scheduled for the period 2020-2025.

Regions with economies largely fuelled by coal like most DeCarb territories need to act in light of this energy transformation provided that the shrinkage of the coal industry can push local communities towards stagnation and introspection unless just transition strategies are implemented. In this vein, particular emphasis should be devoted on the restoration and environmental restitution of the wounded landscape, as well as the selection of appropriate post mining land uses. Land restoration refers to the process of re-building ecological functionality and integrity across degraded landscapes (incl. enhancing local communities' well-being). Land restoration coupled with careful planning for the post coal era, will not only contribute to reverting or mitigating the environmental harm caused by decades of mining but can also aid to secure employment and social cohesion in the affected areas, through the emergence of alternative, sustainable and diversified economic activities.

This report presents the findings of the analysis on environmental restitution and land restoration needs in DeCarb territories harshly suffered from intensive coal driven activities. The analysis focused on

2 THEMATIC BACKGROUND

Fossil fuels make the largest contribution to energy production as combustible fuels (coal, oil and natural gas) account for approximately 50% of total net electricity generated (Eurostat, 2016). In this share, coal (hard coal and lignite), composed of carbon along with assorted other elements, provides one fourth of the production of primary energy in the EU. Coal activities represent a multibillion euro industry, which employs thousands of EU citizens and contributes millions of euros to public finance through taxation. The industry provides jobs to about 240,000 people: out of which 180,000 in the mining of coal and lignite and about 60,000 in coal- and lignite-fired power plants (European Commission, 2018).

The coal industry, closely intertwined with the rise of industrial economy, involves all those companies constructing mine sites, extracting coal from surface and underground, preparing coal for use, and providing support activities for coal mining, processing and use to produce energy. Generally speaking, mining is a temporary activity with a finite life span, lasting from a few years to several decades. Its operational largely depends on the size, quality and quantity of the mineral deposit being extracted. Mine closure usually takes place once the supply of natural mineral resources comes to an end, or operations are no longer profitable (marginal cost is equal to marginal revenue). The shutdown of mining activities brings up a discussion on future post-mining uses in landscapes that have been severely degraded and (adversely) affected by extraction operations.

2.1 Land degradation and restoration

Regardless of the socioeconomic benefits associated with coal powered energy (e.g. employment & rural development), coal driven activities have been found to cause major disturbances to the natural environment (e.g. air pollution, soil erosion, water contamination, biodiversity loss) and exert a long lasting impact on landscape; known as land degradation.

Land degradation can be defined as the reduction or loss of a landscape's biological and production capacity to provide goods and services for its beneficiaries (FAO, 2018). It covers all negative changes in land structure and properties such as scarcity of natural resources, soil fertility decline, natural habitats destruction and biodiversity loss, and deteriorated ecosystems services. Land degradation and desertification can be largely regarded as any change or disturbance to the landscape synthesis and properties, perceived to be deleterious or undesirable, and most importantly deteriorates the value of the biophysical environment.

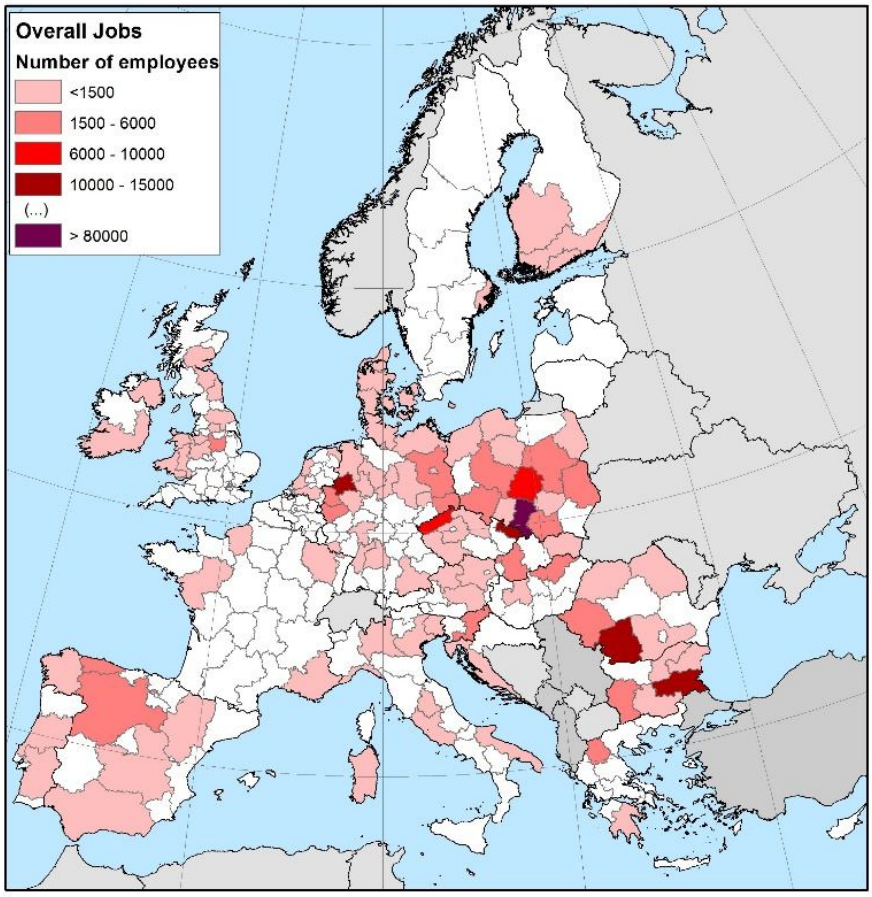
It is a natural or human-induced process that adversely affects the land to function effectively within an ecosystem. Geo-climatic conditions and natural hazards (e.g. soil water erosion wind erosion and intrinsic characteristics of fragile soils) can make a natural environmental or landscape susceptible to degradation and desertification. Human activities that may cause land degradation include deforestation,

engineering and ecological solutions such as planting native grasses and trees, removing contaminants and any hazardous materials, stabilising the terrain (e.g. dams, waste rock piles), landscaping, and restoring topsoil.

- **Remediation**: Remediation focuses on the removal of pollutants & contaminants from a closed mining site intended for redevelopment. The aim is to clean up the contaminated land to safe levels, paving the way for returning the ecosystem to a productive and usable state. At mine sites, remediation often consists of isolating contaminated material in pre-existing tailings storage facilities, capping tailings and waste rock piles with clean topsoil, and collecting and treating any contaminated mine water if necessary.
- **Regeneration:** Efforts to create a productive and functional post-mining landscape that will generate substantial economic and ecological benefits to offset the negative impacts from the shutdown of mining activities. Regeneration aims to restore landscape functions and ecosystem services, and deliver outcomes that include sustainable production, an improved natural resource base, increased biodiversity and enhanced resilience. These outcomes will benefit not only primary producers and land owners, but also the community - environmentally, economically and socially.

For the needs of the DeCarb project and in an effort to avoid confusion, the definition for "land restoration" will remain deliberately as broad as possible so as to encompass a diverse range of improvement activities, scales, environments, and post mining land uses.

Figure 1: Coal regions across the EU (source: European Commission)



All DeCarb territories host coal-fired power plants except for Extremadura (Spain), which has successfully managed to wean itself completely off coal-fired power generation. There are 17 coal fired power plants in operation in DeCarb territories with a total capacity of 21 GW, making up about 2.1% of the total European power generation capacity. With regards to the type of coal, lignite is used as primary fuel in almost all DeCarb territories except for Észak-Magyarország (Hungary) and Savinjska (Slovenia) which use hard coal. The DeCarb territory with the most installed capacity is Łódzkie (Poland) with around 5500 MW, followed by Brandenburg (Germany) and South-West Oltenia (Romania) with 4600 MW and 3900 MW respectively. The power plants with the lowest operational capacity among DeCarb territories are located in Nordjylland (Denmark) and Észak-Magyarország (Hungary) with 740 MW and 1130 MW respectively. The examined lignite fuelled power plants are located in close proximity to mine sites and are connected with them with rail networks/infrastructures to make the supply of raw materials easier and more convenient. The vast majority of coal-fired plants in DeCarb partnership area were commissioned over 30 years ago. These plants are, on average, 34 years old with an estimated

2.3 Potential land uses following the shutdown of coal driven activities

Land restoration projects are meant to address the adverse environmental impacts caused by coal driven activities and return the sites to a productive or usable state. Typical examples of post mining land uses include pastures, agricultural lands or croplands, forests and wildlife habitats, innovation centres, educational, sport and leisure facilities, residential use and other industrial activities. Many mined lands are restored as (native) grasslands, which are not used for any productive activity (e.g. food production and pasture) or recreational purpose; and hence they do not deliver any added value to the local community. It is also possible a restoration programme to include more than one land uses; for instance, to provide a combination of recreational facilities with natural parks or commercial activities. In a broad classification, post mining land uses can be categorised as follows (Table 3).

Table 3: Potential land uses following mine closure

Land use	Description
Forestry	Create foster lands for the long-term production of wood, wood fibre or wood-derived products.
Agriculture	Agricultural use in the form of croplands, pastures, hay production, fodder for livestock, and grazing land.
Recreation	Land used for leisure time and sports activities. This includes the creation of recreation facilities such as parks, camps, amusement areas, and sports centres, as well as structures for less intensive uses and activities such as hiking and canoeing. This type of restoration may include innovation and business support centres, theme paths, concert and conference halls, and laboratories.
Wildlife habitat	Land restored to increase habitat quality that will help to maintain biodiversity and safeguard wildlife. In situations where natural habitats have been destroyed completely from mining activities and coal extraction, restoration can be used to recreate them.
Water resources	Land used for storing water for beneficial uses, such as stock ponds, irrigation, fire protection, flood control and water supply.
Industrial	Land dedicated to industrial and commercial activities; either in the secondary sector (manufacturing, processing, and wholesaling) or in the service sector including hotels, restaurants, and other commercial facilities.
Residential	Land restored to provide housing opportunities to local community in the form of multiple family housing, mobile home parks or other residential lodgings.
Grassland	Previously mine lands restored as (native) grasslands without any productive activity (e.g. food production and pasture) or recreational purpose.

2.4 Environmental restitution needs and land planning requirements

Environmental restitution needs

There are several compelling reasons for regions to promote restoration activities in areas affected by coal driven activities. Restoration needs contain not only environmental improvements and enhanced ecosystem services but also considerable economic potential and growth opportunities that can prompt regions to move away from an economy driven by fossil fuels and resource intensive activities. Land restoration contributes to the transformation of degraded landscapes into resilient, multifunctional assets that boost economic activity and support local employment. From an environmental perspective, bringing degraded land back into a productive and usable state can essentially improve soil fertility and decrease erosion, strengthen food and water supplies, maintain biodiversity and preserve ecosystem services, foster carbon sequestration and improve the quality of life in post mining communities. To sum up, the environmental needs pursued to be covered through land restoration can be classified into 3 broad categories; a) carbon storage and sequestration, b) biodiversity and ecosystem services, and c) water quality and food supply.

- **Carbon storage and sequestration.** Mining activities cause changes in soil structure & properties and severely destroy vegetation, leading to large-scale carbon losses that affect landscape's environmental quality. Restoring former coal mines can help to capture carbon dioxide from atmosphere and store it in the soil and rehabilitated vegetation if appropriate reclamation techniques and post-reclamation management strategies are applied. This requires a thorough and detailed analysis of the different possible post-mining land uses (according to local specificities), to choose the one that will maximise carbon storage and sequestration. For instance, the establishment of vegetation (in the form of green spaces or recreational centres such as golf course), as natural reservoirs of carbon dioxide (by creating green spaces), will essentially increase the sequestration of CO2 below ground, thus mitigating the rising levels of atmospheric CO2, and associated impacts of global climate. Other options include to create opportunities for carbon farming, promote rock solutions and foster reforestation.
- **Biodiversity and ecosystem services**. Even though it is very difficult to return a closed coal mine into its previous ecological state by fully recovering the original ecosystem, reclaimed lands nevertheless may improve habitat quality to maintain biodiversity and safeguard wildlife or in situations where natural habitats have been destroyed completely, restoration can be used to recreate them. Furthermore, restoration can be used to re-establish connections between different habitats that were fragmented due to mining activities, by enhancing the linkage of existing natural landscapes or wildlife corridors. Potential environmental benefits also include enhanced ecological functioning and ecosystem services such as water supply, crops safety, pollination, carbon storage,

- **Focus on landscapes rather than individual sites.** Actions should be revolved around entire landscapes as opposed to individual sites. This entails connecting a diverse range of independent land uses in areas affected by coal driven activities, taking also into account the surrounding environment (e.g. settlements) and key production activities. Land restoration should be seen as part of a broader spatial planning process to promote sustainable development and social welfare, rather than a standalone activity.
- **Foster environmental restitution and reconvert land's functionality.** The primary focus should be on restoring the functionality and environmental status of the landscape in question by returning the land back to its previous form, or looking into possible options for other (post-mining) productive uses (what is called repurposing). This also includes efforts to establish a rich habitat environment, prevent erosion and flooding and withstand the impacts of climate change and other disturbances, caused by mining activities.
- **Allow for multiple societal and economic benefits.** Planning should aim at creating a suite of ecosystem goods/services that will sustain or enhance employment and growth potential, increase social welfare and quality of life, and keep a good environmental status. For instance, trees and plants can be added nearby agricultural sites to enhance food production and diminish erosion.
- **Leverage a suite of strategies and post-mining land uses.** The restoration plan should identify, on first analysis, a number of potential restoration options that comply with territorial specificities and adjacent to regional situation. Coming up with a shortlist of socially, technically, technologically and economically feasible interventions will require the results from environmental, economic and technical analyses as well as consultation with key stakeholders and civic society.
- **Avoid further mining activities.** Moving on from the above principle, fostering environmental restitutions and addressing environmental damage entails a different growth pathway that abides by sustainability principles and leads to decarbonisation. This means that further mining activities in the site are no longer a viable option for the area.
- **Fit to local conditions and growth priorities.** As noted above, restoration plans need to fit local social, economic and ecological contexts as there is no "one size fits all". Population, topography, structure of economy, employment, societal and cultural issues are all factors that needs to be assessed when developing a restoration strategy.
- **Manage adaptively.** Planners should be ready and prepared to adjust restoration planning over time as environmental conditions may change the geophysical state and properties of the site, new technologies may create new opportunities for restoration and policy developments may alter growth priorities, shifting focus from established economic activities to new and perhaps more innovative ones (e.g. from primary sector and agriculture to tourism). This requires continuous monitoring, learning, flexibility and readiness to make the necessary adjustments as the restoration process progresses.

Partner	Study area	Fields/Plants
Ministry for Economic Affairs and Energy, State of Brandenburg	Brandenburg	"Jänschwalde" and "Welzow-Süd" coalfields - "Jänschwalde" and "Schwarze Pump" Power Plants
South-West Oltenia Regional Development Agency	South West Oltenia	Oltenia Energy Complex
Regional Association of Local Governments of Western Macedonia	Western Macedonia	West Macedonia Lignite Centre
Stara Zagora Regional Economic Development Agency	Yugoiztochen	"Maritsa" East Mining and Energy Complex
Energy Agency of Savinjska, Šaleška and Koroska Region	Savinjska	"Velenje" Coalfield - "Šoštanj" Thermal Power Plant
Łódzkie Region	Łódzkie	"Bełchatów" Coal Field – "Bełchatów" Power Station
Eszak-Alfold Regional Energy Agency Non-profit	Eszak-Magyarorszag	Visonta" and "Bükkábrány" coalfields - "Mátra" and "Oroszlány" power plants

3.3 Needs analysis factors

Factors pertaining to the socioeconomic structure, environmental quality, legal conditions, land planning requirements and funding availability of examined territories and which are inherently associated with coal driven activities, were chosen to be investigated in order to establish the coal profile of DeCarb territories and pinpoint environmental restitution and land restoration needs.

1. Economy. Taking into account the economic implications of coal driven activities, this needs analysis area meant to outline DeCarb territories' current economic and development profile and guide the industrial restructuring process in the pathway towards decarbonisation. It allowed to evaluate the economic losses expected from stopping coal related activities, including the effects on other sectors of the economy. The following variables were considered:

- Role of coal in regional economy
- Regional economic strategy and growth priorities

analysis area aimed to a) outline regions' environmental profile, b) identify the different types of environmental damages caused by coal driven activities in the site, c) assess the magnitude (severity) and geographical extent of impact, as well as the capability of the environment to return to a capacity or condition equivalent to the baseline after impact ceases. The following variables were considered:

- Types of environmental degradation from coal driven activities
- Magnitude of environmental damage caused by coal driven activities
- Geographic extent of environmental impact
- Reversibility
- Emissions of air pollutants related to coal driven activities
- Priorities for the environment

5. Funding. This involved the identification of the different types of finance and resourcing options that can be used to support restoration interventions. It is rational that the more a restoration programme will benefit key economic sectors, the more opportunities and more easily to attract private funds, and more an intervention provides societal benefits and employment opportunities for the local community, the better the chances to attract more public support, and share from the regional or even the national budget. Possible funding sources for restoration investments may be Regional Operation Programmes (ROPs), Special Development Programmes, European Energy Efficiency Fund, EU Bodies and Programmes (e.g. European Bank for Reconstruction and Development, European Investment Bank, Horizon 2020), PPPs and direct private investments. The necessary funds may also come from targeted fiscal interventions such as fossil fuel levy, auctioning of air pollutant emission allowances, and administration duty form large hydro power units. The following variables were considered:

- Regional budget
- Additional funding sources

6. Mine closure and reclamation companies. This needs analysis was devoted to mine closure and reclamation companies. Partners performed a SWOT analysis to pinpoint the needs of the sector, which are widely regarded as key factors for the design and successful implementation of land restoration projects. This was realised by identifying the strengths and weaknesses of reclamation companies and exploring the opportunities and threats that may exist in the wider environment. The "strengths" component examines the intrinsic assets and characteristics of a business, including the areas where a reclamation company performs particularly well, as well as the availability of resources (e.g. machinery/equipment, specialised staff, investment capital, previous experience) to support the initiation/implementation of land restoration projects. Weaknesses comprise attributes and resources that work against a successful outcome. These elements put up additional barriers to land restoration project. Weaknesses may include lack of specialised expertise and machinery, lack of geospatial data, insufficient financial resources and limited previous experience in reclamation projects. Opportunities include the external factors that a reclamation company can capitalise on to successfully implement a

3.4 Key success factors for land restoration initiatives

The methodology also included a self-assessment exercise[1] (as part of the needs analysis) in which partners will evaluate the extent to which a number of factors, which are considered as key enablers for land restoration, are in place in their territory.

This type of assessment was employed to assist DeCarb partners to identify whether their territories are adequately prepared to develop restoration strategies and highlight the areas/fields in need of targeted measures and improvements. The factors considered critical to the successful development of restoration activities are classified into three broad themes.

- **Motivation**. Policy makers, landowners, economic actors, stakeholders and citizens should be aware about the necessity to accelerate post mining land restoration, the benefits associated with decarbonisation, and motivated to support relevant interventions each from their side. This implies that the transition to clean energy and green growth pathways is as a key regional priority that has gained the support and approval of local community.
- **Enabling conditions**. A range of environmental, market, policy/regulatory, social and institutional conditions need to be in place to facilitate the establishment of a favourable, enabling environment for post mining land restoration.
- **Capacity and resources**. Land restoration is a resource intensive activity that does not require only significant financial resources but also intellectual capital, technological readiness and leadership, to implement post mining land restoration on a sustained basis.

The following table presents the different themes and factors evaluated in the context of the present needs analysis.

[1] This exercise is based on the Restoration Diagnostic Tool, created by the International Union for Conservation of Nature (IUCN) and World Resources Institute (WRI), and constitutes a major component of the Restoration Opportunities Assessment Methodology (ROAM). ROAM provides a flexible framework to promote and implement restoration programmes and landscape-level strategies.

4 NEEDS ANALYSIS RESULTS

4.1 Brandenburg (DE)

Geography

Brandenburg is one of the 16 federal states of Germany and one of the 5 new states created in 1990 after the reunification of the former West Germany and East Germany. It is situated in the east of the country, bordering with Poland, Saxony, Mecklenburg-West Pomerania, Saxony-Anhalt and Lower Saxony. Brandenburg covers 29,654 km^2 and is home to 2.500.000 inhabitants (Eurostat, 2018). Its capital is Potsdam.

Economy

In 2017, Brandenburg's Gross Domestic Product (GDP) was estimated at 69.5 billion euros, representing approximately 2.2% of the national total (Eurostat, 2018). The average annual growth rate of the region for the period between 2008 and 2017 was 2.9%, slightly above the national annual average growth (2.6%). Regional GDP per capita, expressed in purchasing power standards (PPS) reached €26,100 in 2017, significantly below the national average (€36,000).

The energy sector is major driver of economic development and one of the largest sources of income and employment in the region, accounting for almost 27% of the regional GDP (Agora Energiewende, 2018). Notably, the GDP of the Lusatian mining region (encompassing both Brandenburg and Saxony districts) was estimated at 31.4 billion euros (RWI, 2018). Coal driven activities (i.e. mining, quarries, and electricity production) contributes a large share in the total product, accounting for approximately 13%. Real estate, financial and insurance services and construction combined represent approximately one fourth of Lusatia's GDP, followed by public services with a similar percentage. Wholesale and retail trade, transportation, accommodation, catering services and ICT account for 18%. The manufacturing sector follows with 17% while the primary sector (agriculture, forestry and fishery) account for less than 1%.

The regional strategy to boost economic growth and raise local income levels, foresees investments in Research and Development (R&D), creating competitive economic structures and integrating low-carbon technologies into existing value chains. To this end, the Regional Operational Programme (ROP) includes actions in 4 priority areas:

1. PA1 - Strengthening applied research, development and innovation
2. PA2 - Strengthening SME competitiveness
3. PA3 - Reduction of CO2-emissions in all economic sectors
4. PA4 - Integrated development of urban and rural areas

Mine site / Power plant	Key facts
"Jänschwalde" coalfield	• Mine Type: Open pit mine • Size: 80 km^2 • Type of coal: Lignite • Annual production (raw coal extracted): 9.1 Mt (2018) • Depth of coal deposits: Around 95m • Start of operations: 1974 • End of operations: expected in 2023
"Welzow-Süd" coalfield	• Mine Type: Open pit mine • Size: 108 km^2 • Type of coal: Lignite • Annual production (raw coal extracted): 21.8 Mt (2018) • Depth of coal deposits: Up to 120m • Start of operations: 1959 • End of operations: expected in 2030 (although a decision on further expansion is pending)
"Jänschwalde" power plant	• Installed capacity: 3,000 megawatts • Annual electricity production: 19.5 billion kWh • Net efficiency: approx. 35-36% • Years of operation: 27 years
"Schwarze Pump" power plant	• Installed capacity: 1,600 megawatts • Annual electricity production: 11.6 billion kWh • Net efficiency: approx. 34% • Years of operation: 27 years

Expected impacts on employment & economy

According to government's estimations, around half of the jobs directly or indirectly related to coal driven activities are expected to be lost, following the interruption of mine operations and the decommissioning of power plants in the area. Many of these jobs that require hard skills specific to coal related operations, may become redundant in the post coal era. The total number of job losses can reach 3500, leading to a 26.7% increase in the region's unemployment rate. It is estimated that the unemployment rate will eventually raise from 4.5% to 5.7%. In Lusatia, the economy is largely reliant on coal driven activities and the GDP per capita is 27% lower than the national average; indicating a weak and undiversified economy. In addition, the shrinkage of the coal sector will inevitably affect a

Lignite mining, as part of the spatial and land use planning system, is regulated by dedicated brown coal plans, which may be developed either at state or regional/local level by special lignite committees. These committees are made up of those stakeholders that interact directly or indirectly with the management and/or use of the territory through their decisions and activity, and may be affected (positively or negatively) from lignite mining operations. These may be representatives from State authorities, regional authorities and municipalities, trade unions, chambers of commerce, professional associations, knowledge institutes, environmental organisations and civic society groups.

Brown coal plans are intended to determine the requirements and framework conditions for lignite extraction operations in designated mine sites. They cover all 3 phases of mining: exploration, extraction and reclamation. This means that post-mining land restoration is an integral part of the spatial planning procedure. The requirements for lignite extraction (e.g. demarcation of mining areas, type and depth of mining, displacement of communities, infrastructure and facilities deployment, relocation of traffic routes) and the restoration and environmental restitution of the wounded landscape (either once mining operations have been completed or while they are in progress) are specified in these plans, which are largely site-specific in order to reflect local environmental and development needs. As lignite plans have a long term scope – for instance extraction processes in an open cast mine may exceed 40 years – they are subject to updates and revisions so as to adjust to changing conditions and thus can effectively address the contemporary land restoration and environmental restitution needs.

The Federal Mining Act (Bundesberggesetz – BBergG), which is the primary legal basis for mineral extraction operations in the country, foresees that the granting of a mining concession permit shall meet the requirements foreseen by the State Planning Acts and be in accordance with regional/local lignite (brown coal) plans. In Germany, it is state authorities' jurisdiction to issue mining exploration and concession permits. State authorities may grant a permit only after the approval of the operator's mining (operation) plan and the environmental impact assessment report. This assessment is made on the basis of the BBergG, State Spatial Acts, lignite plans, and other applicable laws such as the Federal Water Act (WHG), the Environmental Impact Assessment Act (UVP-G) and the Federal Nature Conservation Act (BNatSchG).

The requirements for the rehabilitation/restoration of former mine sites are also addressed in the initial planning permit. Mine operators must designate and submit to competent authorities a mine closure plan. If the prescribed actions are deemed as not sufficient, the mining authority may not approve the extraction, potentially asking for additional remedial measures together with corresponding reservations/guarantees for effective land restoration. Post-mining land restoration requirements typically include the uptake (by mine operators) of precautionary measures on post mining land use, site rehabilitation and environmental restitution, site safety, decommissioning, waste dumps and tailings ponds, site water management, off-site infrastructure, and community socio-economic programmes.

As regards Brandenburg, the State plans to allocate 212 million euros from the regional budget (for the period 2018-2022) for the rehabilitation of decommissioned lignite mines in the region; 162 million euros will be allocated for environmental restitution and public safety measures in 262 abandoned mine sites/facilities (where no restoration activities have been carried out by mine operators) and 50 million euros for infrastructure development. In total, 565 million euros (public funds) will be mobilised for restoration works in the State of Brandenburg between 2018 and 2022.

Mine companies

Currently, there are 2 mining companies in Brandenburg, which have established fully owned subsidiaries to undertake restoration works (as bounded by the Law) in the worked out mine sites; LEAG and LMBV. Other mining and reclamation companies operating in Germany are: DMT Group (www.dmt-group.com/), Wismut GmbH (www.wismut.de) and FAB Consulting (https://consulting-fab.de/). The following table presents the SWOT MATRIX for mine closure and reclamation companies in the State of Brandenburg.

Table 4: SWOT MATRIX for mine reclamation companies in the State of Brandenburg (Germany)

STRENGTHS	**WEAKNESSES**
• Advanced machinery/equipment • Extensive mining and reclamation experience • Diversified land restoration and environmental services • Skilful human resources • Investment capital for restoration interventions is readily available	• Difficult geospatial conditions • Schedule constraints • High cost investments
OPPORTUNITIES	**THREATS**
• Clean Energy strategy in place • Legal framework on post mining land restoration exists (but needs to further improve) • Increasing demand for reclamation and environmental services in coal intensive regions • New technology development • Funding programmes for land reclamation projects	• Uncertainty over financial viability and market stability given the forward looking character of mine closure and reclamation plans • Bureaucracy (complex administrative procedures) concerning the initiation and implementation of land restoration projects

these, in Jänschwalde, targeted interventions will be made to restore the Malxe River to its original river course. All these interventions are part of Lusatia's regeneration programme.

In fact, the opencast mine in Cottbus-Nord was permanently closed in 2015, according to the initial schedule. The mine operator, as forced by the Federal Mining Law, is currently working on reducing any interference with nature to the unavoidable minimum. Parallel to ongoing lignite mining activities, rehabilitation works have already begun on the areas already mined-out. According to rehabilitation plans, the proportion of land uses in the former mine site after restoration will be as follows:

- 53% woodlands
- 25% Water resources (biotopes and lakes)
- 10% agricultural land and pastures
- 12% other areas and infrastructures (e.g. roads, tracks and tourism/recreational areas)

In addition to the above projections, this section suggests a series of post mining land uses which can create alternative development routes for Brandenburg's economy. These uses are not associated with coal extraction and combustion, share substantial growth potential and low environmental impact, and can essentially contribute to offset the negative impact from coal phase out in terms of employment and local income.

Post mining land uses and activities with growth and employment potential

To start with, the potential for RES energy generation in Brandenburg's coal mine sites is extremely high. The average wind (10%-15%) and solar (10%-12%) availability factors for the Brandenburg State are above the EU average, favouring investments in RES developments. Brandenburg is already a forerunner in RES generation. With an installed capacity of about 5,500 MW, Brandenburg is the second leading wind power state in Germany (as of 2014). Brandenburg also hosts the largest open-field solar parks in the country with up to 145 MW installed capacity. Overall nine of the ten largest solar power plants in Germany are located in the region. In general, RES projects in former mine sites can aid with the re-employment of the skilled labour from the mining industry, contributing also to regional value creation and creating new job opportunities in trade and research.

The prospects for tourism growth in the State of Brandenburg are also good. The number of arrivals is increasing, the length of stay is satisfactory, the average daily spending is constant, and the number of significant tourist origins is going up. The number of nights spent at tourist accommodation facilities in the region will very soon exceed 4 million. The demand for Brandenburg has been growing steadily despite the region has not yet an established reputation for its tourism offerings in the domestic and overseas marketplaces. Brandenburg has a combination of natural and cultural assets that render the region an attractive destination for families and thrill seekers. These include natural parks, aquatic ecosystems (e.g. lakes, rivers, and lagoons), historical structures, museums, local products and gastronomy, and wine routes.

4.2 South-West Oltenia (RO)

Geography

South-West (Sud-Vest) Oltenia is a development (administrative) region, located in Southwest Romania. The region has a surface of 29,212 km^2, covering 12.3% of the country's territory. South-West Oltenia is made up of 5 counties (Dolj, Gorj, Mehedinti, Olt and Valcea), and has a population of 1,973,140 inhabitants (Eurostat, 2018). The region is bordered by two natural "wonders", the Carpathian Mountain Range in the north and the Danube to the south, with fertile plateaus, rolling hills, forests and pastures in between.

Economy

South-West Oltenia is endowed with rich natural resources (lignite) and a hydrological network composed by the Danube and Olt and Jiu rivers, which have at a large extent shaped its economic identity as the main energy producer in the country. In 2017, the value of regional nominal GDP was €13.62bn, representing 7.3% of the national GDP (Eurostat 2018). Since 2013 when the regional economy has returned on a positive growth trajectory, the regional product has increased by almost 31% (cumulative growth) and the average annual growth rate for the period between 2012 and 2017 is 6.2%. South-West Oltenia, however, remains within the group of 20 regions with GDP per capita below 50% of the EU average. This is expressed as 13.600 PPS per capita (€6.500 per capita in euros); a figure which is 20% lower than the national average (17,000 PPS) and far below (55%) the EU average of 30.000 PPS.

The region is characterised by a large industry base and a highly diversified economy. The tertiary (service) sector accounts for the largest share (47.6%) of the regional output with wholesale, accommodation and catering services to generate €2.2bn, and public services to follow with almost €2bn. The secondary sector, dominated by mining, energy production and automotive, represents 46.8% of the regional gross value added (€6.43bn). In 2017, agriculture contributed €751.58 million, accounting for 5.6% of the regional GDP.

The region's economic structure, mostly fuelled by agriculture, coal mining and the quarrying of granite and marble, varies significantly across the 5 counties. More particularly, Dolj is strongly identified with traditional industries (e.g. automotive, tractors, cars, airplanes, agricultural and heavy machinery, oil and gas extraction, chemical industry, clothing, textiles, furs, leather, food and drinks), and is highly specialised in organic agriculture. Olt has a diverse industry where metallurgy (aluminium) stands out. Gorj's leading industry is mining and raw material processing but other industries such as electronics, electrical engineering, automotive, machine tools and food are also present and on the rise. Finally, Valcea has a strong chemical and food industry; other activities include coal, oil and salt exploitation,

The "Turceni" thermal power plant, situated in Gorj County (South-West Oltenia) on the banks of the Jiu River, is the largest coal fired power plant in Romania, and one of the largest (still operating) in Europe. The plant was designed to operate 8 units. The first unit was opened in 1978, and the last in 1987. From those, Units 1 (commissioned in 1978), 3 (1980), 4 (1981), 5 (1983), are still operational; Unit 2 was decommissioned in 1979 and Unit 8 was never completed. Unit 6 is to be overhauled while Units 4 and 5 have been already refurbished. Finally, Unit 7 shut down its operations in 2014, as failed to comply with legal operating conditions related to pollution limits. The plant became part of the Energy Complex in 2012. The following table presents key facts for the "Turceni" Thermal Power Plant.

Mine site / Power plant	Key facts
"Turceni" Thermal Power Plant	• Installed capacity: 1320 MW (as of 2019) • Annual electricity production: n/a • Net efficiency: 36% • Years of operation: 44

Expected impacts on employment & economy

Without a proper offset strategy, the region with GDP per capita almost 20% lower than the national average and ~13200 coal (direct) related jobs at risk might experience a high increase in the number of unemployed persons, which may reach 22%. This classifies South-West Oltenia among the EU regions to be most severely affected from the shutdown of coal driven activities, in absolute numbers. Nevertheless, the region given the low unemployment rate (5.48%) and the fact that the share of jobs at risk in economically active population is 1.1%, and despite the significant number of job losses, might experience a relatively low to moderate social impact with the possibility to absorb the decline in employment on medium to long term. The expected direct job losses in region's power plant operation based on the capacity projected to be decommissioned (and not replaced by new capacity) in the coming decade could reach 1981. This number, however, can be even higher in the incident of premature retirements, which may result either from operators' failure to comply with BAT emission requirements or as part of a national coal phase out strategy. According to Dias et al. (2018), the capacity of power plants in the Oltenia Energy Complex likely to retire by 2025 is 450MW and by 2030 3065MW. This translates into 254 direct power plant jobs to be at risk in the first wave of decommissioning and other 1727 jobs to be impacted after the second and bigger wave of decommissioning in 2030.

The coal industry annual turnover is estimated at €600 million, representing 4.5% of the regional GDP and a vital source of income for rural communities, some of which are largely reliant on coal related activities and have a mono-industrial profile. The estimated net profits from coal driven activities in the region are over €42 million while a considerable share of revenues is attributed to the state in the form

capacity. A production licence is awarded only after the relevant environmental impact assessment (EIA) is conducted and approved by mining authorities.

Under the National Law, contractors need to have in place comprehensive mine closure and recovery plans prior to the commencement of extraction activities. According to Article 52, titleholders need to submit an official request to NAMR for mine closure alongside with an updated closure and recovery plan that includes a) the reasons of closure based on technical and economic documentation, b) the detailed schedule of works for the restoration of degraded and contaminated land as well as a post-closure monitoring program, c) the social protection program to be employed for mitigating the negative impacts from the termination of extraction operations on employment, infrastructures and local income, d) environmental and water management authorisations for mine closure, and e) decommissioning and land vacating procedures. Notably, the Law foresees the establishment on the part of contractor of a financial guarantee, to ensure that all obligations in the environmental permit are financially secured and funds are available at any time for the rehabilitation of the site contaminated.

As already depicted, the competent authority for the application of the provisions of the National Mining Law is the National Agency for Mineral Resources. Its responsibilities include:

- Administration of mineral resources subject to public property.
- Negotiation and granting of licences and permits in the mining field.
- Enactment of secondary legislation.
- Supervision of compliance by beneficiaries of licences and permits and the applicable legislation.
- Establishment of royalties.
- Approval of exploration activities.
- Termination of mining activities.
- Professional certification.

To end with, a legislative proposal to replace the existing Mining Law was submitted for public consultation at the beginning of 2019. The draft legislation has raised significant debate and different concerns on mining activity in the country. On the one hand, the initiators and proponents of the new legislation claim that this reform will simplify the process of granting licences, enhance environmental protection aspects and impose the adoption of best available technologies in extraction processes. On the other hand, the legislative proposal has been criticised for providing significant powers to titleholders especially by simplifying the procedure by which a mining project may be declared of public utility.

Environmental restitution

The negative impacts of coal mining and lignite based electricity generation on the natural environment of the South-West Oltenia Region comprise the destruction of local ecosystems and agricultural land,

efficiency and reduce CO2 emissions by 300,000 tonnes per year. In 2019, the state budget foresees the allocation of around 7.5 million euros for the closure of non-competitive coal mines in the country, covering works for ecological revitalisation and environmental restitution. In addition, the Regional Operational Programme 2014-2020 foresees funding for land restoration initiatives in former mine sites under Thematic Objectives 4 and 6; namely "TO4 - Supporting the shift towards a low-carbon economy in all sectors" & "TO6 - Preserving and Protecting the Environment and Promoting Resource Efficiency. In particular, the Investment Priority 6c supports actions to improve the regeneration and decontamination of permanently closed coalfields (including conversion areas), reduction of air pollution and promotion of noise-reduction measures. Beneficiaries of these types of activities are public authorities / other public bodies, including their subordinate structures, for historically contaminated sites owned or made available by the owner. To conclude, an estimation for the cost of mine reclamation and environmental restitution works in the Oltenia Energy Complex is not available. Further to this, Romania is continuing to prop up its ailing coal sector (coal is regarded as a sector of national interest and pillar of energy security), thus deferring the decision for region's decarbonisation in the long run.

Mine reclamation companies

There are 2 state owned companies that deal with the shutdown of coal driven activities in Romania, and hold substantial experience in mining and reclamation works; namely SC CONSERVIN, and The National Society for Coal Mines Closures Valea Jiului SA. These two companies operating under the jurisdiction of the Ministry of Economy are responsible for implementing the national mine closure policy. Their duties include managing state aid for mine closure, awarding public procurement contracts and overseeing land restoration and environmental rehabilitation works carried out by contractors to assess their compliance with contract provisions and land restoration requirements. The following table presents the SWOT MATRIX for mine closure and reclamation companies in Romania.

Table 5: SWOT MATRIX for mine reclamation companies in South-West Oltenia (Romania)

STRENGTHS	**WEAKNESSES**
• Extensive mining and reclamation experience • Diversified land restoration and environmental services • Skilful human resources	• Risk involved with government contracts
OPPORTUNITIES	**THREATS**
• Funding programmes for land reclamation projects	• Unfavourable economic conditions discouraging large-scale investments such as land restoration projects

network made up of the Danube, Olt and Jiu Rivers, South West Oltenia has emerged as the main energy producer in the country, accounting for more than 70% of total hydropower production. The examined coal areas (after closure) can also act as low-enthalpy geothermal resources, to be used for small to medium scale power generation and for heating and cooling purposes. They are located in areas with relatively high temperatures at depth, as demonstrated by the several thermal spas found in the region. Overall,

In South-West Oltenia, tourism is one of the fields with an attractive potential which can be further unleashed by utilising its strategic geographic location and the natural wealth of the Carpathians and the Danube River. The region has a rich diversity of natural features that include protected areas, natural parks, mountains, caves, non-polluted rural areas, mineral waters and spas. For instance, the Jiu Valley (the country's former largest coal mining area) is distinguished by wonderful landscapes, an exceptional river basin, and a very ancient history and culture. In the region, there are 6 declared health resorts: Baile Govora, Baile Olanesti, Calimanesti-Caciulata, Horezu, Voineasa and Sacelu; while more centres are currently undergoing the process of authorisation as health resorts. The presence of diverse and special historical, folkloric, religious and cultural elements (with coal related industrial heritage to hold a prominent place), creates also the premise for the development of diversified forms of tourism.

Agriculture is one of the main pillars of the regional economy with an annual turnover of over 750 million euros (5.6% of the regional GDP in 2017) and high growth potential. The sector also accounts for almost half (49.8% in 2017) of the total employment. South-West Oltenia features large areas cultivated with energy plants, especially in the Dolj and Olt counties, which gives the region a competitive advantage and substantial potential to build on regional assets and resources to foster smart specialisation. Notably, South-West Oltenia is now ranked second in the country regarding the orchard and fruit tree nurseries cultivated areas.

Decarbonisation and land restoration recommended pathways

Though the EU has vowed to gradually phase out fossil fuels, Romania exhibits a stronger than ever pro coal stance with limited at the time being interest to change the current status quo in the country's mining regions such as South-West Oltenia. Coal currently covers about a third of domestic energy demand and while the national energy strategy foresees a diminishing role for coal, a coal phase out looks far from imminent. In contrast, the Romanian government has plans for the construction of a new 600 MW unit at Rovinari, Gorj County that will substitute the two recently decommissioned units. The situation is further exacerbated by the fact that the Romanian coal sector is one of the most polluting in Europe. None of the coal based power plants in the country comply with the Industrial Emissions Directive and most of them are operating without an environmental permit. Furthermore, even though over the last two decades a series of coal mines were closed in the country due to a lack of competitiveness, little has been made so far to utilise the restored land for other uses and create

4.3 Western Macedonia (GR)

Geography

The Region of Western Macedonia, situated in the North – Western part of Greece, is one of the 13 administrative regions of the country. Western Macedonia is a landlocked region, bordering with Albania to its west and with North Macedonia to its north. It occupies an area of 9,451 km^2 and its population is around 280,000 inhabitants (2017). With 30 inhabitants per km^2, Western Macedonia is one of the less populated regions in Greece. The region, distinguished by its mountainous surface, is endowed with rich natural resources such as fossil fuels (lignite) ores (asbestos, chromite, marble etc.) that have shaped its identity as the primary and most important energy production centre in Greece. Administratively, the region consists of 4 regional units (Kozani, Grevena, Kastoria and Florina) and 16 municipalities. The capital and largest city of the region is Kozani with 53,880 inhabitants.

Economy

In 2016, Western Macedonia's Gross Domestic Product (GDP) was estimated at 3.8 billion euros, representing 2.2% of the national total (Eurostat, 2018). The average annual growth rate for the period between 2001 and 2009 was 5.1%, while during the years of economic recession, this rate was decreasing annually by 3.4%, rendering the region as one of the most affected by economic crisis. The regional GDP per capita, expressed in purchasing power standards (PPS), reached €17,200 in 2017, a figure below the national average (19,700) and the EU-28 average (29,200).

Energy production through lignite combustion constitutes the main pillar of regional economy with an annual turnover of around 1.5 billion euros. The energy sector accounts for almost 39.4% of the regional GDP and is the largest source of local income and employment in Western Macedonia. According to the Hellenic Statistical Authority (ELSTAT), in 2015, the secondary sector, which is primarily identified by lignite mining and electricity production, accounted for 47.9% of the regional output. The tertiary (service) sector followed with a share of 45.5% while the primary (agriculture) sector represented only 6.7% of the regional added value. The economic structure of Western Macedonia differs in terms of sectoral production and employment from the national model, which is largely dependent on services and trade. Remarkably, at national level, the economy is dominated by the service sector which accounts for almost 80% of the national GDP, followed by industry (16%) and the agricultural sector whose contribution to the national economic output is estimated at no more than 4%.

In Western Macedonia, industrial and manufacturing activities (apart from mining and power production) concern traditional sectors including renowned regional products such as marble, saffron, fruits, local wines, furs and leather manufacturing and specialised arts and crafts. In the services sector, retail and wholesale trade, tourism and public administration services are the most important sub-sectors in terms of value added while health and financial intermediation sectors are gradually growing in importance.

5700 persons are directly employed in the coal industry by the Public Power Company; 4283 in mine sites and 1398 in coal fired power plants. This figure represents 45.9% of job positions in the secondary sector, without taking into account the indirect employed created by coal driven activities. According to Dias et al. (2018), throughout the coal value chain, the number of indirect jobs in coal-related activities at intra- and inter-regional level may exceed 5,200 positions.

The coal industry

Greece is among the EU countries with high dependency on coal for its energy supply. Coal, despite its production and use is declining in Greece, retains a key position in the country's energy mix, accounting for over half of the total energy production. Western Macedonia, with eight of the nine remaining lignite mines on its territory, is recognised as Greece's energy centre. The region has a long standing tradition in lignite mining and coal based power production. The first excavations in Western Macedonia took place in 1939 following the publication of a study by German Professor F. Kegel, who confirmed the availability of rich lignite reserves in the region. The total sum of confirmed lignite reserves that can be exploited for energy generation in the country is estimated at 3.2 billion tonnes. The largest deposits (approx. 1.8 billion tonnes) are located in Western Macedonia. The mining area stretching over the Kozani - Ptolemaida - Amyntaio - Florina axis constitutes one of the largest lignite reserves in Europe.

The region features an energy complex (known as West Macedonia Lignite Centre) with 8 mine sites (coal fields) and 4 power plants (Agios Dimitrios TPS, Kardia TPS, Ptolemaida TPS and Amyntaion TPS); all lignite based. The mining area has coal reserves amounting to 1.82 billion tonnes of lignite and the annual production reaches 40 Mt. The lignite produced in the eight opencast mines is supplied to the adjacent coal fired power stations for the production of electricity. The 4 lignite fired power plants, made up of 12 units, have a combined capacity of 3,401 MW. They represent 40% of thermal units and 20% of the total installed capacity of the interconnected system in Greece. Overall, coal power plants are inefficient and old with an average plant age of 31 years.

In Greece, while the cost of extraction (2.12 euros per ton) is the lowest in Europe, lignite-fired power production is exceptionally costly estimated at 59.9 €/MWh when in Germany is 53.6 €/MWh, in the Czech Republic 39.0 €/MWh, in 38.6 €/MWh in Poland and 31.6 €/MWh in Bulgaria. This is mostly because of the extremely low calorific value of Greek lignite as well as other variable production cost variables.

According to the Law, the right of exploiting mineral resources is reserved to the Greek State. Still, private entities may acquire a mining permit after a license is granted by the State. The owner of the mineral rights has the exclusive right to explore, excavate the earth, extract and exploit any or all the minerals lying above or below the surface of the ground. Mineral rights can be obtained by concession from the State, by hereditary rights, by transfer or lease. To obtain a mining permit, one should submit to the Regional Authority a techno-economic analysis which defines the site of the mines, a geological study, the mineral deposits, the necessary constructions and all budget considerations. The application is transferred to the Ministry of Environment, which is the competent authority to issue the Presidential Decree granting the mineral rights.

Mining is valid for a limited period of time, strictly constrained to the designated site and is bound to the restoration of the site to its previous state. The State in concert with the mine operator is bound to adopt special preventive or repressive measures for the preservation of the environment taking into account sustainable development. On this note, candidate mine operators must submit an environmental impact study (together with an ecological assessment) in order for an environmental permit to be issues and then commence with exploration and extraction activities. The environmental permit is valid for 10 years or longer if the project has environmental management systems in place.

The Law foresees that the mine operator shall take during and beyond extraction operations all the necessary measures to prevent or reduce as far as possible any adverse effects on the natural environment and human health from mining activities. This includes the management of any waste facility, also after its closure. The operators must rely on best available techniques to minimise the risk of extended environmental pollution and proceed with protection measures, taking into account the technical characteristics of the waste facility, its geographical location and the local environmental conditions.

Environmental restitution

The scenery in the mining area is kind of post-apocalyptic with a sprawling black landscape to span over 625 square miles, with a few deserted villages to break the monotony in Western Macedonia's mainland. Ash and dense clouds of smoke from burning lignite cover the sky over the 160 square kilometres Lignite Center.

Actually, Western Macedonia is among the regions with the higher emissions of air pollutants in the EU-28; PM10 emissions are above 5 kt per year, NOx exceed 10 kt per year and SO2 are above 20 kt. In Western Macedonia, recent measurements show that the European limit values for air pollutants are exceeded by more than 20%. The PM10 levels were exceeded by 3% in the settlement of K. Komi, 20% in Kozani, 31% in Ptolemaida, 42% in Florina and reached a peak of 43% in the village of Anargyroi.

The Fund is planned to be financed using 6% of annual revenues from auctioning emissions allowances, and over a period of three years will support activities in six priority areas including renewables, energy efficiency, land restoration, circular economy, industrial heritage and re-skilling of workers.

Mine reclamation companies

The Public Power Company, controlled by the Greek government, is the biggest power company in Greece and the sole responsible body to carry out land restoration works (in concert with its subcontractors) in the West Macedonia Lignite Centre. The following table presents the SWOT MATRIX for the Greek Public Power Company.

Table 6: SWOT MATRIX for the Greek Public Power Company

STRENGTHS	**WEAKNESSES**
• Extensive mining and reclamation experience • Skilful human resources	• Limited scope of reclamation/environmental services
OPPORTUNITIES	**THREATS**
• Increasing demand for reclamation and environmental services in coal intensive regions	• Market instability • Unfavourable economic conditions discouraging large-scale investments such as land restoration projects • Bureaucracy

Former land uses and uses surrounding the mine sites/plants

Before the mines were opened in Western Macedonia, the site was surrounded by forests, grassland and rocky surface, and people were mostly farming. Many settlements in the Western Macedonia Region were forced to relocate to make way for mining activities and the deployment of lignite based power stations. Kardia was the first village of the Region to be relocated. The relocation began in 1972 and was completed in 1976, involving 692 people. In 1979, 300 people were relocated from the Eksohi settlement and 1,228 people from the Haravgi village. The latest relocation concerned Klitos village while two relocations are now in process. The surrounding area is composed mostly by nature (forests, lakes), grassland, and urban agglomerations established to support the operation of lignite extraction and electricity production processes in a distance of over 250 metres of mine sites and power stations.

and protection, water resources protection and carbon storage, and halt biodiversity loss. Further to this, forestry can emerge as a new growth sector (wood trade) and forests become the driving force for secondary sectors such as tourism and manufacturing. According to PPC's restoration programme, 5.374 hectares of forests will be created in the place of former mine sites.

Western Macedonia can benefit from the development of **Renewable Energy Resources**, rendering the conversion of former mine sites and coal fired power plants to produce clean energy a possible and attractive solution. Besides, the positive social attitude towards renewables means that this reconversion option is likely to be met without strong opposition especially by trade unions and workers whose employment status will remain unchanged. In Western Macedonia, there is high solar availability; the solar energy capacity exceeds 1500 kWh per kWp. The region has a favourable solar exposure that make currently operating mine sites the ideal location for solar power generation. The wind power potential, however, is rather limited, having also a narrow frame of application in the locations of mine sites. The average wind speed is only 2.45 m/s. Though geothermal potential in Western Macedonia cannot be easily detected, it is estimated that a solution involving geothermal heat pumps can bring a magnitude of 202 GWh energy production annually. Apart from the construction, operation and management of renewable energy production units, employment opportunities can also arise in the manufacturing of RES equipment. Remarkably, the recent proposal by PPC for the construction of a 200 MW PV park in the areas of the closed mines also included plans for the deployment of an industrial unit dedicated to the manufacturing of equipment and machinery for PV systems.

Western Macedonia is home to sites of spectacular beauty. On its territory there are NATURA protected areas, two National Parks, eight lakes, rivers, valleys and a number of significant archaeological and geological sites. Nonetheless, the **tourism** sector in Western Macedonia is underdeveloped in comparison with the rest of the country where tourism is a key driver of regional growth. In 2016, the number of tourist arrivals was 118,766 when in Greece as a whole the number of tourists exceeded 18 million. What is more, the region has low carrying capacity with less than 3,200 accommodation units (hotels and rooms). Despite its poor performance to date, Western Macedonia can take advantage of its rich natural and cultural assets and unleash its tourism potential. New growth opportunities, of a sustainable nature, for the post lignite era can emerge in therapeutic tourism, eco-tourism, agrotourism, and wine and religious tourism. In this context, the valorisation of the industrial heritage of former mining period should be a priority and hold a prominent place in region's tourism offering.

Decarbonisation and land restoration recommended pathways

Greece demonstrates a low degree of willingness towards the green energy transition, as the country continues to subsidise coal based electricity generation and the Public Power Corporation, in which the state holds 51% of shares, seems determined to prolong Greece's lignite-based model for electricity production with the construction of two new lignite fired units in Western Macedonia. In Greece, there

4.4 Yugoiztochen (BG)

Geography

Yugoiztochen (South Planning Region) is a NUTS2 administrative region, located in South-eastern Bulgaria. The region consists of 4 provinces (Burgas Province, Sliven Province, Yambol Province and Stara Zagora Province) and its capital is Burgas. It has a surface of 19,798.7 km^2, covering approximately 18% of the country's territory. Its population stands at 1,039,549 inhabitants (Eurostat, 2018). The region is characterised by significant intra-regional inequalities with the cities of Burgas and Stara Zagora forming the major axis of urbanisation.

Economy

In 2017, the value of regional GDP was 6.68 billion euros, representing 12.9% of the national GDP (Eurostat 2019). The GDP per capita is 6,400 euros, slightly below the national average. Coal driven activities contribute approximately 2.3 billion euros to regional GDP, and is considered the main pillar of the regional economy. In 2018, the value added generated by activities in the service sector amounted to 3.23 billion euros, representing 48.3% of the regional GVA. Industry provided 3.1 billion euros accounting for 46.5% of the regional product. The relative share of the agricultural sector stands at 5.2%, contributing over 500 million euros annually.

The Regional Development Strategy (2014 – 2020) lays down region's growth priorities to achieve a sustainable and balanced development. The strategy places emphasis on:

1. Improving the business environment to attract competitive investments in the manufacturing sector and support small and medium-sized businesses.
2. Harnessing the area's research potential to more actively integrate innovation in manufacturing, fostering collaboration between educational institutes, R&D units and businesses.
3. Achieving energy efficiency in the manufacturing, domestic and transportation sectors, introducing renewable energy sources and stimulating a low carbon local economy.
4. Improving public e-services and e-markets, as well as providing broadband access for people and businesses.
5. Improving the labour market of the territory by stimulating labour mobility, youth employment, vocational education systems, forms of qualification and retraining and lifelong learning.
6. Supporting social integration, poverty reduction and promoting the social inclusion of disadvantaged groups.
7. Providing support for the optimisation and quality improvement of the health and social services system, improving the education system and preserving and developing the culture, cultural heritage and cultural institutions.

bought by US Contour Global consortium and major investments in NO and SO2 emissions reductions were undertaken.

Mine site / Power plant	Key facts
Maritsa Iztok Coal Mine	• Type of coal: Lignite • Mine type: Open-pit mining • Production (Mt): 30,34 • Years of operation:68
Maritsa Iztok 1 (AES Galabovo Power Plant)	• Type of coal: lignite • Capacity (MW): Initially 200, increased to 670 (2011) • Years of operation: 57
Maritsa Iztok 2	• Type of coal: lignite • Capacity (MW): 1586 • Efficiency (%): 90 • Years of operation: 53
Maritsa Iztok 3 (Contour Global)	• Type of coal: lignite • Capacity (MW): 908 • Efficiency (%) 90 • Years of operation: 41
Brikel Jsc.	• Type of coal: lignite • Capacity (MW): 120 • Efficiency (%) 90 • Years of operation: 59
Maritsa 3 CFPP	• Type of coal: lignite • Capacity (MW): 120 • Efficiency (%) 90 • Years of operation: 48

Expected impacts on employment & economy

Yugoiztochen is one of the regions in the EU-28 which is expected to experience the highest socioeconomic impact from the coal phase out. The total number of job losses (directly from the coal industry) can exceed 12,000, leading to a 70% increase in the region's unemployment rate. Yugoiztochen with GDP/capita almost 20% lower than national average and a 2.3% of jobs at risk in economically active population, might experience an unemployment rate at the level of 9%, which is close to maximal value in Bulgaria. The social impact from the shrinkage of the coal industry might be

the Minister of Environment and Water, the Minister of Agriculture and Food, the Minister of Health and the Minister of Regional Development. At the Regional level, the policy on soil conservation, sustainable use and restoration is implemented by the regional governors and at the local level by the mayors of municipalities.

The **Soil Law** (Promulgated SG No. 66 of July 26, 2013) regulates public relations related to soil conservation and their functions, as well as their sustainable use and sustainable restoration as a component of the environment.

Other regulatory documents setting mine reclamation requirements include:

- **Ordinance No. 3 on Standards on the Permissible Content of Harmful Substances in Soils** (promulgated SG 71/08, August 2008) which defines the standards for the permissible content of harmful substances in soils and the requirements for taking and testing soil samples for determining the content of harmful substances.
- **Ordinance on Inventory and Surveys of Contaminated Soil Areas, Required Restoration Measures, and Maintenance of Rehabilitation Measures Implemented** (Official Gazette, issue 15 of 16 February 2007) which defines the order and manner of carrying out the inventory and surveys of contaminated areas, the necessary restorative measures, as well as the maintenance of the implemented restoration measures.
- **Ordinance No. 4 on Soil Monitoring** (promulgated SG No. 19 of 13 March 2009) regulating the procedure for conducting soil monitoring by establishing a National Soil Monitoring System (NMSP).
- **Order No. RD-564 / 13.10.2016 of the Minister of Environment and Water** which confirms the Methodology for preliminary and detailed studies and the establishment of a public register for inventory of contaminated soil.
- **Order No. RD-619 / 15.09.2009 of the Minister of Environment and Water**, confirming the soil monitoring schemes and indicators for the assessed soil condition according to Art. 10, para. 1 and Art. 11, para. 1 of the Soil Monitoring Regulation.
- **Ordinance No. 26 on the reclamation of disturbed terrains, improvement of poorly productive lands, seizure and utilization of the humus layer**.

Environmental restitution

The negative impacts of coal mining and lignite based energy production on the natural environment of the region of Yugoiztochen include destruction of native flora, biodiversity loss, soil contamination and fertility decline, soil erosion, groundwater contamination, surface water pollution, acid mine drainage as well as air pollution and to a lesser degree deforestation. According to Beyond Coal Europe, in 2018, coal fuelled power plants generated over 24 million tonnes of CO2 emissions, accounting for 44% of Bulgaria's total CO2 emissions. In Yugoiztochen, coal pollution was responsible for 660 premature

Table 7: SWOT MATRIX for mine reclamation companies in Yugoiztochen (Bulgaria)

STRENGTHS	**WEAKNESSES**
• Extensive mining and reclamation experience` • Diversified land restoration and environmental services • Skilful human resources	• Risk involved with government contracts • Lack of geospatial data
OPPORTUNITIES	**THREATS**
• Increasing demand for reclamation & environmental services in coal regions • Open and transparent procurement methods for reclamation services • Funding programmes for land reclamation projects	• Bureaucracy (complex administrative procedures) concerning the implementation of land restoration projects • Resistance from local communities which are largely dependent on coal driven activities

Former land uses and uses surrounding the mine sites/plants

The Yugoiztochen region's mining and plant sites, namely the Maritsa Iztok Energy Complex, and their surrounding areas were formerly forests as well as agricultural areas and rural settlements. The current uses of the site's surrounding areas include rural settlements and agricultural activities. Some of the main constraints to the restoration of the land include soil fertility and land disturbance, caused by decades of coal extraction and combustion.

Post mining land uses

Post mining land uses and activities with growth and employment potential

This section suggests possible post mining land uses in Yugoiztochen Region, based on the needs analysis findings and in accordance with region's growth and environmental priorities. In all cases, priority should be given to address the extent of air pollution caused by old coal fired power plants still operating in the region. The aim should be to recover previous ecological functions and establish a sustainable and functional ecosystem; at the same time it is of particular importance to identify alternative, sustainable routes for the regional economy that will essentially contribute to sustaining local social-economic structures to be inevitably affected by the shutdown of coal driven activities.

The fields identified as regional economic drivers for the region of Yugoiztochen include a) renewables, b) pastures and cultivation, c) tourism and recreation, and d) forestry. Yugoiztochen exhibits high solar availability (above EU average), making the conversion of former mine sites for the production of solar energy an attractive and viable option. Yugoiztochen can also benefit from high temperatures

4.5 Savinjska (SI)

Geography

Slovenia is divided into two NUTS 2 regions, Vzhodna and Zahodna Slovenija and then divided further into twelve NUTS 3 regions. Savinjska is one of the eight NUTS 3 regions of Vzhodna Slovenija, and one of the biggest regions in Slovenia. It is situated at the heart of the country and spans from the Austrian to the Croatian borders. The neighbouring regions are Koroška on the north, Podravska on the east, Spodnjeposavska on the south, Zasavska and Osrednjeslovenska on the west. The region is named after the alpine river "Savinja", which runs through the region, forming a biodiversity hotspot with enormous contribution to ecosystem services, and region's resilience to climate change effects. Savinjska covers 2,301 km^2, and its population exceeds 254.000. There are 31 municipalities in the region, and the largest city (and metropolitan centre) is Celje.

Economy

Savinjska has an export oriented economy, with a long industrial tradition and high concentration of businesses. The regional gross domestic product is 4.85 billion euros (2017), accounting for 10.5% of the national total. The regional GDP per capita, expressed in purchasing power standards (PPS) reached €18,100 in 2016, slightly below the national average (€19,576). The above figures position Savinjska in the fourth place among the 12 NUTS 3 regions in the country, but still far from the EU-28 average (€29,200).

Suprisingly, the economic development of the region can mostly be attributed to the big, successful companies, which have emerged as the backbone of the regional economy, creating more than 40% of added value. Overall, the service sector dominates the regional economy, accounting for 47.6% of the regional gross valued added (GVA), which totalled 2.31 billion euros. Manufacturing adds 1.63 billion euros to the region's product and the primary sector 0.91 billion euros. Their shares in the region's total are 33.6% and 19.8% respectively. Notably, agricultural land covers about 30% of the regional territory. In this breakdown, the coal industry is a major source of income and employment. The gross added value of coal driven activities (coal mining and electricity production from lignite) is over 280 million euros; representing almost 6% of the regional GDP.

The Regional Development Programme for Savinjska Region outlines region's priorities for economic development for the period 2014-2020. The industries that can play a driving role in the economic development of the region by enhancing entrepreneurship and supplying quality and high paying jobs are metal processing, food industry, tourism and energy. The region is committed to promoting a socially integrated and territorially balanced sustainable development. To this end, particular emphasis has been placed on the following development areas: sustainable tourism and destination management, energy

Slovenia bases its energy sector on three pillars – nuclear power, solid fuels and hydro. Energy is predominantly sourced by nuclear power (35%). Solid fuels generate 30% of the country's energy while hydropower provides approximately 28% of the national power. The remaining 7% comes from gas, biomass and solar. From the above, it becomes clear that solid fuels play a key role for Slovenia's energy security. From the energy supply generated by fossil fuels, the big majority (89%) draws from lignite, followed by brown coal (10%). The following table presents key facts for Savinjska's coal driven activities.

Mine site / Power plant	Key facts
"Velenje" coalfield	• Mine Type: Underground • Size: 21 km^2 • Type of coal: Lignite • Annual production (raw coal extracted): 3.4 Mt (2017) • Depth of coal deposits: Up to 500m • Start of operations: 1875 • End of operations: expected in 2054
"Šoštanj" Thermal Power Plant	• Installed capacity: 779 megawatts • Annual electricity production: 3967 GWh (2018) • Net efficiency (Unit 5): 32% • Net efficiency (Unit 6): 43% • End of operations (Unit 5): expected in 2030 • End of operations (Unit 6): expected in 2054

Expected impacts on employment & economy

The potential decline in regional employment due to mine closure and coal fired power plant decommissioning may reach 1,500 job losses. This puts an additional 1.2% of active population being already at risk of losing its job status. With a current unemployment rate at 5.5% (6,600 registered unemployed persons), the permanent interruption of coal-driven activities without a proper offset strategy could lead to a 22.7% increase in the unemployment rate. Therefore, the latter will eventually increase from 5.5% to 6.7%. However, as the unemployment rate is relatively low (5.5%) and the coal industry represents a relatively small share of the total GDP produced in Savinjska, the region will most probably be able to absorb lost jobs and re-employ these people in other more competitive industries. Yet, the number of job losses expected to be lost from the decommissioning of the coal fired plant may be significantly lower than expected, as the energy company (Termoelektrarna Šoštanj") already looks into different alternatives to prolong the operation of the plant, which is responsible for approximately

Legal framework

The Mining Act (ZRud-1), as introduced in July 2010 and last amended in 2013, is the primary legal basis for mining and extraction operations in the Republic of Slovenia. It sets the legal requirements affecting minerals and mining in the country. It consists of 157 articles, which lay down the conditions for the prospection, exploration and extraction of energy and mineral resources (e.g. coal, geothermic resources, oil and gas, bauxite, nickel, sea salt), regulating also concession, ownership, environmental and health & safety issues. More particularly, the Mining Act defines:

- Managing authorities and competent bodies for the management of minerals, mining design, supervision of mining operations, and audit procedures.
- Procedures to obtain prospection/exploration rights.
- Procedures for the grant, refusal and revocation of mining permits (incl. public procurement).
- Financial liabilities of the holders of mining permit incl. guarantee funds for environmental restitution.
- Contractual obligations and Key Performance Indicators (KPIs) in terms of service delivery and production.
- Mining inspection and penalties for low environmental performance, and health and safety incidents.
- Obligations for mine closure and reclamation.
- Technical documentation in mining.

According to the Act, the designation of a mining area at a municipality level must comply with local land use and spatial plans. This is key to securing a good environmental status and high standards of living for local populations, and most importantly ascertaining the appropriate and balanced distribution of land for different uses and economic activities (e.g. residential, farming, forestry, tourism, industry, nature), in accordance with territorial priorities and geospatial characteristics. The process for granting a mining concession permit in Slovenia is as follows. Once a certain area has been approved as suitable and eligible for mining extraction, the Concession Act is published by the competent national or local authority (most probably by the Ministry of Infrastructure and Spatial Planning), and the Mining Right is typically awarded to the Most Economically Advantageous Tender (MEAT) through an open public procurement process. The Concession Act (i.e. tender) defines a) the scope and nature of the procured services (e.g. size of the mining area, duration of mining permit, quantity of the permitted extraction, the type of mineral resource), b) operator's contractual obligations (e.g. environmental protection and health & safety measures, compensatory measures to offset environmental damage) and c) the requirements that bidders need to fulfil to award the contract (e.g. minimum financial guarantees and technical documentation). In this vein, bidders (i.e. candidate operators) must submit a comprehensive mine plan detailing all the preparation works and operation activities to take place in the area in question over the contract duration. Integral part of this plan is the description of restoration works when mining

- External organisations advising on mine closure programmes and assisting with post mining environmental assessments.

Environmental restitution

The consequences of multiyear mining and energy related activities in the Šaleška valley of the Savinjska have been severe. In 70s and 80s, the levels of air pollutant concentrations exceeded national limit values. The accumulated deposition of ash from the coal fired plant in lake sediments and ombrotrophic peats, resulted in minimising the self-cleaning capacity of water resources, and hence led to surface and underground water contamination. In addition, during the period of highest alkaline levels, there were no living organisms in Lake Velenje as a result of natural habitat destructions. The increased emissions of pollutants from Šoštanj Thermal Power Plant also affected the forests, which reflected in defoliation of the trees and reduction of increment, which was noticeable primarily in the mature spruce stands in Zavodnje and Sleme. Similarly, the extensive underground excavation of lignite had an adverse effect on soil quality. Beside gaseous pollutants, the Šoštanj Thermal Power Plant used to emit large quantities of heavy metals that accumulated in the ground and are circulating in the ecosystems of the Šaleška Valley. Another problem of the emission area of the Šoštanj Thermal Power Plant is soil acidification. Overall, mining activities transformed dramatically the landscape within and around the mine site. Further to the environmental damages, coal driven activities caused over 800 building collapses and forced more than 2,000 residents to resettle.

In 1987, the deterioration of environmental conditions in the Šaleška valley (as depicted above) provoked community marches and demonstrations against mine operators and their practices that were proved to spoil the natural environment and pose serious threats to public health. As a result of the public outrage, both the Velenje Coal Mine and the Šoštanj Thermal Power Plant set forward an ecological rehabilitation programme for the recovery of the wounded land and the protection of valuable natural resources. Since then, the operators have invested a vast amount of resources in environmental and social responsibility projects alongside with new environmental technologies to maintain ecological integrity and achieve the ambitious goals for lowering NOx, CO2, and SO2 and dust particle emissions, contributing also to the rehabilitation of degraded land and the safeguarding of water resources. According to Beyond Coal Europe, in 2018, the Šoštanj Thermal Power Plant generated 3.93 million tonnes of CO2 emissions, accounting for 22% of Slovenia total CO2 emissions. In Savinjska, coal pollution was responsible for 44 premature deaths.

It wouldn’t be risky to go so far as to say that the situation is now quite sustainable, even though the aforementioned effects have not been completely diminished. The most visible impact from lignite mining in the area of Šaleška valley has been the sinking of the ground’s surface and the subsequent formation of 3 lakes due to acidification (namely Velenjsko jezero, Škalsko jezero, Družmirsko jezero). This had direct impact on populations based and agrarian settlements and consequently caused the

(green) taxation, and strictly gathered for this use. Other sources of co-financing, especially for coordination and support projects dealing with capacity development, education/training and reskilling and stakeholder engagement, could be the Horizon 2020 framework programme for coal intensive regions or the European Bank for Reconstruction and Development. Innovative financial mechanisms such as crowd funding could also provide an interesting alternative for financing landscape regeneration.

Mine companies

Both the "Velenje" Coal Mine and the "Šoštanj" Thermal Power Plant are operated by HSE doo through its subsidiaries "Premogovnik Velenje, doo" and "Termoelektrarna Šoštanj" respectively. HSE doo is a state owned company, technologically advanced and with substantial experience in mining and reclamation works. Its headquarters are located in Ljubljana. There are also 3 business units in Maribor, Šoštanj and Nova Gorica. The company's operations are mostly based on the sales and trade in electricity and thermal energy, CO2 emission coupons, certificates of origin and other renewable energy certificates, the provision of ancillary services needed for the functioning of the electricity system and on the management and implementation of energy projects. The following table presents the SWOT MATRIX analysis for the energy colosseum of the Republic of Slovenia.

Table 8: SWOT MATRIX for mine reclamation companies in Savinjska (Slovenia)

STRENGTHS	**WEAKNESSES**
• Advanced machinery/equipment • Extensive mining and reclamation experience • Skilful human resources • Geospatial data is available	• Limited experience in specialized fields related to reclamation processes
OPPORTUNITIES	**THREATS**
• Open and transparent procurement methods for reclamation services • Funding programmes for land reclamation projects • New legislations and strategies such as the national decarbonisation strategy, the national coal phase-out program and the Slovenia Energy Concept	• Land use constraints

Former land uses and uses surrounding the mine sites/plants

The area of lignite seam and the adjacent coal fired plant extends over almost the entire Šaleška valley, creating a large industrial zone that stretches along the Paka River from Velenje to Šoštanj. The mining

valorise natural heritage assets therein (mostly man-made lakes). The aim is to increase the availability of leisure opportunities in the area by constructing suitable infrastructures for new recreational activities (swimming, surfing, cycling, hiking, horse riding, sport fishing), and showcasing area's distinguished characteristics and identity. The latest project in the area involves the restoration of a landscape of 46,090 m^2 around and close to the Velenje Lake, alongside with the construction of a big stage for events and concerts. Previous restoration activities were key to increasing visitor inflows in the region. In 2018, the number of both domestic and foreign visitors exceeded 100,000; further to this, the Velenje beach received an award for the best natural bathing place in the country.

The potential for RES energy generation in Savinjska is extremely high. The region has high sun exposure levels especially from solar resource; the average solar availability factor is 12%-14% (significantly above the EU average). That favours investments in solar panels, which could potentially be connected with the Šoštanj thermal power plant. Energy production from solar power may be both a strategic possibility and opportunity for the region. Given the recent expansion of the plant with a new 600 MW unit (to remain operational until 2053), the development of RES projects can help to avoid locking the country into a carbon-intensive future whilst accelerating decarbonisation efforts, and secure country's energy security and supply. It can also aid to counterbalance losses in employment from the coal phase out, boosting at the same regional sustainable economic development. The examined coal areas (after closure) can also act as low-enthalpy geothermal resources, to be used for small to medium scale power generation and for heating and cooling purposes. They are located in areas with relatively high temperatures at depth, as demonstrated by the several thermal spas found in the region. In contrast, in Savinjska's coal mining areas, there is little potential for wind energy projects given the low attitude and low average wind speeds. The wind availability factor in Savinjska is significantly below 10%.

Finally, new agricultural areas could be created to allow cultivation and pasture to flourish; thus providing new employment and income opportunities for locals. In Savinjska, there are over 11,000 farms; 90% of which are run by an individual or a family and rely primarily on family labour. The region is endowed with favourable natural conditions for farming and agriculture, which position Savinjska at the second place in agricultural production at national level behind the Drava Statistical Region. Agricultural land covers about 30% of the region's territory and in 2017, agriculture accounted for 2.7% of the regional GDP.

Decarbonisation and land restoration recommended pathways

Slovenia may have not yet announced an official phase-out date for coal but the need for a transition to a low carbon economy is increasingly recognised and embraced by local communities even in the country's coal intensive regions such as Savinjska. The national energy strategy (2015), which transposed at national level all relevant EU regulations, foresees a decreased role for fossil fuels in the

4.6 Łódzkie (PL)

Geography

The Łódzkie Region is a Polish province located at the heart of the country next to Mazowieckie and covers an area of 18,219 km2. Łódzkie has a total population of 2.47 million residents and the population density stands at 135 persons per km^2 (Eurostat 2018). The two-thirds of the population lives in urban centres. The capital and main centre of economic activity is Łódź; the 3rd largest city in Poland with around 700,000 inhabitants. Administratively, the Łódzkie region is divided into 24 districts and 177 municipalities. The largest cities are Bełchatów, Kutno, Pabianice, Piotrków Trybunalski, Radomsko, Tomaszów Mazowiecki and Zgierz.

Economy

In 2018, the regional GDP was estimated at 28.2 billion euros and a 4.26% growth is expected for 2019. The GDP per capita was 18,600 (PPS) in 2016, slightly below the national average (19,900). Łódzkie has a long industrial tradition, which goes back to the 19th century during which the region and especially its capital Łódź was famous for its (now declined) textile industry. The region's economy is dominated by the service sector which accounts for 58.7% of the regional GDP. After services, industry is second most important pillar of the regional economy. Industrial activities, with an annual turnover of almost 9.9 billion euros, account for 38.4% of the region's GDP (higher than the national average), representing a vital source of income and growth for urban agglomerations. The majority of the province's industrial and manufacturing plants are concentrated within the Łódź Industrial District. The most developed branches of industry are the production of textiles and clothing, mining of lignite, generation and distribution of electricity, production of chemicals, production of foodstuffs, production of machines and equipment, production of electrical equipment and building materials. The primary sector accounts for 2.9% of the regional GDP, generating around 750 million euros every year. The share of coal driven activities in the regional GDP is 1.27%; coal mining and electricity production contribute around 360 million euros to regional economy.

Employment

At the end of March 2019, there were 67.700 registered unemployed persons and the unemployment rate stood at 6.2% (minus 0.4% as compared to April 2018), significantly higher than the national rate (4.6%). Łódzkie has a similar to the national one employment distribution. The largest portion of the active labour force is employed in the service sector (55-60%), industry accounts for 38-42% while agriculture employs around 10-12%. Poland employs about half of the European coal workforce. In Łódzkie region, the coal industry employs about 8930 workers; 6388 in extraction sites and 2538 in the

8,500 jobs provided directly by the coal industry. With current unemployment rate at the level of 6.2% and almost 8,500 jobs at risk (0.65% from economically active population), Łódzkie will experience a slight increase in its unemployment rate that could eventually reach 7%. This means that the region will most probably be able to absorb lost jobs and re-employ these people in other more competitive industries. Nevertheless, the social impact from the shrinkage of the coal industry might be worse, taking into account an estimated 30,000 jobs in sectors/companies with connection and tights with coal. The companies that will be mostly affected will be those providing mining support services and are involved in the production of mining machinery and equipment as well as other metal finished products. Lower impact is foreseen for construction and engineering companies, as well as R&D centres and the transportation industry.

Legal framework

The legal basis that governs mining operations and drives permitting procedures is made up of the Geological and Mining Law (2015), the Act on the Liberty of Economic Activity (2014), the Nature Conservation Law (2015), the Environmental Protection Law (2013), the Water Law (2015) and the Act on Land Use Planning and Space Management (2015). The Geological and Mining Law constitutes the most updated legal scheme to regulate mining in Poland as of April 2019. According to this Act, an entrepreneur undertaking mining activities is obliged after the completion of extraction activities to proceed with the planned reclamation works in the wounded landscape. Mine operators' obligations include to secure or safely remove remaining equipment, installations and facilities from the site, and restore basic ecological functions. Permitted extraction activities shall be carried out under an approved technical operation plan. This means that candidate mine operators, in order to obtain the final permission, must have in place a detailed technical operation plan that sets out the intended mining activity, including plans for land, forest and water use, and schedule of technical works/operations in the area concerned.

Regarding post-mining land restoration, a number of important provisions are also identified in the following acts:

- The Act on the Protection of Arable and Forest Land of 3 February 1995 (Journal of Laws 2015, item 909, as amended)
- The Act on Mining Waste (Journal of Laws 2013, item 1136, as amended)
- The Act of 13 April 2007 on preventing the damages to nature and their compensation (Journal of Laws of 2014, item 1789, as amended)
- The Act of 27 April 2001. The Environmental Protection Law (Journal of Laws of 2016, item 672, as amended)

- The Regional Operational Programme of the Łódzkie Region for 2014-2020 under the Priority Axis "Preservation and protection of the natural environment, supporting the efficient management of resources" (280 million euros).
- The National Fund for Environmental Protection and Water Management (Earth Surface Protection Programme).
- The Operational Programme Infrastructure and Environment 2014-2020, Version 11.2, Warsaw, 1 August 2019, Action 2.5 Improving the quality of the urban environment (budget of Action 2.5 - 251.5 million EUR).
- The LIFE Programme (the budget for 2014-2020 is 3,456 million EUR, including 2.592 million EUR for environmental protection).
- Commune's Reclamation Programmes.
- Loan Programmes from Development Banks such as "GOSPODARSTWA KRAJOWEGO".

Mine reclamation companies

There are eight important companies actively engaging with mine closure and reclamation in Poland. These are ALDEX SA, MENARD POLSKA, DEKONTA POLSKA, SUEZ POLSKA, GEOTRADE, SEGI-AT, EKOLOGUS and PROTE.The following table presents the SWOT MATRIX for mine closure and reclamation companies in the region of Łódzkie.

Table 9: SWOT MATRIX for mine reclamation companies in Łódzkie (Poland)

STRENGTHS	**WEAKNESSES**
• Diversified land restoration and environmental services • Skilful human resources • Collaboration with foreign companies (a pioneer in land reclamation) • Geospatial data is available	• Lack of modern machinery/equipment • Risk involved with government contracts • Difficult geospatial conditions
OPPORTUNITIES	**THREATS**
• Legal framework on post mining land restoration exists • Increasing demand for reclamation and environmental services in coal intensive regions • New technology development • Funding programmes for land reclamation projects	• Market instability • Unfavourable economic conditions discouraging large-scale investments such as land restoration projects • Bureaucracy (complex administrative procedures) concerning the initiation/implementation of land restoration projects

local and incoming visitors together with modern infrastructure including ski lifts and a catering-accommodation base.

Post mining land uses and activities with growth and employment potential

This section suggests also possible post mining land uses that could be part of a regional just transition plan that needs to support a coal phase out decision. These comprise economic activities that are not related to lignite extraction and combustion, are of a sustainable nature, share substantial growth potential and can contribute to offset the negative impact from coal phase out in terms of employment and local income.

To start with, Łódzkie is well suited for investing in tourism and recreation. Tourism can provide an alternative viable route for Łódzkie's economy, succeeding coal driven activities in the post coal era, as it offers several attractive features in terms of both natural and cultural resources. Having historically been an industrial city and despite an influx of over 500,000 foreign tourists annually, the Region is mostly shunned by tourists in favour of the more popular Polish cities such as Krakow, Warsaw or Wroclaw. However, this situation can be reversed, with the region claiming its position as an attractive tourist destination for visitors primarily concerned for environmental sustainability and cultural heritage. As indicated below, former coal mines could provide venues for conferences, concerts and other special events, and host modern sport facilities such as indoor ski runs, hippodromes and racetracks. Other touristic and recreational activities might include mining themed holidays in former mine areas or/and the organization of concerts.

In addition, Łódzkie Region can benefit from the development of Renewable Energy Resources, rendering the conversion of former mine sites and coal fired power plants to produce clean energy a possible and attractive solution. Łódzkie higher suitability for wind power generation with an average wind speed of 12.2 miles per hour. The solar resource is lower, but the conversion can still be considered feasible. Finally, due to the intensive excavation of land in former mine sites that has deteriorated soil quality and stability, housing projects seem a technically difficult option to consider.

Decarbonisation and land restoration recommended pathways

Poland is the largest coal producer in Europe and is extremely dependent on domestic coal for its energy supply. Coal accounts for almost 80% of energy production and 51% of total primary energy supply. Poland, in spite of having the most polluting coal industry in the EU, demonstrates a low willingness to decrease its emissions let alone to completely wean itself off fossil fuels. In contrast, the Polish government plans the extension of coal driven activities in the country with the commissioning of new lignite fuelled power stations and the construction of two coal extraction sites in Zloczew and Silesia. The draft national energy explicitly states that coal will continue to have a key role in the country's energy mix for the next decade; Poland will produce 60% of its energy from coal. As the country seems

4.7 Eszak-Magyarorszag (HU)

Geography

Eszak-Magyarorszag (North Hungary) is one of the seven administrative (NUT2) regions of Hungary. As its name suggests, Eszak-Magyarorszag is located in the north-eastern part of the country. The region borders with Slovakia in the North and with Ukraine in the East. Eszak-Magyarorszag has a surface area of 13,433 km^2, covering 14.4% of the country's territory. Its population stands at 1.47 million inhabitants. The region is sparsely populated with 88 inhabitants per km^2, when the national average is 131 inhabitants. Administratively, Eszak-Magyarorszag is divided into 3 counties (Borsod-Abaúj-Zemplén, Heves and Nógrád) and 29 districts. The capital and main centre of economic activity is Miskolc.

Economy

Despite the rapid growth in the 2010s during which the GDP per capita in Eszak-Magyarorszag has been steadily growing by 5% annually (since 2013), Eszak-Magyarorszag remains one of the least developed regions in the country and in the EU-28. Its gross domestic product amounted to €8.8bn in 2016, corresponding to a GDP per capita in purchasing power standards (PPS) of 13,000 PPS per inhabitant (Eurostat, 2018). Eszak-Magyarorszag is the Hungarian region with the lowest GDP per capita; 21% lower than the national average (16,400 PPS). Notably, Central Hungary's (the top-ranking region in the country) GDP per capita was almost 2.5 times higher than those of Eszak-Magyarorszag. Industry and manufacturing (the chemical, engineering, automotive and electronics industries) are the main pillars of the regional economy, followed by agriculture and tourism. Tourism importance as a driver of regional growth has increased recently as the number of tourist arrivals is on the rise and new tourism facilities are deployed, owing to the outstanding natural and cultural heritage of the region. The regional economy is entirely open, and depends on the EU for over 80% of its foreign trade. Still, region's stock of foreign direct investment (FDI) is far below the national average: 4.6% of total in 2016.

The Territorial and Settlement Development Operational Programme outlines country's priorities for sustainable regional development. This is a centralised operational programme which covers the budgetary period 2014-2020 and incorporates the territorial development objectives of all regions incl. Eszak-Magyarorszag. The main priorities of the Operational Programme include: 1) economic development and job creation; 2) improvement of the framework conditions of entrepreneurship (e.g. through improvement of public services, for example health and transport services; development of settlements' infrastructure; elimination of segregation and human resources development); 3) transition to a low-carbon economy; and 4) development of cities' and settlements' identity, cohesion and satisfaction. Policy measures related to innovation-specific objectives include support to the development of industrial parks and incubators, SMEs' market-oriented innovation and to their

used in Hungary is produced indigenously (the rest is imported), though coal accounts for only 19.5% of the country's total primary energy supply.

In Hungary, there are now 2 active opencast lignite extraction sites (Visonta and Bükkábrány) with about 0.5 billion tonnes lignite reserves in total. The coal mines are operated by the energy company Opus Global. The lignite produced in the two opencast mines is supplied to the adjacent coal fired power station at Visonta for electricity production. The Mátra Power Plant, made up of five lignite-fired units and two topping gas turbines, is the second largest power plant in Hungary (and the largest one using coal as fuel), with an installed capacity of 966 MW (2 x 100 MW units, 1 x 220 MW, 2 x 232 MW, two gas turbines of 2 x 33 MW and a 16 MW solar park). The Mátra Power Plant is fully supplied with local resources and provides about 15% of the country's electricity and over 80% of the coal based electricity. The average annual production is estimated at 6,200 GW. In addition, the country hosts a series of smaller power units fuelled with coal with the "Oroszlány" Power Plant to be the largest one. The "Oroszlány" Power Plant, consists of 4 commissioned units with a total installed capacity of 240 MW. "Oroszlány" Power Plant is the second largest coal fired plant in the country, accounting for 3.7% of the total electricity generated and around 17% of the share of power generated by coal plants. Until 2014, the power plant was supplied with lignite from the associated "Márkushegy" underground mine. Following the shutdown of extraction operations in "Márkushegy", the power plant continued to operate using stockpiles from previous years, as well as lignite imported from other EU regions.

The two coal fired power plants has a combined annual capacity of 1130 MW and their average efficiency power is estimated below 30%. This rate is not a surprise as all units in Hungary were commissioned during sixties and seventies. The low efficiency rate suggests that the continued use of coal as an energy source will require the refurbishment or replacement of old, inefficient power plants, to cut down high operation costs and CO2 emissions. The "Mátra" Power Plant is licensed to produce energy by 2025 – the government plans to extend the licensing period - while "Oroszlány" is scheduled to be decommissioned by the end of 2020.

In the energy field, the national target is to increase the renewable energy share in gross final energy consumption to 14.65% by 2020. Unless further investing on the clean energy sector, Hungary may increase its dependency on imported fossil-fuels to cover its energy needs and fall behind environmental targets. Domestic gas and oil production is already peaked, and increasing the use of lignite will result in failing to achieve CO2 targets. As a result, national goals on the share of renewables need to be revised, notwithstanding that Hungary will retain nuclear power generation, approving the construction of two nuclear reactors to replace phased out generation capacity and address the need for new capacity.

of enterprises active or dependent on coal mining (15-20 large enterprises and SMEs), most of which providing supporting services and equipment. For instance, the segment of mining equipment manufacturers, which provides machinery essential for coal extraction activities might confront serious challenges to continue to grow in a sustainable way, taking into account the changes expected ahead in the coal sector. Hungary is a net exporter of mining equipment while the industry has a total annual turnover of around 300 million euros, and about 1,000 employees.

Legal framework

The national Mining Law, as introduced in 1993 and amended in 2000, lays down the conditions for the prospection, exploration, extraction and exploitation of energy and mineral resources in Hungary. The Law addresses issues related to concession procedures, security zones and protective pillars, mine plans, safety of mining; landscape rehabilitation; mine damages, right to use water, fines for environmental damage, and state supervision of mining activities.

Until April 2015, the authority responsible for mining permitting was the MBFH (under the Ministry of National Development) and its regional departments of mines. Since April 2015 regional mining authorities and several other authorities representing the various mining, environment, nature conservation, soil protection, and cultural heritage inspectorates, have merged to form "Government Offices" (20 in total including Budapest) as a one-stop-shop in charge of licensing mineral extraction processes.

For ore minerals (incl. hydrocarbons, coal, geothermal energy), the Mining Law foresees a concession tendering procedure for granting an extraction right. The Minister shall designate concession areas (in accordance with spatial plans) and then publish the call on ore minerals exploration and extraction in the Official Journal on hydrocarbons and geothermal energy. The exploration and extraction right is typically awarded to the Most Economically Advantageous Tender (MEAT) through an open public procurement process.

To acquire a mineral extraction right, the beneficiary of exploration permission, shall process with the establishment of a mining plot after the final exploration report, which presents the results of exploration activities including information on available mineral reserves, environmental status and feasibility analysis, has been approved by the mining authority. The applicant needs to submit an official request no later than 5 moths from the approval of the final evaluation report. According to the Mining Act, extraction of mineral raw materials shall only be permitted on the section of the surface and depth separated for this sole purpose (i.e. mining plot).

According to Article 27 of the Mining Act, extraction activities shall be carried out under an approved technical operation plan. This means that the candidate, in order to obtain the final permission, must prepare a detailed technical operation plan that sets out the intended mining activity, including plans

pollution in Eszak-Magyarorszag from coal can be generally characterised as low and the effects can be detected mainly within or close proximity to the mine sites and power plants in question.

Funding

The mining right holder is legally bound to cover the entire cost of restoration works in worked out mine sites, and return the land into its previous ecological state. The state has not budgeted any specific amount for land restoration in former mine sites; still social protection and environmental restitution programs can be approved on a case by case basis. For the coal mines located in Eszak-Magyarorszag, there is no approved state grant; all restoration works are to be undertaken by the mining right holder, in accordance with the approved preliminary land remediation plan and local spatial plans.

Mine reclamation companies

Currently, there are 3 environmental and construction/engineering companies in Hungary that can undertake environmental restitution and land restoration works in former mine sites. These are ENVIROTIS (https://envirotis.hu/), BÁNYAVAGYON-HASZNOSÍTÓ (http://www.bvh.hu/) and ENVECON (http://www.envecon.hu/). The following table presents the SWOT MATRIX for mine closure and reclamation companies in Hungary.

Table 10: SWOT MATRIX for mine reclamation companies in Eszak-Magyarorszag (Hungary)

STRENGTHS	**WEAKNESSES**
• Diversified land restoration and environmental services • Skilful human resources	• Lack of modern machinery/equipment • Limited experience in reclamation projects
OPPORTUNITIES	**THREATS**
• Regional decarbonisation strategy in place • Legal framework on post mining land restoration exists • Public Private Partnerships (PPPs) for land reclamation projects	• Uncertainty over the closure date of mine sites

Former land uses and uses surrounding the mine site/plants

The "Matra" power plant and the "Visonta" coal field are located in the valley of the Matra Mountains in close vicinity to the town of Gyöngyös in Heves County. The land that was cleared to make way for extraction purposes was previously covered by agricultural land and meadows, utilised by local communities for crop farming and animal husbandry. The examined sites are now surrounded with grassland, meadows, ditches, creeks, artificial mine lakes and road infrastructures while the major

Poland, Czech Republic and Bulgaria - the country's coal fired electricity production rate (15%) is among the lowest in the EU and much of this energy is imported from abroad – b) the rising costs of EU carbon prices, c) "Matra" station owners' intention to maintain the operation of the plant by converting into low carbon solutions and d) the low social pressure and political risk from losing jobs. At the UN Climate Action Summit in New York, the Hungarian President unveiled that the country is planning to wean itself from coal-fired electricity generation by 2030, in an attempt to help reduce emissions and tackle climate change. When it comes to land restoration, alternative options for post mining land use are already available in Eszak-Magyarorszag and the region appears adequately prepared to proceed with restoration programmes in former mine sites should the political will exist. Still, more efforts should be made to:

- Set forward a coordinated and integrated approach and procedures to assess possible and alternative land uses, which should not be constrained to cross sectoral collaboration of competent public administrations but involve all those actors (e.g. environmental institutions, economic operators, citizens) who retain an interest in the area and will be directly or indirectly affected by future land use(s).
- Raise public awareness on the environmental and socioeconomic benefits associated with decarbonisation and post mining land restoration.
- Devise ways to stimulate the demand for the restored land and attract investors' interest; for example through taxation.
- Increase investment capital for environmental restitution and land restoration interventions. This can be done through the formation of a dedicated fund, which will be based on the state revenues from environmental taxes imposed on coal driven (and associated) activities.

territories, the ratio between indirect and direct jobs is 1.93. This implies that for every direct job created in the coal industry, almost two additional jobs are created and preserved in the local economy in support of coal driven operations. The highest ratio between indirect and direct jobs is observed in Brandenburg (Germany) and Łódzkie (Poland) with 4.44 and 3.33 respectively.

For some DeCarb territories, the coal industry represents a major source of employment for local populations. For instance, in Western Macedonia (Greece), coal mining and power generation activities account for 6.3% of the regional employment. Remarkably, the coal industry is responsible for 45.9% of job positions in the secondary sector, without taking into account the indirect employed created by coal driven activities.

Table 11: Coal related employment in DeCarb territories

Territory	Employment in coal mines	Employment in coal fired power plants	Indirect employment	Total employment
Brandenburg (DE)	3,402	1,107	20,000	24,509
South West Oltenia (RO)	10,600	2,600	8,000	21,200
Western Macedonia (GR)	4,283	1,398	5,200	10,881
Yugoiztochen (BG)	10,773	1,885	19,558	32,216
Savinjska (SI)	1,255	311	2,500	4,066
Łódzkie (PL)	6,338	2,538	30,305	39,181
Eszak-Magyarorszag (HU)	1,655	632	5,697	7,984
Nordjylland (DK)		250	1,021	1,271
DeCarb territories	**38,306**	**10,721**	**94,781**	**143,808**

Expected impact from the shutdown of coal driven activities

The EU has embarked on an energy transition to decrease its carbon emissions by 40% below 1990 levels until 2030. This entails the decarbonisation of the EU economy, which requires a switch from fossil fuels (especially coal) to cleaner and more sustainable sources of energy such as renewables. However, this transition will not come without challenges for territories strongly dependent on coal. The shrinkage of the coal industry, as anticipated with the closure of coal fields and the decommissioning of coal fuelled power plants over the next decade, will inevitably create a shockwave for coal intensive regions, to be experienced in the form of severe losses in local employment and income. Therefore, the future of these regions should be designed on the foundations of a just transition strategy that will exploit region's competitive advantages and strengths, to diversify the economy and set forward an alternative route

geothermal and hydroelectric power. Finally, South West Oltenia (Romania) region with GDP per capita almost 20% lower than the national average and ~13200 coal (direct) related jobs at risk might experience a high increase in the number of unemployed persons, which may reach 22%. South West Oltenia (Romania) will be one of the EU regions to experience the highest job losses from the shutdown of coal driven activities in absolute numbers. Nevertheless, the region thanks to its low unemployment rate (5.48%), and the fact that the share of jobs at risk in economically active population is 1.1%, and despite the significant number of job losses, might experience a low to moderate medium social impact with the possibility to absorb the decline in employment on medium to long term.

With 9,000 direct jobs and 30,000 indirect jobs at risk, Łódzkie (Poland) will be the most affected region in absolute numbers among DeCarb territories. Notwithstanding this, Łódzkie might experience a low social impact, as it is characterised by a low unemployment rate (4%) and a highly diversified economy. The same stands for Észak-Magyarország (Hungary), which features a small number of workers in coal driven activities (2,200) and a low unemployment rate and the coal industry represents only a small share of the regional product. The positions that may face a higher risk are those in coal extraction processes as previous experience shows that the remaining coal-fuelled power stations will not permanently close but will most probably switch their input fuel to natural gas or biomass thus maintaining the previous employment status.

Environmental pollution

Coal combustion in power production plants, including lignite extraction and transportation are one of the leading causes for the emission of harmful air pollutants such as PM10, NOx and SO2 particles, with detrimental effects on human health and the environment. At a time when the EU has stepped up its efforts to phase out from coal and meet its climate change targets, coal is responsible for almost 15% of total EU emissions (Agora Energiewende and Sandbag 2018).

In 2016, coal driven activities in DeCarb partnership countries generated 540.7 million tonnes of GHG emissions. This volume ranges from 265.6 million tonnes in Germany and 129.3 million tonnes in Poland to 6.8 million tonnes in Hungary and Denmark. In DeCarb territories, coal combustion accounts on average for 24.5% of total GHG emissions generated at country level. The highest shares are observed in Bulgaria (44%), Poland (36%), Greece (31%) and Germany (29%).

It is well known that coal is a high polluting industry; however the situation is exacerbated in DeCarb territories from the fact that the vast majority of active coal fuelled power plants have been commissioned over thirty years ago and most of them have not undergone the necessary retrofitting and technology upgrading to meet the new EU standards in accordance with the Industrial Emissions Directive. For instance, in Western Macedonia (Greece), air pollutants caused by Thermal Power Plants exceed the European limit values by more than 20%.

as they share substantial wind resource availability because of high altitudes and strong wind speeds. DeCarb territories can also benefit from high temperatures geothermal resources in mine sites (especially Western Macedonia and Brandenburg) and abundant water resources (where relevant, especially South West Oltenia) to engage in geothermal and hydro power production. Successful examples of mine site redevelopment for solar and wind energy generation can be retrieved from Brandenburg (Germany) and Észak-Magyarország (Hungary).

Tourism and recreation uses exhibit also attractive growth potential in most DeCarb territories, which can be further unleashed by utilising the natural wealth and industrial heritage of mining sites and surrounding areas. In particular, DeCarb territories are characterised by rich diversity of natural features that include protected areas, natural parks, mountains, caves, non-polluted rural areas, mineral waters and spas. Therefore, land restoration and revitalisation programmes need to include targeted interventions to enhance environmental quality in former mine sites, valorise natural heritage assets therein (e.g. man-made lakes, green areas) and provide for attractive leisure opportunities. New sustainable growth opportunities can emerge in cultural, therapeutic, religious and eco-tourism. The territories that are better suited to investing in tourism are Brandenburg (Germany), South-West Oltenia (Romania), Savinjska (Slovenia) and Łódzkie (Poland).

Agriculture is traditionally one of the main pillars of rural economies, and as such can re-position itself as a key economic driver for DeCarb territories in the new post coal economic reality. Cultivated area already accounts for a considerable portion in the examined territories, and further area available for farming can be made available after the closure of mine sites. The territories that demonstrate the higher potential for agricultural development thanks to favourable climate conditions and unique natural ingredients are South-West Oltenia, Western Macedonia, Yugoiztochen and Savinjska.

Table 13: Development potential in DeCarb territories

	Solar Energy Development	Wind Energy Development	Hydropower Development	Geothermal Energy Development	Agriculture	Tourism
Brandenburg	Medium	High	Low	Medium	Low	High
South West Oltenia	High	Low	High	Medium	High	High
Western Macedonia	High	Low	Low	High	High	Medium
Yugoiztochen	High	Low	Low	Medium	Medium	Medium
Savinjska	High	Low	Low	High	High	High
Łódzkie	Low	High	Low	Medium	Medium	High
Eszak-Magyarorszag	Medium	Low	Low	Medium	High	Low

coal period, with particular emphasis on alternative, sustainable routes for regional economies. To date, only Germany, Denmark, Spain have coal phase out plans.

When it comes to the legal framework for land restoration in mine sites, all DeCarb countries have in place legal acts that define mine operators' obligations on mine reclamation and environmental restitution in worked out sites. Notably, mine operators need to have in place mine closure and recovery plans prior to the commencement of extraction activities; further to this it is mandatory to provide a financial guarantee, to ensure that all obligations in the environmental permit are financially secured and funds are available at any time for the rehabilitation of the site contaminated. While in all countries mine operators are legally bound to fund with own capitals the restoration works prescribed in the mine closure operation plans, a series of countries such as Germany have decided to allocate a respectable amount for post mining land restoration interventions in coal intensive regions. These funds are mostly directed to the rehabilitation of decommissioned/abandoned mines and social recovery programs (e.g. for re-skilling of coal workers).

This section present with the common needs among DeCarb territories towards the efficient environmental restitution and post mining land restoration. All DeCarb territories are in a dire need to:

- Enhance the legal framework governing mining operations with stricter legal provisions concerning mine operators' liabilities for managing the consequences on the natural environment such as the long-term depletion of aquifers, the permanent loss of natural soil fertility even after completed renaturation, and the usability of water bodies, as well as the associated burden on the people living in the mining regions.
- Set forward a coordinated and integrated approach and procedures to assess possible and alternative land uses, which should not be constrained to cross sectoral collaboration of competent public administrations but involve all those actors (e.g. environmental institutions, economic operators, citizens) who retain an interest in the area and will be directly or indirectly affected by future land use(s). Furthermore, policy making, planning and decision making on post mining environmental restitution and land restoration should be coordinated across different disciplines (horizontal integration) and between different levels of government (vertical integration).
- Raise public awareness on the environmental and socioeconomic benefits associated with decarbonisation and post mining land restoration.
- Devise ways to stimulate the demand for the restored land and attract investors' interest; for example through taxation.
- Increase investment capital for environmental restitution and land restoration interventions. This can be done through the formation of a dedicated fund, which will be based on the state revenues from environmental taxes imposed on coal driven (and associated) activities.

European Commission (2018). Coal Regions in Transition. Retrieved from https://ec.europa.eu/energy/en/topics/oil-gas-and-coal/coal-and-other-solid-fuels

Eurostat (2019). Shedding light on energy in the EU - A guided tour of energy statistics — 2019 edition.

Eurostat (2016). Fossil fuels. Retrieved from https://ec.europa.eu/eurostat/web/main/home

Food and Agriculture Organisation of the United Nations (2015). Forest and Landscape Restoration, Unasylva 245, Vol. 66, ISSN 0041-6436.

Food and Agriculture Organisation of the United States - FAO (2018). Soil degradation. Retrieved from http://www.fao.org/soils-portal/soil-degradation-restoration/en/

Frasher Institute (2018, July 24). Mining. Retrieved from https://www.fraserinstitute.org/categories/mining

German Federal Ministry for Economic Affairs and Energy (2018). Coal. Retrieved from https://www.bmwi.de/Redaktion/EN/Artikel/Energy/coal.html

Hayes, J. (2015). Returning Mined Land to Productivity through Reclamation. Cornerstone: The Official Journal of the World Coal Industry, Vol. 3, Issue 4.

Hayes, J. (2015, December 30). Returning Mined Land to Productivity through Reclamation. Retrieved from https://www.worldcoal.org/returning-mined-land-productivity-through-reclamation

IUCN and WRI (2014). A guide to the Restoration Opportunities Assessment Methodology (ROAM): Assessing forest landscape restoration opportunities at the national or sub-national level. Working Paper (Road-test edition). Gland, Switzerland: IUCN. 125pp.

Za Zemiata (2018). Just Transitionn Bulgaria -Mission possible for Maritsa Iztok energy complex? A preliminary Analysis.November 2018. Available at: https://bankwatch.org/wp-content/uploads/2018/11/Maritsa-Iztok.pdf

Kazmierczak, U., Lorenc, M. and Strzałkowsk, P. (2017), "The analysis of the existing terminology related to a post-mining land use: a proposal for new classification", Environmental Earth Sciences (2017) 76:693.

Kivinen, S. (2017). Sustainable Post-Mining Land Use: Are Closed Metal Mines Abandoned or Re-Used Space? MDPI – Sustainability 2017, 9(10).

7 ANNEX A: SELF-ASSESSMENT FORMS

Southwest Oltenia (RO)

Theme	Feature	Factor	Status
Motivation	Benefits	- Perception that land restoration creates economic benefits	
		- Perception that land restoration creates societal benefits	
		- Perception that land restoration creates environmental benefits	
		- Perception that land restoration provides opportunities for sustainable development	
	Awareness	- Green economy awareness among companies	
		- Public awareness on green economy and its potential benefits	
		- The benefits associated with decarbonisation are widely known	
		- Opportunities for restoration are identified	
	Legal requirements	- Legal framework on post mining land restoration exists	
		- Law regulating active coal mines and requiring land restoration exists	
		- Restoration regulations are widely enforced	
Enabling conditions	Environmental conditions	- The extent of environmental degradation makes land restoration feasible	
		- Plants and animals that can impede restoration are absent	
		- Native flora and fauna are readily available	
	Market conditions	- There is increasing demand/interest for the degraded land	
		- Market reforms to make smooth the transition to a post coal era are being implemented	
		- Green market segmentation is developing	
	Social conditions	- Local community can benefit from restoration opportunities	
		- Local community participates in decision making concerning restoration	
	Institutional conditions	- Integrated planning for land restoration exists	
		- Roles and responsibilities are clearly defined	
		- Effective cross-department coordination is in place	
Capacity and resources	Leadership	- Political commitment towards decarbonisation exists	
		- Transition plan to a post coal era exists	
	Knowledge	- Geospatial data is available	
		- Restoration know-how exists	
		- Collaboration schemes with environmental agencies and knowledge institutes are in place	
		- Collaboration schemes between mining companies and conservation bodies are in place	
	Finance	- Incentives to shut down coal driven activities are provided	
		- Investment capital for restoration interventions is readily available	

Brandenburg (DE)

Theme	Feature	Factor	Status
Motivation	Benefits	- Perception that land restoration creates economic benefits	
		- Perception that land restoration creates societal benefits	
		- Perception that land restoration creates environmental benefits	
		- Perception that land restoration provides opportunities for sustainable development	
	Awareness	- Green economy awareness among companies	
		- Public awareness on green economy and its potential benefits	
		- The benefits associated with decarbonisation are widely known	
		- Opportunities for restoration are identified	
	Legal requirements	- Legal framework on post mining land restoration exists	
		- Law regulating active coal mines and requiring land restoration exists	
		- Restoration regulations are widely enforced	
Enabling conditions	Environmental conditions	- The extent of environmental degradation makes land restoration feasible	
		- Plants and animals that can impede restoration are absent	
		- Native flora and fauna are readily available	
	Market conditions	- There is increasing demand/interest for the degraded land	
		- Market reforms to make smooth the transition to a post coal era are being implemented	
		- Green market segmentation is developing	
	Social conditions	- Local community can benefit from restoration opportunities	
		- Local community participates in decision making concerning restoration	
	Institutional conditions	- Integrated planning for land restoration exists	
		- Roles and responsibilities are clearly defined	
		- Effective cross-department coordination is in place	
Capacity and resources	Leadership	- Political commitment towards decarbonisation exists	
		- Transition plan to a post coal era exists	
	Knowledge	- Geospatial data is available	
		- Restoration know-how exists	
		- Collaboration schemes with environmental agencies and knowledge institutes are in place	
		- Collaboration schemes between mining companies and conservation bodies are in place	
	Finance	- Incentives to shut down coal driven activities are provided	
		- Investment capital for restoration interventions is readily available	

Western Macedonia (EL)

Theme	Feature	Factor	Status
Motivation	Benefits	- Perception that land restoration creates economic benefits	
		- Perception that land restoration creates societal benefits	
		- Perception that land restoration creates environmental benefits	
		- Perception that land restoration provides opportunities for sustainable development	
	Awareness	- Green economy awareness among companies	
		- Public awareness on green economy and its potential benefits	
		- The benefits associated with decarbonisation are widely known	
		- Opportunities for restoration are identified	
	Legal requirements	- Legal framework on post mining land restoration exists	
		- Law regulating active coal mines and requiring land restoration exists	
		- Restoration regulations are widely enforced	
Enabling conditions	Environmental conditions	- The extent of environmental degradation makes land restoration feasible	
		- Plants and animals that can impede restoration are absent	
		- Native flora and fauna are readily available	
	Market conditions	- There is increasing demand/interest for the degraded land	
		- Market reforms to make smooth the transition to a post coal era are being implemented	
		- Green market segmentation is developing	
	Social conditions	- Local community can benefit from restoration opportunities	
		- Local community participates in decision making concerning restoration	
	Institutional conditions	- Integrated planning for land restoration exists	
		- Roles and responsibilities are clearly defined	
		- Effective cross-department coordination is in place	
Capacity and resources	Leadership	- Political commitment towards decarbonisation exists	
		- Transition plan to a post coal era exists	
	Knowledge	- Geospatial data is available	
		- Restoration know-how exists	
		- Collaboration schemes with environmental agencies and knowledge institutes are in place	
		- Collaboration schemes between mining companies and conservation bodies are in place	
	Finance	- Incentives to shut down coal driven activities are provided	
		- Investment capital for restoration interventions is readily available	

Łódzkie (PL)

Theme	Feature	Factor	Status
Motivation	Benefits	- Perception that land restoration creates economic benefits	
		- Perception that land restoration creates societal benefits	
		- Perception that land restoration creates environmental benefits	
		- Perception that land restoration provides opportunities for sustainable development	
	Awareness	- Green economy awareness among companies	
		- Public awareness on green economy and its potential benefits	
		- The benefits associated with decarbonisation are widely known	
		- Opportunities for restoration are identified	
	Legal requirements	- Legal framework on post-mining land restoration exists	
		- Law regulating active coal mines and requiring land restoration exists	
		- Restoration regulations are widely enforced	
Enabling conditions	Environmental conditions	- The extent of environmental degradation makes land restoration feasible	
		- Plants and animals that can impede restoration are absent	
		- Native flora and fauna are readily available	
	Market conditions	- There is increasing demand/interest for the degraded land	
		- Market reforms to make smooth the transition to a post coal era are being implemented	
		- Green market segmentation is developing	
	Social conditions	- Local community can benefit from restoration opportunities	
		- Local community participates in decision making concerning restoration	
	Institutional conditions	- Integrated planning for land restoration exists	
		- Roles and responsibilities are clearly defined	
		- Effective cross-department coordination is in place	
Capacity and resources	Leadership	- Political commitment towards decarbonisation exists	
		- Transition plan to a post coal era exists	
	Knowledge	- Geospatial data is available	
		- Restoration know-how exists	
		- Collaboration schemes with environmental agencies and knowledge institutes are in place	
		- Collaboration schemes between mining companies and conservation bodies are in place	
	Finance	- Incentives to shut down coal driven activities are provided	
		- Investment capital for restoration interventions is readily available	