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SMART STRATEGIES FOR THE TRANSITION IN COAL INTENSIVE REGIONS

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ABSTRACT: The TRACER project supports a number of coal-intensive regions around Europe to design (or re-design) their Research and Innovation (R&I) strategies in order to facilitate their transition towards a sustainable energy system. The TRACER consortium consists of different target regions: South East Bulgaria, North West Bohemia - Czech Republic, Lusatian Lignite District - Germany, Western Macedonia - Greece, Upper Silesian Coalfield - Poland, West Region, Jiu Valley - Romania, Wales – UK, Kolubara - Serbia, Donetsk - Ukraine. Core activities of TRACER include the implementation of an EDP (Entrepreneurial Discovery Process) to mobilise a wide range of stakeholders in each target region to develop an appropriate governance structure and to bring regional stakeholders together to discuss and agree on a shared vision and priorities for coal transition. R&I strategies, industrial roadmaps and decision support tools will be developed jointly with key stakeholders of the TRACER target regions. Further TRACER activities include the identification and analysis of best practice examples of successful and ambitious transition processes in coal intensive regions, a detailed assessment of social, environmental and technological challenges, the elaboration of guidelines on how to mobilise investment as well as dedicated activities to stimulate R&I cooperation among coal intensive regions in Europe and beyond.

Keywords: energy transition, coal intensive regions, R&I strategies, industrial roadmaps, entrepreneurial discovery process, social challenges, re-skilling needs, SET Plan, mobilising investment.

1 INTRODUCTION

The EU has set itself a long-term goal of reducing greenhouse gas emissions by 80-95% compared to 1990 levels by 2050. In view of these objectives, the Member States are in a disadvantageous position due to the current state of the technologies used and the available local energy resources, so these specificities must be taken into account when planning and implementing the national and/or regional energy strategies.

Currently, 41 regions in 12 EU Member States are actively mining coal. This provides direct employment to about 185,000 people across the EU, with additional indirect jobs relying on coal production. However, the EU's decision to move to emission-free technology is not subject to discussion and it is therefore necessary to take into account the difficulties of these regions, to anticipate and propose the energy policy that is in line with the tasks. These regions need an effective roadmap to make the necessary transition to a more diversified economic base and a more sustainable energy system, while safeguarding the social cohesion for communities and regions dependent on coal production. At the same time, the production and consumption of coal in the EU has been in steady decline over the past few decades, partly due to relatively high extraction costs, which have turned Europe's coal industry less competitive, but also due to the commitment by a number of Member States to phase out coal use for power generation.

In a changing world, the EU needs to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States to deliver high levels of employment, productivity and social cohesion.

2 THE TRACER PROJECT

The overall objective of TRACER is to support a number of coal-intensive regions around Europe to design (or re-design) their Research and Innovation (R&I) strategies in order to facilitate their transition towards a sustainable energy system. Nine (9) European regions are involved in this procedure, 6 of them in EU Members States (Bulgaria, Czech Republic, Germany, Greece, Poland, Romania), and 3 in countries outside the EU (UK, Serbia and Ukraine).

For this purpose, regional policy makers and other key stakeholders will be assisted by the TRACER partners through the provision of information, expertise and advice, as well as by decision support tools, concrete Roadmaps and blueprints on the energy transition paths in their regions that will be developed in the framework of TRACER.

In order to achieve this a number of activities will be implemented. In the first year of the project an investigation of the current status in the target regions and the analysis of the best practices were made. This includes an analysis of renewable energy technologies and the extent of their application in partner countries,

the identification of best practices on social issues and tourism as well as the exploration of best practices of smart specialisation strategies and on financing.

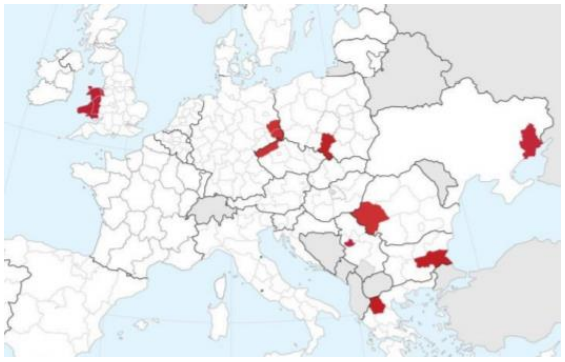

Figure 1: TRACER target regions (in red)

TRACER project is based on the cooperative approach. One of the important actions of the project will be the establishment of close collaboration with other sections of Horizon 2020 and other EC funded programs, as well as the R&I Cooperation in the framework of the Implementation Plans jointly developed by European countries, as part of the EU's SET Plan and with the EU Coal Regions in Transition Platform.

3 TRACER TARGET REGIONS

The Smart Specialisation Strategy approach (S3) is based on research that suggests that innovation depends on cooperation, which can allow underused knowledge and innovation capacities to be identified and used more effectively. The S3 approach is therefore based on an inclusive process of stakeholder involvement centred on an "entrepreneurial discovery" process (EDP).

The implementation of an Entrepreneurial Discovery Process (EDP) to mobilise a wide range of stakeholders and key actors in each target region is a core activity within TRACER. Structures and mechanisms will be put in place to ensure that permanent regional stakeholder groups will maintain momentum after the end of the project and ensure the integration of TRACER target regions in the EU Coal Regions in Transition Platform.

3.1 Southeast Bulgaria (BG34)

The target region in Bulgaria is the Southeast region, where Maritsa East is located. Maritsa East is the largest energy complex in Bulgaria, built on a site with significant lignite deposits.

The Southeast region covers a total area of 19,799 km^2 and, as of the end of 2016, the population of the region was estimated to 1,046,125 people. The Maritsa East complex consists of three open mines and four thermal power plants (TPPs) with a total capacity of 4,414 MW. The complex is located on the territory of four regions – Stara Zagora, Haskovo, Yambol and Sliven, covering an area of 240 km^2.

The employees of Maritsa East coal mines encompass 7,250 engineers, technicians, workers and administrative staff. The personnel of the power plants burning coal from Maritsa East mines amounts to about 3,900. There are several times more engaged workers in the activities connected with coal industry. The power generation from the four TPPs varies from 14,000 to 16,500 GWh, which is about 42% of the domestic gross electricity consumption.

3.2 North West Bohemia (CZ04)

The target region in the Czech Republic is North West Bohemia (covering an area of 8,649 km² and 1,120,654 inhabitants) which includes all active lignite mining in the country, located in two mining districts – North Bohemia and Sokolov coal mining districts. The total area affected by mining of coal is about 270 km^2. There are three active mining companies in North Bohemia coal mining district: Severní energetická a.s.a Vršanská uhelná, a.s., and Severočeské doly, a.s. Chomutov. Severní energetická a.s. operates one surface mine Československé armády and one subsurface mine Centrum, Vršanská uhelná a.s. operate mines Vršany and Ŝverma. Severočeské doly, a.s. Chomutov, operate mines Bílina a Libouš / Doly Nástup Tušimice. In Sokolov mining district there is one active mining companySokolovská uhelná právní nástupce, a.s. operating one surface mine Jiri.

The overall production of lignite of 38.2 million tons (2014) is used mainly to produce electricity and heat, in total 35.9 TWh of electricity and 53 PJ of heat. Major producers are 9 units of the CEZ group, three units owned by mining companies and a large number of smaller units of various producers which often combine production of heat and power.

3.3 Lusatia region, Brandenburg (DE40) and Dresden (DED2), Germany

The target region in the case of Germany is the Lusatian Lignite District within the Federal States of Brandenburg and Saxony (NUTS-2 structures), from which 1/3 of the total German lignite production (180 million tons) is derived. Up to now the total devasted area comprises approximately 900 km² - which is half of the nationwide claimed area, while about 550 km² (61%) of the removed landscape are already reclaimed successfully, with 10,000 ha agricultural land and 30,000 ha afforested.

Lusatia is the second largest lignite region in Germany. The average annual lignite production from the operating open-cast mines Welzow Süd, Nochten, Reichwalde and Jänschwalde is about 60 million tons, feeding the power plants Jänschwalde, Boxberg and Schwarze Pumpe with an installed capacity of 6.7 GW. The net electricity generation amounts to 50 billion kWh. In addition, there are 1.9 million tons processed products: pulverised lignite, briquettes and fluidised-bed lignite. Although the industrial base is quite diversified, it is a rather structurally weak region. It is still suffering from the wide-ranging transition process of the early 1990s, starting with the closure of most under market conditions unprofitable opencast mines and upgrading facilities, accompanied by the loss of about 70,000 jobs within one decade. However, the actual economic data show a promising trend. The Lusatian Lignite District appears rather dynamic and quite favourable: since 2004 the nominal economic performance in the region has increased by 55%.

3.4 Western Macedonia (EL53), Greece

The target region in Greece is the Western Macedonia Region (WMR), in which the most important lignite reserves in Greece (with an estimated deposit of 1.8 billion tons) are located. WMR is located in the Northwest part of Greece and covers an area of 9,451

km², while the population of the area was estimated at 278,706 in 2014. In 2010, lignite production at the West Macedonia Lignite Centre (WMLC) amounted to 43.3 million tons, mostly mined by the Public Power Corporation (PPC). The few privately operated mines in the Florina area in WMR produced a total of 2.8 million tons of lignite. It is further important to mention that, until June 2010, 18 lignite units of total capacity of 4,438 MW operated in 6 Steam Power Plants of PPC in the region. In the meantime, some of these units were shut down, while one 'new' unit is planned (by PPC) to start operation in the area soon. Lignite capacity is expected to decrease by 3,495 MW between 2014 and 2030. It is obvious that the impacts of such developments on the economy of Western Macedonia will be enormous, as for example the personnel employed by PPC in WMR were 5,522 employees (2014), 4,199 out of which were permanently employed. It is estimated that PPC creates around 45.9% of the direct job opportunities in the secondary sector or 6.3% of all the jobs in WMR, without taking into account the indirect employment created.

3.5 Upper Silesia coal field (PL22), Poland

The target region for Poland is the largest industrial district in the country, i.e. the Upper Silesia Coalfield (GOP), with 19 mines operating at the moment. Up to 30% of the deposit is explored by recent mining operations. The reserve deposits cover 23% and the perspective areas cover about 27% of the whole area. At the moment over 80% of coal deposits in Poland occur in this area.

Approximately half of Polish electricity production, 79.9 TWh (48.4%), is generated at coal-fired power plants. The coalfield, which has an area of 5,800 km² (the Polish part, as there is another part of it in the Czech Republic), being the most important coal basin of Poland and also one of the largest in Europe belongs to the Silesian region - the most densely populated region in Poland. Within the area of 12,300 km² there are 4.5 million inhabitants.

Traditionally, Upper Silesia has been a mining region, however the importance of this branch of industry is now on the decline. Mines are being closed down in the most densely populated areas (Katowice).

3.6 Jiu Valley / West region (RO42), Romania

The target region in Romania is the West region including four counties: Timiș, Arad, Caraș-Severin and Hunedoara. Jiu Valley – the hard coal intensive area is located in Hunedoara County. Jiu Valley, also called the Petroșani coalfield, is the gateway to Retezat National Park, being surrounded by Parâng and Retezat Mountains and crossed by the Jiu River. The total surface of the West region is 32,034 km² of which Jiu Valley represents 3% and its population is 2,016,294 inhabitants with 7% in Jiu Valley (2016 data). Hard coal exploitation started there in 1840.

In 1994, 15 hard coal mining perimeters were located in Petrosani basin, exploitation being carried out in 2012 only in 7 perimeters. Hard coal production in 2015 was 1.3 million tons with a decreasing trend in 2016 (1.07 million tons), 2017 (0.784 million tons) and 2018 (0.538 million tons). In Hunedoara Energy Complex (CEH) one TPP (thermal power plant) and one CHPP (Combined Heat and Power Plant) are both running on hard coal, with total installed capacity of 1,225 MW. The employees in CEH Mining Division were 3,479 in 2018 (compared with 5,853 in 2015 and about 55,000 employees in 1989), while the expected closure of mining perimeters and the mono-industrial specificity of Jiu Valley area will generate a "domino" effect in terms of unemployment, social vulnerability and depopulation, decrease in population incomes, and quality of life.

3.7 Kolubara region (RS11 and RS21), Serbia

The target region in Serbia is chosen to be the Kolubara coal mining and power generation region. Located in the central part of Serbia, south from the Sava River, the largest area of the region is within the administrative borders of Belgrade. The coal reserves amount to 2.2 billion tonnes of lignite with an average annual production of 22.6 million tons. The coal is mined there from the end of 19th century, but the turning point in production came in the middle of 20th century with the opening of the first open pit, which started mass surface mining of lignite.

Today, Kolubara mining basin is the largest coal supplier for Electric Power Industry of Serbia (EPS) and plays a vital role in the country's energy independence. About 20 billion kWh of electricity per year (more than a half of the total electricity generated in the country) are generated in four thermal power plants (14 generating units) with total installed capacity of 3.3 GWel, all based on the lignite from Kolubara basin. It is worth mentioning that the Kolubara basin is also the largest employer in the country (most of the 36,500 jobs in EPS are there). The total area of the Kolubara mining region is 2,474 km² and the total population 214,951 (2018 census).

3.8 Donetsk region, Ukraine

The Donetsk region is designated as the 'target region' in Ukraine for TRACER, in which 20 coal mines (15 of which are state-owned) are located. Donetsk region is located in the south-east of Ukraine. Its area is 26,517 km². Coal reserves in the Donetsk region (Central Donetsk Coal Basin) amount to approx. 25 billion tons, and coal production in 2017 was at the level of 11.4 million tons (data from the territory which is under the government control). Coal in the Donetsk region was mined starting from the end of the 19th century. The main places of coal mining are located in the Donetsk ridge (central part of the Donetsk region). An ample part of the mines has been closed, but there remains the problem of 'mine waters', which, to keep up the infrastructure, need to be pumped out, even after the closure of mines. The coal extracted in the Donetsk region is used by the power and metallurgical industry.

At the territory of Donetsk region controlled by Ukraine, there are 4 thermal power stations and one CHP plant, which in 2017 produced about 12 billion kWh (which is almost 25% of the total output of the Ukrainian thermal power plants).

3.9 Wales (UKL1, UKL2), United Kingdom

The target region in the UK is the region of Wales (with two NUTS-2 structures, namely West Wales and the Valleys (UKL1) & East Wales (UKL2). Wales has a long history in coal-mining, but has largely transitioned to other sectors. Wales has significant experience since the 1970s with the reclamation of coal-mining/industrial land, and with the socio-economic regeneration of coal-mining and other industrial communities. Significant public funding, including that from the EU Structural

Funds, has been invested in transport infrastructure, business support, and human and knowledge capital. Wales was one of the first European regions to engage with what is now known as the Smart Specialisation Strategy approach in the early/mid-1990s.

Welsh Government is putting over €100 million into Tech Valleys – a plan to bring high-tech industry to a former coal area. It is funding a wide range of energy technology projects in the region's universities, as well as focused investments in marine energy, mine water heat storage and a planned rail test centre on an old coal mine.

In 2016, 43% of the country's electricity consumption came from RES. Wales has a target to generate 70% of its electricity consumption from RES by 2030 and is investing heavily in world-class R&I in a variety of fields that are relevant to the SET plan.

4 PROJECT RESULTS

The TRACER project is running since April 2019 and the first results are already available. This chapter summarises the most important outputs reached so far.

4.1 Current role of coal mining in the target regions, national and regional policies

One of the first outcomes of the TRACER project is a detailed report on the current situation and policy intentions in 9 European coal-intensive regions facing the challenge of transition towards low-carbon economy.

Coal mining and coal utilization play a very different role across regions. The volumes in the Polish and German regions are the largest, while the ones in the Romanian and UK regions – the lowest.

In most regions, the coal-related businesses take a serious share of the employment and gross value added (GVA), especially in the Bulgarian, Greek, and Serbian regions. In many regions, however, both the sectoral employment and GVA are going down. The most striking examples are Germany and Romania, where the jobs in coal mining decreased 10 times for one or two decades. The reduction is attributed to both the diminishing coal production and utilization, on one hand, and increasing mechanization and rationalization, on the other hand.

In the majority of the countries, the coal regions are more developed than the country average in terms of economic indicators and infrastructure.

Coal mining and burning cause serious environmental and health problems in all regions. In most cases, however, a positive trend is observed, either due to the reduction of coal activities, or due to the introduction of advanced pollution control technologies. Despite that general trend, the land damaged by coal mining increases in some regions, due to untimely recovery.

All target countries, except for Ukraine, are obliged to contribute to the 2030 and 2050 EU targets for emission reduction, renewable energy, and energy efficiency and these obligations are currently part of the national energy strategies and / or National Energy and Climate Plans.

The nine countries have different visions and priorities regarding coal sector, only some of which are in line with their "green" declarations and commitments. Wales has closed the last remaining coal-fired power station in 2020. Germany, Romania, Greece, and the Czech Republic have committed to substantially reduce and / or eliminate coal mining and use, although coal will continue to play an important role in the next two decades. Germany, Romania, and Greece have already significantly decreased their coal volumes. Germany decided to phase-out coal until 2038. Romania plans to reduce its use so that by 2030 only 20.5% of its electricity originates from coal. Greece intends to phase out all lignite power generation by 2028, and the Czech Republic to decommission the old coal-fired plants until 2025 and after that to continue the decrease of coal use until 2040.

In Bulgaria, Poland, Serbia, and Ukraine, on the other hand, coal mining and utilization remains a priority in the long term. In Bulgaria lignite mining and utilization is planned to continue at least until 2050, although the quantities decrease over time. In Poland, in 2030, 60% of the electricity is expected to come from coal and there are no plans for its role after 2030. In Serbia and Ukraine, the indigenous coal resources will continue to be a pillar of the electricity system in the next decades.

In relation to their future intentions about coal, some countries are much more advanced in planning the regional transition towards carbon-free economy - improvement of the local environment, re-skilling of the workforce, stimulation of new start-ups, etc. For example, in Wales and Germany there is much clarity about what needs to be done, based on their past experience (lessons learned) and long-standing discussions. On the other hand, in Bulgaria, Serbia, and Ukraine no concrete plans to ensure sustainable transition have been reported.

Most countries have indicated potential public financial sources to support some aspects of the regional transition, but the financing is still not arranged.

4.2 Best practice examples

The goal of the energy transition is to shift the central, coal-based heat and power production towards decentralised, renewable energy production. Therefore, new technologies and transition strategies need to be implemented.

Decentralised means that the implementation is not only focused on the former coal intensive region, it is especially focused on the whole country. It is important to setup strategies on national and regional level to support that renewable energy production pathway.

One of the most important goals reached in the first year of the project implementation was the identification and analysis of best practice examples of successful and ambitious transition processes in coal intensive regions.

These best practice processes serve as a guideline for the TRACER's target regions. They will provide input to the other work packages, as the analysis will be carried out with a broad viewpoint. The following best practice reports were elaborated:

- Best practice technologies, industrial roadmaps and transition strategies for transition from coal towards new technologies
- Best practice R&I strategies for smart specialisation and SET plan implementation actions
- Best practices regarding financing
- Best practices regarding labour markets, social issues and tourism
- Best practices regarding post-mining land reclamation and environmental protection

The collected best practice examples will be presented to the TRACER target regions during stakeholder mobilisation actions. The best practice reports are published on the project homepage, as well as on a user-friendly best practice platform https://tracer-

h2020.eu/best-practice-platform/.

4.3 Guideline on available European funds and programmes for low carbon energy projects in coal intensive regions

Another important outcome of the TRACER project within the first year of the project implementation was the elaboration of the guideline on available European funds, describing EU funding opportunities, such as the European Fund for Strategic Investments (EFSI), Cohesion Policy funds, Horizon 2020 (Horizon Europe), national public and private co-financing. The guideline is adapted to each target region separately. The guideline is available in English and in national languages.

The main financing opportunities are as follows:

- National and regional Operational Programmes
- National funds (available not in all target countries)
- Horizon Europe
- European Economic Area Grants and Norway Grants
- European Investment Bank
- Interreg Danube Transnational Programme
- Just Transition Fund
- Modernisation Fund

4.4 Environmental impacts and sustainable reclamation solutions

As the nine TRACER target regions show the environmental impact of coal mining is quite serious and over the long-term. Therefore, the ecological problems are site/regional specific. However, there are similar challenges across regional and country boundaries, e.g. the restoration of soil functions on dumped raw soils, the wastewater cleaning or to ensure an adequate post-mining land stability.

There is a good agreement within the TRACER consortium that a suitable and effective postmining land use is crucial for the acceptance of mining in the societal discourse. Post-mining conditions should provide ecosystem services and produce lands capable of supporting the future needs. Nevertheless, in many regions an overall publicly discussed guiding principle (landscape vision) for the long-term development of post-mining landscapes beyond the implementation of technical and biological land reclamation is missing.

There are some sounding examples for sustainable reclamation strategies and post-mining landscaping. However, in most cases there are no ecological criteria to define and evaluate the restoration success as intended in mine closure planning. In addition, long-term investigations on ecosystem development are lacking.

In each of the regions there is practical knowledge in agricultural and forest reclamation with some recommendations on promising plants and/or cropping systems, although at a different level - with or without scientific support. However, the practical experience with energy cropping, special crops or other renewables on reclaimed land is very low, with only few promising examples, especially regarding SRC with poplar and black locust, although the processing chains are underdeveloped.

In some regions post-mining landscapes are already activated for wind energy and solar power. The cropping potential of mine sites depends on a proper land preparation and is often underestimated. Therefore, the exploitation of biomass resources from reclaimed is low and insufficient - effective post-mining management plans and recommendations on land use considering the very special site conditions are missing.

In many regions the reclamation and cropping experiences are poor. The major focus lies on revegetation/greening and early plant growth. However, from the ecological point of view restoring biological systems is a long-range process taking several decades. It remains unclear whether the applied reclamation solutions are sustainable in the long term.

Unfortunately, in most cases the later land users are not involved into practical reclamation. Basic failures in land reclamation - like the dumping of unfertile spoil materials, an insufficient amelioration or not site-adapted choice of tree species – are difficult to rectify afterwards.

The course of reclamation is determined already with substrate dumping and land preparation and the choice of site-adapted land use forms. Even more it is important to make use of the regional cropping experience to ensure a sustainable land management.

5 CONCLUSIONS

In the coming 2 years, the TRACER will work on a key challenge to mobilise a wide range of stakeholders in 9 coal regions across Europe and prepare the R&I strategies. Active involvement of the different stakeholder groups will be implemented by a large set of soft support measures, such as guidelines, specific reports, working group meetings, matchmaking meetings, workshops etc.

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