

Smart strategies for the transition in coal intensive regions

Project No: 836819



***Decision Support Toolkit
on substituting coal-fired generation
with clean energy***

WP 6 – Task 6.4 / D6.6

August 2022



Authors: Djordjina Milovanović, Energoprojekt Entel, Serbia
Jasmina Mandić Lukić, Energoprojekt Entel, Serbia
Danila Srančević, Energoprojekt – Entel, Serbia
Angel Nikolaev, Black Sea Energy Research Centre, Bulgaria
Georgia Veziryianni, Centre for Renewable Energy Sources and Saving, Greece
Eftychia Mavrou, Centre for Renewable Energy Sources and Saving, Greece
Bianca Lepădatu, ISPE – PC, Romania
Gloria Popescu, ISPE – PC, Romania
Marian Dobrin, ISPE – PC, Romania
Sabina Irimie, AISVJ, Romania
Rona Michie, European Policies Research Centre (EPRC), University of Strathclyde, United Kingdom
Liliana Fonseca, European Policies Research Centre (EPRC), University of Strathclyde, United Kingdom

Editors: Charalampos Malamatenios, Centre for Renewable Energy Sources and Saving, Greece
Rita Mergner, WIP Renewable Energy, Germany
Rainer Janssen, WIP Renewable Energy, Germany

Contact: ISPE Proiectare si Consultanta
Marian Dobrin
Email: marian.dobrin@ispe.ro
Tel: +40 (0)724 211 230
1-3 Lacul Tei Blvd.
020371 Bucuresti, Romania
www.ispe.ro



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 836819. The sole responsibility for the content of this report lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the INEA nor the European Commission are responsible for any use that may be made of the information contained therein.

TRACER website: www.tracer-h2020.eu

Contents

<i>Executive summary</i>	<i>4</i>
<i>1. 5 Ws and 1 H</i>	<i>5</i>
<i>2. Basic principles</i>	<i>5</i>
<i>3. Current state diagnosis</i>	<i>11</i>
<i>4. Planning – Forecasting – Prioritizing</i>	<i>15</i>
<i>5. Securing financing</i>	<i>21</i>
<i>6. Recommendations</i>	<i>27</i>
<i>7. References and key resources</i>	<i>28</i>

Executive summary

The EU-funded TRACER project (www.tracer-h2020.eu) aimed to support, throughout its 3-year duration, nine coal-intensive regions¹, which are at different stages of their energy transition, to shape or fine-tune their Research and Innovation (R&I) Strategies and exchange previous experiences in order to facilitate transition towards sustainable energy systems.

The TRACER project, coordinated by WIP Renewable Energies – Germany, facilitated the mobilisation of a wide range of stakeholders in all nine European regions, to discuss and agree on a shared vision and priorities for coal transition. Several TRACER reports were delivered until now covering thorough analyses of the current situations, in terms of energy, environment and social aspects, and 2030-2050 transition projections in all 9 target coal intensive regions, together with best practices assessment globally. The R&I Strategies were based on the European Union's "Smart Specialisation Strategy" (S3) approach and the Entrepreneurial Discovery Process (EDP) focused on each of the 9 coal-intensive regions, while for the energy technologies were considered the R&I priorities of the EU's SET Plan.

This current document is mainly based on the prior deliverables in TRACER project, previous work performed by the Secretariat of the Initiative for coal regions in transition (CRIT) and the Just Transition Toolbox for coal developed by Wuppertal Institute.

It is part of a set of two Decision Making Toolkits (DSTs) that will serve as guidance for stakeholders in coal regions in transition for a better-informed decision-making process, on how to plan, set targets, choose optimal solution during implementation in compliance with legal and regulatory framework, and be prepared to secure finance for the transition to a sustainable energy system:

- A. **Decision support toolkit on substituting coal-fired generation with clean energy** that will serve as a guideline for stakeholders in coal intensive regions on how to substitute energy production from coal with clean energy (demand of the energy production through alternative/clean energy resources, investment costs, estimated workplaces from the alternative energy resources/technologies, etc.), to get a feeling what it really means to substitute coal in an existing energy system;
- B. **Decision support toolkit on post mining landscape management** (ecosystem services) which will help policy makers, local authorities and planners to take informed decisions, to set targets, access financial resources and attracted investors. This guidance will lead to choosing optimal solutions in compliance with the environmental legislation in force.

This toolkit (A) will highlight a logical sequence of a set of actions, for an effective transition process from coal, based on a step-by-step approach, and alternative options, if any.

Most often decision-support tools are applied with the help of purpose-designed software packages and drawing on specialised databases. The TRACER DSTs are guides aiming to present in a non-technical language all relevant aspects related to TRACER target regions transitioning from coal.

The online versions of both documents are interactive pdf formats easy to navigate and to access references.

¹ Lusatia Region (Brandenburg DE40 and Dresden DED2 - Germany), West Macedonia (EL53 - Greece), Wales (UKL1 and UKL2 - UK), Southeast Region (BG34 - Bulgaria), Jiu Valley, West Region (RO42 - Romania), Kolubara region (RS11 and RS21 - Serbia), Donetsk region (Ukraine), Upper Silesia (PL22 - Poland), North West Bohemia (CZ04 - Czech Republic)

1. 5 Ws and 1 H

The 5 Ws (What/Why/Where/Who/When) and 1 H (How), which this section focuses on, more specifically concern:

1. *What does this DST stand for?* ⇒ The aim of this toolkit is to provide guidance to the policy makers and stakeholders in coal intensive regions on how to substitute energy production from coal with clean energy in an existing energy system (in terms of covering the demand for energy, costs, new jobs, etc.).
2. *Why is needed?* ⇒ This toolkit will highlight a logical sequence of a set of actions for an effective and environmental oriented substitution of coal-fired power and heat generation with clean energy. Taking better-informed decisions means less resources (i.e. time, human and money) needed for planning.
3. *Where is useful?* ⇒ Coal intensive regions, already in transition or about to initiate the transition process towards a sustainable energy system must make the most of this guidance related to the substitution of the energy production from coal with clean energy in their attempt to retain their character as “energy centres” of their countries.
4. *Who is it aimed at?* ⇒ Policy makers, local and/or regional - national authorities, mining or energy companies, planners and civil society representatives from coal intensive regions, involved directly or indirectly in the substitution of the energy production from coal with clean energy in an existing energy system (either locally or in a wider, i.e. national, level).
5. *When to make use of it?* ⇒ Obviously, this toolkit has to be studied prior to starting the substitution of coal-fired power and heat generation with clean energy process, for defining an optimal and adaptive way to perform this substitution in order to respond to their unique contexts and opportunities.

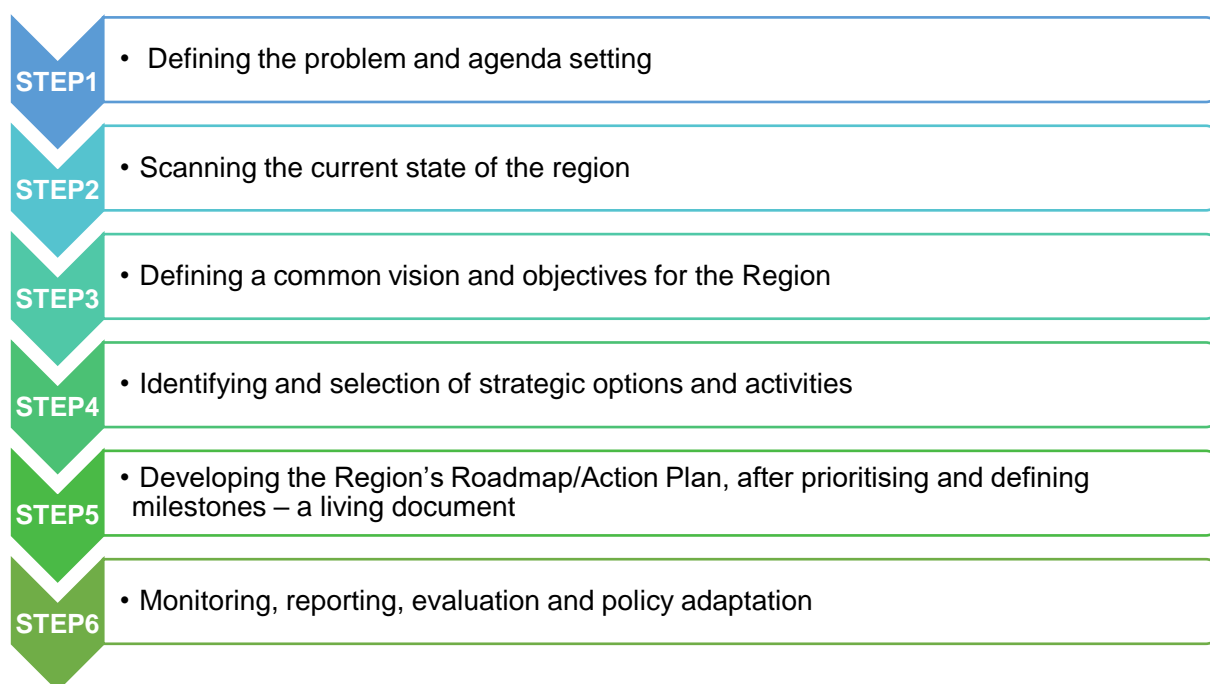
Finally,

6. *How to make the most of it?* ⇒ For its effectiveness, it is recommended to make use of this “tool” simultaneously with the existing (or being processed) development transition plans of the regions concerned, everything that is provided for in the corresponding National Energy and Climate Plan (NECP) of each country, as well as the planned programs for the promotion of RES and energy saving projects at the regional level.

2. Basic principles

As several regions in the world are facing a politically-initiated phasing-out of lignite mining and coal conversion, some main guiding principles in transformation processes of coal phase-out are provided in this Section, as key drivers for a technically feasible, cost-effective and socially acceptable transition from coal. Strategically planning a transition in coal intensive regions is like drawing a roadmap towards sustainable energy systems.

A well-planned transition from coal can be achieved by taking a step-by-step approach, from the current state to the desired state of the region, as follows:



Step 1: Defining the problem and agenda setting

Defining the problem is an important step in the agenda setting process and will largely define the next steps of the procedure, including what an appropriate strategy is, what suitable actions are, and which stakeholders need to be involved. Consulting with a wide range of stakeholders, from the start, can help define the problem more holistically and ensure that not only a sub-set of problems are addressed.

It is indeed crucial for the acceptance of the guiding principles to actively involve the regional population in the process by offering them the opportunity to contribute with ideas and thus to identify with the process. Participatory processes not only help to improve the quality of strategies, but also lay the foundation for ownership by actors needed for its implementation. The governance of the transition process must be set-up to correspond to the identified problems.

Step 2: Scanning the current state of the region

Strategic planning needs a sound knowledge base of the regional challenges, facts and figures. Gathering the necessary information, which normally is a long-term process requiring skills, institutional capacity, and cooperation between different stakeholders, is an iterative process with both a short term and a long-term perspective. Thus, a two-track approach should be followed:

- a. quickly gather key facts for the first cycle of strategy development;
and, in parallel,
- b. build capacities in the region (skills, institutional capacity and cooperation between different stakeholders) to provide the knowledge for future adaptations of the strategy (gathering and assessing missing data as well as continuously updating most important data).

In principle, the current state / context should be analysed based on the following core information:

- the geographic characteristics about the size and extent of the region, but also about the type of mining and natural assets;

- social and demographic factors, including information about employment and the labour market;
- the economic characteristics, including technical and knowledge infrastructure;
- the institutional setting - including the existing and/or ongoing national / regional strategic documents (i.e. RIS3, Territorial Just Transition Plans, Regional Development Strategies, Integrated Development Plans, etc.) and initiatives / technical assistance (i.e. EC–DG Reform SRSS and SRSP, START; EIB; World Bank, etc.) - which frames the possibilities of development led by decision makers.

With this core information gathered and analysed, policymakers and the local stakeholders will have at hand a solid database to understand the strengths and weaknesses of the region. To make use of all the information, there are several analysis methods which can help to understand the status quo, including the coal value chains and economic interconnections, but also the region's future potential, such as the SWOT analysis, PESTLE analysis, market analysis, value-chain analysis, dynamic shift share analysis, and/or comparative advantages analysis.

Step 3: Defining a common vision and objectives for the Region

A transition strategy needs to specify its target with respect to the direction towards which it wants to develop. This should include:

- **A long-term vision:** Given that transition and structural change processes generally take several decades, the vision should have a long-term view and include an outlook with a 30-year time horizon. Such a vision is generally qualitative and describes a narrative.
- **Development objectives:** The general vision should be underpinned by clear concrete objectives. These objectives can address a shorter time frame (e.g. 5 to 10 years).

Visions and objectives need to respond to the specific conditions of the region, but they also need to be in line with national, EU, and international goals. For example, and as regards the energy sector, the **European Green Deal** is the new strategic priority of the European Union representing an all-encompassing strategy for achieving long-term, sustainable growth in Europe, creating wealth and jobs while significantly cutting emissions and pollution, with the ultimate objective of making the EU the first climate-neutral bloc by 2050.

In addition to that, the new **Fit-for-55** 'package' proposed legislation (presented in July 2021), designed to evolve the functioning of key sectors to reduce greenhouse gas emissions by 55% in 2030 compared to 1990, deemed critical to Paris commitments and 2050 carbon neutrality, needs to be mentioned, which in the meantime (in May 2022) was supplemented / recapped by **REPowerEU** plan, which in order to overcome dependencies from Russian fossil fuels requires swift implementation of Fit-for-55 but notes that gas consumption will now have to decrease more swiftly, limiting its role as a transitional fuel.

In this context, the **Integrated National Energy and Climate Plans** that have been developed in all EU Member States (plus in most of the countries of the "Energy Community") and are currently under reformation should be taken into serious consideration. This is also the case with the EU Cohesion Policy and the pilot actions that the European Commission launched for "regions in industrial transition", "coal regions in transition" and "creating new value chains through interregional investment in innovation".

Step 4: Identifying and selection of strategic options and activities

Once a long-term vision for the region is created and concrete objectives are defined, strategic actions to reach these objectives need to be identified. Practitioners often already

have concrete ideas for possible actions. This is a valuable knowledge base which should be explored. However, formalised approaches can help with “out of the box” thinking and can help ensure individual steps add up to a coherent portfolio of actions.

Scenarios are an approach of exploring future development options and for analysing the consequences or the impacts that certain actions might have. In order to identify potential pathways to reach the “desired” future for a region, scenarios are often combined with a back-casting process. First, a rough sketch of what a desired future for the region would look like must be made, and then work backwards must be done. The desired future can be described in general terms, using projections or analogies relating to the specific case. Then, through an iterative process, the pathways and steps involved in how this desired future can be achieved are identified.

There are simpler approaches of identifying options for action, such as the collection of options through interviews with stakeholders, consultation with experts, policymakers and market actors, or by transferring international good practices. Such approaches have their advantages in that the effort to identify options is generally less and, in many cases, there is a lot of local knowledge about what could be done or improved. They also enable immediate action on the ground when time pressure for implementation is high and can be used to achieve rapid convergence alongside the process of developing a robust and holistic strategy. However, special care must be taken so that these “quick decisions” do not conflict with long-term goals. Infrastructure investments in particular may set irreversible framework conditions for many years or even decades and risk setting the region on undesired paths on development paths that are not acceptable or cause stranded assets.

Other established approaches to identifying options in a strategic way are the “Logic Model” and the “Theory of Change”. Both approaches aim to describe possible processes from interventions to outcomes. This analytical process helps to better understand how certain goals can be achieved. As logic models and theories of change often appear as a chain of effects, they do not need to be linear, and if well implemented, they can also be used to identify correlations of different measures (synergies, gaps in strategies, etc.). Besides, both approaches can be combined with scenarios as well as with back-casting, while they can be used or developed in the context of participatory processes.

Step 5: Developing the Region’s Roadmap / Action Plan, after prioritising and defining milestones

Having identified and select the strategic options and key activities for the transition to a cleaner energy future in the targeted coal intensive region, as well as having at hand any other developed (and agreed) strategies, such as R&I strategies for smart specialisation and/or strategies for the re-skilling/re-training of the local workforce, the elaboration of concrete Roadmaps on how to finally implement the provisions of the these policy documents/strategies, gradually until 2030 at first and then until 2050, is the next logical step. This, again, needs to be supported (in the overall decision-making process) by the governance structures set up in the region for this purpose.

The elaboration of the Roadmap(s) aims at the formulation of the optimal planning and the identification of a series of measures and actions for the achievement of the targets set within the overall planning, but also in the frame of the R&I strategies for smart specialisation and the corresponding strategies for the re-skilling/re-training of the local workforce of the target region. Through the Roadmap, the appropriate guiding directions will be offered to the relevant policy makers, aiming at the enhancement of the legislative framework and the incorporation of the new energy technologies in the energy system and of the proposed (re)training, but also the stimulation of investments in the low-carbon energy sector.

The elaboration of the Roadmap(s) for each coal intensive region needs to be accomplished in three basic steps:

1. Selection of the priority energy technologies to be included in the Roadmap (with this selection the corresponding local workforce that will need to be reskilled or retrained will be also selected / identified);
2. Determination of the process to be used in the Roadmap's development, i.e. formulation of the major axes needed to accomplish the objectives of the Roadmap, proposition of a number of measures under each one of main axes to overcome specific barriers, and, finally, decomposition and analysis of the identified priority measures to specific actions;
3. Assessment of priority measures alternative scenarios (categorization of measures into High / Medium / Low priority).

Such Roadmaps have been developed in the frame of the TRACER Project for the target regions aiming to contribute to the formulation of an optimal planning, in order for the targets in view of the energy transition – in terms of having available the appropriately trained / skilled personnel that will work on the new, cleaner, energy production technologies - to be achieved, as well as the R&I strategies on energy to be appropriately and efficiently implemented in the regions. More about TRACER target regions' Roadmaps, together with the corresponding R&I Strategies online in [TRACER Publications – National Policies and Challenges](#).

Step 6: Monitoring, reporting, evaluation and policy adaptation

This last step of the process aims to inform the next policy cycle, adapting the strategy based on what was learned in the first round. Indeed, as regions normally undergo a continuous process, the end of one policy cycle actually marks a new beginning, i.e., entering into the next cycle, adapting the strategy based on learning from the first round.

Some changes are immediately necessary, due to changes in the institutional or political context (e.g., new government and policy priorities at national level, new financing options, changes in international conditions in the energy sector, changes in markets, etc.), and others stem from practical application experience (i.e., a particular approach did not work as expected). But to make a strategy truly effective, it's important to take a closer look at what worked and what didn't. To do this, an appropriate monitoring and evaluation (M&E) system must be established.

Monitoring and evaluation (M&E) needs to be considered and implemented from the very beginning of the policy cycle. M&E systems:

- should include a mix of quantitative indicators (e.g., CO₂ emissions, money spent, jobs created), prioritising what is important over what is merely measurable, and qualitative ones;
- must reflect the various objectives of the strategy, and not only those that are easy to measure or which are the priority of the implementing agency (for just transition processes in coal regions, a balanced mix of economic, environmental and social assessment criteria is key);
- are helpful for future decision making, but they require a significant effort and regional authorities need institutional capacities of their own to ensure that results of M&E processes can be taken up in the revision of the strategy.

More about developing strategies for a Just Transition in coal intensive regions can be found in the [Just Transition Toolbox for coal regions](#), Wuppertal Institute. Berlin.

In TRACER, the [Strategy for Smart Specialisation](#) (S3) approach was used (TRACER-D2.2, 2019), which involves a prioritisation exercise named the Entrepreneurial Discovery Process (EDP). The EDP aims to help stakeholders identify the domains and economic activities where regions or countries have the potential to generate competitive knowledge-driven growth, and to target investment and resources on these themes. This multi-actor development work is guided and shapes a shared vision for the region and is the epitome of

collective action within S3. It emerges from a process of knowledge-sharing and discussion of the existing and potential regional areas of strength, and as a result of entrepreneurial insight. The S3 approach seeks to respect the multitude of visions and values present in a region, and to potentially combine them in creative ways for the benefit of the region's development.

TRACER applied the EDP to help formulate and shape visions for the target coal regions in their transition to sustainable energy systems. Guidance developed for the TRACER target regions in June 2020 suggested that the regions' visions could be defined in response to the following question: *"What is the overarching developmental goal for the region, in relation to sustainable energy research and innovation, to support transition to a low carbon economy?"*

It was suggested that this could include some of the following dimensions:

- **A societal dimension**, e.g. shifting from coal production and use to more sustainable forms of energy, in order to contribute to the wider energy transition and a low carbon economy;
- **An economic dimension**, e.g. developing/expanding a particular sustainable energy industry, with a view to supporting overall prosperity or regional economic development;
- **An employment or skills dimension**, e.g. creating new jobs or transitioning workforce skills, in order to provide new employment opportunities for people in the region, or for particular groups of people (e.g. ex/current miners, young people, researchers);
- **A research/innovation/technological dimension**, e.g. enhancing specific kinds of R&I capacities, as a contribution to business development and economic growth, or new employment, or new opportunities for universities;
- **A collaborative/engagement dimension**, e.g. increasing opportunities for cooperation among regional stakeholders, in order to enhance social capital.

The guidance also suggested that the regional priorities could be defined in terms of concrete and achievable objectives and focused on the region's existing strengths, resources, and emerging opportunities, in an inter/national context.

Box 1: Indicative themes for regional priorities in TRACER target regions

The following themes were suggested as a focus for agreed priorities, related to the region's existing strengths/resources and potential:

- Natural resources or energy sources,
- Geographical location (e.g. proximity to resources or to markets),
- Infrastructure and physical capital (e.g. in relation to energy),
- Funding for investment in physical, human and knowledge capital, and for financing particular types of businesses or particular types of R&I activities,
- Key businesses and other economic actors,
- Human resources and skills,
- Research and innovation infrastructure and capacities, or funding for the diffusion and application of specific technologies
- Governance structures,
- Stakeholder engagement and social capital.

Source: TRACER supplementary guidance: *Developing a regional vision & priorities (including via online working)* (June 2020)

The regional shared vision and priorities were developed through a collaborative and iterative process with stakeholders. The TRACER target regions are all at different stages of their transition out of coal, and their transition into sustainable energy systems – this is reflected in the emerging visions and priorities. The visions and priorities were then carried forward into the next TRACER activities, to help inform the preparation of reports focused on the target regions on:

- projections for the transition to 2030/2050;
- research and innovation strategies relating to energy;
- the needs for workforce retraining;
- roadmaps for energy R&I and skills, related to energy transition;
- blueprints for energy transition.

Box 2: Examples of visions developed by the TRACER target regions

Jiu Valley, Romania: “Jiu Valley micro-region will become revitalised from a social point of view, with a sustainable development, interconnected with the major regional, national and European networks, and having a competitive economic environment. The integrated transition of Jiu Valley micro-region will be implemented by investing in human potential, education, spirituality and morality, thus creating the right environment and generating the necessary force for the human capital, able to develop the local economy by implementing innovative ideas.”

Kolubara, Serbia: “Transition in Kolubara target region to coal phase-out should be planned well in advance. The transition should be gradual and supported by additional hydro pumped storage facilities with the aim to keep the electricity supply stable and minimise dependence on imports. Transition and reclamation activities should be well prepared before and developed immediately after each mine field closure. To support the transition process, new energy-related research and innovation (R&I) activities need to be developed, focused on the application of innovative technologies in line with the resources present in the Kolubara region.”

Western Macedonia, Greece: “The region’s production model must be rebooted, regenerated and be ready to be enriched with new activities that will create new jobs. The new production model should be non-dependent on coal, yet maintain its “energy” character and be based on the exploitation of new alternative and environmentally friendly resources and technologies (e.g., RES, hydrogen, energy storage). It should further expand to other sectors (e.g., agricultural, manufacturing, agri-food, mild forms of tourism exploiting the natural landscape and the cultural background). The regions’ significant technological and research infrastructure could be upgraded and expanded to support new business activities – still energy based, but in innovative sectors and / or products. This, coupled with the highly trained technical staff, could constitute a very efficient and powerful tool for the new orientation of the production and economy of the area to alternative (energy and not only) paths.”

3. Current state diagnosis

In order to assess, as correctly as possible, the current state of play in a coal region in transition, in terms of basic economic indicators (GDP, demography), policies and measures, legislative framework, energy technologies, energy production/consumption, environmental and social aspects, labour market status as regards employment / unemployment but also retraining / reskilling needs, etc., a lot of tools and methods exist. For example, some can use statistics analyses, others prefer to distribute questionnaires for data collecting, while others carry out face-to-face/online/phone interviews.

Apart from these methods, there are also some situational analysis tools, such as the SWOT and PESTLE analysis, that could be used for this purpose. SWOT (strengths, weaknesses, opportunities, and threats) analysis is a framework used to evaluate a company's competitive position and to develop strategic planning, assessing internal and external factors, as well as current and future potential. On the other hand, the PESTLE (Political, Economic, Sociological, Technological, Legal and Environmental) analysis is a concept in marketing principles mostly used as a tool by companies to track the environment they're operating in or are planning to launch a new project/product/service, etc.

Apparently, the best way of carrying out a rational current state diagnosis and assessment is the combination of all (or as much as possible of) the above. Considering this context, the following methods can be applied to carry out the current state diagnosis of a region:

1. **Collection of statistical data** – the main method to obtain quantitative information about the administrative structure, demographics, economy, national energy balances, employment, education, infrastructure, land use, and others.
2. **Literature review**, including:
 - a. National, regional, and local policy;
 - b. Annual reports of the national and/or regional energy holding, TPPs, and the mining companies – these provide information about the employees, produced energy carriers, financial results, and others;
 - c. Energy, environmental, economic, and social analyses.
3. **Personal interviews** (face-to-face or online) with:
 - a. Policy makers (anonymous or not) - to collect information about the planned policy change in the energy field;
 - b. Representatives of the coal sector - to understand the situation of the enterprises, and the employees' skills, culture, and desires;
 - c. Business associations and entrepreneurs – to get insight about the business environment in the region;
 - d. Experts – to identify the energy, environment, and social needs, barriers, and opportunities for the region.
 - e. Researchers – to collect information about the research capabilities, needs, and opportunities, as well as results from relevant studies.
4. **PESTLE analysis** of the region's transition away from coal, assuming that the transition starts immediately.
5. **SWOT analysis** of the social and re-skilling issues in the region to ensure smooth transition.
6. **Stakeholder workshops**. It is necessary to involve all stakeholders – public authorities, NGOs, energy and non-energy businesses, labour unions, civil society representatives, and consultants, in order to:
 - a. improve the analyses; all stakeholders have the opportunity to contribute to the definition of the challenges faced by the region, SWOT analysis, PEST analysis, and conclusions;
 - b. agree about the problems and opportunities and take ownership of the results;

These are important pre-conditions to ensure the involvement and collaboration of all stakeholders in the next steps of the process – establishment of a common vision, strategies, and roadmaps.

A type of report that includes an in-depth analysis of the existing situation in coal intensive regions, in different stages of transition to a sustainable energy system, being the main source of data could be the “Baseline Study”, including the following main sections:

- General description of the economic and demographic profile of the region including notable trends and projections;
- Overview and general characteristics of coal-related industry and locations;
- Socio-economic characteristics of coal-related industry;
- Characteristics, trends and challenges of coal-related locations and communities;
- Coal transition strategies, plans and projects;
- Current strategies and plans for economic diversification / development and decarbonisation.

Sectors to be assessed should be:

General information of the region	<ul style="list-style-type: none"> ✓ Demographic data ✓ Number and characteristics of settlements (urban, rural) ✓ Geography, morphology, hydrology and land use in the region ✓ Economy characteristics: existing type of industrial activities, main sources of income ✓ Overall review on the quality of the environment in the region (air emissions and quality, water quality, land degradation)
Regional socio-economic profile	<ul style="list-style-type: none"> ✓ Total number of citizens ✓ Age and gender distribution ✓ Education status ✓ Employment by sectors (Agriculture, Forestry & Fishing, Industry, Mining and quarrying, Construction, Trades, Transport, Accommodation and food services, Information and communication, Professional, scientific, technical, administrative and support services, Public administration, Defence, Education, Human health and social work activities, Arts, entertainment and recreation; other services) ✓ Share of jobs in coal mining and coal fired power plants ✓ Share of jobs in the coal-related activities ✓ Jobs and skills in the mining and power generation sectors ✓ Jobs and skills in the coal-related activities ✓ Economic indicators (GDP per capita, energy consumption per capita)
Regional coal industry profile	<ul style="list-style-type: none"> ✓ Type of coal ✓ Type of mine ✓ Production rate of coal ✓ Number and structure of employees (by age and profile) ✓ Remaining operation period
Final energy consumption in the region	<ul style="list-style-type: none"> ✓ Electricity consumption by sectors (industry, residential, services) ✓ Heat consumption by sectors (industry, residential, services) ✓ Transport (optional)
Energy demand by sources	<ul style="list-style-type: none"> ✓ Solid: coal, biomass (wood, pellets) ✓ Liquid: fuel oil, bio-fuel ✓ Gas: natural gas, bio-gas, syngas
Energy generation plants in the region (capacity, no. of units, age, power generation per year, remaining life span)	<ul style="list-style-type: none"> ✓ Thermal power plants (fossil, nuclear) ✓ Hydro power plants ✓ Wind power plants ✓ Solar power plants ✓ Biomass power plants ✓ Others

Renewable energy resources in the region and potentials for energy generation	A theoretical wind and solar potential can be estimated using WB open-source platforms: Global Wind Atlas 3.0 and Global Solar Atlas 2.0
Current or expected transition challenges facing the region	To be evaluated based on stakeholders' consultation methods (interviews, workshops, round tables, etc.)

As far as renewable energy sources (RES) are, for the time being, the “cleanest” source of energy, there are a number of issues that need to be taken into account when diagnosing the situation regarding RES potential in regions under transitions. So, the best available renewable resource geospatial data should be used to estimate the achievable energy generation capacity and corresponding annual generation of specific RES technologies at specific sites within the region, depending on the technology, given system performance, topographic limitations, environmental, and land-use constraints. This results in a data set of locations across the region defined by resource characteristics and correspond to the evaluation of the **RES technical potential**.

Then, the Levelized Cost of Energy (LCOE) has to be estimated for each RE technology at these same locations, incorporating regional plant construction costs, technology cost, and performance and estimated intra-regional transmission costs. At each of these locations a Levelized Avoided Cost of Energy (LACE) should be further estimated by valuing the potential revenues available to a RE project at the location, which equals the amount the project would be paid for the electrical energy and capacity it can provide (else, what a utility would not have to purchase from other sources). For the full supply curve for each technology, the difference [LACE–LCOE] gives the net value for a location. A specific location is considered economically viable if its net value is positive, and the technical potential associated with locations with positive net value is summed and deemed the region's **RES economic potential**.

The TRACER assessment of the target regions' current situation took place in the second half of 2019 and first half of 2020. Some assessment issues of the current situation in TRACER target areas that deserve mention are listed in the next Box.

Box 3: Issues in assessing the current state of play in the TRACER target regions

In some of the target regions, like the South-East Region (BG34) in Bulgaria, Northwest Bohemia (CZ04) in Czech Republic, the Region of Western Macedonia (EL53) in Greece, the Upper Silesia (PL22) in Poland, and the Jiu Valley micro-region / West (RO42) in Romania, this procedure was followed more or less. In other cases, like e.g. the Lusatian Lignite District in Germany or Wales in the UK, work in this field was already done by the local authorities, so in the case of TRACER only some minor adaptations have been made.

Especially as regards the Bulgaria's South-East Region (SER), it must be mentioned that this was the first study made to provide a basis for the region transition out of coal. At that time, although the EU policy and the huge financial losses in the coal sector clearly indicated that serious restructuring is inevitable, there was (almost) no national and regional policy related to coal phase out. Additionally, many stakeholders, such as most public authorities, coal and related businesses, and labour unions, strongly opposed the transition to low carbon energy.

In Jiu Valley micro-region, Romania, an unprecedented bottom-up stakeholder consultation process was performed, during 2 hard pandemic years, under different complementary EU initiatives (EC DG-Reform SRSS, SRSP and DG-Ener START) with TRACER project. All quadruple helix stakeholders' categories, i.e., industrial/business associations and individual businesses, research & education institutions, public sector bodies, and civil society (trade unions, NGOs, former miners, etc.), were informed, consulted/interviewed and engaged. It was long awaited and appreciated in Jiu Valley communities, but also overwhelming, the key stakeholders being practically the targeted for crossfires.

4. Planning – Forecasting – Prioritizing

After putting in practice the key principles and starting rolling-out the step-by-step approach recommended in Section 2, including an “in deep” current diagnosis (Section 3) and a “common vision” definition for the coal intensive region, it is time to assess the options for substituting coal-fired generation.

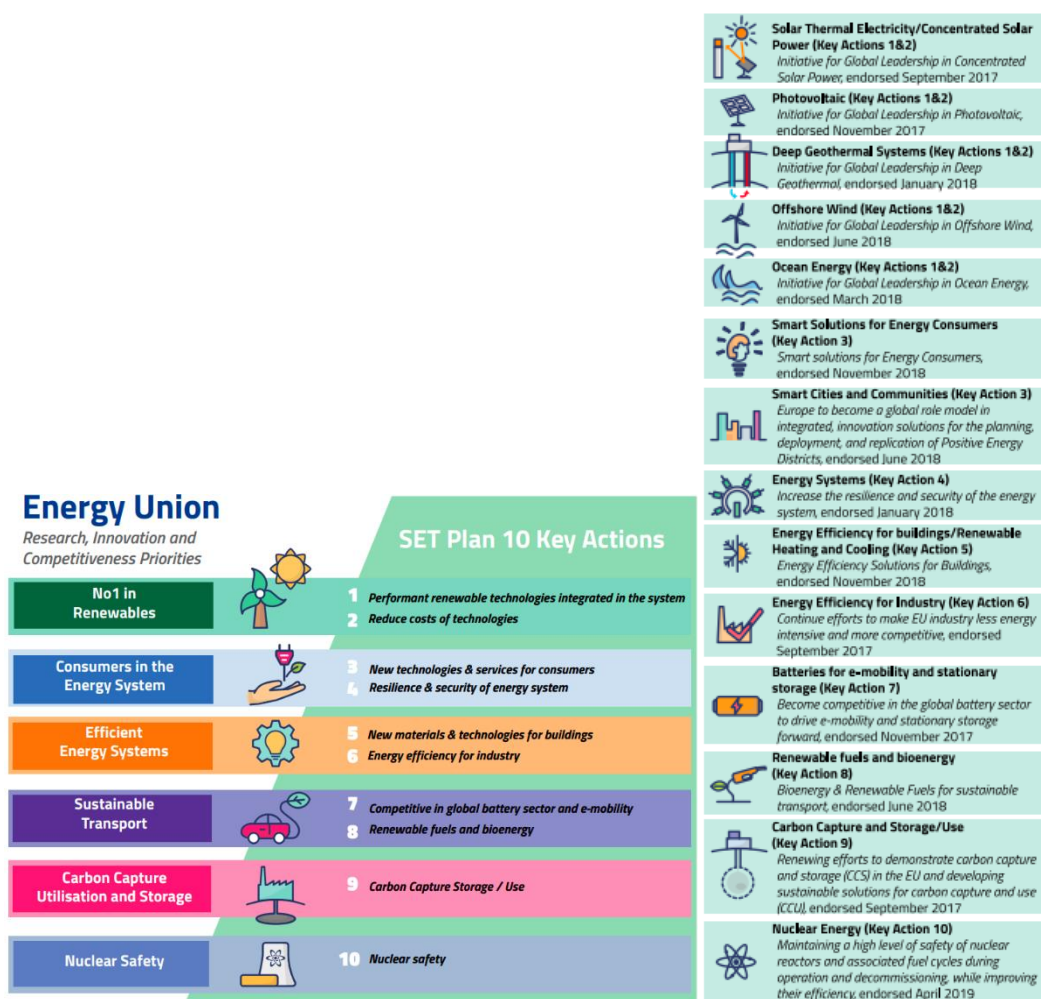
Each coal region in transition differs in terms of location (geography, rural or urban), existing infrastructure (including the coal-related one), economic specialisation and opportunities, geology, workforce, sectoral demands, former opened or underground mining, etc. And each coal-fired PP (power plant) has particular challenges like contaminated sites, economic viability of the energy companies, etc. – strongly influencing the timespan of assets repurposing or reuse.

To this end, the Technology Options Toolkit (EC-CRIT, 2021) is tackling the topic “re-use of coal power plants”, recommending solutions for:

ENERGY STORAGE system integration in existing PPs	CONVERSION	NON-ENERGY USE
Thermal energy storage, i.e. <u>molten salt</u> energy high-temperature storages or <u>Carnot batteries</u> or <u>MGA</u> (Miscibility Gap Alloys)	Conversion to <u>gas</u> , as transition fuel to 100% RES (short term option)	<u>Data centres</u>
Pumped hydro energy storage in former <u>open casts/pits</u> or <u>underground</u> mines	Conversion to sustainable <u>biomass</u> , via a secure and long-term efficient feedstock supply (short term option)	<u>Logistical ports</u> for off-shore wind
Chemical battery storage systems, i.e. li-ion and sodium sulphur	Conversion to other renewable energy as <u>clean energy hubs</u> with <ul style="list-style-type: none">- solar power and/or heating,- wind power,- deep geothermal energy- mixed RES for power and/or heat and/or hydrogen generation	<u>Industrial parks</u>
<u>Gravity batteries</u> in former underground mines		Offices, students' union centres
Combined solutions as conversion to RES and storage (sector coupling)		Cultural sites

More about technological solutions for “re-use of coal power plants” are provided in TRACER Best Practice Platform and in the Just Transition Toolbox for coal regions, Wuppertal Institute.

It is important to notice that, in every phase of the region's "Planning-Forecasting-Prioritization" process, the mandates of the “Clean Energy Transition Technologies and Innovations Report” and of the National Energy and Climate Plans that set out the policies and financial measures that EU countries will take to reach the climate and energy targets, should be taken into consideration. At the same time, and as regards the energy technologies that are considered critical in order to achieve the EU's energy and climate goals and make Europe a global leader in clean energy and energy efficiency, the Strategic Energy Technology Plan (SET Plan) forms the European framework for boosting the transition towards a climate neutral energy system through the development of low-carbon technologies in a fast and cost-competitive way (TRACER-D6.1, 2021).



Source: (Dufour, E., Lisi, V. and Robison, R., 2019)

SET Plan (EC, 2021) has defined 10 key actions for research and innovation (to the left) and fourteen (14) technology areas (to the right) that have the highest innovation potential for delivering cost reductions and improvement of performance, thus contributing to the decarbonisation of the European energy system. In the right image, the 14 technology areas are further associated with the key actions and implementation plans (*italic*). Therefore, in the process of defining a regional development strategy in the field of energy based on smart specialisation, driven by Research, Technology and Innovation (RIS3), it is important to consider the implementation plans (IP) adopted by SET Plan, defining the R&I priorities and investment agendas. The above pool of SET Plan actions and technologies as well as the CRIT Technology Options Toolkit were the basis of the analysis carried out within the TRACER project for performing an optimum decision-making process, based on each target region specificity, looking at the options for substituting coal-fired generation with clean or alternative energy, and reuse some of the assets, or repurpose through total industrial transformation. As it turned out, the most promising technologies - which should be given further attention - in the majority of the TRACER project's target regions, are wind and PV systems, as well as the various bioenergy production technologies. In addition, the comparative advantage of "green Hydrogen" production should not be neglected, and indeed some of the TRACER target regions have started to take the first steps in this direction.

Wales in the UK is in a different coal phase-out stage, with the gradual but irreversible decline of the coal era and subsequent virtual disappearance in the 1990s. Since then, Wales has been undergoing a continuous process of industrial transformation. Several examples of initiatives which are helping Wales transition to more sustainable energies are briefly presented in the Box below.

Box 4: Energy transition related case studies from Wales, UK

Developing the marine energy sector in Wales (Link: <https://www.marineenergywales.co.uk/>)

Wales is in a good position to play a global leading role in marine energy, with 1,200km of coastline, up to 6GW of generating capacity potential for wave and tidal stream, the potential for four tidal lagoons and nearby accessible grid infrastructure. This is supported by an existing supply chain, seven strategically located ports (including the third largest in the UK at Milford Haven) and good road and rail links to other major cities and transport hubs.

Wave and tidal technologies are still in the pre-commercialisation stage, but around 20 emerging marine renewable energy developers are actively progressing projects in Wales. Four test and demonstration sites are under development with >€50 million being committed into the strategic development of Wales' test centre network to date, and there are testing opportunities across a wide range of scales.

HYNET North West (Link: <https://hynet.co.uk/about/>)

HyNet North West, a 'hydrogen' initiative, is an industrial decarbonisation cluster in the North West of England and North Wales, which aims to act as a catalyst for clean growth across the regions from the mid-2020s onwards. The project aims to lead the creation of a low carbon economy in the region, protecting and creating local jobs and attracting inward investment, establishing the region as a world leader in clean energy innovation.

HyNet involves both the upgrade to existing infrastructure, as well as the developing new infrastructure, including: underground pipelines, hydrogen production plants and storage facilities.

Pembroke Net Zero Centre – PNZC

Link: <https://uk-ireland.rwe.com/innovation/pembroke-net-zero-centre-pnzc>

The Pembroke Net Zero Centre is a new initiative in Wales led by RWE, the German multinational energy company. RWE's site at Pembroke Power Station in south-west Wales has undergone major transformations during the last 60 years - from hosting an oil-fired power station in the 1960s, to transitioning to a natural gas-fired power station in the 2010s. The PNZC initiative will see the site continuing its transformation as part of a decarbonisation hub (the South Wales Industrial Cluster), linking-up with new innovative technologies needed for a low carbon future, through three pillars:

- Decarbonisation of Pembroke Power Station, including CCS and initial Hydrogen feasibility studies;
- Green Hydrogen production, including feasibility studies for the development of an initial 100 - 250MW 'pathfinder' electrolyser on the Pembroke site but also looking at GW-scale opportunities in the longer-term;
- Floating Offshore Wind development in the Celtic Sea.

It is anticipated that the deployment of the PNZC, alongside the South Wales Industrial Cluster activities, will help unlock the route to Net Zero in South Wales, helping support the future of existing industries, businesses and jobs and attracting new industries and businesses, further developing the production and use of hydrogen for home heating, power generation and transport across the region.

Biomass based District Heating

Links: <https://www.sustainable-energy.co.uk/projects/biomass-and-chp-district-heating/>
<https://www.sustainable-energy.co.uk/projects/2-5mw-biomass-district-heating-newport-city-homes/>

Heat networks, including communal heat schemes and district heat networks, will have a role to play where the heat demand density is high. An [interactive map](#) published by the UK Government shows the progress of heat network projects through the planning system by region, status, energy type, capacity, heat network type, type of building and number of connections. [Project pipelines](#) provide an overview of upcoming procurement, encouraging new sources of finance to enter the sector. Wales has a range of completed heat network projects, including a 2.5 MW biomass district heating scheme for [Newport](#) and biomass and CHP district heating for [Blaenau Gwent County Borough Council](#).

However, there are other problems that need to be solved before achieving a “just transition” to cleaner forms of energy. Indeed, the main characteristics of the labour market structure and social challenges in coal-intensive regions in transition, such as mono-industrial identity, depopulation, unemployment, poverty, migration, aging, brain drain, are common elements for all the mining and power generation from coal areas in Europe. According to the EU’s Joint Research Centre (JRC), by 2025, coal-intensive regions in the EU will face the loss of 77,000 direct jobs. The scenario is even worse on the long-term: 160,000 direct jobs are expected to be lost by 2030.

At the same time, an increase in jobs in the Renewable Energy Sources (RES) sector is already happening, which is expected to continue and perhaps grow further. This is of particular interest to carbon-intensive regions in transition, especially if this transition is to be in the direction of substituting coal-fired generation with clean energy (i.e., RES), as the existing labor force (as well as the new one that will soon enter the labor market) will have to be redirected to new jobs. In these regions, the vocational education and training (VET) system and the labour market are expected to be challenged by the rise of coal workers seeking re-employment in the near future and the surge in vacancies in RES.

As reskilling initiatives for the transition of coal workers to the RES sector are currently extremely limited, with only one EU country (Germany) offering relevant C-VET courses (RES-SKILL, 2020), a lot of effort should be put by the regions in the direction of developing novel curricula and tailored training contents to facilitate coal workers’ reorientation to the RES industry, as well as in supporting VET providers and academic institutes to integrate these curricula / materials into their VET and work-based learning (WBL) offerings. The procedure of an efficient retraining/reskilling planning requires a number of specific to each region preconditions, but this is the right time at which it will be done.

In conclusion, increased well-being is needed to secure social acceptance of the abandonment of mining projects and coal-fired power generation, and to maintain regional competitiveness and future prosperity. To this aim, in *TRACER Best practice report on labour markets, social issues and tourism* (TRACER-D2.4, 2020) the following key drivers for the regions have been identified

- a. Support policies (industry, environment, social, education & labour market) and the inclusion of transition away from coal in state level energy and climate policies;
- b. Strategic planning (structures, actions, documents);
- c. Implementation resources (human capacity, competences, skills; secured financial support);
- d. Formal dual education, training, retraining/reskilling and up-skilling, apprenticeship and life-long learning labour-market oriented programs for working people, their families, and their communities, including skills audit and matching;
- e. Ability of a region to attract new investments;
- f. Sustainable employments in RES industry, energy efficiency, digitalisation, circular economy;
- g. Proactive stakeholders’ attitude and willingness to be engaged in the decision-making process;
- h. Respect for, and protection of, human and labour rights (ACTU, 2016).

In order to implement a successful and socially acceptable transition process, it is considered as been essential to identify a personalized approach for each coal intensive region, having in view the specificity of the socio-cultural heritage, thus leading to sustainable employments, citizens regaining their self-esteem, identity, livelihood and stability.

More about success stories related to re-skilling and apprenticeship programs can be found in [TRACER-D2.4 Best practice report on labour markets, social issues and tourism](#) and [TRACER Best Practice Platform](#); about renewable industry job creation potential and the needs for workforce retraining in [TRACER-D6.3 Report on the needs for workforce retraining](#); about the [Opportunities and challenges ahead for the EU coal regions](#) and the [Opportunities for jobs and growth in coal regions offered by clean energy technologies](#) in two corresponding studies of JRC (JRC 2018 & 2020); and about employment opportunities in [Just Transition Toolbox for coal regions](#), Wuppertal Institute. Berlin.

Lessons learned during the EDP process in TRACER regions

As the Smart Specialisation Strategy (S3) approach is based on research that suggests innovation is a collaborative and dynamic process (through interaction between actors, knowledge is not just exchanged, but learning occurs, which can allow underused knowledge and innovation capacities to be identified and used more effectively) it foresees forms of inclusive and cooperative stakeholders' involvement (Foray, D., et. al, 2012), namely in the form of an Entrepreneurial Discovery Process (EDP). This generally consists of meetings, workshops or other interactions taking place within the region which bring stakeholders together to build trust and working relationships, share knowledge, and discuss and agree on a common vision and priorities based on regional strengths (or "specialisation").

Given regional strengths and capabilities will vary, the implementation of S3 as well as of any other strategy related to the transition and the EDP varies largely depending on the regional context. The TRACER target regions have taken different approaches to S3 to reflect the varied interests and needs of stakeholders, to take into account existing structures, and to promote synergies and complementarities where possible. The strategy processes have therefore been diverse across TRACER regions, allowing for a rich comparison and reflection on lessons learned from the process (TRACER-D5.2, 2022).

The TRACER project approach sought to involve a broad array of stakeholders from the quadruple helix i.e., public authorities, industry, research & education, and civil society. Several workshops were conducted across the target regions, promoting discussion. In addition, interviews carried out by the TRACER partners allowed for the collection of more detailed information. This work shifted stakeholders' attitudes by nurturing working relationships (e.g., Kolubara region, Serbia) and increasing understanding of the coal transition (e.g., Donetsk, Ukraine), narrowed the main interests and priorities for the coal transition (e.g., green energy tourism in North West Bohemia, Czech Republic), and established networks and/or strengthened existing bodies to coordinate efforts for the transition (e.g., Jiu Valley, Romania).

The interactive focus of S3 thus enabled TRACER's strong impact on community building and networking through these activities, with hundreds of relevant participants being involved in some instances (e.g., Southeast region, Bulgaria). Interest has also largely been maintained even after these first collaborative activities (e.g., Western Macedonia, Greece).

Challenges have nonetheless hindered the stakeholder engagement process, even beyond the impact of COVID, which necessitated a major change in working practices. The move to online communication tools during the pandemic had implications for stakeholder engagement, in particular where stakeholders were more comfortable with face-to-face interaction, or lacked the technology or IT skills to participate in online meetings. Other challenges included uncertainty regarding future funding programmes (e.g., Wales, United Kingdom), lack of skilled workers which can paralyse some R&I activities (e.g., Donetsk, Ukraine), the need for capacity-building for R&I (e.g., Western Macedonia, Greece) and for complex planning and needs assessments (e.g., Kolubara, Serbia), and a lack of clear and integrated legislation, which can hinder cooperation and hinder the transition process.

Box 5: Key lessons learned under the TRACER stakeholders' engagement activities

R&D&I activities and workforce re-qualification needs to support the energy future of the region, and thus require constant enhancement. The significant technological and research infrastructure and highly trained technical staff are important assets in the transition to “green energy” (Western Macedonia, Jiu Valley, Kolubara). Furthermore, it is necessary to come to an agreement on the need for innovation, business synergies and the circular economy. These may help with funding e.g., attracting foreign investments, where a well-developed R&D&I sector is seen as a key regional strength. Institutional and innovation capacity should be considered here. This can be a significant hindrance for less developed and peripheral regions that do not benefit from the infrastructure, skilled workforce, and institutional thickness or dynamics necessary for R&D&I activities to thrive.

It is essential to **develop a coherent vision for the region’s specialisation and its role in the broader context.** This requires planning over the long term rather than corrective measures. Most of the TRACER regional teams reported that their target regions have already undertaken certain steps to define development strategies, including:

- Energy fields (e.g., in Bulgaria: large-scale solar PV, possibly later complemented by energy storage and/or hydrogen, small-scale projects - energy efficiency & RES in buildings, and replacement of some of the coal-fired capacities by combined-cycle gas turbines);
- Green energy as a leverage for regional tourism development (North West Bohemia, Czech Republic);
- Scale of future energy production (as in Lusatia, Germany – where it already is and will continue to be an export region for energy);
- Developing a shared view on need for collective effort at all levels to seize areas of opportunity (e.g., digitalization, reskilling in Wales, UK);
- Adaptation to domestic and international frameworks, including climate change mitigation (as observed in Poland, Romania, Serbia, and Ukraine).

Awareness of politically sensitive topics plays an important role. Some stakeholders were hesitant to express their position during meetings due to the specificity of the topic (e.g., Lusatia, Germany). Adaptation was needed in these cases, namely in-depth conversations in their own offices or through e-mail. For several target regions (Western Macedonia, Upper Silesia, Donetsk) the main concern of both the involved stakeholders and of the local community remains the replenishment of the current jobs related to lignite/coal activities. Social issues are extremely important; energy transformation must not deteriorate the living standards of local populations, and many people still see coal as a main energy source (Upper Silesia, Donetsk).

The process should be as interactive as possible and not just informative. To build consensus it is worth proceeding with a series of meetings to build relationships among stakeholders, especially in places where cooperation is not established yet at a satisfactory level. Also, the discussion should be stimulated where possible to encourage progress and not just an exchange of views. It is necessary to maximise knowledge exchange and optimise the cooperation between different stakeholders’ groups, researchers, and practitioners.

The mobilisation toll on stakeholders needs to be considered while planning further activities. Consultation fatigue is real, and stakeholder engagement should be scheduled carefully, understanding their available time-capacity. It is important to keep in mind that stakeholders may already have many obligatory meetings related to energy transition, they may also be involved in other consultations, or they may not have the time to attend every upcoming event.

The governance structures to support the S3 implementation process and the TRACER activities have depended on the regional context and capabilities. The TRACER work sought to use the existing structures where possible to avoid duplication of efforts, only creating new bodies where necessary.

Box 6: Examples of just transition from coal governance structures in TRACER target regions

In the majority of TRACER regions, new networks or bodies had to be established (North West Bohemia (CZ); Upper Silesia (PL); West region/Jiu Valley (RO); Kolubara (RS); Wales (UK)). For example:

- In **Romania's Jiu Valley/West Region**, a new working group was established with 25-27 members from the quadruple helix, which after a series of transformations became officially the governance structure for a just transition "Jiu Valley Integrated Territorial Development Association" ADTIVJ. This allowed for an integrated approach at the micro-region level, aligned with the transformation planning at the regional level. Project ideas were also generated together and endorsed by local authorities and are expected to further develop;
- In **Wales, in the United Kingdom**, the *Net Zero Wales: Skills Economics Advisory Forum* was set up, with representatives from higher and further education, industry, regional skills partnership, local authorities and Welsh Government. The forum supports Welsh Government to progress the green skills agenda and to promote the just transition and decarbonisation.

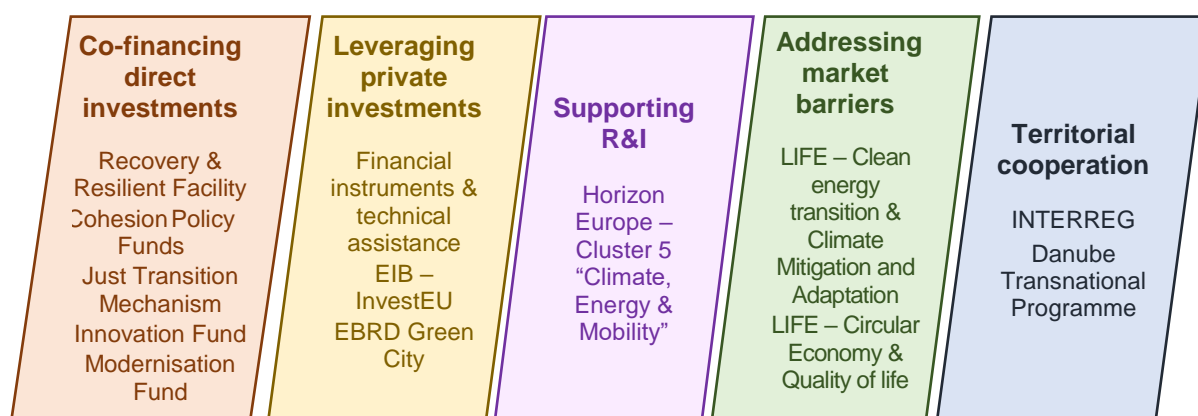
The remaining TRACER regions joined existing committees or working groups (Southeast region (BG); Lusatia (DE); Western Macedonia (EL); Donetsk (UA)). For example:

- In **Western Macedonia**, the TRACER partner (CRES) came in close contact with the group of the *Western Macedonia Region Working Team for Coal Platform*, with members representing research and higher education bodies, regional managing authorities, municipalities and the Ministry of Environment and Energy. The main goals in joining were mobilising stakeholders and disseminate TRACER findings as an additional tool in the energy transition phase;
- In the **German Lusatia region**, the TRACER partner joined the *Regional Lignite Mining Company* (LEAG) group which included Ministry staff, a recultivation company, nursery staff and farmers. The TRACER partner helped generate new value chains for LEAG and operating farmers, by developing a strategy for the future and starting the implementation of a field trial.

5. Securing financing

According to the Transition Financing Toolkit, developed by the European Commission Initiative for Coal Regions in Transition (EC-CRIT, 2021), the EU funding landscape, if properly managed and planned, offers a number of opportunities to support the implementation of sustainable energy systems, with a focus on transition strategies from coal. Comprehensive planning, including a good financing strategy, coordinating fund mobilisation efforts and capacity building at the regional and local level will support local actors, with limited capacity to access finance, to turn Transition and R&I Strategies into successful implemented projects.

Several funding programs are available (Dobrin M., et al., 2021) for:



First step, highlighted by the EC Initiative for Coal Regions in Transition (EC-CRIT, 2021) in finance mobilisation, is to ensure that a sufficient number of high-quality projects are ready to be financed. Once a project is identified and prioritised, the second step lies in preparing different documentation, such as:

- technical feasibility studies;
- risk assessments;
- financial planning;
- grant applications.

Support for projects preparation can be found in several initiatives like JASPERS, EIB - InvestEU initiatives Circular City Centre (C3), ADAPT, EC - TARGET, the European Investment Advisory Hub or the EEEF's technical assistance facility.

The European City Facility – EUCF provides grants to local authorities to develop investment concepts, as well as technical assistance and capacity building opportunities. Investment concepts translate a project idea into financial language in order to mobilise financing for its realisation. Also, the Covenant of Mayors has an interactive funding guide that gathers EU and national funding sources, as well as information about support services and innovative financing schemes.

Strengthening the administrative capacity for finance mobilisation among public authorities, SMEs, R&I entities, transition governance structures find support through LIFE and Horizon Europe programs. The LIFE programme offers training for setting up so-called ‘Integrated Programmes’ via own dedicated technical assistance calls (via the funding & tender platform). For Horizon Europe, the network of National Contact Points (NCP portal) is the main structure to provide guidance and training on all aspects of participation.

Specific technical support for coal regions refers to TARGET (Technical Assistance for Regions undergoing a Green Energy Transition) which is a new technical assistance programme co-developed by the EC and EIB for EU coal, peat and oil shale regions to support the pipeline development and implementation of projects. TARGET is focusing the following areas: clean energy and energy efficiency, in particular clean heating and energy-efficient renovations of buildings.

As presented above, EU financing opportunities are diverse and can be of three types:

- grants (non-repayable funding),
- loans (lend money in favourable conditions) and
- guarantees (whereby funding partners take over / a part of the obligation if the debt cannot be paid back).

An overview of the funding programs is presented in the table below.

Type of funding	Focus on	Recipients	Application via
The European Regional Development Fund - ERDF			
Grants, loans and guarantees	<ul style="list-style-type: none"> - Innovation and research - Digital transition - Support for SMEs - Low-Carbon Economy 	Regional public and private entities, with special attention paid to disadvantaged regions and areas, notably rural areas and outermost regions	Operational Programs URBACT Urban Innovation Actions INTERREG
The European Social Fund Plus - ESF+			
Grants	<ul style="list-style-type: none"> - Investments in youth, especially to support them finding a qualification and job - Support to the most vulnerable suffering from job and income losses - Promotion of social innovation, social entrepreneurship and cross-border labour mobility under the new Employment and Social Innovation (EaSI) strand 	Public administrations, workers' and employers' organisations, NGOs, charities and companies.	Operational Programs Funding & Tenders platform for EaSI strand and ESF+ technical assistance
Cohesion Fund (CF)			
Grants (the level of financing from the Cohesion Fund for a programme can amount to up to 85% of its cost)	<ul style="list-style-type: none"> - Trans-European transport networks, notably priority projects of European interest as identified by the EU. - The Cohesion Fund will also support infrastructure projects under the Connecting Europe Facility. - Environmental projects that are related to energy or transport, e.g. improving energy efficiency, use of RES, developing rail transport, supporting intermodality, and strengthening public transport, etc 	Public and regional authorities in Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia.	Operational Programs
HORIZON Europe			
Grant funding and prizes	<ul style="list-style-type: none"> - Focus of pillar II: health; culture, creativity and inclusive society; civil security for society; digital, industry and space; climate, energy and mobility; food, bioeconomy, natural resources, agriculture and environment - Focus of 'mission areas': adaptation to climate change including societal transformation; cancer; climate-neutral and smart cities; healthy oceans, seas, coastal and inland waters; soil health and food. 	Scientists and academics, research organisations, universities, industry, SMEs, students, etc.	Funding & Tenders platform
Just Transition Fund - JTF			
Just Transition Fund / grants Invest EU programme EIB public sector loan	Support of investments in SMEs that target diversification; creation of new firms; research and innovation; environmental rehabilitation; clean energy, energy efficiency and district	National and local authorities, businesses and start-ups in the in the territories most negatively affected by the transition process (as identified in the	Member states

Type of funding	Focus on	Recipients	Application via
	heating projects; up- and reskilling of workers; job-search assistance and active inclusion of jobseekers' programmes; transformation of existing carbon-intensive installations.	Territorial Just Transition Plans).	
JTF – Public sector loan facility			
Grant funding and loans	Energy and transport infrastructure; district heating networks; public transport; energy efficiency measures; social infrastructure.	Exclusively for public entities	Member states EC published first calls for proposals JTM-2022-2025-PSLF-STANDALONE-PROJECTS JTM-2022-2025-PSLF-LOAN-SCHEMES
<u>LIFE Programme</u>			
Grant funding	<ul style="list-style-type: none"> - Focusing on the topics 'Environment' and 'Climate Action' under four sub-programmes: Nature and Biodiversity, Circular Economy and Quality of Life, Climate Change Mitigation and Adaptation and – most importantly for coal regions – Clean Energy Transition - Contribute to the shift towards a clean, circular, energy efficient, low-carbon and climate-resilient economy, including through the transition to clean energy; protect and improve the quality of the environment; halt and reverse biodiversity loss, thereby contributing to sustainable development. 	EU national or local authorities, private commercial organisations and private non-commercial organisations (e.g. non-governmental organisations).	LIFE website
Connecting Europe Facility - <u>CEF</u>			
Primarily grants, with different co-financing rates depending on the project type; blending calls	Energy; transport; digital.	The new CEF (2021-2027) will focus more on climate change, digital connectivity and renewable electricity. Industry, small and medium-sized enterprises, research organisations, other public and private entities established in a Member State or in a third country associated with the programme or created under EU law, and international organisations.	CEF website
Research Fund for Coal and Steel - <u>RFCS</u>			
Grant Funding	<ul style="list-style-type: none"> - For steel: clean steel production processes; optimised utilisation and conservation of resources, energy savings and industrial efficiency improvements; 	Universities, research centres and private companies.	RFCS website

Type of funding	Focus on	Recipients	Application via
	emission reductions from steel production. - For coal: health and safety at work; environmental protection; technologies supporting transition away from coal in coal regions.		
<u>Modernisation Fund</u>			
Grants, guarantees, loans, capital injections (decided by Member States)	Generation and use of energy from renewable sources; energy efficiency; energy storage; modernisation of energy networks, including district heating, pipelines and grids; just transition in carbon-dependent regions: redeployment, re-skilling and upskilling of workers, education, job-seeking initiatives and start-ups.	Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania and Slovakia	Member States select the investments they wish to submit for Modernisation Fund support.
<u>Innovation Fund</u>			
Grants (up to 60% of additional capital and operational costs).	Innovative low-carbon technologies and processes in energy intensive industries, including products substituting carbon-intensive ones; innovative renewable energy; energy storage; carbon capture and storage (CCS); carbon capture and utilisation (CCU).	EU Member States	<u>Funding and tender's platform</u>
<u>European Globalisation Adjustment Fund for Displaced Workers - EGF</u>			
Grant funding (co-financing rate 60-85%)	The EGF can co-finance measures such as: help with looking for a job; career advice; education, training and re-training; mentoring and coaching; entrepreneurship and business creation.	EU Member States	Member states via contact person
<u>Recovery and Resilient Facility - RRF</u>			
Grants and loans	Clean technologies and renewables; energy efficiency buildings; sustainable transport and charging stations; rollout of rapid broadband services; digitalisation of public administration and services; data cloud capacities and sustainable processors; education and training to support digital skills.	EU Member States; and, indirectly, EU citizens, public or private organisations and businesses.	Member States (based on <u>NECPs</u>)
<u>REPowerEU</u>			
Grants and loans	Residential building sector: energy efficiency and heat pumps Solar and wind energy	EU Member States by updating/amending the Regulation establishing the Recovery and Resilience Mechanism	Member States (based on updated <u>NECPs</u>)
<u>InvestEU</u>			
Grants, loans and guarantees	- Sustainable Infrastructure; research, innovation and digitalization; small and medium businesses; social investment	Public and private investors, project promoters, and SMEs.	Financial implementing partners (i.e. <u>EIB</u>)

Type of funding	Focus on	Recipients	Application via
	and skills. - Coal regions may especially use this mechanism for strategic investments focusing on building stronger value chains as well as supporting activities in critical infrastructure and technologies		
INTERREG			
Grants	- P1 – A smarter Europe (i) developing and enhancing research and innovation capacities and the uptake of advanced technologies (iv) developing skills for smart specialisation, industrial transition and entrepreneurs' hip - P2 – A Greener, low carbon Europe (ii) promoting renewable energy (iv) promoting climate change adaptation, and disaster risk prevention, resilience, taking into account ecosystem-based approaches (v) promoting access to water and sustainable water management (vii) Enhancing protection and preservation of nature, biodiversity and green infrastructure including in urban areas, and reducing all forms of pollution - P3 – A more social Europe - P4 – A better cooperation governance	local, regional and national public authorities and organisations established and managed by public authorities responsible for research, innovation, technology transfer institutions, sectoral agencies and regional development agencies, networks, clusters and associations, research and development institutions, universities with research facilities, business support organisation (e.g. chamber of commerce, business innovations centres, technology information centres), higher education, education/training centre and school, NGOs, private enterprises including SME, or industrial and technological hubs and parks	Interreg Europe Danube Transnational Programme
<u>Interregional Innovation Investments (I3) Instrument</u>			
Financial and advisory support as grant	- Investments in cross-regional innovation projects under the common priorities of smart specialization (S3), targeting mature partnerships to help them accelerate market uptake and scale-up - increasing the capacity of regional innovation ecosystems from less developed regions to participate in global value chains, as well as the capacity to participate in partnerships with other regions	Legal entities (public or private bodies), established in one of the eligible countries	EIASME Platform (European Innovation Council and SME Executive Agency)

The TRACER target regions from the EU Member States have prepared for launching their Operational Programs (OP), according to the Partnership Agreement 2021-2027 with the EC. Additional bilateral or multilateral assistance through grant-based technical support is available via [UNDP](#), [USAID](#), [CIDA](#), [JICA](#), [EEA and Norway grants](#), etc. for developing and implementing just transition plans, policies and implementation strategies through knowledge transfers, co-creation of policy pathways, trainings, demonstration projects etc.

And last, but not least, facilitating the access of local SMEs to private financing is of great importance. Local financial institutions in EU countries can access EU funds to provide loans, micro-finance or equity financing through venture capital funds or social investors. For more information, visit the [European Investment Fund \(EIF\)](#).

6. Recommendations

From a wide literature review on how the concept has been used and framed by labour organizations, business organizations, researchers, civil society organizations and several country governments, seven basic principles that – taken together – underlie the “justness” of transition can be selected. These principles highlight that supporting just transitions means not only dealing with compensation and employment measures for affected workers, but also looking for ways to ensure environmental protection and restoration, diversify industry and other economic activities, and tackle socio-economic inequity and gender inequality.

These principles provide a framework for making a reality out of the concept of just transition as economies decarbonize. Importantly, the principles should be pursued in parallel, not selectively. That means, for instance, that the absence of adequate support for workers is not in itself a reason for delaying the low-carbon transition, since such a delay would magnify inequalities associated with the impacts of climate change.

A just transition means actively encouraging decarbonization at the same time as putting in place programmes and measures to ensure those affected are supported. As such, the recommended principles for a just, low-carbon transition are (SEI, 2020):

- 1) **Actively encourage decarbonization:** The prospect of negative impacts in carbon-intensive regions is not a reason to avoid or delay decarbonization. Delay is fundamentally unjust. A just transition is one in line with achieving globally agreed climate goals – that is, one that accomplishes a very swift decline in emissions towards a near-zero carbon economy.
- 2) **Avoid the creation of carbon lock-in and more “losers” in these sectors:** Ensure that transition is not undermined by ongoing investment or other forms of support to carbon-intensive industry (where alternatives are available) or fossil fuel production, or to reinforce the dependence of other businesses on these activities.
- 3) **Support affected regions:** Generate opportunities to nurture and maintain economic vitality and stability. Prioritize support to regions with lower financial capacity to invest in diversification, and those who bear lower historical responsibility for global emissions.
- 4) **Support workers, their families and the wider community affected by closures or downscaling:** Provide assistance to find new livelihood opportunities. When re-employment is not possible, ensure that adequate social protections are available. The economic, social and personal impacts of transition should not exacerbate the vulnerability of the most marginalized or weakest people. The transition must not compromise basic rights of workers, or threaten broader human rights.
- 5) **Clean up environmental damage, and ensure that related costs are not transferred from the private to the public sector:** The “polluter pays” principle should be respected.
- 6) **Address existing economic and social inequalities:** Response measures need to include a social equity perspective. Social equity and the empowerment of vulnerable social groups must be an explicit goal in designing support measures, evaluating economic opportunities, assessing impacts, and prioritizing transition support outcomes.
- 7) **Ensure an inclusive and transparent planning process:** This process should be based on wide social dialogue. Economic development paths and priorities should be

determined locally. International cooperation and solidarity are needed for financial and technological support.

7. References and key resources

Key resources

- ✓ EC-CRIT platform [toolkits to support EU coal regions in transition](#)
- ✓ IEA Roadmap for the global energy sector – [Net zero by 2050](#)
- ✓ Wuppertal Institute for Climate, Environment, Energy – [A Just Transition Toolbox for coal regions | Coal Transitions](#)
- ✓ [TRACER deliverables](#)

References

- ACTU (2016). *Sharing the challenges and opportunities of a clean energy economy: A Just Transition for coal-fired electricity sector workers and communities*. Melbourne: Australian Council of Trade Unions. Retrieved from <https://www.actu.org.au/media/1032953/actu-policy-discussion-paper-a-just-transition-for-coal-fired-electricity-sector-workers-and-communities.pdf>
- Alves Dias, P., et al. (2018) *EU coal regions: opportunities and challenges ahead*, EUR 29292 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-89884-6 (online), 978-92-79-89883-9 (print), doi:10.2760/064809 (online), 10.2760/668092 (print), JRC112593. URI: <https://publications.jrc.ec.europa.eu/repository/handle/JRC112593>
- Atteridge, A. and Strambo, C. (2020). *Seven principles to realize a just transition to a low-carbon economy*. SEI policy report. Stockholm Environment Institute, Stockholm. Available at: <https://www.sei.org/wp-content/uploads/2020/06/seven-principles-for-a-just-transition.pdf>
- Dobrin M., et al. (2021). Possible Transition Scenarios from Coal and Financing Opportunities for Jiu Valley Micro-Region. Analyses carried out within the European Tracer project. *EMERG*, Vol. 7, Issue 4, 13-31. doi:10.37410/EMERG.2021.4.01
- Dufour, E., Lisi, V. and Robison, R. (2019). *A guide to the SET-Plan: Including the role of the Social Sciences and Humanities*. Brussel: Cambridge: Energy-SHIFTS. Retrieved from https://energy-shifts.eu/wp-content/uploads/2019/11/Energy-SHIFTS_D1.4_SET-Plan_Scoping-guide.pdf
- EC (2021). *Strategic Energy Technology Plan - SET Plan*. Retrieved from https://ec.europa.eu/energy/topics/technology-and-innovation/strategic-energy-technology-plan_en
- EC (2022). *Energy*. Retrieved from European Commission: https://energy.ec.europa.eu/system/files/2022-05/COM_2022_230_1_EN_ACT_part1_v5.pdf
- EC-CRIT (2021). *Technology Options Toolkit*. Brussel: European Commission. Retrieved from https://energy.ec.europa.eu/topics/oil-gas-and-coal/eu-coal-regions/resources/technology-options-toolkit-transforming-industries-coal-regions-climate-neutral-economy_en
- EC-CRIT (2021). *Transition Financing Toolkit*. Brussel: European Commission. Retrieved from https://energy.ec.europa.eu/topics/oil-gas-and-coal/eu-coal-regions/resources/transition-financing-toolkit_en
- Foray, D., e. al. (2012). *Guide to Research and Innovation Strategies for Smart Specialisation (RIS 3)*. Brussel: Publications Office of the European Union.
- Kapetaki, Z., et al. (2020). *Clean energy technologies in coal regions*, Kapetaki, Z. editor(s), EUR 29895 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-10356-1, doi:10.2760/384605, JRC117938. URI: <https://publications.jrc.ec.europa.eu/repository/handle/JRC112593>

- RES-SKILL PROJECT (20210) *Skills matching analysis and development of transition profiles* — Project co-funded by the ERASMUS+ Programme of the European Union, www.res-skill.eu
- TRACER-D2.2 (2019). *Best practice report: Smart Specialisation Strategies and SET plan implementation actions*. Brussels: TRACER H2020 project. Retrieved from: https://tracer-h2020.eu/wp-content/uploads/2019/10/TRACER-D2.2_Report_final.pdf
- TRACER-D2.4 (2020). *Best practice report on labour markets, social issues and tourism*. Brussels: TRACER H2020 project. Retrieved from: https://tracer-h2020.eu/wp-content/uploads/2020/02/D2.4_TRACER_Deliverable_final.pdf
- TRACER-D5.2 (2022). *Analytical report on the outcomes of the mobilisation process in each region, assessing the views of different stakeholders on the region's current situation, potential and challenges, and possible future actions*. Brussels: TRACER H2020 project. Retrieved from: <https://tracer-h2020.eu/wp-content/uploads/2021/09/TRACER-Report-5.2.-Outcomes-of-EDP-in-Target-Regions.pdf>
- TRACER-D6.1 (2021). *Projections for the transition to 2030 / 2050 in the target regions*. Brussels: TRACER H2020 project. Retrieved from: https://tracer-h2020.eu/wp-content/uploads/2021/06/TRACER-D61_Energy-Projections.pdf
- TRACER-D6.3 (2022). *Report on the needs for workforce retraining*. Brussels: TRACER H2020 project. Retrieved from: https://tracer-h2020.eu/wp-content/uploads/2021/09/TRACER-D6.3_Needs-for-workforce-retraining.pdf