REECOL Ecological rehabilitation and long term monitoring of post mining areas

Deliverable 2.1

Comprehensive overview of the project

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EXECUTIVE SUMMARY

The REECOL project, funded under the Research Fund for Coal and Steel (RFCS), is aimed at developing sustainable technologies for rehabilitating post-mining lands. This project is particularly focused on addressing the ecological challenges and opportunities associated with post-mining areas, ensuring that the solutions proposed are feasible, applicable, and sustainable.

To ensure the delivery of high-quality results, 11 partners from 5 European countries will collaborate and contribute their expertise:

- **from Poland:** „Poltegor – Instytut" Instytut Górnictwa Odkrywkowego (the coordinator), Główny Instytut Górnictwa, Instytut Techniki Górniczej KOMAG, Polska Grupa Górnicza S.A.;
- **from Czech Republic**: Výzkumný ústav pro hnědé uhlí a.s.;
- **from France:** Bureau de Recherches Géologiques et Minières, Institut national de l'environnement industriel et des risques, Valorhiz SAS;
- **from Slovenia:** Premogovnik Velenje d.o.o.;
- **from Greece:** Dimosia Epicheirisi Ilektrismou AE, Polytechneio Kritis.

The research and development actions will be complemented by communication and dissemination activities. These are aimed at building awareness, knowledge, and attitudes among target audiences, which are expected to lead to the future acceptance of the project's results and their subsequent implementation and adoption.

1. Problem Identification

Coal mining has been a critical element of industrial progress since the 19th century, particularly during the Industrial Revolution. This era witnessed a significant surge in the demand for fossil fuels for electricity generation, heating, and powering steam engines. This demand led to the establishment of approximately 50 mining regions across Europe. Despite a gradual decline in coal extraction, the industry remains substantial.

The enduring presence of coal mining highlights its deep-rooted significance in Europe's economic and social fabric. However, the industry faces an inevitable downturn, driven by environmental concerns and the shift towards sustainable energy sources. This transition is at the heart of the European Union's ambitious and transformative European Green Deal, which sets forth a strategic vision to reshape Europe's economy and energy landscape. Central to this vision is the phasing out of coal and a significant reduction in coal-fuelled power plants, targeting a two-thirds decrease before 2030. The broader objective includes a 55% reduction in emissions by 2030, leading Europe towards climate neutrality by 2050.

In this transformative phase, REECOL emerges as an initiative aiming to synergize existing knowledge and methodologies in post-mining rehabilitation. The project's core objective is to facilitate the transition of coal mining areas, focusing on ecosystem rehabilitation and monitoring, and ensuring future land uses are sustainable and cost-effective. By directly addressing the Research Fund for Coal and Steel (RFCS) Programme's third objective, REECOL commits to minimizing the environmental impacts of transitioning coal mines.

REECOL's approach is holistic, encompassing not only environmental rehabilitation but also addressing economic and social dimensions. By focusing on six coal regions in transition across Europe, REECOL ensures that its impact is felt in areas most dependent on coal, thereby facilitating a just and equitable transition. The economic assessment component of REECOL is pivotal, evaluating the commercial viability, employment impact, and added value of new or improved ecosystem rehabilitation technologies and measures.

In summary, the issue at hand is multifaceted: it involves addressing the environmental legacy of coal mining, ensuring economic vitality, and fostering social well-being in regions undergoing transition. REECOL stands at the crossroads of this transition, embodying the objectives of the European Green Deal and serving as a beacon for sustainable and inclusive development in post-coal Europe.

2. Project Goals

REECOL's mission is to make a significant change in how post-mining areas are rehabilitated. To achieve this, the project has set **five clear objectives** that guide its work and strategies:

1) **To assess and catalogue knowledge and experience on post-mining rehabilitation approaches**

   The first objective involves a thorough examination and organization of existing knowledge and experiences in post-mining rehabilitation. The project acknowledges the diversity and complexity of mining sites, each with unique challenges and requirements. By analyzing past projects and drawing from the consortium partners' experiences, REECOL plans to build a comprehensive database. This resource will be invaluable for various stakeholders in the mining industry, aiding in more informed decision-making for site rehabilitation.

2) **To develop and test new solutions for post mining land reclamation, revegetation and ecosystem rehabilitation and analyse costs and benefits of the proposed solution**

   The second goal is focused on developing and testing innovative approaches for land restoration and ecosystem recovery in post-mining areas. This includes planting new vegetation and restoring ecological balance. Recognizing that unsuccessful restoration can lead to significant ecological issues, such as soil erosion and water contamination, REECOL's research is critical. The project will explore various solutions, taking into account different environmental conditions and intended future land uses, aiming to provide reliable and effective restoration strategies.

3) **To develop and test tools for efficient short and long term monitoring of ecosystem rehabilitation, suited for various post-mining rehabilitation approaches**

   The third objective is to create tools for effective monitoring of rehabilitation efforts, both in the immediate and long term. These tools will track key indicators of a successful rehabilitation, employing both ground-based assessments and advanced technologies like satellite imagery. This dual approach ensures a comprehensive evaluation of the restoration's effectiveness, emphasizing the importance of sustainable and enduring recovery efforts.

4) **To develop an innovative certification method for ecosystem rehabilitation of post-mining areas**

   Objective four is to develop a certification method for assessing the quality of ecological rehabilitation in post-mining areas. This innovative certification process aims to establish clear standards and best practices for the industry. It addresses the need for mining companies to rehabilitate their sites responsibly, considering both environmental safety and the intended post-mining land use. The certification method will provide a structured framework to ensure rehabilitation efforts meet these high standards.

5) **To familiarise stakeholders and disseminate results in the coal regions in transition with innovative and sustainable ecological rehabilitation options, requirements for their implementation, long-term viability and socio-economic impact**

   The final objective centres on disseminating the findings and knowledge gained through REECOL to stakeholders in coal regions undergoing transition. This involves educating them about sustainable rehabilitation methods, implementation requirements, long-term viability, and the socio-economic impacts. By sharing insights and innovative approaches, REECOL aims to influence positive changes in post-mining area management, enhancing economic growth, community well-being, and environmental health in these regions.

Overall, REECOL's project goals represent a balanced blend of research, innovation, and practical application, all aimed at transforming the landscape of post-mining rehabilitation. These objectives not only address ecological restoration but also consider the broader implications for communities and industries affected by mining activities.

3. Technical Strategies for Rehabilitation

The approach of the REECOL project is centred around delivering innovative and impactful research that directly benefits coal regions in transition. The project's results are expected to significantly enhance decisions related to post-mining rehabilitation and revitalization, offering environmental protection, relieving unsustainable development pressures on green spaces, and opening up long-term repurposing opportunities in coal-affected areas.

A key innovative aspect of REECOL includes the development of new technologies for rehabilitating land damaged by mining activities. One such ground-breaking approach is the use of highly active composts, guided succession of low-growing plant species, and a novel method of non-contact soil remediation.

1. **Managing Invasive Vegetation and Enhancing Native Plant Growth**

   Addressing the risk of invasive vegetation and reducing the costs of controlling tree growth in post-mining areas are critical components of REECOL's approach. The project plans to develop a novel method for creating anthropogenic soil that supports native plant communities. This method will start at the laboratory proof-of-concept stage (TRL 3) and is expected to advance to TRL 6, involving tests in conditions simulating the real environment.

2. **High-Quality Compost Mixture**

   The project also focuses on developing methods for preparing high-quality compost mixtures to improve degraded soils. The unique composition of this compost will include brown coal and solid organic waste, such as feathers, enhanced by highly active microorganisms. A notable aspect of this process is biosolubilization – a clean technology that transforms low-value carbon into agriculturally valuable humic substances. This process makes valuable nutrients more accessible to plants, starting at TRL level 4 and aiming to reach TRL level 6.

3. **Non-contact soil remediation**

   This remediation technology, involving multi-phase aerosol spraying, is a pioneering solution not currently seen elsewhere in the world. It aims to stabilize, enrich, and provide essential nutrients to the soil while maintaining optimal moisture and structure. The development of this non-contact soil remediation device is set to progress from Technology Readiness Level (TRL) 3 to TRL 6, with a prototype tested under near-real conditions.

REECOL's approach is characterized by its innovative and practical solutions to complex challenges in post-mining rehabilitation. By leveraging advanced technologies and scientific methods, the project aims not only to restore damaged landscapes but also to create sustainable environments that benefit both local ecosystems and communities.

4. Methodology

The REECOL project is structured around a series of carefully designed work packages (WPs), each targeting specific aspects of post-mining ecological rehabilitation. This structured approach ensures that every facet of the project aligns with the overarching objectives and provides a clear roadmap for execution and assessment. The project consists of six work packages in total, with four technical WPs, one dedicated to coordination and management, and another focusing on promotion and dissemination.
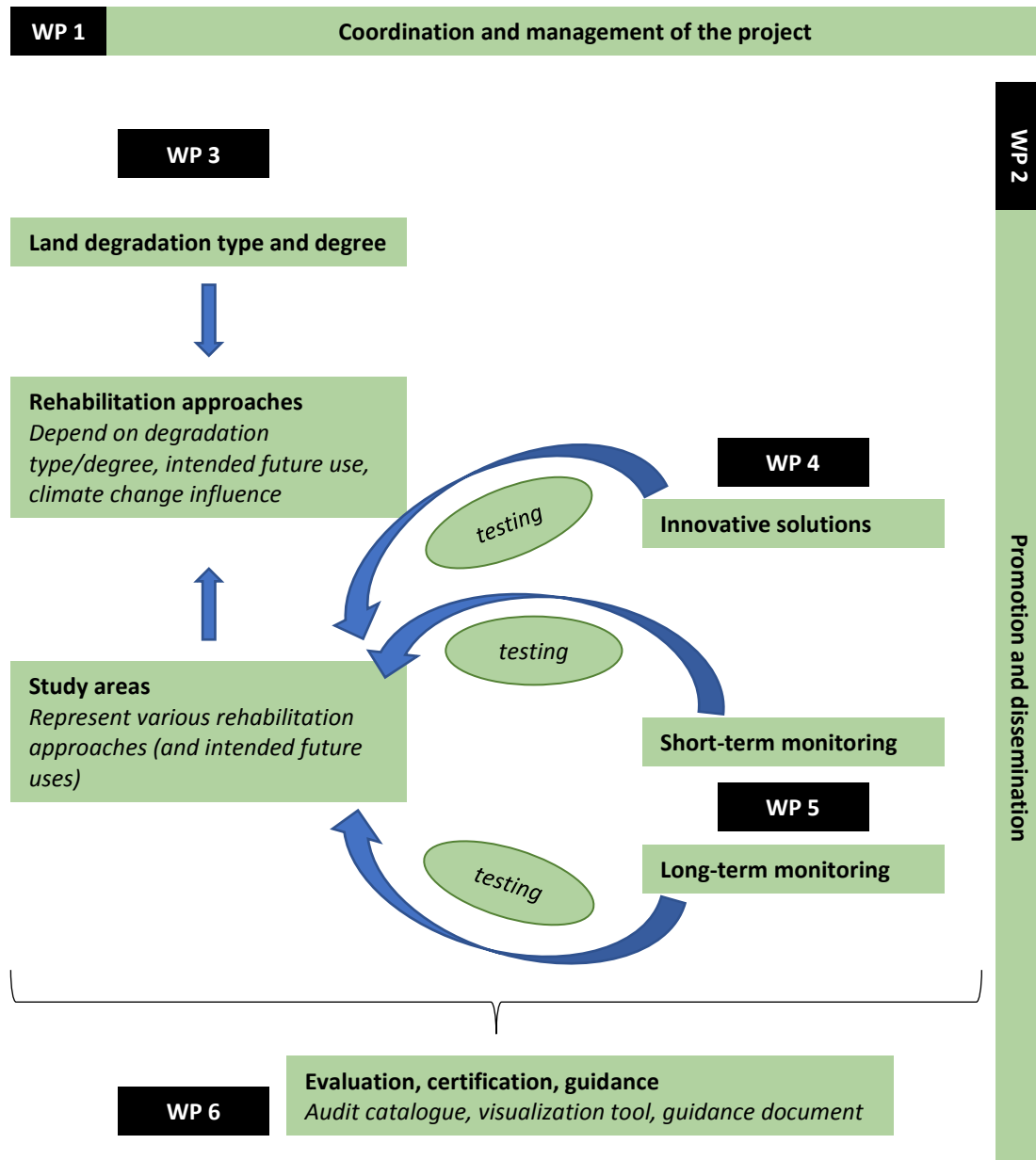
Figure 1. Workflow diagram of Work Package interrelations in the REECOL project

4.1.   Work Package 1: Coordination and management of the project

Work Package 1 (WP1) is essential for the successful execution of the REECOL project, focusing on the coordination and management of all project activities. This work package is responsible for overseeing the progress of tasks, ensuring they align with the set timelines and objectives. A significant aspect of WP1 involves facilitating smooth communication among project partners, which includes regular reporting on each partner's contributions and maintaining an open channel of information flow.

In addition to communication, WP1 manages the technical and administrative aspects of the project. This includes organizing and conducting meetings, handling budget allocation, and ensuring the efficient use of resources across all work packages. Furthermore, WP1 plays a critical role in integrating activities across various work packages, promoting synergy and cohesion within the project.

4.2. Work Package 2: Promotion and dissemination

Work Package 2 (WP2) in the REECOL project is centred around enhancing the project's visibility and ensuring the widespread dissemination of its results. The overall goal of this work package is to effectively communicate the project's findings and innovations to a broad audience, ranging from industry experts to the general public.

A key element of WP2 is the development of a comprehensive Communication and Dissemination Plan. This plan will outline the purpose and scope of the project's outreach efforts, identifying the target audience and stakeholders, defining the core messages, and specifying the methods and timing for message dissemination. The execution of this plan will be closely monitored to ensure effectiveness and reach.

To facilitate the dissemination of project results, WP2 includes the creation and regular updating of a project website and active engagement on social media platforms like Facebook, LinkedIn, and Twitter/X. In addition, there will be a concerted effort from all project partners to publish findings in national and international journals, with a target of at least 20 publications. The project also plans to organize four events within the partnership and participate in at least 12 external events in various countries to further promote its results.

Another significant component of WP2 is the development of a comprehensive handbook summarizing the key findings of the REECOL project. This handbook will serve as a valuable resource for stakeholders involved in or considering post-mining area remediation and restoration. It will offer both innovative ideas and essential technical information, guiding the implementation of various revitalization concepts. This handbook, available electronically, will be widely disseminated through the project's website, partner networks, and an international final conference.

4.3. Work Package 3: Identification of post mining areas and ecosystem rehabilitation approaches

Work Package 3 (WP3) in the REECOL project is focused on the systematic identification and evaluation of post-mining areas, addressing ecosystem rehabilitation approaches, and understanding the impact of climate change. This work package is divided into several key tasks, each contributing to a comprehensive understanding of post-mining landscapes and informing subsequent project activities.

4.3.1. Classification of ecosystem degradation and mapping of degraded land

This task involves classifying post-mining areas based on the degree and nature of land degradation. Factors such as soil fertility, texture, moisture, chemical contamination, and organic matter content will be examined, as these are crucial in determining the viability of revegetation and plant survival. The identified degradation types or classes will be linked with physical, bio-, and geochemical indicators, which will be monitored in WP5.

4.3.2. Identification of post –mining rehabilitation schemes regarding future land uses and affordability of the solutions

This task focuses on characterizing various post-mining rehabilitation schemes, considering different future land uses and the affordability of these solutions. It will assess the time, costs, challenges, and potential difficulties involved in achieving successful rehabilitation. The task will also define appropriate rehabilitation approaches for the land degradation types identified in T.3.1, considering various soil constraints and environmental factors.

4.3.3. Climate change influence on post-mining rehabilitation schemes

The objective here is to analyse the interplay between climate change and rehabilitation schemes for post-mining areas. This task will assess how climate change, including extreme weather events, impacts these schemes. It involves evaluating the technical and biological aspects of land reclamation in the context of changing climate conditions, ensuring the selection of species with a broad range of tolerances, and considering the micro-scale climate impact of land use changes.

4.3.4. Selection of post mining rehabilitation case study areas

In this task, various study areas will be selected to represent different post-mining reclamation schemes as identified in T.3.2. These areas include Amynteon Lignite Mining Area in Greece, PGG's mining areas in Poland, the mining area of PV in Slovenia, Radovesice and Strimice dumps in the Czech Republic, the Konin Brown Coal Mine in Poland, and the former mining site in Mazingarbe, France. Each location will undergo a detailed assessment of its degradation status, biotic and abiotic conditions, contamination, and future land use plans. These study areas are essential for the practical application of new solutions for land reclamation and monitoring in WP4 and WP5, providing a diverse range of conditions and challenges for testing and refining rehabilitation approaches.

4.4. Work Package 4: Development of new solutions for post mining land reclamation and their testing in case study areas

Work Package 4 (WP4) of the REECOL project is dedicated to developing innovative solutions for enhancing soil properties and introducing appropriate vegetation in post-mining areas. This work package encompasses experimental work in real conditions across selected post-mining field plots, as identified in WP3.

4.4.1. Development of directed succession methods for revegetation on post-mining terrains with a high redevelopment potential

This task focuses on developing methods to direct the succession of low-growing plant species on post-mining terrains with high redevelopment potential. Laboratory simulations will be conducted to understand the conditions favourable for this directed succession. Selected herbs and grass species will be tested for their ability to compete with invasive plants and trees. Additionally, cost-effective methods like fertilizer application, organic matter enrichment, and pH correction will be explored to enhance vegetation development. The use of mine tailings as a fertilizing product due to their mineral potential will also be investigated. Subsequently, these approaches will be tested in real conditions on field plots in the study areas.

4.4.2. Development of a technology for non-contact remediation and control of soil parameters with use of bio-waste

The objective here is to create a non-contact soil remediation technology using multiphase aerosol spraying. This technology aims to stabilize and fertilize the soil and maintain optimal growth parameters for plants. It will involve using material from cellulose waste with seeds of plants from T.4.1 and enriching the soil with necessary nutrients from bio-waste. The operation of this technology will be monitored through a system collecting data from sensors and UAVs. A prototype of the multiphase aerosol spraying device will be developed and tested to refine its operational parameters.

4.4.3. Development of a technology for soil regeneration by composts of high biological activity

This task is focused on developing a technology for soil restoration using a compost mixture that includes lignite, solid organic waste, and highly active microorganisms. The process will involve biosolubilization, a clean and cost-effective technology for extracting nutrients from lignite. The composting process will be optimized with pre-grown bacterial inocula to enhance biotransformations. This technique will be tested in semi-technical scale composters and eventually in field experiments to determine the soil additive's behaviour and optimize the composting technology.

4.4.4. Analysis of revegetation possibilities regarding future land uses

The focus of this task is on analysing different revegetation options suitable for post-mining areas, considering factors like climate change adaptation and future land use. The growth of energy plants and industrial crops will be examined, along with the impact of various techniques and soil amendments on soil properties. Field experiments will be conducted to study the effects of bio-waste and compost on soil stabilization and plant nutrition, as well as the soil-plant pollutant transfer in different plant species.

4.4.5. Cost-benefit analysis of the new solutions for post mining land reclamation

This task proposes a framework for identifying the most suitable solution for each post-mining land reclamation context, considering environmental, legal, regulatory, economic, and social issues. It will involve a cost-benefit analysis integrating potential ecosystem benefits generated by revegetation. The assessment will be linked with the technological solutions applied to each site, incorporating rehabilitation performance, costs, and capital and operational expenses.

4.5. Work Package 5: Short and long term monitoring of ecosystem rehabilitation

Work Package 5 (WP5) in the REECOL project is dedicated to developing a robust toolbox for monitoring the rehabilitation of mining areas over both short and long terms, focusing on the ecological functions of the soil and above-ground ecosystems. This work package is crucial in providing the means for data interpretation related to future land uses and ensuring a comprehensive evaluation of soil ecological functions.

4.5.1. Identification of bio- and geochemical indicators for monitoring of ecological functions

This task involves selecting biological (e.g., plant and soil organisms) and geochemical indicators that reflect key ecological functions required for the aimed future land use. These indicators will be chosen based on literature, previous experience, and their robustness for routine analysis. The focus will be on carbon cycling, nutrient availability, pollution retention/transformation, habitat for diversity, and water retention. The indicators will be selected not only based on their ability to reflect the soil state but also on the availability of routine analyses and standardized methods. This task will directly contribute to methodologies for ecological certification in WP6.

4.5.2. Short and long term monitoring solutions for post mining rehabilitation activities in the case study areas

Task 5.2 will acquire on-site data using the identified (bio)indicators to develop and refine short-term monitoring solutions, testing them in selected case study areas from WP3. These solutions will also be used to monitor new reclamation measures developed in WP4. Long-term sustainability of rehabilitation schemes will be measured using long-term monitoring solutions based on satellite imagery and remote sensing data. This task will utilize these technologies in the selected case study areas to monitor reclamation results and observe undesired processes such as the spread of invasive species. Biological vegetation research will be conducted in these areas, assessing the composition and diversity of flora and conducting a comprehensive set of pedological analyses.

4.6. Work Package 6: Developing an audit catalogue to evaluate and certify ecological rehabilitation industry best practice of post-mining areas

Work Package 6 (WP6) in the REECOL project is focused on developing an audit catalogue and a visualization tool to assess and certify the ecological rehabilitation of post-mining areas, aligning with industry best practices.

4.6.1. Development of a European audit catalogue for ecological rehabilitation of post-mining areas

This task involves reviewing existing ecological rehabilitation guidelines and standards, particularly those relevant to UN Sustainable Development Goals for the mining sector and EU Green Deal initiatives. The analysis will structure the schemes based on various criteria, such as origin, type, objective, focus, parameters used, development dynamics, and stakeholder engagement. Insights from WP3 tasks, specifically on post-mining reclamation schemes and climate change influence, will be integral to this analysis. The goal is to establish a set of clearly defined European requirements for ecological rehabilitation, which will be informed by project results, particularly from WP4 and WP5. The developed audit catalogue will serve as a basis for third-party verification or certification processes, ensuring conformity with international best practices in ecological rehabilitation.

4.6.2. Development of a customized visualization tool (dashboard) to visualize ecological rehabilitation progress

The objective of this task is to compile various factors relevant to assessing ecological restoration progress, such as ecosystem function, physical water or substrate conditions, and structural diversity. These factors will be integrated into a semi-automated tool with graphical visualization capabilities, enabling stakeholders to evaluate and compare ecological restoration progress across different mining sites in Europe. The development of this visualization tool will involve considering how it can be effectively used by various stakeholders for monitoring and evaluation purposes.

4.6.3. Development of a practical guidance document for the audit catalogue by the industry end-user

In conjunction with the audit catalogue developed in T.6.1, a practical guidance document will be created to facilitate the understanding and implementation of the audit process. This document will be validated at pilot sites to ensure its effectiveness and applicability in real-world scenarios. The guidance document will serve as a comprehensive resource for industry end-users, providing clear instructions and insights on utilizing the audit catalogue for ecological rehabilitation certification and evaluation.

5. Potential Impact and Value

REECOL's initiatives are specifically designed to significantly enhance post-mining ecological rehabilitation approaches. This improvement takes into consideration various critical factors such as the degree of ecosystem degradation, future land uses, the affordability of solutions, and the impact of climate change. Through these efforts, REECOL aspires to make a substantial positive impact across multiple dimensions.

1) **Comprehensive Environmental Recovery**

   At the heart of REECOL's activities is the development and testing of new solutions for land reclamation, revegetation, and overall ecosystem rehabilitation in coal regions transitioning away from mining. These efforts align with the Research Fund for Coal and Steel's (RFCS) goals of supporting a just transition of coal mines (both operating and in closure) and minimizing their environmental impact. By focusing on innovative land reclamation and rehabilitation, REECOL contributes to the broader goal of transitioning towards a climate-neutral economy. This includes fostering alternative activities on former mine sites and addressing environmental damages from coal mining.

2) **Social Benefits**

   Socially, REECOL's activities are expected to increase stakeholder engagement in innovative rehabilitation policies. Embracing the 4R principle (Reduce, Recycle, Reuse, and Recover), the project aims to have a positive effect on public health. This enhanced willingness to engage in new rehabilitation strategies signifies a shift towards more responsible and community-centric mining practices.

3) **Economic Growth**

   Economically, efficient and effective rehabilitation practices are anticipated to stimulate economic growth in the study sites. By introducing innovative rehabilitation and monitoring methods, REECOL can support economic activities across various sectors, contributing to the revitalization of regions previously dependent on coal mining.

4) **Environmental Enhancement**

   Environmentally, REECOL adopts the DPSIR framework, used by the European Environmental Agency, to understand and address the drivers, pressures, impacts, and responses associated with mining activities. This model will guide the project in adopting innovative technologies and improved monitoring methods to better the state of rehabilitated ecosystems while reducing negative impacts.

5) **Capacity and Knowledge Building**

   In terms of capacity and knowledge development, REECOL will contribute by raising awareness, sharing information, facilitating technology transfer, and shaping opinions. This dimension is crucial for ensuring

REECOL emphasizes the interconnected nature of these dimensions, demonstrating how social, economic, and environmental aspects, often perceived as competing, are actually co-dependent. With proper governance and management, the positive impact across all these areas can be significantly enhanced.

ANNEX: STATE OF THE ART

Current and Completed Relevant Projects

CERA (EIT Raw Materials, 2017-2021)

Focused on establishing a comprehensive certification system for the sustainable extraction and transport of mineral resources. The REECOL project can use the CERA 4in1 certification system to develop an auditable protocol for post-mining area rehabilitation, enhancing industry best practices and sustainability standards.

OPI-TPP 2.0 (Regional Operational Programme of the Silesian Voivodeship for 2014-2020)

This project is cantered on managing post-mining areas in the Silesian Voivodeship, focusing on their economic and environmental transformation. For REECOL, the data and methodologies developed in OPI-TPP 2.0 are valuable for analysing the potential for revitalization and redevelopment of post-mining areas, providing insights into sustainable economic integration and environmental rehabilitation.

RECOVERY (RFCS, 2019-2023)

Dedicated to the land rehabilitation and ecological restoration of areas affected by coal mining, RECOVERY aims to expedite the recovery of ecosystems to a healthy state. REECOL can draw from RECOVERY's approach to ecosystem services to enhance its own strategies for ecological restoration, particularly in understanding the impact of restored ecosystems on human well-being and evaluating alternative restoration actions.

TEXMINE (RFCS, 2019-2022)

Focused on minimizing the environmental impact of extreme weather events on mining operations, TEXMIN is crucial for understanding and managing the effects of climate change on the mining sector. REECOL can extend TEXMIN's research by specifically analysing how these climate-related challenges impact the ecological restoration of post-mining areas, adapting management strategies accordingly.

AMMER (ESA)

Utilizing remote sensing for the assessment of inland surface water eutrophication, AMMER explores the potential of satellite data in complex environmental monitoring. REECOL can adopt AMMER's remote sensing technologies to track the progress and effectiveness of its restoration activities, particularly in evaluating water quality and ecosystem health in rehabilitated mining areas.

RAFF (RFCS, 2019-2022)

Investigating safety and environmental concerns associated with the creation and use of pit lakes, RAFF is developing risk assessment methodologies for these unique landscapes. REECOL can leverage RAFF's findings to enhance its approaches to managing soil erosion, water quality, and overall safety in post-mining rehabilitation scenarios.

SUMAD (RFCS, 2019-2022)

Identifies sustainable uses of post-mining areas, particularly focusing on renewable energy development on waste dumps. REECOL will expand on SUMAD's focus, addressing all aspects of ecological rehabilitation and the reintroduction of ecosystems for diverse future uses.

POMHAZ (RFCS, 2022-2025)

Aiming to improve hazard assessment and risk management in abandoned coal mines, POMHAZ focuses on a comprehensive analysis of post-mining hazards. REECOL can incorporate POMHAZ's methodologies for multi-hazard management into its framework, ensuring a more integrated and safer approach to post-mining land restoration.

HYPASS (ANR, 2018-2021)

Concentrated on innovative approaches for managing steel slag and recovering strategic metals, HYPASS blends environmental protection with economic viability. REECOL can utilize HYPASS's methodologies,

especially in cost-benefit analysis, adapting them to coal-mining site rehabilitation to ensure economic and environmental effectiveness of its restoration strategies.

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Key European Union Policy Frameworks and Documents in Context

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS The European Green Deal COM/2019/640 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS EU Soil Strategy for 2030 Reaping the benefits of healthy soils for people, food, nature and climate, COM/2021/699 final

Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries and amending Directive 2004/35/EC

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy

Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage