Mine toH2

RFCS JT PROJECT

Repurposing a former coal mine: Green hydrogen for the transport sector using the circular economy coupled with the heating sector

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Comprehensive overview of the project

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Executive Summary

The MINE-TO-H2 project is a large-scale demonstration initiative that aims to repurpose the former underground coal mine "Pozo Fondón" (Langreo, Asturias, Spain) into a hub for sustainable hydrogen production and use. By integrating green hydrogen production, renewable energy generation, and heating sector applications, the project contributes directly to the European Green Deal and the objectives of the RFCS Just Transition program.

A 2.5 MW green hydrogen plant—scalable to 5 MW—will be installed, using electrolysis of mine water powered by electricity from a new photovoltaic installation on a former open-pit coal mine and additional renewable sources via a Power Purchase Agreement (PPA). The hydrogen will be stored in 500-bar cylinders and transported via virtual pipeline to a newly built 350-bar refuelling station for intercity buses. Demonstration in real operational conditions will be carried out using hydrogen-powered buses to connect the major cities of Asturias: Oviedo, Gijón and Avilés.

In a novel integration of energy systems, the project also connects the hydrogen plant to the existing geothermal district heating at Pozo Fondón. Waste heat from the electrolyser will be recovered through water cooling and fed into the geothermal loop, significantly improving system efficiency and reducing energy consumption. Figure 0-1 presents a scheme of the MINE-TO-H2 project.

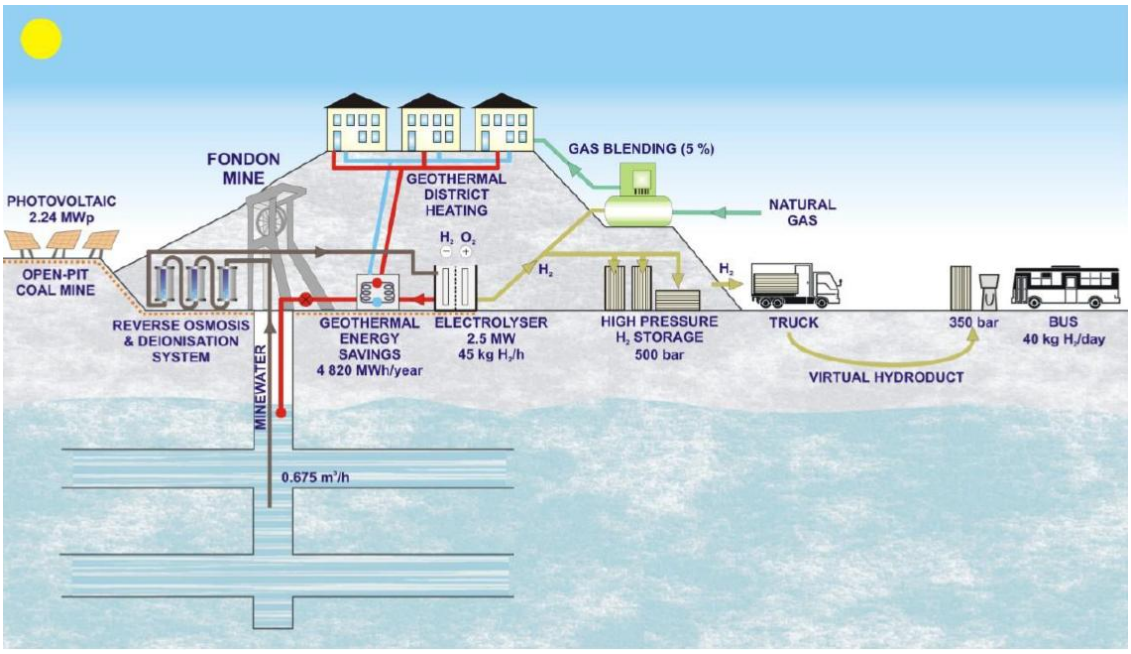

Figure 0-1 Scheme of the MINE-TO-H2 project. All the elements but the geothermal district heating and the natural gas network will be implemented by the project.

MINE-TO-H2 also includes hydrogen blending into the natural gas network, making it the first such initiative in Spain and paving the way for regulatory innovation and industrial-scale implementation of green hydrogen injection.

From a socio-economic perspective, the project addresses the re-skilling and training of former coal workers, develops business models for replication, and conducts benchmarking activities with coal mines in Poland and Slovenia to ensure cross-border applicability. Its circular economy approach valorises legacy mining infrastructures, avoids the use of potable water for hydrogen production, and leverages industrial synergies to enable a just and sustainable transition.

By combining mature and emerging technologies, MINE-TO-H2 advances the technological readiness of integrated green hydrogen solutions and contributes to the creation of quality green jobs, decarbonisation of transport and heating, and the revitalisation of coal-dependent regions.

1 Introduction

This deliverable (D7.6) offers a comprehensive overview of the MINE-TO-H2 project, a five-year large-scale demonstration initiative (2024–2029) funded under the RFCS-2023-JT call, which seeks to contribute to the European Green Deal and the objectives of the Just Transition by transforming a former coal mine into a sustainable, circular energy hub. The project focuses on the repurposing of "Pozo Fondón", an abandoned coal mine in Langreo (Asturias, Spain), through the deployment of a 2.5 MW green hydrogen plant, scalable to 5 MW, integrated with applications in zero-emission public transport and district heating.

MINE-TO-H2 leverages key synergies between mine water, renewable electricity (primarily from a new photovoltaic installation), geothermal energy from existing district heating infrastructure, and natural gas networks. This integrated approach allows the project to simultaneously address decarbonisation in hard-to-abate sectors—particularly road transport and building heating—while maximising circularity and resource efficiency.

The project will demonstrate several innovative components under real operating conditions, including the production of green hydrogen from mine water via electrolysis, its storage at 500 bar, and distribution through a virtual hydrogen pipeline to a refuelling station for intercity buses. These buses, equipped with fuel cell and hydrogen internal combustion technologies, will connect the main cities of Asturias: Oviedo, Gijón, and Avilés.

This deliverable is part of Work Package 7: Communication, dissemination and exploitation, led by the University of Oviedo (UNIOVI). The objectives of WP7 are to:

- Disseminate project results through a multi-platform strategy, including digital media, publications, public workshops and stakeholder engagement.
- Support exploitation of the technological and organisational outcomes by identifying pathways for replication and business model development.
- Organise demonstration activities and maximise project visibility at local, national and European levels.

In particular, Deliverable D7.6 plays a transversal role, providing a coherent narrative that aligns the project's technical work with its environmental and socio-economic ambitions. It serves not only as a formal summary for internal and external stakeholders, but also as a strategic communication tool to position MINE-TO-H2 as a replicable model for coal regions undergoing structural transition.

2 Objectives

One of the energy priorities for the EU is to develop green hydrogen. Green hydrogen can be obtained via electrolysis using renewable electricity to split water into hydrogen and oxygen and is referred to as “renewable fuels of non-biological origin”. It will play a key role in decarbonising sectors where other alternatives might be unfeasible or more expensive. It can replace fossil-based hydrogen for transport and industrial processes and start new industrial products, such as green fertilisers and steel.

The use of innovative energy carriers such as hydrogen, mainly coming from renewable electricity, will play a vital role in the European Green Deal that is committed to tackling climate and environmental-related challenges and transforming the Union into a fair and prosperous society with a modern resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use.

The European Green Deal is supported by the Fit for 55, which consists of a set of proposals to revise and update EU legislation and to implement new initiatives to ensure that EU policies align with the climate goals agreed upon by the Council and the European Parliament. The Fit for 55 package also states that all Union actions and policies should pull together to help the Union achieve a successful and just transition towards a sustainable future, including the Research Fund for Coal and Steel.

The Fit for 55 package includes, among others, a proposal to revise the renewable energy directive. The proposal is to increase the current EU-level target of at least 32% of renewable energy sources in the overall energy mix to at least 40% by 2030. It also proposes introducing or enhancing sectorial sub-targets and measures across sectors. It focuses on sectors where progress with integrating renewables has been slower, particularly in transport, buildings and industry.

Hydrogen can be used as a fuel, an energy carrier or a feedstock and could reduce emissions in hard-to-abate sectors, particularly in industry and transport. In 2022, hydrogen accounted for less than 2% of Europe’s energy consumption and was primarily used to produce chemical products, such as plastics and fertilisers. 96% of this hydrogen was made with natural gas, resulting in significant CO_2 emissions.

The European Commission has proposed to produce 10 million tonnes of renewable hydrogen by 2030 and to import 10 million tonnes by 2030.

Considering the above, MINE-TO-H2 is a demonstration project that addresses the repurposing of the former coal mine “Pozo Fondon” in Langreo (Asturias, Spain) through a 2.5 MW Green Hydrogen Plant, scalable up to 5 MW, where green hydrogen for the passenger road transport sector will be produced using circular economy actions:

- by electrolysis of mine water, and
- with electricity from a photovoltaic installation located in a former open-pit coal mine and other renewable

The green hydrogen produced will be stored in 500-bar pressure cylinders. It will be transported by a virtual hydroduct to a hydrogen refuelling station at 350 bar built for intercity buses with fuel cell technology and H_2 internal combustion engines, helping to decarbonise passenger transport by road.

The project will include the premiere European testing and demonstration in actual conditions of intercity buses, which CaetanoBus and others are currently developing, to connect Asturias's most important and populated cities: Oviedo, Gijón and Avilés.

In addition, the Green Hydrogen Plant will be coupled to the heating sector in two ways: (1) by blending part of the hydrogen into the existing natural gas grid; and (2) by hybridising with the existing geothermal facility at "Pozo Fondon", improving the energy efficiency of the whole system by employing a new waste heat recovery process by cooling the electrolyser.

A Coal Mining companies Benchmarking will be developed in a Polish underground coal mine and offered to an underground Slovenian mine to address the feasibility of the solution developed under the MINE-TO-H2 proposal in other European countries, as well as to demonstrate its replicability.

Specific SMART objectives of MINE-TO-H2

1. More circular economy activities within former coal mines: using mine water for electrolysis to save water from the population supply.
2. Significant climate change mitigation: achieving relevant energy savings in geothermal district heating by employing a new waste heat recovery process via electrolyser cooling.
3. Better adaptation of coal mines to phase-out transformation: by assessing the feasibility of the proposed green hydrogen plant solution for selected locations in coal mining companies.
4. Increased coal mine management motivation to invest in renewables: by demonstrating the economics of green hydrogen plants and the advantages that former coal mines represent for this kind of investment based on the MINE-TO-H2 project.

5. An increased number of former coal miners trained and re-skilled in renewable energies: by developing and implementing training and re-skilling programmes to handle green hydrogen plants.

2.1 Key performance indicators (KPI)

Following the above specific objectives, the Key Performance Indicators are proposed in Table 1. All the objectives are realistic and achievable during the MINE-TO-H2 project duration.

Table 2-1 Key Performance Indicators.

#	KPI description	Related objective	KPI range	Related task/date
1.	Amount of mine water that is used to undergo the electrolysis	1. More circular economy activities within former coal mines	At least 13 m3 of mine water is used for the electrolysis of 1000 kg of hydrogen	Task 5.2 Cold testing Completion date: Month 42
2.	Amount of energy saved by the geothermal district heating through a new waste heat recovery process by cooling the electrolyser	2. Significant climate change mitigation.	At least 4,000 MWh/year of energy savings by employing a new waste heat recovery process by cooling the electrolyser to feed the geothermal district heating	Task 5.3 Hot testing Completion date: Month 45
3.	Number of coal mining companies that are advised on whether the project is feasible in their circumstances	3. Better adaptation of coal mines to phase-out transformation	At least 3 coal mining companies from two different European countries are advised on the feasibility of the solution in their specific location and installations	Task 6.2 Coal mining companies benchmarking Completion date: Month 45

#	KPI description	Related objective	KPI range	Related task/date
4.	Number of managers from coal mines responsible for investments that are trained on the business plan of the green hydrogen plant	4. Increased coal mine management motivation to invest in renewables	At least 10 managers from different coal mines responsible for investments trained on the adaptation and implementation of green hydrogen plants in former coal mining environments	Task 6.3 Business case development Completion date: Month 51
5.	Number of former coal miners trained and re-skilled to handle green hydrogen plants	5. An Increased number of former coal miners trained and re-skilled in renewable energies	At least 20 workers of different countries will be trained and re-skilled according to the needs to facilitate the operation of the green hydrogen plant	Task 6.4 Training and re-skilling Completion date: Month 54
6.	Number of km done in one day of transport demonstration	2. Significant climate change mitigation	More than 300 km per day when connecting the most important and populated cities of Asturias: Oviedo, Gijón and Avilés	Task 7.4 Exploitation strategy development Completion date: Month 56
7.	Kg of H2 produced per hour in the electrolyser	2. Significant climate change mitigation	At least 40 kg of H2 produced per hour	T5.4 Operational phase Completion date: Month 54
8.	Percentage of H2 injected	2. Significant climate change mitigation	At least 2.5% of H2 injected per year	T5.4 Operational phase Completion date: Month 55

By meeting these objectives, MINE-TO-H2 positions itself as a pioneering initiative in Europe, not only from a technological standpoint but also as a policy-relevant, socially inclusive model for coal regions seeking a viable and sustainable future beyond carbon-intensive industries.

3 Approach

MINE-TO-H2 is an ambitious project aiming to bridge the gap between Research and Innovation by leveraging critical competitive advantages in former coal mine environments addressing the production of green hydrogen.

In the first place, with water electrolysis being the most promising method for green hydrogen production, MINE-TO-H2 goes beyond state of the art, focusing for the first time as a novelty on the following circular economy actions addressing end-of-life coal mines:

By employing mine water as an input for the electrolysis. Water represents an essential raw material for producing green hydrogen by electrolysis. Mine water can be re-used for the production of hydrogen through electrolysis. Currently, formed mines are flooded by the same phreatic level at an artificial minor level through water pumping to a security level to avoid affection to buildings, industry and other areas. This process has to address a problem for its operation as input for electrolysis due to seasonal variations in the physicochemical characteristics of the water, as well as variations induced by different rainfall. By re-using mine water for the electrolysis there is no need to employ another water supply.

By using renewable energy from photovoltaic installations to be located in a former open-pit coal mine, considering at the same time reserve plots for contingencies. Given that the area occupied by a close former open-pit coal mine is quite extensive, it is possible to consider different use actions. MINE-TO-H2 will use these areas for photovoltaic energy generation, addressing their specific problems, mainly geotechnical and geomorphological issues.

By hybridising with geothermal facilities. Geothermal energy is a renewable source that harnesses the heat from inside the earth, in our case, through the water that floods the mines. MINE-TO-H2 will develop a novel concept introducing a new waste heat recovery process to increase the overall efficiency of the district heating through the cooling of the electrolyser, as the energetic losses of the electrolyser are in the form of heat. It will be done with water in a closed circuit (the common ones with this kind of electrolysers are air condensers) to reduce significantly heat pump consumption (around 7%).

In the second place, MINE-TO-H2 includes green hydrogen storage and distribution at 500 bar, something that also represents a novel approach with a twofold innovation:

High-pressure on-site storage at 500 bar. There is no 500-bar distribution in Spain, being a substantial improvement because more hydrogen can be transported with the same energy (three times as much). The current storage and distribution pressure is 200 bar.

Some 350 bar systems are beginning to be installed in France and England, although these products are now coming onto the market. MINE-TO-H2 will demonstrate storage and transportation at 500 bar.

Site hydrogen refuelling without compression. The refuelling facilities will address public transport vehicles and trucks that use a refuelling pressure of 350 bar. Thus, using a distribution pressure of 500 bar, installing a hydrogen compression facility at the refuelling stations will not be necessary. This will reduce the investment and maintenance costs of these facilities significantly. To pressure down from 500 to 350 bar at the refueling station a dispenser will be used to fill in the Buses tank at 350 bar. The dispenser is a pressure reduction device as well as a flow measure and control device which is coordinated with the vehicle.

In the third place, MINE-TO-H2 will complement the coupling with the heating sector developed via hybridising with the geothermal facilities by blending part of the hydrogen into the existing natural gas grid. Spain has no grid injection experience yet, and MINE-TO-H2 would be the first. The injection will be a scaling-up of the R&D developed by HYREN on the performance of gas infrastructures and consumers' appliances, demonstrating the hydrogen admissibility level of the different equipment, enabling the technology to be adapted on an industrial scale, being a novelty through breakthrough technology.

Moreover, Europe has no consensual regulation on injection conditions into the network. MINE-TO-H2 will allow a real example that can be used to develop the legislation’s problem and analyse grid behaviour.

Finally, MINE-TO-H2 will test and demonstrate in real conditions for the first time the intercity buses to connect the most important and populated cities of Asturias: Oviedo, Gijón and Avilés. Currently, intercity buses fueled by hydrogen are not an existing technology.

4 Methodology

The methodological framework of the MINE-TO-H2 project is designed to integrate technological demonstration, socio-economic transformation, and cross-regional replicability into a single operational model. The project is structured to advance from detailed planning and technical preparation to real-world implementation, validation, and transferability assessment, all within a controlled but scalable environment.

The methodology addresses five key challenges identified in the project design phase (figure 4.1), each linked to specific technical risks, validation needs, and socio-institutional barriers. These are tackled through an iterative and multidisciplinary work plan, supported by continuous monitoring and evaluation via Key Performance Indicators (KPIs) as outlined in Section 2.

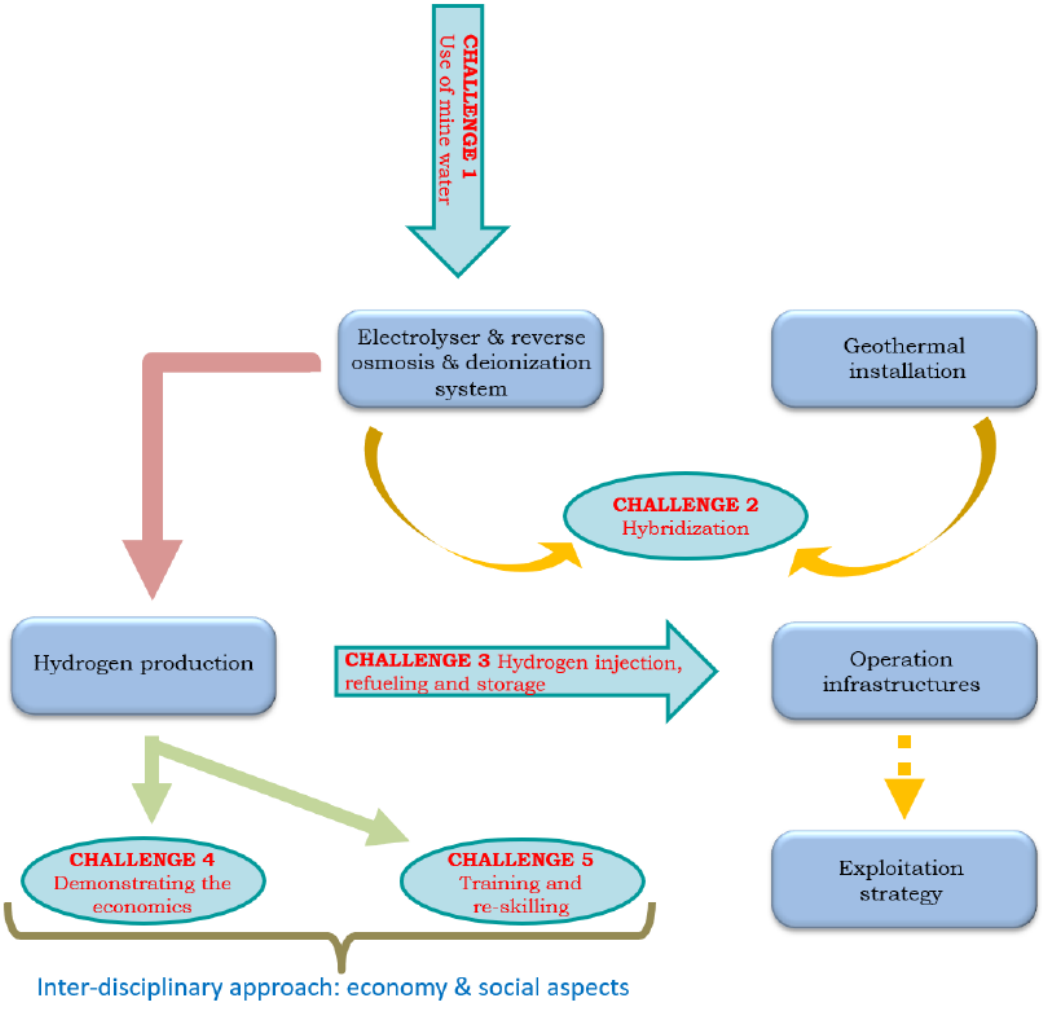

Figure 4-1 The overall methodology of MINE-TO-H2.

4.1 CHALLENGE 1: Use mine water to feed the reverse osmosis and deionisation system

Regarding water quality, electrolysers need an outstanding quality of purified water, especially mineralogical concentration, turbidity or electrical conductivity, to optimize their production and performance and extend their useful life, thus reducing their maintenance by avoiding additional economic costs and not reducing productivity.

The water quality currently pumped from the closed mining wells is continuously monitored through periodic checks and analyses, and its physicochemical characteristics are well known. As they are subsoil waters, these characteristics vary in each location and depend mainly on the mineralogical formation of the area in which they are. Moreover, characteristics may change due to seasonal variations in the physicochemical characteristics of the water, as well as variations induced by different rainfall.

The water quality of Fondón mine is not very good, with pH between 7,8 – 8, a high level of conductivity over 1000 µS/cm, and high Fe content up to 7 mg/l. In addition, it has a high level of Suspended solids (7 mg/l), Sulphates (350 mg/l) and dissolved magnesium (55 mg/l).

To adapt this water to the requirements that the manufacturers of electrolysers request for their proper functioning, it is necessary to have a treatment plant located between the pumping well and its entrance to the plant. This water quality will request a specific design for its treatment through Reverse Osmosis and Electro-Deionization, adapting the prefiltering, the membranes for the process and recirculating levels.

Mine water consumption is estimated at 3780 m3/year, with an hourly consumption of 630 l/h. After a preliminary solid filtration, the technology selected for MINE-TO-H2 is a reverse Osmosis process that consists of passing water through a semi-permeable membrane at a high differential pressure exceeding the osmotic pressure. The process will be completed with Electro-deionization (EDI), consisting of passing the water through resin chambers delimited by ion-selective membranes.

The amount of water to be provided as an input to the plant extraction must be carried out by pumping. The existing facilities already have equipment and facilities adapted to perform this pumping, so they are usable equipment. The flow rates required by the electrolysers will not be the same as those currently pumped, needing the inclusion in the project of an adequately dimensioned intermediate storage tank, whose primary function will be to ensure the supply for the proper functioning of the electrolysers in terms of volume and flow required. To overpass this problem, a pump will be used with a fixed speed, operating against the water tank level installed upstream of the module. Thus, the pump operates whenever the water inventory in the tank falls below a certain level.

The water requirement is estimated at one m3/h. The accumulated experience shows for Hunosa the evidence of a sufficiently high flow in the water drains naturally from the La Nalona mine. This has been the case for decades, with sufficiently high flow levels.

The raw water pipeline will include a connection to allow the installation of a second electrolyser, identical to the one that is going to be installed under the MINE-TO-H2 project, to allow the possibility of scaling the project up to 5 MW, requiring a second electrolyser (not under the MINE-TO-H2 project). The pump system will also consider the historical pumping data, the meteorological data, the safe water level in Fondon Mine, the water balance of the area and the water monitoring.

4.2 CHALLENGE 2: Hybridization with the existing geothermal plant

There is no previous experience of heat reuse and the challenge is to analyse how it behaves and what the energy utilisation percentages are, both in real and theoretical phases, and to see how much the district heating is optimised. We have to match the cooling conditions of the electrolyser (flow and temperature) with the operating conditions of the coolers, which are the operating conditions of the machine's evaporator. It is necessary to operate within this working map. The surplus energy that has to be dissipated from the electrolyser and cannot be used in the geothermal plant will have to be cooled with mine water.

The technology selection analysis will be focused on electrolysis technology between technologies developed in the market for industrial level: Polymer Electrolyte Membrane (PEM) and Alkaline (ALK). Other technologies, such as Solid Oxide Electrolyser Cells (SOEC) or Anion-Exchange Membrane (AEM), will not be considered as their implementations for industrial scale are being studied for the time being.

Alkaline electrolysis is the most mature and developed technology of all production technologies. It is characterized by using a liquid electrolyte, which is generally an alkaline solution. PEM technology, though, can withstand higher current densities than other electrolysis solutions, which translates into a smaller footprint for equipment stacks. In the electrochemical reaction of electrolysis of water with PEM, the electrolyte is a solid polymeric membrane. This technology has less time in the market but is quickly growing. PEM electrolyser system typically has lower footprints, lower electrical consumption, faster start-time from standby, higher flexibility in ranges of operation, and higher purity of the product. On the other side, it has higher capital expense (CAPEX). However, the deployment of the technology is slightly higher than ALK.

Regarding Electrolysis, the main challenge will come from the target of obtaining an improvement of the Global Efficiency of the whole Plant, higher than adding individual efficiencies of either, making most of the waste heat in the Electrolysis system for the

reduction of electricity consumption in the District Heating, and avoiding other complementary cooling systems for the Electrolyser as Aero-condensers.

Therefore, the integration of heat recovery from electrolysis is not only interesting from the point of view of having a new resource, which will allow us to expand the heat network and reduce CO2 emissions, but it is also a very efficient solution to be implemented in the current geothermal network to improve the performance of the entire system.

4.3 CHALLENGE 3: Hydrogen injection into natural gas grids, hydrogen refuelling and storage

Hydrogen injection into natural gas grids and blending systems have become promising solutions to enable a cleaner and more sustainable economy energy transition scenario (for example, hydrogen can be used to support the integration of intermittent renewable energy sources into the grid, helping to balance the supply and demand of electricity). In recent years, significant progress has been made in developing hydrogen injection and blending technologies, with many pilot projects and demonstrations taking place worldwide.

There are still several challenges that need to be addressed to enable the widespread adoption of hydrogen injection into gas distribution grids and blending systems, including the cost and scalability of hydrogen production and delivery, as well as the need to improve the efficiency of renewable hydrogen production, the adaptation of existing infrastructures, and the implementation of adequate safety measures and the required and reasonable standards and regulations development and deployment.

Research and pilot projects are necessary to assess this technology's technical and economic feasibility in the case of distribution and transportation networks. Several materials and tests are being developed and shall be done in the market to define materials and mixtures valid for secure operation of the insfraestructure, and to provide evidence for the standards and regulations that shall be developed in the incoming years.

Spain has no grid injection experience yet, and MINE-TO-H2 would be the first. The injection will be a scaling-up of the R&D developed on the performance of gas infrastructures and consumers' appliances, demonstrating the hydrogen admissibility level of the different equipment, enabling the technology to be adapted on an industrial scale.

Part of the hydrogen production from the electrolyser (variable depending on the network's consumption and the maximum percentages allowed by the regulations of the Gas System Technical Manager) will be directly connected through a blending and

injection system to the nearby natural gas distribution network (less than 1 km away). The primary function of the blending system is to mix hydrogen and natural gas in a predetermined proportion before injecting it into the natural gas distribution network. This mixture aims to reduce CO2 emissions and adapt the distribution network to use hydrogen as a renewable energy source.

The permissible blending percentages in natural gas distribution networks depend on various factors, such as the quality of natural gas, pressure in the network, and hydrogen absorption capacity, among others. The blending of 2 to 5% is the most commonly used blending percentage as it is considered a safe and stable proportion for the distribution network. It is compatible with most combustion equipment that uses natural gas. The blending system consists of different elements, such as a measurement and control system that determines the optimal proportion of the mixture and safety and protection devices such as valves and leak detectors.

Once the hydrogen and natural gas are mixed, it is injected into the distribution network. The injection system is responsible for introducing the mixture into the network, ensuring that the required technical and safety specifications are met, adjusting the pressure of the hydrogen and natural gas mixture to the levels needed for the distribution network and controlling the flow rate of the injected mixture. The allowable blending percentage is not always feasible as it depends on the flow rate of the distribution network at any given time.

It is important to note that the function of the blending and injection systems is critical to ensuring the proper integration of hydrogen into the natural gas distribution network.

Regarding H2 injection in Natural Gas distribution network, it is still not regulated in Spain. A new Technical Note is under review at this moment, which shall allow a 5% volume of Hygrogen blending.

On the other hand, the main challenges associated with hydrogen refuelling stations include the high capital costs and low utilization rates, the need to improve the efficiency of renewable hydrogen production, the implementation of adequate safety measures, and the development of a reliable and sustainable hydrogen supply chain for the long-term success of this technology. Developing hydrogen refuelling stations is a complex process requiring collaboration between governments, industry, and other stakeholders. However, with continued investment and innovation, hydrogen fuel cell vehicles and refuelling infrastructure could be essential in transitioning to a more sustainable energy system.

The development of hydrogen refuelling stations is still in its early stages, and relatively few stations are available worldwide. There are many opportunities for the development of hydrogen refuelling stations. For example, hydrogen can store excess energy from renewable sources, helping to balance the grid and reduce curtailment.

Additionally, fuel cell vehicles offer the potential for zero-emission transportation, which can help reduce air pollution and greenhouse gas emissions.

At present, hydrogen refuelling station technology is still evolving, and several different types of stations are in use or under development. The most common type of station is the compressed hydrogen station, which compresses hydrogen gas to around 700 bar for storage and dispensing for domestic and light commercial vehicles and about 350 bar for heavy-duty vehicles. Another type of station is the liquid hydrogen station, which stores hydrogen in a cryogenic liquid state at -253°C.

Within MINE-TO-H2 a 500 bar storage loading and unloading system will be installed and tested, a transportation tube-trailer – 500 bar (loading system), and a HRS Dispenser from 500 bar to 350 bar H2 Bus tank.

Several emerging technologies for hydrogen storage and dispensing, such as metal hydride and solid-state hydrogen storage, offer the potential for higher storage densities and improved safety. Additionally, some companies are developing mobile hydrogen refuelling stations, which can be used in areas where it is not feasible to build a permanent station. Overall, hydrogen refuelling station technology is still evolving, and there is ongoing R&D to improve efficiency, reduce costs, and increase safety.

Despite the progress made in hydrogen storage, several challenges still need to be addressed. One major challenge is achieving high storage density at a reasonable cost, which requires the development of new materials and storage technologies. The safety of hydrogen storage systems is also a concern, as hydrogen is highly flammable and can pose a risk in case of a leak or rupture. Another challenge is the compatibility of hydrogen storage with existing infrastructure and transportation systems. Developing an efficient hydrogen supply chain requires investment in the production, transportation, and distribution of hydrogen and the development of refuelling infrastructure for fuel cell vehicles.

In conclusion, hydrogen storage technologies have made significant progress in recent years. However, several challenges still need to be addressed to achieve widespread adoption of hydrogen as a sustainable energy source. Further research and development are required to improve storage density, safety, and compatibility with existing infrastructure and transportation systems.

4.4 CHALLENGE 4: Demonstrating the economics of green hydrogen plants

This challenge represents a twofold inter-disciplinary approach to economy (social sciences): First, the need to assess the feasibility of the proposed green hydrogen plant solution for selected locations in coal mining companies, undertaking a coal mining

companies benchmarking (CMB) by developing and testing a mechanism to investigate the possibility of multiplying the solution based on repurposing former coal mines into green hydrogen plants.

To undergo this challenge, MINE-TO-H2 will (1) identify and describe the technological and operational parameters of the solution based on the work carried out in the previous work packages; (2) identify the economic conditions for the implementation and operation of the investment; and (3) test the tool for selected locations and formulating recommendations for the business model.

A Coal Mining companies Benchmarking (CMB) will be developed in three underground coal mines to address the feasibility of the solution developed under the MINE-TO-H2 proposal in other European countries, as well as to demonstrate its replicability. GIG-PIB foresees a specific budget category to run water analyses from different locations when they cannot be provided by the stakeholders, as water quality is a critical variable for the economic feasibility of the whole process.

The overarching aim of the CMB process is to structure the assessment process, the feasibility of the solution for selected locations, and the awareness among decision-makers responsible for investing and development strategies. Critical paths to implementing alternative activities on former mine sites will be identified.

Based on the experience gained with the specific deployment of the green hydrogen plant and on the coal mining companies benchmarking (CBM), a business case will be developed to encourage other coal mining companies to follow this innovative business alternative. Again, four managers from the previously mentioned Polish and, if possible, from the Slovenian mine will be trained in the business case to test to point out any shortcomings and improvements they consider appropriate.

The business case is a strategic instrument or tool used to assess and make the best investment decision in initiatives or projects proposed by users or the business, to organize, plan and prioritize the tasks that must be undertaken in the short, medium and long term. The business case will define this investment opportunity to assess its scope and the option or not for the mining company. It will estimate whether the project is profitable for the organization and whether the future project adds value to the mining company.

The business case will be the document that has to be brought before a committee to be valued by financiers, lawyers, directors, and area users, who, after all, will be the great beneficiaries of the project. The steps to create a business case are: (1) Define the project and its objectives; (2) List the background and problems to be solved; (3) Calculate the metrics: NPV (Net Present Value), IRR (Project Internal Rate of Return) and Net Cash Flow; (4) Assess Risks and create a strategy to mitigate them; (5) Prepare a plan to present and communicate it; and (6) Conceptualize the scope of the project.

In short, the business case will be a management tool for coal mine companies and other stakeholders, which supports the definition and clarifies whether or not a project of a green hydrogen plant adds value to the organization or if, on the contrary, it is an investment that has not been perfectly defined and contrasted with alternative solutions inside or outside the company.

4.5 CHALLENGE 5: Training and re-skilling of former coal miners

Handling and maintenance of green hydrogen plants (electrolysers, depuration, storage, etc.) is a new activity, and the workers have to be trained, so till the moment, there is no formation, and there are no people formed in this area.

Former coal miners must be trained and re-skilled in renewable energies by developing and implementing training and re-skilling programmes to handle green hydrogen plants. This challenge also represents an interdisciplinary approach to social aspects supporting the just transition of the coal sector and regions and improving the management of the workforce, something that may be difficult to achieve.

The number of workers required to run the hydrogen plant will depend on the working regime. MINE-TO-H2 will train twelve HUNOSA workers to operate the plant and be available if needed. These operators already have a technical background in industrial plants (electrical and mechanical knowledge) but with a focus on coal mining and conventional thermal power plants.

However, a hydrogen plant is a complex and sensitive system that requires constant supervision to ensure safe and efficient operation. Therefore, workers must be appropriately trained and have the necessary knowledge and skills to operate and maintain the plant effectively.

Operators working in a hydrogen plant need technical training in the technology and process. In addition, they need to understand the principles of hydrogen handling safety and the plant's control and monitoring systems. Specific training may include training in hydrogen production processes, storage and distribution systems, risk analysis, safety standards and quality control.

Relevant training and re-skilling programmes will facilitate upgrading skills and transfer these former coal mining occupations to the renewable energy sector. The programmes can serve as reference guidelines for planning or updating curricula to upgrade or develop new skills at different educational levels: vocational schools and apprenticeships, continuing education and training, and university-level courses. To validate the training and re-skilling programmes, a test of them will be carried out using five subject matter experts so that they can point out any shortcomings and improvements they consider appropriate.

4.6 Work Plan of the project

The work plan is divided into seven interlinked Work Packages (WPs), which are presented in Figure 4-2:

- WP1: Project management and coordination.
- WP2–WP5: Technical design, integration and demonstration (electrolysis, water treatment, heat recovery, transport, blending).
- WP6: Benchmarking, replicability and business model development.
- WP7: Communication, dissemination and exploitation.

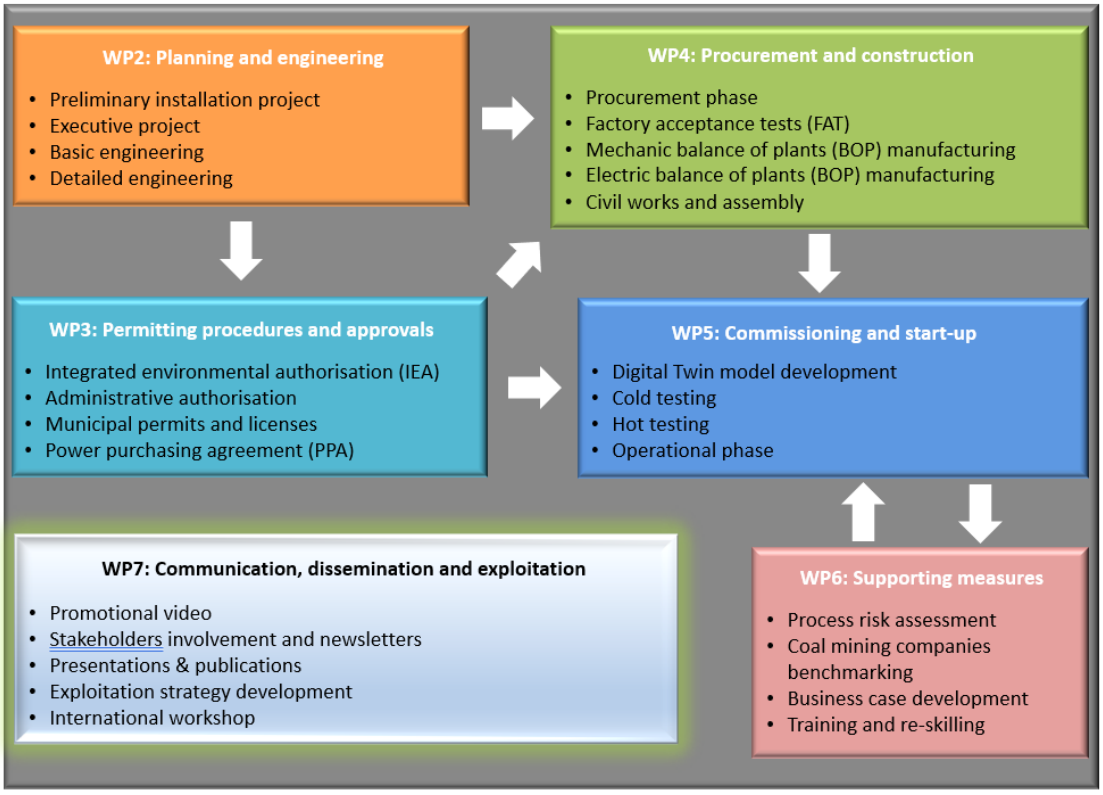

Figure 4-2. Work plan of the MINE-TO-H2 project

5 Impact

5.1 Pathways towards impoac

MINE-TO-H2 will provide opportunities and attract investment, innovation and jobs to coal regions in transition through repurposing former coal mine sites addressing green hydrogen production using the circular economy, renewable energies and coupling with the heating sector. Developing a green hydrogen plant will enable coal mining companies to understand, evaluate, design and implement this alternative economic activity leaving behind short-term patchworks, promoting sustainable local economic growth based on renewable energies, and maximising the number of green and quality jobs.

The proposal will leverage key competitive advantages of underground and open-pit coal mines, enhancing any other project focused on similar technologies but in different environments and creating sources of wealth and sustainable resources from problems such as coal waste heaps and mine water that will become solutions for photovoltaics and as a raw material for electrolysis. Thus, it will allow the re-purposing of former coal mines, promoting sustainable economic growth in places that will remain abandoned and will not contribute to maintaining the economic activity of surrounding areas.

Moreover, it will contribute to protecting the most vulnerable workers in the transition by addressing the skill gaps of former coal mining workers and developing a framework for training and re-skilling. Simultaneously, the climate transition, giving a clear roadmap considering for the first time the potential of end-of-life coal mines to develop green hydrogen plants. This approach nowadays is entirely inexistent.

Another pathway towards impact is increasing energy efficiency in electrolysis plants by hybridisation with a geothermal installation. The standard air-cooling equipment is avoided, as the plant incorporates a process of heat recovery from the electrolyser, improving the energy efficiency of the whole system, something that can be extrapolated to all installations to be built in the future in former coal mining areas.

The proposal is replicable in mines with geothermal installations or even without them, where it is possible to use the mine water. Moreover, MINE-TO-H2 is a scalable project, as it uses 2.5 MW electrolysers cells and stacks specifically designed to be joined one after another in different periods.

MINE-TO-H2 goal to produce green hydrogen becomes a vital decarbonisation option in processes where electrification and other solutions are not available, facilitating the transition to a carbon-neutral industrial base in energy-intensive industries such as steel, cement, etc., or fossil fuel consumption sectors like transport.

It will contribute to socialising hydrogen by making society less afraid of it and eliminating the perspective that it poses a greater safety risk than other fossil fuels, spreading the hydrogen culture among contractors and subcontractors by facilitating their learning and encouraging the market to move in this direction.

On the other hand, green hydrogen storage and distribution at 500 bar is a novel approach with a twofold innovation. First, Spain has no 500 bar distribution, and much more hydrogen can be transported with the same energy at this pressure. Second, installing a hydrogen compression facility at the refuelling stations at 350 bar will not be necessary.

Regarding hydrogen injection, there is no consensual European regulation on the conditions for injection into the network, allowing a real example that can be used to develop the problem of this standardisation and to analyse the grid behaviour in an actual situation. MINE-TO-H2 will take advantage of existing gas infrastructures, minimising the impact of building new infrastructures from an economic and environmental point of view. Thanks to the availability of gas system infrastructures constructed already and with high capillarity, a gradual and modular transition are enabled for all natural gas consumers and facilitate achieving economies of scale as soon as possible.

The injection of hydrogen through blending into existing gas networks also results in an efficient energy transition, enabling the decarbonisation of complex sectors to electrify and maximising the use of infrastructures to provide a different service and extend their useful life. The transformation of natural gas infrastructures can be gradual in terms of the levels of hydrogen injected and the regions to be converted, allowing the adoption by the different sectors to be modulated according to their situation (location, adaptation costs and timescales, international competitiveness, etc.). Through adaptations to existing natural gas networks and combustion equipment, these levels can gradually increase and eventually evolve towards the exclusive use of green hydrogen.

Finally, hydrogen-powered intercity buses, generating zero emissions, will provide the necessary autonomy to complete a full working day and significantly reduce recharging times compared to battery-powered electric vehicles (from hours to 9-10 minutes), with consequent cost savings and increased availability. As an effect of this, hydrogen-powered intercity buses will encourage the passenger transport market to begin the leap towards the development of intercity coaches, using the same 350 bar infrastructure as intercity buses.

As there is no green hydrogen market in the region (and very limited in Spain) to compete with fossil fuels in mobility and gas distribution, MINE-TO-H2 will be a market demand tractor in Asturias and Northern Spain, aiming to be the precursor of other

possible complementary projects, as well as the development of a University-Business Campus focused on hydrogen, helping public administrations and authorities to undergo a hydrogen learning process, facilitating the following projects to come.

5.2 Scale and significance of the project's contribution to the expected outcomes and impacts

Outcomes refer to the expected effects, over the medium term, of projects supported under a given topic. The project results should contribute to these outcomes, fostered by the dissemination and exploitation measures. This may include the uptake, diffusion, deployment, and use of the project's results by target groups. Outcomes generally occur during or shortly after the end of the project.

After successful dissemination and exploitation of project results, MINE-TO-H2 expects the following changes in the targeted groups: Up-take by 2 regional or national bus fleets investing in hydrogen-powered intercity buses; Up-take by 4 regional industries undergoing a decarbonisation process by buying the hydrogen injected into the natural gas network through power purchasing agreements (PPA) and other renewable energies; 4 coal mining companies test the mechanism for investigating the possibility of multiplying the solution based on repurposing former coal mines into green hydrogen plants; 3 coal mining companies and 5 industrial stakeholders developing their case-specific pre-feasibility studies employing the moulded business case; 2 coal regions in transition plan and implement training and re-skilling programmes based on those designed by MINE-TO-H2; More than 20 citations in less than 2 years after the open access publications and the project completion; More than 150 stakeholders register on the website and receive annual newsletters and; More than 100 people attend the international workshop, visit the plant and use the hydrogen-powered intercity buses.

On the other hand, impacts are broader long-term effects on society, the environment, the economy and science, enabled by the outcome of R&I investments (long term). Impacts generally occur sometime after the end of the project.

The expected broader environmental effects of the project contributing to the expected impact are a lower climate impact of passenger transport by road, decarbonisation in processes where electrification and other solutions are not available, facilitating the transition to a carbon-neutral industrial base, and decarbonising the natural gas heating sector by increasing the regions transforming natural gas infrastructures. Perfectly aligned with the European Green Deal objectives, MINE-TO-H2 will contribute to the aim of "reducing net EU greenhouse gas emissions to 55% below 1990 levels by 2030", cutting greenhouse gas emissions in road passenger transport while growing the economy, helping to transform the EU into a modern, resource-efficient and competitive economy, and to achieve the challenge of no net emissions of greenhouse gases by 2050.

The expected broader economic effects of the project contributing to the expected impact are increased refuelling efficiency, leading to a more than 95% time reduction in refuelling compared with electric vehicles; increasing the energy efficiency of systems near green hydrogen plants by incorporating heat recovery from the electrolyser; increasing the number of subcontractors that learn and encourage the market to move in this direction; attracting investment, innovation and jobs to coal regions in transition through an increased interest in repurposing former coal mine sites; and generating thermal energy independently and thus reduce external energy dependence, the impact of which has become so evident.

The expected broader technological effects of the project contributing to the expected impact are a lower climate impact of passenger transport by road; a leap towards developing intercity coaches, using the same 350 bar infrastructure as intercity buses; a transformation of natural gas infrastructures in terms of the levels of hydrogen injected; obtaining an improvement of the global efficiency of the District Heating and the Electrolysis plant, making most of the waste heat in the Electrolysis system for the reduction of electricity consumption in the District Heating, and avoiding other complementary cooling systems for the Electrolyser as Aero-condensers.

The expected broader scientific effects of the project contributing to the expected impact are the development of further research based on the project knowledge; and additional pilots such as the Onshore Power Supply (OPS) addressing hydrogen as an energy regenerator for docked ships, in times when there is no renewable energy, so the engines can remain switched off, even without conventional renewable energy such as photovoltaic, with no need to use the diesel engines.

Finally, the expected broader societal effect of the project contributing to the expected impact is to increase the number of former coal miners trained and re-skilled in renewable energies; to increase the knowledge of public administrations and authorities about hydrogen, facilitating the way for the following projects to come. It will contribute to the European Green Deal objective of “no place left behind” by focusing on the regions and sectors most affected by the transition because they depend on fossil fuels or carbon-intensive processes, as well as the objective of “no person left behind” by stimulating the creation of green and quality jobs that former mine workers can perform via training and re-skilling programmes.

6 Anticipated Benefits

The MINE-TO-H2 project is expected to deliver a broad range of tangible and measurable benefits at environmental, technological, economic and social levels, both during its implementation and beyond its lifetime. These benefits go beyond standard project outcomes by directly addressing structural challenges in coal-dependent regions and offering a viable model for sustainable energy redevelopment.

The anticipated benefits stem from the project's integrated and systemic approach, which combines green hydrogen production, circular resource use, transport and heating decarbonisation, and just transition strategies in a single operational site.

6.1 Site-Level Benefits

The project site at Pozo Fondón will undergo a deep transformation, resulting in:

- The establishment of the first renewable hydrogen plant in a former underground coal mine in Spain, integrating energy generation, storage, distribution and hybrid uses.
- The creation of a local supply chain for hydrogen mobility, involving the installation of a refuelling station, the operation of zero-emission buses, and the virtual pipeline logistics system.
- The modernisation and optimisation of the geothermal district heating system, increasing its efficiency and reducing electricity consumption by integrating the electrolyser's waste heat.
- The revalorisation of abandoned mining infrastructure, including water pumping galleries, surface buildings, open-pit areas (for PV installation), and energy evacuation points.

This approach not only reduces environmental impact, but also reindustrialises the site with clean technologies, avoiding land sealing or large-scale civil works.

6.2 Benefits for the Region of Asturias

At the regional level, MINE-TO-H2 will:

- Improve air quality and reduce noise pollution in the transport corridors of central Asturias by substituting diesel with hydrogen in long-range buses.

- Strengthen the position of Asturias as a reference region in Spain for hydrogen and clean energy innovation, complementing other regional hydrogen valley initiatives.

- Contribute to energy security and diversification by establishing decentralised renewable energy systems that connect generation and consumption at a local scale.

- Mobilise industrial and research actors in the hydrogen value chain, stimulating new collaboration between public authorities, utilities, mining operators and academia.

These benefits align closely with the objectives of the Just Transition Strategy for Asturias, reinforcing its roadmap for post-coal economic revitalisation.

6.3 Social and Employment Benefits

The project places a strong emphasis on employment retention and re-skilling, anticipating:

- The requalification of at least 20 former coal workers into renewable hydrogen operations and maintenance roles.

- Increased employment opportunities in engineering, logistics, digital monitoring and environmental services, linked to hydrogen infrastructure.

- Enhanced social acceptance of the energy transition through direct involvement of former mining communities and local stakeholders.

- A model of inclusive transition, addressing potential job displacement while creating high-quality green jobs in the same geographical areas affected by decarbonisation.

Additionally, the training programmes developed within the project will be designed for replication and certification, providing long-term value and scalability across the EU.

6.4 Industrial and Policy Benefits

The outcomes of MINE-TO-H2 will benefit industrial actors and policymakers through:

- Availability of a validated technical model for hydrogen production in post-mining sites, including system configurations, operational data and lessons learned.

- Contribution to standardisation and regulatory development, particularly in areas such as hydrogen blending into natural gas networks, 500-bar storage safety, and hybridisation with heating systems.
- A tested business case framework adaptable to different regional contexts, useful for guiding public and private investment decisions.
- Strengthened capacity of coal mining operators to assess, plan and implement low-carbon infrastructure projects, supported by benchmarking activities and decision-making tools.

The project will also support broader policy debates on sector coupling, circular economy, and just transition, providing a real-world example of integrated climate action in a structurally vulnerable area.

6.5 Benefits Beyond the Project

Thanks to its open-access philosophy and replication tools, MINE-TO-H2 will generate benefits that extend beyond the project scope:

- Open access to training curricula, system specifications, and monitoring protocols.
- Replicability guidelines and business planning templates for other coal mining sites.
- A comprehensive set of communication and dissemination materials targeting technical audiences, public authorities and civil society.

These outputs will support the scaling up of similar initiatives across Europe and reinforce the role of post-coal regions in the climate-neutral energy transition.

7 Glossary

BOP- Balance of Plant

GIG – Główny Instytut Górnictwa

H_2 – Molecular hydrogen. In this project, it refers to green hydrogen produced via water electrolysis using renewable electricity.

KPIs – Key Performance Indicators. Quantitative metrics used to assess the progress and success of the project.

OPS Onshore Power Supply

PPA – Power Purchase Agreement. A long-term electricity supply contract between a generator and a buyer, used here for sourcing renewable energy.

RFCS – Research Fund for Coal and Steel. EU funding programme supporting research in coal and steel sectors and their transition.

UNIOVI – Universidad de Oviedo.

Virtual Pipeline – A non-physical method of transporting hydrogen (or gas) using high-pressure trailers or cylinders, instead of fixed pipelines.

WP – Work Package. A subdivision of the project work plan, grouping related tasks under a common objective.

Annex: State of the art

1. Relevant ongoing and closed projects

The projects most relevant to MINE-TO-H2 objectives belong to the RFCS. There relevant projects in direct relation to renewable energy deployment. It is necessary to search H2020 to find more relevant projects related to renewables.

Other RFCS projects are related to the recycling of mining waste, the restoration of waste heaps and their rehabilitation addressing sustainable uses such as implementing renewable energy infrastructures.

- **SAFEH2PIPE (RFCS-2022- 101112650; 2023-2026*):*** *" Guidelines for material selection and qualification for safe transportation of H2-NG mixtures in EU pipelines*". This project focuses on developing technical guidelines for the safe use of existing or new pipeline infrastructure when transporting hydrogen-natural gas mixtures. MINE-TO-H2 will build upon the material compatibility insights and safety criteria proposed in SAFEH2PIPE to ensure that the blending of green hydrogen into the local gas grid at Pozo Fondón is carried out in compliance with EU standards and under safe operational conditions.
- **HYSCORE (RSFC-2022- 101112571; 2023-2026):** *"Hydrogen Storage and Carriage as Opportunity for Renewable Energy Transition"*. This project addresses the technical challenges associated with hydrogen transport via steel pipelines, focusing on the development of advanced simulation-based safety assessment frameworks. The aim is to ensure that steel infrastructure can withstand hydrogen exposure without degradation, particularly due to risks such as hydrogen embrittlement under pressure and diffusion-related material fatigue. MINE-TO-H2 will benefit from the findings of HYSCORE in the context of its hydrogen blending demonstration into the existing natural gas grid. The project's injection strategy requires the adaptation of pipeline safety protocols, material compatibility assessments, and monitoring systems—all of which can be informed by the methodological tools developed in HYSCORE. Moreover, the insights gained into pressure-dependent performance of steel components and resistance to hydrogen-induced failure will be crucial for scaling up blending ratios and ensuring safe, long-term infrastructure adaptation. By aligning with the safety-driven innovations promoted in HYSCORE, MINE-TO-H2 contributes to building the technical knowledge base required for the large-scale integration of hydrogen into Europe's gas networks.
- **GreenJOBS (RFSC- 2021 - 101057789; 2022-2025):** *"Leveraging the competitive advantages of end-of-life underground coal mines to maximise the creation of green and quality jobs"*. This project focuses on repurposing former coal mining sites by integrating renewable energy production, circular economy principles, and employment strategies aimed at vulnerable worker populations. MINE-TO-

H2 aligns with this vision by transforming the Pozo Fondón coal mine into a renewable hydrogen hub, combining green hydrogen production, energy storage, heat recovery and public transport decarbonisation. It also leverages some of the same competitive advantages identified in GreenJOBS, such as the use of mine water, connection to the electricity grid, and availability of post-mining infrastructure for circular applications. However, MINE-TO-H2 takes a step further by integrating sector coupling, including hydrogen blending into the gas grid and hybridisation with geothermal district heating. The project will also contribute to employment and reskilling goals by developing targeted training programmes for former coal workers, focused on the operation and maintenance of hydrogen production systems and distribution infrastructure. By providing new employment pathways within the hydrogen value chain, MINE-TO-H2 supports the creation of quality green jobs and reinforces the socio-economic transformation objectives pursued by GreenJOBS.

- **TRACER (H2020-836819, 2019-2022):** "*Facilitating the transition to a sustainable energy system in coal intensive regions*". MINE-TO-H2 will closely follow decentralised electricity production assessment (social, environmental and technological) built upon mobilising many stakeholders.
- **BestRES (H2020-691689-2016, 2016-2019):** "*Best practices and implementation of innovative business models for renewable energy aggregators*". It aimed to identify best practices for renewable electricity generation like wind and photovoltaic leads to price deterioration during production hours in Europe. MINE-TO-H2 will identify best practices business models for renewable electricity generation among the ones investigated in BestRES for aggregating various renewable sources, storage and elastic demand.
- **LoCAL (RFCR-CT-2014-00001, 2014-2017):** "*Low-Carbon After-Life: Sustainable use of flooded coal mine voids as a thermal energy source - a baseline activity for minimising post-closure environmental risks*". LoCAL seeks to unlock mine waters commercially viable potential as a thermal energy resource for flooded coal mine workings. MINE-TO-H2 will use the knowledge related to controlling technical barriers to geothermal energy implementation and the optimum market pathways that maximise socio-economic benefits.

2. Relevant international literature

The existence of very recent scientific papers in all the areas addressed by the project (wind, photovoltaic, hydrogen, geothermal, in mining and employment prospects of renewable deployment) shows that MINE-TO-H2 addresses topics directly related to the current state of research.

- Temiz, M., & Javani, N. (2020). **Design and analysis of a combined floating photovoltaic system for electricity and hydrogen production**. *International Journal of Hydrogen Energy, 45(5)*, 3457-3496.

https://doi.org/10.1016/j.ijhydene.2018.12.226
In this paper, the electrical energy demand of a small community is investigated where a floating photovoltaic system and integrated hydrogen production unit are employed.

- Ortega, M., del Río, P., Ruiz, P., Nijs, W., & Politis, S. (2020). **Analysing the influence of trade, technology learning and policy on the employment prospects of wind and solar energy deployment: The EU case**. Renewable and *Sustainable Energy Reviews 122*, 109657. https://doi.org/10.1016/j.rser.2019.109657.
  This paper estimates the gross employment stemming from deploying three renewable electricity technologies –photovoltaic, wind onshore and wind off-shore – up to 2050 for all Member States of the European Union. It uses a novel analytical methodology to provide disaggregated results per activity in the supply chain for different scenarios.
- Menendez, J., Ordonez, A., Alvarez, R., & Loredo, J. (2019). **Energy from closed mines: Underground energy storage and geothermal applications**. *Renewable & Sustainable Energy Reviews 108*, 498-512. https://doi.org/10.1016/j.rser.2019.04.007.
  This paper explores the use of abandoned mines for underground pumped hydroelectric energy storage, compressed air energy storage plants and geothermal applications, presenting a case study in which the three uses are combined in just one mine.
- Bodis, K., Kougias, I., Taylor, N., & Jager-Waldau, A. (2019). **Solar photovoltaic electricity generation: A lifeline for the European coal regions in transition**. *Sustainability 11(13)*, 3703. https://doi.org/10.3390/su11133703.
  This paper analyses to what extent the use of photovoltaic electricity generation systems can help with a socially fair transition in the coal regions of the EU. The solar photovoltaic potential is assessed in selected regions where opencast coal mines are planned to cease operation.

3. Other relevant documents

- European Commission (2020). **A hydrogen strategy for a climate-neutral Europe**. COM(2020) 301 final. Brussels, 8.7.2020. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2020%3A301%3AFIN
  A priority for the EU is to develop renewable hydrogen, produced using mainly wind and solar energy. The EU presents a roadmap towards a hydrogen ecosystem in Europe to 2050 that will guide us to develop a Green Hydrogen Plant's feasible and innovative business plan.