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WP2 – D2.1

State of the art and European/national/regional hydrogen roadmaps and initiatives report

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Executive Summary

The H2Excellence project (ERASMUS-EDU-2022-PEX-COVE; project number: 101104447) is committed to establishing Centres of Vocational Excellence (CoVE) in fuel cells and green hydrogen technologies, aligning with the imperative of combatting climate change. The work carried out in the task 2.1 "*State of the art; European, national, and regional hydrogen roadmaps and ecosystem initiatives mapping*" provides a comprehensive overview of the current status of national and regional hydrogen ecosystems across the CoVE countries within the H2Excellence consortium. The state-of-the-art analysis on the hydrogen ecosystem yields numerous advantages across key aspects. It offers stakeholders clear and comprehensive information, enabling a deep understanding of the operating landscape. Understanding the maturity level of these ecosystems guides informed strategic decisions, identification of strengths, weaknesses, opportunities, and threats, and devising effective collaboration and development strategies. Additionally, it provides insights into the regulatory environment, facilitating compliance and advocating for supportive policies. Furthermore, assessing current roadmaps and large-scale projects related to hydrogen provides a comprehensive overview of ongoing initiatives, identifying areas of innovation, collaboration opportunities, and gaps needing addressal. It also aids proactive planning for workforce development by considering potential implications for the job market, identifying emerging skill demands, and ensuring alignment with industry trends. This work describes 14 regional and national roadmaps within the CoVEs, along with mapping approximately 79 projects and initiatives contributing to job creation in the sector. Strategies for hydrogen deployment in France, Poland, Spain, Italy, Portugal, and Finland reflect unique approaches, resources, and objectives. The research underscores the pivotal role of hydrogen in driving job creation and economic growth across Europe, potentially creating up to 5.4 million highly skilled jobs by 2050. However, addressing the skills gap is crucial, particularly for SMEs facing limitations in investing heavily in upskilling initiatives. This work will contribute to the WP2 analysis on identify the need for specific training in the hydrogen sector to bridge the gap between existing skills and future workforce requirements.

1. Introduction

The **H2Excellence project** (ERASMUS-EDU-2022-PEX-COVE; project number: 101104447), with its focus on establishing Centres of Vocational Excellence (CoVE) in fuel cells and green hydrogen technologies, aligns directly with the imperative of fighting climate change by addressing skills gaps and fostering collaboration. As climate neutrality necessitates a substantial reduction in fossil fuel usage, transitioning to renewable energy sources becomes paramount. However, this transition presents challenges, particularly in terms of energy storage and adapting to variable generation profiles. Here, **hydrogen emerges as a promising solution**. The project's assessment of national and regional hydrogen ecosystems in the Cove host countries is crucial in recognizing the role of hydrogen in achieving climate neutrality, the future implications for employments. By providing technical support for SMEs and designing training programs, the project contributes to the wider goal of replacing fossil fuels with low-carbon alternatives. Thus, the H2Excellence project not only addresses immediate skills needs but also contributes to the broader energy transition towards a sustainable future.

Hydrogen, when sustainably produced, emits no CO_2 and minimally pollutes the air. Complementing other storage applications, including hydro-pumps and batteries, as well as smart grid applications, hydrogen can act as a vector for seasonal storage of renewable energy. Additionally, low-carbon hydrogen can replace fossil fuels in challenging sectors and complement renewable energy sources, aiding economic transformation. Achieving these objectives requires implementing hydrogen infrastructure at scale, including production, transport, distribution, and usage, necessitating governmental support and favourable policies. This interest has spurred the development of numerous hydrogen strategies globally, with Japan launching the first in 2017, and approximately actually 60 national hydrogen strategies are present worldwide.[1]

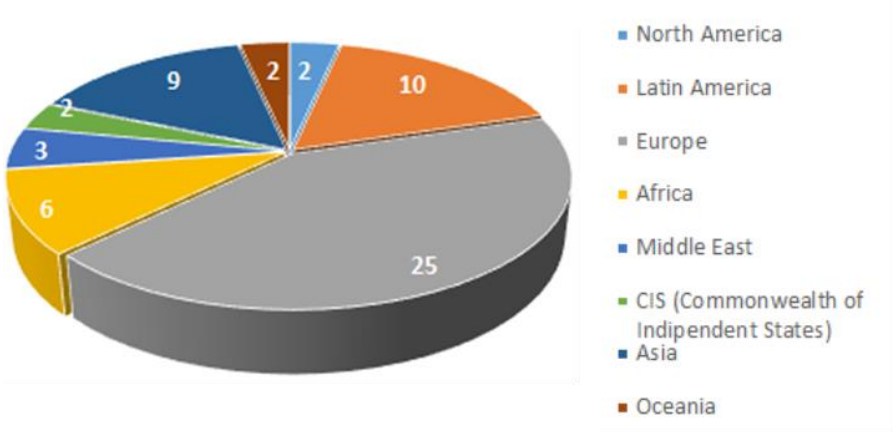

Figure 1 Graphical representation of the various national hydrogen strategies worldwide.

Moreover, this interest and the development of dedicated policy has also led to a significant increase in Research and Development (R&D) projects to improve, for example, the technical aspects related to different hydrogen technologies, as well as the establishment of large demonstrative projects

[1] https://www.energypolicy.columbia.edu/publications/national-hydrogen-strategies-and-roadmap-tracker/

showcasing hydrogen's ability to decarbonize various sectors or demonstrating the integration with renewable energy.

Our study examines national government actions (strategies and roadmaps) and large hydrogen initiatives on hydrogen in different European countries (Italy, France, Spain, Portugal, Finland and Poland) detailing respective goals, targeted sectors, and related infrastructures.

1.1 Purpose of Document

The main objective of this document is to provide clear and comprehensive information on the current state of national and regional hydrogen ecosystems within each CoVE region represented in our consortium. The analysis conducted in this work aims to thoroughly describe the maturity level of these ecosystems, examining factors such as national legislation on hydrogen strategy, current roadmaps, and large-scale projects related to hydrogen and associated technologies. Additionally, this assessment will take into account the potential implications for the job market in the foreseeable future.

The state-of-the-art analysis on the hydrogen ecosystem will yield numerous advantages across different key aspects, enabling:

- **Informing Stakeholders:** By providing clear and comprehensive information on the current state of national and regional hydrogen ecosystems, stakeholders within the consortium, can gain a deep understanding of the landscape they are operating in.
- **Strategic Decision-Making**: Understanding the maturity level of these ecosystems is crucial for making informed strategic decisions. It allows consortium members to identify strengths, weaknesses, opportunities, and threats, enabling them to devise effective strategies for collaboration and development.
- **Legislative and Policy Considerations**: Examining factors such as national legislation on hydrogen strategy provides insights into the regulatory environment surrounding hydrogen technologies. This understanding is essential for navigating legal frameworks, ensuring compliance, and advocating for supportive policies where necessary.
- **Mapping Current Initiatives**: Assessing current roadmaps and large-scale projects related to hydrogen provides a comprehensive overview of ongoing initiatives. This knowledge helps identify areas of innovation, potential collaboration opportunities, and gaps that need to be addressed for the advancement of hydrogen technologies.
- **Anticipating Job Market Trends**: By considering the potential implications for the job market, the assessment facilitates proactive planning for workforce development. Identifying emerging skill demands and job opportunities enables stakeholders to better prepare for future workforce needs and ensure alignment with industry trends.

The work outlined in this document will aim to cover the following Key **Performance Indicators (KPIs):**

- ✓ *#Assessed hydrogen roadmaps: at least 10 (comprising national and regional hydrogen roadmaps);*
- ✓ *#Identified large scale hydrogen projects and initiatives driving job creation: at least 30 (with balanced representation across CoVEs);*

The state-of-the-art description provided in this deliverable**, along with other analyses conducted in WP2**, **are crucial for subsequent WPs, identifying the training needs and new roles required for the hydrogen industry job market**. The main beneficiaries of this information will be **WP3 "Teaching,**

training, and learning activities”, where new curricula and teaching materials on fuel cells and hydrogen for various qualification levels will be developed, and in **WP4 “Cooperation, partnerships, and networking”**, where the efforts will focus on establishing a network involving education, business, and industry stakeholders.

2. Methodology

Obtaining a comprehensive mapping of the Hydrogen ecosystem within the various states involved in the H2Excellence project necessitated a meticulously planned and executed multi-step process.

- ✓ The initial phase involved an in-depth examination through a preliminary study focusing on Hydrogen, encompassing an exploration of the diverse pro-Hydrogen policies prevalent at the European level.

- ✓ The first step allowed us to proceed with the development of a questionnaire, utilizing specific inquiries meticulously designed to glean insights into the varied landscape of Hydrogen initiatives across different European states. These inquiries spanned not only strategic approaches and implemented roadmaps but also delved into regulatory frameworks, in addition to scrutinizing ongoing projects and demonstrative initiatives pertaining to the subject matter.

- ✓ The prepared questionnaire was disseminated among the diverse participants comprising the project consortium. Each participant, representing their respective nation, actively engaged in the collaborative effort, offering invaluable insights and data pertinent to the prevailing Hydrogen landscape within their region. This collective effort served to construct a comprehensive panorama of the existing Hydrogen scenario across the European landscape.

- ✓ The collected data was analyzed and verified using various documents from institutional websites and qualified internet sources within the sector, such as the Hydrogen Observatory, as well as relevant scientific articles on the topic.

- ✓ In the final stage of this complex process, the collected data was carefully examined and analyzed. This thorough review was supported by using a variety of resources, including various documents from institutional archives and reputable online platforms dedicated to disseminating information about Hydrogen, such as the prestigious Hydrogen Observatory. Additionally, relevant scientific literature and articles, selected for their relevance and academic rigor, were utilized to enhance the analytical process, ensuring a thorough and comprehensive understanding of the topic.

The questionnaire was made using Microsoft Excel and it composed of "**mixed-type questions**", combining open-ended questions with free responses and closed-ended questions with predefined responses within specific boxes. This approach allows for the collection of both qualitative information through open responses and quantitative information through structured responses in the boxes.

The entire questionnaire is reported in the **Appendix 1**.

It is divided in four sections:

1. The first excel sheet named **"READ ME"** provides an explanation of how the questionnaire is structured and the symbolism used for the different questions.

2. The second section is named **"NATIONAL ROADMAPS AND POLICIES**" consists of 8 questions related to understand the national strategies, roadmaps, and normative aspects on H2 fields in each country analysed. For each question, an adjacent box has been constructed, providing a clear and precise explanation of the question itself. This is to provide support in understanding the question and to prevent misunderstandings.

Question 1 - Can you please tell us which high-level policy documents (such as roadmaps and strategies) your country has in place or announced to define the role of hydrogen in your energy system and decarbonisation plans?

The question is asking for information about significant policy documents, such as roadmaps and strategies, that the CoVes countries has either implemented or announced. Specifically, the focus is on documents that outline the role of hydrogen in your energy system and plans for decarbonization. In other words, the question is seeking insights into the official guidance or plans (strategy, roadmap, guidelines ecc...) your country has established to incorporate hydrogen into its energy framework and address decarbonization objectives.

Question 2 - Which regulatory measures/standards on definitions and certification schemes for hydrogen has your country established or announced?

This question is seeking information about the regulatory measures and standards that your country has either implemented or announced concerning the definitions and certification schemes for hydrogen. In simpler terms, the question is asking about the official rules and standards that your country has put in place or plans to put in place regarding how hydrogen is defined and certified. This could include guidelines or criteria for what qualifies as ""certified"" hydrogen and the processes involved in certification.

Question 3- Which Hydrogen-related regulations on market framework, safety and customs has your country established or announced?

Specifically, it is interested in regulations related to the market framework, safety, and customs regarding hydrogen. In simpler terms, the question is asking about the official rules and standards that your country has established or plans to establish regarding how hydrogen is handled in the market, ensuring safety, and dealing with customs procedures. This could include guidelines on how hydrogen is traded, stored, and transported, as well as safety measures and customs regulations associated with hydrogen-related activities.

Question 4 -Which funding programmes and policies to mitigate risk and facilitate investments (such as subsidies, grants, tax breaks / credits, tariff policies, contracts for difference, etc) have you established or announced?

This question is seeking information about the funding programs and policies that the different governments, or entity has either established or announced to address risks and encourage investments in the hydrogen sector. Specifically, it is interested in initiatives such as subsidies, grants, tax breaks or credits, tariff policies, contracts for difference, and any other financial mechanisms that are in place or planned to support and incentivize investments in the hydrogen industry.

Question 5 -Which Policies to support the creation of demand for low-emission hydrogen (such as quotas, mandates, subsidies on FCEVs/zero-emissions vehicles, low-carbon fuels standards, low-carbon public procurement framework, etc)?

This question is asking about the policies that have been put in place or announced to stimulate demand for low-emission hydrogen. It specifically inquiries about measures aimed at encouraging the use of low-emission hydrogen in various sectors. Here's a breakdown of the elements mentioned in the question:

- Quotas: This could refer to set targets or requirements for the use of low-emission hydrogen in specific industries or applications.

- Mandates: These are official requirements or directives compelling the use of low-emission hydrogen in certain contexts.

- Subsidies on FCEVs/Zero-emissions Vehicles: Financial incentives or support provided for the purchase or use of Fuel Cell Electric Vehicles (FCEVs) or other zero-emission vehicles that utilize low-emission hydrogen.

- Low-carbon fuels standards: Standards specifying the acceptable level of carbon emissions for fuels, encouraging the use of low-emission alternatives like hydrogen.

- Low-carbon public procurement framework: This involves incorporating criteria favouring low-emission hydrogen in public procurement processes.

Question 6 -Which policies support research, development, innovation and demonstration of hydrogen technologies?

This question is asking about the policies that are in place to support various stages of hydrogen technology, including research, development, innovation, and demonstration. It could involve financial incentives, regulatory frameworks, loans, demonstration grant, R&D grant ecc... or other forms of support for research institutions in hydrogen-related activities.

Question 7 -Which Memorandum of Agreements and other international cooperations on hydrogen has your country signed with other governments or the private sector?

This question is seeking information about any formal agreements or collaborations, such as Memoranda of Agreements (MOAs) ore Memorandum of Understanding (MoUs), that your country has entered into concerning hydrogen. The focus is on international cooperation, indicating partnerships established with other governments or private sector entities outside your country. The question aims to understand the extent of your country's engagement and collaboration on hydrogen-related initiatives at the global level. Such agreements could involve joint research projects, technology exchange, or other collaborative efforts to advance hydrogen technologies and applications.

3. The third section is named **"H_2 Project and Initiatives"** consists of one question, related to collect information to large scale project, and other initiatives on H_2 field . The aim of investigating large hydrogen-related projects or initiatives is to assess the implications on the job market currently underway and anticipated to develop in this sector.. Also in this section, each question is accompanied by a clear and concise explanation, aimed at facilitating comprehension of the question itself and avoiding any potential misunderstandings.

Question 1-Which projects exist in your country related to large-scale hydrogen initiatives?

This question is seeking information on significant initiatives or undertakings that involve the production, utilization, or deployment of hydrogen on a large scale. Large-scale hydrogen initiatives could include projects related to hydrogen production from renewable sources, extensive hydrogen infrastructure development, or widespread integration of hydrogen technologies across various sectors, or also H_2 valleys.

4) The fourth and final section, named **"NATIONAL HYDROGEN TRAINING OFFER"**, is dedicated to mapping the existing hydrogen training offerings in the various countries under study. This allows for comparison and analysis to understand what is lacking and where intervention is needed for improvement. Although it is not directly part of the objectives of Task 2.1 and therefore not included as an integral part of this deliverable, it remains of great interest to the project. Therefore, this analysis is reported within **Appendix 2.**

The questionnaire was **shared among the project partners by e-mail and through the SharePoint platform** specifically created for the H2Excellence project. The response to the questionnaire from all

participating CoVE members in the project were positive, providing ample information to proceed with the verification and analysis of the data, as detailed in the subsequent chapters of the deliverable.

3. Assessed hydrogen strategies and roadmaps.

This section aims to assess aspects related to the national and regional roadmaps implemented by various European countries. The analysis focused on the participating countries, utilizing a specifically designed questionnaire to gather information on national and regional strategies in each country. The primary objective was to map at least 10 roadmaps for hydrogen. This objective has been largely achieved, identifying **14 roadmaps (national and regional) in the project partner countries.**

Figure 2 Schematic representation of mapped European roadmaps.

The different strategies for kick-starting the hydrogen market in European countries all stem from a European movement that views this molecule as central to the energy transition, initiated in 2020 with the European Hydrogen Strategy. Therefore, it is important to first evaluate the policies and incentives adopted by the EU before describing the different situations in the states under analysis. The chapter will be divided into several sections: one general section concerning the European framework and then a section dedicated to mapping out individual states used as case studies in this analysis.

3.1-Europe policy hydrogen framework

The European Union's policy framework for the development of the renewable hydrogen value chain[2] is structured around a multi-layered regulatory framework aimed at addressing the specific role renewable hydrogen can play in the broader energy system of the EU.

In March 2020, the European Union announced its ambitious target to achieve climate neutrality by 2050, recognizing hydrogen as an indispensable tool for decarbonizing the economies of its member states. Subsequently, in July of the same year, the E**uropean Commission adopted a hydrogen strategy for a climate-neutral Europe**[3], underscoring the pivotal role of hydrogen in decarbonizing various sectors such as industry, transport, power generation, and heating. This strategy outlined policy action points across five key areas: investment support, production and demand support, establishing a hydrogen market and infrastructure, promoting research and cooperation, and fostering international collaboration. Over the next three decades, the Commission aims to progressively increase hydrogen production across Europe.

This commitment to hydrogen was further emphasized in the "**Fit-for-55**"[4] package unveiled in July 2021, which proposed legislative measures translating the European hydrogen strategy into a concrete policy framework. Among these proposals, there were targets for the adoption of renewable hydrogen in industry and transport by 2030. Additionally, the package included the Hydrogen and Decarbonized Gas Market Package, offering initiatives to support the development of dedicated hydrogen infrastructure and an efficient hydrogen market. Furthermore, renewable hydrogen was identified as a primary lever in the "**REPowerEU**" initiative[5], aimed at cost-effectively decarbonizing the EU and reducing reliance on imported fossil fuels. "REPowerEU" targets the domestic production of 10 million tonnes per year of renewable hydrogen by 2030, alongside equivalent imports of renewable hydrogen by the same year.

To achieve these ambitious targets, Europe has implemented a range of tools to stimulate and support investments in sustainable hydrogen production, exemplified by initiatives such as the EBH **Hydrogen Bank** and the **Recovery and Resilience Facility** for clean energy has been made available to EU countries to invest in hydrogen projects across the value chain. Investment support has also been extended through the Important Projects of Common European Interest (IPCEIs) on hydrogen. The first IPCEI, known as "**IPCEI Hy2Tech**," approved in July 2022, focuses on developing innovative technologies throughout the hydrogen value chain to decarbonize industrial processes and the mobility sector, with a particular emphasis on end-users. In September 2022, the Commission approved "**IPCEI Hy2Use**," complementing "IPCEI Hy2Tech." This initiative aims to support the construction of hydrogen-related infrastructure and the development of innovative, sustainable technologies for integrating hydrogen into the industrial sector. A comprehensive overview of these initiatives underscores the EU's commitment to promoting industrial, funding, research, and innovation initiatives in the hydrogen sector.

[2] https://h2perform.de/en/value-chain/
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0301
[4] https://www2.deloitte.com/ce/en/pages/about-deloitte/articles/ce-fit-for-55-package.html
[5] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3131

Among these initiatives is the **Clean Hydrogen Partnership** (2021-2027), a joint public-private partnership supported by the Commission under Horizon Europe. Building upon the success of its predecessor, the Fuel Cells and Hydrogen Joint Undertaking, it includes the Hydrogen Valleys Platform, an EU-led initiative under Mission Innovation. A joint declaration on renewable hydrogen research and innovation was signed by the Commission and key stakeholders on March 1st, 2023, committing to accelerating joint action in research, development, demonstration, and deployment of Hydrogen Valleys.

The **European Clean Hydrogen Alliance**, launched in tandem with the EU hydrogen strategy in 2020, aims to facilitate the ambitious deployment of hydrogen technologies by 2030. It brings together various stakeholders, including industry, national and local authorities, civil society, and others, to promote renewable and low-carbon hydrogen production, demand across sectors, and hydrogen transmission and distribution. The alliance has launched thematic roundtables and published a hydrogen project pipeline to advance its objectives.

Additionally, the **Hydrogen Public Funding Compass** serves as an online guide for stakeholders to identify public funding sources for hydrogen projects, providing information on relevant EU programs and funds (2021-2027) for the sector.

Figure 4 and 5 provide a comprehensive overview of the policies and the funding and initiatives supporting the EU Renewable Hydrogen Market[6] respectively, illustrating the breadth and depth of efforts aimed at realizing Europe's hydrogen ambitions.

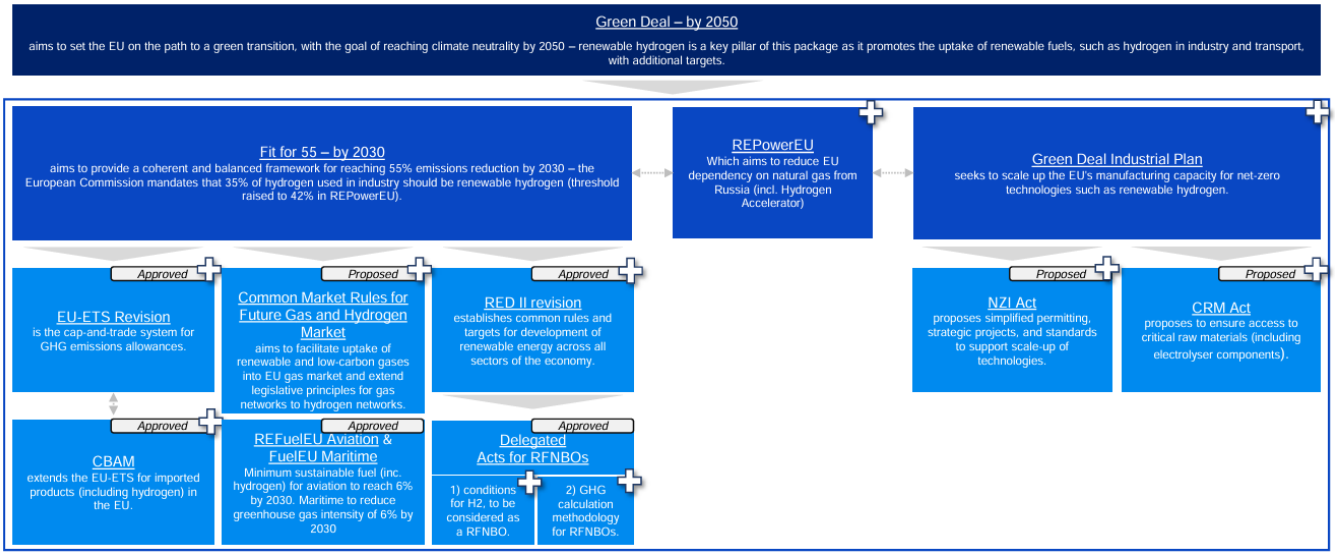

Figure 3 Policies supporting the EU Renewable Hydrogen Market.

[6] https://www3.weforum.org/docs/WEF_Accenture_Enabling_Measures_Roadmap_for_Renewable_Hydrogen_Europe_2023.pdf

Figure 4 Funding and Initiatives supporting the EU Renewable Hydrogen Market.

3.2 National and regional roadmaps for H_2 market development

3.2.1 France

France is steadfast in its pursuit of becoming a global leader in hydrogen deployment. The groundwork for this ambition was laid back in 2015 with the initiation of a "plan for storage of renewable energies using decarbonized hydrogen," mandated by Law No. 2015-992. Building upon this foundation, the Minister for Energy unveiled the Multiannual Energy Program (PPE)[7] in 2018, outlining three primary roadmaps aimed at specific objectives:

Increasing the share of green hydrogen for industrial use.

• Deploying hydrogen in the mobility sector.

• Stabilizing energy networks through hydrogen operationalization.

Subsequently, in 2019, the plan was reinforced with a target of achieving 10% low-carbon hydrogen by 2023 and between 20% and 40% by 2030. To fuel these ambitions, substantial financial support is earmarked for the hydrogen sector, as delineated in the Multiannual Energy Program spanning from 2019 to 2028. Notably, an annual investment of EUR 50 million is designated for hydrogen initiatives.

Moreover, introduced in September 2020, **the National Strategy for the Development of Decarbonized Hydrogen**[8] outlines a cohesive plan with strategic goals. It seeks to establish a strong French electrolyser sector, essential for driving industrial decarbonization efforts, and promoting the

[7] https://www.ecologie.gouv.fr/programmations-pluriannuelles-lenergie-ppe

[8] https://www.entreprises.gouv.fr/fr/strategies-d-acceleration/strategie-nationale-pour-developpement-de-l-hydrogene-decarbone-france

widespread adoption of carbon-free hydrogen, particularly in heavy mobility sectors. Furthermore, it underscores the significance of fostering research and development initiatives, along with enhancing skills development within the hydrogen sector, ensuring its sustainable growth and advancement.

In 2021, the principal French organization on Hydrogen theme, named "France Hydrogène"[9] released a comprehensive study titled 'A roadmap for an ambitious hydrogen strategy,' delineating two scenarios dedicated to the H_2 production: **'Ambition 2030'** and **'Ambition+ 2030**.' These scenarios envision annual production targets of 680,000 and 1,090,000 tonnes of low-carbon or renewable hydrogen, respectively, aimed at meeting the regulatory demands of the 'Fit for 55' package. Identifying seven large clusters as pivotal hubs for large-scale hydrogen projects underscores France's commitment to cost-effective deployment strategies.

This production, mostly destined for industrial purposes during the ten year period 2021-2030, will help lay the foundations for a national hydrogen supply chain and reduce costs for the end consumer in anticipation of the large-scale expansion of the use of hydrogen in the transportation sector in the years after 2030, once there Is a full range of hydrogen-fuelled transportation methods (road, maritime, rail and air) available on the market. By 2040, the transportation sector is expected to become the main driver of growth In the French hydrogen market.

France boasts one of the most sophisticated hydrogen legal frameworks within the EU. The prevailing legal measures predominantly govern hydrogen deployment in the mobility sector, with the 2019 **Mobility Orientation Act** establishing a framework for refuelling stations catering to private vehicles, buses, and ships. Oversight of the hydrogen injection process into the gas grid falls under the purview of the Energy Regulator, aligning with the mandates of the Energy Code. The development of hydrogen refuelling infrastructure sets in this roadmap an ambitious target, with 100 charging stations slated for operation by 2023 and 400-1000 stations by 2028. Regarding hydrogen storage, France refrains from setting ambitious goals. This decision stems from the understanding that large-scale storage of electricity in the form of hydrogen, to mitigate renewable energy intermittency, may not be imperative before circa 2050.

In February 2021, the French government introduced a draft **Ordinance on Hydrogen**[10], addressing critical aspects such **as hydrogen taxonomy, governmental support schemes for low- and zero-carbon production, guarantees of origin, and certification regimes.** Emphasizing regulation requirements for hydrogen injection and transportation via the gas grid, the document aligns with national efforts to accelerate hydrogen sector support, including the National Strategy for the Development of Decarbonized Hydrogen within the framework of France Relance, the nation's post-Covid investment plan.

In conclusion, France's holistic approach to hydrogen deployment, spanning from legislative frameworks to strategic roadmaps and substantial investments, underscores its unwavering commitment to lead the global transition towards a sustainable hydrogen economy.

Roadmap for Bourgogne-Franche-Comté region:

Bourgogne-Franche-Comté is one of the territories identified at European level as a **"hydrogen territory of the future"**[11] thanks to its many assets, including actors in the hydrogen and fuel cell research like FC Lab and FORVIA Faurecia, in the industries ecosystem and the many projects led by the local authorities.

[9] https://www.france-hydrogene.org/
[10] https://hsfnotes.com/energy/2021/02/12/recent-developments-in-the-french-hydrogen-sector-the-draft-hydrogen-ordinance/
[11] https://aer-bfc.com/wp-content/uploads/2024/01/plaquette-h2-2023-gb.pdf

The objective of Bourgogne-Franche-Comté is to become a Positive Energy and carbon neutral region looking forward to 2050. The Hydrogen roadmap, developed in conjunction with all those involved in the hydrogen ecosystem, confirms the Bourgogne-Franche-Comté region's commitment to embracing the challenge of ecological and energy transition. The projects and territories committed to hydrogen in Bourgogne-Franche-Comté have received more than **€800 million in support from the French State and the Region**.

Roadmap for Nouvelle- Aquitaine region:

The **Nouvelle-Aquitaine regional roadmap**[12] for hydrogen, adopted with the aim of structuring and advancing the industrial hydrogen sector across the entire value chain, outlines a comprehensive strategy geared towards promoting the supply of green and recovered hydrogen for various applications. The action plan begins with a focus on bringing together conducive market conditions within the territories, emphasizing the need to reduce additional costs associated with hydrogen-powered vehicles and infrastructure development. This includes the **establishment of region-wide infrastructure for hydrogen production and distribution, leveraging road, rail, and port networks, and exploring maritime uses for hydrogen to enhance environmental sustainability.** Furthermore, the roadmap underscores the importance of encouraging and supporting hydrogen projects, fostering collaboration among stakeholders, and enhancing citizen involvement through awareness-raising and community engagement initiatives. It also emphasizes the critical role of research and development, innovation, and training to address challenges and capitalize on opportunities in the hydrogen sector. Last but not least roadmap action is dedicated to the **development of the hydrogen economy in the region** by supporting viable industrial supplies, nurturing startups and SMEs, and **establishing local hydrogen hubs** and ecosystems. Overall, the Nouvelle-Aquitaine roadmap presents a multifaceted approach aimed at fostering the growth and integration of hydrogen technologies to drive sustainable development and economic growth in the region.

Roadmap for Brittany region:

The Brittany region, in collaboration with its hydrogen stakeholders, aims to establish itself as a leader in France's renewable hydrogen market, leveraging local expertise and technology dissemination to drive innovation and job creation. This roadmap[13] aligns with the France objectives of significantly reducing greenhouse gas emissions and transitioning away from fossil fuels by 2050. With transport being the second-largest emitter of greenhouse gases in Brittany, the roadmap targets the **deployment of renewable hydrogen to reduce emissions and ensure sustainable regional development and energy self-sufficiency**.

Key quantitative objectives have been outlined for achievement by 2030, including the establishment of **eight local hydrogen loops and the circulation of 400 vehicles by 2025, leading to significant reductions in CO_2 emissions**. Additionally, the roadmap proposes the development of three renewable hydrogen maritime industrial zones and the **deployment of electro-hydrogen drive chain pilot ships to further reduce fuel consumption and emissions in the maritime sector.**

Strategically, the roadmap emphasizes the phased deployment of a hydrogen supply network aligned with the introduction of new vehicle offerings, targeting initiation in 2025, consolidation through 2030, and generalization through 2050. It identifies key industries such as maritime, agri-food logistics, and

[12] https://entreprises.nouvelle-aquitaine.fr/sites/default/files/2022-05/Feuille%20de%20route%20Hydrogène_EN.pdf
[13] https://www.bdi.fr/wp-content/uploads/2020/03/DeploymentOfRenewableHydrogenBrittanyRoadmap2030.pdf

storage for targeted development, aiming to capitalize on existing market opportunities and drive innovation in hydrogen applications.

Ultimately, the Brittany roadmap seeks to position the region as a frontrunner in renewable hydrogen deployment, driving positive environmental and economic outcomes while contributing to the achievement of regional and national climate goals.

3.2.2 Poland

Poland is the fifth largest producer of hydrogen worldwide, accounting for 14% of Europe's hydrogen.

The national roadmap for H_2 in Poland, is explained in the **Polish National Hydrogen Strategy**[14] until 2030 with a perspective until 2040 was officially adopted in November 2021.The document sets out 6 primary objectives, namely:

1) Implementation of hydrogen technology in the energy sector (power and heating).

- The Polish Energy Policy 2040 aims to increase the share of renewable energy sources (RES) to a minimum of 32% of the energy mix, with a particular focus on photovoltaic (PV) and offshore wind.
- Hydrogen will enhance the efficient utilization of RES during full-load hours and provide additional energy during periods of low supply. Further electrification of sectors using low-carbon energy sources.
- Transformation of district heating through the integration of polygeneration systems and the introduction of fuel cell heating systems.

2) Use of hydrogen as an alternative fuel in transport (for low-emissions mobility).

- Investments in hydrogen-fueled buses for public transport: **100-250 hydrogen buses** to be deployed by 2025, along with the construction of hydrogen refueling infrastructure consisting of **32 hydrogen refueling stations** with supporting infrastructure.
- I**mplementation of hydrogen-fueled trains** and supporting infrastructure to enhance the competitiveness of trains and integrate them into the common TEN-T corridors.
- Exploration of hydrogen utilization in aviation and maritime through pilot projects and further research from hydrogen energy sources.

3) Low-emissions hydrogen in hard to decarbonize industry sectors.

- The primary goal is to transition to low-carbon hydrogen production from fossil fuels, while also advancing the electrification of processes and integrating hydrogen into the industry value chain, particularly in sectors such as steel, ammonia, refineries, and chemical industries.

[14] https://www.gov.pl/attachment/06213bb3-64d3-4ca8-afbe-2e50dadfa2dc

- The strategy includes the implementation of **large-scale pilot projects** aimed at testing the first industrial deployment of these technologies.
- The strategy is focused on the creation of **hydrogen valleys**, which serve as hubs for hydrogen production, distribution, and utilization, fostering collaboration and innovation in the hydrogen sector.

4) Safe and efficient transportation, distribution, and storage of hydrogen.

Polish Energy Policy 2040 defines wind, mainly offshore, and solar as the main clean energy sources essential to meet the RES targets. In parallel, new hydrogen infrastructure will be built near production and consumption sites, setting the backbones for fully integrated Polish and European hydrogen systems.

- Extensive support for research and development is essential to drive innovation and optimize storage technologies, both underground and in tanks, for efficient hydrogen utilization.
- In distribution, there is a focus on testing existing pipelines to ensure their compatibility with hydrogen or blending mixture, while prioritizing health and safety measures.

5) Implementation of a stable regulatory framework to enable the development of a hydrogen market.

- The principal objective is to establish a stable policy environment aligned with EU objectives, along with clear guidelines for financial incentives, encourages investments trough:
- A regulatory framework for hydrogen as an alternative fuel in transport. (planned for 2021)
- A legislative package detailing comprehensive hydrogen policies in alignment with EU directives, accompanied by financial incentives (planned for 2022-2023).

Currently, Poland lacks dedicated legislation specifically addressing hydrogen. While existing legal provisions touch upon hydrogen, particularly in transportation, they remain insufficient. The Act on Electromobility and Alternative Fuels, passed in January 2018 and subsequently updated, serves as a foundational legal document. It sets the stage for alternative fuel infrastructure development, including hydrogen refuelling stations. By promoting electromobility and alternative fuels, including hydrogen, the Act underscores hydrogen's potential in greening the transportation sector. Moreover, it specifies technical norms and standards aligning with international safety standards, crucial for ensuring hydrogen infrastructure compatibility within the EU.

The Strategy's objective is to establish robust legal frameworks conducive to a competitive and efficient hydrogen market in Poland. This entails overcoming existing barriers to market development. Key initiatives include formulating legislation for hydrogen's use as an alternative fuel in transportation, establishing the operational framework for the hydrogen market, and, in the longer term, crafting a detailed legislative package. This package would delineate market operations, incorporate EU laws, and introduce incentives for low-carbon hydrogen production.

However, the projected actions for Q3-Q4 2021, including creating a legal framework for hydrogen in transportation, have yet to materialize. Further work on developing the hydrogen legislative package, scheduled for the turn of 2021/2022, also faces delays. These setbacks underscore the challenges in aligning regulatory frameworks with ambitious strategic goals.

Roadmap for Wielkopolska region:

The **Wielkopolska Hydrogen Strategy 2030**[15], approved in April 2023, is a proactive response from local government authorities to address the pressing need for widespread stakeholder involvement in efforts to decarbonize the economy and combat climate change.

Aligned with EU and national hydrogen development plans, the Strategy aims to harness the region's potential in building the hydrogen economy chain, focusing on both demand and supply aspects. Key insights from the analysis of the region's resources highlight significant potential for hydrogen economy integration, driven by favourable conditions for renewable energy sources, ample supply of biogas and biomethane, a robust automotive industry, strategic geographical location, and proactive local government initiatives such as the **Wielkopolska Hydrogen Platform** and the "**Hydrogen School" project**.

The vision for Hydrogen Wielkopolska is to establish the region as a hub where hydrogen serves as a widely available, safe, and socially acceptable energy carrier, replacing fossil fuels across various sectors. The mission is to create an enabling environment for all stakeholders to leverage the region's resources, skills, and geographical advantages in developing various facets of the hydrogen economy, aiming to enhance the region's quality of life. To gauge the region's progress in developing the hydrogen ecosystem, a set of indicators will be monitored periodically, with assessments scheduled for 2025, 2030, and 2040. This adaptive approach allows for ongoing refinement of the Strategy based on evolving data and the maturation of Poland's hydrogen economy.

Roadmap for Pomerania region: (Proposed in 2024)

The final report of the "Pomerania on Light Gas" project[16] offers insights into the development of the **hydrogen economy in the Pomeranian Voivodeship until 2040**. It not only assesses the current situation but also envisions a future with a thriving hydrogen economy in Pomerania.

Pomerania possesses various advantages for successfully fostering the hydrogen economy, including favourable environmental conditions and existing hydrogen projects. However, to bolster the region's energy security, drive decarbonization, and enhance prosperity, it's crucial to:

- Raise awareness among regional entrepreneurs,
- Foster innovation,
- Create an enabling environment for hydrogen economy development.

When crafting a strategy for Pomerania's hydrogen economy, it's essential to consider uncertainties such as the price of green hydrogen, the model of the hydrogen economy (centralized or distributed), competition from alternative energy sources, hydrogen transmission and distribution, technology

[15] http://iw.org.pl/wp-content/uploads/2023/06/The-Strategy-for-the-development-of-hydrogen-Wielopolska-until-2030-with-a-perspective-until-2040-summary.pdf

[16] https://4cf.pl/wpcontent/uploads/pdf/Pomorskie%20na%20lekkim%20gazie_raport%20ko%C5%84cowy.pdf

efficiency and cost-effectiveness, the pace of energy transition, climate policy, public support for decarbonization and hydrogen, foreign investment interest in Polish hydrogen, and the necessary competencies.

The report outlines scenarios for Pomerania's hydrogen economy development, ranging from vying for attention to establishing hydrogen valleys and communities. However, the key to success lies in supporting local entrepreneurship and considering social factors when planning hydrogen initiatives in Pomerania. This report serves as a roadmap for Pomerania's journey towards a sustainable future. While it presents challenges, it also offers significant opportunities to create a region that prioritizes environmental sustainability while fostering prosperity and development for its residents.

3.2.3 Spain

In October 2020, the Spanish government's Council of Ministers at the proposal of the Ministry for Ecological Transition and the Demographic Challenge ("MITECO"), approved the **"Hydrogen Roadmap: a commitment to renewable hydrogen"**[17] (hereafter the "Hydrogen Roadmap"). The purpose of the Hydrogen Roadmap is to identify the challenges and opportunities for robust development of renewable hydrogen in Spain, providing a series of measures aimed at boosting investment. Through these measures, the Government aims to create a framework that will allow Spain to position itself as a future technological leader in the field of green hydrogen, taking into consideration its potential to play a relevant role in energy storage and the decarbonisation of those economic sectors that are most difficult to electrify. However, there are other strategic and legislative documents that complete Spain's Strategic Energy and Climate Framework, and which take into account the role of green hydrogen as a key energy vector for achieving climate neutrality in 2050. These include the **National Integrated Energy and Climate Plan ("PNIEC") 2021-2030**[18], the **Draft Law on Climate Change and Energy Transition**[19], the **Long-Term Decarbonisation Strategy 2050**[20], and the **Energy Storage Strategy**[21].

The roadmap sets the following objectives for 2030 with an estimated investment of 8.9 million (between 2020-2030):

• **4 GW of installed electrolyser capacity**, with an intermediary target of **300-600 MW** by 2024. • A minimum share of 25% renewable hydrogen of total hydrogen consumption.

• A minimum share of 28% renewable energy consumption in transport, including through:

- A minimum of **150 to 200 hydrogen-fuelled buses**.
- A minimum of **5,000 to 7,500 light and heavy vehicles**.
- The use of **hydrogen-powered trains** on at least two commercial lines.

[17] https://www.miteco.gob.es/content/dam/miteco/es/ministerio/planes-estrategias/hidrogeno/h2executivesummary_tcm30-513831.pdf
[18] https://www.miteco.gob.es/es/prensa/pniec.html
[19] https://commission.europa.eu/projects/entry-force-law-climate-change-and-energy-transition_en#:~:text=The%20Law%20on%20Climate%20Change,100%25%20renewable%20electricity%20system).
[20] https://www.miteco.gob.es/content/dam/miteco/es/prensa/anexoelp2050_tcm30-516147.pdf
[21] https://cicenergigune.com/en/blog/spanish-energy-storage-strategy-approved

- A network of a minimum of **100 to 150 public renewable hydrogen stations** and the introduction of green hydrogen-powered handling machinery at the main five ports and airports.

In Spain, the Hydrogen Roadmap of October 2020 outlines guidelines for developing specific hydrogen legislation. Currently, hydrogen production facilities are regulated similarly to other inorganic gas production facilities, regardless of size, potentially hindering small-scale projects.

Regarding hydrogen injection into the gas grid, the PD-01 protocol applies, providing technical specifications for gas circulation and referring to standard UNE-EN 16726. There is currently no specific limit on hydrogen content by volume, assessed case by case.

The roadmap includes measures to review technical and regulatory aspects of gases for hydrogen injection. Nationally, the Land Law (Ley del Suelo) regulates land use, with hydrogen production plants considered chemical facilities requiring permits. The roadmap aims to reclassify in-situ renewable hydrogen production at service stations as not solely industrial activities.

Additionally, **RD-L 6/2022**[22], part of Spain's response to the Ukraine war's economic and social consequences, includes measures to support renewable energy projects. These measures demonstrate the Spanish government's commitment to fostering the renewable energy sector, particularly supporting renewable hydrogen projects where transportation infrastructure was previously a barrier.

On 19 May 2022, Spain's **Royal Decree 376/2022** (RD 376/2022)[23], came into force. The decree regulates the criteria for the sustainability and reduction of greenhouse gas emissions from biofuels, bioliquids and biomass fuels, as well as the system of guarantees of origin (GoO) of renewable gases – applicable to biogas, biomethane and renewable hydrogen-describing the certification procedure. This regulatory framework, although not yet complete, showcases Spain's proactive approach to promoting renewable energy sources, including hydrogen. It aligns with the country's broader efforts to achieve environmental sustainability and mitigate climate change.

The different regions in Spain are moving forward with their specific roadmaps, which are focused to create hydrogen valleys as incentive for reindustrialization, sustainable development, just transition and the creation of quality employment on a local scale. Some of the planned valleys are the Basque Hydrogen Corridor (BH2C), the Hydrogen Valleys of Galicia (H2Pole), Castilla y León in Garray (Soria), Catalonia, Mallorca, Cartagena, Puertollano, Extremadura, Valencia and two valleys in Andalucía, more specifically in Huelva and Algeciras.

Roadmap for Basque region:

The **Basque Hydrogen Strategy**[24], unveiled in Spring 2021, aims to establish a hydrogen production, distribution, and consumption ecosystem in the Basque Country, leveraging its industrial, logistical, and technological strengths. The strategy's key objectives are:

1. Foster a robust and sustainable local market by promoting renewable, low-carbon hydrogen production and stimulating domestic demand.

[22] https://www.lamoncloa.gob.es/consejodeministros/resumenes/Documents/2023/100123-Presentacion_hidrogeno-verde-reforma-mercado-electrico-UE.pdf
[23] https://www.engie.es/aprobado-el-sistema-de-garantias-de-origen-para-gases-renovables/
[24] https://eve.eus/EveWeb/media/EVE/pdf/H2/Estrategia-Vasca-del-Hidrogeno.pdf

2. Position hydrogen as a viable decarbonization tool for Basque industry and other hard-to-decarbonize sectors like transport.

3. Develop storage, transportation, and distribution infrastructure to support local market growth and lay the groundwork for future international hydrogen trade.

4. Drive training, research, and industrial development to position the Basque Country as a technology exporter in an expanding market.

The strategy includes an Action Plan comprising 58 proposed lines of action, structured into six central themes, with targets to be achieved by 2030.

A pivotal instrument for realizing these goals is the **Basque Hydrogen Corridor (BH2C**), established in November 2021. This association, comprised of 78 organizations including institutions, companies, research centers, and universities, spearheads a public-private partnership strategy. Building on the region's successful tradition of such collaborations, the BH2C encompasses 38 projects spanning the entire hydrogen value chain, from production and transport to usage, product development, and inter-university training initiatives.

Roadmap for the Valencian Region.

In line with the objectives of the European Green Deal and the European Hydrogen Strategy, as well as with the National Energy and Climate Plan (PNIEC), and within the framework of the Strategic Plan for Valencian Industry (PEIV), the Generalitat Valenciana (regional government) intends to promote initiatives focused on generating a hydrogen value chain based on the production and consumption of renewable hydrogen in different sectors that need to improve their competitiveness by reducing the energy bill and adapt to the requirements and commitments to reduce greenhouse gas emissions, supporting the fulfilment of the climate objectives established by the European Union from the regional action, such as: energy-intensive industries, the port sector, the refining industry, mobility and water treatment.

The Renewable Hydrogen Strategy in the Valencian Region[25] includes ambitious actions, raised in a cooperative way among the actors of the value chain present in the region, in order to generate a significant impact on improving business competitiveness.

The action plan to achieve the objectives of the Renewable Hydrogen Strategy of the Valencian Region to 2030 is structured in four axes:

- Generation and demand impulse
- Technological development
- Regulatory development
- Regulatory framework and promotion

The planned strategy encourages relevant innovations and investments, through different objectives for 2030, such as launching 10 pilots for testing and development of advanced industrial equipment

[25] https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-launches-plans-for-low-carbon-green-hydrogen-cluster-in-spains-valencia-region.html

for the generation and application of renewable H_2; reaching a production of 75,000 t/year of hydrogen from renewable energies; combining renewable energies and batteries in pilot projects for electrolysis systems; having in operation electrolysis facilities with a total power of at least 900MW; developing at least 2 pilot projects of electrolysis systems using water from wastewater treatment plants (WWTPs); developing 2 pilot projects that use the current gas network to transport hydrogen; developing 5 pilot projects with direct injection of hydrogen for processes with high hydrogen consumption; covering 25% of the hydrogen consumed in the chemical industry with renewable hydrogen; cover 10-20% of the needs of the ceramics industry with renewable hydrogen; development of pilot projects for the adaptation of industrial processes that guarantee a 10-20% consumption of renewable hydrogen in the ceramics industry; introducing 13 prototypes of port/airport machinery and transport; covering 100% of the hydrogen consumed in the refining industry with renewable hydrogen; supplying renewable hydrogen to 100 light and heavy goods vehicles, including 15 buses, and having 7 public hydrogen plants/hydroline stations in operation, as well as 2 commercial train lines powered by renewable hydrogen; development of hydrogen technology for traction in railway transportation; developing at least 2 pilot projects with the use of waste heat from hydrogen production; developing at least 1 pilot project using hydrogen as a flexibility mechanism for the electricity sector; installing advanced testing facilities for industrial equipment for the generation and use of hydrogen and housing manufacturing units for electrolyzers.

3.2.4 Finland

The ambition of Finland is to be a frontrunner in Europe's high-value hydrogen economy by 2035, unlocking economic value and promoting societal well-being. To achieve this, Finland aims to leverage collective strengths and ongoing hydrogen projects. A **National Hydrogen Roadmap for Finland**[26] was commissioned by Business Finland and was delivered in 2020. The Roadmap contains a list of suggestions for each part of the hydrogen value chain:

- Production: Finland has good wind resources, both offshore and onshore, allowing an increase in the production of renewable electricity, essential for the production of low-carbon hydrogen. It has also a fairly strong electricity grid to support the increased transmission of power.
- Storage: Finland lacks deposits suitable for underground hydrogen storage. However, its natural gas pipeline could potentially store and transport hydrogen in the future.
- Transport: Finland's transport sector offers opportunities for hydrogen-powered fuel cells, particularly in heavy long-distance transport where battery electricity is not competitive.
- Use: Opportunities for clean hydrogen use in Finland include its refinery and biofuel industries, which could transform to using clean hydrogen as prescribed by current regulations. Efforts by major steel manufacturers to reduce carbon emissions could create a significant demand for clean hydrogen in Finland.

[26] https://www.businessfinland.fi/4abb35/globalassets/finnish-customers/02-build-your-network/bioeconomy--cleantech/alykas-energia/bf_national_hydrogen_roadmap_2020.pdf

Creating a hydrogen economy requires collective action rather than passive observation. Finland has the potential to develop a wide range of new businesses across the hydrogen value chain, but this requires proactive efforts from all stakeholders. The roadmap outlined in this document provides a starting point for Finland to capitalize on the opportunities presented by hydrogen. However, this roadmap lacks specific targets focuses primarily on research, development, and innovation.

The Government adopted a **Resolution on Hydrogen Plan**[27] on 9 February 2023. In its resolution, the Government describes Finland's objectives regarding hydrogen and the measures to promote them. Finland's goal is to become the European leader in the hydrogen economy in the entire value chain aligning with this vision, aiming for Finland to account for 10% of the EU's clean hydrogen production and use. In June 2023, enter in force the **Clean Hydrogen Economy Strategy**[28] outlines tactical actions needed for Finland to become the leading hydrogen economy ecosystem in Europe. This strategy emphasizes three main points:

- expanding domestic clean hydrogen production,
- accelerating the ramp-up of clean industries,
- growing exports of hydrogen-related technologies and services.

Finland must swiftly execute recommended actions and practical measures to address existing barriers and accelerate the hydrogen economy's scale-up. Key points include:

1) Build Europe's leading hydrogen ecosystem: Rapidly create favorable market conditions and regulations to accelerate the development of a hydrogen economy as outlined in the Government Resolution.

2) Drive progress through hydrogen valleys and cross-collaboration - Establish hydrogen valleys to expedite projects based on regional strengths and ensure collaboration and sharing of best practices between these valleys.

3) Accelerate and align decision-making - Establish well-led public and private sector bodies to coordinate and drive hydrogen strategy implementation. Ensure these bodies have clear mandates and the ability to make timely, cross-sectoral, strategic decisions.

4) Position Finland as a leader on the global hydrogen map - Influence hydrogen development within the EU, attract investments to Finland, and promote Finnish technology and services worldwide. Continuously communicate Finland's strengths, build strategic partnerships, and foster relationships with key countries.

Finland currently lacks a comprehensive hydrogen-specific legal framework. Moreover, no specific targets for hydrogen deployment were included in its NECP (National Energy and Climate Plans). According to the Commission's assessment, there are also "no technology-specific policies to promote fuel cell vehicles and hydrogen refueling stations infrastructure". However, several policy instruments, such as car taxes and carbon pricing, create an incentive for hydrogen utilization. Additionally, revised

[27] https://valtioneuvosto.fi/en/-//1410877/government-adopts-resolution-on-hydrogen-finland-could-produce-10-of-eu-s-green-hydrogen-in-2030#:~:text=The%20Government%20adopted%20a%20resolution,in%20the%20entire%20value%20chain.

[28] https://h2cluster.fi/wp-content/uploads/2023/06/H2C-H2-Strategy-for-Finland.pdf

legislation on guarantees of origin includes hydrogen and simplifies the process of identifying hydrogen's level of sustainability.

In conclusion, Finland stands poised to pioneer Europe's high-value hydrogen economy, leveraging strategic plans, governmental resolutions, and policy instruments to propel its vision forward and capitalize on the vast potential of hydrogen technology.

3.2.5 Portugal

The Portuguese government aims to achieve carbon neutrality by 2050, viewing hydrogen as a key driver for decarbonizing various sectors of the national economy. Portugal, a leading renewable energy economy in Europe, targets 80% electricity consumption from renewables by 2030. With its strategic coastal location, existing infrastructure, and commitment to low-cost renewables, Portugal emerges as a significant green hydrogen hub in Europe.

The government aims to ensure energy sector stability, gradually integrating hydrogen as a sustainable pillar and strategic opportunity. Moreover, the Portuguese hydrogen economy seeks to enhance energy sector independence by substituting imported fossil fuels with domestically produced green energy.

The **National Hydrogen Strategy**[29] was enacted by Council of Minister's resolution 63/2020, of 14 August 2020, in alignment with the **2050 Carbon Roadmap for carbon Neutrality**[30] (RNC 2050) and the **2030 National Energy and Climate Plan**[31] (PNEC 2030).

The strategy promotes an industrial policy around hydrogen, based on the definition of a set of public policies that guide, coordinate and mobilize public and private investment in projects of production, storage, transportation, and consumption of renewable gases in Portugal.

As outlined in this national document, Portugal stands to gain from various applications of green hydrogen, particularly in heavy road, maritime, rail, and even air transport, as well as in replacing natural gas within the industrial sector. Additionally, leveraging hydrogen for electricity generation through fuel cells and its integration into the natural gas grid for residential purposes are among the other supply-side advantages envisioned in the national strategy.

The key goals for 2030 are:

- 5% green hydrogen in final energy consumption, road transport and industry.
- 5% of green hydrogen in the industrial sector's energy consumption.
- 5% of green hydrogen in energy final consumption;

[29] https://kig.pl/wp-content/uploads/2020/07/EN_H2_ENG.pdf
[30] https://www.portugal.gov.pt/download-ficheiros/ficheiro.aspx?v=%3D%3DBAAAAB%2BLCAAAAAAABACzMDexBAC4h9DRBAAAAA%3D%3D
[31] https://energy.ec.europa.eu/system/files/2020-06/pt_final_necp_main_en_0.pdf

- 15% green hydrogen injected into natural gas networks.
- 50 to 100 hydrogen refuelling stations.
- Between 2 and 2.5GW of installed electrolyser capacity.

The national strategy provides several support mechanisms to encourage new investments in green hydrogen:

- The injection of hydrogen into natural gas networks may benefit from a partial or total exemption from network access tariffs for an initial period.
- A public allowance to hydrogen production, through a premium that covers the difference between the production price of green hydrogen and the price of natural gas in the Iberian natural gas market (MIBGAS).

Fiscal mechanisms aimed at encouraging the replacement of natural gas with green hydrogen involve adjusting relative prices between the two alternatives, penalizing natural gas while reducing the cost of hydrogen. Tax benefits and positive discriminations in applicable taxes will be established based on the advantages of green hydrogen.

In January 2023, the Portuguese government announced a **support scheme**[32] aimed at tendering for the supply of renewable hydrogen and biomethane, with the goal of replacing natural gas with renewable gases. This initiative seeks to establish 120GWh/year of renewable hydrogen and 150GWh/year of biomethane, offering a maximum subsidy of €127/MWh for hydrogen and €62/MWh for biomethane, with contracts expected to be valid for 10 years.

Another significant step was taken in April 2021, during the Portuguese Presidency of the Council, when Portugal signed **a Memorandum of Understanding with the European Investment Bank (EIB)**[33] to boost the development of the hydrogen sector in the country and incentivize investments. Additionally, Portugal signed an **international agreement with Morocco**[34] in the same year, recognizing the strategic opportunity represented by the decarbonization of the economy and the transition to green energy, highlighting the importance of green hydrogen as a cleaner and more accessible energy source for the future of both countries' economies.

Regarding the legislative framework for hydrogen, Portugal has introduced specific regulations, although they are not highly detailed. With the publication of Decree-Law no. 62/2020 on August 28, 2020, which transposed Directive (EU) 2019/692, green hydrogen was included in the scope of the Portuguese National Gas System and defined as a gas of renewable origin. This law ensures that the production of green hydrogen is a liberalized activity with low administrative requirements, allowing producers to allocate the product for various purposes, including self-consumption, injection into public gas networks, bulk supply to consumers, export, or use in other sectors such as transport.

[32] https://hydrogen-central.com/hydrogen-policy-portugal-announces-support-scheme-renewable-hydrogen-icis/

[33] https://www.eib.org/en/press/all/2021-117-the-eib-partners-up-with-the-portuguese-republic-to-accelerate-investments-in-the-hydrogen-sector

[34] https://northafricapost.com/47322-morocco-portugal-sign-agreement-to-boost-cooperation-in-green-hydrogen-field.html#google_vignette

Recently in the framework of Council Regulation (EU) 2022/2577, to accelerate the deployment of renewable energy, Portugal has adopted the following measures:

-**Decree Law 30-A/2022**[35],18th April- which approves measures for the simplification of the production of energy from renewable sources;

-**Decree Law 72/2022**[36],19th October- alters measures for the implementation of initiatives for the production and storage of energy from renewable sources;

-**Decree Law 11/2023**[37], 10th February- simplifies procedures for environmental licensing;

-**Decree Law n.º30/2023**[38], 13th July- published by DGEG as guidelines on procedures to be adopted in the licensing of industrial activity in the production of hydrogen from renewable sources;

Also, in July 2023, the Portuguese Government presented a proposal to the European Commission to revise the National Energy and Climate Plan 2030, calling for an increase in the installed capacity of electrolyzers in 2030 to 5.5 GW.

3.2.6 Italy

According to the Integrated **National Energy and Climate Plan** ("PNIEC")[39], published in December 2019, one of the primary objectives Italy is aiming to achieve by 2030 is the reduction of around 30% of national greenhouse gas emissions. With this in mind, hydrogen is considered as having a key role in reaching this goal as a result of its unique chemical and physical attributes, and specifically because hydrogen can be produced by renewable energy sources and can be stored and transported as a gas or liquid.

In November 2020, the Ministry of Economic Development published the **"Italian Hydrogen Strategy: preliminary guidelines"**[40]. This document sets a medium and a long-term objective, according to which the national energy consumption is expected to consist of 2% hydrogen by 2030 and 20% by 2050. The Hydrogen Strategy also identifies the sectors that will be crucial for the use and development of the hydrogen, such as public transportation, chemicals and refining. The strategy is not yet in force.

The key role of hydrogen in the context of the national energy transition has been further confirmed by the **National Recovery and Resilience Plan** ("NRRP")[41], submitted by the Italian Government to The European Commission on 30 April 2021 and approved by the European Commission on 13 July 2021. The NRRP is part of the Next Generation EU programme, namely the € 750 billion recovery package, consisting of grants and loans, set up by the European Union in response to the Covid-19 pandemic crisis. The NRRP, whose total value is equal to € 191.5 billion, has been conceived based on three

[35] https://data.dre.pt/eli/dec-lei/30-a/2022/04/18/p/dre/pt/html
[36] https://diariodarepublica.pt/dr/detalhe/decreto-lei/72-2022-202357817
[37] https://data.dre.pt/eli/dec-lei/11/2023/02/10/p/dre/pt/html
[38] https://www.dgeg.gov.pt/pt/areas-setoriais/energia/energias-renovaveis-e-sustentabilidade /hidrogenio/nota-interpretativa-licenciamento-h2-renovavel/
[39] https://www.mimit.gov.it/images/stories/documenti/PNIEC_finale_17012020.pdf
[40] https://www.mimit.gov.it/images/stories/documenti/Strategia_Nazionale_Idrogeno_Linee_guida_preliminari_nov20.pdf
[41] https://www.governo.it/sites/governo.it/files/PNRR.pdf

strategic pillars: (i) digitalization and innovation, (ii) ecological transition, and (iii) social inclusion. In the context of the ecological transition, paramount importance has been given to renewable energy, hydrogen and sustainable mobility.

Currently, hydrogen is mostly used in chemical and metallurgical industries in Italy. It is commonly obtained through a thermochemical process called “steam methane reforming” which consists in the conversion of fossil fuels (e.g. coal and natural gas) into “grey” hydrogen. This produces high CO_2 emissions and other pollutants; therefore, in order to reduce such emissions, both “blue” and “green” hydrogen should be considered as alternatives.

To date, in Italy, only a small share of the hydrogen production originates from electrolysis to create green hydrogen. However, an increasing interest in green hydrogen is expected over the coming years thanks to the progressive reduction in the cost of renewable power and electrolysers.

Compared with other energy sources, the hydrogen market is still at an early stage in Italy. Nevertheless, it is at the heart of the Italian new green deal given its huge potential in terms of decarbonization and exploitation of renewable energy. In recent years, the Italian government and private companies have invested in research and innovative projects to boost the development of new hydrogen-related technologies. Italy is one of the leading countries in Europe in terms of research in hydrogen sector.

In Italy, the regulatory framework for hydrogen is primarily defined by the Ministerial Decree issued on October 23, 2018[42], concerning the "Technical rules of fire prevention for the design, construction, and operation of hydrogen distribution facilities for automotive vehicles". This decree has addressed some of the regulatory barriers that previously hindered the construction and operation of hydrogen plants. However, hydrogen production in Italy is still considered an industrial activity, whether it occurs through steam reforming or electrolysis methods. Consequently, restrictive measures regarding land use, including zone prohibitions, apply regardless of the production method used. Recently, the government approved Decree Law 13 of February 24, 2023, known as the "simplification decree"[43], which simplifies bureaucracy related to renewable energy development, including hydrogen. Additionally, with Italian Legislative Decree No. 224 of April 17, 2023, the system of guarantees of origin (GoO) [44]for renewable gases, applicable to biogas, biomethane, and renewable hydrogen, along with the certification procedure, has been re-regulated. The movement in the regulatory Italian framework trace a positive trajectory for the development of the hydrogen market in the country. On this wave also different initiatives has been planned indifferent region focused to create hydrogen valleys as incentive for reindustrialization, sustainable development, just transition and the creation of quality employment on a local scale. Some examples are: H_2 Valley in South Tyrol, H_2ISEO, H_2MO, Puglia Green H_2 Valley and Enea Casaccia H_2 DEMO Valley.

Piedmont region hydrogen roadmap:

The **Piedmont roadmap for hydrogen[45]**, adopted on July 1, 2022, sets out an ambitious vision to align with both European and national objectives in the energy and environmental sectors. Its

[42] https://www.gazzettaufficiale.it/eli/id/2018/11/05/18A07049/sg
[43] https://www.gazzettaufficiale.it/eli/id/2023/04/21/23A02439/sg
[44] https://www.mase.gov.it/sites/default/files/Archivio_Energia/Archivio_Normativa/dm_224_14-07-2023_garanzie_di_origine.pdf
[45] https://www.regione.piemonte.it/web/media/33319/download

comprehensive strategy encompasses five key goals: firstly, contributing significantly to the attainment of these broader hydrogen objectives; secondly, nurturing the growth of local enterprises while attracting new ones to the region; thirdly, streamlining access to EU and national funding streams; fourthly, fostering an environment conducive to research and development in hydrogen technologies; and finally, promoting robust dialogue and collaboration among governmental bodies, academic institutions, and businesses.

To achieve these strategic objectives, the roadmap delineates actions across four primary areas:

1) Hydrogen production, distribution, and energy use: it underlines the importance of supporting the establishment of green and sustainable hydrogen production plants, with a particular emphasis on simplifying authorization procedures to expedite their development. Moreover, it advocates for the planning and construction of dedicated hydrogen pipelines and the exploration of hydrogen blending initiatives.

2) Mobility and transport: support will be given for fleet replacement with hydrogen-powered vehicles for urban transport and commercial fleets, the deployment of hydrogen powered rolling stock and the assessment of the potential of hydrogen-powered vessels for inland waterways.

3) Diversification of production, research development and innovation: this aspect focuses on the development of industrial production with a focus on hydrogen markets. Support for product diversification (systems and components), decarbonisation of hard-to-abate sectors, support for R&D and public-private partnerships, as well as support for exports of hydrogen-related products and technologies, are foreseen.

4) As part of the “transversal pillar”, the roadmap will also promote skill development and training on hydrogen technologies, participation in European and national networks, associations and projects, and dialogue with stakeholders focusing on future legislation and regulation of the sector.

The roadmap's implementation will be facilitated through a combination of EU, national, and regional funding programs, including Italy's Recovery and Resilience Plan, the European Structural and Investment Funds, and regional budget allocations. Additionally, a dedicated regional hydrogen team will be instrumental in coordinating efforts, disseminating information on funding opportunities and regulatory updates, facilitating cross-sectoral project management, and ensuring alignment with regional, national, and European initiatives.

4. Large scale hydrogen projects and initiatives driving job creation.

Hydrogen is increasingly becoming a cornerstone of future plans for both governments and industries across Europe. As we progress towards 2030 and, notably, 2050, green hydrogen is poised to emerge as a critical player in the economy, serving not only as an energy source but also as a vital raw material. The significant advancements underway in various sectors—production, storage, distribution, and end use—are expected to lead to a substantial increase in job opportunities within this sector.

This chapter introduces a study focusing on mapping the large-scale projects and initiatives related to hydrogen, which are driving significant job creation. The objective of this study was to identify **at least 30 major hydrogen projects and initiatives**, ensuring a balanced representation across Communities of Vocational Excellence. This objective has met comprehensively, with a total of 79 projects/initiatives mapped out, as illustrated in the following graph.

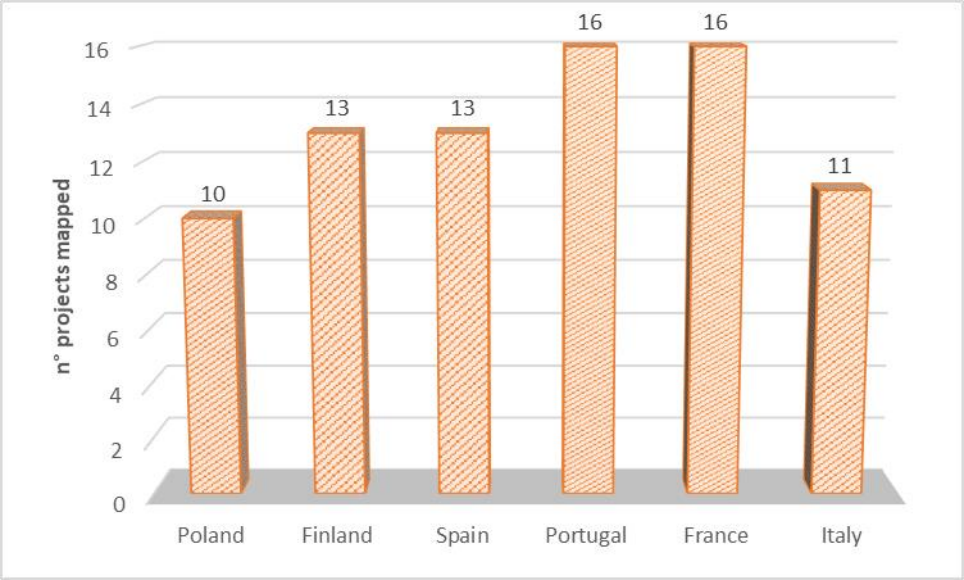

Figure 5 Mapping large-scale projects across the six countries under study.

Given the paramount importance of these initiatives in demonstrating the efficacy of hydrogen technologies in decarbonizing key European sectors and stimulating job creation, the analysis commences with a statistical examination of large-scale projects and initiatives across European countries. This examination takes into account factors such as the number of projects, their scale, and their intended final uses.

Following this initial analysis, our focus will shift to providing a schematic explanation of the most representative large-scale projects within the Cove's countries. Additionally, two separate sections will be dedicated to the significance of H_2Valleys in Europe as crucial demonstrators of the hydrogen ecosystem, and to the H_2 job creation market in Europe.

All projects mapped in this study are documented in Section 3 of the Questionnaire titled "H_2 Project and R&D Activities" within Annex 1.

4.1 Overview of Green Hydrogen Project in Europe:

As of the beginning of 2023, Europe boasted a total of 795 green hydrogen projects[46] utilizing electrolysis technology for hydrogen production and related products. Figure 6 provides an overview of the distribution of these projects across European countries, with Germany as a leader, closely followed by Spain, France, the UK, and the Netherlands. Notably, the top five and top ten countries collectively accounted for 62% and 84% of the total projects, respectively, indicating a concentration of green hydrogen initiatives in a select few nations.

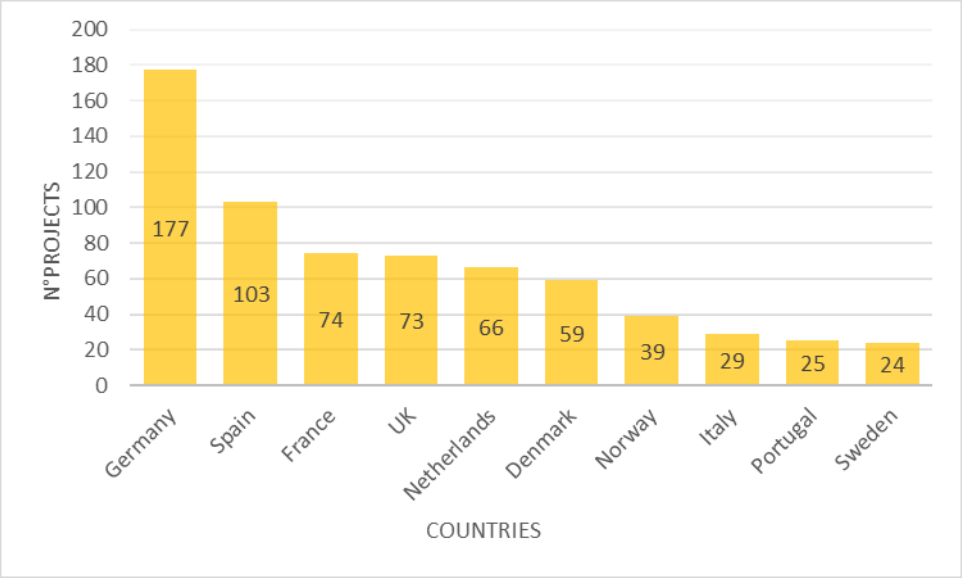

Figure 6 Top ten European countries in terms of the number of green hydrogen projects.

Figure 7 offers insight into the status of these projects, revealing that a majority are still in their early stages. Among the total projects, 277 were in the feasibility study stage, 160 were in the conceptualization stage, 126 were in the demonstration phase, and 121 were operational.

[46] https://workdrive.zohoexternal.com/external/e8593d6c9f0f334455ec8adcdc28573fadbd5216e15f550f7f62311e0f3206b3

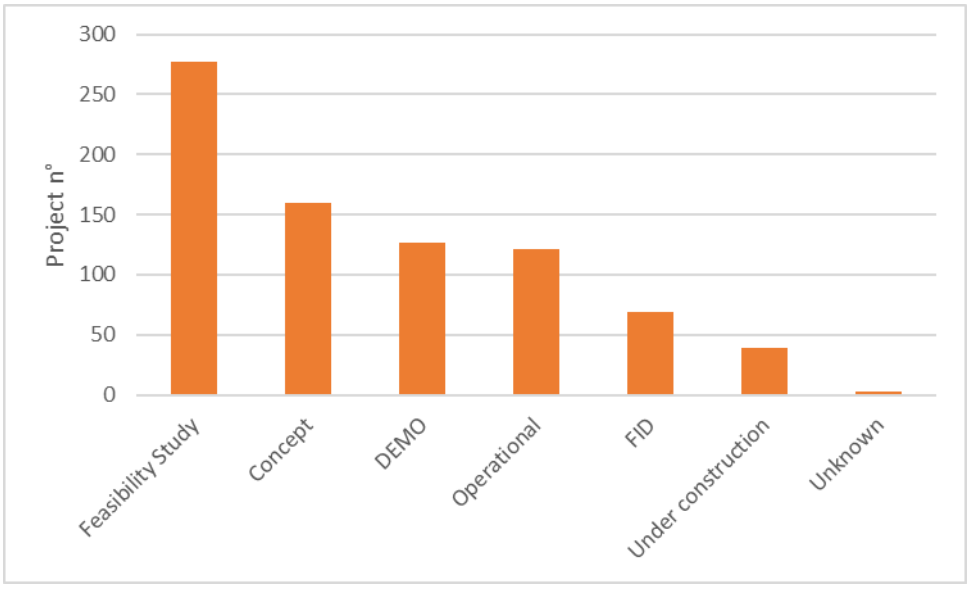

Figure 7 Status of green hydrogen project in Europe.

Examining the final applications of these projects in Figure 8, we observe that a considerable proportion are dedicated to the transportation sector, with 123 projects identified.

This is followed by 123 projects catering to high-temperature heat applications, 104 projects focusing on power generation, and 97 projects dedicated to injecting hydrogen into natural gas pipelines. It's worth noting that some projects are geared towards producing hydrogen as a base for other chemical products, such as Ammonia Production (45 projects, 4.8%) and Methanol Production (38 projects, 4.1%).

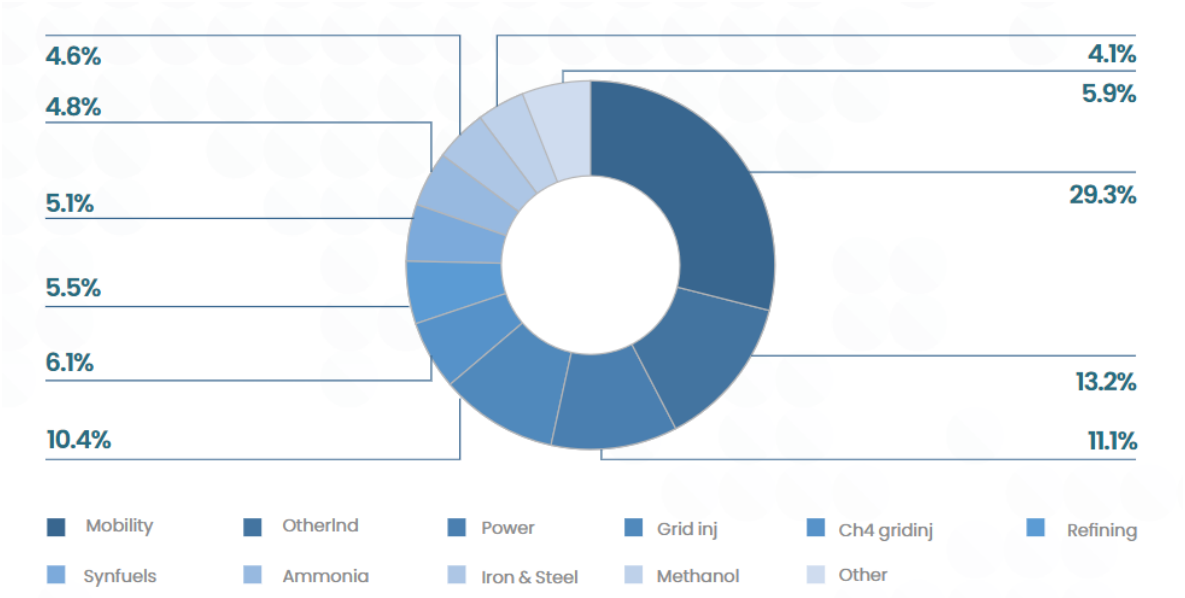

*Figure **8** Number of final uses of green hydrogen projects*.

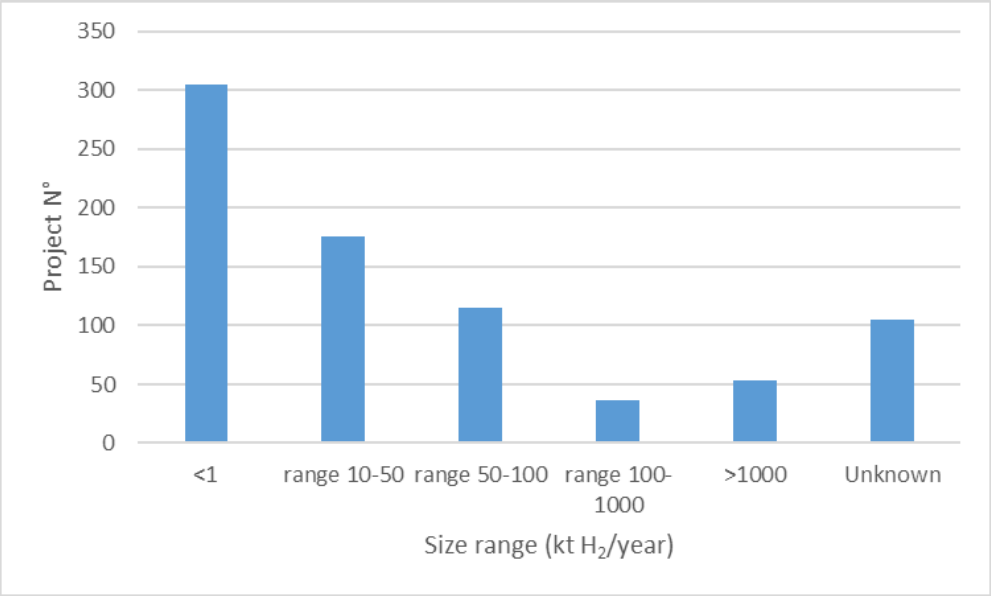

Figure 9 Number of Green Hydrogen Project by different scales (kt H_2/y)

Figure 15 sheds light on the scale of current green hydrogen projects in Europe, revealing that the majority are small demonstration initiatives. Specifically, 305 projects produce less than 1,000 tons of hydrogen per year, constituting 38% of the total number of projects. Following closely are medium-sized projects, with 176 producing between 1,000 and 10,000 tons annually, and 115 projects generating between 10,000 and 50,000 tons per year. Notably, the number of large-scale green hydrogen production projects remains relatively low, with only 37 projects producing between 50,000 and 100,000 tons annually, and 53 projects producing between 100,000 and 1,000,000 tons per year.

4.2 Large-Hydrogen projects in the H2Excellence project CoVEs

In this section, only the two most relevant large projects for each country studied are shown, while the complete list of the mapped project is in the Annex 1- third section "H_2 Project and R&D Activities".

4.2.1 Portugal

Project Name	**Madoqua P2X**
Promoter Name	Madoqua Ventures
Project Type	H_2 production- NH_3 production
Production category	Electrolyser- Haber-Bosch process (NH_3)
End-use category	industrial
Location	Sines
Capacity	1GW-150.000 tH_2/y and 300,000 tNH_3/y
Description	MadoquaPower2X will use renewable energy and 1 GW of electrolysis capacity to produce annually 150,000 tons of green hydrogen and 300,000 tons of green ammonia at large scale. It is the first project to be installed at the future energy and technological hub of Sines with an industrial scale
website/link	https://madoquapower2x.com/

Figure 10 Schematic representation of the MadoquaP2X project.

Project Name	**H2MED**
Promoter Name	Enagas, GRT gaz, OGE, REN, and Teréga
Project Type	Transportation
Production category	/
End-use category	Distribution
Location	From the Iberian Peninsula to North and Central Europe
Capacity	/.
Description	The H_2med project is a transnational initiative to interconnect the hydrogen networks of the Iberian Peninsula to Northwest Europe, enabling Europe to be supplied with affordable green hydrogen by 2030. This initiative was launched by France, Spain and Portugal, with a strong support by Germany, and is promoted by the TSOs of these countries.
website/link	https://h2medproject.com/the-h2med-project/

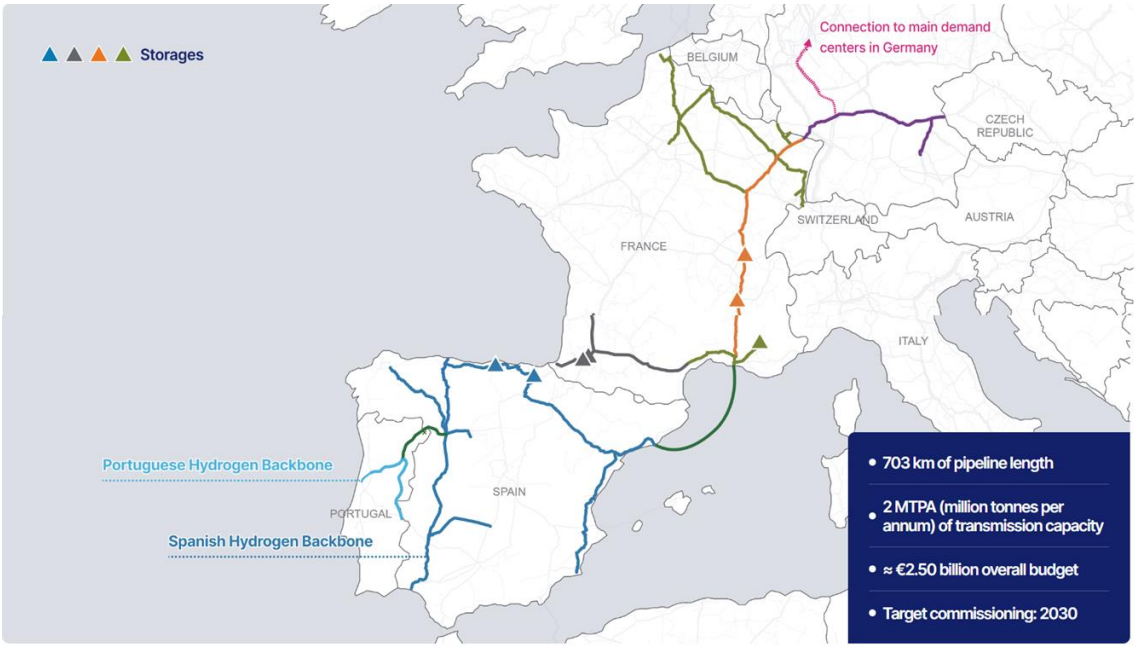

Figure 11 Schematic representation of the routes planned by the H2MED project.

4.2.2 France

Project Name	**HyVence**
Promoter Name	GEOSEL
Project Type	Production
Production category	Electrolyser
End-use category	Trasportation
Location	Fos-sur-Mer Lavalduc and Engrenier brine reservoirs
Capacity	125 MW/15000 tH_2/y
Description	The HyVence (Hydrogen de Provence) project combines a 600 MW peak floating solar farm to a 125 MW electrolysis plant. The floating solar farm will be installed on industrial brine reservoirs currently used by Geosel for its operations.
website/link	https://hyvence.fr/

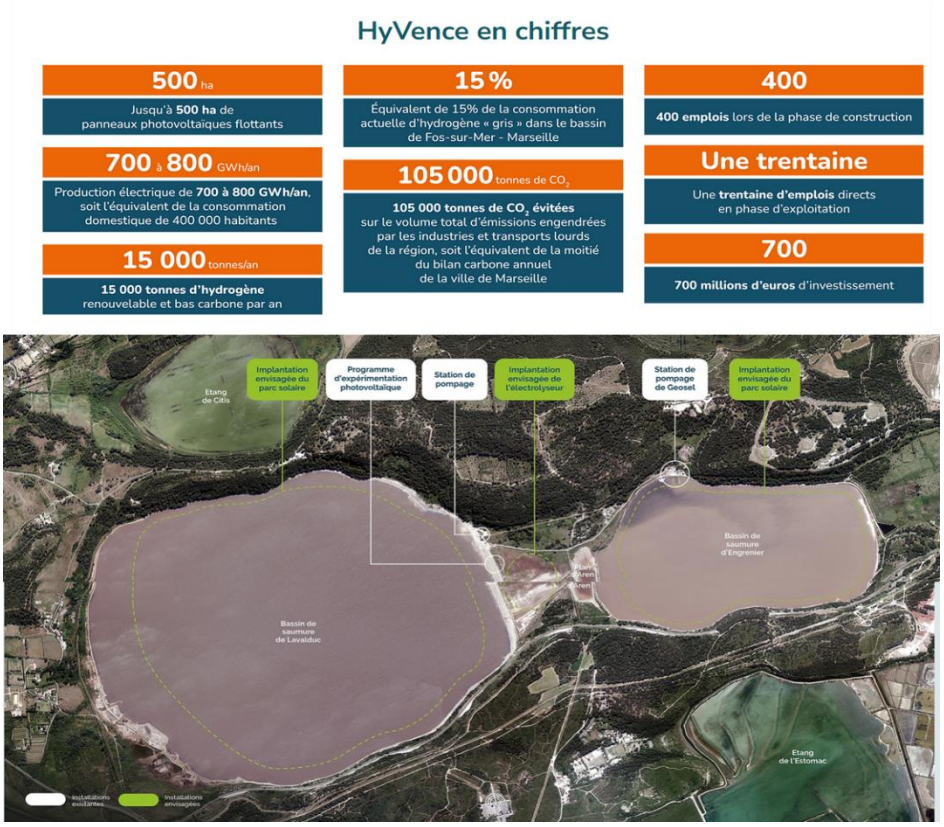

Figure 12 Schematic representation of the H2Vence project.

Project Name	**H2V(Vigneux- Dunkerque-Marseille Fos-Thionville- Illange- Valenciennes- Saint- Clair-du Rhône- Portes du Tarn)**
Promoter Name	H2V
Project Type	Production
Production category	Electrolyser
End-use category	Industry and mobility
Location	The projects are being developed in various regions of France.
Capacity	.H2V project (2030) 3GW- 405.000 tH_2/year
Description	H2V is developing green hydrogen gigafactories in France and Europe..
website/link	https://h2v.net/les-projets/

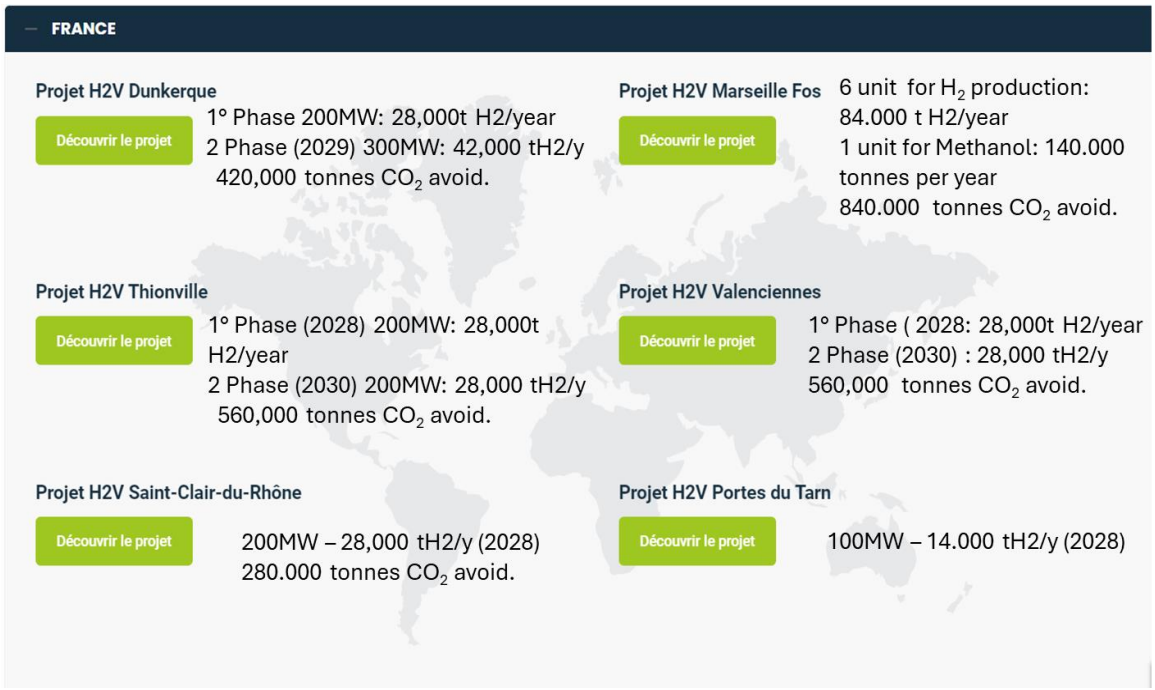

Figure 13 Schematic representation of the H2V projects.

4.2.3 Poland

Project Name	**Amber H2 Valley**
Promoter Name	ORLEN GROUP
Project Type	Production-Storage-Distribution-Utilization
Production category	Electrolyser
End-use category	Mobility- Industrial
Location	Gdynia City
Capacity	4,000 T/year
Description	Amber Hydrogen Valley aim is an activation of the long-lasting hydrogen economy the Pomerania Region in Poland, by the creation of a whole hydrogen value chain, from H2 production, storage and distribution to various end-uses (mobility, industr energy).
website/link	https://h2v.eu/hydrogen-valleys/amber-hydrogen-valley

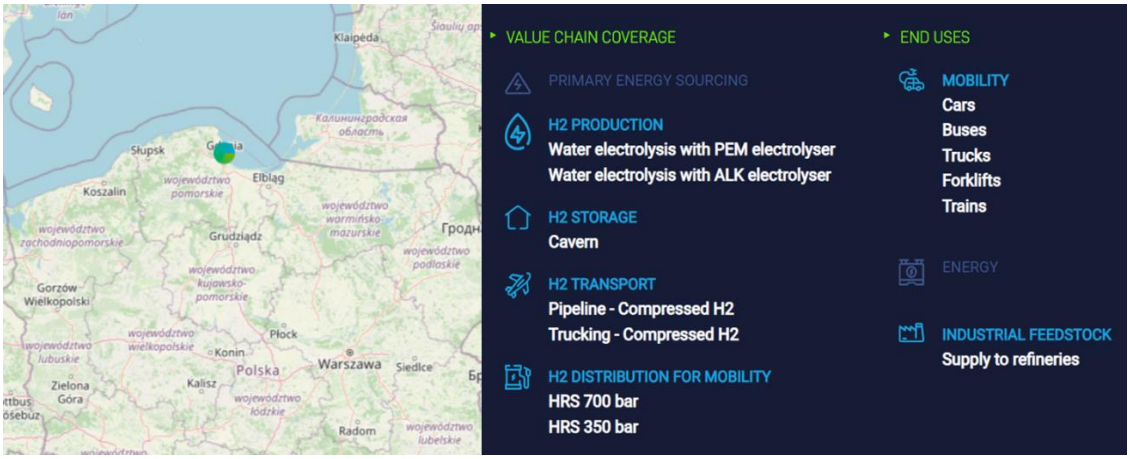

Figure 14 Schematic presentation of the Amber H_2 Valley.

Project Name	**Hydrogen Eagle**
Promoter Name	ORLEN GROUP
Project Type	Infrastructure- Production-distribution-storage
Production category	Electrolyser
End-use category	Public transport- Industry- power application
Location	Pomeranian Area
Capacity	110MW
Description	Hydrogen Eagle is a staged, comprehensive infrastructure project which aims to establish production, transport and distribution capacities for zero/low-emission hydrogen.
website/link	https://www.orlen.pl/content/dam/internet/orlen/pl/en/about-company/media/press-releases/2021/obrazy/Orlen_prezentacja_Hydrogen_final.pdf.coredownload.pdf

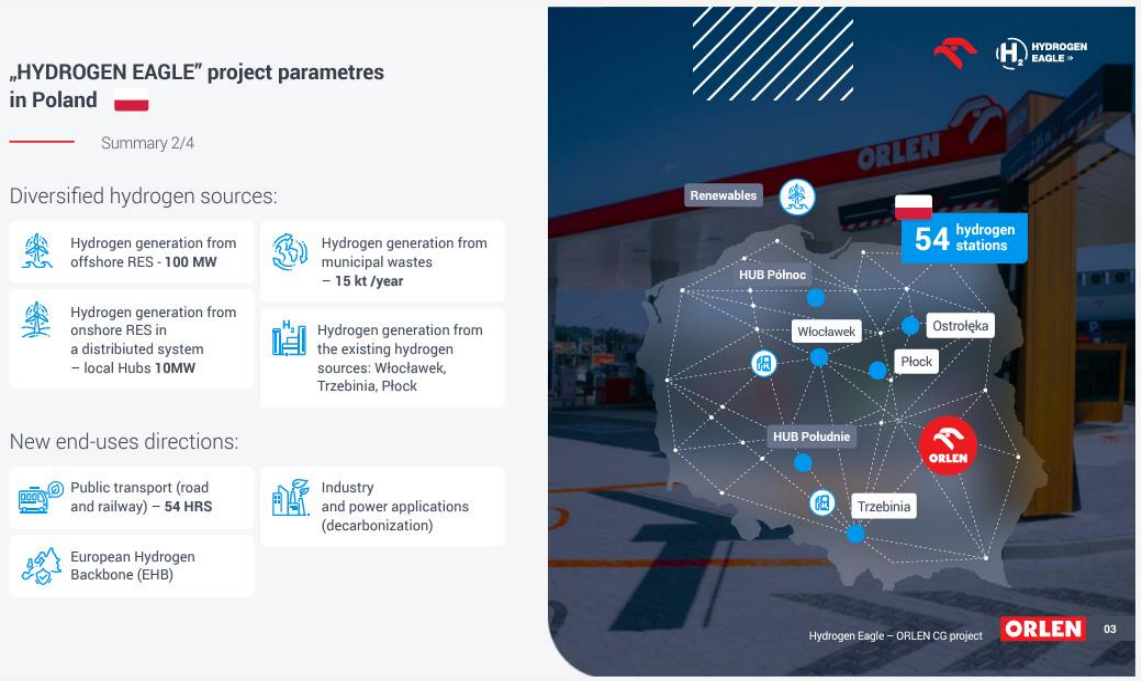

Figure 15 Schematic presentation of Hydrogen Eagle project.

4.2.4 Italy

Project	**SunsHyne Project (SoutH2 Corridor)**
Promoter Name	Snam Rete Gas S.p.A.
Project Type	Infrastructure- H_2 distribution
Production category	/
End-use category	/
Location	Italy, from the entry point in Sicily up to north with interconnection to Austria and Switzerland.
Capacity	10 MtH_2/y from Africa to Europe
Description	The project includes the construction of an Italian backbone for the dedicated transport of H2 to supply the H2 Italian and European demand by connecting production plants and import infrastructures to final demand and neighbour countries..
website/link	https://www.sunshynecorridor.eu/sunshyne-project/

Figure 16 Schematic presentation of the Italian route planned by the SunsHyne project.

Name	**Gela and Taranto H_2 Projects**
Promoter Name	Eni and Enel Green Power
Project Type	*H_2 production*
Production category	Ellectrolyzer
End-use category	Industry- (Refinery)
Location	Gela (Sicily region)- Taranto (Apuglia region)
Capacity	20 MW (Gela)- 10 MW(Taranto)
Description	Two projects by Italian multinational corporations Enel Green Power and Eni to develop green hydrogen will receive public funding approved by the European Commission under IPCEI Hy2Use.The project involves installing electrolyzers at two locations: one in Gela, Sicily, with a capacity of 20 MW, and another near Eni's refinery in Taranto, Apulia, with a capacity of 10 MW. Both will utilize PEM (polymer electrolyte membrane) technology. The aim is to produce green hydrogen, using solely renewable energy sources, to facilitate the decarbonization of the respective plants.
website/link	https://www.eni.com/en-IT/media/press-release/2022/10/green-hydrogen-projects-gela-taranto.html

Figure 17 ***Gela and Taranto refineries designated as production sites for H_2***

4.2.5 Spain

Name	**Catalina Project**
Promoter Name	Copenhagen Infrastructure Partners
Project Type	H_2 production
Production category	Electrolyzer
End-use category	Industry- (Refinery)
Location	PtX located in Aragon, ES, transporting green hydrogen through a pipeline to the Spanish East Coast (Sagunto)
Capacity	500 MW- 47,000 t H_2/y
Description	Catalina is a world-leading large-scale green hydrogen project to develop 1.1 GW of combined onshore wind and photovoltaic plants and 500 MW electrolyser connected to a green ammonia plant through a dedicated hydrogen pipeline of 221 km.
website/link	https://catalinaptx.com/#theproject

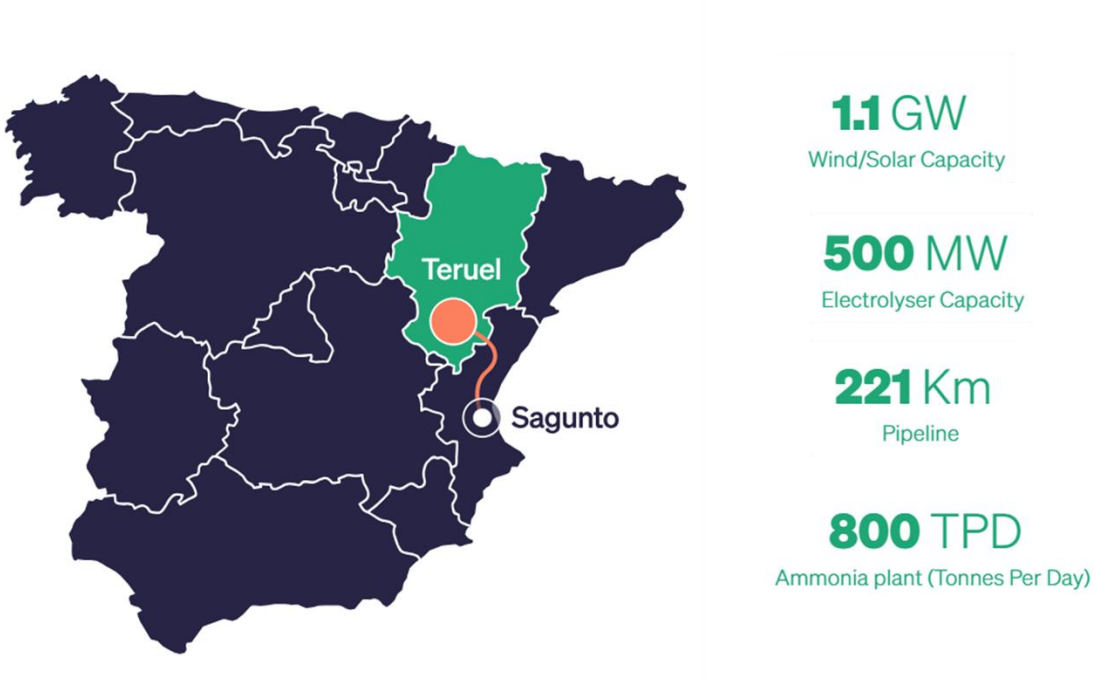

Figure 18 Schematic presentation of the Catalina' s project.

Name	Green Hysland Project
Promoter Name	/
Project Type	H_2 production/distribution infrastructure and utilization
Production category	Electrolyzer
End-use category	Mobility- heat & power sector
Location	Mallorca Island
Capacity	7.5MW- 330 tH_2/y
Description	GREEN HYSLAND aims to establish a comprehensive Hydrogen (H2) ecosystem on the island of Mallorca, encompassing all key elements of the H_2 value chain: production, distribution infrastructure, and utilization across mobility, heat, and power sectors. The project will integrate 6 deployment sites on the island, featuring 7.5MW of electrolysis capacity linked to local PV plants and 6 fuel cell end-user applications such as buses, cars, and CHP systems at commercial buildings. Additionally, it will facilitate electricity supply at the port and H_2 injection into the local gas grid. Infrastructure deployment, including a dedicated H_2 pipeline, road trailers for distribution, and a hydrogen refueling station (HRS), will enable widespread distribution of green H_2 to local end-users.
website/link	https://greenhysland.eu/

Figure 19 Schematic presentation of Green Hysland project.

4.2.6 Finland

Name	P2X Harjavalta project
Promoter Name	P2X
Project Type	H_2 production/Ammonia -methane and methanol Production
Production category	Electrolyzer
End-use category	e-fuel
Location	Harjavalta
Capacity	20MW(online 2024) 1GW(online 2031)
Description	P2X Solutions is currently constructing Finland's first industrial-scale green hydrogen and synthetic methane production plant in Harjavalta. The company targets 1 GW of electrolysis capacity by 2031. The project is going to build a fueling station network for hydrogen-powered vehicles.
website/link	https://p2x.fi/en/project/

Figure 20 Schematic presentation of the P2X project.

Name	Nordic Ren-Gas Oy projects
Promoter Name	Nordic Ren-Gas Oy
Project Type	H_2 production
Production category	Electrolyzer
End-use category	Mobility
Location	Lahti/ Mikkeli/Tampere-Kotka
Capacity	120MW-40MW-60MW-40MW
Description	Ren-Gas develops and delivers sustainable energy projects. We accelerate the cost effective decarbonization of heavy transportation sector by developing a clean P2X gas production network in Finland
website/link	https://ren-gas.com/projektit/

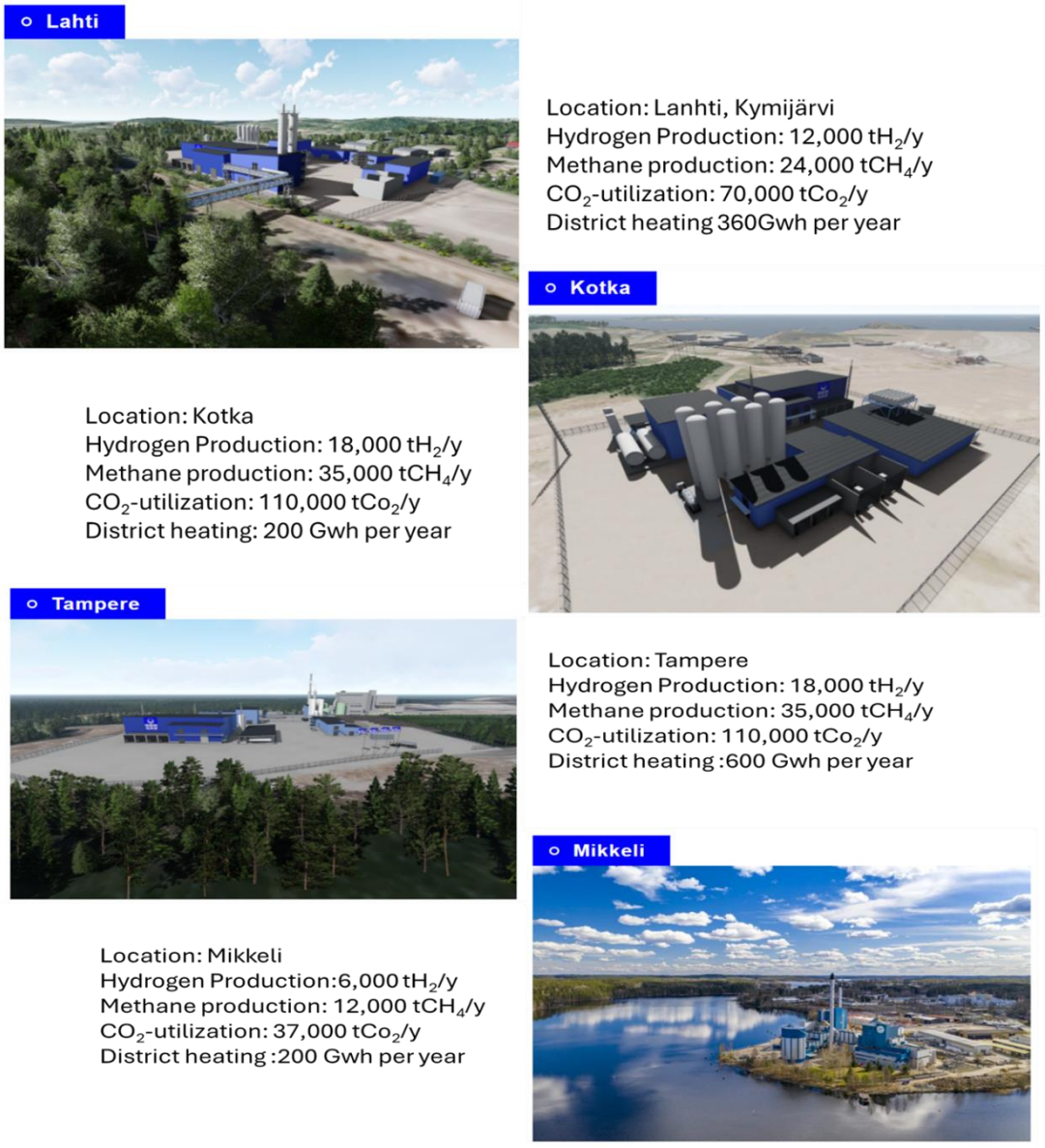

Figure 21 Schematic description of the Nordic Ren-Gas Oy projects.

4.3 Hydrogen Valleys in Europe

In Europe, the emergence of Hydrogen Valleys represents a significant shift towards establishing fully integrated regional hydrogen ecosystems. These initiatives signify a departure from mere demonstration projects, serving as the pioneering force for the broader adoption and industrialization of hydrogen technologies within the continent.

Hydrogen Valleys are pivotal in advancing the New Hydrogen Economy by providing a framework for scaling up hydrogen production, distribution, and utilization in a cohesive and strategic manner. Unlike isolated projects, Hydrogen Valleys encompass a holistic approach, integrating various stakeholders and components of the hydrogen value chain to create synergies and maximize efficiency.

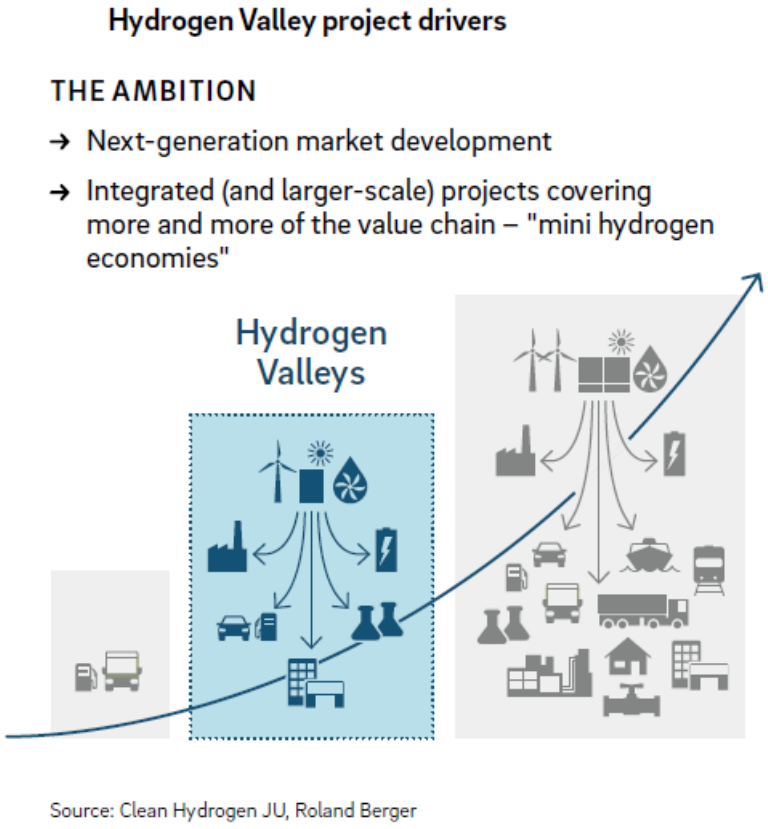

Figure 22 Hydrogen Valleys project drivers.

One of the key features of Hydrogen Valleys is their ability to pool hydrogen supply and demand, essentially creating self-sustaining 'mini hydrogen economies'. This approach facilitates the optimization of asset utilization and cost reduction through economies of scale.

Moreover, Hydrogen Valleys are characterized by their geographical specificity, ranging from local or regional initiatives centred around major industrial hubs to broader initiatives spanning across national or international regions. This geographical focus allows for tailored solutions that address the unique challenges and opportunities present in each area. Another characteristic is that they cover multiple

aspects of the hydrogen value chain, from production through to distribution and end-use applications, catering to diverse sectors such as mobility, industry, and energy, these initiatives demonstrate the versatility and potential of hydrogen as a clean energy carrier.

While the term 'Hydrogen Valley' may be specific to Europe, similar concepts are emerging globally under different labels such as Hydrogen Hubs, Clusters, or Ecosystems. Regardless of the terminology, these initiatives share common goals of fostering collaboration among stakeholders, closing the hydrogen value chain loop, and accelerating the transition towards a sustainable energy future. In the figure below a map of the actual H_2 valleys in the H2Excellence CoVEs countries are shown, the date reported are update to May 2023 [47].

A description of the reported valley is reported in the Annex 1- section 3- H_2 Project and R&D Activities.

[47] https://h2v.eu/hydrogen-valleys

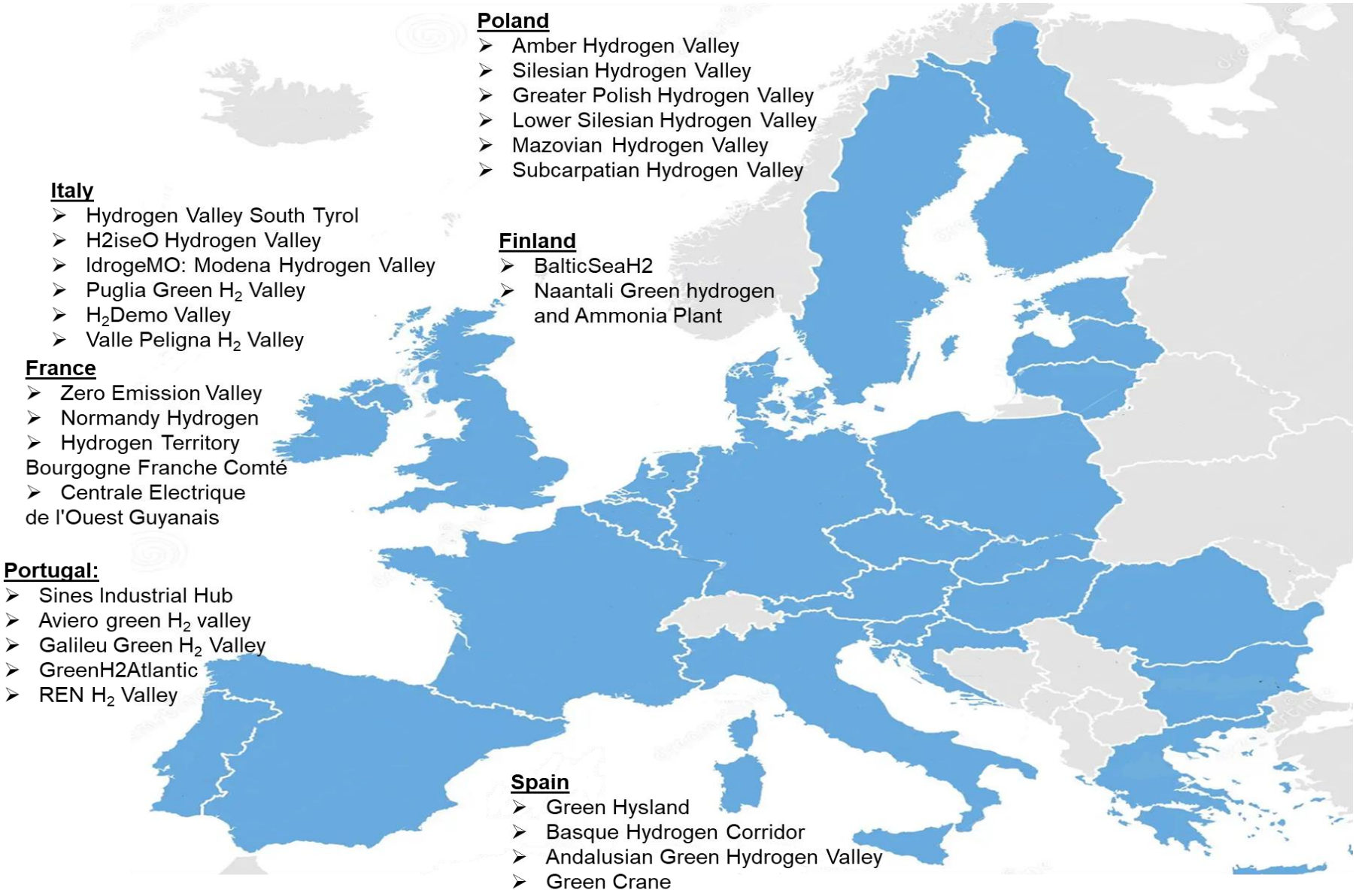

Figure 23 H2Excellence CoVes country Hydrogen Valleys.

4.4 Hydrogen Job creation market

The trajectory for Hydrogen deployment in Europe is advancing swiftly, with the sector poised for rapid expansion in the years ahead to meet ambitious targets set for 2030 and 2050. This growth is expected to generate significant economic and employment opportunities across the entire European Union. Projections indicate that the European Hydrogen value chain will employ **over one million people by 2030, a number that could soar to 5.4 million by 2050**.[48]

An increase in employment within the hydrogen sector is evident across the six mapped countries:

- Spain is projected to see around 181,000 jobs[49].
- France anticipates between 50,000 and 150,000 positions. [50]
- Finland estimates approximately 115,000 jobs. [51]
- Italy expects 200,000 temporary jobs and up to 10,000 permanent ones according to its hydrogen strategy. [52]
- Portugal foresees between 2,500 and 18,450 new jobs. [53]
- Poland is projected to have 240,000 new job opportunities. [54]

Approximately, in the 2030 scenario, more than **500.000 jobs are forecasted to emerge in hydrogen production and distribution equipment manufacturing**, as well as **in infrastructure development for various end-use applications**.

A further **350,000 highly skilled positions are expected to be allocated to value-added solutions, including fuel cells, specialized components, and end-use applications such as fuel cell-powered vehicles and industrial heating equipment.**

The principal worker profile is described in the table below, carried out by a study of ISQ, on the base of the data presented in the work of Willem Hazenberg "Competencies needed for hydrogen in the industry and network"[55].

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[48] https://joint-research-centre.ec.europa.eu/system/files/2019-04/final_insights_into_hydrogen_use_public_version.pdf
[49] https://www.manpowergroup.com/en/news-releases/news/green-hydrogen-revolution-has-the-potential-to-spur-significant-economic-and-job-growth-across-europe
[50] https://www.businessfrance.fr/discover-france-news-green-hydrogen-in-france-the-promise-of-50-000-to-150-000-jobs
[51] https://www.horizoneducational.com/finnish-government-plans-to-become-world-leader-in-hydrogen/t1489?currency=usd#:~:text=Finnish%20Government%20Plans%20to%20Become%20World%20Leader%20in%20Hydrogen,-Nordic%20Nation%20aims&text=By%202030%2C%20the%20Nordic%20nation,115%2C000%20new%20jobs%20in%202035
[52] https://www.sacofgas.it/en/hydrogen/national-strategy/
[53] https://www.edp.com/en/edp-stories/hydrogen-inspires-ideas-and-ideals-on-a-global-scale
[54] https://europeanclimate.org/wp-content/uploads/2021/01/energy-boost-for-poland.pdf
[55]https://www.researchgate.net/publication/370188756_COMPETENCIES_NEEDED_FOR_HYDROGEN_IN_THE_INDUSTRY_AND_NETWORK_A_Paper_submitted_to_THE_FACULTY_OF_NEW_ENERGY_BUSINESS_SCHOOL_IN_CANDIDACY_FOR_THE_DEGREE_OF_POST-HBO_HYDROGEN_SPECIALIST

( ) Chemical engineer (EQF 6-8)
( ) Designer and project engineer hydrogen fuel station (EQF 6-8)
( ) Educators and teachers for all positions (EQF 6-8)
( ) Energy Planner (EQF 6-8)
( ) Engineer for automotive power electronics with fuel cells (EQF 6-8)
( ) Fuel cell designer (EQF 6-8)
( ) Fuel cell engineering (EQF 6-8)
( ) Fuel cell vehicle development engineer (EQF 6-8)
( ) Gas Engineer (EQF 6-8)
( ) Hydrogen energy engineer (EQF 6-8)
( ) Hydrogen energy system operations engineer (EQF 6-8)
( ) Hydrogen fuel station manager (EQF 6-8)
( ) Installation, operations, engineering and management manager hydrogen power plant (EQF 6-8)
( ) Plant Manager - electrolysis (EQF 6-8)

It is clear that, these roles will require individuals with specified expertise and specialized technical knowledge. Additionally, existing job profiles across different industries will need to adapt, requiring supplementary skills and tailored training programs to meet the specific demands of the burgeoning hydrogen sector. **The development of suitable training programs and continuous learning opportunities is paramount to meet the immediate needs and milestones of the sector**, such as the 2024 target of 6 GW of renewable hydrogen capacity outlined in the European Hydrogen Strategy.

Ensuring that the workforce possesses the required skills for the hydrogen sector is a primary concern for companies, particularly for small and medium-sized enterprises (SMEs) that may face limitations in investing heavily in upskilling and reskilling initiatives. Additionally, regions heavily reliant on fossil fuels are undergoing significant transitions, necessitating the adaptation and preparation of their workforce for sustainable economic activities. **The reskilling and upskilling of workers for hydrogen-related activities represent both a challenge and an opportunity in these transitioning nations**, underscoring the importance of addressing social and labor considerations to facilitate a successful green transition.

5. Conclusion

This document provides a comprehensive overview of the current status of national and regional hydrogen ecosystems across the CoVE countries within H2Excellence consortium. Through an in-depth analysis of factors such as legislative frameworks, ongoing projects, and potential job market implications, we aim to offer stakeholders valuable insights that can inform strategic decision-making and development in the hydrogen sector, moreover, the state-of-the-art description provided in this deliverable, along with other analyses conducted in WP2, are crucial for subsequent WPs, identifying the training needs and new roles required for the hydrogen industry job market.

The KPIs related to this task have been significantly achieved, enabling the description of 14 regional and national roadmaps within the project's COVEs, along with approximately 79 projects and initiatives mapping various activities across different countries, contributing to job creation within this sector.

The strategies for hydrogen deployment in France, Poland, Spain, Italy, Portugal, and Finland reflect each country's unique approach, resources, and objectives within the broader context of Europe's transition to a sustainable hydrogen economy. France, with its comprehensive and ambitious approach, has laid the groundwork for becoming a global leader in hydrogen deployment, uniquely featuring not only a national roadmap for hydrogen development but also numerous regional strategies that consider regional growth. Other countries, such as Spain and Poland, also have regional hydrogen roadmaps that consider local regional characteristics to develop a hydrogen market, actively contributing to achieving national objectives. The results obtained about the large-scale hydrogen projects and initiatives had highlighted the pivotal role of hydrogen in driving job creation and economic growth across Europe. With over 79 projects mapped out in the different H2Excellence countries partners, ranging from feasibility studies to operational endeavors, it is evident that hydrogen is poised to emerge as a cornerstone of future economic development. The projections indicating up to 5.4 million highly skilled jobs by 2050 underscore the transformative potential of hydrogen technologies in reshaping the European job market and driving sustainable growth.

Ensuring that the workforce possesses the requisite skills for the hydrogen sector is a primary concern for companies, particularly for SMEs that may face limitations in investing heavily in upskilling and reskilling initiatives. The reskilling and upskilling of workers for hydrogen-related activities represent both a challenge and an opportunity in these transitioning regions, underscoring the importance of addressing social and labor considerations to facilitate a successful green transition.

One of the main outcomes of our research is the identification of the need for specific training in the hydrogen sector. Currently, the number of skilled workers in this field is insufficient compared to the personnel forecasts for the coming years. The H2Excellence project addresses this need by providing technical support to SMEs and designing training programs. In doing so, it not only meets immediate skill requirements but also contributes to the broader energy transition towards a sustainable future by replacing fossil fuels with low-carbon alternative.

6 Annexes

List of annexes in order of mention.

- Annex 1: State of Art Questionnaire
- Annex 2: Benchmarking of H2 training offer

Grant Agreement Number: **101104447**

Project acronym: **H2 Excellence**

Project full title: **H2 Excellence: Fuel Cells and Green Hydrogen Centers of Vocational Excellence towards affordable, secure, and sustainable energy for Europe**

WP2 D2-1– Annex 1: State of Art Questionnaire

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Annex 1 comprises the questionnaire utilized to collect data for Deliverable 2.1. It is structured into sections as outlined in the deliverable Methodology chapter. Each section is divided by the participating countries in the survey, however, there's an exception for Section 1, "readme," which elucidates the questionnaire's structure and the symbolism employed for various questions. Given that this section is identical for all participating countries, it will be presented only once. In the chapter 1, is reported the questionnaire section 1- readme, Chapter 2 includes Section 2- “National and Regional H2 roadmaps”, Chapter 3 includes the questionnaire section 3 “H2 Project and R&D activities”, and in the Chapter 4, includes the questionnaire section 4 related to the training offerings.

Section 1- Read Me

READ ME SECTION:

Its objective is to collect information at the country level to assess the maturity level of the ecosystem, the national hydrogen strategy legislation and respective roadmaps, and the status of implementation of hydrogen projects and related technologies that may impact the job market in the years to come. The last section aims to gather information about training opportunities in the hydrogen sector available in your country at all levels. This information will be useful for analyzing the H2 Training Ecosystem and conducting a gap analysis in this sector.

KPI to reach:

#Assessed hydrogen roadmaps: at least 10 (comprising national and regional hydrogen roadmaps):
#Identified large scale hydrogen projects and initiatives driving job creation: at least 30 (with balanced representation across CoVEs)

The questionnaire is divided into three parts:

1. **H_2 National Roadmap and Policy**: This section includes questions about hydrogen policies.(Although the questions specifically mention hydrogen, we are also interested in policies related to hydrogen-based fuels such us ammonia, syntetic methane/e-methane, syntetic methanol/e-methanol ect...

2.**H_2 project and R&D activities**: This section consists of tables to collect data about large project on hydrogen and R&D activities.
3. **National Training offer:** The aim of this section is to analyse the H2 training offer in the different countries.

For each question, there is an accompanying explanation to assist you in completing the form accurately. Additionally, when you see the symbol there is a drop-down menu. **If you have any doubts, in the SharePoint folder, there is an example file where I have marked a response for each question.**

Please provide a link to where we can find more details about the policy/project online. If no information is available online, you can also attach a document to this survey and provide the name of the document in the "Link/Document" section.

Feel free to add more rows if the ones provided in any of the tables are not sufficient.

2 Section 2- National/regional H_2 Roadmaps

2.1 Finland

National /Regional H_2 Roadmaps

Can you please tell us which high-level policy documents (such as roadmaps and strategies) your country has in place or announced to define the role of hydrogen in your energy system and decarbonisation plans?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	2030 and 2050 Targets (with baseline year)	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
A Strong and Committed Finland	Includes the development of regional networks around industrial clusters to support new clean manufacturing and industry across the region; it promises the use og green hydrogen	https://valtioneuvosto.fi/documents/10184/1587702198/Excerpts+of+the+outcome+of+the+negotiations+on+the+Government+Programme+16+June+2023.pdf/f6c8c388-26c8-2712-4996-789b511a37ec/Excerpts+of+the+outcome+of+the+negotiations+on+the+Government+Programme+16+June+2023.pdf?t=1686921846994	Other			In force			National	
Resolution on hydrogen	In it's resolution plan, government of Finland plans to produce 10% of EU's green hydrogen in 2030	https://valtioneuvosto.fi/en/-/1410877/government-adopts-resolution-on-hydrogen-finland-could-produce-10-of-eu-s-green-hydrogen-in-2030	Strategy			In force			National	
National Renewable energy policy	Hydrogen in Finland – a part of the national energy and climate strategy but now there is a resolution on hydrogen	https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/164323/TEM_2022_55.pdf?sequence=4&isAllowed=y	Strategy			In force			National	
Clean hydrogen economy strategy for Finland	An industrial hydrogen network Finland; Hydrogen Cluster Finland's guidelines for government regarding the hydrogen economy development in Finland	https://h2cluster.fi/wp-content/uploads/2023/06/H2C-H2-Strategy-for-Finland.pdf	Guidelines			In force			National	
National hydrogen roadmap for Finland	Business Finland's roadmap on hydrogen to shape up hdrogen strategy in Finland	https://www.businessfinland.fi/4abb35/globalassets/finnish-customers/02-build-your-network/bioeconomy--cleantech/alykas-energia/bf_national_hydrogen_roadmap_2020.pdf	Roadmap			In force			National	

Which regulatory measures/standards on definitions and certification schemes for hydrogen has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Which Hydrogen-related regulations on market framework, safety and customs has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
National hydrogen roadmap for Finland	Business Finland's roadmap on hydrogen to shape up hdrogen strategy in Finland which also includes the market reform proposals. This is not exactly the policy document but this has become a foundation for industrial group to work on hydrogen related activities including investment decisions.	https://www.businessfinland.fi/4abb35/globalassets/finnish-customers/02-build-your-network/bioeconomy--cleantech/alykas-energia/bf_national_hydrogen_roadmap_2020.pdf	Other	This is a policy proposal and much of this document has been included in Resolution on	Proposed	2022		National	
Clean hydrogen economy strategy for Finland	An industrial hydrogen network Finland; Hydrogen Cluster Finland's guidelines for government regarding the hydrogen economy development in Finland	https://h2cluster.fi/wp-content/uploads/2023/06/H2C-H2-Strategy-for-Finland.pdf	Other	This is a policy proposal and much of this document has been included in Resolution on	Proposed	2023		National	

Which funding programmes and policies to mitigate risk and facilitate investments (such as subsidies, grants, tax breaks / credits, tariff policies, contracts for difference, etc) have you established or announced?

Policy Name	Short description	Link/Document	Type of policy	Financial source & its use	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Business Finland's competitive RDI funding	Research and development activities related to hydrogen solutions will be promoted withm Business Finland's competitive RDI funding, in which the green transition is one of the focus areas (326 million euros)	https://www.clean-hydrogen.europa.eu/system/files/2023-11/EG0223266ENN.pdf	Other	Business Finland's competitive RDI funding for the green transition i(326 million euros)	In force			National	This is a national funding programme that includes the funding for hydrogen
Sustainable Growth Programme for Finland	In the Sustainable Growth Programme for Finland, 150 million euros have been allocated to low-carbon hydrogen and carbon capture and utilisation for 2023-24	https://www.clean-hydrogen.europa.eu/system/files/2023-11/EG0223266ENN.pdf	Other	The Sustainable Growth Programme for Finland allocates 150 million euros for low-carbon hydrogen and carbon capture and utilisation for 2023-24	In force		2024	National	This is a national funding programme that includes the funding for hydrogen

Which Policies to support the creation of demand for low-emission hydrogen (such as quotas, mandates, subsidies on FCEVs/zero-emissions vehicles, low-carbon fuels standards, low-carbon public procurement framework, etc)? -[established or announced]

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Which policies support research, development, innovation and demonstration of hydrogen technologies?

Policy Name	Short description	Link/Document	Type of policy	Subject of R&D	Status	Year of announcement	Year that the policy entered in force	Jurisdiction and / or administering institution	Amount invested & number of gears
Business Finland's competitive RDI funding	Research and development activities related to hydrogen solutions will be promoted withm Business Finland's competitive RDI funding, in which the green transition is one of the focus areas (326 million euros)	https://www.clean-hydrogen.europa.eu/system/files/2023-11/EG0223266ENN.pdf	R&D grants	RDI funding	In force			National	This funding programme supports the R&D activities related to hydrogen
Sustainable Growth Programme for Finland	In the Sustainable Growth Programme for Finland, 150 million euros have been allocated to low-carbon hydrogen and carbon capture and utilisation for 2023-24	https://www.clean-hydrogen.europa.eu/system/files/2023-11/EG0223266ENN.pdf	R&D grants	Sustainable Growth Programme	In force			National	This funding programme supports the R&D activities related to hydrogen

Which Memorandum of Agreements and other international cooperations on hydrogen has your country signed with other governments or the private sector?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Can you please tell us if your country has any other type of policy which does not fit in the previous categories in place or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Figure 1- Questionnaire Section two- National and Regional Hydrogen Roadmaps for Finland

2.2 Spain

National /Regional H_2 Roadmaps

Can you please tell us which high-level policy documents (such as roadmaps and strategies) your country has in place or announced to define the role of hydrogen in your energy system and decarbonisation plans?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	2030 and 2050 Targets (with baseline year)	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
RIS3	Development strategy of hydrogen in Andalusia in the RIS3 scope	https://www.aeh2.org/wp-content/uploads/2021/01/estrategia-del-hidrogeno-en-andalucia.pdf			The Ministry of Industry, Energy, and Tourism sets a necessary minimum of 21 hydrogen service stations in Spain by the year 2020, along with an estimated fleet of vehicles using this fuel reaching 2,800. By 2030, there's a target of achieving a 10% penetration of hydrogen vehicles in Andalusia. Additionally, it aims to establish a market for energy storage in the form of hydrogen exceeding $1.3 billion annually by 2050, assuming a cost of $150 per MWh.	Ended	2014	2015	Regional	
RIS4	RIS4	https://s4andalucia.es/			To achieve that the innovation regional system be more eficient for the transition to a more intelligente and competence economy	In force	2021	2023	Regional	
SPAIN RENEWABLE HYDROGEN ROADMAP	The Spanish government has developed the county's "Hydrogen Roadmap: A Commitment to Renewable Hydrogen" plan to contribute to achieving climate neutrality and a 100% renewable electricity system with objectives for 2030 and a vision for 2050 to ensure that renewable hydrogen contributes to the country's climate neutrality by 2050.	https://www.miteco.gob.es/content/dam/miteco/es/ministerio/planes-estrategias/hidrogeno/h2executivesummary			Vision 2030 foresees for which it will be necessary to mobilize investments estimated at 8,900 million euros during the period 2020-2030. an installed capacity of 4 GW electrolysers. In the long term, hydrogen can play an essential role in energy storage from a 100% renewable electricity system, a	In force	2020		National	
2023-2030 PNIEC (Draft update)	Draft update of 2023-2030 PNIEC submitted to public consultation on June 2023.	https://energia.gob.es/_layouts/15/HttpHandlerParticipacionPublicaAnexos.ashx?k=64347			Thus, in the contemplated scenario, the measures included in this update of the PNIEC will allow us to achieve the following results in 2030: - 32% reduction in greenhouse gas emissions compared to 1990 - 48% of renewables on the final use of energy - 44% (FEC) improvement in energy efficiency - 81% renewable energy in electricity generation - Have 19 GW of self-consumption and 22 GW of storage - Reduction of foreign energy dependence from 73% in 2019 to 51% in 2030	In force	2021			
Hydrogen Basque Country Strategy	Hydrogen Basque Country Strategy	https://eve.eus/Eve/Web/media/EVE/pdf/H2/Estrategia-Vasca-del-Hidrogeno.pdf	Strategy		industrial H2 consumption from low carbon oridin. 10 pilots where H2 is used in buildings. 20 H2 buses. 450 H2 goods transport vehicles. 10 H2 refueling stations. Until 2050: Massive deployment of green hydrogen and major expansion of production. in field of syntetic fuel -hydrogen plants in Basque country- H2 production as surplus of RES etc...	In force	2021	2021	Regional	
ESTRATEGIA A LARGO PLAZO PARA UNA ECONOMÍA ESPAÑOLA MODERNA, COMPETITIVA Y CLIMÁTICAMENTE NEUTRA EN 2050.	Long-Term Decarbonisation Strategy 2050	https://www.miteco.gob.es/content/dam/miteco/es/prensa/anexoslp2050_tcm30-516147.pdf	Strategy			In force	2020	2020	National	
Renewable Hydrogen Strategy in the Valencian Region	The Renewable Hydrogen Strategy in the Valencian Region aims to boost business competitiveness through collaborative efforts along the value chain. It centers on four main areas: increasing generation and demand, advancing technology, enhancing regulations, and fostering a supportive environment. Key objectives by 2030 include piloting advanced industrial equipment, reaching 75,000 tons per year of renewable hydrogen production, and integrating hydrogen across industries, transportation, and energy sectors. The strategy also emphasizes infrastructure development and innovative technologies to facilitate the widespread adoption of renewable hydrogen.	https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-launches-plans-for-low-carbon-green-hydrogen-cluster-in-spains-valencia-region.html	Strategy		2030- objectives: 10 pilots for testing and development of advanced industrial equipment for the generation and application of renewable H_2.	In force			National	

Which regulatory measures/standards on definitions and certification schemes for hydrogen has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
RD-l 6/2022	Measures deployment of dedicated direct electricity lines dedicated to the production of renewable H2 and of hydroproducts transporting renewable H2 renewable	https://www.lamoncloa.gob.es/consejodeministros/resumenes/Documents/2023/100123-Presentacion_hidrogeno-verde-reforma-mercado-electrico-			In force			National	
RD 376/2022	Entry into force of a system of guarantees of origin	https://www.engie.es/aprobado-el-sistema-de-garantias-de-origen-para-gases-renovables/			In force			National	

Which Hydrogen-related regulations on market framework, safety and customs has your country estabilished or annunced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
PD-01 protocol	No hydrogen-specific legislation exists in Spain at the moment. However, this is expected to change in the coming future. The injection of hydrogen into the gas network is regulated by the PD-01 Protocol, which sets technical and safety criteria with a reference to the European UNE-EN 16726	UNE-EN 16726:2016+A1:2019	Other		In force		2019		
Real Decreto 148/2021	The Spanish Hydrogen Roadmap aims to establish a legal framework for Power to X plants and electrolysis facilities, addressing barriers to renewable hydrogen production. However, specific steps for implementation are lacking. Electrolysis is currently classified as "energy use" rather than an "energy conversion device," hindering renewable hydrogen production. Addressing this issue is crucial for competitive pricing. While a Royal Decree proposes eliminating connection charges temporarily, no concrete steps have been taken to address this legal barrier. The Roadmap also includes reviewing technical and regulatory aspects for hydrogen injection into the gas grid.	https://www.boe.es/eli/es/rdl/2021/03/09/148	Law		In force	2021	2021		

Which funding programmes and policies to mitigate risk and facilitate investments (such as subsidies, grants, tax breaks / credits, tariff policies, contracts for difference, etc) have you established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Financial source & its use	Status	Year that the Year of announcement	Jurisdiction	Comments
Plan de Recuperación, Transformación y Resiliencia.	Regulatory basis for the incentive program for pioneering singular renewable hydrogen projects within the framework of the Recovery, Transformation and Resilience Plan.	https://www.boe.es/boe/dias/2021/12/24/pdfs/BOE-A-2021-21342.pdf					2021	National	150 million eur.
H2 Cadena de valor	Support for the renewable hydrogen value chain.	https://ayudasenergiaidae.es/h2-cadena-valor-2a-	Other			Ended	2023	National	Help for investement
PIICE HY2TECH	Direct award of grants to Spanish projects for their participation in the major project of common European interest in hydrogen technology within the PRTR.	https://ayudasenergiaidae.es/piice-hy2tech/	Other					National	250 million eur.

Which Policies to support the creation of demand for low-emission hydrogen (such as quotas, mandates, subsidies on FCEVs/zero-emissions vehicles, low-carbon fuels standards, low-carbon public procurement framework, etc)? -[established or announced]

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
	Regulatory basis for the incentive program for pioneering singular renewable hydrogen projects within the framework of the Recovery, Transformation and Resilience Plan.	https://www.boe.es/boe/dias/2021/12/24/pdfs/BOE-A-2021-21342.pdf							

Which policies support research, development, innovation and demonstration of hydrogen technologies?

Policy Name	Short description	Link/Document	Type of policy	Subject of R&D	Status	Year of announcement	Year that the policy entered in force	Jurisdiction and / or administering institution	Amount invested & number of years
	Support for the renewable hydrogen value chain.	https://ayudasenergiaidae.es/h2-cadena-valor-2a-							
Renewable energy and hydrogen. Complementary plans with the Autonomous Regions (Recovery, Transformation and Resilience Plan (RTRP))	This program aims to develop strategic actions centered on hydrogen to reshape the current energy landscape and reduce greenhouse gas emissions. Initially launched with several Autonomous Communities and the Spanish National Research Council (CSIC), it involved a framework agreement with the Ministry of Science and Innovation. Subsequently, additional Autonomous Communities joined, including Cantabria and Castilla y León, following an agreement by the Council for Scientific, Technological and Innovation Policy on June 22, 2022.	https://www.europarl.europa.eu/RegData/etudes/BRIEF/2022/698878/EPRS_BRI(2022)698878_EN.pdf					June 2022-June 2026		Strategic actions based on hydrogen to transform the current energy paradigm and minimise greenhouse gas emissions. TRL4-7
PERTE de energías renovables, hidrógeno renovable y almacenamiento	The Strategic Project for the Recovery and Economic Transformation of Renewable Energies, Renewable Hydrogen, and Storage aims to advance technology, knowledge, industrial capabilities, and new business models to bolster Spain's leadership in clean energy. With measures mobilizing over 16.3 billion euros, it seeks to establish a domestically crafted energy transition, generating economic, industrial, labor, innovation, and SME involvement opportunities. The project is expected to create over 280,000 jobs, encompassing direct, indirect, and induced employment throughout the economy.	https://www.prtr.miteco.gob.es/es/perte/perte-de-energias-renovables-hidrogeno-renovable-y-almacenamiento.html					2021-2030		from TRL3 to TRL 6

Which Memorandum of Agreements and other international cooperations on hydrogen has your country signed with other governments or the private sector?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Guarantee of Origin System	In collaboration with other European countries for renewable hydrogen, this system of Renewable Enegy Guarantee of Origin (REGO) allows the production method of hydrogen to be traced and to provide appropriate price signals to consumers.								
SHYNE	SHYNE (Spanish Hydrogen Network) is a consortium of 33 entities aimed at promoting renewable hydrogen in Spain, led by Repsol. With an investment of 3.23 billion Euros, its goal is to drive fast and effective decarbonization using hydrogen as a key energy vector. The project aims to create an ecosystem connecting regional hydrogen initiatives and establish two innovation hubs in Castile-La Mancha and Madrid. It will advance competitive technologies like photoelectrocatalysis and solid oxide electrolysis to maintain technological sovereignty. Additionally, a knowledge management center in Madrid will coordinate actions to position participating centers and universities as European references. SHYNE aligns with EU and Spanish government objectives, including reaching 4 GW of capacity by 2030 and supporting multisectoral consortia like SHYNE to boost the hydrogen	https://www.repsol.com/en/press-room/press-releases/2022/shyne-largest-consortium-to-promote-renewable-hydrogen-in-spain-is-born/index.cshtml	Cooperation Agreement		Planned	2022			
Cooperation agreement between NLHydrogen and AeH2.	Netherlands and Spain sign a memorandum of understanding between the NLHydrogen and AeH2 associations.	https://www.investinspain.org/content/icex-invest/en/noticias-main/2023/nlhidrogen.html	Memorandum of Understanding		In force	2023			

Can you please tell us if your country has any other type of policy which does not fit in the previous categories in place or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Figure 2- Questionnaire Section two- National and Regional Hydrogen Roadmaps for Spain.

2.3 Italy

National /Regional H_2 Roadmaps

Can you please tell us which high-level policy documents (such as roadmaps and strategies) your country has in place or announced to define the role of hydrogen in your energy system and decarbonisation plans?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	2030 and 2050 Targets (with baseline year)	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Strategia Nazionale Idrogeno Linee Guida Preliminari	Published by the Ministry of Economic Development, the National Hydrogen Strategy Preliminary Guidelines set the vision and targets for hydrogen penetration toward a decarbonized and sustainable economy. By 2030, the ambition is to reach a 2% hydrogen penetration in final energy demand, including applications in long-distance freight transport, heavy industry, refineries and blending into the gas grid. To supply this demand, 5 GW of electrolysis capacity is expected to be installed in the same period.	https://www.mimit.gov.it/images/stories/documenti/Strategia_Nazionale_Idrogeno_Linee_guida_preliminari_nov20.pdf	Strategy	in consultation	5GW of electrolysis by 2030 2% of final energy demand (forecast, not a target)	Proposed	2020		National	
LA STRATEGIA REGIONALE PER L'IDROGENO DEL PIEMONTE	Regional roadmap for hydrogen	w.regione.piemonte.it/web/media/33319	Roadmap			In force	2022	2022	Regional	

Which regulatory measures/standards on definitions and certification schemes for hydrogen has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Regola tecnica sulle caratteristiche chimico fisiche e sulla presenza di altri componenti nel gas combustibile	On June 2022, the Environment Ministry (MASE) updated an existing ministerial decree regulating the injection of elements into fuel gas, which dated back to 2018. The amendment focused on the maximum share of hydrogen into gas, that has been set at 2%.	https://www.gazzettaufficiale.it/atto/serie_generale/caricaDettaglioAtto/originario?atto.dataPubblicazioneGazzetta=2022-06-16&atto.codiceRedazionale=22A03534&elenco30giorni=true	Law		In force	2022	2022	National	

Which Hydrogen-related regulations on market framework, safety and customs has your country established or annunced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Legislative Decree 257 December 2016	Legislative Decree no. 257, December 16, 2016 (implementing the AFID Directive), establishes a national strategic framework for the development of a network of refuelling/recharging stations for alternative fuels, in order to progressively reduce oil dependence in the transport sector, including hydrogen in the list of alternative fuels. A strategic objective is to achieve an adequate number of refuelling stations by the end of 2025.	https://www.lmslex.com/wp-content/uploads/Newsletter-March-2021-ENG-1.pdf	Other	implemented in Italy in the Legislative Decree no. 257 of December 16, 2016)	In force	2014	2016	National	Hydrogen refuelling infrastructure
Ministerial Decree of October 23, 2018	Such Decree provides for technical standards for the design, construction and operation of hydrogen refuelling stations for mobility use, for external safety distances related to hydrogen supply, compression, storage and distribution equipment. In particular, according to Article 5 of such Decree, hydrogen distribution stations may not be built in totally built-up territorial areas when the average density of building is higher than specific parameters, in areas of expansion of the urban aggregate indicated in the general regulatory plan in which a certain building index is envisaged and in areas designated as public green spaces.	https://www.lmslex.com/wp-content/uploads/Newsletter-March-2021-ENG-1.pdf	Other	Decree	In force	2018	2018	National	Hydrogen refuelling infrastructure
decreto-legge n. 36 del 30 aprile 2022, convertito con la legge 29 giugno 2022, n. 79	In particular, the decree-law provides for the exemption from the payment of general charges related to the electrical system for the consumption of electricity from renewable sources in electrolysis plants for the production of green hydrogen. Additionally, green hydrogen is not subject to excise duty if not directly used in thermal engines as fuel. Specifically, the benefits exclusively support activities related to hydrogen that meet the requirement of a 73.4% reduction in greenhouse gas emissions over the life cycle for hydrogen. These benefits are intended for green hydrogen production plants, referring to hydrogen that involves less than 3 tCO2eq/t H2, produced through an electrolytic process using renewable energy sources as defined in Directive (EU) 2018/2001 (Renewable Energy Directive) or from grid electricity.	https://www.gazzettaufficiale.it/eli/id/2022/09/23/22A05525/SG	Law		In force	2022	2022	National	Hydrogen production
Article 38 of Legislative Decree No. 199, dated November 8, 2021,	it has introduced simplifications for the construction and operation of electrolyzers with a capacity of less than 10 MW, specifically those installed in industrial areas or as stand-alone units.	https://def.finanze.it/DocTribFrontend/getAttoNormativoDetail.do?ACTION=getArticolo&id=194D92DE2-E0D3-429E-8A58-5BFF69A98337}&codiceOrdinamento=20000380000000&articolo=Articolo%2038	Law		In force	2021	2021	National	Reduced Procedure
Italian Legislative Decree No. 224 of April 17, 2023, the system of guarantees of origin (GoO)	DL for guarantees of origin (GoO) for renewable gases, applicable to biogas, biomethane, and renewable hydrogen, along with the certification procedure, has been re-regulated.	https://www.mase.gov.it/sites/default/files/Archivio_Energia/Archivio_Normativa/dm_224_14-07-2023_garanzie_di_origine.pdf	Law		in force	2023		National	

Which funding programmes and policies to mitigate risk and facilitate investments (such as subsidies, grants, tax breaks / credits, tariff policies, contracts for difference, etc) have you established or announced?

Policy Name	Short description	Link/Document	Type of policy	Financial source & its use	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Converting disused industrial areas to hydrogen hub - (500 million from MiTE	At the end of 2021, the Italian Ministry of Ecological Transition (MiTE) has launched a bidding procedure aimed at funding projects to convert disused industrial areas into hubs for production and distribution of renewable hydrogen. The projects will be funded through the National Recovery and Resilience Plan (PNRR) budget, with a EUR500 million, and must be completed by 2025.	https://modernswitch.com/news/italy-next-steps/?mc_cid=07efbb08b8&mc_eid=da4624d261 https://www.mite.gov.it/sites/default/files/archivio/bandi/AECE/2021_12_15_Avviso_pubblico_PNRR_M2C2_Investi	Subsidies		In force	2021	2021	National	
National Recovery and Resilience Plan - Mission 2 (PNRR M2C2)	Among the objectives of the Italian National Recovery and Resilience plan, one aims to develop low-carbon technologies and to settle a more sustainable and resilient electricity and transport sectors. This component includes five objectives: increase energy from renewable sources; improvement and digitalisation of the electricity grid; production, distribution and final use of hydrogen; sustainable transport; R&D for the main clean technologies supply chains. The budget dedicated to hydrogen is EUR 3.19 billion, from 2021 to 2026, plus EUR 0.45 million for hydrogen supply chain R&D (of the total EUR 2 million allocated to R&D).	https://www.governo.it/sites/governo.it/files/PNRR_0.pdf PAMS	Subsidies		In force	2021	2021	National	
Decree-law to simplify and speed up renewables and hydrogen authorisation processes	The Decree intervenes by modifying certain provisions of the Unified Environmental Text (Legislative Decree April 3, 2006, No. 152), specifically Article 8 concerning the Technical Commission for Environmental Impact Assessment – VIA and VAS. To simplify the development of green hydrogen in Italy, the measure adds "projects related to green or renewable hydrogen production plants" to those prioritized for state-level environmental assessment procedures, as implemented by the National Integrated Plan for Energy and Climate (PNIEC). It introduces the following sentence in Annex II to the second part of the Unified Text: "6-bis) Integrated chemical plants for the production of green or renewable hydrogen, i.e., plants for industrial-scale production through chemical transformation processes of green or renewable hydrogen, in which various functionally connected production units are juxtaposed."	https://www.mase.gov.it/comunicati/dl-pnrr-mase-rinnovabili-piu-semplici-e-corsia-veloce-idrogeno-le-novita-ambiente-ed	Other		Proposed	2023		National	Reduced procedure example: Article 38 of Legislative Decree No. 199, dated November 8, 2021, has introduced simplifications for the construction and operation of electrolyzers with a capacity of less than 10 MW, specifically those installed in industrial areas or as stand-alone units.

Which Policies to support the creation of demand for low-emission hydrogen (such as quotas, mandates, subsidies on FCEVs/zero-emissions vehicles, low-carbon fuels standards, low-carbon public procurement framework, etc)? -[established or announced]

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Figure 3- Questionnaire Section two- National and Regional Hydrogen Roadmaps for Italy

2.4 France

National /Regional H_2 Roadmaps

Can you please tell us which high-level policy documents (such as roadmaps and strategies) your country has in place or announced to define the role of hydrogen in your energy system and decarbonisation plans?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	2030 and 2050 Targets (with baseline year)	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Stratégie National	National Strategy for the Development of Decarbonized Hydrogen in France:Hydrogen in energy networks: Hydrogen can be used to facilitate the deployment of renewable energies by improving the stability of energy networks./New uses in industry: The use of decarbonized hydrogen can be integrated into certain industrial processes to reduce CO2 emissions. Hydrogen could, for example, be used in steel production for the reduction of iron ore or in the chemical industry for fertilizer manufacturing./Future heavy mobility: This includes decarbonized planes and ships. The use of hydrogen by these sectors can be the subject of demonstrations./Future heavy mobility: This includes decarbonized planes and ships. The use of hydrogen by these sectors can be the subject of demonstrations./Future H2 infrastructure: Hydrogen represents a significant potential in the medium term for the decarbonization of the gas sector (liquid H2, reuse in the gas network)./Continue the R&D effort in the field of hydrogen to remain at the forefront internationally, as France has cutting-edge research in this field.	Stratégie nationale pour le développement de l'hydrogène décarboné en France | entreprises.gouv.fr	Strategy		2050	In force	2020	2020	National	
National Hydrogen plan	National Hydrogen Development Plan	ecologie.gouv.fr/sites/default/files/Plan_deploiement_hydrogene.pdf	Other	Plan	2030	In force	2018	2018	National	
PPE	Programmations pluriannuelles de l'énergie (PPE)	https://www.ecologie.gouv.fr/programmations-pluriannuelles-lenergie-ppe	Other	Plan		In force	2019	2019	National	
Regional Roadmap	Roadmap for Bourgogne-Franche-Comté region	https://aer-bfc.com/wp-content/uploads/2024/01/plaquette-h2-2023-gb.pdf	Roadmap		2030	In force	2014	2014	Regional	
Regional Roadmap	Roadmap for nouvelle-aquitene region	https://www.nouvelle-aquitaine.fr/sites/default/files/2022-05/Feuille%20de%20route%20H2%20-%20Nouvelle-Aquitaine.pdf	Roadmap						Regional	
Regional roadmap	Roadmap for Brittany region	[illegible]	Roadmap		2030	In force			Regional	

Which regulatory measures/standards on definitions and certification schemes for hydrogen has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Certification Guide	Guide for the evaluation of compliance and certification of hydrogen	s3.production.france-hydrogene.org/uploads/sites/4/2021/11/Guide_20certification_20H2_20charte_20ADEME_20_28ID_202714844_29_2.pdf	Law		In force	2021	2020	National	

Which Hydrogen-related regulations on market framework, safety and customs has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
H2 Safty	Security of the development of the Hydrogen sector.	https://www.economie.gouv.fr/files/files/directions_services/cge/securite-hydrogene.pdf	Directive		In force	2018	2022	National	

Which funding programmes and policies to mitigate risk and facilitate investments (such as subsidies, grants, tax breaks / credits, tariff policies, contracts for difference, etc) have you established or announced?

Policy Name	Short description	Link/Document	Type of policy	Financial source & its use	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
	Law project 2024 Finance Bill/ creation of tax credit to encourage businesses to undertake new industrial projects in four key sectors of the energy transition.	Crédit d'impôt au titre des investissements en faveur de l'industrie verte (C3IV) | impots.gouv.fr	Tax breaks					National	

Which policies support research, development, innovation and demonstration of hydrogen technologies?

Policy Name	Short description	Link/Document	Type of policy	Subject of R&D	Status	Year of announcement	Year that the policy entered in	Jurisdiction and / or administering institution	Amount invested & number of gears
MiTE funds hydrogen R&D with EUR110 million from PNRR	The Ministry of Ecological Transition (MiTE) will sign an agreement with ENEA (National Agency for new technologies, energy and sustainable development) on hydrogen research activities. The agreement includes a contribution of EUR 110 million from the PNRR (the Recovery and Resiliance National Plan) and the R&D activities will take place between 2022 and 2025.	https://www.mite.gov.it/comunicati/pnrr-mite-accordo-da-110-milioni-con-enea-ricerche-sull-idrogeno	R&D grants	Hydrogen research activities	In force	2022		National	
MiTE 150 million call for tenders	Built on the Mission 2 of PNRR (National Recovery and Resilience Plan), the Ministry of Ecological Transition (MiTE) will prepare two call for tenders on hydrogen R&D: 120 million for universities and research institutions, 130 million for private entities. Update April 2022: call for tenders publised on MiTE website and clode on 9th May	https://www.mite.gov.it/comunicati/pnrr-mite-accordo-da-110-milioni-con-enea-ricerche-sull-idrogeno https://www.mite.gov.it/bandi/avvisi-pubblici-la-selezione-di-progetti-di-ricerca-nel-settore-dell-idrogeno-pnrr-	R&D grants	Hydrogen research activities	In force	2022		National	
EU Commission approves EUR 450 m support	The EU Commission approved a EUR 450 m scheme under the Temporary Crisis and Transition Framework to support integrated renewable hydrogen production and renewable electricity in Italy's brownfield industrial areas. The projects will be selected through an open competitive bidding process for up to EUR 20 m (about USD 21.8 m) per project.	https://ec.europa.eu/commission/presscorner/detail/es/ip_23_2044	R&D grants	open to companies of all sizes active in Italy with the exception of credit and other financial	In force	2022	2023	National	450 M from 2023 to 31 Dec 2025
IPCEI Hydrogen 1	Italy participates in IPCEI;precipal themes are: Hydrogen production through the development of new generation technologies; Fuel cell production; New technologies for storage, transportation, and distribution; Development of applications for end-users, with a focus on naval and railway mobility.	https://www.mimit.gov.it/it/incentivi/ipcei-idrogeno-1-h2-technology; https://www.mimit.gov.it/it/incentivi/ipcei-idrogeno-2-h2-industry	R&D grants	see description	In force	2022	2023	National	700 Meuro until the 2030
IPCEI Hydrogen 2	The IPCEI H2 Industry (IPCEI Hydrogen 2) supports research, development, and innovation activities, including those related to the initial industrial application. It will cover a large part of the hydrogen value chain, specifically addressing: The construction of hydrogen-related infrastructure, particularly electrolyzers. Large-scale transport infrastructure for the production, storage, and transport of renewable and low-carbon hydrogen. The development of innovative and more sustainable technologies for integrating hydrogen into industrial processes across various sectors, especially those that are more challenging to decarbonize, such as the steel, cement, and glass industries.	https://www.mimit.gov.it/it/incentivi/ipcei-idrogeno-2-h2-industry		see description	In force	2022		National	350 Meuro until the 2036

Which Memorandum of Agreements and other international cooperations on hydrogen has your country signed with other governments or the private sector?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in	Jurisdiction	Comments
Italy - Algeria cooperate on the construction of a hydrogen pipeline Gas Pipeline Algeria	Having signed an initial agreement in 2022, the two leaders doubled down on this entente, announcing they signed an agreement to build a new gas, hydrogen-ready pipeline and undersea power cable, connecting Algeria to the Italian island of Sardinia	https://decode39.com/5608/meloni-tebboune-algeria-italy-gas-pipeline/	Memorandum of Understanding		In force	2023	2023	International	
Confindustria signed a Memorandum of Understanding (MoU) with ACWA Power (Italy-Suadi Arabia)	The Memorandum of Understanding (MoU) with ACWA Power underscores the significance of an opportunity for Italian companies to collaborate in essential sectors such as energy, water desalination, and green hydrogen. Saudi Arabia is currently making substantial efforts to diversify its economy and strengthen its industrial foundation. The collaboration between Italian businesses and ACWA Power aligns with Saudi Arabia's ambitions and the mutually beneficial nature of the two economies. The signing of this memorandum represents an exceptional opportunity for Italy to enter the Saudi market, particularly in sectors poised for exponential growth. These sectors include renewable and green energy solutions, offering the potential to address critical global challenges.	https://energynews.biz/acwa-power-and-confindustria-sign-mou-for-green-hydrogen-and-water-solutions/	Memorandum of Understanding		In force	2023	2023	International	
SoutH2 Corridor	The countries' energy ministers signed a letter to politically support the construction of "SoutH2 Corridor", with Italy acting as the crucial link to pump the green gas from Northern Africa to Central Europe. It's a crucial development for Italy's strategy to act as a South-North green energy bridge- 4 project are funded	https://decode39.com/6673/south2-hydrogen-corridor-eu-italy-austria-germany/	Cooperation Agreement		In force	2023	2023	International	SoutH2 Corridor is expected to be fully operational as early as 2030, reads the note.

Can you please tell us if your country has any other type of policy which does not fit in the previous categories in place or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Figure 4- Questionnaire Section two- National and Regional Hydrogen Roadmaps for France

2.5 Poland

National /Regional H_2 Roadmaps

Can you please tell us which high-level policy documents (such as roadmaps and strategies) your country has in place or announced to define the role of hydrogen in your energy system and decarbonisation plans?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	2030 and 2050 Targets (with baseline year)	States	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Polish Hydrogen Strategy to 2030	The Polish Hydrogen Strategy to 2030 with an Outlook to 2040 (PSW) is a strategic plan outlining key objectives for developing Poland's hydrogen economy and the necessary actions to achieve them. Aligned with global, European, and national efforts toward a low-carbon economy, the PSW focuses on six main objectives: Implementing hydrogen technologies in power and heating sectors/Using hydrogen as an alternative fuel in transportation/Supporting industry decarbonization/Establishing hydrogen production in new facilities/Ensuring efficient and safe transmission, distribution, and storage of hydrogen/Creating a stable regulatory environment. These objectives aim to accelerate the decarbonization of energy-intensive sectors and promote environmentally friendly hydrogen production. The PSW outlines 44 measures to achieve its goals, which will support climate and energy targets, decarbonize hydrogen production, and enhance regional development through initiatives like hydrogen valleys. Horizontal activities focus on utilizing Polish R&D potential and developing production facilities for hydrogen vehicles and components. The PSW supports various low- and zero-emission hydrogen production methods, including water electrolysis, biomass gasification, and waste gasification, among others. Consistent with national energy and climate strategies, such as the Strategy for Responsible Development and the Energy Policy of Poland until 2040, the PSW builds upon these objectives to integrate hydrogen technologies across energy, heating, transportation, and industrial sectors.	https://www.gov.pl/attachment/06213bb3-64d3-4ca8-afbe-2c50dadfa2dc	Strategy		2030 and 2040; does not take into account the perspective to 2050	In force	2021	2021	National	Poland's hydrogen strategy needs to be adapted to EU guidelines, especially in the area of green hydrogen. In addition to regulatory changes, increasing funding for hydrogen technologies will be key. Investment in energy research and development should increase to 10 per cent (by 7 percentage points), so that the volume of funding is at the level of other IEA member countries.
The Strategy for the development of hydrogen Wielopolska until 2030 with a perspective until 2040 – summary	In April 2023, the Board of the Wielkopolska Voivodeship adopted the Strategy for the Development of the Wielkopolska hydrogen region until 2030, with a vision extending to 2040. This strategy provides an in-depth analysis of the potential and opportunities for the hydrogen economy's growth in Wielkopolska. It outlines the vision for the Wielkopolska hydrogen ecosystem, key goals for the horizon up to 2030, planned development measures, and optimistic directions for activities. It also discusses prospects for renewable hydrogen production, utilization across industries, agriculture, and transportation sectors, integration with renewable energy sources (RES), as well as current barriers and external conditions influencing hydrogen economy development. Notably, the Strategy for the Development of Hydrogen Wielkopolska until 2030 with a Perspective to 2040 is the first document of its kind developed at the regional level in Poland. Its development was co-financed through EU funds under the project "Building a support system for high-quality R&D projects, particularly those developing low and zero-emission technologies, with a focus on hydrogen (BSW-H2)", within the Wielkopolska Regional Operational Program 2014-2020, Measure 1.2 Strengthening the	http://iw.org.pl/wp-content/uploads/2023/06/The-Strategy-for-the-development-of-hydrogen-Wielopolska-until-2030-with-a-perspective-until-2040-summary.pdf	Strategy		2030 and 2040; does not take into account the perspective to 2050	In force	2023	2023	Regional	
Report "Pomorskie na lekkim gazie - kierunki i scenariusze rozwoju gospodarki hydorowej do 2030 z perspektywy do 2040"	The project had three key objectives: 1) Diagnosis of the state of the hydrogen economy in the Pomeranian Voivodeship; 2) Presentation of potential development directions for a hydrogen economy with a perspective until 2040 3) To create a vision, mission, strategic and specific objectives for the Pomorskie Voivodeship Pomorskie Voivodeship in the context of construction and development of a hydrogen economy.	https://4cf.pl/wp-content/uploads/pdf/Pomorskie%20na%20lekkim%20gazie_raport%20ko%C5%84cowy.pdf	Other	Scenarios for Pomerania Region	2030 and 2040; does not take into account the perspective to 2050	Proposed	2024	none	Regional	
Energy Policy of Poland until 2040 (EPP2040)	The Energy Policy of Poland until 2040 (EPP2040), adopted by the Council of Ministers in February 2021, outlines an ambitious plan for Poland's energy transformation. It prioritizes energy security, fair transition, and sustainable economic development, with a focus on reducing coal use, particularly in residential areas, to improve air quality. Aligned with the National Energy and Climate Plan for 2021-2030, EPP2040 sets new goals for a low-emission pathway towards climate neutrality, emphasizing a just transition, zero-emission energy systems, and improved air quality. This transformation involves increasing the use of renewable energy sources (RES) for heat generation and promoting alternative fuels in transport, including electromobility and hydromobility. Developed through extensive foresight analyses, consultations, and stakeholder engagements, EPP2040 underwent public consultation and inter-ministerial review, receiving positive assessments for its consistency with national development strategies. Additionally, it garnered approval from the Centre for Strategic Analysis at the Chancellery of the Prime Minister.	https://www.dziennikustaw.gov.pl/MP/2021/264	Other	Poland's energy policy		In force	2021	2022	National	

Which regulatory measures/standards on definitions and certification schemes for hydrogen has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	States	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Production hydrogen(Permitting process (include former LAP: emission regulation))	The Law on Electromobility and Alternative Fuels, enacted in January 2018 and updated thereafter, establishes a framework for developing alternative fuel infrastructure, including hydrogen refueling stations, in Poland. It addresses safety concerns and promotes the use of hydrogen alongside electromobility to reduce transportation emissions. The law also sets technical standards aligned with international norms to ensure compatibility across the European Union. By recognizing hydrogen's role in greening the transport sector and providing a clear legal framework, the law supports investment and development of hydrogen technology in Poland.	The Act of July 7, 1994 - Construction Law Article 33, paragraph 3, part 1	Law		In force	1994	1994	National	. Operational barriers - There is no regulation of the main requirements with applicable provisions for the construction of hydrogen production facilities (i.e.
Law on Electromobility and Alternative Fuels	The Law on Electromobility and Alternative Fuels, enacted in January 2018 and updated thereafter, establishes a framework for developing alternative fuel infrastructure, including hydrogen refueling stations, in Poland. It addresses safety concerns and promotes the use of hydrogen alongside electromobility to reduce transportation emissions. The law also sets technical standards aligned with international norms to ensure compatibility across the European Union. By recognizing hydrogen's role in greening the transport sector and providing a clear legal framework, the law supports investment and development of hydrogen technology in Poland.	https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20230000875	Law		In force	2018	2018	National	In Poland, the advancement of hydrogen technology, notably through the Power to Gas (P2G) method using electrolysis, is vital. However, the lack of clear regulations on connecting electrolyzers to the

Which Hydrogen-related regulations on market framework, safety and customs has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	States	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Law on Electromobility and Alternative Fuels	The Law on Electromobility and Alternative Fuels, enacted in January 2018 and updated thereafter, establishes a framework for developing alternative fuel infrastructure, including hydrogen refueling stations, in Poland. It addresses safety concerns and promotes the use of hydrogen alongside electromobility to reduce transportation emissions. The law also sets technical standards aligned with international norms to ensure compatibility across the European Union. By recognizing hydrogen's role in greening the transport sector and providing a clear legal framework, the law supports investment and development of hydrogen technology in Poland.	https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20230000875	Law		In force	2018	2018	National	

Which funding programmes and policies to mitigate risk and facilitate investments (such as subsidies, grants, tax breaks / credits, tariff policies, contracts for difference, etc) have you established or announced?

Policy Name	Short description	Link/Document	Type of policy	Finacial source & its use	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Green Public Transport	The 'Green Public Transport' program, initiated by the National Fund for Environmental Protection and Water Management, is significantly impacting many Polish cities by supporting the adoption of zero-emission electric and hydrogen buses. This program, aimed at promoting eco-friendly transportation, especially benefits smaller and medium-sized cities seeking development opportunities. By providing grants and preferential loans, the program addresses challenges like unemployment, inadequate public transport, and air pollution, thereby enhancing living standards. Noteworthy projects funded by the program include the purchase of electric and hydrogen buses in various cities like Chełm, Gdynia, and Radomsko. The program's success is evident from the overwhelming response, with over 101 applications received in the second call, indicating a growing commitment to zero-emission public transport across the country.	https://archiwum.nfosigw.gov.pl/oferta-finansowania/srodki-krajowe/programy-priorytetowe/zielony-transport-publiczny-faza-ii/ostania-i-odpowiedzi/	Other	the state budget	In force	2021	its not policy - founding programme	National	funding from national projects
Strategic programme "New technologies in the field of energy"	The National Centre for Research and Development in 2021 announced a competition in the strategic programme 'New Technologies for Energy', where support for hydrogen production and use technologies was included. The total budget allocated to support hydrogen technologies amounted to PLN 141.2 million.1 Earlier in 2018, as part of the 'Modern methods of hydrogen storage' programme, NCBD engaged in activities aimed at developing a novel mobile hydrogen tank for use with fuel cells. The programme's budget closed at PLN 32 million	https://www.gov.pl/web/ncbr/nowe-technologie-w-zakresie-energii	Other	the state budget	Ended	2020	its not policy - R&D founding programme	National	funding from national projects
The Hydrogen Storage Programme	The Hydrogen Storage Programme is aiming at developing an innovative Hydrogen Storage System (HSS) for use with fuel cells in mobile facilities, and to demonstrate it in a Mobile Facility. The NCBD allocates 32 million PLN to finance research and development works conducted within the Programme.					2018		National	

Which Policies to support the creation of demand for low-emission hydrogen (such as quotas, mandates, subsidies on FCEVs/zero-emissions vehicles, low-carbon fuels standards, low-carbon public procurement framework, etc)? -[established or announced]

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Hydrogen production -	The Ministry of Infrastructure and Construction oversees the permitting requirements for hydrogen facilities, while the Ministry of the Environment issues all environmental permits. However, Polish law lacks specific processes for hydrogen production facilities. Instead, facilities like refineries must follow standard procedures for obtaining construction permits, including assessments and permits from the Ministry of the Environment. The approval process for a refinery or gas production facility is similar to that of a typical industrial facility, with the exception of requiring an additional specialist assessment and MKIś.								
The Energy Law	The Energy Law in Poland, though not specifically tailored to hydrogen, covers various aspects relevant to hydrogen infrastructure. For hydrogen production, it may address access to the electricity grid and electricity tariffing for electrolysis. Producers might be classified as energy consumers, necessitating compliance with consumer legislation. Regarding transmission, existing provisions for energy substances transmission could guide hydrogen transmission infrastructure regulations. Similarly, storage regulations under the Energy Law could offer a framework for hydrogen storage, including security, access, and tariff regulations. Additionally, safety and technical standards outlined in the Energy Law can be adapted for hydrogen infrastructure to ensure safe operation, risk management, and emergency procedures.		law		In force	1997	1997	National	Further Adaptations As the hydrogen sector develops and new technologies and business models emerge, it may be necessary to further adapt the Energy Law to better reflect the specificities and needs of hydrogen. This may include the introduction of specialized provisions for hydrogen
Tax	Taxation and customs regulations for hydrogen in Poland, like in other countries, are part of broader rules for fuels and energy carriers. Duties may apply to hydrogen imports, while internal taxation could include excise tax, VAT, and environmental charges. Discussions are ongoing to determine preferential treatment for hydrogen to support its market and infrastructure development. Environmental levies may be lower for hydrogen compared to fossil fuels to promote sustainable development.		law		In force			National/international	Further Regulatory Developments - the development of hydrogen taxation and duty regulations will depend on a number of factors, including Poland's energy and climate policy, European Union regulations and global energy and environmental trends. As interest in hydrogen as a key component of the low-carbon economy grows, these regulations can be expected to evolve to better support
Law on Electromobility and Alternative Fuels	The Law on Electromobility and Alternative Fuels, enacted in January 2018 and updated thereafter, establishes a framework for developing alternative fuel infrastructure, including hydrogen refueling stations, in Poland. It addresses safety concerns and promotes the use of hydrogen alongside electromobility to reduce transportation emissions. The law also sets technical standards aligned with international norms to ensure compatibility across the European Union. By recognizing hydrogen's role in greening the transport sector and providing a clear legal framework, the law supports investment and development of hydrogen technology in Poland.	https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20230000875	Law		In force	2018	2018	National	
Green transport zones	In Poland, in the context of laws and regulations concerning green transport zones and the use of hydrogen, several documents and initiatives play an important role. The basic founding act for the hydrogen economy is to be the Polish Hydrogen Strategy, supported by the European Parliament's Alternative Fuels Infrastructure Directive (AFID). Poland implements the AFID Directive through the Act on Electromobility and Alternative Fuels, recently updated in 2020, which treats hydrogen as an alternative fuel. Under this law, hydrogen-powered vehicles can benefit from incentives such as the possibility to enter Clean Transport Zones (SCTs) free of charge or excise duty exemptions. The Clean Transport Zones (SCTs), to be introduced in Poland from 2024, are not only open to zero-emission vehicles. In the initial years of SCTs, access will also be given to emission vehicles meeting certain Euro emission standards, with different minimum conditions depending on the city. Kraków, for example, plans to introduce the SCT from 1 July 2024. Restrictions on SCT access do not apply to vehicles belonging to services and vehicles used by people with disabilities.		Law						These initiatives are part of a wider plan to reduce emissions and promote clean transport technologies, including hydrogen, as key elements for the sustainable development and decarbonisation of Poland's economy.

Which policies support research, development, innovation and demonstration of hydrogen technologies?

Policy Name	Short description	Link/Document	Type of policy	Subject of R&D	Status	Year of announcement	Year that the policy entered in force	Jurisdiction and / or administering institution	Amount invested & number of years
government funding programmes NCBR	NCBD is an executive agency within the meaning of the Public Finance Act of 27 August 2009, supervised, since 1 August 2022, by the Minister of Funds and Regional Policy. The Centre conducts its activities on the basis of the provisions of the Act of 30 April 2010 on the National Centre for Research and Development and the statutes annexed to the Ordinance of the Minister of Science and Higher Education of 3 September 2010 on the statutes of the National Centre for Research and Development. The functioning of the National Centre for Research and Development is also regulated by a number of executive acts and legal acts related to the implementation of programmes financed from European funds.	https://www.gov.pl/attachment/b6556cc3-f523-4ab6-bdf3-502603063 6e8	R&D grants	infrastructure, manufacturing resources, innovation, mobility, E-FUELS	In force	2009	2009	National	15 mld pln/15 years

Which Memorandum of Agreements and other international cooperations on hydrogen has your country signed with other governments or the private sector?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Hydrogen agreement signed in Sanok	An agreement to undertake work on the development of hydrogen investments in Sanok was signed in 2021. The signing ceremony between the mayor of the city of Sanok, the president of Hynfra, the president of Fibrain and the president of the Sanok Municipal Enterprise was attended by the deputy minister, Małgorzata Jarosińska-Jedynak. The Sanok project, which involves, among other things, the modernisation of the district heating system and the construction of new renewable and hydrogen-based sources of energy generation in the city, will be one of the first such local government investments in heat decarbonisation in the country. The implementation of the Hydrogen Project will create a base for the development of other hydrogen projects, including the construction of hydrogen refuelling stations for transport projects.	https://www.gov.pl/web/funduusze-regiony/porozumienie-wodorowe-podpisane-w-sanoku	Cooperation Agreement		In force	2021	2021		

Can you please tell us if your country has any other type of policy which does not fit in the previous categories in place or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Figure 5- Questionnaire Section two- National and Regional Hydrogen Roadmaps for Poland

2.6 Portugal

National /Regional H_2 Roadmaps

Can you please tell us which high-level policy documents (such as roadmaps and strategies) your country has in place or announced to define the role of hydrogen in your energy system and decarbonisation plans?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	2030 and 2050 Targets (with baseline year)	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Roteiro e Plano de Ação para o Hidrogénio em Portugal, DGEG, 2019 The National Hydrogen Strategy (EN-H2), Resolução do Conselho de Ministros nº 63/2020, de 14/08/2020	Implement a green hydrogen production support mechanism/ Set forth the required hydrogen regulatory framework/Set hydrogen incorporation targets/Submit applications to the Hydrogen IPCEI/Industrial green hydrogen production project in Sines/Decarbonize the transport sector/Decarbonize a priority sector of the national industry/Use wastewater for hydrogen production/Implement collaborative laboratories (COLAB's)	https://www.dgeg.gov.pt/media/5eac1vcd/resolu%C3%A7%C3%A3o-do-conselho-de-ministros-n-%C2%BA-632020.pdf	Roadmap		7 000 MI of Investment in hydrogen production projects/"10% to 15% injection of green hydrogen into natural gas networks 2% to 5% of green hydrogen in the industrial sector's energy consumption 1% to 5% of green hydrogen in the road transport sector's energy consumption 3% to 5% green hydrogen in the national shipping sector's energy consumption 1,5% to 2% of green hydrogen in the energy final consumption/900 MI Support for investment and production/Setting up 50 to 100 hydrogen refuelling stations/300-600 MI Reduction in imports of natural gas	Planned	2020		National	
Roteiro e Plano de Ação para o Hidrogénio em Portugal, DGEG, 2019 The National Hydrogen Strategy (EN-H2), Resolução do Conselho de Ministros nº 63/2020, de 14/08/2020	Implement a National Hydrogen Alliance	https://www.dgeg.gov.pt/media/5eac1vcd/resolu%C3%A7%C3%A3o-do-conselho-de-ministros-n-%C2%BA-632020.pdf	Strategy			Proposed	2020		National	
PLANO NACIONAL ENERGIA E CLIMA 2021-2030 (PNEC 2030)	National Grid Backbone for H2 transportation and distribution-Implement supporting infrastructures for H2/-Promote H2Valleys-Develop sustainable infrastructures for the distribution and storage of green H2, supporting local needs of productions and consumption	https://www.dgeg.gov.pt/media/vedhi5t1/pnec-pt_template-final-vers%C3%A3o-final_30_06_2023.pdf	Strategy			Planned	2023 (to 2030)	2023	National	
National Action Framework for the development of the alternative fuels market in the transport sector	Approves the National Action Framework for the development of the alternative fuels market in the transport sector	https://diariodarepublica.pt/dr/en/detail/tipo/88-2017-107567058	Strategy			In force	2017	2017	National	
National Energy and Climate Plan 2030 (PNEC 2030).	Approves the National Energy and Climate Plan 2030 (PNEC 2030).	https://diariodarepublica.pt/dr/en/detail/tipo/53-2020-137618093	Other			In force	2020	2020	National	
ROADMAP FOR CARBON NEUTRALITY 2050 (RNC2050)	LONG-TERM STRATEGY FOR CARBON NEUTRALITY OF THE PORTUGUESE ECONOMY BY 2050	https://www.portugal.gov.pt/download-ficheiros/ficheiro.aspx?v=%3D%3DBAAAAB%2BLCAAAAAAABACzMDexBAC4h9DRBAAAAA%3D%3D	Roadmap		2050		2019	2019	National	

Which regulatory measures/standards on definitions and certification schemes for hydrogen has your country established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Guarantees of Origin	Sets forth the process for issuing guarantees of origin for low carbon gases and for renewable gases, updating the renewable energy targets.	Decreto-Lei n.º 60/2020 DR (diariodarepublica.pt)	Law	...as Certification Schem...	In force	2020	2020	National	
National Gas System (NGS)	Establishes the organization and functioning of the National Gas System (NGS) and the legal schemes applicable to the reception, storage and regasification of Liquefied Natural Gas (LNG)	https://diariodarepublica.pt/dr/en/detail/decree-law/62-2020-141377978	Law		In force	2020	2020	National	
Regulation of the National Gas Distribution Network	Regulation of the National Gas Distribution Network	https://diariodarepublica.pt/dr/detalhe/despacho/806-b-2022-177875746	Directive		In force	2022	2022	National	
Regulation of the National Gas Transmission Network	Regulation of the National Gas Transmission Network	https://diariodarepublica.pt/dr/en/detail/tipo/806-c-2022-177875747	Directive		In force	2022	2022	National	
Regulation on Access to Networks, Infrastructures and	Regulation on Access to Networks, Infrastructures and Interconnections in the Gas Sector	https://diariodarepublica.pt/dr/en/detail/tipo/407-2021-163158540	Law		In force	2021	2021	National	
Regulation of Commercial Relations for the Electricity and Gas	Approves the Regulation of Commercial Relations for the Electricity and Gas Sectors	https://diariodarepublica.pt/dr/en/detail/tipo/1129-2020-152518409	Law		In force	2020	2020	National	
Tariff Regulation for the Gas Sector	Approves the Tariff Regulation for the Gas Sector	https://diariodarepublica.pt/dr/en/detail/regulation/825-2023-216305855	Law		In force	2023	2023	National	
Service Quality Regulation for the Electricity and Gas Sectors	Approves the Service Quality Regulation for the Electricity and Gas Sectors	https://diariodarepublica.pt/dr/en/detail/regulation/826-2023-216305856	Law		In force	2023	2023	National	
Gas Sector Infrastructure Operation Regulation	Approves the Gas Sector Infrastructure Operation Regulation	https://diariodarepublica.pt/dr/en/detail/tipo/341-2021-161377990	Law		In force	2021	2021	National	
Procedures to be adopted in licensing of industrial activity of producing green Hydrogen	Interpretive Note that guides the procedure to be adopted in licensing leading to the exercise of the industrial activity of producing hydrogen from renewable sources	https://www.dgeg.gov.pt/pt/destaques/hidrogenio-renovavel-nota-interpretativa-para-o-procedimento-a-adotar-no-licenciamento/	Directive		In force	2023	2023	National	
Decree Law 30-A/2022 ,18th April-	It approves measures for the simplification of the production of energy from renewable sources	https://data.dre.pt/eli/dec-lei/30-a/2022/04/18/p/dre/pt/html	Law		In force	2022	2022	National	
Decree Law 72/2022	It alters measures for the implementation of initiatives for the production and storage of energy from renewable sources	https://diariodarepublica.pt/dr/detalhe/decreto-lei/72-2022-202357817	Law		In force	2022	2022	National	
Decree Law 11/2023	it simplifies procedures for environmental licensing	https://data.dre.pt/eli/dec-lei/11/2023/02/10/p/dre/pt/html	Law		In force	2023	2023	National	
Decree Law n.º30/2023	published by DGEG as guidelines on procedures to be adopted in the licensing of industrial activity in the production of hydrogen from renewable sources	https://www.dgeg.gov.pt/pt/areas-setoriais/energia/energias-renovaveis-e-sustentabilidade/hidrogenio/nota-interpretativa-licenciamento-h2-renovavel/	Law		In force	2023	2023	National	

Which Hydrogen-related regulations on market framework, safety and customs has your country established or annunced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Centralized purchasing system for biomethane and hydrogen produced by electrolysis from water	Establishes the centralized purchasing system for biomethane and hydrogen produced by electrolysis from water, using electricity from renewable energy sources. Order nº 15/2023, of 2023-01-04, from Government	https://diariodarepublica.pt/dr/en/detail/government-order/15-2023-205689383	Law		In force	2023	2023	National	

Which funding programmes and policies to mitigate risk and facilitate investments (such as subsidies, grants, tax breaks / credits, tariff policies, contracts for difference, etc) have you established or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other" please comment	Financial source & its use	Status	Year that the policy Year of announcement	Jurisdiction	Comments
Support to the production of Green Hydrogen and other renewable gases	Ministério do Ambiente - Fundo Ambiental	https://www.fundoambiental.pt/apoios-prr/c14-hidrogenio-e-renovaveis/02c14-i012023-hidrogenio-e-gases-renovaveis.aspx	Other	Public Founding	PRR	In force	2023	National	02/C14-i01/2023 - Apoio à produção de hidrogénio renovável e outros gases renováveis
Decarbonization of Public Transportation	Ministério do Ambiente - Fundo Ambiental	https://www.fundoambiental.pt/apoios-prr/c15-mobilidade-sustentavel/01c15-i05-descarbonizacao-transportes-publicos.aspx	Other	Public Founding	PRR	In force	2023	National	01/C15-i05 - Descarbonização de Transportes
Green Shipping	Ministério do Ambiente - Fundo Ambiental	https://tcsportugalportugal.pt/wp-content/uploads/2023/05/PRR-Avisos-Abertos-Maio-2023.pdf	Other	Public Founding	PRR	In force	2023	National	TC-C10-i05 - Green Shipping
Decarbonization of Industry	Ministério do Ambiente - Fundo Ambiental	https://www.ispmei.pt/Paginas/Descarbonizacao-da-Industria.aspx	Other	Public Founding	PRR	In force	2022	National	TC-C11-i01 - Descabornização da Indústria
Regulation of the Incentive System to Support the Production of Renewable Hydrogen and Other Renewable Gases	Approves the Regulation of the Incentive System to Support the Production of Renewable Hydrogen and Other Renewable Gases	https://diariodarepublica.pt/dr/en/detail/order/38-a-2022-173321558	Subsidies			In force	2022	National	Order nº 38-A/2022, of 2022-02-18, from
Exceptional measures to ensure the simplification of procedures for the production of energy from renewable sources	Amends the Decree-Law adopting exceptional measures to ensure the simplification of procedures for the production of energy from renewable sources	https://diariodarepublica.pt/dr/en/detail/decree-law/72-2022-202357817	Other	Simplification of legal procedures		In force	2022	National	Decree Law nº 72/2022, of 2022-10-19
Approves measures to reduce burdens, eliminate licensing and simplify administrative procedures on companies, with a special focus on the	Measures to reduce burdens, eliminate licensing and simplify administrative procedures on companies, with a special focus on the environmental area	https://diariodarepublica.pt/dr/en/detail/decree-law/11-2023-207272800	Other	Simplification of legal procedures		In force	2023	National	Decree Law nº 11/2023, of 2023-02-10

Which Policies to support the creation of demand for low-emission hydrogen (such as quotas, mandates, subsidies on FCEVs/zero-emissions vehicles, low-carbon fuels standards, low-carbon public procurement framework, etc)? -[established or announced]

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
Targets for the consumption of energy from renewable sources	Sets out the targets for the consumption of energy from renewable sources, supplementing the transposition into national legal order of the European Directive on the subject	https://diariodarepublica.pt/dr/en/detail/decree-law/84-2022-204502328	Quotas			2022		National	Decree Law nº 84/2022, of 2022-12-09

Which policies support research, development, innovation and demonstration of hydrogen technologies?

Policy Name	Short description	Link/Document	Type of policy	Subject of R&D	Status	Year of announcement	Year that the policy entered in force	Jurisdiction and / or administering institution	Amount invested & number of years

Which Memorandum of Agreements and other international cooperations on hydrogen has your country signed with other governments or the private sector?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments
H2MED	H2Med, the EU's first renewable hydrogen corridor	https://www.lamoncloa.gob.es/presidente/actividades/Documents/2022/031222-H2MED.pdf	Other		Proposed	2022		International	
Netherlands-Portugal - Memorandum of Understanding on Production and Transport of Hydrogen	The Netherlands-Portugal - Memorandum of Understanding on Production and Transport of Hydrogen (2022-03-23): Portugal and the Netherlands signed a Memorandum of Understanding (MoU) to strengthen the cooperation in the development of green hydrogen. Their aim is to advance the strategic value chain of production and transport of hydrogen produced from renewable energy, connecting the two country's 2030 hydrogen plans. The ports of Sines and Rotterdam will play an important role in this agreement	https://www.iea.org/policies/13542-portugal-and-the-netherlands-green-hydrogen-agreement	Memorandum of Understanding			2022		International	
Morocco-Portugal - Agreement on cooperation in the field of green hydrogen development	The Morocco-Portugal - Agreement on cooperation in the field of green hydrogen development (2021-02-02): The agreement seeks to strengthen the ties of friendship between the two countries, to boost bilateral cooperation and to align the priorities of green hydrogen in Morocco and Portugal with the related decarbonization strategies of the Paris Climate Agreement.	https://northafricapost.com/47322-morocco-portugal-sign-agreement-to-boost-cooperation-in-green-hydrogen-field.html	Cooperation Agreement			2021		International	
European Investment Bank-Portugal Memorandum of Understanding	The European Investment Bank-Portugal Memorandum of Understanding to establish institutional cooperation in the hydrogen sector (2021-04-07): The EIB is available to provide financial support to eligible projects, technical assistance and advisory support to foster investments in the sector in Portugal and to improve the bankability of	https://www.eib.org/en/press/all/2021-117-the-eib-partners-up-with-the-portuguese-republic-to-	Memorandum of Understanding			2021		International	

Can you please tell us if your country has any other type of policy which does not fit in the previous categories in place or announced?

Policy Name	Short description	Link/Document	Type of policy	If "Other", please comment	Status	Year of announcement	Year that the policy entered in force	Jurisdiction	Comments

Figure 6- Questionnaire Section two- National and Regional Hydrogen Roadmaps for Portugal

3. Questionnaire section 3- H_2 Project and Initiatives

3.1 Finland

Which projects exist in your country related to large-scale hydrogen initiatives?												
	VALUE CHAIN COVERAGE	Potential impact on job creation n°		Job profile			Quoted installed capacity					
Name		2030	2050	H_2 Value Chain Coverage	Areas of expertise	Project duration (started –online)	MWel	tH_2/y	Tonne CO_2 avoided	Production process	End-Use	link of reference
P2X Harjavalta project	H2 PRODUCTION	It will hugely impact to job creation by 2030 and beyond		H2 PRODUCTION	System Design and Construction	2024 (date online)	20			Alkaline electrolyzer	Mobility	https://p2x.fi/en/project/
Kokkola H2 Plant	H2 PRODUCTION			H2 PRODUCTION	OTHER	2014	9			Alkaline electrolyzer		https://www.woikoski.fi/en/woikoski/hydrogen.ht
H-Flex-E (Hydrogen-Flexibility-Electricity)	H2 PRODUCTION						10					https://www.epv.fi/project/power-to-x-to-power/
Nordic Ren-Gas Oy-Lahti/Mikkeli/Tampere/Kotka	H2 PRODUCTION			H2 PRODUCTION		2025	120/60/40/40	Lanhti (12.000H2 - 24.000CH4)- Kotka (18.000H2-35.000 CH4)-Tampere (18.000 H2-35.000CH4)-Mikkeli (6.000H2-12.000CH4)	Lanhti 70.000-Kotka 110.000-Tampere 110.000-Mikkeli 37.000		Mobility	https://ren-gas.com/en/news/lahti-energia-and-nordic-ren-gas-have-signed-a-cooperation-agreement-planning-starts-for-the-finnish-largest-hydrogen-and-p2x-fuel-investment/
Green North Energy Oy Flexen's hyde, Åland	H2 PRODUCTION					2026	280				E-fuels	https://www.greennorth.energy/en/news/green-north-energy-has-made-a-reservation-for-a-site-for-its-green- https://flexens.com/project-portfolio/
PlugPower (Kristinankaupunki)	H2 PRODUCTION						1000		4 000 000			https://www.ir.plugpower.com/press-releases/news-...
PlugPower (Porvo)	H2 PRODUCTION						200		4 000 000			https://www.ir.plugpower.com/press-releases/news-...
Kristinankaupunki PtX plant	H2 PRODUCTION											https://www.epressi.com/tiedotteet/energia/kopp...o-epetous-leading-...
Solar Foods	H2 PRODUCTION											https://solarfoods.com/solar-foods-receives-a-34-million-grant-to-...
SHARC – Sustainable Hydrogen and Recovery of Carbon (phase 1-phase 2-phase 3) and Recovery of Carbon (phase 1)						online: 2025(I) 2027(II)2029(III)	50 (I phase) 165(II phase) 270 (III phase)					https://h2cluster.fi/projects/
Naantali green hydrogen and Ammonia plant	H2 PRODUCTION			H2 PRODUCTION							Other chemicals	https://www.greennorth.energy/en/project/
Baltic Sea H2	H2 PRODUCTION	It will hugely impact to job creation by		H2 PRODUCTION								https://balticseah2valley.eu/

Figure 7- Questionnaire Section three- H_2 projects and initiatives for Finland.

3.2 Spain

Which projects exist in your country related to large-scale hydrogen initiatives?												
Name	VALUE CHAIN COVERAGE	Potential impact on job creation n°		Job profile		Project duration (Started/finished)	Quoted installed			Production process	End-Use	link of reference
		2030	2050	H_2 Value Chain Coverage	Areas of expertise		MWel	tH_2/y	Tonne CO_2 avoided			
HYDEAL AMBITION - SPAIN	H2 PRODUCTION					2020-2028	3300 by 2028- subsequently 67 GW			electrolyzer		https://www.hydeal.com/
GREEN CRANE	H2 VALLEY					2019						https://www.comunidad.madrid/sites/default/files/anton_martinez_-_enermadrid_2020.pdf
KRL HYDROGEN INNOVATION CENTER	H2 DISTRIBUTION FOR MOBILITY					Planned Start: 2023 / End date: 2024		Nm3/h / Fuel Cell Electrical capacity: 20 kW		H2 production rate: 0,5	Other	
POWER SKID	H2 DISTRIBUTION FOR MOBILITY					Project is developed in 2 separate locations. Location 1: System Validation 6/21. Location 2: System Validation 10/21		Nm3/h / Fuel Cell Electrical capacity: 6 kW	Pressurized gas storage: 20 kg			https://www.h2vector.com/en/projects/
H2SAREA		Creating more than 1,340 direct and more than 6,700 indirect jobs				Dates: 2021-2024			1.5 Mtons of CO2			https://fuelcellsworks.com/news/basque-hydrogen-corridor-unveiled-a-e1-3billion-hydrogen-project/
ARENHA						April 2020-April 2024		1 Nm3/hr		10 kgNH3/day at low pressure (<50 bar) and temperature (<450 °C)		https://arenha.eu/
H2PORTS	H2 TRANSPORT					2019-2023						https://h2ports.eu/
ECLOSIÓN		The project will favor the creation of 15 new highly qualified jobs, of which 10 are expected to be held by women (2022-2024).				2021 - 2024						https://www.aqualia.com/en/web/aqualia-en/eclosion-missions
GREEN HYSLAND	H2 VALLEY				System Design and Construction	Jan 2021- Dec 2025			20700 mTon CO2/year	330 kt/y H2		https://greenhysland.eu/

Planta de hidrógeno verde de Puertollano	H2 PRODUCTION					2022						https://www.iberdrola.com/conocenos/nuestra-actividad/hidrogeno-verde/puertollano-planta-hidrogeno-verde
Catalina Project	H2 PRODUCTION	*8,000 jobs created (costruction and installation phase)				2020-2024 (development)/2024-2027(construction phase)/ 2028.... (operation phase)	500		>3.1 Mtonnes in the first 10 years			https://catalinaptx.com/
Fertiberia/Iberdola-Palos de la Frontera	H2 PRODUCTION	>1000 jobs in the first phase				online 2027	200 (I phase) 370 (II phase)		23.000 (I phase) 39.100(II pahse			https://www.iberdrola.com/documents/20125/3076059/230329-iberdrolas-h2-project-in-palos-selected-as-a-major-project-of-european-interest.pdf
Andalusian Green Hydrogen Valley	H2 VALLEY				Design, Construction, and Supply of Components		2000	300			Methanol	https://www.cepsa.com/en/businesses/commercial-clean-energies/green-hydrogen/andalusian-valley#:~:text=Framed%20by%20Positive%20Motion%2C%20we,continent%20with%20greater%20energy%20autonomy.

Figure 8- Questionnaire Section three- H_2 projects and initiatives for Spain.

3.3 France

Which projects exist in your country related to large-scale hydrogen initiatives?												
Name	**VALUE CHAIN COVERAGE**	**2030**	**2050**	**H_2 Value Chain Coverage**	**Areas of expertise**	**Project duration**	**Quoted MWel**	**tH2/year**	**Produc Tonne CO_2 avoided**		**End-Use**	**link of reference**
Elogen electrolyser gigafactory	H2 PRODUCTION			H2 PRODUCTION	System Design and Construction							https://elogenh2.com/en/2022/03/08/press-release-elogen-will-build-its-future-gigafactory-in-vendome-in-the-centre-val-de-loire-region/
Forvia high-pressure hydrogen tank gigafactory	H2 STORAGE	600		H2 TRANSPORT	Design, Construction, and Supply of Components							https://www.faurecia.com/en/newsroom/forvia-inaugurates-its-allenjoie-industrial-platform-dedicated-mobility-future
GEN-HY electrolyser gigafactory	H2 PRODUCTION			H2 PRODUCTION	System Design and Construction		1000					https://www.eiffageenergiesystemes.com/newsroom/news/gen-hy-and-eiffage-energie-systemes-have-launched-gen-hy-cube-dedicated-to-creating-a-cell-plant-to-produce-green-hydrogen-in-montbeliard
Genvia electrolyser gigafactory	H2 PRODUCTION			H2 PRODUCTION	System Design and Construction		100					https://genvia.com/vision/
INOCEL fuel cell gigafactory	H2 PRODUCTION	700		H2 TRANSPORT	System Design and Construction							https://inocel.com/inocel-launches-gigafactory-in-belfort-a-new-milestone-for-high-power-fuel-cells/
John Cockerill electrolyser gigafactory	H2 PRODUCTION			H2 PRODUCTION	System Design and Construction		1000					https://hydrogen.johncockerill.com/en/manufacturing-facilities/
McPhy electrolyser gigafactory	H2 PRODUCTION			H2 PRODUCTION	System Design and Construction		1000					https://mcphy.com/fr/communiques/lancement-de-la-gigafactory-delectrolyseurs-mcphy-sur-le-site-de-belfort/?cn-reloaded=1
Plastic Omnium high-pressure hydrogen tank gigafactory	H2 PRODUCTION			H2 TRANSPORT	Design, Construction, and Supply of Components							https://www.plasticomnium.com/en/plastic-omnium-starts-working-on-a-french-hydrogen-tank-plant-construction-the-largest-in-europe/
McPhy electrolyser gigafactory	H2 PRODUCTION			H2 PRODUCTION	System Design and Construction		1000					https://mcphy.com/fr/communiques/lancement-de-la-gigafactory-delectrolyseurs-mcphy-sur-le-site-de-belfort/?cn-reloaded=1
Plastic Omnium high-pressure hydrogen tank gigafactory	H2 PRODUCTION			H2 TRANSPORT	Design, Construction, and Supply of Components							https://www.plasticomnium.com/en/plastic-omnium-starts-working-on-a-french-hydrogen-tank-plant-construction-the-largest-in-europe/
Symbio fuel cell gigafactory (SymphonHy)	H2 PRODUCTION			H2 TRANSPORT	System Design and Construction							https://www.symbio.one/en/news-and-media/symbio-inaugurates-its-first-gigafactory-symphonhy-europes-largest-integrated-site
Ataweg HRS factory	H2 PRODUCTION			H2 DISTRIBUTION FOR MOBILITY	System Design and Construction							https://www.usinenouvelle.com/article/le-fabricant-de-stations-hydrogene-ataweg-accelere-son-expansion-au-bourget-du-lac.N2093241
HyVence project	H2 PRODUCTION			H2 PRODUCTION			125	15.000			Mobility	https://hyvence.fr/
H2V(Vigneux-Dunkerque-Marseille Fos-Thionville- Illange- Valenciennes- Saint- Clair-du Rhône- Portes du Tarn)	H2 PRODUCTION	775		H2 PRODUCTION	Design, Construction, and Supply of Components		Dukerque-(I phase 200-II phase 300)/Thionville 200/ Saint-Clair-du Rhone 200 /Valenciennes 200	Dukerque-(I phase 28.000-II phase 42.000)/Thionville 28.000 Saint-Clair-du Rhone 28.000 /Valenciennes 28.000/ Marsille Fos-84,000H2-Methanol 140.000.	Dukerque-420,000/Thionville 560.000 Saint-Clair-du Rhone 280.000/Valenciennes 560.000			https://h2v.net/les-projets/
Normandy Hydrogen Valley				H2 TRANSPORT				33000			Mobility	https://www.normandie.fr/normandie-hydrogene
Zero Emission Valley (ZEV)	H2 PRODUCTION	300		H2 TRANSPORT	Operations and Maintenance				1500			https://mcphy.com/en/achievements/hydrogen-mobility-en/zero-emission-valley-zev/

Figure 9- Questionnaire Section three- H_2 projects and initiatives for France.

3.4 Italy

Which projects exist in your country related to large-scale hydrogen initiatives?												
Name	VALUE CHAIN COVERAGE	Potential impact on job creation n°		Job profile		Project duration (Started/finished)	Quoted installed capacity			Production process	End-Use	link of reference
		2030	2050	H_2 Value Chain Coverage	Areas of expertise		MWel	tH_2/y	Tonne CO_2 avoided			
H2 Porto Torres project	H2 PRODUCTION					2021-2030	III phase from 20 to 200			electrolyser	Refining	https://www.smartenergy.net/smartenergy-develops-a-200-mwe-green-hydrogen-plant-in-sardinia-italy/
Gela and Taranto H2 Project	H2 PRODUCTION						10 (taranto) 20 (Gela)			electrolyser	Refining	https://www.eni.com/en-IT/media/press-release/2022/10/green-hydrogen-projects-
SunsHyne Project (SoutH2 Corridor)	H2 DISTRIBUTION FOR MOBILITY			H2 DISTRIBUTION FOR MOBILITY		2021-2030		10 M			Other	https://www.sunshynecorridor.eu/sunshyne-project/
Hydra project						6 year project				decarbonization of Steel industry using H2	Steel	https://www.rina.org/en/media/press/2023/10/10/hydra-project
Valle Peligna Hydrogen Valley	H2 VALLEY						30	4200			Refining	https://hydrogen-news.it/in-valle-peligna-abruzzo-nascera-una-hydrogen-valley-oltre-100-milioni-di-euro-gli-investimenti-
ENEA Hydrogen Demo Valley	H2 VALLEY	about 1000			Design, Construction, and Supply of Components		0,2			Low and high-temperature elecrtolyser	Blending in natural gas pipelines	https://www.eai.enea.it/archivio/pianeta-idrogeno/enea-hydrogen-valley-towards-an-infrastructural-hub-in-italy.html
H2iseO Hydrogen Valley	H2 VALLEY					2020-2026	SMR-CCS: 2,8MW in Brescia/Iseo			SMR of biomethane and CCS and electrolyser	Mobility	https://www.fnmgroup.it/h2iseo_hydrogen_valley_en/?lang=en
Hydrogen Valley South Tyrol	H2 VALLEY					2014-2035					Mobility	https://h2v.eu/hydrogen-valleys/hydrogen-valley-south-tyrol
Valcamonica H2 Valley	H2 VALLEY				Design, Construction, and Supply of Components		43	830	42	electrolyser	Mobility	https://www.h2valcamonica.eu/en
IdrogenMO	H2 VALLEY							400		electrolyser	Other	https://www.gruppohera.it/-/idrogemo-progetto-hera-e-snam-per-la-hydrogen-valley
Puglia Green Hydrogen	H2 VALLEY						220					https://www.edisonnext.it/it/casi-di-successo/puglia-hydrogen-valley/

Figure 10 - Questionnaire Section three- H_2 projects and initiatives for Italy.

3.5 Portugal

Which projects exist in your country related to large-scale hydrogen initiatives?												
Name	VALUE CHAIN COVERAGE	Potential impact on job creation n° 2030	2050	Job profile H_2 Value Chain Coverage	Areas of expertise	Project duration (Started/finished)	Quoted installed capacity MWel	Nm³ H_2/hour	Tonne CO_2 avoided	Production process	End-Use	link of reference
H2Sines.Rdam	H2 PRODUCTION	N/A	N/A	H2 Production H2 Storage H2 Distribution	*	N/A	400	N/A	221 MT (CO2 avoided)	N/A	Refining	https://www.portoflrotterdam.com/sites/default/files/2022-12/Sines%20and%2
GreenH2Atlantic	H2 PRODUCTION	1147 direct and 2744 indirect jobs	N/A	H2 PRODUCTION	*	01-12-2021 / 30-11-2027	100	10 kton/year	82.16 ktonCO2-eq/year	Alkaline Electrolysis	Other	https://www.greenh2atlantic.com/ https://cordis.europa.eu/project/id/101035908
H2Enable	H2 PRODUCTION	N/A	N/A	H2 PRODUCTION	*	01-01-2023 / 31/12/2025	40	5.5 kton/year	N/A	Alkaline Electrolysis	Other	https://www.bondaltilmedia.com/bondaltilmedia/projeto-de-hidrogenio...
MadoquaPower2X	H2 PRODUCTION	500	N/A	H2 PRODUCTION	*	N/A	100	150 kton/year of H2	1,200 ktpa (CO2 avoided)	Alkaline Electrolysis (H2) Haber-Bosch	Ammonia	https://madoquapower2x.com/
H2MED	H2 TRANSPORT	N/A	N/A	H2 TRANSPORT	*	2022 / 2030	/				Other	https://h2medproject.com/the-h2med-project/
M-ECO2	H2 PRODUCTION	118	N/A	H2 PRODUCTION	*	01-01-2023 / 31-12-2025	70	7 kton/year	N/A	Alkaline Electrolysis	E-fuels	https://resiway.com/wp-content/uploads/202
Galp H2 Park	H2 PRODUCTION	N/A	N/A	H2 PRODUCTION	*	Start production in 2025	100	15,000 tonnes/year of H2	110,000 tonnes of CO2-equivalent	PEM Electrolysis	Refining	https://portalconomico.pt/noticias/hidrogenio-verde-projeto-de-217-milhoes-da-
HyTagus Cluster	H2 Production H2 Storage H2 Distribution	N/A	N/A	H2 Production H2 Storage H2 Distribution	*	N/A		N/A	N/A	N/A	Other	http://www.hytagusvalley.net/
Green Hydrogen Valley (Sines H2G Valley)	H2 PRODUCTION	N/A	N/A	H2 PRODUCTION	*	01-07-2022 / 30-06-2025	92,5	N/A	N/A	HEVO electrolyser	Mobility	https://www.fusion-fuel.eu/co-financed-projects/
Galileu Green H2 Valley	H2 PRODUCTION	N/A	N/A	H2 PRODUCTION	*	COD Q2 2026	360	N/A	N/A	Alkaline Electrolysis	E-fuels	https://h2v.eu/hydrogen-valleys/galileu-green-h2-valley
Aveiro Green H2 Valley	H2 PRODUCTION	N/A	N/A	H2 PRODUCTION	*	COD beginning of 2027	100	9,116 t p.a. H2	N/A	Alkaline Electrolysis	Focused on Power to Industry, Gas grid Injection and Power to Mobility	https://h2v.eu/hydrogen-valleys/aveiro-green-h2-valley
REN H2 VALLEYS	H2 Production H2 Storage H2 Distribution	N/A	N/A	H2 PRODUCTION	*	N/A	N/A	N/A	N/A	N/A	Blending in natural gas pipelines	https://www.ren.pt/pt-pt/atividade/gases-renovaveis
Hyperion H2 Setúbal	H2 PRODUCTION	N/A	N/A	H2 PRODUCTION	*	N/A	7,5	1.5k		N/A	Other	https://energynews.biz/epc-tenders-h2-setubal-project/
Moving2Neutrality	H2 PRODUCTION	500 to 600	N/A	H2 PRODUCTION	*	01-01-2022 / 31-12-2025	100	10 kton/year	952k of GHG	N/A	Mobility	https://www.bioref-colab.pt/en/projects
H2Driven	H2 PRODUCTION/ Methanol Production	N/A	N/A	H2 PRODUCTION	*	01-10-2022 / 31-12-2025	90	12.48 kton/year	105k	N/A	Mobility	https://www.bioref-colab.pt/en/projects
SABOR MOGADOURO	H2 PRODUCTION	N/A	N/A	H2 PRODUCTION	*	N/A	40	4.8 kton/year	N/A	N/A	Mobility	https://www.apren.pt/contents/documents/christian-pho-duc-smartenergy.pdf

Figure 11- Questionnaire Section three- H_2 projects and initiatives for Portugal.

3.6 Poland

Which projects exist in your country related to large-scale hydrogen initiatives?												
Name	VALUE CHAIN COVERAGE	Potential impact on job creation n°		Job profile		Project duration (Started/finished)	Quoted installed capacity			Production process	End-Use	link of reference
		2030	2050	H_2 Value Chain Coverage	Areas of expertise		MWel	Nm^3 H_2/hour	Tonne CO_2 avoided			
ORLEN - Hydrogen Eagle (PL02)	H2 PRODUCTION			PRIMARY ENERGY SOURCING	OTHER						Other	- https://www.orlen.pl/content/dam/internet/orlen/pl/en/about-company/media/press-releases/2021/obrazy/Orlen_prezentacja_Hydrogen_final.pdf.coredownload.pdf
IPCEI Hy2Use	H2 PRODUCTION			PRIMARY ENERGY SOURCING	Research and Development					electrolysis	Other	https://www.orlen.pl/content/dam/internet/orlen/pl/en/about-company/media/press-releases/2021/obrazy/Orlen_prezentacja_Hydrogen_final.pdf.coredow
Synthos - Development and demonstration of hydrogen generation technology - IPCEI Hy2Tech	H2 PRODUCTION			H2 PRODUCTION	System Design and Construction					electrolysis	Other	https://ipcei-hydrogen.eu/page/view/980c9e77-9251-49cc-8037-dd1355c7d550/hy2use
Green H2	H2 PRODUCTION			H2 PRODUCTION			5MW (Subsequently 50 MW)			PEM electrolysis	E-fuels	https://climate.ec.europa.eu/system/files/2022-07/if_pf_2021_zepak_en.pdf
Amber H2valley	H2 VALLEY				Design, Construction, and Supply of Components							https://h2v.eu/hydrogen-valleys/amber-hydrogen-valley
Lower Silesian Hydrogen Valley	H2 VALLEY				Design, Construction, and Supply of Components	Started in 2021						https://h2poland.eu/en/categories/hydrogen-valleys/public-perception/doliny-wodorowe-w-polsce/
Silesian H2 Valley	H2 VALLEY				System Design and Construction							https://h2poland.eu/en/categories/hydrogen-valleys/public-perception/doliny-wodorowe-w-polsce/
Greater Polish Hydrogen Valley	H2 VALLEY				Design, Construction, and Supply of Components	started in 2021						https://h2poland.eu/en/categories/hydrogen-valleys/public-perception/doliny-wodorowe-w-polsce/
Mazovian Hydrogen Valley	H2 VALLEY				System Design and Construction							https://h2poland.eu/en/categories/hydrogen-valleys/public-perception/doliny-wodorowe-w-polsce/
Subcarpatian Hydrogen valley	H2 VALLEY				Design, Construction, and Supply of Components							https://h2poland.eu/en/categories/hydrogen-valleys/public-perception/doliny-wodorowe-w-polsce/

Figure 12- Questionnaire Section three- H_2 projects and initiatives for Poland.

4. Questionnaire section 4- H_2 training offer benchmarking

4.1 Finland

H_2 traing offer benchmarking										
No	*University Name / Training Provider Name*	*Region/Country*	*Course/programme title*	*How much is the topic H2 covered in the course?*	*Description*	*Links to the course/programme*	*Which area does it contain (i.e. A1, B1, B2...)*	*EQF Level*:*		
								"03-05"	"06-08"	life-long-learning
1	**Vaasa University of Applied Sciences (VAMK)**	Vaasa/Finland	Hydrogen Economy	5 (total coverage)		https://www.vamk.fi/en/hanke/hydrogen-economy	H2 Cross-cutting activities		x	x
2	**Aalto University**	Espoo, Finland	Hydrogen and Electric Systems, Master of Science (Technology)	5	The Hydrogen and Electric Systems Master's Programme gives you a comprehensive view of the energy and hydrogen system and an excellent opportunity to build a career – in Finland or abroad – in a growing field in dire need of workforce. Aalto University has developed the programme in collaboration with the industry, and it deals with the topics companies in the field deem the most important and beneficial.	https://www.aalto.fi/en/study-options/hydrogen-and-electric-systems-master-of-science-technology	All		x	
3	**Aalto University**	Espoo, Finland	Introduction to hydrogen economy	5	The course provides the student a general understanding about the hydrogen economy and its value chain. It covers the integration of hydrogen economy to power and energy systems, the role of hydrogen in energy and power markets, the basics of hydrogen production, storing and utilisation, as well as the role of derivatives of hydrogen.	https://fitech.io/en/studies/introduction-to-hydrogen-economy/	H2 Cross-cutting activities		x	x

4	**Tampere University**	Tampere/Finland	Hydrogen end-use and infrastructure	5 (total coverage)	This course gives a good understanding of the possibilities of hydrogen in transportation and moving machines.	https://fitech.io/en/studies/hydrogen-end-use-and-infrastructure/	All		x	x
5	**Tampere University**	Tampere/Finland	Geopolitics of hydrogen	5 (total coverage)	This course examines the emerging geopolitics of hydrogen. This involves political risks along with economic and power political competition among producer and consumer countries of hydrogen and related derivative fuels.	https://fitech.io/en/studies/geopolitics-of-hydrogen/	Other		x	x
6	**Vaasa University**	Vaasa/Finland	Hydrogen as fuel in combustion engines	5 (total coverage)	The course is designed to provide students with know-how and knowledge in the fundamentals of hydrogen as combustion engine fuel, of hydrogen-driven engines and gas turbines, and of the fuel system for hydrogen in marine and on-shore applications.	https://fitech.io/en/studies/hydrogen-as-fuel-in-combustion-engines/	Production+Storage+Final Uses		x	x
7	**University of Oulu**	Oulu/Finland	Hydrogen production and storage	5 (total coverage)	The course provides the student understanding about hydrogen production technologies, hydrogen storage and safety issues. It also covers the new hydrogen production technologies currently under research	https://fitech.io/en/studies/hydrogen-production-and-storage/	Production+Storage		x	x
8	**University of Jyväskylä**	Jyväskylä/Finland	Catalytic processes and materials in sustainable hydrogen production	4	The course introduces you to catalytic chemistry in hydrogen production and materials used in electro- and photo-catalytic methods.	https://fitech.io/en/studies/catalytic-processes-and-materials-in-sustainable-hydrogen-production/	H2 Production		x	x
9	**Turku University**	Turku/Finland	FITech Hydrogen project course	5 (total coverage)	The project course aims to educate students and participating companies about the opportunities and challenges within the hydrogen economy. Students propose practical solutions for real challenges faced by companies in this sector, while also enhancing their transferable skills like teamwork, problem-solving, and communication	https://fitech.io/en/studies/fitech-hydrogen-project-course/	All		x	x
10	**FITech and Jotpa programme**	Online	Several courses on hydrogen sector	5 (total coverage)		https://fitech.io/en/studies/?fit_course_types=upcoming&orderby=start_date&fit_topic=4167	All		x	x

Figure 13- Questionnaire Section four- H_2 training offer benchmarking for Finland.

4.2 Spain

H_2 traing offer benchmarking										
No	*University Name / Training Provider Name*	*Regional/Country*	*Course/programme title*	*How much is the topic H2 covered in the course?*	*Description*	*Links to the course/programme*	*Which area does it contain (i.e. A1, B1, B2...)*	*EQF Level*: "03-05"	"06-08"	life-long-learning
1	**Ariema**	Spain	CursoH2	4	3 months training. 6 modules covering all the value chain of hydrogen and its aplications. Mod. 1. Fundamentals and markets: green hydrogen. Mod. 2. Hydrogen production (fuels, electrolysis, electrolysers). Mod. 3 (Hydrogen logistics: storage, power to gas, compressors, distribution). Mod 4. Fuel cells (stationary and transport applications, service stations). Mod 6. Safety, standardization and opportunities.	https://cursoh2.com/curso-h2/	All			X
2	**MU, UPC, URV, UPV-EHU, UNIZAR, EOI, FHA, SOM**	Spain	MÁSTER INTERUNIVERSITARIO DE FORMACIÓN PERMANENTE EN TECNOLOGÍAS DE	5 (total coverage)	60 ECTS, during 2 years, for proffessionals that aim to gain knowledge on the hydrogen technology. Modules are: H2 production, H2 storage, T&D, H2 transformation, H2 application and H2 market.	https://www.mondragon.edu/cursos/es/master-interuniversitario-tecnologias-hidrogeno	All			x
3	**Censolar/Lean Hydrogen Company**	Spain	Solar hydrogen course		15 h formation	https://www.censolar.org/producto/curso-de-	Production+Distribution+Final			
4	**Escuela de Organización Industrial (EOI)**		Executive program in green hydrogen	5 (total coverage)	150 h blended format. CONTENTS: Module 1: Introduction and context Module 2: Current situation of Hydrogen Module 3: Hydrogen value chain: Production: From fossil fuels or by electrolysis. Storage: Storage technologies/Hydrogen compression; Transport; Commercialization Module 4: Production technologies. Types of Electrolyzers Module 5: Hydrogen Storage Logistics. Module 6: Safety Management in Hydrogen Projects:Security challenges posed by Hydrogen. Safety management in Hydrogen projects: generation, storage, distribution, hydrogen plants,... Module 7: Technical viability of Renew able Hydrogen projects: Design of a typical renew able hydrogen installation. Module 8: Economic viability of Renew able Hydrogen projects: Financing of renew able hydrogen projects.	https://www.eoi.es/es/cursos/89541/programa-ejecutivo-en-hidrogeno-renovable-madrid	All		X	X
5	**Universidad San Jorge / SEAS**	Spain	Online course on Hydrogen processes and fuel cells (PROCESOS DE HIDRÓGENO Y PILAS DE COMBUSTIBLE)	3	150 h, 6ECTS, on-line. 6 modules covering all the value chain of hydrogen and its aplications. Mod. 1. Fundamentals and markets: green hydrogen. Mod. 2. Hydrogen production (fuels, electrolysis, electrolysers). Mod. 3 (Hydrogen logistics: storage, power to gas, compressors, distribution). Mod 4. Fuel cells (stationary and transport applications, service stations). Mod 6. Safety, standardization and opportunities.	https://documentacion.eigetucurso.com/microsites/seas/curso-hidrogeno/?piloto=0224&gad_source=1&gclid=EAIaIQobChMI-czE24S_hAMVSDIGAB1q2ANdEAAYASAAEgKjd_D_BwE	All			
6	**IngeoexpertAltlantHy**		Course: Hydrogen technologies		Online course. 80 hours.	https://ingeoexpert.com/cursos/curso-de-tecnologias-de-hidrogeno/	Production+Distribution+Final Uses			
7	**Asociación Gallega del Hidrógeno (AGH2)/ Xunta de Galicia**	Spain	Cadena de valor y economía del hidrógeno (nivel básico)	1(Low Coverage)	Online course. 30 hours.	https://agh2.org/formacion/	Production+Distribution+Final Uses			
8	**Asociación Gallega del Hidrógeno (AGH2)/ Xunta de Galicia**	Spain	Seguridad en instalaciones de hidrógeno (nivel básico)	1(Low Coverage)	Online course. 30 hours.	https://agh2.org/formacion/	H2 Cross-cutting activities			
9	**Asociación Gallega del Hidrógeno (AGH2)/ Xunta de Galicia**	Spain	Tecnologías del hidrógeno (nivel básico)	1(Low Coverage)	Online course. 30 hours.	https://agh2.org/formacion/	All			

10	**Asociación Gallega del Hidrógeno (AGH2)/ Xunta de Galicia**	Spain	Movilidad con vehículos de hidrógeno (nivel básico)	1(Low Coverage)	Online course. 30 hours.	https://agh2.org/formacion/	Storage+Final Uses			
11	**Arveng Training & Engineering**	Spain	Tecnologías del Hidrógeno: Visión Práctica	3	On line course 40 hours: 1 Energy vector; 2 Hydrogen physico-chemistry; 3 H2 production (I): SMR and other methods; 4 H2 production (II): Electrolysis; 5 Hydrogen storage; 6 Transport of hydrogen; 7 Design of pipelines and pressure vessels; 8 Fuel cells and H2 turbines; 9 Hydrogen uses (I); 10 Hydrogen uses (II); 11 Ammonia and metanol; 12 Safety; 13 Balanced cost of HFCVs; 14 Htdrogen projects	https://arvengtraining.com/cursos/tecnologias-del-hidrogeno-vision-practica/ ; https://arvengtraining.com/cursos/hidrogeno-fundamentos-y-aspectos-practicos/#1627995750831-51ab3e4f-ae6f	All	X	X	X
12	**Arveng Training & Engineering**	Spain	Introduction to ASME B31.12	Hydrogen Pipeline Systems (Introducción a ASME B31.12 – Sistemas de Tuberías de Hidrógeno)	3	On line course. 8 hours. Contents: 1. ASME B31.12 – Background; 2. General Characteristics of Hydrogen; 3. B31.12 – General Structure of the Code; 4. IP – Industrial Pipe; 5. B31.12 vs B31.3; 6. PL – Line Pipes; 7. PL– Prescriptive Design vs Performance Based Design; 8. PL – New vs converted pipes; 9. Materials for Hydrogen service;	https://arvengtraining.com/cursos/tecnologias-del-hidrogeno-vision-practica/	All	X	X	X
13	**Arveng Training & Engineering**	Spain	ASME B31.12) Design of Hydrogen Piping Systems (ASME B31.12 | Diseño de Sistemas de Tuberías de Hidrógeno)		3	On line course. 8 hours. Contents: 1 ASME B31.12 – Descripción General; 2 Características Generales del H2; 3 B31. 12 GR – Requisitos Generales; 4 B31.12 IP – Tuberías Industriales de H2; 5 B31.12 PL – Tuberías de línea (pipelines); 6 Apéndices	https://arvengtraining.com/cursos/tecnologias-del-hidrogeno-vision-practica/	All	X	X	X
14	**Arveng Training & Engineering**	Spain	Diverse course related to technical aspects of hydrogen technologies			Arveng Training & Engineering acompany providing Training and Engineering services based in Madrid, Spain. Established in July 2010, Arveng works in different areas of activity participating in multidisciplinary engineering projects, providing solutions to solve specific requirements.	https://arvengtraining.com/categoria-producto/todos/	Storage+Distribution	X	X	X
15	**TECPA**	Spain	Hydrogen energy specialist course 300h	5 (total coverage)	300-hour hydrogen course -online-: 1.- Introduction to hydrogen energy; 2.- The chemistry of hydrogen; 3.- Energy context; 4.- Hydrogen production; 5.- Storage and distribution; 6.- The hydrogen plants; 7.- The fuel cell; 8.- Applications of hydrogen; 9.- Safety in hydrogen energy; 10.- Hydrogen energy economy; 11.- Practical cases; 12.- Final course project;	https://www.tecpa.es/cursos-on-line/curso-hidrogeno/	All		X	
16	**TECPA**	Spain	Green Hydrogen course	5 (total coverage)	50 h. GREEN HYDROGEN ONLINE COURSE PROGRAM: Topic 1: Hydrogen; Topic 2: Green hydrogen; Topic 3: Hydrogen production and storage; Topic 4: Hydrogen distribution; Topic 5: Fuel cells	https://www.tecpa.es/cursos-on-line/curso-online-hidrogeno/	All	X	X	X
17	**TECPA**	Spain	Green hydrogen expert course	5 (total coverage)	150 h. HYDROGEN EXPERT COURSE PROGRAM: 1.- The energy context; 2.- The chemistry of hydrogen; 3.- Hydrogen production; 4.- Hydrogen storage; 5.- The distribution of hydrogen; 6.- Hydrogen fuel; 7.- The fuel cell; 8.- Safety management in hydrogen plants; hydrogen online course	https://www.tecpa.es/cursos-on-line/formacion-hidrogeno/	Storage+Distribution		X	X
18	**TECPA**	Spain	Green ammonia course	2	50 h GREEN AMMONIA COURSE PROGRAM: 1. Green ammonia in the energy transition; 2. Green hydrogen production; 3. Green ammonia synthesis processes; 4. Plant design and operation; 5. Storage and transportation; 6. Green Ammonia Applications	https://www.tecpa.es/cursos-on-line/amoniaco-verde/	Storage+Final Uses		X	X
19	**Universidad de Burgos**	Spain	Máster de Formación Permanente en Tecnologías del Hidrógeno (Online)	Full hydrogen chain value	Módulo 1. Aplicaciones y mercado del hidrógeno (3 ECTS) Módulo 2. Fundamentos técnicos del sector del hidrógeno (6 ECTS) Módulo 3. Producción de hidrógeno (9 ECTS) Módulo 4. Almacenamiento, transporte y distribución de hidrógeno (9 ECTS) Módulo 5. Pilas de combustible y usos finales del hidrógeno (9 ECTS) Módulo 6. Materiales para el hidrógeno (9 ECTS) Módulo 7. Trabajo fin de máster (15 ECTS)	https://www.ubu.es/master-de-formacion-permanente-en-tecnologias-del-hidrogeno-online/informacion-basica/plan-de-estudios	All			X
20	**Universidad de Loyola**	Spain	Máster Universitario en Energías y Tecnologías del Hidrógeno	4	60 ECTS, OFICIAL TITTLE, INCLUDES INTERSHIPS.	https://www.uloyola.es/masteres/energias-tecnologias-hidrogeno	Production+Storage+Final Uses		X	
21	**Universidad de Nebrija**	Spain	Master en Tecnologías de Hidrógeno	5 (total coverage)	With the Master in Hydrogen Technologies you will be able to work in a developing sector that demands qualified personnel for the management, implementation, distribution and storage of hydrogen technology.	https://www.inesem.es/Master-Tecnologias-Hidrogeno?utm_medium=cpc&utm_source=google&utm_campaign=MX&utm_content=&utm_term=&gad_source=1&gclid=CjwKCAiA0PuuBhBsEiwAS7fsNYuWhS55fcAW5RZFpwtkglHC0f3t8_k8ZxJtHhbt-My_RgblwX3cqRoCcSAQAvD_BwE	All			X

Figure 14- Questionnaire Section four- H_2 training offer benchmarking for Spain.

4.3 France

H_2 traing offer benchmarking in Great-Est and Bourgogne Franche-Comté										
No	*University Name / Training Provider Name*	*Country*	*Course/programme title*	*How much is the topic H2 covered in the course?*	*Description*	*Links to the course/programme*	*Which area does it contain (i.e. A1, B1, B2…)*	*EQF Level*:*		
								"03-05"	"06-08"	life-long-learning
1	**AFPA**	France	BTS Industriel H2	3	H2 Storage	https://www.afpa.fr/formation-qualifiante/technicien-superieur-de-maintenance-d-installations-option-hydrogene	H2 Storage	X		
2	**Lycée Germaine Tillon**	France	BTS Electronique colorée H2	4	Energy vector	https://www.emfor-bfc.org/formation/structure/176-lycee-germaine-tillion	Energy vector	X		
3	**Lycée Gustave Eiffel**	France	BTS Maintenance des systèmes de production coloré H2	3	H2 Production	https://www.emfor-bfc.org/formation/structure/7463-lycee-gustave-eiffel	H2 Production	X		
4	**Lycée Joseph Fourier**	France	BTS Maintenance des systèmes de production coloré H2	3	H2 Production	https://www.emfor-bfc.org/formation/structure/4792-lycee-joseph-fourier		X		
5	**UIMM FC**	France	Licence Pro MSE - Maintenance des systèmes energetiques - coloration H2	4	H2 Storage	https://formation-industries-fc.fr/jeunes-apprentis/trouver-ma-formation/formation-	H2 Storage	X		
6	**IUT Longwy**	France	BUT Métiers de la transition et de l'efficacité Énergétiques - management de l'énergie pour le bâtiment et l'industrie	3	H2 Production	iut-longwy.univ-lorraine.fr/but-mt2e/	H2 Production	X		
7	**IUT Longwy**	France	BUT Métiers de la transition et de l'efficacité Énergétiques - réalisation des installations énergétiques pour le bâtiment et l'industrie	3	H2 Production	iut-longwy.univ-lorraine.fr/but-mt2e/	H2 Production	X		
8	**IUT Longwy**	France	BUT Métiers de la transition et de l'efficacité énergétiques (MT2E)	3	H2 Storage	iut-longwy.univ-lorraine.fr/but-mt2e/	H2 Storage	X		
9	**Université de Bourgogne**	France	Master Automotive Engineering for Sustainable Mobility	4	Energy vector+Final Uses	https://www.isat.fr/formations/masters/master-automotive-engineering-for-sustainable-mobility	Energy vector+Final Uses		X	
10	**Université de Bourgogne**	France	Diplôme d'ingénieur - Electronique et systèmes numériques	2	H2 Distribution	https://esirem.u-bourgogne.fr/electronique-systemes-numeriques	H2 Distribution		X	
11	**UFC**	France	Master Energie	3	Final Uses	http://formation.univ-fcomte.fr/master/energie-ener-	Final Uses		X	
12	**UFC**	France	Master CMI Energie-hydrogène efficacité énergétique	5 (total coverage)	H2 Production	http://formation.univ-fcomte.fr/cmi/energie-hydrogene-	H2 Production		X	

13	UFC	France	Master of Engineering - Hydrogen Energy	5 (total coverage)	H2 Production	stat.univ-fcomte.fr/formation/cmi-[illegible]	H2 Production		X	
14	Univeristé de lorraine	France	Master Énergie parcours Énergie et Procédés	4	H2 Production	fst.univ-lorraine.fr/formations/master-energie	H2 Production		X	
15	Univeristé de lorraine	France	Master Énergie parcours Mécanique et Énergie	4	H2 Production	fst.univ-lorraine.fr/formations/master-energie	H2 Production		X	
16	Univeristé de lorraine	France	Ingénieur ENSIC	4	H2 Production	fst.univ-lorraine.fr/formations/master-energie	H2 Production		X	
17	SCIFA	France	Master Electronique, Énergie électrique, Automatique - parcours Intelligence-Mesures Énergétiques pour Énergies Nouvelles	4	Final Uses	scifa.univ-lorraine.fr/content/master-eea#imeen	Final Uses		x	

Figure 15- Questionnaire Section four- H_2 training offer benchmarking for France.

4.4 Italy

H_2 traing offer benchmarking										
No	*University Name / Training Provider Name*	*Country*	*Courselprogramme title*	*How much is the topic H2 covered in the course?*	*Description*	*Links to the courselprogramme*	*Which area does it contain (i.e. A1, B1, B2...)*	*EQF Level*:		
								"03-05"	"06-08"	life-long-learning
1	**Politecnico di Milano**	Italy	HYDROGEN TECHNOLOGIES	5 (total coverage)	The course is focused on the technologies related to hydrogen as a carbon-free energy vector supporting the energy transition goals.	https://www11.ceda.polimi.it/schedaincarico/schedaincarico/controller/scheda_pubblica/SchedaPublic.do?&evn_default=evento&c_classe=811511&polij_device_category=DESKTOP&__pj0=0&__pj1=3ace828b9d95828c2c92676d06d797b9	All		X	
2	**Politecnico di Torino**	Italy	Polygeneration and advanced energy systems	4	Applications of fundamentals of chemical thermodynamics and electrochemistry to energy systems.	https://didattica.polito.it/pls/portal30/gap.pkg_guide.viewGap?p_cod_ins=01QGXND&p_a_acc=2024&p_header=S&p_lang=IT&multi	All		X	
3	**Universià degli Studi di Perugia**	Italy	Hydrogen: a sector-coupling enabler	5 (total coverage)	This series of lectures aims at providing a full overview on the hydrogen technology and value chain, understanding the basic principles of hydrogen technologies and the use of hydrogen as decarbonized energy carrier, finding synergies among scientific disciplines to address the major challenges.	https://ing.unipg.it/files/dottorato/didattica/22_23/mod_baldinelli_a_22-23.pdf	All		X	
4	**Università degli Studi di Roma "La Sapienza"**	Italy	Tecnologie dell'Idrogeno e dello Storage	4		https://corsidilaurea.uniroma1.it/sites/default/files/programma_tecnologie_dellidrogeno_e_dello_storage_elettrochimico.pdf	All		X	
5	**Università della Calabria**	Italy	SISTEMI INDUSTRIALI H2 PER LA TRANSIZIONE ENERGETICA	5 (total coverage)	The course introduces knowledge of hydrogen technology and fuel cells.	https://www.unical.it/storage/cds/21743/activities/116153/	All		X	
6	**Politecnico di Torino**	Italy	Idrogeno per la mobilità	5 (total coverage)	The course consists of six days dedicated to presenting and discussing the technological trajectories of hydrogen utilization in various mobility sectors (automotive, railway, maritime, and aviation). Additionally, challenges for establishing the hydrogen paradigm, such as safety and environmental sustainability of products and processes in the supply chain, will be addressed.	https://www.polito.it/didattica/master-e-formazione-permanente/corsi-executive/catalogo-corsi-executive/idrogeno-per-la-mobilita	Production+Distribution+Final Uses			X
7	**Università degli Studi di Genova**	Italy	SISTEMI PROPULSIVI A RIDOTTO IMPATTO AMBIENTALE	2	The course delves into the most relevant and current issues concerning environmentally friendly propulsion systems	https://corsi.unige.it/off.f/2022/ins/58962	Final Uses		X	
8	**Università degli Studi di Salerno**	Italy	HYDROGEN ENERGY AND PROPULSION SYSTEMS	5 (total coverage)		https://unisa.coursecatalogue.cineca.it/insegnamenti/2024/516086/2018/10001/500268?coorte=2023&schemaid=16424	Final Uses		X	

9	**Università degli Studi di Napoli Parthenope**	Italy	Tecnologie per la Generazione dell'Energia e la Mobilità	1(Low Coverage)	The course aims to provide students with basic methodological tools for studying fluid machinery and energy conversion systems for both stationary (energy generation) and mobile (propulsion) applications	https://uniparthenope.coursecatalogue.cineca.it/insegnamenti/2023/7039/2018/9999/10094?coorte=2021&schemaid=4102	Production+Final Uses		X	
10	**Università della Tuscia**	Italy	HYDROGEN TECHNOLOGIES	5 (total coverage)		https://unitus-public.gomp.it/Insegnamenti/Render.aspx?CUIN=A72301398	All		X	
11	**Università degli Studi di Perugia**	Italy	LABORATORIO DI SISTEMI ENERGETICI	2		https://www.unipg.it/didattica/corsi-di-laurea-e-laurea-magistrale/archivio/offerta-formativa-2023-24?idins=296901#modulo-	Production+Final Uses		X	
12	**RINA**	Italy	Basic course on hydrogen-based energy transition	5 (total coverage)	Hydrogen: the Italian and European energy landscape, the potential of H2 and future scenarios Hydrogen production: its colours, transport and storage The use of hydrogen: overview of its applications in Italy and Europe and its main sectors of use. The regulatory framework on hydrogen: European and national policies, standards and certifications on H2 The role of hydrogen in smart cities and hydrogen valleys.	https://www.rina.org/it/business/certification/training/hydrogen-learning-hub/corso-base	Energy vector			X
13	**ENEA Formazione**	Italy	Hydrogen and fuel cells	5 (total coverage)	This course aims to provide general information on hydrogen and its characteristics, to illustrate the state of the art in the development of technologies for the production, storage and transport of hydrogen, as well as its	https://formazione.enea.it/scheda_corso-520	Production+Storage+Final Uses			X
14	**Politecnico di Torino**	Italy	Hydrogen for Mobility Training Course	5 (total coverage)	This course is designed and delivered as part of the "Lifelong Learning Initiatives" offer catalogue of the PNRR Ecosystem of Innovation Project "NODES - North West Digital And Sustainable". The subjects covered have been assessed as capable of producing a considerable impact in terms of the territories and industrial systems intercepted and generates the possibility of increasing the ability to share skills by creating a network of value in the area	https://www.polito.it/didattica/master-e-formazione-permanente/corsi-executive/catalogo-corsi-executive/idrogeno-per-la-mobilita	Energy vector+Final Uses			X
15	**TUV SUD**	Italy	Introduction to hydrogen	5 (total coverage)	This virtual classroom course provides a comprehensive introduction to hydrogen, hydrogen technologies and associated risks, as well as protective measures and occupational health and safety in relation to hydrogen. Through this course you will gain the following key benefits: Understand what hydrogen is Understand the dangers of hydrogen Be able to define the protective measures for handling hydrogen Understand which occupational health and safety regulations apply.	https://www.tuvsud.com/it-it/store/italia/catalogo-formativo/industria-it/PIDR1_IT	H2 Cross-cutting activities			X
16	**BUREAU VERITAS**	Italy	Training in COMBUSTION & HYDROGEN	4	Bureau Veritas, in partnership with CO3 Srl, a company specialized in combustion and use of fire systems, offers a range of training courses to acquire the knowledge necessary to operate fire equipment in national and international environments. The courses are suitable for Technicians, Operators, Maintenance Managers, Dealers and are specially structured with lessons and exercises to suit you, whatever your previous experience in combustion and heat exchange.	Several courses, basic and advanced levels: https://www.bureauveritas.it/needs/formazione-ambito-combustione-idrogeno	Other			X
17	**KIWA**	Italy	The safe management of hydrogen systems	4	Training course on the regulatory and technical basis for the safe implementation of hydrogen plants. In particular, the logic and technologies for the correct design of the associated safety measures will be analysed.	https://www.kiwa.com/it/it/servizi2/formazione/corso-gestione-impianti-idrogeno/	H2 Cross-cutting activities			X
18	**SMART TRAINING AND TECHNOLOGIES**	Italy	Hydrogen and fuel cells	5 (total coverage)	This course aims to provide general information on hydrogen and its characteristics, to illustrate the state of the art in the development of technologies for the production, storage and transport of hydrogen, as well as its applications. The aim of the course is to inform technicians (graduates, diploma holders, operators) about the opportunities provided by current and future pathways oriented towards the world of work, professions and skills certification.	https://www.smart2t.it/corso/idrogeno-e-celle-combustibile	Production+Distribution+Final Uses			X
19	**CEI - COMITATO ELETTROTECNICO ITALIANO**	Italy	Hydrogen and fuel cells	5 (total coverage)	The course aims to provide basic information on the exploitation of hydrogen as a possible future energy carrier	https://mycorsi.ceinorme.it/corso/534/idrogeno-e-celle-a-combustibile?sso=y	Energy vector			X
20	**Federazione Italiana per l'uso Razionale dell'Energia**	Italy	Hydrogen: scenarios and opportunities	5 (total coverage)	The course aims to provide the technical, regulatory, foundations and market knowledge to correctly understand and approach the hydrogen vector. It will also analyse the different phases of the "hydrogen supply chain", from generation/distribution/storage to different uses, whether in stationary	https://fire-italia.org/evento/idrogeno-scenari-e-opportunita/	All			X
21	**ENEA**	Italy	Hydrogen Summer School	5 (total coverage)	The aim is to provide a technological overview and a basis for exchange on the challenges for a sustainable integration of hydrogen as an energy carrier in our society.	https://h2summerschool.enea.it/	Other		X	
22	**TECH ITALIA**	Italy	Master in Hydrogen Technologies	5 (total coverage)	The main objective of this private Master's programme is to enhance the engineers' capabilities in the hydrogen sector. Thus, during the 12 months of this programme, they will broaden their knowledge of the value chain: from hydrogen generation to end uses and their interaction with other components of the energy system. The case studies provided by the teaching staff will be of great benefit, as students will be able to integrate different methodologies and techniques into their daily practice.	https://www.techtitute.com/it/ingegneria/master/master-tecnologie-idrogeno	All		X	
23	**Università di Messina**	Italy	Master's Degree "ENERGY AND ENVIRONMENTAL SUSTAINABILITY: Hydrogen. The new challenges of the energy transition".	5 (total coverage)	The Master covers the entire hydrogen value chain: production technologies, storage technologies, transport/logistics/hydrogen infrastructure, hydrogen end uses (stationary, transport, industrial, residential and fuel cells), safety, regulatory and standardisation aspects, as well as digital technologies for control and monitoring and socio-economic aspects.	https://unisom.it/master-esa-hydrogen-le-nuove-sfide-della-transizione-energetica/	All		X	
24	**Politecnico di Torino**	Italy	HySET – Hydrogen Systems and Enabling Technologies	5 (total coverage)	The main aim of HySET is to train professionals and researchers with multidisciplinary knowledge in the field of hydrogen and related systems, through training in an international and multicultural environment, in order to stimulate global collaboration capable of responding to the complex challenges arising from the energy transition. Active cooperation between academia and industry is one of the strengths of the programme, which also envisages the involvement of additional academic and industrial partners.	https://hysetmaster.polito.it/	All		X	

Figure 16- Questionnaire Section four- H_2 training offer benchmarking for Italy.

4.5 Poland

H_2 traing offer benchmarking										
No	*University Name / Training Provider Name*	*Region/Country*	*Course/programme title*	*How much is the topic H2 covered in the course?*	*Description*	*Links to the course/programme*	*Which area does it contain (i.e. A1, B1, B2…)*	*EQF Level*:*		
								"03-05"	"06-08"	life-long-learning
1	**Gdansk University of Technology**	Poland	Hydrogen technology and electromobility, bachelor of science - engineering, full-	3	Studying hydrogen technology and electromobility gives students the opportunity to acquire knowledge and skills in such areas as electricity networks and systems, electromobility, electrochemistry or high voltage techniques.	https://ects.pg.edu.pl/pl/courses/15204/subjects	Final Uses	X		
2	**Collegium Humanum & Tuv Sud**	Poland	Master of Business Administration (MBA) - Hydrogen Technology Management	5 (total coverage)	The MBA-Hydrogen Technology Management program, offered by Collegium Humanum in collaboration with Apsley Business School, is Poland's premier management qualification, accredited as a Professional Class program by the Association for Management Education. Partners include TÜV SÜD Poland, Ludwig-Bölkow-Systemtechnik, Hydrogen Poland, the National Chamber of Commerce, and the Office of Rail Transport. Graduates are eligible for positions on supervisory boards of state-owned companies, RES Commissioner, and RES manager roles. Additionally, they receive certifications such as the "TÜV SÜD hydrogen technology expert" and "ISO 50001:2018 Internal Auditor TÜV SÜD" upon successful completion of exams.	https://humanum.pl/zarzadzanie-technologiami-wodorowymi-mba/?gad_source=1&gclid=CjwKCAiA29auBhBxEiwAnKcSqk92mhPo78Scp2OgExtzfCEv36WbqDhqctqw7zQHffhSoiXYOtQifBoCx94QAvD_BwE	Final Uses		X	
3	**Silesian University of Technology**	Poland	MBA Hydrogen Technologies and Energy Transformation	5 (total coverage)	The graduate of the Master of Business Administration with the profile Energy and Digital Transition / Energetic and Digital Transition acquires interdisciplinary, advanced managerial competences. The graduate acquires knowledge based on the latest developments in contemporary disciplines, management and quality sciences, economics, law, finance, accounting, psychology, sociology, logistics,	https://rekrutacja.polsl.pl/kierunek/spd-mba4/	Final Uses		X	
4	**PKN Orlen**	Poland	H2 Academy	2	The aim of the programme is to exchange knowledge between experts and practitioners with many years of experience in the field and people interested in the indicated topics who are new to the industry. The Academy will comprise a series of lectures/workshops/meetings with experts and scientists from the hydrogen industry. Organised in various locations in Poland, the lectures will not only help to deepen theoretical knowledge, but above all to see and experience first-hand how hydrogen technology works in various aspects of the industry.	https://akademiah2.pl/	H2 Production	X		

5	**Łukasiewicz Rzeszów University of Technology**	Poland	Modern energy technologies - hydrogen technologies	4	The study programme includes extended education in selected aspects of hydrogen technologies, including centralised and distributed hydrogen production technologies, methods of hydrogen storage in various states of aggregation, distribution systems using transmission networks and dedicated forms of transport, directions of use of hydrogen and its derivatives in various branches of the economy - transport, energy, heating, and above all in the chemical and petrochemical industries.	https://wch.prz.edu.pl/kierunki-studiow/studia-ii-stopnia/technologie-wodorowe	Energy vector+Pruduction		X	
6	**AGH University of Science and Technology**	Poland	Master of Science and Engineering II degree course in	4	The study programme additionally offers the possibility to individualise the study path according to the student's interests by choosing from a range of specialised elective subjects.	https://sylabusy.agh.edu.pl/public/api/education-program-document/show/23-ewo-iii-s	Energy vector+Pruduction		X	
7	**Poznan University of Technology**	Poland	Postgraduate Studies in Hydrogen Power Systems Engineering	4	The study programme has been developed taking into account the current situation on the labour market and offers a wide range of career prospects in many sectors. prospects in a wide range of industries. The aim of the studies is to provide structured knowledge of of hydrogen technology and renewable energy sources with an emphasis on practical knowledge and skills. and skills.	https://h2.put.poznan.pl/index.php/program-studiow/	Energy vector+Pruduction		X	

Figure 17 Questionnaire Section four- H_2 training offer benchmarking for Poland.

4.6 Portugal

H_2 traing offer benchmarking										
No	*University Name / Training Provider Name*	*Region/Country*	*Course/programme title*	*How much is the topic H2 covered in the course?*	*Description*	*Links to the course/programme*	*Which area does it contain (i.e. A1, B1, B2_)*	*EQF Level*:		
								"03-05"	"06-08"	life-long-learning
1	I. S. Técnico de Lisboa	Portugal	Specialization Course – Hidrogénio: Segurança, Produção, Armazenamento, Distribuição e Aplicações	5 (total coverage)	The Hydrogen: Safety, Production, Storage, Distribution and Applications course introduces the main industrial technologies for green hydrogen and oxygen, with an emphasis on commercial electrolysis systems for producing green hydrogen and oxygen. This course will have both distance and face-to-face sessions, promoting a hands-on application of the knowledge acquired.	Curso de Especialização – Hidrogénio: Segurança, Produção, Armazenamento, Distribuição e Aplicações – Técnico Lisboa (ulisboa.pt)	All			x
2	Inst. Politécnico de Portalegre	Portugal	Postgraduate course in Hydrogen	5 (total coverage)	The aim of this training is to provide trainees with knowledge of electrolytic hydrogen production technologies, with reference to commercial green hydrogen production systems and related technologies. Safety and standardization issues will be addressed.	Curso - Pós-Graduação - Hidrogénio (ipportalegre.pt)	H2 Production		x	
3	Universidade de Évora	Portugal	Collaborative Laboratory for Green Hydrogen	2	HyLAB aims to bring research activities closer to industrial ecosystems on the subject of implementing the green hydrogen economy to accelerate the energy transition along the entire hydrogen value chain.	HyLAB – Green Hydrogen Collaborative Laboratory	LNEG Laboratório Nacional de Energia e Geologia	Energy vector		
4	Empresa Portuguesa das Águas Livres (EPAL)	Portugal	Advanced Renewable Energy Program in the water sector	3	The Advanced Renewable Energy Program in the water sector aims to provide, in an aggregated and coherent way, technical and management skills in the field of various renewable energies, namely photovoltaic, solar thermal, wind, hybrid and biogas.	Curso PERSA 2023 (4ª edição) by EPAL - Issuu	Energy vector			x
5	Master D	Portugal	Renewable Energy Course	1(Low Coverage)	The Renewable Energies course is aimed at anyone with an interest in the installation and maintenance of solar thermal, photovoltaic and wind systems and is an asset for people whose current work is related to the technology	Curso de Energias Renováveis – Formação Master D	Energy vector			x
6	SGS Academy	Portugal	European and National Strategy for Renewable Hydrogen	2	This training aims to provide an overview of the European and national hydrogen strategy and the impact of the new European legislation.	SGS Academy lança formações em hidrogénio - Jornal das Oficinas	Other			x
7	SGS Academy	Portugal	The Challenges of Hydrogen and its Safe Use	2	This training provides a comprehensive overview of the entire hydrogen value chain, with an emphasis on its technical components, applicability and the risks and precautions to be taken when using it.	SGS Academy lança formações em hidrogénio - Jornal das Oficinas	Production+Storage+Distribution			x
8	SGS Academy	Portugal	Mobility and Hydrogen	2	This training aims to enable trainees to understand the whole context of the application of hydrogen technology in the area of mobility and to know how to train specialized human resources in the mobility sector.	SGS Academy lança formações em hidrogénio - Jornal das Oficinas	Final Uses			x
9	AP2H_2	Portugal	Training in Hydrogen Technologies and Economics	2	The course offers 24 hours of training, spread over 16 sessions, lasting 1.30 hours, three times a week, from 2pm to 3.30pm, via the Zoom platform, and covers the H2 value chain, delving into topics related to applications; security; business models and competitiveness.	Formação em Tecnologias e Economia do Hidrogénio (ap2h2.pt)	All			x

10	**Universidade de Coimbra**	Portugal	Hydrogen School	1(Low Coverage)	School, with lots of chemistry (experiments, challenging lessons, problems to solve or discuss, talks with researchers, internships during the vacations and much more) for secondary school students.	Universidade de Coimbra - Hidrogénio (uc.pt)	Other	x		
11	**Universidade de Lisboa**	Portugal	Hydrogen and New Energy Vectors	3	In the framework of the Master course in Energy Engineering and Environment. the students acquire fundamental knowledge about the utilization of Hydrogen as an energy vector and also competences that allow problem solving and also participate in laboratory work.	https://fenix.ciencias.ulisboa.pt/degrees/meea/paginas-de-disciplinas	Energy vector		x	x
12	**Universidade Nova de Lisboa**	Portugal	Hydrogen Production and Utilization	3	Acquisition of knowledge and competences in Hydrogen production processes, storage and use of Hydrogen. Economic and environmental viability. Sessions of problem solving and applications. Case studies	https://guia.unl.pt/pt/2020/fct/program/782/course/10766	Energy vector			X
13	**INEGI**	Portugal	Hydrogen Technologies and Economy	5 (total coverage)	The course approaches the different technologies for the production of Hydrogen, storage, distribution and applications including success cases regarding green Hydrogen and blending in natural gas networks. Also regulamentation, legislation and opportunities for a Hydrogen market creation are explored.	https://www.inegi.pt/pt/programas/tecnologias-e-economia-do-hidrogenio/	All			x
14	**ISQ Academy**	Portugal	Specialization in Green Hydrogen	5 (total coverage)	Characterize the production process, storage of Hydrogen, its constitution and behavior; Evaluate the energy potential of H2 in comparison with other fuels, proposing its use in different applications; Technically characterize the different processes of transforming H2 into energy Ensure compliance with technical and legal requirements applicable to H2 storage, transport, distribution and use systems. Identify the safety requirements necessary for the operation and handling of equipment and installations containing H2. Technically and economically propose the use of green hydrogen as a measure to decarbonize industry.	https://academy.isq.pt/informacaocurso.aspx?id=56	All			x
15	**ISQ Academy**	Portugal	H2 - Production, Storage and Safety in Hydrogen Operations	5 (total coverage)	As a general objective, trainees should know the production process, storage of Hydrogen, its constitution and behavior; evaluate the energy potential of H2 in comparison with other energies, proposing its use in different applications; identify the safety requirements necessary for the operation and handling of equipment and installation with H2. The training path - H2 - is made up of three Modules, which can be attended independently: M1 – H2 - Hydrogen Production through Electrolysis – 8h M2 – H2 - Hydrogen Storage and Applications – 8h M3 – H2 - Safety and Hydrogen Handling – 8h	https://academy.isq.pt/informacaocurso.aspx?id=13	Production+Storage+Distribution			x
16	**Universidade Lusófona**	Portugal	Renewable Energy	1(Low Coverage)	The Electrical Engineering and Energy Systems course at Lusófona University has a subject on Renewable Energies. This subject covers hydrogen in the topic "RENEWABLE ENERGIES AND HYDROGEN: Hydrogen Introduction; Markets among other aspects".	Energias Renováveis	Disciplinas	Universidade Lusófona (ulusofona.pt)	Energy vector		x	

Figure 18- Questionnaire Section four- H_2 training offer benchmarking for Portugal.

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WP2 D2.1– Annex 2: Benchmarking of H_2 training offer

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This annex presents the analysis of the finding from the fourth section of the questionnaire, which focuses on the national hydrogen training landscape. The complete list for each country studied is reported in the **Annex 1-State of Art Questionnaire**.

The idea behind this study is mapping the existing hydrogen training offerings in the various countries under study. This allows a comparison and an analysis of the different training offer that allow us to understand what is lacking and where intervention is needed for improvement.

1. Methodology

The methodology used, like the other sections of the questionnaire, employs a mixed-type format, combining open-ended questions with free responses and closed-ended questions with predefined responses within specific boxes. This approach facilitates the collection of both qualitative information through open responses and quantitative information through structured responses in the boxes.

The question posed is:

What is the current status of the national hydrogen training offer in your country?

This question is accompanied by a series of boxes intended to gather specific information about training offerings, such as:

- **University Name / Training Provider Name**: The name of the institution or organization providing the course.
- **Course/programme title**: The title of the course.
- **How much is the topic H2 covered in the course?** – This assesses the extent to which the hydrogen topic is covered within the course, using a scale from 1 to 5, where 1 indicates minimal coverage and 5 indicates comprehensive coverage.
- **Description:** A brief description of the course.
- **Links to the course/programme**: This requires a hyperlink to the course training webpage.
- **Which area does it contain** : This question aims to identify the main topics covered by the course in the hydrogen field from a list provided, including energy vector, H2 production, H2 storage, H2 distribution, final uses, and various combinations thereof.
- **EQF Level**: The European Qualifications Framework (EQF) categorizes qualifications into different levels, ranging from 1 to 8, with 1 being the lowest and 8 the highest. Different ranges have been proposed to categorize the training offerings.
- **EQF Range "03-05**":
    - ✓ EQF-03-04: Programmes designed to complete lower secondary education (ISCED level 2 – EQF level 3) in preparation for tertiary education, or to provide knowledge and skills relevant to employment, or both.[1]

[1] https://www.cedefop.europa.eu/en/tools/vet-glossary/glossary?letter=U

- ✓ EQF 05 short-cycle tertiary education designed to provide participants with professional knowledge, skills and competences. Typically, short-cycle, tertiary education programmes are practically based, occupation-specific and prepare students to enter the labour market; however, these programmes may also provide a pathway to other tertiary education programmes; academic tertiary education programmes below the level of a bachelor programme or equivalent are also classified as ISCED level 5[2];

- **EQF range "06-08"**[3]: Programmes of education and training that build on secondary education, providing learning activities in specialized fields at a high level of complexity and specialization. Tertiary education includes what is commonly understood as academic education but also includes advanced vocational or professional education; there is usually a clear hierarchy between qualifications granted by tertiary education programmes:
    - Level 6: bachelor or equivalent level.
    - Level 7: master or equivalent level.
    - Level 8: doctoral or equivalent level.
- **Lifelong learning**[4]: Any learning activity undertaken throughout life in a formal, non-formal or informal setting, which results in improving knowledge, know-how, skills, competences and qualifications for personal, social or professional reasons.

[2] https://www.cedefop.europa.eu/en/tools/vet-glossary/glossary?letter=S
[3] https://www.cedefop.europa.eu/en/tools/vet-glossary/glossary/tritobathmia-ekpaideysi-kai-katartisi-epipeda-5-eos-8-tis-isced-epipeda-6-eos-8-toy-epep
[4] https://www.cedefop.europa.eu/en/tools/vet-glossary/glossary?letter=L

2. Benchmarking H2 Training Offer: -Statistical Analysis

The data collected in the fourth section of the questionnaire were analyzed in statistical terms principally comparing the number of courses dedicated to hydrogen on a country-by-country basis, their EQF level, and their main focus areas.

In total, 95 courses were identified across the six countries, with Italy and Portugal showing a higher representation compared to others.

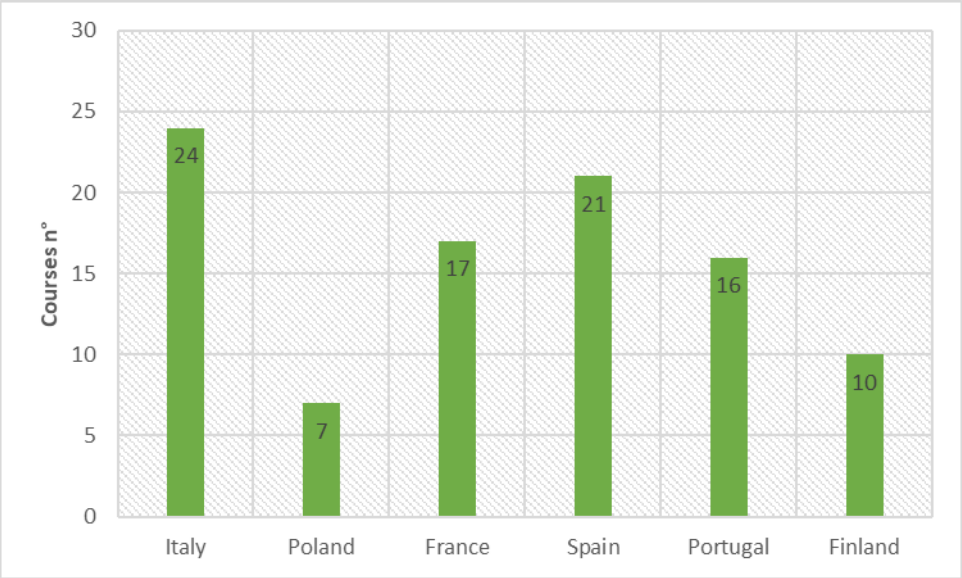

Figure 1Training courses distribution across the six countries within the H2Excellence consortium.

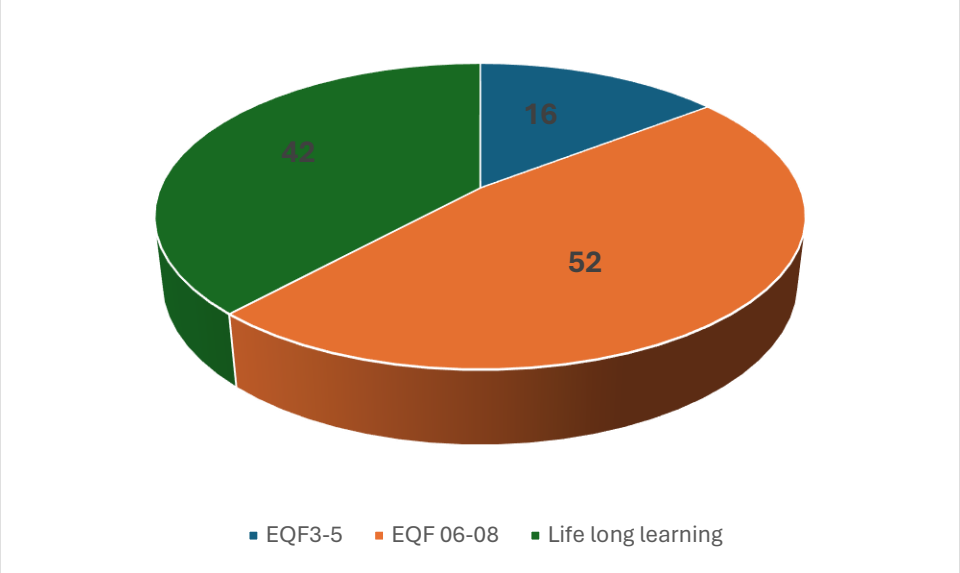

Figure 2 Training courses level distribution.

Regarding the EQF level of the courses, 47.3% fell into the "06-08" range , which encompasses programs of education and training building on secondary education, offering specialized learning activities at a high level of complexity and specialization. Meanwhile, 38.2% were

categorized under "life-long-learning," indicating learning activities aimed at improving knowledge, know-how, skills, competencies, and qualifications for personal, social, or professional reasons.

Figure 3 illustrates the distribution of courses across different thematic areas. The majority of the mapped courses provide comprehensive training on H_2, totaling 29 courses.

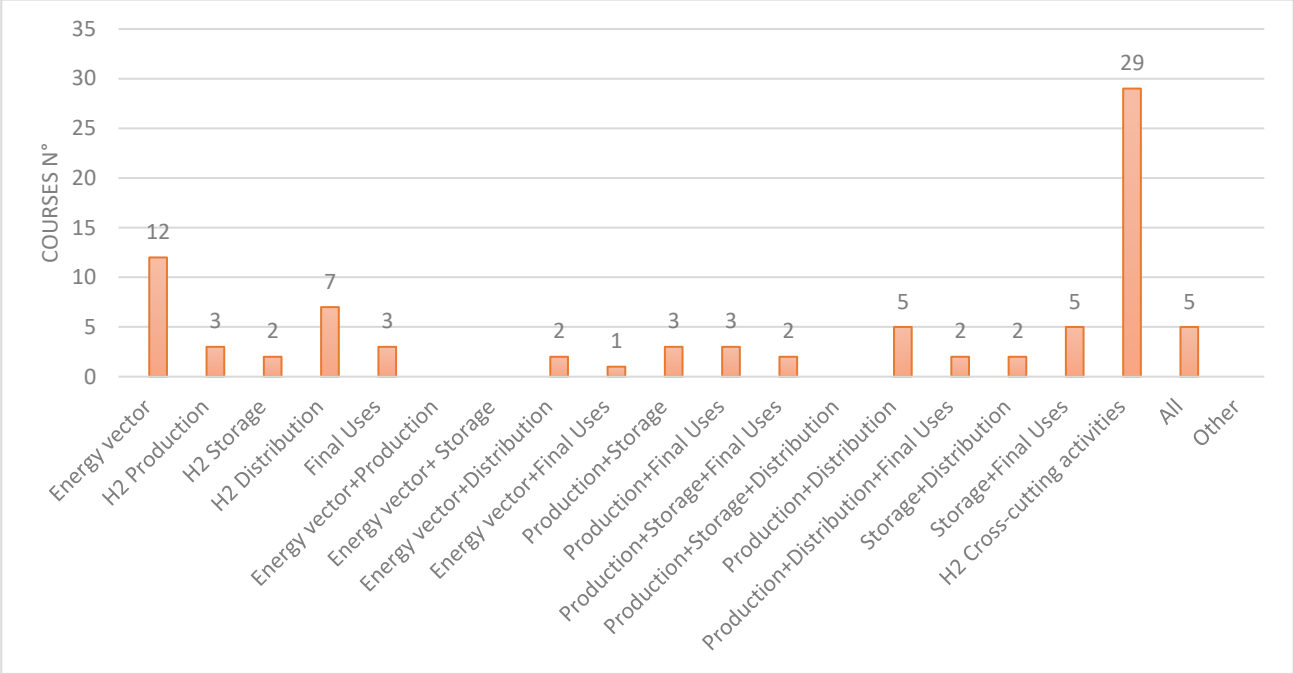

Figure 3 Distribution of the training courses based on the thematic area of H_2.

3.Benchmarking H_2 Training Offer: Aligning Training Programs with Job Profile Requirements

The data collected from this survey in the various COVE's countries will be further analyzed by ISQ, the leader of the WP, to map and align their analysis on the main job roles and related training requirements in the hydrogen sector with the training offerings collected within our study. Specifically, ISQ, based on the data obtained from a study conducted by Willem Hazenberg Mba Eur Ing Ri (2023)[5], has identified 133 professions of highest priority according to the hydrogen value chain and the objectives of the H2Excellence project, as presented in Table 1. Such data has been validated by 121 stakeholders worldwide through an online questionnaire, as the objective of task 2.3, and will be extensively presented in the dedicated deliverable.

Table 1. Required professions along the H2 value chain and their corresponding EQF level training

Chemical engineer (EQF 6-8)
Designer and project engineer hydrogen fuel station (EQF 6-8)

[5] COMPETENCIES NEEDED FOR HYDROGEN IN THE INDUSTRY AND NETWORK A Paper submitted to THE FACULTY OF NEW ENERGY BUSINESS SCHOOL IN CANDIDACY FOR THE DEGREE OF POST-HBO HYDROGEN SPECIALIST- Willem Hazenberg Mba Eur Ing Ri- Thesis work- April 2023- DOI:10.13140/RG.2.2.12146.17608

Educators and teachers for all positions (EQF 6-8)
Energy Planner (EQF 6-8)
Engineer for automotive power electronics with fuel cells (EQF 6-8)
Fuel cell designer (EQF 6-8)
Fuel cell engineering (EQF 6-8)
Fuel cell vehicle development engineer (EQF 6-8)
Gas Engineer (EQF 6-8)
Hydrogen energy engineer (EQF 6-8)
Hydrogen energy system operations engineer (EQF 6-8)
Hydrogen fuel station manager (EQF 6-8)
Installation, operations, engineering and management manager hydrogen power plant (EQF 6-8)
Plant Manager - electrolysis (EQF 6-8)
Driver of a hydrogen tube trailer/tanker truck (EQF 3-5)
Electrician hydrogen vehicle (EQF 3-5)
Electrolyzer Technicians (EQF 3-5)
Fire department specialist (EQF 3-5)
Fuel cell manufacturing technician (EQF 3-5)
Fuel cell power systems operator and instructor (EQF 3-5)
Fuel cell retrofit installer (EQF 3-5)
Fuel cell technicians (EQF 3-5)
Fuel cell testing technician (EQF 3-5)
Hydrogen Dispenser Technicians (EQF 3-5)
Hydrogen energy system installer (EQF 3-5)
Hydrogen energy technician (EQF 3-5)
Hydrogen Process Operator Specialist (EQF 3-5)
Maintenance Technician: Compression (EQF 3-5)
Plant builder - electrolysis (EQF 3-5)
Production and assembly of electrolysers, fuel cells and components (EQF 3-5)
Stationary applications (fuel cell) plant builder (EQF 3-5)
Technician backup energy system with fuel cell (EQF 3-5)
Automation Engineer (EQF 6-8)
Compression Specialist (EQF 6-8)
Electromechanical engineer (EQF 6-8)
Engineer modeling hazardous phenomena (EQF 6-8)
Engineers Electrical (EQF 6-8)
Hydrogen systems safety researcher and analyst (EQF 6-8)
Explosive atmospheres (ATEX) equipment repairman (EQF 3-5)
Chemistry technician (EQF 3-5)
Control room operator (EQF 3-5)
Hydrogen fuel transporter - driver (EQF 3-5)
Hydrogen pipeline construction worker (EQF 3-5)
Hydrogen Process Operator Specialist, including Supervisory Control and Data Acquisition - SCADA (EQF 3-5)
Power plant operators (EQF 3-5)
Automation technology electronics technician - Industry and trade (EQF 6-8)
Fluid engineer (EQF 6-8)
Occupational specialist in the field of distribution network technology (EQF 6-8)
Commissioning Technician (EQF 3-5)

Electrical and process technician (EQF 3-5)
Electrician - Industry and trade (EQF 3-5)
Incident commander fire department (EQF 3-5)
Chief Operating Officer (EQF 6-8)
Chief Technical Officer (EQF 6-8)
Hazardous materials management specialist (EQF 6-8)
Hydrogen systems program manager (EQF 6-8)
Inspectors for in service pressure equipment (EQF 6-8)
Installation engineer for piping systems (EQF 6-8)
Manager emission reduction credit portfolio (EQF 6-8)
Metrology engineer (EQF 6-8)
Operations engineer - site manager (EQF 6-8)
Pipeline Engineer (EQF 6-8)
Policy analyst and hydrogen fuel sales (EQF 6-8)
Process Safety Engineer (EQF 6-8)
Production Planner (EQF 6-8)
R&D program manager (EQF 6-8)
R&D researcher/engineers (EQF 6-8)
Reservoir Technologist (EQF 6-8)
Security Managers (EQF 6-8)
Certifiers of equipment (EQF 3-5)
Company fireman/woman - Industry and trade (EQF 3-5)
Gas fitters (EQF 3-5)
Gas Technician (EQF 3-5)
Industrial maintenance technician (EQF 3-5)
Industrial mechanic - Industry and Trade (EQF 3-5)
Installation technician for piping systems (EQF 3-5)
Laboratory Technician (EQF 3-5)
Maintenance/operational technician (EQF 3-5)
Mechanical engineering fitters (EQF 3-5)
On site emergency teams (EQF 3-5)
Pipeline builder (EQF 3-5)
Pipeline Technicians (EQF 3-5)
Process technician (EQF 3-5)
Safety Managers (EQF 3-5)
Safety Testing Officer (EQF 3-5)
Service rig crew (EQF 3-5)
Station operators - compression (EQF 3-5)
Tank and equipment manufacturer (EQF 3-5)
Technical occupations, including pressure vessels, etc. (EQF 3-5)
Building Inspector (EQF 6-8)
Business developer/business manager (EQF 6-8)
Electrochemical engineer/electrochemist (EQF 6-8)
Engineer civil (EQF 6-8)
Facilities Engineer (EQF 6-8)
Facility maintenance planner (EQF 6-8)
Infrastructure and general systems integration (EQF 6-8)

Infrastructure planner/project manager (EQF 6-8)
Innovation Manager (EQF 6-8)
Installation Manager (EQF 6-8)
Maintenance planner (EQF 6-8)
Material engineer (EQF 6-8)
Materials Specialist (EQF 6-8)
Mechanical engineer (EQF 6-8)
Networking engineer (EQF 6-8)
Operational safety/risk/Quality, Health, Safety and Environment engineer (EQF 6-8)
Power electronics engineer (EQF 6-8)
Production Engineer (EQF 6-8)
Production Supervisor (EQF 6-8)
Project manager for standardization and regulation (EQF 6-8)
Renewable interconnections specialist/ Systems integration specialist (EQF 6-8)
Service engineer (EQF 6-8)
Storage and renewable energy planner/project manager (EQF 6-8)
Test engineer (EQF 6-8)
Welding Engineer (EQF 6-8)
Boiler builder (EQF 3-5)
Installation builder/network builder - electricity and gas (EQF 3-5)
Installation technician - Industry and trade (EQF 3-5)
Maintenance professionals: electrical, electromechanical, instrumentation & control, mechanical engineering (EQF 3-5)
Mechanic/Assembler (EQF 3-5)
Mechanical operator (EQF 3-5)
Mechanical technician (EQF 3-5)
Non-destructive (NDE) inspector and technician (EQF 3-5)
Operator automated production line (EQF 3-5)
Pipe fitter/pipeline contractor (EQF 3-5)
Pipe fitter/steam fitter (EQF 3-5)
Process Operator (EQF 3-5)
Production line operator/technician (EQF 3-5)
Service Technician (EQF 3-5)
Shift fire chief (EQF 3-5)
Test Technician (EQF 3-5)
Vehicle Inspectors (EQF 3-5)
Welder (EQF 3-5)
Welding Inspector (EQF 3-5)

As evident from the presented table, the primary occupational categories primarily fall into two EQF level ranges of the project, namely "03-05" and "06-08". In this questionnaire, we have collected 95 courses. Among them, **16 courses align with the training requirements identified by the ISQ study for EQF 03-05 range**, **while 52 courses align with the EQF 06-08 range.**