GREEN HYSLAND

Deployment of a H2 Ecosystem on the Island of Mallorca

# First version of the project exploitation plan

## Deliverable No 7.7

September 2022

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## Disclaimer



## Copyright Message

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[1] Dissemination level security: PU= public, CO=confidential.
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## Document history and status

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| **V1.01** | 15/03/2022 | Filip Dumitriu / FEDARENE | First draft submission to exploitation group |
| **V1.02** | 28/03/2022 | Katharina Bouchaar/ ENERCY | Draft Review |
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| **V1.06** | 13/09/2022 | Filip Dumitriu / FEDARENE | Revision and incorporation of final input |
| **V1.07** | 28/09/2022 | Ángela Sánchez / ENAGÁS | Final review before submission |

## Preface

The aim of **GREEN HYSLAND** is to **deploy a Hydrogen ecosystem on the island of Mallorca**. The initiative is receiving **10 Million Euros of funding** from the European Commission through the **Clean Hydrogen Partnership**. It is a 5-year-project that started on the 1st January 2021, and will end on 31st December 2025. The consortium is formed by **30 partners from 11 countries**, 9 from the European Union, as well as Chile and Morocco. The project will deliver the **first hydrogen valley of the Mediterranean**, developing a fully functioning hydrogen ($H_2$) ecosystem covering all the value chain, from the production to the distribution and consumption of, at least, 330 tonnes per year of green $H_2$, traced through a Guarantee of Origin System. This hydrogen will be used in six different applications, as follows:

- The **$H_2$ pipeline and the injection point** of part of the $H_2$ produced at the Lloseta plant into the island's natural gas network operated by Redexis.
- The **100 kWe fuel cell** that will supply electricity to the maritime station of the **Balearic Port**.
- The **50 kWe CHP** system to be located in the **Iberostar Bahía de Palma hotel** (4*), which will cover part of the hotel's energy demand.
- The **25 kWe CHP** system to be located at the **Municipal Sports Centre in Lloseta**, which will cover part of the site's energy demand.
- The integration of **5 hydrogen buses to the EMT** city bus fleet of Palma de Mallorca.
- The integration of **$H_2$ vans** in the Alfill Logistics vehicle fleet as well as the search for rental car companies to incorporate $H_2$ vehicles in their **rental car fleets**.

The infrastructures which will be developed within the project are:

- The **green $H_2$ production plant** located on CEMEX land in Lloseta.
- The deployment of a **Hydrogen Refuelling Station** (HRS) at the EMT facilities.
- The development of tube trailers which will transport the H2 produced in Lloseta's plant to the different applications.

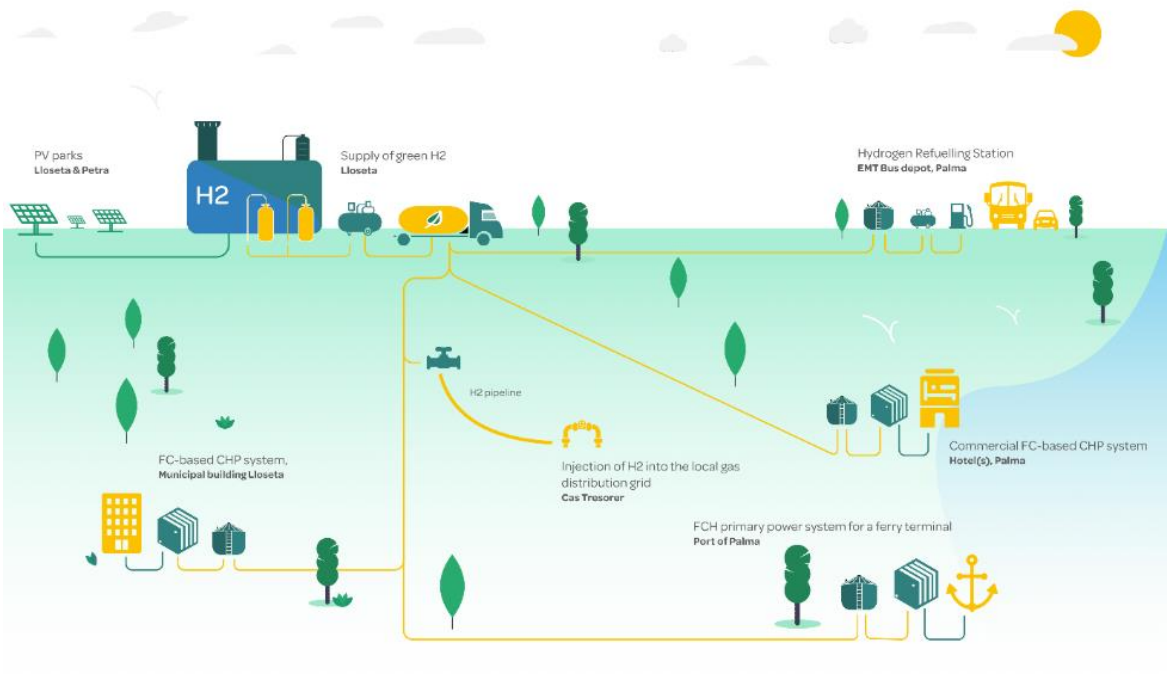
This initiative aims to reduce the $CO_2$ emissions of Mallorca up to 20,700 tonnes per year by the end of the project.

The project will also deliver **a roadmap towards 2050** that compiles a long-term vision for the **development of a widespread $H_2$ economy in Mallorca and the Balearic Region**, in line with the **environmental objectives set for 2050.** This long-term roadmap will be an evolution of the current regional roadmap for the deployment of renewable energies and the energy transition, and will involve local and regional stakeholders through public consultations.

In addition, GREEN HYSLAND contemplates the **development of replication experiences** in five other EU islands: Madeira (PT), Tenerife (ES), Aran (IE), Greek Islands and Ameland (NL) as well as Chile and Morocco. Within the project, the impact of deployment of $H_2$ technologies at regional level (Mallorca and Balearic Islands) at technical, economic, energy, environmental, regulatory and socioeconomic levels will be analyzed. Additionally, detailed techno-economic studies for scaling-up renewable $H_2$

production, interconnecting infrastructure and local $H_2$ end-uses, both within the island of Mallorca and beyond, will be developed to facilitate and de-risk future sector investment.

The infrastructures for the hydrogen production and distribution, together with the end-users' pilot sites and the logistics required for the green hydrogen distribution will be developed as follows:




| No | Participant Name | Short Name | Country Code | Logo |
|---|---|---|---|---|
| 1 | ENAGÁS S.A., | ENAGAS | ES | |
| 2 | ACCIONA ENERGIA S.A. | ACCIONA ENER | ES | |
| 3 | REDEXIS GAS S.A. | REDEXIS GAS SA | ES | |
| 4 | Empresa Municipal de Transports Urbans de Palma de Mallorca S.A. | EMT-PALMA | ES | |
| 5 | CALVERA MAQUINARIA E INSTALACIONES S.L. | CALVERA | ES | |
| 6 | AJUNTAMENT DE LLOSETA | Lloseta Council | ES | |
| 7 | AUTORIDAD PORTUARIA DE BALEARES | PORTS BALEARS | ES | |

| | | | | |
|---|---|---|---|---|
| 8 | CONSULTORIA TECNICA NAVAL VALENCIANA S.L. | COTENAVAL | ES | |
| 9 | BALEARIA EUROLINEAS MARITIMAS S.A. | Balearia | ES | |
| 10 | INSTITUTO BALEAR DE LA ENERGIA | IBE | ES | |
| 11 | UNIVERSITAT DE LES ILLES BALEARS | UIB | ES | |
| 12 | FUNDACION PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGIAS DEL HIDROGENO EN ARAGON | FHa | ES | |
| 13 | CENTRO NACIONAL DE EXPERIMENTACIONDE TECNOLOGIAS DE HIDROGENO Y PILASDE COMBUSTIBLE CONSORCIO | CNH2 | ES | |
| 14 | ASOCIACION ESPANOLA DEL HIDROGENO | AeH2 | ES | |
| 15 | COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES | CEA | FR | |
| 16 | ENERCY BV | ENER | NL | |
| 17 | HYENERGY CONSULTANCY LTD | HYE | NL | |
| 18 | STICHTING NEW ENERGY COALITION | NEW ENER.COALIT | NL | |
| 19 | HYCOLOGNE GMBH | HyCologne | DE | |
| 20 | FEDERATION EUROPEENNE DES AGENCES ET DES REGIONS POUR L'ENERGIE ET L'ENVIRONNEMENT | FEDARENE | BE | |
| 21 | NATIONAL UNIVERSITY OF IRELAND GALWAY | NUI GALWAY | IE | |
| 22 | THE EUROPEAN MARINE ENERGY CENTRE LIMITED | EMEC | UK | |

| | | | | |
|---|---|---|---|---|
| 23 | GASNAM - ASOCIACION IBERICA DE GASNATURAL Y RENOVABLE PARA LA MOVILIDAD | GASNAM | ES | |
| 24 | UNIVERSIDAD DE LA LAGUNA | ULL | ES | |
| 25 | ENERGY CO-OPERATIVES IRELAND LIMITED | En.Coop.Ireland | IE | |
| 26 | AGENCIA REGIONAL DA ENERGIA E AMBIENTE DA REGIAO AUTONOMA DA MADEIRA | AREAM | PT | |
| 27 | GEMEENTE AMELAND | Gem.Ameland | NL | |
| 28 | DIKTYO AEIFORIKON NISON TOY AIGAIOU AE | DAFNI | EL | |
| 29 | ASOCIACION CHILENA DE HIDROGENO | H2 CHILE | CL | |
| 30 | Association Marocaine pour l'Hydrogène et le Développement Durable | AHMYD | MA | |

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# Executive Summary

This first version of the exploitation plan focuses on presenting the exploitation planning process, the methodology followed to identify the key exploitable results (KER), to discuss their exploitation and to design the exploitation routes. A preliminary list of key exploitable results was identified but given the early stages of project deployment, it remains indicative.

In order to assist the development of the exploitation plan, validate the content, the approach and generally the identification of KERs and exploitation pathways, an exploitation group was convened. Given their role in the project deployment, the members of the Deployment Advisory Group were included as well as other project partners who had direct involvement in exploitation focused activities including business model development, techno-economic, upscaling and replication studies.

This preliminary exploitation plan reveals GREEN HYSLAND's potential key exploitable results as well as their exploitation roadmaps. Based on first input from partners, these exploitation roadmaps include:

- new dedicated infrastructure including pipelines, large scale hydrogen production plant and hydrogen refuelling stations;
- training, up-skilling and knowledge dissemination enabling certain partners to generate didactic content, train the trainers programmes, or become centers of excellence for hydrogen and decarbonization within their regions;
- development and replication of new and integrated business models establishing the criteria for successful and thriving hydrogen sector in Mallorca, with the aim of showing other island-based communities how to best foster a hydrogen economy; this will include exploitation for decarbonization of sectors such as tourism, mobility/transport, district heating and cooling and industry;
- policy making and planning in the Balearic Islands through the Mallorca Hydrogen regional roadmap which will provide a mid- to long-term orientation of the deployment of H2 within the Balearic Islands.

To further inform the exploitation plan and provide insight into the exploitation potential of GREEN HYSLAND, GASNAM and FEDARENE launched 2 separate surveys in order assess interest, awareness and trends regarding green H2 uses among their constituencies.

The sustainable transport association GASNAM organized a first survey of their 140 members from the road and maritime transport sectors to assess the interest and awareness of H2 uses among their members. The first survey was followed by a workshop with the presence of 40 GASNAM member companies from all over Spain and Portugal, who are participating in projects associated with the production, storage, transport, distribution and use of renewable hydrogen.

Nearly half of the survey takers think the renewable hydrogen development goals set by the Spanish government are not very ambitious in the long-term.

On the other hand, they believe the intensity of national aid must be increased and some restrictions must be eliminated so that projects may be feasible such as: receiving aid after providing the final certificates, the need to classify the project as R&D&i by a certifying authority, expanding the object of the subsidy to power supply system injection projects and natural gas and hydrogen blending, etc.

In addition, they believe the national regulatory framework is not appropriate for hydrogen development as it must treat renewable hydrogen as a fuel of general interest and not just as a mere chemical product. With respect to the administrative procedures, the key lies in reducing the barriers by including lean mechanisms to streamline the processes and times. The implementation of the Renewable Gas Guarantees of Origin system is imperative as well.

FEDARENE launched as well a survey targeting its own over 80 members from 25 EU countries, who are regional authorities and regional and local energy agencies. Regions and energy agencies are sustainable energy market facilitators providing technical assistant to multiple target groups including public authorities, companies, communities and citizens.

According to the results of the survey green hydrogen is considered to play an important role in the decarbonization of the EU's energy system despite some remaining challenges, and FEDARENE members consider this technology has a role to play in the energy transition. Some survey contributors are already involved in projects (see section 4.1.2 Projects on p.7-8) or project proposals, and most of them are aware of projects taking place in their regions/countries.

The main benefits of green $H_2$ are considered to be:

- Energy storage and RES penetration;
- Sector coupling;
- Flexible carrier of green energy;
- Potential to decarbonize hard-to-abate sectors (steel industry or heavy transport).

The main barriers include: high cost for storage and transport of hydrogen is mentioned several times; immaturity of end-use products; competing technologies (such as batteries); unfamiliarity of the technology to end-users.

In order to gauge changes of interest and awareness throughout the lifetime of GREEN HYSLAND, both organizations will launch another survey in year 5 of the project. Conclusions from the changes identified will be included in the PEDR – final results deliverables due date M60.

A final version of the exploitation plan will be developed by M60. Its elaboration will follow the evolution of the project until the submission of the final project report and will require regular working sessions with the exploitation working group in order to monitor the development of key exploitable results, the contribution of project deliverables to identifying them and the visibility on emerging exploitation pathways.

# Introduction

The GREEN HYSLAND Exploitation plan is a public document developed in the context of WP7 focusing on Communication, Dissemination & Exploitation. In accordance to Horizon 2020 guidelines as well as art.28.1 of the Grant Agreement, "exploitation" means "*the use of results in further research activities other than those covered by the action concerned, or in developing, creating and marketing a product or process, or in creating and providing a service, or in standardization activities*". The exploitation plan will recognize the Key Exploitable Results (KERs) and their stakeholders. In accordance with art. 26.1 of the Grant Agreement, "results" means "any tangible or intangible output of the action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected, which are generated in the action as well as any attached rights, including intellectual property rights". A KER is an identified main interesting result (as defined above) which has been selected and prioritized due to its high potential to be "exploited" – meaning to make use and derive benefits-downstream the value chain of a product, process or solution, or act as an important input to policy, further research or education.

The aim of the GREEN HYSLAND exploitation plan is to develop the framework of activities, needs, responsibilities and expected return on the project activities and results. Within the GREEN HYSLAND project, exploitation activities are embedded within multiple workstreams and tasks:

- **Creation and Analysis of Impact and Development of Business Models** activities in WP5 provide the essential basis for the exploitation of the project's results by evaluating the environmental and socio-economic impacts of the project. Actions aim also at establishing the market framework and optimum business models for the operation of an integrated H2 Island concept on Mallorca, aiming to attract the interest of potential investors with an integrated business case for H2.
- **Scaling up and Replication of Hydrogen island ecosystems across the EU activities** in WP6, lays the ground for the exploitation of the project's results by: providing detailed techno-economic studies for scaling-up renewable H2 production within the island of Mallorca and beyond, aiming to facilitate and de-risk future sector investment; assessing regulatory barriers and opportunities for deployment of H2 in Spanish and EU Islands; delivering a detailed regional H2 roadmap to 2050; establish a replication methodology for the application of the H2 Island concept and associated business models to other EU H2 Territories and beyond.
- **Communication and Dissemination activities** in WP7 are instrumental to raising awareness about the GREEN HYSLAND project, engaging end-users, stimulating transfer of results and building a community of followers who will play specific roles in the exploitation process.
- **Assessing interest, awareness and trends regarding H2 uses among Spanish and EU stakeholders**: the sustainable transport association GASNAM organizes two surveys of their 140+ strong member organizations from the road and maritime transport sectors, one in Year 1 of the project and one in Year 5, to gauge the change of interest and awareness of H2 uses among their members throughout the lifetime of GREEN HYSLAND. These surveys will be followed by at least two workshops, one for road transport and one for maritime transport stakeholders, which will focus on developing concrete future H2 commercial opportunities inspired by the results of the techno-economic studies and the deployment of the H2 ecosystem in Mallorca. The workshops will be followed up with Europe-wide bilateral H2 Development Technical Assistance meetings undertaken by ENAG, NEC, ENER and HYE.

FEDARENE, European Federation of Regions and Energy Agencies, launches a similar set of surveys to assess the trends in its own cross-EU constituency.

- **Exploitation plan** identifies the exploitable results, exploitation routes and the role of GREEN HYSLAND partners in their exploitation.
- **Exploitation of results at the Spanish national level** will be detailed with input from GASNAM and the support of ENAGAS.

This document will present the overall exploitation approach of the project and the interconnected activities above, showcasing the exploitation pathways of the project as a whole as well as the ones of individual partners.

This document is the first version of the exploitation plan, drafted within the first 18 months of the project. As detailed throughout this document, the plan will be upgraded considering the project's progress, outputs and feedback from project partners. Considering the expected progress during the delivery of GREEN HYSLAND, the main operational outputs and results are expected during the second half of the project.

# General context

GREEN HYSLAND is co-funded under the Horizon 2020 research and innovation funding programme of the European Union. The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) of the European Commission selected the project GREEN HYSLAND to benefit from grant funding. The Fuel Cells and Hydrogen Joint Undertaking (FCH JU) is a unique public private partnership supporting research, technological development and demonstration (RTD) activities in fuel cell and hydrogen energy technologies in Europe. Its aim is to accelerate the market introduction of these technologies, realizing their potential as an instrument in achieving a carbon-clean energy system. Fuel Cells and Hydrogen Joint Undertaking ceased operations on 29 November 2021. Its successor, the Clean Hydrogen Partnership (CH JU), was established on 30 November 2021 to take over its legacy portfolio and to continue developing the European value chain for safe and clean hydrogen technologies.

In line with the new EU Hydrogen Strategy, GREEN HYSLAND will be the first Southern European Flagship project and it will create a 'green hydrogen ecosystem' in the Balearic Islands. GREEN HYSLAND will generate, distribute and use at least 300 tons of renewable hydrogen locally per year, produced from new built solar energy plants on the island of Mallorca. The project is also part of the "Hydrogen Road Map: a commitment to renewable hydrogen" approved by the Spanish Government, which will boost Spain as a technological benchmark in the production and use of renewable hydrogen, with a production capacity of 4 GW by 2030 and an estimated total investment of 8.9 billion EUR.

# GREEN HYSLAND Exploitation Planning

The GREEN HYSLAND Exploitation Plan will summarize the project's and partners' strategies and concrete actions related to the protection, dissemination and exploitation of the project results. Considering the expected progress during the delivery of GREEN HYSLAND, the main operational outputs and results are expected during the second half of the project. Therefore, this first version of the exploitation plan focuses on presenting the exploitation planning process, the methodology followed to identify the key exploitable results (KER), to discuss their exploitation and to design the exploitation routes. A preliminary list of key exploitable results was identified but given the early stages of project deployment, remain indicative.

## 1 First version of the Exploitation plan

### 1.1 Definition and launch of Exploitation Process

On 21 October 2021 took place the first meeting on exploitation between WP7 leaders FEDARENE, the GREEN HYSLAND coordinators ENAGAS and Enercy to discuss the key objectives, methodology and tools of the project's exploitation process. Following a presentation from FEDARENE, discussion and following Email exchanges, a preliminary agreement was reached on:

- general approach regarding the main components of the exploitation plan, mainly: key conclusions and outputs relevant for EU exploitation arising from the business models and techno-economic studies (WP5 & WP6); individual exploitation roadmaps (see section 1.7);
- content of the first version of the exploitation plan, in the absence of actual results or relevant deliverables;
- an adjusted timeline for the submission of the first version of the exploitation plan, leaving sufficient time for process preparation and briefing of project partners;
- a template to assist with the collection of the relevant input for "individual exploitation roadmaps" from key GREEN HYSLAND project partners;
- the list of members to be included in the "GREEN HYSLAND Exploitation Working Group".

### 1.2 Presentation of Exploitation plan process to consortium

On 24 November 2021 during the GREEN HYSLAND Steering Committee meeting, FEDARENE presented the exploitation process and steps toward drafting the deliverable to the whole consortium. Project partners were introduced to:

- definition and scope of "exploitation" in the GREEN HYSLAND project;
- preliminary table of contents of the exploitation plan;
- "individual exploitation roadmap" template;
- preliminary "key exploitable results" initially identified in the project proposal;
- adjusted exploitation timeline until the new date of submission: M18 (June 2022).

No questions or issues were raised regarding the process and objectives.

## 1.3 Awareness and interest surveys: development and launch

To further inform the exploitation plan and provide insight into the exploitation potential of GREEN HYSLAND, GASNAM and FEDARENE launched 2 separate surveys in order assess interest, awareness and trends regarding green H2 uses among their constituencies.

The sustainable transport association GASNAM organized a first survey of their 140 members from the road and maritime transport sectors to assess the interest and awareness of H2 uses among their members. These surveys will be followed by at least two workshops, one for road transport and one for maritime transport stakeholders, which will focus on developing concrete future H2 commercial opportunities inspired by the results of the techno-economic studies and the deployment of the H2 ecosystem in Mallorca. The workshops will be followed up with Europe-wide bilateral H2 Development Technical Assistance meetings undertaken by ENAG, NEC, ENER and HYE.

FEDARENE launched as well a survey targeting its own over 80 members from 25 EU countries, who are regional authorities and regional and local energy agencies. Regions and energy agencies are sustainable energy market facilitators providing technical assistant to multiple target groups including public authorities, companies, communities and citizens.

Both surveys were launched at the beginning of 2022, with an input collection period lasting until end of March 2022. Some preliminary conclusions from these surveys are presented in the section 1.5 of this document, with full reports in the annexes. In order to gauge changes of interest and awareness throughout the lifetime of GREEN HYSLAND, both organizations will launch another survey in year 5 of the project. Conclusions from the changes identified will be included in the PEDR – final results deliverables due date M60.

## 1.4 GREEN HYSLAND Exploitation Group

In order to assist the development of exploitation plan, validate the content, the approach and generally the identification of KERs and exploitation pathways, an exploitation group was convened. Given their role in the project deployment, the members of the Deployment Advisory Group were included as well as other project partners who had direct involvement in exploitation focused activities including business model development, techno-economic, upscaling and replication studies. The GREEN HYSLAND exploitation group was first engaged for the review of this first version of the exploitation plan and the process it lays out.

The GREEN HYSLAND Exploitation group is composed of the following organizations:

| Organization | Acronym | Rationale for involvement in exploitation group |
|---|---|---|
| **ENAGÁS S.A.** | ENAGAS | - Overview of and involvement in all project activities and outputs as GREEN HYSLAND coordinators<br>- Members of the Deployment Advisory Group<br>- Direct involvement in KER development and exploitation |
| **ENERCY BV** | ENER | - Members of the Deployment Advisory Group<br>- Expertise in exploitation planning<br>- Contribution to Scaling up and Replication of Hydrogen island ecosystems across the EU (WP6)<br>- Direct involvement in T6.1.1: Studies for scaling-up green H2 Supply in Mallorca and the Balearic Islands |

| | | |
|---|---|---|
| | | - Direct involvement in T6.1.2: Technical Scale-up studies: end-user applications<br>- Direct involvement in KER development and exploitation |
| **Aragón Hydrogen Foundation** | FHA | - Members of the Deployment Advisory Group<br>- Support to Scaling up and Replication of Hydrogen island ecosystems across the EU (WP6)<br>- Lead on regulatory work inside GREEN HYSLAND (WP6)<br>- Direct involvement in KER development and exploitation |
| **European Marine Energy Centre Limited** | EMEC | - Members of the Deployment Advisory Group<br>- Support to Scaling up and Replication of Hydrogen island ecosystems across the EU (WP6)<br>- Direct involvement in KER development and exploitation |
| **HyEnergy Consultancy Limited** | HYE | - Members of the Deployment Advisory Group<br>- direct involvement in T5.4: Development of integrated H2 Island Business Models<br>- Direct involvement in T6.1.1: Studies for scaling-up green H2 supply in Mallorca and the Balearic Islands<br>- Direct involvement in T6.1.2: Technical Scale-up studies: end-user applications<br>- In charge of final report on business models (D5.5)<br>- In charge of Study for scaling-up of FC-based energy applications (D6.2)<br>- Direct involvement in KER development and exploitation |
| **HYCOLOGNE GMBH** | HYC | - Members of the Deployment Advisory Group<br>- Support to Scaling up and Replication of Hydrogen island ecosystems across the EU (WP6)<br>- Direct involvement in T6.1.2: Technical Scale-up studies: end-user applications<br>- Support to the development of the regional roadmap (WP6) |
| **NEW ENERGY COALITION** | NEC | - Members of the Deployment Advisory Group<br>- Support to Scaling up and Replication of Hydrogen island ecosystems across the EU (WP6)<br>- Direct involvement in T6.1.1: Studies for scaling-up green H2 supply in Mallorca and the Balearic Islands<br>- Direct involvement in KER development and exploitation |
| **ASOCIACION IBERICA DE GASNATURAL Y RENOVABLE PARA LA MOVILIDAD** | GASNAM | - GASNAM with support from ENAG will provide input for the exploitation of results at the Spanish national level<br>- Support to commercial exploitation of mobility-related results at national level (WP7)<br>- Organizes two surveys of their 140+ member organizations from the road and maritime transport sectors to gauge the change of interest and awareness of H2 uses among their members throughout the lifetime of GREEN HYSLAND |

## 1.5 First version of individual exploitation roadmaps

In order to provide a clear image of the Green Hyland exploitation intentions, the exploitation plan includes the preparation of individual exploitation plans for relevant project partners, defining roles and responsibilities. Given the submission of this first version of the exploitation plan takes place at an

early stage of the GREEN HYSLAND project, with limited visibility on the specifics of the key exploitable results, only a few partners were invited to provide some preliminary insight into their KER's and exploitation routes. The preliminary inputs are presented below in section 1.7.

Partners were asked to fill out the following table:

## Partner X Exploitation Roadmap

| **Partner name:** | |
|---|---|
| Responsible person for exploitation activity & contact details: | |
| Current main products/services in the company: | |
| Present geographical markets: | |
| Is your Company part of a bigger group with broader interests: | |
| Main customers (e.g. individual people/households, municipal/regional institutions, etc.): | |
| Other relevant information: | |

| **Number of Exploitable Result**[1] | **1** |
|---|---|
| Name of Exploitable Result | |
| Description of Exploitable Result (summarize technical approach) | |
| Target Sectors where the result will be exploited | |
| Target geographical markets where the results will be exploited | |
| Commercial Exploitation Route – how exploitation will be implemented | |
| Expected revenue from exploitation | |
| Summarize innovative aspects | |
| Explain the role of the partner in the exploitation, indicating required skills and experience | |
| Timeline for exploitation | |
| Other relevant information | |

[1] In accordance with art. 26.1 of the Grant Agreement, "results" means "any tangible or intangible output of the action, such as data, knowledge and information whatever their form or nature, whether or not they can be protected, which are generated in the action as well as any attached rights, including intellectual property rights". A KER is an identified main interesting result (as defined above) which has been selected and prioritised due to its high potential to be "exploited" – meaning to make use and derive benefits- downstream the value chain of a product, process or solution, or act as an important input to policy, further research or education.

# 2 Plan for Exploitation of Results – final results

## 2.1 Implementation-Exploitation feedback loop

A final version of the exploitation plan will be developed by M60. Its elaboration will follow the evolution of the project until the submission of the final project report and will require regular working sessions with the exploitation working group in order to monitor the development of key exploitable results, the contribution of project deliverables to identifying them and the visibility on emerging exploitation pathways.

Meeting dates of the exploitation group will be fixed in coordination with DAG meetings as well as the deliverables submission timelines to enable the experts to discuss how the project results can be exploited based on concrete progress and milestones. A first working session is expected by M36 (to update the PEDR), and additional reviews of the sessions will be programmed taking into consideration the project's progress. These exploitation working sessions will focus on types A and B as detailed in the grant agreement:

| **Session type A: Identifying and updating outcomes, results** | **Session type B: Update on KER list** |
|---|---|
| Identification, description | Identification, complete description, IP Aspects |
| Relevant stakeholders, and their potential interest in the result | Stakeholders, simplified Business Model Canvas, entities exploiting the result |
| Target groups and interest in the result | Pathway: commercial, non-commercial exploitation |
| Preliminary classification: exploitable/ dissemination level | Tools and external support needs: pitches, Investor's networks; Exploitation strategy and roadmap, business plans |

## 2.2 Key Exploitable Results

In the GREEN HYSLAND project proposal a draft list of KERs was provided. This list was updated as part of the development of the first version of the exploitation plan.

| Key exploitable result | Organisation involved in exploitation | Initial application & end-use (as per Grant Agreement) | Description of Exploitable Result (summary of technical approach) | Target Sectors where the result will be exploited | Role of the partner in the exploitation |
|---|---|---|---|---|---|
| **Hydrogen infrastructure: pipeline delivery** | ENAG | Development of dedicated infrastructure for hydrogen, own commercial exploitation, direct industrial use | Operational discharge of the tube trailer into the hydrogen pipeline:<br>-The connection between a tube trailer with a hydrogen dedicated pipeline<br>-New services and new value chains<br>-Paving the path to adapt the regulatory framework to facilitate further developments<br>The plant will start production by the end of summer, and RDX expects to have the hydrogen pipeline finished at the end of 2022. Onwards this activity will be carried out | Energy, TSO´s and DSO´s sectors | Not defined yet |
| **Scale up multi-MW electrolysis interconnections** | ENAG | Research and/or own commercial exploitation (own facilities) | Large scale hydrogen production plant deployment, to supply hydrogen to multiple end users. This will enable to boost the energy transition based on green hydrogen, and to increase of the installed electrolysis capacity on the territory | Energy and industrial sectors | - Know-how of the management and coordination to deploy a MW-electrolysis plant;<br>- Lessons learned and barriers e.g when obtaining licenses, which could enable to implement policy/regulatory changes. |

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| | HYE | N/A | This area will investigate the scale with which electrolysis technologies can be scaled up in Mallorca and the required infrastructure that will surround it. | Hydrogen production and energy storage/distribution infrastructure | Having undertaken similar roles for different studies across the hydrogen value chain, HyEnergy will be supply hydrogen sector expertise and knowledge to this task to ensure estimates and considerations are realistic.<br><br>HyEnergy will also assist the partners to understand the evolution of the hydrogen market in coming decades to accurately estimate CAPEX and OPEX costs.<br><br>Through this work, partners will be able to scale-up green hydrogen production with more confidence within the wider regional and global market. |
| **Expansion plan for Hydrogen Refuelling Station (upgrading** | ENAG | Exploitation in further upgrades-updates of HRS (pressure, flow) and integration with | Exploitation in further upgrades-updates of HRS (pressure, flow) and integration with different application-end uses. Research and/or commercial exploitation | Transport sector and infrastructure developers | The definition of the optimal design, construction and operation of the HRS infrastructure |

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| **pressure, capacity)** | CVA | different application-end uses. Research and/or commercial exploitation | | | |
| | HYC | N/A | We built up the first HRS in 2010. Since then we supported the new development of five more fuelling stations in the region for 52 FC Busses | Cities, Bus Operator, Municipalities, regions | Part of the JIVE and Mehrlin Project, Consulting and networking |
| **Integrated business model** | ENAG | Logistics and optimization of integrated Green H2 production, delivery and use. Interest for other islands and regions | Logistics and optimization of integrated Green H2 production, delivery and use. Interest for other islands and regions | Energy sector and infrastructure developers | Provide the data required to develop the business models, such as energy consumption of the plant and operation of the hydrogen infrastructures… |
| **Mallorca Hydrogen regional roadmap** | IBE | Regional roadmap, policy making | The roadmap is meant to provide with a mid- to long-term orientation of the deployment of H2 within the Balearic Islands, describing its overall potential and specifically defining scaling up objectives for end-users. The Roadmap should reflect on state-of-the-art studies and existing legislative and economic barriers, so as to provide a comprehensive path on how to reach those objectives, including clear policy, legal and economic recommendations. | Policy makers; broad general public; Renewable energy companies; Energy storage companies; traditional energy companies; Research; etc. | IBE will primarily be involved in the exploitation for policy making purposes. |
| | HYE | N/A | This roadmap will inform local policy makers and businesses on the most suitable technologies available to | The establishment of a hydrogen sector. This will include: | HyEnergy will be responsible for assessing the scale up of fuel cell |

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| | | | Mallorca across the hydrogen value chain (production, storage and distribution, applications) and their respective scale-up opportunities through to 2050. | - Green hydrogen production<br>- Storage and distribution technologies<br>- Transport – road, maritime, aviation<br>- Heating<br>- Power Production | transportation opportunities based in the region, as well as assisting other areas of the roadmap.<br><br>HyEnergy have considerable experience modelling hydrogen opportunities for both private clients and as part of publicly funded projects.<br><br>Furthermore, as part of the SEAFUEL project, HyEnergy have produced a set of hydrogen roadmaps, as well as sustainable energy and climate action plan (SECAP), for isolated regions. These roadmaps asses the local energy mixes and infrastructure (electricity and gas) and evaluate the potential of hydrogen with respect to their unique circumstances with goal of providing local policy |

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| | | | | | makers with a set of recommendations to initiate hydrogen growth. HyEnergy will utilize this experience greatly within this task and exploitation result 1 too. |
| **Business models for H2 Islands** | ENAG | Policy making, own commercial exploitation from stakeholders involved in the business plan; exploitation as research | Policy making, own commercial exploitation from stakeholders involved in the business plan; exploitation as research | Energy sectors, policy makers etc. interested on renewable hydrogen economies | Business models development associated to renewable gases, based on the different regions scenarios |
| | HYE | | The integrated hydrogen island business model will take real-world data from GREEN HYSLAND deployments and use this to inform a set of three time-based hydrogen sector scenarios.<br><br>The first two of these scenarios will focus on establishing the necessary criteria for a successful and thriving hydrogen sector in Mallorca, with the aim of showing other island-based communities how to best foster a hydrogen economy. These scenarios will then be expanded in 2050 to show how hydrogen potential can grow across islands, by including the Balearic archipelago in our predictions. | The establishment of a hydrogen sector in isolated, non-industrial areas. This will include:<br>- Green hydrogen production<br>- Storage and distribution technologies<br>- Transport – road, maritime, aviation<br>- Heating<br>- Power Production | We will work closely with replication areas based within the project (Chiloé, Greek Islands, Madeira, Ameland, Irish islands) to understand how Mallorca's hydrogen business model can be altered for each of their unique cases.<br><br>Further capitalizing on the business models in a local context however, will require a strong base of local expertise both in the energy sector, and policy and regulation. Furthermore, with public |

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| | | | These models will include real-world data, techno-economic, and socio-economic analysis from within the project to enable a better understanding of both the challenges and advantages of deploying hydrogen in island geographies. This will include, for example, the scale-up of production facilities, required policy and regulation, CAPEX and/or OPEX support, and the best and most suitable applications for isolated areas. | | acceptance a key hurdle to overcome to the establishment of a hydrogen economy worldwide, communication and dissemination, particularly around safety, will also be key. |
| **Technical and executive staff with a specific set of skills in hydrogen.** | FHA | N/A | Up-skilling in leadership, management and labour is of vital importance in the imminent shift to a green energy and mobility sector. | energy and mobility sector | FHa has more than 19 years of experience in the sector implementing hydrogen projects, so it can identify, generate the didactic content and train the trainees and trainers. |
| **Knowledge to become Hydrogen Centre of excellence** | EMEC | N/A | EMEC is based on the Orkney isles in the North of Scotland and was one of the first Hydrogen valleys in Europe. EMEC have been involved from early on, in a number of different Hydrogen disciplines. EMEC and Orkney are now moving to become a centre of excellence for Hydrogen and decarbonization within Scotland. | The results shall predominantly be exploited within the technology demonstration and Research and Development sectors. | The partner will drive this exploitation activity and the development of Orkney. EMEC has significant skills and experience both technical and in business development which will facilitate this happening. EMEC has also done this |

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| | | | The EMEC team has developed significant experience in designing the systems and procedures required to safely produce, handle and use hydrogen and is now bringing this experience to bear in supporting development projects outside of Orkney, in Scotland and throughout Europe. These replication activities, such as our involvement in the GreenHysland project, offers EMEC exciting opportunities to further contribute to the development of this sector, in the pursuit of a rapid and cost-effective transition towards the 'Net Zero' energy systems of the future.<br><br>Consequently, key lessons learned have been taken and adapted from the GreenHysland project to enable this journey on Orkney. These lessons learned will allow EMEC and Orkney to move into the centre of excellence more quickly and much more effectively than otherwise would have been conceivable. | | before in the Marine Energy Sector. |
| **Decarbonization of Tourism and other industries on Orkney** | EMEC | N/A | There is a key opportunity to leverage Orkney's demonstration experience to inform the development of hydrogen projects for other islanded | The target sectors where this result will be exploited are the | To support the decarbonization of the tourism sector, while recognizing the isolated |

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| | | | communities around the world. These replication activities offer EMEC exciting opportunities to pave the way for decarbonization of many carbon-intensive sectors such as transport, heating and also tourism.<br><br>The significance of tourism is particularly important for island communities, as the sector offers economic, social and cultural value to many local people. Many residents rely on the influx of tourists during the summer months to support their cost of living throughout the year. This has a knock-on effect on other industries such as fisheries, agriculture and construction by creating a larger market and tourist-friendly infrastructure. In order to secure the economic benefit which tourism brings to island communities, it is necessary to look into environmentally friendly and zero emission alternatives. The research and development into green hydrogen on Orkney can provide a route to achieving this and decarbonizing these sectors.<br><br>The link between tourism and | aviation, maritime and tourism sectors. | nature of islands as a key factor in the path to net-zero emissions, a focus should be placed on finding solutions to the problem of carbon emissions from transportation. EMEC's long time experience and skills as a leading testing and demonstration site can provide an ideal remote island environment for exploiting the lessons learned with regards to hydrogen development in an island context. This will lead to further research and development of emerging hydrogen technologies by creating a testing environment for aviation and maritime decarbonization activities. |

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| | | | transport is very strong especially for islands, as they are often located in more remote destinations which require air, land and sea transport routes. This is a key reason why islands, such as Orkney, have a responsibility to research and develop decarbonization pathways for aviation and maritime activities. As transport routes have become more easily accessible, it has allowed more tourists to travel to remote islands which has in turn boosted island economies. Islands therefore have a responsibility to engage in research and development of zero carbon technologies and clean fuel alternatives to support the decarbonization of these transport systems. Hydrogen has been recognized as a potential clean fuel for decarbonizing the maritime and aviation sectors, and Orkney's ambition to develop a green hydrogen economy will support the efforts to decarbonize these sectors. | | |
| **Hydrogen buses** | HYC | N/A | HyCologne supported since 2010 the operation of Hydrogen/FC Buses in the region and were part in CHIC and JIVE. Today we have 52 FC Buses in Operation, the biggest fleet in | Bus Operator, Municipalities, Regions | Part of the JIVE Project, Consulting and networking |

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| | | | Europe. 100 more FC Busses will come in the next years. | | |
| **Studies for scaling-up green H2 supply** | IBE | N/A | H2 is expected to play a significant role in supporting the deployment of renewable energies, storing energy and decarbonizing gas grid and thermal power plants. Several studies will be carried out within the frame of the Roadmap that could potentially lead to individual exploitable results. | Policy making; Renewable energy companies; Energy storage companies; traditional energy companies; Research; etc. | IBE will primarily be involved in the exploitation for policy making purposes. |
| **Studies on the potential of H2 in decarbonization of the industry** | IBE | N/A | Large industries and energy intensive ones could make use of H2 to decarbonize their energy demand. | Policy making, energy intensive industries, research | IBE will primarily be involved in the exploitation for policy making purposes. |
| **Studies on the potential of Hydrogen to District Heathg & Cooling** | IBE | N/A | Within the Roadmap, a study will be carried out to assess the actual potential of Hydrogen as a vector to decarbonize distict heating and coaling. | Policy making, building sector, energy sector | IBE will primarily be involved in the exploitation for policy making purposes |
| **Studies on the potential of H2 for heavy-duty and maritime mobility** | IBE | N/A | Within the roadmap several studies will be carried out with regards to heavy duty mobility such as lorries and maritime mobility, including the research of the potential of LNG/H2 blending and cold ironing | Policy making, transportation sector, shipping | IBE will primarily be involved in the exploitation for policy making purposes |

**Table of preliminary Key Exploitable Results (First version of exploitation plan M21)**

Apart from incorporating the expected commercial exploitation outcomes of each partner, the exploitation plan will lay out the H2 island business model proposed by GREEN HYSLAND including market opportunity, potential impact, risks and challenges, capital and OPEX requirements and potential revenues. Considering the outputs from WP5-WP6 (Tasks 5.1 to 5.7 for the impact analysis, and results from Tasks 6.1 for scaling-up), and based on the business cases (Task 5.4), the partners involved in them will develop an initial business plan and exploitation strategy. The business cases will be used as a base to identify which results are subject to be further exploited. The development of the following deliverables will be instrumental to the identification of the final list of KERs and the elaboration of the final version of the exploitation plan:

| **Deliverables** | **WP** | **Lead partner** | **Due dates** | **Following amendment** |
|---|---|---|---|---|
| D5.4 Report on the market and techno-economic analysis | WP5.Creation and Analysis of Impact and Development of Business Models | NUI GALWAY | M48 | M48 |
| D5.5 Final report of the business models | | HYE | M58 | M58 |
| D6.1 Study for scaling-up green H2 supply in Mallorca and the Balearic Islands | WP6.Scaling up and Replication of Hydrogen island ecosystems across the EU | ENAGAS | M36 | M36 |
| D6.2 Study for scaling-up of FC-based energy applications | | HYE | M24 | M24 |
| D6.3 Study on the decarbonization of the sea-ferry stations at Balearic ports | | ENER | M24 | M24 |
| D6.4 Study on the development of cold ironing at the Port of Mallorca | | PORTS BALEARS | M36 | M36 |
| D6.6 Policy and RCS recommendations for the scaling-up and replication | | FHa | M54 | M54 |
| D6.7 Hydrogen Roadmap for Mallorca & Balearic Islands | | IBE | M60 | M60 |

# 3 Intellectual Property Protection and Ownership of Results

The Horizon 2020 Grant Agreement and the GREEN HYSLAND consortium agreement signed by all the project partners regulate the dissemination, access rights and use of knowledge and intellectual property. To facilitate exploitation of the project results and to avoid conflicts of interest among partners, the following main rules have been agreed among them[2]:

## 3.1 Ownership of Results

Results are owned by the project partner who generates them.

In accordance with the first paragraph of Article 26.2 of the Grant Agreement, two or more partners shall own Results jointly if:

a) They have jointly generated them and

[2] Detailed overview of agreed protection measures are available in the *GREEN HYSLAND Consortium Agreement, version 1.2, 2020-03-18*

b) it is not possible to:
i. establish the respective contribution of each beneficiary, or
ii. separate them for the purpose of applying for, obtaining or maintaining their protection

Once the Results have been generated, joint owners may agree in writing to apply another regime than joint ownership. Unless otherwise agreed:

- Each of the joint owners shall be entitled to use their jointly owned Results for further research activities on a royalty-free basis, and without requiring the prior consent of the other joint owner(s), and
- Each of the joint owners shall be entitled to otherwise exploit the jointly owned Results and to grant non-exclusive licenses to third parties (without any right to sub-license), if the other joint owners are given:

a) at least 45 calendar days advance notice; and
b) Fair and Reasonable compensation.

The joint owners shall agree on all protection measures and the division of related cost in advance. Where such joint Results are covered by intellectual property rights, the joint owners shall execute a joint ownership agreement regarding the allocation and the terms and conditions of exploitation of the joint Results as soon as possible and before any industrial or commercial exploitation.

With respect to Parties not established for the purpose of directly carrying on an industrial or commercial activity (for instance public bodies), considering their specific positioning, “Fair and Reasonable compensation” necessarily means a financial compensation in case of direct or indirect exploitation of joint Results.”

Subject to the joint ownership agreement or otherwise agreed by the joint owners, following generation of a joint Result, the joint owners shall enter into good faith discussions in order to agree on an appropriate course of action for filing application(s) for Intellectual Property Rights in such joint Result, including the decision as to which Party is to be entrusted with the preparation, filing and prosecution of such application(s) and in which countries of the world such application(s) for Intellectual Property Rights are to be filed. The filing of any application(s) for Intellectual Property Rights on joint Results shall require mutual agreement between the project partners. Save as otherwise explicitly provided herein, all costs related to application(s) for Intellectual Property Rights in joint Results and Intellectual Property Rights resulting from such application(s) shall be shared proportionally to the percentage of ownership between the joint owners.

In the event that one of the joint owners of an Intellectual Property Right or an application for an Intellectual Property Right on a joint Result wishes to discontinue the payment of its share of the maintenance fees or other costs in any particular country or territory (the "Relinquishing Owner"), the Relinquishing Owner shall promptly notify the other joint owner(s) of its decision, and the Relinquishing Owner and the other joint owner(s) shall agree in good faith on the actions to be taken.

## 3.2 Transfer of Results

Each project partner may transfer ownership of its own Results following the procedures of the Grant Agreement Article 30. It may identify specific third parties it intends to transfer the ownership of its Results to in Attachment (3) to this Consortium Agreement. The other partners hereby waive their right to prior notice and their right to object to a transfer to listed third parties according to the Grant Agreement Article 30.1.

The transferring Party shall, however, at the time of the transfer, inform the other partners of such transfer and shall ensure that the rights of the other partners will not be affected by such transfer. Any addition to Attachment (3) after signature of this Agreement requires a decision of the General Assembly. The GREEN HYSLAND partners recognize that in the framework of a merger or an acquisition of an important part of its assets, it may be impossible under applicable European Union (EU) and national laws on mergers and acquisitions for a Party to give the full 45 calendar days prior notice for the transfer as foreseen in the Grant Agreement.

The obligations above apply only for as long as other partners still have - or still may request - Access Rights to the Results.

## 3.3 Access Rights

The GREEN HYSLAND project partners have identified and agreed on the "Background" for the Project and have also, where relevant, informed each other that Access to specific Background is subject to legal restrictions or limits. In accordance with art. 24.1 of the Grant Agreement, 'Background' means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that:

a) is held by the beneficiaries before they acceded to the Agreement, and
b) is needed to implement the action or exploit the results.

Any partner may add further own Background during the Project by written notice to the other partners. However, approval of the General Assembly is needed should a partner wish to modify or withdraw its Background. Furthermore, any partner shall have the right to exclude some of its Background with respect to a new partner, by written notice to the Coordinator.

Each partner shall implement its tasks in accordance with the Consortium Plan and shall bear sole responsibility for ensuring that its acts within the Project do not knowingly infringe third party property rights.

Any Access Rights granted expressly exclude any rights to sublicense unless expressly stated otherwise. The partners agree that certain partners, such as public bodies and non-profit organizations, may not carry Exploitation activities out directly due to their legal status and accordingly may need to sublicense the Access Right in order to carry out an Exploitation activity. Such a partner requesting Access Rights shall confirm the requirement for a right to sublicense, which the partner granting Access Rights shall not unreasonably refuse Access Rights shall be free of any administrative transfer costs.

Access Rights granted under the GREEN HYSLAND Consortium Agreement shall be granted on a non-exclusive, non-transferrable basis. Results and Background shall be used by the requesting partner only for the purposes for which Access Rights to such Results and/or such Background to it have been granted. All requests for Access Rights shall be made in writing. The granting of Access Rights may be made conditional on the acceptance of specific conditions aimed at ensuring that these rights will be used only for the intended purpose and that appropriate confidentiality obligations are in place. For the avoidance of doubt, this means that the owning project partner may impose to the partner requesting an Access Right the execution of a separate agreement. The requesting partner must show that the Access Rights are Needed.

Access Rights to Results if Needed for Exploitation of a project partner's own Results shall be granted on Fair and Reasonable conditions and upon prior written agreement. Access rights to Results for

internal research activities linked to the Project, for the duration of the Project, shall be granted on a royalty-free basis. Access Rights to Background if Needed for Exploitation of a partner's own Results shall be granted on Fair and Reasonable conditions and upon prior written agreement.

# 4 Main exploitation routes

While at this point of the project implementation, the list of key exploitable results and their exploitation roadmaps remain indicative, a few partners involved more extensively in the deployment phase already submitted initial individual exploitation roadmaps enabling to already see how they plan to exploit the Green Hysland KER. The partners having contributed at this phase are: ENAGAS, HYE, FHA, EMEC, HYC, IBE. Based on these results, the following exploitation routes emerge contributing to the EU green hydrogen market development:

- **New dedicated infrastructure**: a few infrastructure related KERs are expected within Green Hysland to be developed and are a prerequisite for hydrogen market development. As detailed by ENAGAS, these KERs include: the pipeline delivery (connection between the tube trailer with a hydrogen dedicated pipeline including related new services, values chains and adapted regulatory framework); a large-scale hydrogen production plant deployment, to supply hydrogen to multiple end users; the hydrogen refuelling station to be expanded with further upgrades-updates and integration with different application-end uses. HyEnergy will support the investigation for the scale-up of the electrolysis technologies in Mallorca and the required infrastructure that will surround it. HYCOLOGNE will utilise their experience of having supported the new development of five more fuelling stations in the region for 52 fuel cell buses, and will support the expansion plan for Hydrogen Refuelling Station.

- **Training, up-skilling and knowledge dissemination**: the experience and knowledge gained through Green Hyslands will enable specific partners to develop their training and dissemination knowledge activities. FHA will train technical and executive staff with a specific set of skills in hydrogen. FHA will identify, generate the didactic content and train the trainees and trainers to this end. The EMEC team has developed significant experience in designing the systems and procedures required to safely produce, handle and use hydrogen and is now bringing this experience to bear in supporting development projects outside of Orkney, in Scotland and throughout Europe. The technical knowledge gained from Green Hysland will assist EMEC and Orkney in becoming a center of excellence for Hydrogen and decarbonization within Scotland.

- **Development and replication of new and integrated business models:**

    - **Integrated hydrogen island business model**: within Green Hysland a detailed financial and business model will be developed considering the results from the techno-economic analysis and multiple scenarios, upon which specific business cases will be built. The first two of these scenarios will focus on establishing the necessary criteria for a successful and thriving hydrogen sector in Mallorca, with the aim of showing other island-based communities how to best foster a hydrogen economy. These scenarios will then be expanded in 2050 to show how hydrogen potential can grow across islands, by including the Balearic archipelago in our predictions. More

important from an exploitation point of view, partners such as HYE will work closely with replication areas based within the project (Chiloé, Greek Islands, Madeira, Ameland, Irish islands) to understand how Mallorca's hydrogen business model can be altered for each of their unique cases. ENAGAS will also use this KER for further policy making, for the own commercial exploitation from stakeholders involved in the business plan. Exploitation for scale-up purposes will be explored by IBE by carrying out several studies within the frame of the Roadmap that could potentially lead to individual exploitable results.

- **Sustainable tourism:** the exploitation of green hydrogen on islands based on the Green Hysland outputs will specifically serve the decarbonization of tourism. As detailed by EMEC, there is a key opportunity to leverage Orkney's demonstration experience to inform the development of hydrogen projects for other islanded communities around the world in carbon-intensive sectors such as transport, heating and also tourism. To support the decarbonization of the tourism sector, while recognizing the isolated nature of islands as a key factor in the path to net-zero emissions, a focus should be placed on finding solutions to the problem of carbon emissions from transportation. EMEC's long-time experience and skills as a leading testing and demonstration site can provide an ideal remote island environment for exploiting the lessons learned with regards to hydrogen development in an island context. This will lead to further research and development of emerging hydrogen technologies by creating a testing environment for aviation and maritime decarbonization activities.

- **Mobility/transport**: as reminded by EMEC, the link between tourism and transport is very strong especially for islands, as they are often located in more remote destinations which require air, land and sea transport routes. This is a key reason why islands, such as Orkney, have a responsibility to research and develop decarbonization pathways for aviation and maritime activities. Regarding exploitation within the region of Mallorca, within the Mallorca Hydrogen regional roadmap to be developed by IBE, several studies will be carried out with regards to heavy duty mobility such as lorries and maritime mobility, including the research of the potential of LNG/H2 blending and cold ironing. IBE will primarily be involved in the exploitation for policy making purposes.
  However, the exploitation of the mobility related studies and experience can also serve other regions and land-based mobility as well. HyCologne's exploitation will focus on the deployment of fuel cell electric buses. HyCologne supported since 2010 the operation of hydrogen/fuel cell buses in their region and will pursue the commercialisation and deployment of these buses through the JIVE project (Joint Initiative for hydrogen Vehicles across Europe).

- **District heating & cooling:** in the frame of the Mallorca Hydrogen regional roadmap, IBE will carry out a study to assess the actual potential of Hydrogen as a vector to decarbonize district heating and coaling. This will open a key new exploitation route for Green Hysland results.

- **Decarbonization of the industry:** EMEC clearly explains the Green Hysland exploitation potential for decarbonizing tourism and related industries. "*The significance of tourism is particularly important for island communities, as the sector offers economic, social and cultural value to many local people. Many residents rely on the influx of tourists during the summer months to support their cost of living throughout the year. This has a knock-on effect on other industries such as fisheries, agriculture and construction by creating a larger market and tourist-friendly infrastructure. In order to secure the economic benefit which tourism brings to island communities, it is necessary to look into environmentally friendly and zero emission alternatives. The research and development into green hydrogen on Orkney can provide a route to achieving this and decarbonizing these sectors*." IBE within the Mallorca Hydrogen regional roadmap will also carry out a study how large industries and energy intensive ones could make use of hydrogen to decarbonize their energy demand.

- **Policy making and roadmap development:** to develop the hydrogen market and stimulate its production and use in key sectors, informed policy support is needed. To this end, the Mallorca Hydrogen regional roadmap developed by IBE will provide a mid- to long-term orientation of the deployment of H2 within the Balearic Islands, describing its overall potential and specifically defining scaling up objectives for end-users. The Roadmap should reflect on state-of-the-art studies and existing legislative and economic barriers, so as to provide a comprehensive path on how to reach those objectives, including clear policy, legal and economic recommendations.

# 5 Individual Exploitation roadmaps

## 5.1 ENAGAS

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|---|---|
| Responsible person for exploitation activity & contact details: | *Carlos Navas Pérez*<br>cjnavas@enagasrenovable.es<br>*+ 34 608 42 03 64*<br><br>*Ángela Sánchez Herce*<br>dt.gnne.ash@enagas.es<br>*+ 34 696 48 90 16* |
| Current main products/services in the company: | *The company is certified as Transmission System Operator (TSO) by the European Union* |
| Present geographical markets: | *Spain - Greece, Albania, Italy, Mexico, Chile, Peru and the United States* |
| Is your Company part of a bigger group with broader interests: | |
| Main customers (e.g. individual people/households, municipal/regional institutions, etc.): | *SMEs and private and public companies* |
| Other relevant information: | *Has more than 30 renewable energy projects with more than 60 partners* |

| **Number of Exploitable Result** | **1** |
|---|---|
| Name of Exploitable Result | H2 infrastructure: pipeline delivery |
| Description of Exploitable Result (summarize technical approach) | Operational discharge of the tube trailer into the hydrogen pipeline |
| Target Sectors where the result will be exploited | Energy, TSO´s and DSO´s sectors |
| Target geographical markets where the results will be exploited | Territories interested in having a decarbonized gas network |
| Commercial Exploitation Route – how exploitation will be implemented | Not defined yet |
| Expected revenue from exploitation | Not defined yet |
| Summarize innovative aspects | The connection between a tube trailer with a hydrogen dedicated pipeline<br>New services and new value chains<br>Paving the path to adapt the regulatory framework to facilitate further developments |
| Explain the role of the partner in the exploitation, indicating required skills and experience | Not defined yet |
| Timeline for exploitation | The plant will start production by the end of summer, and RDX expects to have the hydrogen pipeline finished at the end of 2022. Onwards this activity will be carried out |

| | |
|---|---|
| Other relevant information | It will help to identify required policy changes to boost the energy transition, such as the blending % mixture allowed… |

| **Number of Exploitable Result** | **2** |
|---|---|
| Name of Exploitable Result | Scale up multi-MW electrolysis interconnections |
| Description of Exploitable Result (summarize technical approach) | Research and/or own commercial exploitation (own facilities). |
| Target Sectors where the result will be exploited | Energy and industrial sectors |
| Target geographical markets where the results will be exploited | Territories developing a sustainable energy model |
| Commercial Exploitation Route – how exploitation will be implemented | Not defined yet |
| Expected revenue from exploitation | |
| Summarize innovative aspects | Large scale hydrogen production plant deployment, to supply hydrogen to multiple end users. This will enable to boost the energy transition based on green hydrogen, and to increase of the installed electrolysis capacity on the territory |
| Explain the role of the partner in the exploitation, indicating required skills and experience | Know-how of the management and coordination to deploy a MW-electrolysis plant<br>Lessons learned and barriers identified, e.g when obtaining licenses, which could enable to implement policy/regulatory changes |
| Timeline for exploitation | |
| Other relevant information | Operational data of the hydrogen production plant |

| **Number of Exploitable Result** | **3** |
|---|---|
| Name of Exploitable Result | Expansion plan for HRS (upgrading pressure, capacity) |
| Description of Exploitable Result (summarize technical approach) | Exploitation in further upgrades-updates of HRS (pressure, flow) and integration with different application-end uses. Research and/or commercial exploitation |
| Target Sectors where the result will be exploited | Transport sector and infrastructure developers |
| Target geographical markets where the results will be exploited | Territories where the green hydrogen will play a key role in the energy transition, specifically on sustainable mobility |

| | |
|---|---|
| Commercial Exploitation Route – how exploitation will be implemented | Not defined yet |
| Expected revenue from exploitation | Not defined yet |
| Summarize innovative aspects | Enables different end users, interested in using green hydrogen, to have an accessible refilling facility.<br>The deployment of a dual HRS, to refuel hydrogen buses and light vehicles. |
| Explain the role of the partner in the exploitation, indicating required skills and experience | The definition of the optimal design, construction and operation of the HRS infrastructure |
| Timeline for exploitation | From the second third of 2023 onwards |
| Other relevant information | Improves the social acceptance of green hydrogen, through the use of hydrogen in the day to day activities |

| **Number of Exploitable Result** | **4** |
|---|---|
| Name of Exploitable Result | Integrated business model |
| Description of Exploitable Result (summarize technical approach) | Logistics and optimization of integrated Green H2 production, delivery and use. Interest for other islands and regions |
| Target Sectors where the result will be exploited | Energy sector and infrastructure developers |
| Target geographical markets where the results will be exploited | Mainly isolated territories such as other islands |
| Commercial Exploitation Route – how exploitation will be implemented | Not defined yet |
| Expected revenue from exploitation | Not defined yet |
| summarize innovative aspects | The possibility of adapting the concept to different scenarios, in terms of energy demand, existing infrastructure… |
| Explain the role of the partner in the exploitation, indicating required skills and experience | Provide the data required to develop the business models, such as energy consumption of the plant and operation of the hydrogen infrastructures… |
| Timeline for exploitation | According to the timeline stablished for the business model development defined on the Grant Agreement |
| Other relevant information | |

| **Number of Exploitable Result** | **5** |
|---|---|
| Name of Exploitable Result | Business models for H2 Islands |
| Description of Exploitable Result (summarize technical approach) | Policy making, own commercial exploitation from stakeholders involved in the business plan; exploitation as research |
| Target Sectors where the result will be exploited | Energy sectors, policy makers etc. interested on renewable hydrogen economies |
| Target geographical markets where the results will be exploited | Balearic Islands, follower territories and in general isolated territories |

| | |
|---|---|
| Commercial Exploitation Route – how exploitation will be implemented | Not defined yet |
| Expected revenue from exploitation | Not defined yet |
| Summarize innovative aspects | It will enable to implement renewable hydrogen models to boost the energy transition |
| Explain the role of the partner in the exploitation, indicating required skills and experience | Business models development associated to renewable gases, based on the different regions scenarios |
| Timeline for exploitation | According to the timeline stablished for the hydrogen business models development defined on the Grant Agreement |
| Other relevant information | |

## 5.2 Aragon Hydrogen Foundation

| **Partner name:** | ***FHa*** |
|---|---|
| Responsible person for exploitation activity & contact details: | *Mercedes Sanz*<br>*msanz@hidrogenoaragon.org*<br><br>*Aitor Sanzo*<br>*asanzo@hidrogenoaragon.org* |
| Current main products/services in the company: | *Support the development of strategic projects, in the short medium and long term in the field of hydrogen and fuel cell technologies in order to create employment, generate wealth and improve the competitiveness of the industrial sector in the Aragon region.*<br><br>*Develop a strategic agenda that contains the master lines for the steps to take as well as a time horizon for them, integrating the activities of the scientific community, the current state of the art for the technology and the business projects.*<br><br>*Promote a network of companies where **FHa** is the main actor linking the scientific research produced in our R&D facilities with the industrial technological development.*<br><br>*FHa has been working on fuel cell and hydrogen technologies for more than 19 years, organizing, managing and executing all kinds of actions related to hydrogen as an energy vector, with the aim of generating,* |

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|---|---|
| | *storing and transporting hydrogen for use in fuel cells, transport applications or distributed energy generation.* |
| Present geographical markets: | *National and international* |
| Is your Company part of a bigger group with broader interests: | *FHa is a private, non-profit foundation, today supported by a board formed by 89 members. The position of the president of the Board of the Foundation is hold by the Regional Minister of the Government of Aragon with competent for Industry, currently is the vice president of the Government of Aragon and Regional Minister of Industry, Competitiveness and Enterprise Development, Arturo Aliaga López. The vice president of the Board of the Foundation is hold by the Director-General of the Government of Aragon with competent for Industry, currently is the General-Director of Industry and SMEs of the Department of Industry, Competitiveness and Business Development of the Government of Aragon, Javier Navarro Espada.* |
| Main customers (e.g. individual people/households, municipal/regional institutions, etc.): | municipal/regional institutions, safety public services, energy and gas sector entities, consultancy firms, training services entities and particular investors. |
| Other relevant information: | *FHa receives unique sectorial and institutional support on a regional basis, in addition to its extensive experience in which the entire hydrogen value chain is worked on, which has enabled FHa to provide added value in the various activities in which it has participated, gaining sufficient experience and knowledge to tackle the work in which it participates with notable quality, safety and solvency.* |

| **Number of Exploitable Result** | **1** |
|---|---|
| Name of Exploitable Result | Technical and executive staff with a specific set of skills in hydrogen. |
| Description of Exploitable Result (summarize technical approach) | Up-skilling in leadership, management and labour is of vital importance in the imminent shift to a green energy and mobility sector. |
| Target Sectors where the result will be exploited | energy and mobility sector |
| Target geographical markets where the results will be exploited | National and international |
| Commercial Exploitation Route – how exploitation will be implemented | Through training courses and outreach activities |

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| Expected revenue from exploitation | Increase the competitiveness of companies, and recycling of workforces, avoiding situations of unemployment due to changes in business models. |
| Summarize innovative aspects | Gaps in training aspects are covered |
| Explain the role of the partner in the exploitation, indicating required skills and experience | FHa has more than 19 years of experience in the sector implementing hydrogen projects, so it can identify, generate the didactic content and train the trainees and trainers. |
| Timeline for exploitation | |
| Other relevant information | |

## 5.3 THE EUROPEAN MARINE ENERGY CENTRE LIMITED

| **Partner name:** | ***European Marine Energy Centre (EMEC)*** |
|---|---|
| Responsible person for exploitation activity & contact details: | Noor Van Velzen<br>leonore.vanvelzen@emec.org.uk |
| Current main products/services in the company: | Test site services in Marine and Hydrogen sector; Consultancy and environmental services; technical support services; academic and R&D research. |
| Present geographical markets: | Scotland (main focus); UK (several projects); Some Europe, Some USA. |
| Is your Company part of a bigger group with broader interests: | No, we are a limited not for profit. |
| Main customers (e.g. individual people/households, municipal/regional institutions, etc.): | Technology developers, government funders, engineering firms, other business to business. |
| Other relevant information: | Further information about EMEC can be found at: https://www.emec.org.uk/ |

| **Number of Exploitable Result** | **1** |
|---|---|
| Name of Exploitable Result | **Knowledge to become Hydrogen Center of excellence** |
| Description of Exploitable Result (summarize technical approach) | EMEC is based on the Orkney isles in the North of Scotland and was one of the first Hydrogen valleys in Europe. EMEC have been involved from early on, in a number of different Hydrogen disciplines. EMEC and Orkney are now moving to become a center of excellence for Hydrogen and decarbonization within Scotland.<br><br>The EMEC team has developed significant experience in designing the systems and procedures required to safely produce, handle and use hydrogen and is now bringing this experience to bear in supporting development projects outside of Orkney, in Scotland and throughout Europe. These replication activities, such as our involvement in the GreenHysland project, offers EMEC exciting opportunities |

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| | to further contribute to the development of this sector, in the pursuit of a rapid and cost-effective transition towards the 'Net Zero' energy systems of the future.<br><br>Consequently, key lessons learned have been taken and adapted from the GreenHysland project to enable this journey on Orkney. These lessons learned will allow EMEC and Orkney to move into the center of excellence more quickly and much more effectively than otherwise would have been conceivable. |
| Target Sectors where the result will be exploited | The results shall predominantly be exploited within the technology demonstration and Research and Development sectors. |
| Target geographical markets where the results will be exploited | The principle geographical market will be Scotland due to the nature of the center of excellence, but EMEC shall be able to offer services to European partners as well. |
| Commercial Exploitation Route – how exploitation will be implemented | The principal route shall be in the following staged approach:<br>1) Lessons learned understood to expand/ improve EMECs facilities and service offering with regards to green hydrogen development projects<br>2) Targeted investment in procuring the facilities and infrastructure needed to grow a successful green hydrogen economy<br>3) Expansion of the services offered to scale up hydrogen activities and to offer these services outside of Orkney so that other islands can learn from these experiences<br>4) Targeted marketing of new demonstration facilities and services to bring wider attention to the exciting opportunities in becoming a hydrogen centre of excellence<br>5) Increase in technology developers coming to Orkney to deploy and develop their innovative solutions to many of the challenges faced for a successful green hydrogen economy to thrive<br>6) Increase in consultancy services delivered so that a global chain of island communities can be inspired to go on their own green hydrogen journey |
| Expected revenue from exploitation | We will not give a revenue figure but a short-term revenue increase of 5% 1- 2 years would be expected with a 10% increase over 5 years. |
| Summarize innovative aspects | The main innovation is to be able to offer an area or demonstration facility with the ability to cover all areas of |

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| | hydrogen demonstration, use and scale up activities. This would then present, essentially a one-stop shop for technology developers to trial their technology and concepts. |
| Explain the role of the partner in the exploitation, indicating required skills and experience | The partner will drive this exploitation activity and the development of Orkney. EMEC has significant skills and experience both technical and in business development which will facilitate this happening. EMEC has also done this before in the Marine Energy Sector. |
| Timeline for exploitation | We would expect exploitation activities to start immediately and for results to be seen within a year. The activities would likely end after year 2 and by year 5 we would expect to see maximum results. |
| Other relevant information | |

| **Number of Exploitable Result** | **2** |
|---|---|
| Name of Exploitable Result | **Decarbonization of Tourism and other industries on Orkney** |
| Description of Exploitable Result (summarize technical approach) | There is a key opportunity to leverage Orkney's demonstration experience to inform the development of hydrogen projects for other islanded communities around the world. These replication activities offer EMEC exciting opportunities to pave the way for decarbonization of many carbon-intensive sectors such as transport, heating and also tourism.<br><br>The significance of tourism is particularly important for island communities, as the sector offers economic, social and cultural value to many local people. Many residents rely on the influx of tourists during the summer months to support their cost of living throughout the year. This has a knock-on effect on other industries such as fisheries, agriculture and construction by creating a larger market and tourist-friendly infrastructure. In order to secure the economic benefit which tourism brings to island communities, it is necessary to look into environmentally friendly and zero emission alternatives. The research and development into green hydrogen on Orkney can provide a route to achieving this and decarbonizing these sectors.<br><br>The link between tourism and transport is very strong especially for islands, as they are often located in more remote destinations which require air, land and sea transport routes. This is a key reason why islands, such as Orkney, have a responsibility to research and develop |

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| | decarbonization pathways for aviation and maritime activities. As transport routes have become more easily accessible, it has allowed more tourists to travel to remote islands which has in turn boosted island economies. Islands therefore have a responsibility to engage in research and development of zero carbon technologies and clean fuel alternatives to support the decarbonization of these transport systems. Hydrogen has been recognized as a potential clean fuel for decarbonizing the maritime and aviation sectors, and Orkney's ambition to develop a green hydrogen economy will support the efforts to decarbonize these sectors. |
| Target Sectors where the result will be exploited | The target sectors where this result will be exploited are the aviation, maritime and tourism sectors. |
| Target geographical markets where the results will be exploited | The target geographical market will be the Orkney islands and possibly expand to other island nations with sharing experience from the key lessons learned. |
| Commercial Exploitation Route – how exploitation will be implemented | The principal route shall be in the following staged approach:<br><br>1) Lessons learned understood to expand and improve EMECs facilities and service offering and through that support the decarbonization of the tourism sector which is so vital to island communities<br>2) Targeted investment in required infrastructure and equipment to support and accelerate the decarbonization of the transport sector which supports the arrival and departure of tourists on Orkney<br>3) Expansion of services focused on this sector through the deployment of innovative technologies which focus on decarbonizing the sector<br>4) Target future projects in the tourism sector so that we can continue learning from projects and further ambitions to decarbonize the sector through future experiences<br>5) Increase in aviation, maritime and tourism projects in Orkney through the deployment of new technologies and by looking at hydrogen alternatives to fossil fuels to power vessels and aircrafts<br>6) Increase in consultancy services delivered to the sector and in the form of feasibility studies so that a strong foundation can be laid to build upon through demonstration and trials of technologies and to inspire future projects |

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| Expected revenue from exploitation | This exploitation would expect to be revenue neutral but would be vital for decarbonizing the sector. |
| Summarize innovative aspects | The innovative aspects which have arisen as a result of the project learnings involve key lessons which will aid in the scaling up of hydrogen-related activities on Orkney, particularly as a test and demonstration site for maritime and aviation decarbonization activities. The isolated nature of islands means that tourism is reliant on transport infrastructure, and this is important for Orkney to develop a green hydrogen economy which facilitates the demonstration of innovative zero-emissions transport technologies. In order for the tourism sector to be supported in the transition to net-zero carbon emissions, new and innovative technologies to decarbonize transport must be explored and this requires testing and demonstration facilities, such as on Orkney. |
| Explain the role of the partner in the exploitation, indicating required skills and experience | To support the decarbonization of the tourism sector, while recognizing the isolated nature of islands as a key factor in the path to net-zero emissions, a focus should be placed on finding solutions to the problem of carbon emissions from transportation. EMEC's longtime experience and skills as a leading testing and demonstration site can provide an ideal remote island environment for exploiting the lessons learned with regards to hydrogen development in an island context. This will lead to further research and development of emerging hydrogen technologies by creating a testing environment for aviation and maritime decarbonization activities. |
| Timeline for exploitation | We would expect exploitation activities to start immediately and for results to be seen within a year. The activities would likely end after year 2 and by year 5 we would expect to see maximum results. |
| Other relevant information | |

## 5.4 HyEnergy Consultancy Limited

| **Partner name:** | ***HyEnergy Consultancy*** |
|---|---|
| Responsible person for exploitation activity & contact details: | *Ian Williamson*<br>*Ian.williamson@hy-energy.co.uk*<br>*(+44)7899 941422* |

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| | *Josh Williamson*<br>*Josh.williamson@hy-energy.co.uk*<br>*(+44)7944 240014* |
| Current main products/services in the company: | *Professional Services – Consultancy* |
| Present geographical markets: | *UK and EU* |
| Is your Company part of a bigger group with broader interests: | |
| Main customers (e.g. individual people/households, municipal/regional institutions, etc.): | *SMEs and private companies based in or adjacent to the hydrogen economy.*<br>*As well as regional, national governments and policy bodies.* |
| Other relevant information: | |

| **Number of Exploitable Result** | **1** |
|---|---|
| Name of Exploitable Result | Hydrogen island business models |
| Description of Exploitable Result (summarize technical approach) | The integrated hydrogen island business model will take real-world data from GREEN HYSLAND deployments and use this to inform a set of three time-based hydrogen sector scenarios.<br><br>The first two of these scenarios will focus on establishing the necessary criteria for a successful and thriving hydrogen sector in Mallorca, with the aim of showing other island-based communities how to best foster a hydrogen economy. These scenarios will then be expanded in 2050 to show how hydrogen potential can grow across islands, by including the Balearic archipelago in our predictions.<br><br>These models will include real-world data, techno-economic, and socio-economic analysis from within the project to enable a better understanding of both the challenges and advantages of deploying hydrogen in island geographies. This will include, for example, the scale-up of production facilities, required policy and regulation, CAPEX and/or OPEX support, and the best and most suitable applications for isolated areas. |
| Target Sectors where the result will be exploited | The establishment of a hydrogen sector in isolated, non-industrial areas. This will include:<br>- Green hydrogen production<br>- Storage and distribution technologies<br>- Transport – road, maritime, aviation<br>- Heating<br>- Power Production |
| Target geographical markets where the results will be exploited | Other isolated and island-based communities, particularly those based within Europe. |

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|---|---|
| Commercial Exploitation Route – how exploitation will be implemented | This piece of work will allow businesses based both within and outside the project to more confidently invest in hydrogen activities within these geographies |
| Expected revenue from exploitation | Information not available yet |
| Summarize innovative aspects | Information not available yet |
| Explain the role of the partner in the exploitation, indicating required skills and experience | We will work closely with replication areas based within the project (Chiloé, Greek Islands, Madeira, Ameland, Irish islands) to understand how Mallorca's hydrogen business model can be altered for each of their unique cases.<br><br>Further capitalizing on the business models in a local context however, will require a strong base of local expertise both in the energy sector, and policy and regulation. Furthermore, with public acceptance a key hurdle to overcome to the establishment of a hydrogen economy worldwide, communication and dissemination, particularly around safety, will also be key. |
| Timeline for exploitation | Information not available yet |
| Other relevant information | |

| **Number of Exploitable Result** | **2** |
|---|---|
| Name of Exploitable Result | Mallorca Regional Roadmap |
| Description of Exploitable Result (summarize technical approach) | This roadmap will inform local policy makers and businesses on the most suitable technologies available to Mallorca across the hydrogen value chain (production, storage and distribution, applications) and their respective scale-up opportunities through to 2050. |
| Target Sectors where the result will be exploited | The establishment of a hydrogen sector. This will include:<br>- Green hydrogen production<br>- Storage and distribution technologies<br>- Transport – road, maritime, aviation<br>- Heating<br>- Power Production |
| Target geographical markets where the results will be exploited | Mallorca and the Balearic Islands. |
| Commercial Exploitation Route – how exploitation will be implemented | Information not available yet. |
| Expected revenue from exploitation | Information not available yet |
| Summarize innovative aspects | Information not available yet |
| Explain the role of the partner in the exploitation, indicating required skills and experience | HyEnergy will be responsible for assessing the scale up of fuel cell transportation opportunities based in the region, as well as assisting other areas of the roadmap. |

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| | HyEnergy have considerable experience modelling hydrogen opportunities for both private clients and as part of publicly funded projects.<br><br>Furthermore, as part of the SEAFUEL project, HyEnergy have produced a set of hydrogen roadmaps, as well as sustainable energy and climate action plan (SECAP), for isolated regions. These roadmaps asses the local energy mixes and infrastructure (electricity and gas) and evaluate the potential of hydrogen with respect to their unique circumstances with goal of providing local policy makers with a set of recommendations to initiate hydrogen growth. HyEnergy will utilize this experience greatly within this task and exploitation result 1 too. |
| Timeline for exploitation | Information not available yet |
| Other relevant information | |

| **Number of Exploitable Result** | **3** |
|---|---|
| Name of Exploitable Result | Scale up multi-MW electrolysis interconnections |
| Description of Exploitable Result (summarize technical approach) | This area will investigate the scale with which electrolysis technologies can be scaled up in Mallorca and the required infrastructure that will surround it. |
| Target Sectors where the result will be exploited | Hydrogen production and energy storage/distribution infrastructure |
| Target geographical markets where the results will be exploited | Mallorca |
| Commercial Exploitation Route – how exploitation will be implemented | Information not available yet |
| Expected revenue from exploitation | Information not available yet |
| Summarize innovative aspects | Information not available yet |
| Explain the role of the partner in the exploitation, indicating required skills and experience | Having undertaken similar roles for different studies across the hydrogen value chain, HyEnergy will be supply hydrogen sector expertise and knowledge to this task to ensure estimates and considerations are realistic.<br><br>HyEnergy will also assist the partners to understand the evolution of the hydrogen market in coming decades to accurately estimate CAPEX and OPEX costs.<br><br>Through this work, partners will be able to scale-up green hydrogen production with more confidence within the wider regional and global market. |
| Timeline for exploitation | Information not available yet |
| Other relevant information | |

## 5.5 HYCOLOGNE GMBH

| **Partner name:** | ***HyCologne*** |
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|---|---|
| Responsible person for exploitation activity & contact details: | *Carsten Krause*<br>*krause@hycologne.gmbh*<br>*+491715699489* |
| Current main products/services in the company: | *Consulting, Networking, Project development* |
| Present geographical markets: | *Greater Cologne* |
| Is your Company part of a bigger group with broader interests: | *We are connected with other H2 Networks in North rhine westalia and also in NL or B like Waterstofnet* |
| Main customers (e.g. individual people/households, municipal/regional institutions, etc.): | *Public Private Partnership: Cities, Companies, research institutes, regions* |
| Other relevant information: | |

| **Number of Exploitable Result** | **1** |
|---|---|
| Name of Exploitable Result | Hydrogen Busses |
| Description of Exploitable Result (summarize technical approach) | HyCologne supported since 2010 the operation of Hydrogen/FC Busses in the region and were part in CHIC and JIVE. Today we have 52 FC Busses in Operation, the biggest fleet in Europe. 100 more FC Busses will come in the next years. |
| Target Sectors where the result will be exploited | Bus Operator, Municipals, Regions |
| Target geographical markets where the results will be exploited | Europe |
| Commercial Exploitation Route – how exploitation will be implemented | |
| Expected revenue from exploitation | Knowledge, Networking, new projects, |
| Summarize innovative aspects | Experiences in operating and tendering H2 Busses. |
| Explain the role of the partner in the exploitation, indicating required skills and experience | Part of the JIVE Project, Consulting and networking |
| Timeline for exploitation | 2011 - 2022 |
| Other relevant information | |

| **Number of Exploitable Result** | **2** |
|---|---|
| Name of Exploitable Result | Hydrogen Fueling Station HRS |
| Description of Exploitable Result (summarize technical approach) | We built up the first HRS in 2010. Since then we supported the new development of five more fuelling stations in the region for 52 FC Busses. |
| Target Sectors where the result will be exploited | Cities, Bus Operator, Municipals, regions |
| Target geographical markets where the results will be exploited | Europe |
| Commercial Exploitation Route – how exploitation will be implemented | |

| | |
|---|---|
| Expected revenue from exploitation | Knowledge, Networking, new projects, |
| Summarize innovative aspects | Experiences in operating and tendering HRS |
| Explain the role of the partner in the exploitation, indicating required skills and experience | Part of the JIVE and Mehrlin Project, Consulting and networking |
| Timeline for exploitation | 2010 - 2022 |
| Other relevant information | |

## 5.6 INSTITUTO BALEAR DE LA ENERGIA

| **Number of Exploitable Result** | **1** |
|---|---|
| Name of Exploitable Result | Hydrogen Roadmap for Mallorca |
| Description of Exploitable Result (summarize technical approach) | The roadmap is meant to provide with a mid- to long-term orientation of the deployment of H2 within the Balearic Islands, describing its overall potential and specifically defining scaling up objectives for end-users. The Roadmap should reflect on state-of-the-art studies and existing legislative and economic barriers, so as to provide a comprehensive path on how to reach those objectives, including clear policy, legal and economic recommendations. |
| Target Sectors where the result will be exploited | Policy makers; broad general public; Renewable energy companies; Energy storage companies; traditional energy companies; Research; etc. |
| Target geographical markets where the results will be exploited | Balearic Islands; European Union; European islands |
| Commercial Exploitation Route – how exploitation will be implemented | Not expected to be commercialized as such, although it is expected to serve as a way to support investments in energy transition to the Balearic Islands. |
| Expected revenue from exploitation | Not expected. |
| Summarize innovative aspects | The roadmap will be one of the first of its kind on islands, allowing to provide replication scenarios and strategies for others to follow. |
| Explain the role of the partner in the exploitation, indicating required skills and experience | IBE will primarily be involved in the exploitation for policy making purposes. |
| Timeline for exploitation | The Roadmap is expected to be finalized by M60, although the first orientations of the roadmap by mid-project will be already exploitable, providing with increased certainty for investors in green H2. |
| Other relevant information | |

| **Number of Exploitable Result** | **2** |
|---|---|
| Name of Exploitable Result | Studies for scaling-up green H2 supply |
| Description of Exploitable Result (summarize technical approach) | H2 is expected to play a significant role in supporting the deployment of renewable energies, storing energy and |

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|---|---|
| | decarbonizing gas grid and thermal power plants. Several studies will be carried out within the frame of the Roadmap that could potentially lead to individual exploitable results. |
| Target Sectors where the result will be exploited | Policy making; Renewable energy companies; Energy storage companies; traditional energy companies; Research; etc. |
| Target geographical markets where the results will be exploited | Balearic Islands; European Union; European islands |
| Commercial Exploitation Route – how exploitation will be implemented | Information not yet available |
| Expected revenue from exploitation | Information not yet available |
| Summarize innovative aspects | The studies will start from a living example on how to make use of H2 to provide energy services to the grid and the whole energy system, which makes of it more valuable. |
| Explain the role of the partner in the exploitation, indicating required skills and experience | IBE will primarily be involved in the exploitation for policy making purposes. |
| Timeline for exploitation | Information not yet available, but studies expected to be finalized in M45 |
| Other relevant information | |

| **Number of Exploitable Result** | **3** |
|---|---|
| Name of Exploitable Result | Studies on the potential of H2 in decarbonization of the industry |
| Description of Exploitable Result (summarize technical approach) | Large industries and energy intensive ones could make use of H2 to decarbonize their energy demand. |
| Target Sectors where the result will be exploited | Policy making, energy intensive industries, research |
| Target geographical markets where the results will be exploited | Balearic Islands primarily |
| Commercial Exploitation Route – how exploitation will be implemented | Information not yet available |
| Expected revenue from exploitation | Information not yet available |
| Summarize innovative aspects | Not particularly innovative |
| Explain the role of the partner in the exploitation, indicating required skills and experience | IBE will primarily be involved in the exploitation for policy making purposes. |
| Timeline for exploitation | The study is expected to be finalized in M36 |
| Other relevant information | |

| **Number of Exploitable Result** | **4** |
|---|---|
| Name of Exploitable Result | Studies on the potential of H2 to DHC |
| Description of Exploitable Result (summarize technical approach) | Within the Roadmap, a study will be carried out to assess the actual potential of Hydrogen as a vector to decarbonize distict heating and coaling. |

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| Target Sectors where the result will be exploited | Policy making, building sector, energy sector |
| Target geographical markets where the results will be exploited | Balearic Islands & other places with similar weather conditions |
| Commercial Exploitation Route – how exploitation will be implemented | Information not yet available |
| Expected revenue from exploitation | Information not yet available |
| Summarize innovative aspects | To this point there is little experience in DHC in warm countries, which makes of it particularly interesting in combination with the potential of H2 as energy storage element, which could reduce peaks in electricity demand in summer. |
| Explain the role of the partner in the exploitation, indicating required skills and experience | IBE will primarily be involved in the exploitation for policy making purposes. |
| Timeline for exploitation | The study is expected to be finalized in M36 |
| Other relevant information | |

| **Number of Exploitable Result** | **5** |
|---|---|
| Name of Exploitable Result | Studies on the potential of H2 for heavy-duty and maritime mobility |
| Description of Exploitable Result (summarize technical approach) | Within the roadmap several studies will be carried out with regards to heavy duty mobility such as lorries and maritime mobility, including the research of the potential of LNG/H2 blending and cold ironing |
| Target Sectors where the result will be exploited | Policy making, transportation sector, shipping |
| Target geographical markets where the results will be exploited | European Union |
| Commercial Exploitation Route – how exploitation will be implemented | The study is expected to be finalized in M36 |
| Expected revenue from exploitation | The study is expected to be finalized in M36 |
| Summarize innovative aspects | Particularly innovative as it is expected to offer a concrete view on the road to decarbonization of two highly difficult sectors |
| Explain the role of the partner in the exploitation, indicating required skills and experience | IBE will be focusing primarily on policy-making |
| Timeline for exploitation | The study is expected to be finalized in M36 |
| Other relevant information | |

# 6 First results from awareness and interest surveys

To further inform the exploitation plan and provide insight into the exploitation potential of GREEN HYSLAND, GASNAM and FEDARENE launched 2 separate surveys in order assess interest, awareness and trends regarding green H2 uses among their constituencies.

The sustainable transport association GASNAM organized a first survey of their 140 members from the road and maritime transport sectors to assess the interest and awareness of H2 uses among their members. The first survey was followed by a workshop held on 29 March 2022 at Madrid International Lab with the presence of 40 GASNAM member companies from all over Spain and Portugal, who are participating in projects associated with the production, storage, transport, distribution and use of renewable hydrogen.

FEDARENE launched as well a survey targeting its own over 80 members from 25 EU countries, who are regional authorities and regional and local energy agencies. Regions and energy agencies are sustainable energy market facilitators providing technical assistant to multiple target groups including public authorities, companies, communities and citizens.

Both surveys were launched at the beginning of 2022, with an input collection period lasting until end of March 2022. The preliminary conclusions from these surveys are presented below, with full reports in the annexes I and II. In order to gauge changes of interest and awareness throughout the lifetime of GREEN HYSLAND, both organisations will launch another survey in year 5 of the project. Conclusions from the changes identified will be included in the PEDR – final results deliverables due date M60.

## 6.1 At Spanish national level (GASNAM members)

### 6.1.1 Survey results

Gasnam sent the survey to all members on 11 February 2022, and sent out a reminder on 23 March 2022, indicating the deadline for responding to the survey was 29 March 2022, the date of the workshop. The survey evaluated the survey takers' level of knowledge, sensitivity and interest in the green hydrogen value chain in addition to identifying local and regional trends on the Iberian Peninsula (see Annex I. *Survey*).

A face-to-face workshop was held on 29 March 2022 at Madrid International Lab with the presence of 40 GASNAM member companies from all over Spain and Portugal, who are participating in projects associated with the production, storage, transport, distribution and use of renewable hydrogen.

The survey as well as the workshop organized are part of *Task 7.2 Exploitation of results and development of Exploitation Plan*.

The same survey will be conducted at the end of the project to estimate the change in the level of knowledge and interest in the use of renewable hydrogen.

Those who participated in the survey and workshop are Gasnam members with an interest in hydrogen and most coincide in believing that hydrogen is fundamental to limiting the effects of global warming and its consequences for climate change (general rise in temperatures, extreme weather phenomena, heat waves and flooding, harvest shortages, etc.). However, they do not believe it will be competitive until 2030.

Nearly half of the survey takers think the renewable hydrogen development goals set by the Spanish government are not very ambitious in the long-term.

On the other hand, they believe the intensity of national aid must be increased and some restrictions must be eliminated so that projects may be feasible such as: receiving aid after providing the final certificates, the need to classify the project as R&D&i by a certifying authority, expanding the object of the subsidy to power supply system injection projects and natural gas and hydrogen blending, etc.

In addition, they believe the national regulatory framework is not appropriate for hydrogen development as it must treat renewable hydrogen as a fuel of general interest and not just as a mere chemical product. With respect to the administrative procedures, the key lies in reducing the barriers by including lean mechanisms to streamline the processes and times. The implementation of the Renewable Gas Guarantees of Origin system is imperative as well.

Most of the survey takers believe the gas infrastructure can have a significant impact on the development of the hydrogen market. Injecting hydrogen into the power supply system is a necessary lever. Therefore, real-life experiments must be promoted in order to validate the technology.

On the other hand, the strategy for developing first-party technology throughout the value chain must be specified in order to guarantee the supply of equipment, and the industrial system as well as officially approved training for various technical profiles linked to the world of hydrogen must be reinforced to, thus, be able to meet the goals on the roadmap set forth by the Spanish government.

As concerns the creation of a hydrogen refuelling station system to develop hydrogen-based mobility, planning is needed to guarantee the establishment of an organized and accessible supply system with the proper capillarity.

The need to establish an inter-ministerial governing body to draft policies for hydrogen deployment in transport with the participation of sector role-players was made clear during the workshop held on 29/03/2022.

When it comes to maritime transport, nearly half of the survey takers believe the ammonia produced by renewable hydrogen will penetrate as maritime fuel before other alternatives such as the use of hydrogen in fuel cell batteries or syngas.

### 6.1.2 Workshop results

The face-to-face workshop was held on 29 March 2022 at Madrid International Lab. The purpose of the meeting was to draft a position paper on the deployment, strategy and regulatory framework in effect to complete the general information received through the survey conducted as part of the Green Hysland project.

Those in attendance were divided into 5 groups in the morning to discuss the following topics:

1. **Hydrogen production and logistics:** the outlook for compliance with the goals in the roadmap published by the Spanish government, strategic, regulatory and technical barriers.
2. **HRS construction:** the outlook for compliance with the goals in the roadmap, the regulatory framework, applicable regulations, incentives policy.
3. **Published aid:** the assessment of the suitability of the aid being offered as far as attaining the goals, difficulties accessing aid, aspects to be reviewed.
4. **The use of hydrogen for road transport:** outlook on the vehicle offer, aid intensity, barriers to transformation.

5. **The use of hydrogen for maritime transport and at ports:** the outlook for compliance with the roadmap goals, barriers to production and use. Equipment availability, drive in national production, barriers.

Afterwards, each of the groups presented their main conclusions (full summary of the workshop is available in ANNEX I of this document):

- Increasing the intensity of national aid and eliminating some restrictions such as: receiving aid after providing the final certificates, the need to classify the project as R&D&i by a certifying authority, expanding the object of the subsidy to power supply system injection projects and blending in combustion engines, etc.

- The regulatory framework needs to be developed to treat renewable hydrogen as a fuel of general interest and not just as a mere chemical product.

- Reducing the administrative obstacles by including streamlined mechanisms for project development is key.

- Injecting hydrogen into the system is a necessary lever and, therefore, real-life experiments must be promoted in order to validate the technology.

- The implementation of the Renewable Gas Guarantees of Origin system is imperative as well.

- The potential for lowering emissions must be considered when comparing the sustainability of the different energies with technologically neutral criteria.

- Policies must make it possible to activate the demand for hydrogen with end user aid. As an example, the intensity of aid for hydrogen-powered vehicles should be greater than for battery-powered vehicles given that hydrogen-powered vehicles are more expensive and there is greater uncertainty about refuelling since the hydrogen refuelling system is essentially non-existent.

- The strategy for developing first-party technology throughout the value chain must be specified in order to guarantee the supply of equipment and reinforce the industrial system to be able to meet the goals on the roadmap.

- Officially approved training is required for various technical profiles linked to hydrogen.

- The deployment of a hydrogen refuelling station system requires planning to guarantee the creation of an organized and accessible supply system with the proper capillarity.

- Finally, the need to establish an inter-ministerial governing body to draft policies for hydrogen deployment in transport with the participation of sector role-players was made clear.

## 6.2 At EU level (FEDARENE members)

This Green Hysland Survey performed by FEDARENE analyses the results of the performed survey and draws conclusion. FEDARENE has developed the survey at European level with the aim to gauge the interest and awareness of hydrogen ($H_2$) uses among its members.

The survey focused on 4 main topics:

1. Interest and knowledge on green hydrogen;
2. Hydrogen in Road/Rail Transport;
3. Hydrogen in Maritime/Waterway transport;
4. Hydrogen in Power and buildings, in relation to energy transition.

This survey was conducted between January and March 2022 and the 13 questions have been answered by 29 FEDARENE members. The replies are well spread across all European regions and areas (rural, urban, islands).

A full report is available in Annex II of this exploitation plan.

According to the results of the survey green hydrogen is considered to play an important role in the decarbonization of the EU's energy system despite some remaining challenges, and FEDARENE members **consider this technology has a role to play in the energy transition**. Some survey contributors are already involved in **projects** (see section 4.1.2 Projects on p.7-8) or project proposals, and most of them are aware of projects taking place in their regions/countries.

The **main benefits** of green $H_2$ are considered to be:

- Energy storage and RES penetration;
- Sector coupling;
- Flexible carrier of green energy;
- Potential to decarbonize hard-to-abate sectors (steel industry or heavy transport).

The **main barriers**:

- high cost for storage and transport of hydrogen is mentioned several times. Especially in relation to maritime/waterway transport, the high costs of hydrogen and yet-to-be-achieved profitability compared to other technologies and energy sources was often mentioned. This comment from a respondent summarized the situation: "financial mechanisms, business models and legal frameworks have to be established and deployed."
- Immaturity of end-use products arrives in second place due to the fact that the hydrogen value chain is not yet stable and competitive, and with technological barriers and lack of references and best practices. "The greatest technological barriers are found at the end of the value chain, in the use of hydrogen as an industrial product or as a fuel for thermal consumption", writes a respondent." Another declares that there are few equipment ready for the direct use of hydrogen in the market.
- competing technologies (such as batteries) are well developed and widely used and
- hydrogen is considered an unfamiliar technology to end-users.

The different regions of Europe and the densities/types of areas are facing **different situations** and therefore have different visions of the role of green $H_2$ and related benefits. The most striking disparities identified were the following:

- Competition with other technologies is an important challenge in urban areas while in other areas, the immaturity of the end-use products is a bigger issue;
- Overall, interest and readiness for market update for hydrogen technologies seem lower in Eastern Europe than in other regions of Europe;
- Although Northern countries declared that no green $H_2$ objective was set for their region/country, they are still very much interested in the technology and in developing projects. This was especially clear for the maritime/waterway transport sector, where 100% of respondents from the region declared that green H2 had a role to play in the sector (section 4.1.4 Projected future role of hydrogen in different sectors, p.10).

In terms of **future opportunities**, we have noted that urban areas seem more advanced in terms of $H_2$ projects compared to other parts of Europe, which indicates a void yet to fill. Similarly, only 10% of respondents had already applied to FCH JU calls in the past and 38% are not aware of the opportunities provided by the partnership so more projects can be initiated in the future with additional promotion and support for the targeted audience.

Islands are not yet very advanced in green hydrogen, still most of them are very interested in the development of hydrogen projects. Islands should be supported to take the role as testbed of innovative technologies before deploying the solutions on the mainland among others by highlighting opportunities and connecting the essential stakeholders.

# Annex I – Survey and Workshop conclusions at Spanish level (Gasnam Members)

GREEN HYSLAND

Deployment of a H2 Ecosystem on the Island of Mallorca

## Survey and main conclusions of the first workshop – GASNAM

May 2022



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 101007201. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation programme, Hydrogen Europe and Hydrogen Europe Research.

## Disclaimer



## Copyright Message

| Grant Number 101007201 | GREEN HYSLAND | | |
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| **Full title** | GREEN HYSLAND – Deployment of a H2 Ecosystem on the Island of Mallorca | | |
| **Topic** | FCH-03-2-2020 - Decarbonizing islands using renewable energies and hydrogen - H2 Islands | | |
| **Start Date** | 1 January 2021 | | |
| **End Date** | 31 December 2025 | | |
| **Project URL** | http://greenhysland.eu/ | | |
| **Project Coordinator** | ENAGAS | | |
| **Deliverable** | | | |
| **Work Package** | WP7 - Communication, Dissemination & Exploitation | | |
| **WP Leader** | FEDARENE | | |
| **Lead partner for deliverable** | GASNAM | | |
| **Type** | SURVEY | | |
| **Dissemination level**[1] | CO | | |
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| **Due Date** | MAY 2022 | | |
| **Responsible Author(s)** | CARLA GARCÍA HERAS, GASNAM | | |
| **Reviewer(s)** | | | |
| **Reviewer(s) contribution** | | | |
| **Status of the project** | Draft | In review | Released |
| **Version** | V1.01 | | |

[1] Dissemination level security: PU= public, CO=confidential.
[2] Type: R=Report, DEM=demonstrator, DEC= dissemination, ORDP: Open Research Data Pilot.

## Document history and status

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| v.1 | 28/04/2022 | Carla García | First version |
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## Preface

GREEN HYSLAND aims to deploy a fully-functioning Hydrogen (H2) ecosystem in the island of Mallorca by producing and delivering green hydrogen from solar energy, turning the island into Europe's first H2 hub in Southern Europe. The project includes a roadmap for the development of a complete renewable hydrogen economy in Mallorca and the Balearic Islands, in line with the environmental objectives set for 2050. GREEN HYSLAND demonstrations will provide Europe with a blueprint for decarbonization of island economies, and an operational example of the contribution of H2 towards the energy transition and the 2050 net zero targets. The development of replication experiences are foreseen in five other EU islands (Madeira - PT, Tenerife - ES, Aran - IE, Greek Islands and Ameland – NL) and beyond (Chile and Morocco).

| No | Participant Name | Short Name | Country Code | Logo |
|---|---|---|---|---|
| 1 | ENAGÁS S.A. | ENAGAS | ES | |
| 2 | ACCIONA ENERGIA S.A. | ACCIONA ENER | ES | |
| 3 | REDEXIS GAS S.A. | REDEXIS GAS SA | ES | |
| 4 | Empresa Municipal de Transports Urbans de Palma de Mallorca S.A. | EMT-PALMA | ES | |
| 5 | CALVERA MAQUINARIA E INSTALACIONES S.L. | CALVERA | ES | |
| 6 | AJUNTAMENT DE LLOSETA | Lloseta Council | ES | |
| 7 | AUTORIDAD PORTUARIA DE BALEARES | PORTS BALEARS | ES | |
| 8 | CONSULTORIA TECNICA NAVAL VALENCIANA S.L. | COTENAVAL | ES | |
| 9 | BALEARIA EUROLINEAS MARITIMAS S.A. | Balearia | ES | |
| 10 | INSTITUTO BALEAR DE LA ENERGIA | IBE | ES | |
| 11 | UNIVERSITAT DE LES ILLES BALEARS | UIB | ES | |
| 12 | FUNDACION PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGIAS DEL HIDROGENO EN ARAGON | FHa | ES | |
| 13 | CENTRO NACIONAL DE EXPERIMENTACIONDE TECNOLOGIAS | CNH2 | ES | |

| | | | | |
|---|---|---|---|---|
| | DE HIDROGENO Y PILASDE COMBUSTIBLE CONSORCIO | | | |
| 14 | ASOCIACION ESPANOLA DEL HIDROGENO | AeH2 | ES | |
| 15 | COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES | CEA | FR | |
| 16 | ENERCY BV | ENER | NL | |
| 17 | HYENERGY CONSULTANCY LTD | HYE | NL | |
| 18 | STICHTING NEW ENERGY COALITION | NEW ENER.COALIT | NL | |
| 19 | HYCOLOGNE GMBH | HyCologne | DE | |
| 20 | FEDERATION EUROPEENNE DES AGENCES ET DES REGIONS POUR L'ENERGIE ET L'ENVIRONNEMENT | FEDARENE | BE | |
| 21 | NATIONAL UNIVERSITY OF IRELAND GALWAY | NUI GALWAY | IE | |
| 22 | THE EUROPEAN MARINE ENERGY CENTRE LIMITED | EMEC | UK | |
| 23 | GASNAM - ASOCIACION IBERICA DE GASNATURAL Y RENOVABLE PARA LA MOVILIDAD | GASNAM | ES | |
| 24 | UNIVERSIDAD DE LA LAGUNA | ULL | ES | |
| 25 | ENERGY CO-OPERATIVES IRELAND LIMITED | En.Coop.Ireland | IE | |
| 26 | AGENCIA REGIONAL DA ENERGIA E AMBIENTE DA REGIAO AUTONOMA DA MADEIRA | AREAM | PT | |
| 27 | GEMEENTE AMELAND | Gem.Ameland | NL | |
| 28 | DIKTYO AEIFORIKON NISON TOY AIGAIOU AE | DAFNI | EL | |

| | | | | |
|---|---|---|---|---|
| 29 | ASOCIACION CHILENA DE HIDROGENO | H2 CHILE | CL | |
| 30 | Association Marocaine pour l'Hydrogène et le Développement Durable | AHMYD | MA | |

# Content

# Executive Summary

Gasnam sent the survey to all members on 11 February 2022, and sent out a reminder on 23 March 2022, indicating the deadline for responding to the survey was 29 March 2022, the date of the workshop. The survey evaluated the survey takers' level of knowledge, sensitivity and interest in the green hydrogen value chain in addition to identifying local and regional trends on the Iberian Peninsula (see Annex I. *Survey*).

A face-to-face workshop was held on 29 March 2022 at Madrid International Lab with the presence of 40 GASNAM member companies from all over Spain and Portugal, who are participating in projects associated with the production, storage, transport, distribution and use of renewable hydrogen.

The survey as well as the workshop organized are part of *Task 7.2 Exploitation of results and development of Exploitation Plan*.

The same survey will be conducted at the end of the project to estimate the change in the level of knowledge and interest in the use of renewable hydrogen.

Those who participated in the survey and workshop are Gasnam members with an interest in hydrogen and most coincide in believing that hydrogen is fundamental to limiting the effects of global warming and its consequences for climate change (general rise in temperatures, extreme weather phenomena, heat waves and flooding, harvest shortages, etc.). However, they do not believe it will be competitive until 2030.

Nearly half of the survey takers think the renewable hydrogen development goals set by the Spanish government are not very ambitious in the long-term.

On the other hand, they believe the intensity of national aid must be increased and some restrictions must be eliminated so that projects may be feasible such as: receiving aid after providing the final certificates, the need to classify the project as R&D&i by a certifying authority, expanding the object of the subsidy to power supply system injection projects and natural gas and hydrogen blending, etc.

In addition, they believe the national regulatory framework is not appropriate for hydrogen development as it must treat renewable hydrogen as a fuel of general interest and not just as a mere chemical product. With respect to the administrative procedures, the key lies in reducing the barriers by including lean mechanisms to streamline the processes and times. The implementation of the Renewable Gas Guarantees of Origin system is imperative as well.

Most of the survey takers believe the gas infrastructure can have a significant impact on the development of the hydrogen market. Injecting hydrogen into the power supply system is a necessary lever. Therefore, real-life experiments must be promoted in order to validate the technology.

On the other hand, the strategy for developing first-party technology throughout the value chain must be specified in order to guarantee the supply of equipment, and the industrial system as well as officially approved training for various technical profiles linked to the world of hydrogen must be reinforced to, thus, be able to meet the goals on the roadmap set forth by the Spanish government.

As concerns the creation of a hydrogen refuelling station system to develop hydrogen-based mobility, planning is needed to guarantee the establishment of an organized and accessible supply system with the proper capillarity.

The need to establish an inter-ministerial governing body to draft policies for hydrogen deployment in transport with the participation of sector role-players was made clear during the workshop held on 29/03/2022.

When it comes to maritime transport, nearly half of the survey takers believe the ammonia produced by renewable hydrogen will penetrate as maritime fuel before other alternatives such as the use of hydrogen in fuel cell batteries or syngas.

# 1. Survey

## 1.1. Main findings from the survey

52 companies responded to the survey.

The main conclusions drawn are:

- All of the survey takers know the different "colours" of hydrogen, distinguishing between green, blue and grey hydrogen.
- Most of the survey takers believe the climate ambitions of limiting global warming to below 1.5ºC cannot be achieved without the presence of hydrogen.
- More than half of the survey takers think the goals set by the government to develop the hydrogen economy as well as the support mechanisms announced are not realistic for achieving decarbonization goals. This is because the goals set by the hydrogen roadmap are very ambitious in the short-term since they require a lot of investment. Depending on the capacity and whether or not in situ hydrogen generation is provided for, the investment needed for a hydrogen refuelling station varies between 1.5 and 3.5 million. A high initial subsidy is considered essential given the high investment necessary. Moreover, these public investments in hydrogen refuelling stations must be linked to captive vehicle fleets which guarantee minimal consumption. This will take time to develop. Half of the survey takers also believe there are no plans or any adequate investment policy to transform the gas infrastructure into hydrogen infrastructure.
- Most of the survey takers believe Spain does not have the proper regulatory framework to develop hydrogen because the applicable laws are meant for the hydrocarbon and chemicals industries. There is no unified legislation for projects where hydrogen is used as a fuel or for the production of renewable hydrogen.
- 53.8% of the survey takers believe green hydrogen will be cost competitive in comparison to the hydrogen generated from fossil fuels as of 2030. In order for green hydrogen to be competitive, there must be immense hydrogen production and an economy of scale in vehicle manufacturing.
- Most of the survey takers believe the gas infrastructure can have a significant impact on the development of the hydrogen market. Those surveyed who do not believe it has a significant impact state this is because they do not think it may be used in the current state.
- 44.2% of the survey takers believe Power to Gas plays a very important role in the Spanish strategy and 40.4% think it has a transition role.
- 61.5% of the survey takers believe carbon capture has a transition role in the generation of hydrogen in Spain and 26.9% believe it is a very important role.

**Road transport**

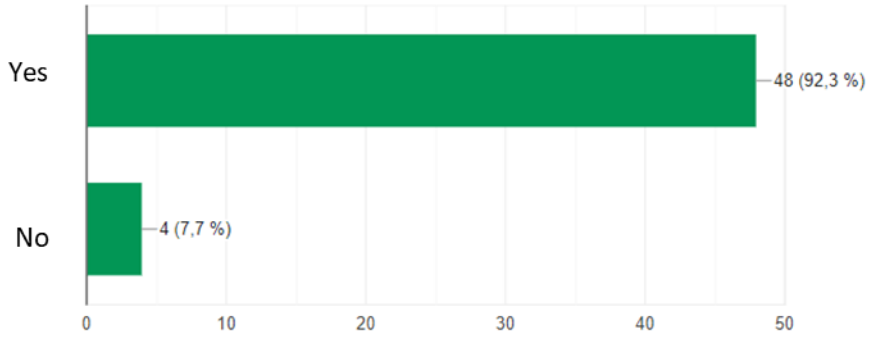
- Most of the survey takers believe hydrogen vehicles are safe.
- Most of the survey takers indicate it will be reasonable to purchase a private hydrogen vehicle beyond 2025. There are already models available in the passenger car and bus market with the first lorries expected in 2024.48.1% of the survey takers are aware of more than 5 green hydrogen generation projects underway and 44.2% are aware of 3-5 projects.
- 73.1% of the survey takers believe the use of hydrogen as a fuel for Urban Goods Distribution
- (UGD) will be a reality after 2025. The rest believe it will be in 2025.
- 65.4% of the survey takers believe the use of hydrogen as a fuel for heavy vehicles will be a reality after 2025. Whereas the remaining 34.6% believe it will be reasonable in 2025.
- 48.1% of the survey takers believe the level of institutional support for the development of a hydrogen refuelling station system could be better and 48.1% believe it is insufficient while 3.8% think it is good.

**Maritime transport**

- 53.8% of those surveyed do not know whether any maritime hydrogen projects are being developed, 30.8% are aware of at least one project and the remaining say there are none (15.4%).
- 59.6% of the survey takers believe hydrogen will begin to play a relevant role in maritime transport after 2030, 36.5% believe it will in 2050 and 3.9% say it will in 2025. This is because no engines have been developed yet to operate with hydrogen and there is no port infrastructure for the supply of hydrogen.
- 44.2% of the survey takers believe hydrogen and natural gas blending has a transition role in the maritime sector and 42.3% believe it is very important. However, the remaining 13.5% believe it is non-existent.
- 42.3% of those surveyed believe the ammonia produced by renewable hydrogen will penetrate as maritime fuel before other alternatives, 32.7% think syngas produced with renewable hydrogen will and 29.6% say the hydrogen used in fuel cell batteries will.

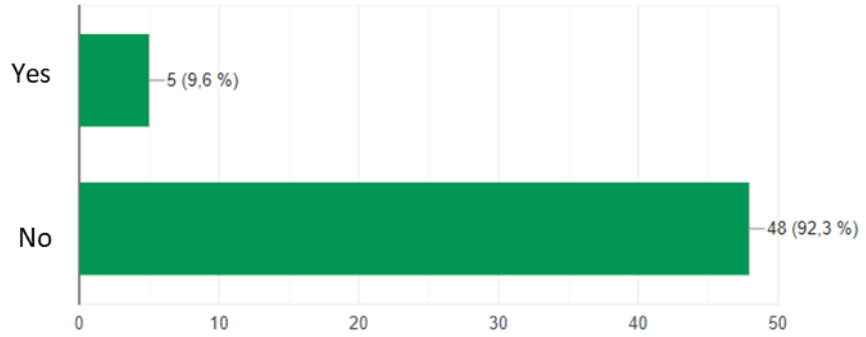
## 1.2. Graphs with the survey responses

**Are you a Gasnam member?**

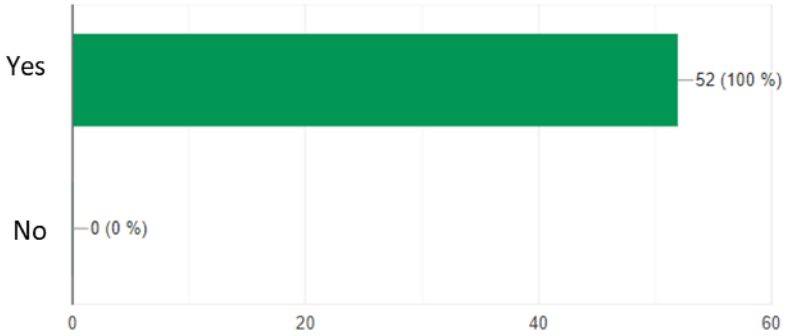



**GENERAL CONSIDERATIONS**

**Considering the goal of limiting global warming to below 1.5ºC, do you believe the climate ambitions can be achieved without hydrogen?**

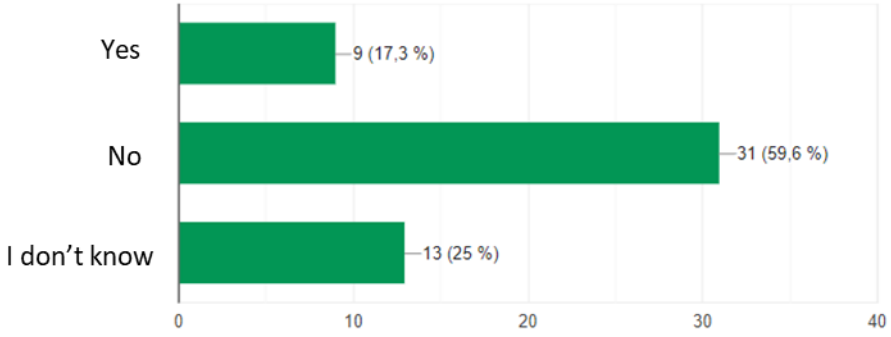



**Are you aware of the difference between green, blue and grey hydrogen?**

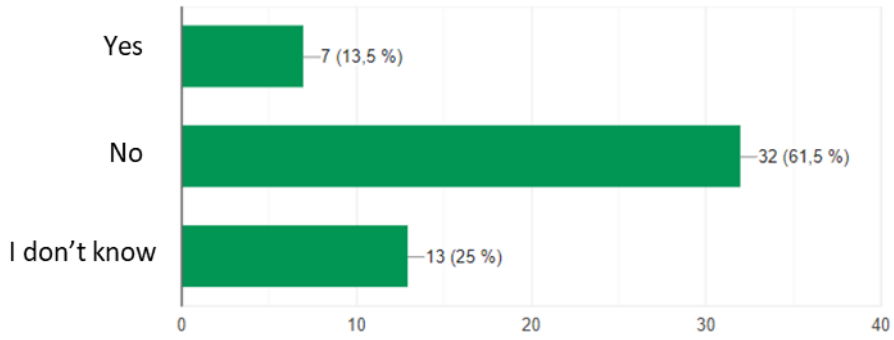



**SUPPORT MECHANISMS AND REGULATORY FRAMEWORK**

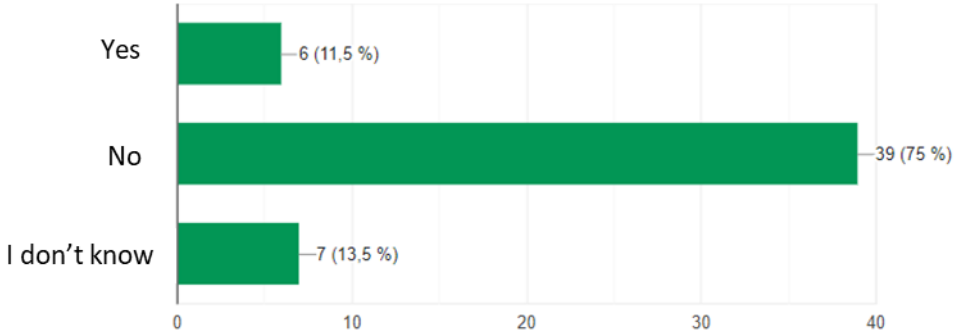
**Do you believe the goals in your country for the development of the renewable hydrogen economy are realistic?**



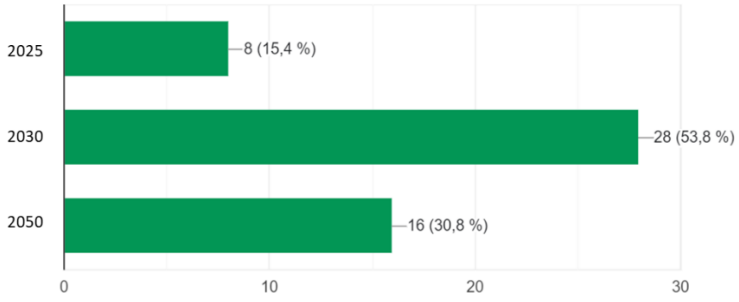
**Are the support mechanisms announced by your governments adequate in terms of achieving these goals?**



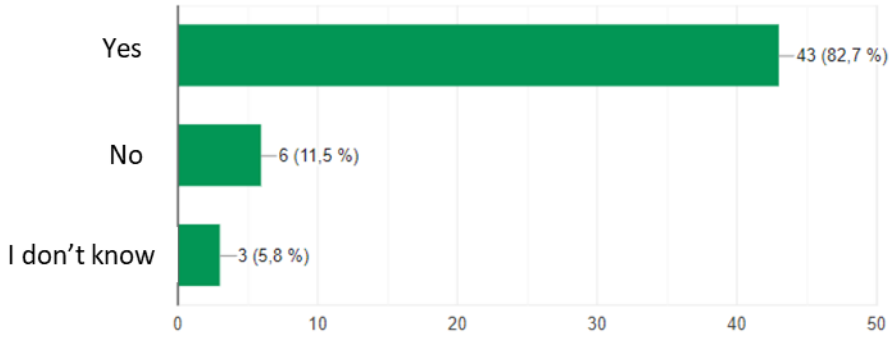

**Do you believe your country has the proper regulatory framework to develop a hydrogen market?**



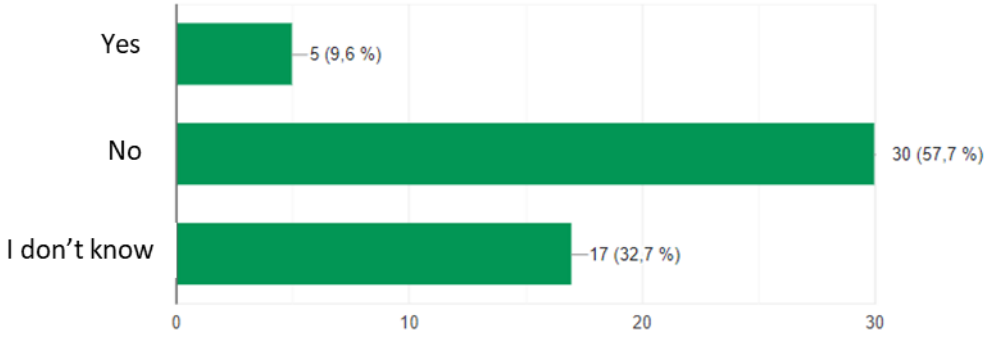

**On what date will green hydrogen be cost competitive in comparison with fossil fuel-generated hydrogen?**



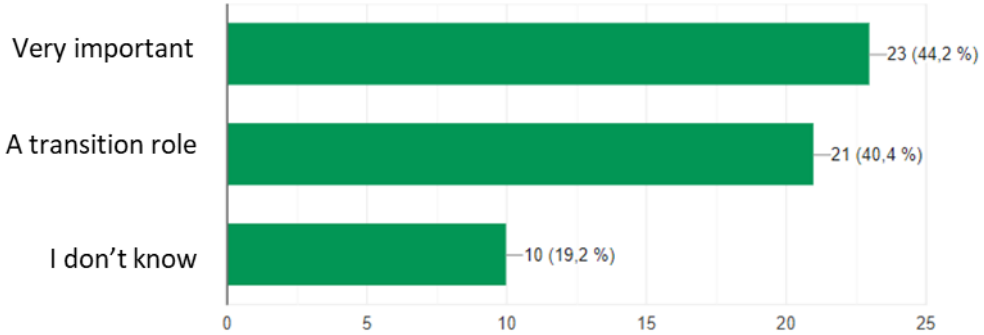
**Do you believe the gas infrastructure may have a significant impact on the development of the hydrogen market?**



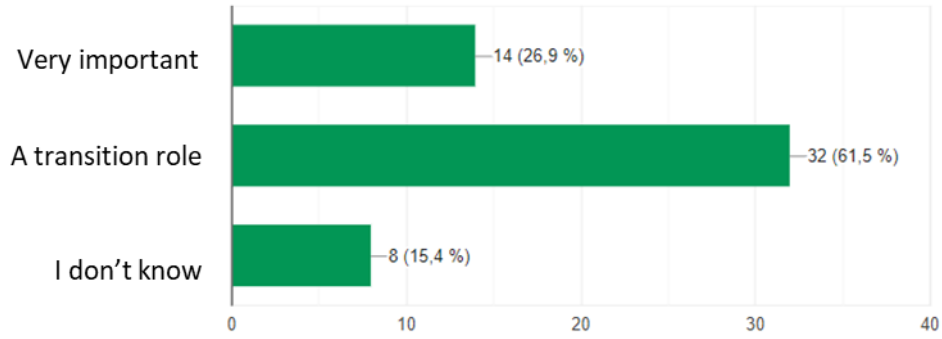

**Does your country have proper plans and policies for investment in order to transform the gas infrastructure into hydrogen infrastructure?**



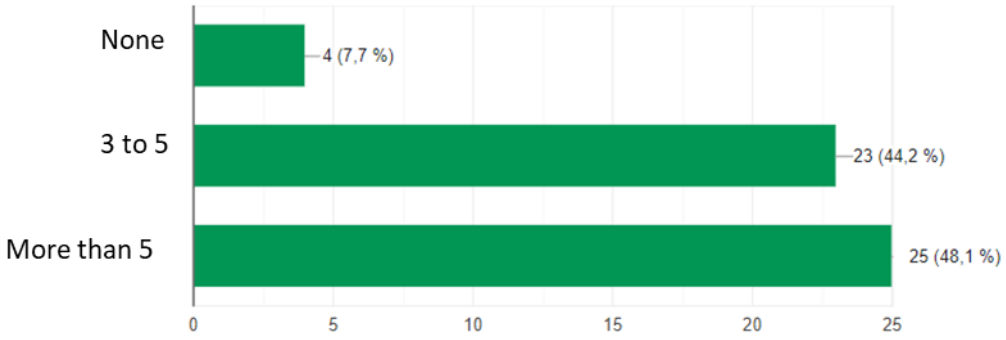

**What role will power to gas have in your country's energy strategy?**




**What role will hydrogen generation with carbon capture have in your country's energy strategy?**

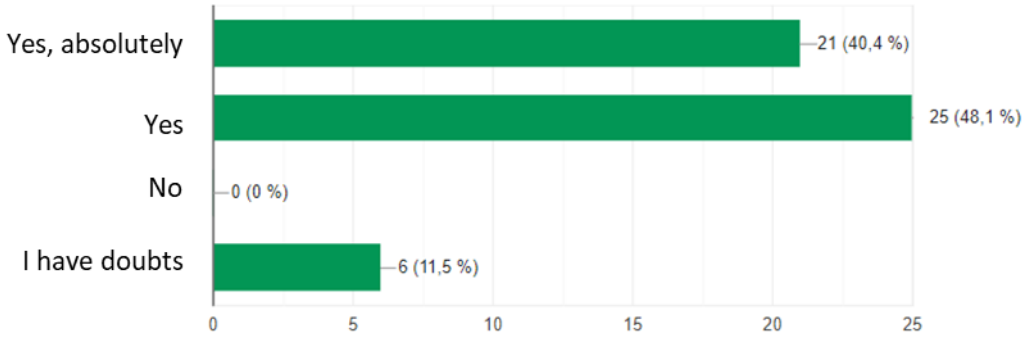



**How many green hydrogen generation projects are underway in your country?**

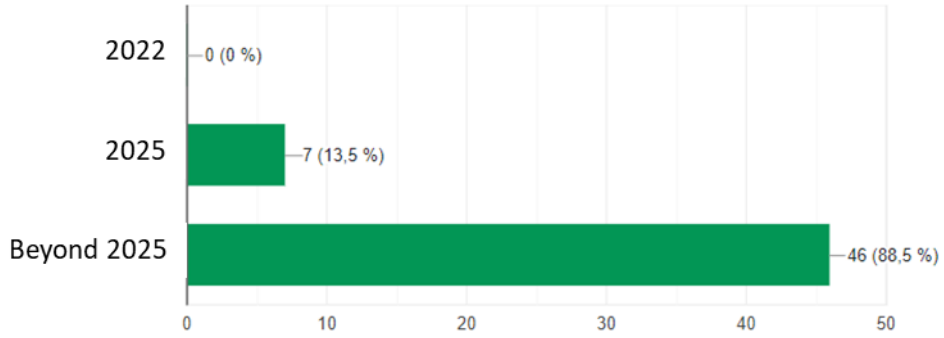



**HYDROGEN IN ROAD TRANSPORT**

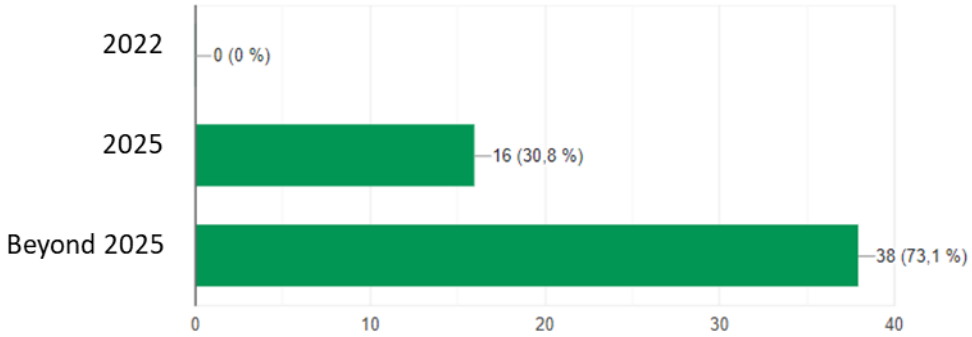
**Do you believe hydrogen-powered vehicles are safe?**



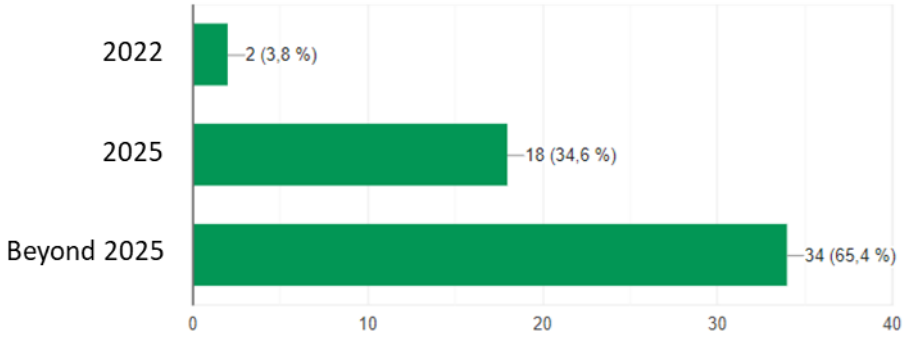
**At the pace of hydrogen development in mobility, when do you think the purchase of a private hydrogen-powered vehicle will be reasonable?**



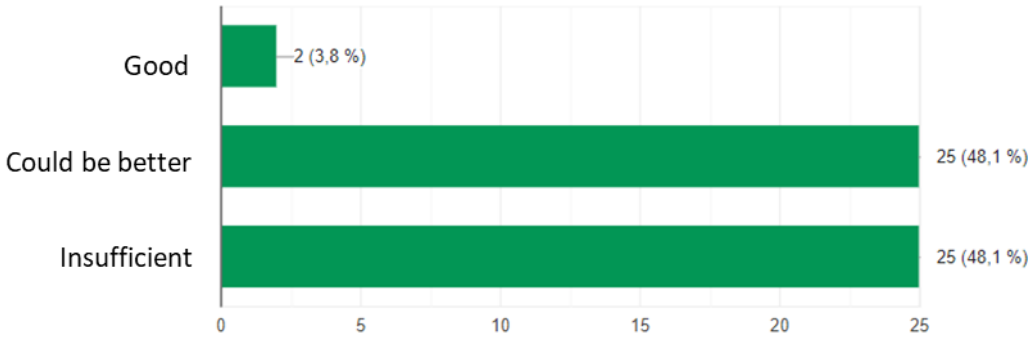

**When do you believe the use of hydrogen as a fuel for UGD will be a reality in your country?**




**When will the use of hydrogen as a fuel for heavy goods transport be a reality in your country?**

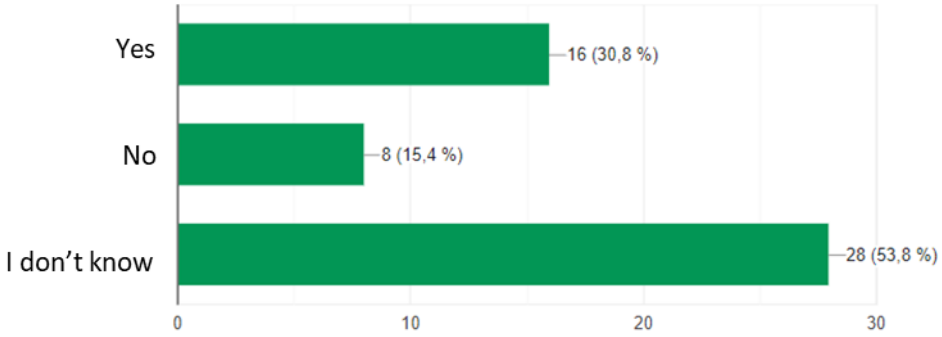


**Do you believe the level of institutional support for the development of the hydrogen refuelling station system in your country is…?**

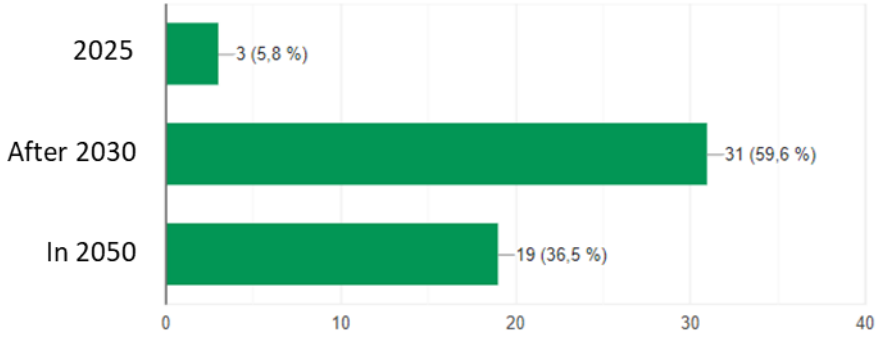



**HYDROGEN IN MARITIME TRANSPORT**

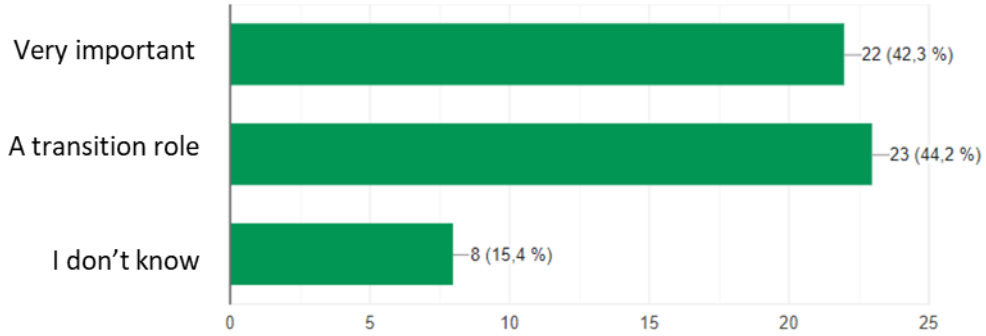
**Is any type of hydrogen maritime transport project underway in your country?**



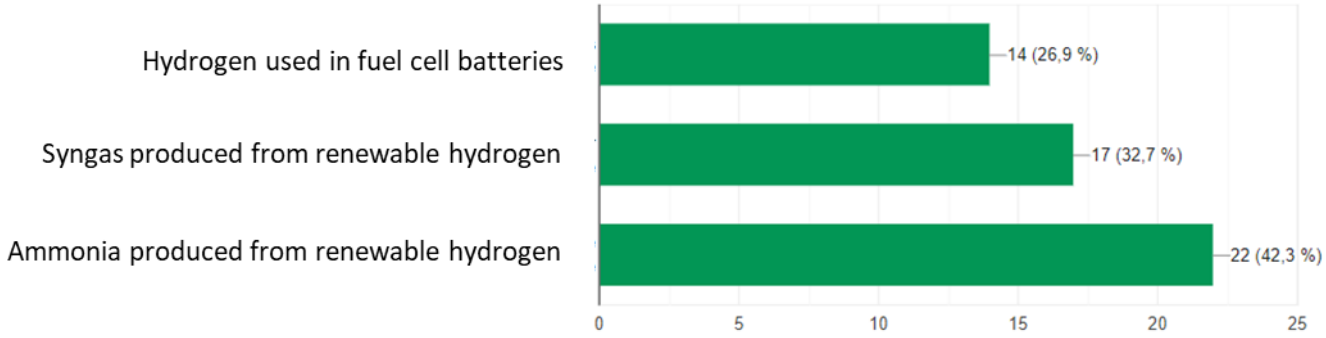

**When do you believe hydrogen will begin playing a relevant role in maritime transport?**



**What could be the role for hydrogen and natural gas blending in the maritime sector?**




**As a maritime fuel, which do you believe will penetrate first?**




## 1.3. Survey conducted

(see Annex I of survey report)

# 2. Workshop

## 2.1. Organization

The face-to-face workshop was held on 29 March 2022 at Madrid International Lab. The purpose of the meeting was to draft a position paper on the deployment, strategy and regulatory framework in effect to complete the general information received through the survey conducted as part of the Green Hysland project.

Those in attendance were divided into 5 groups in the morning to discuss the following topics:

6. **Hydrogen production and logistics:** the outlook for compliance with the goals in the roadmap published by the Spanish government, strategic, regulatory and technical barriers.
7. **HRS construction:** the outlook for compliance with the goals in the roadmap, the regulatory framework, applicable regulations, incentives policy.
8. **Published aid:** the assessment of the suitability of the aid being offered as far as attaining the goals, difficulties accessing aid, aspects to be reviewed.
9. **The use of hydrogen for road transport:** outlook on the vehicle offer, aid intensity, barriers to transformation.
10. **The use of hydrogen for maritime transport and at ports:** the outlook for compliance with the roadmap goals, barriers to production and use. Equipment availability, drive in national production, barriers.

Afterwards, each of the groups presented their main conclusions.

More than 40 companies participated in the meeting.

| 1. Production and Logistics |
|---|
| Company |
| Junta de Castilla y León |
| Carburos Metalicos |
| CALVERA |
| BUREAU VERITAS |
| EXOLUM |
| ENAGAS |
| AXPO IBERIA SLU |
| AIR LIQUIDE |
| GASNAM |

| 2. Construcción de HRS's |
|---|
| Company |
| Cetil Dispensing Technology |
| Repsol |
| PRF S.A. |
| Disa Holding Energético S.L.U. |
| Naturgy |
| Scale Gas |
| REDEXIS |
| Madrileña Red de Gas |
| MOLGAS |

| 3. Aid |
|---|
| Company |
| Nortegas |
| FUNDACION HIDRÓGENO ARAGÓN |
| REDEXIS |
| DH2 Energy |
| GASNAM |

| 4. Road Transport |
|---|
| Company |
| ALSA |
| Molgas Energia |
| IVECO ESPAÑA S.L. |
| DIMSPORT/Dobleeco Solutions SL |
| TOYOTA |
| Volvo Trucks España |
| TMB |

| 5. Maritime Transport |
|---|
| Company |
| BALEARIA |
| Wartsila Iberica |
| Lloyd's Register |
| AUTORIDAD PORTUARIA DE GIJÓN |
| Fundacion Valenciaport |
| DNV |
| Puerto de Barcelona |
| Burckhardt Compression España S.A. |
| CIDAUT |
| Autoridad Portuaria de Huelva |

## 2.2. Meeting Summary

The lack of public economic aid, the absence of a regulatory framework for guarantees of origin, the cost of the equipment, the scarce technical training and the limited development of the industrial system are some of the barriers being faced by specialists and companies committed to hydrogen as one of the great decarbonized and emissions-free transport models. These barriers were made public during the Renewable Hydrogen Workshop organized by the GASNAM association in Madrid which gathered Gasnam members with an interest in the hydrogen sector who were distributed among five working groups.

All of them agreed that hydrogen can help Spain reach the European $CO_2$ reduction goals given that it enables the decarbonization of decisive sectors which are required to reduce emissions such as transport.

**Regulatory framework and driving the demand for renewable hydrogen as keys to the development of this energy vector**

The working group that **analysed the current deployment of the hydrogen refuelling station system** on the Iberian Peninsula made clear there is a lack of regulations and a stable long-term framework to develop H2 supply infrastructures in the mobility sector.

As concerns the technical barriers, the complexity of the production chains was also mentioned given that many of the technologies are still in the development phase. This group also indicated that economic support is needed from the government-until the vehicle fleet is big enough to amortise the investments in infrastructure given that manufacturing chains cannot grow in the short term if there is not enough demand.

The participants agreed on the need to create a renewable hydrogen culture with aid for consumers so they may become ambassadors for this clean energy. Therefore, proper mechanisms are needed in order to establish the colour of hydrogen.

It was also pointed out that this energy vector does not appear as a source of energy in official statistics.

The working group on **production and logistics** explored some of the foregoing aspects a bit deeper and added a few specific barriers such as the lack of real blending experiments to normalize the use of hydrogen, how the lack of regulation prevents decision making on investment in projects, the lack of equipment and material manufacturers throughout the hydrogen value chain needed to achieve the goals set on the hydrogen roadmap and the shortage of technical experts to meet the sector needs. In conclusion, they believe regulations need to be developed to encourage the use of renewable hydrogen because the regulations on the industry are too restrictive and the bureaucratic procedures

are quite lengthy. Renewable hydrogen must be treated as a fuel of general interest and not just as a mere chemical product. Therefore, we need a regulatory framework for guarantees of origin and equal treatment with respect to other energy vectors.

The working group on the **use of hydrogen in long-distance road vehicles** insisted on the fact that Spain should be a hydrogen production superpower, yet this energy vector only appears in major official decarbonization plans as a mere option. They indicated that there is a greater commitment to electric vehicles. To exemplify this, they mentioned that the allocation of aid for both types of vehicles is identical in spite of the fact that fuel cell battery vehicles are associated with a high cost at present, and it is a technology that offers great benefits in terms of autonomy and refuelling time.

Others needs shared by those in this group were as follows: the need to create a guide explaining the regulations in effect for opening a hydrogen refuelling station and the need to gradually increase the quantity of hydrogen in the system.

**Suitability of aid and subsidies**

Another working group analysed the **aid and subsidies** that exist in Spain for the development of renewable hydrogen projects, each with their own unique characteristics. All of them agreed that such aid is necessary to developing first-party technology throughout the supply chain in order to reindustrialize the country and not end up replacing energy dependence with technology dependence. However, they gave more reasons for justifying the economic support: the creation of qualified jobs, activating the demand for hydrogen with aid for end users, production and distribution. In conclusion, they believe it is necessary to adjust the expectations which have been too high and negatively impact aid granting processes as far as deadlines and allocations. They also complained of the disconnection between existing aid given that there should be an inter-ministerial body to coordinate all the different types of aid.

The final GASNAM Hydrogen Workshop working group discussed the **use of this energy vector at ports**. They underlined the confusion that exists in the market with all the different energy alternatives, the high price of investment along with the uncertainty, the lack of port infrastructures and the absence of any large-scale supply guarantees. They also reiterated the lack of clear regulation and the shortage of certain materials, equipment and components.

## 2.3. Main Conclusions



- Increasing the intensity of national aid and eliminating some restrictions such as: receiving aid after providing the final certificates, the need to classify the project as R&D&i by a certifying authority, expanding the object of the subsidy to power supply system injection projects and blending in combustion engines, etc.

- The regulatory framework needs to be developed to treat renewable hydrogen as a fuel of general interest and not just as a mere chemical product.

- Reducing the administrative obstacles by including streamlined mechanisms for project development is key.

- Injecting hydrogen into the system is a necessary lever and, therefore, real-life experiments must be promoted in order to validate the technology.

- The implementation of the Renewable Gas Guarantees of Origin system is imperative as well.

- The potential for lowering emissions must be considered when comparing the sustainability of the different energies with technologically neutral criteria.

- Policies must make it possible to activate the demand for hydrogen with end user aid. As an example, the intensity of aid for hydrogen-powered vehicles should be greater than for battery-powered vehicles given that hydrogen-powered vehicles are more expensive and there is greater uncertainty about refuelling since the hydrogen refuelling system is essentially non-existent.

- The strategy for developing first-party technology throughout the value chain must be specified in order to guarantee the supply of equipment and reinforce the industrial system to

be able to meet the goals on the roadmap.

- Officially approved training is required for various technical profiles linked to hydrogen.
- The deployment of a hydrogen refuelling station system requires planning to guarantee the creation of an organized and accessible supply system with the proper capillarity.
- Finally, the need to establish an inter-ministerial governing body to draft policies for hydrogen deployment in transport with the participation of sector role-players was made clear.

Annex II offers the presentations given by each group.

# Annex I. Survey format

# Annex II. Presentations given by each group

**ANNEXES are available in the full report here:** https://greenhysland.eu/wp-content/uploads/2022/09/GREEN-HYSLAND_Survey-and-main-conclusions-of-the-first-workshop-GASNAM_compressed.pdf

## Annex II – Green Hysland Survey Report (EU/FEDARENE)

GREEN HYSLAND

Deployment of a H2 Ecosystem on the Island of Mallorca

# Green Hysland Survey Report EU/FEDARENE

May 2022

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 101007201. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation programme, Hydrogen Europe and Hydrogen Europe Research.

| Grant Number 101007201 | **GREEN HYSLAND** |
|---|---|
| **Full title** | GREEN HYSLAND – Deployment of a H2 Ecosystem on the Island of Mallorca |
| **Topic** | FCH-03-2-2020 - Decarbonizing islands using renewable energies and hydrogen - H2 Islands |
| **Start Date** | 1 January 2021 |
| **End Date** | 31 December 2025 |
| **Project URL** | http://greenhysland.eu/ |
| **Project Coordinator** | ENAGAS |
| **Work Package** | 7 – Communication, Dissemination & Exploitation |
| **WP Leader** | FEDARENE |
| **Type** | Report |
| **Responsible Author(s)** | Mélissa Miklos, FEDARENE<br>Filip Dumitriu, FEDARENE |
| **Reviewer(s)** | Matthias Watzak-Helmer, FEDARENE<br>Filip Dumitriu, FEDARENE |

## Disclaimer



## Copyright Message

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# Table of figures

# 1. Executive Summary

This Green Hysland Survey Report analyses the results of the performed survey and draws conclusion. FEDARENE has developed the survey at European level with the aim to gauge the interest and awareness of hydrogen ($H_2$) uses among its members.

The survey focused on 4 main topics:

5. Interest and knowledge on green hydrogen;
6. Hydrogen in Road/Rail Transport;
7. Hydrogen in Maritime/Waterway transport;
8. Hydrogen in Power and buildings, in relation to energy transition.

This survey was conducted between January and March 2022 and the 13 questions have been answered by 29 FEDARENE members. The replies are well spread of all European regions and areas (rural, urban, islands).

The main conclusions are:

- FEDARENE members are aware of the potential offered by green hydrogen for the energy transition, and are generally interested in developing more projects related to this technology.
- Yet, several important barriers remain – above all, high costs – and disparities between regions and areas also exist.
- Several opportunities for the future were identified, as it seems many members were not aware of the funding programme of the FCH JU/Clean Hydrogen Partnership[3],
- Especially islands appear to be motivated and ready to take on the role of green hydrogen testbeds.

From the overall 13 questions, conclusions were drawn, which can be found on p. 19 and 20 of this report.

[3] Fuel Cells and Hydrogen Joint Undertaking, now the Clean Hydrogen Partnership

# 2. Background and objectives

This survey has been conducted in the framework of Task 7.2 Exploitation of results and development of Exploitation Plan. As indicated in the Grant Agreement, "GASNAM with support from ENAG will provide input for the exploitation of results at the Spanish national level, and FED, ENAG, NEC, ENER and HTS on the European level. GASNAM will organise two surveys of their 140+ strong member organisations from the road and maritime transport sectors, one in Year 1 of the project and one in Year 5, to gauge the change of interest and awareness of $H_2$ uses among their members throughout the lifetime of GREEN HYSLAND. FEDARENE will do a similar set of surveys at the European level."

The goal of the FEDARENE survey is twofold:

1) assess the awareness and interest of FEDARENE members regarding the use of green hydrogen
2) identify trends at local and regional level across Europe regarding green hydrogen production and uses.

The results of this first survey will also inform upcoming project activities led by FEDARENE targeting island and EU stakeholders working in the field, notably the organisation of yearly webinars and workshops and the development of the project's exploitation strategy.

# 3. Survey process and sample

The survey was officially opened to FEDARENE members on 17 January 2022, after having completed a pre-testing phase with FEDARENE and DAFNI staff. It ran until the end of March 2022.

In total, 29 FEDARENE members took the survey. The sample is balanced in terms of geographic coverage (respondents are more or less evenly spread between Northern, Southern, Western and Eastern Europe) and demographics/landscape (urban vs rural vs island).

These characteristics were taken into account for the analysis and clustering of results, comparing answers coming from Northern, Southern, Western and Eastern Europe, and also checking if results differ when we analyse them in view of the landscape members inhabit (urban, rural or island). This clustering allowed us to nuance our results, and highlight some regional specificities that would not have been visible otherwise.

# 4. Analysis

## 4.1 Assessing interest and awareness on green hydrogen

### 4.1.1 General knowledge and interest

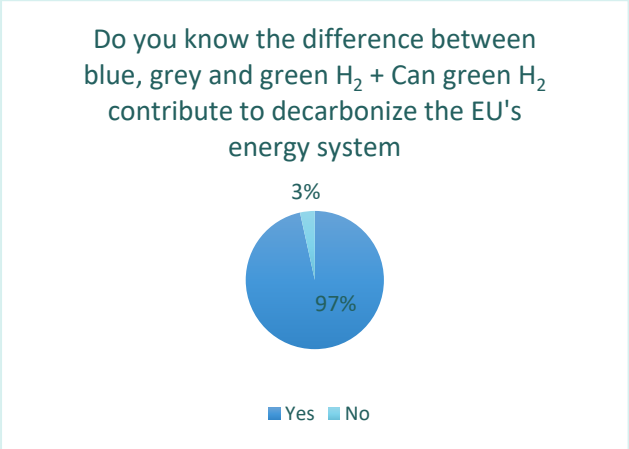



FIGURE 1: GENERAL KNOWLEDGE ON GREEN H2 AND CONFIDENCE IN ITS CAPACITY TO DECARBONIZE THE EU'S ENERGY SYSTEM

As figure 1 shows, a large majority of the respondents (97%) were familiar with the main types of hydrogen (blue/grey/green) and consider that green hydrogen can contribute to decarbonize the EU's energy system.

Many of them mention its great potential for (local) energy storage and as flexible carrier of green energy, that can be used to decarbonize hard to abate sectors such as steel, chemical industry, or heavy transport. A respondent wrote: "Hydrogen is a flexible carrier of green energy that can be used in a variety of cases where electricity or other forms of green energy are not practical. Hydrogen also has the potential to be produced close it its end use which reduces transport or grid costs and promotes local economic resilience."

### 4.1.2 Projects

Most respondents declared being aware of at least one hydrogen project currently running in their region (59% between 1 and 3 and 17% more than 3) and 69% are thinking about developing a green hydrogen project in the near future.

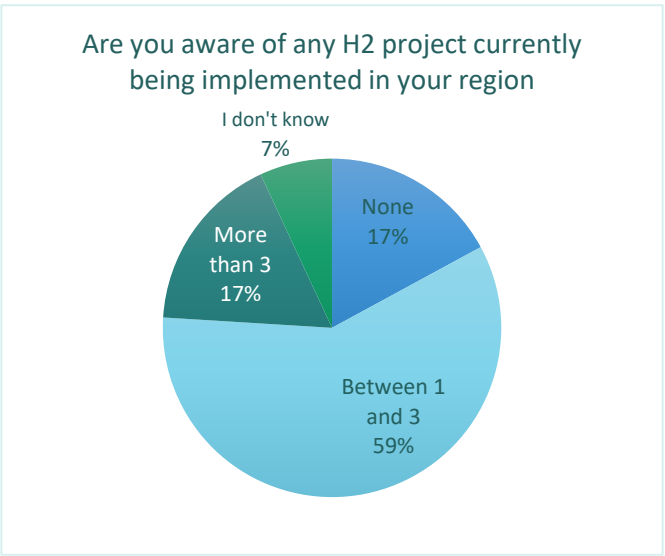



FIGURE 2: AWARENESS ON CURRENTLY RUNNING HYDROGEN PROJECTS IN THE REGIONS

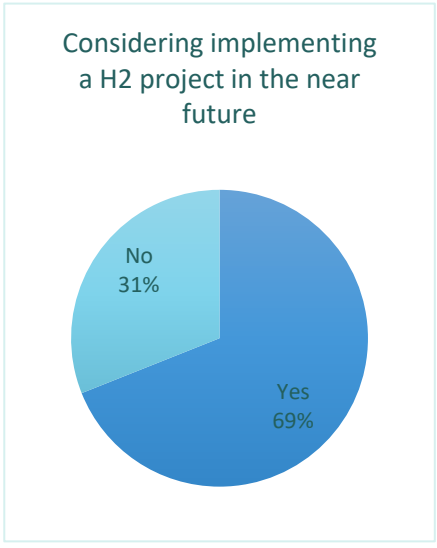



FIGURE 3: INTEREST IN IMPLEMENTING A H2 PROJECT IN THE NEAR FUTURE

Looking at the type of contexts of respondents on figure 4, it seems much more $H_2$ projects are being implemented in urban regions, which means there is still potential for development in island and rural areas.

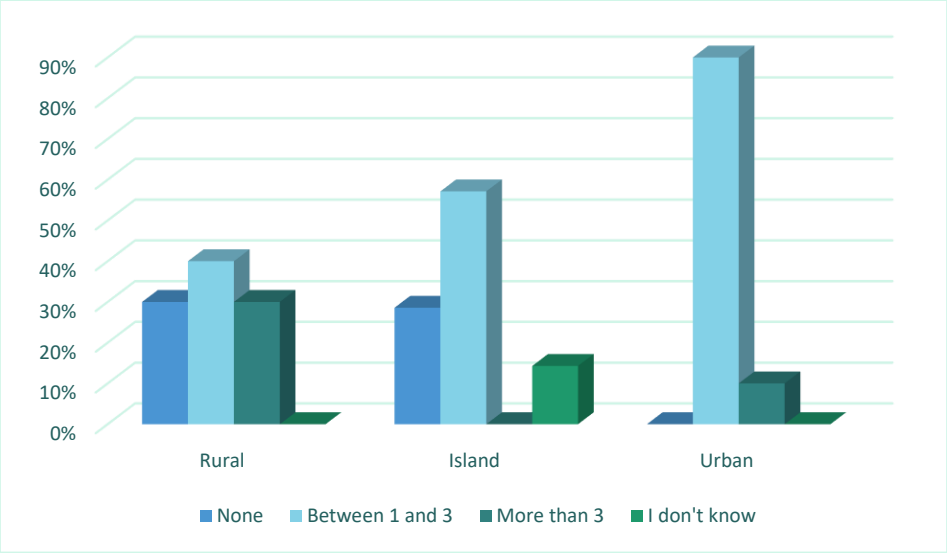



FIGURE 4: AWARENESS ON CURRENTLY RUNNING HYDROGEN PROJECTS IN THE REGIONS - LANDSCAPE CLUSTERING

Northern and Southern respondents seem most interested in undertaking such enterprise than Eastern and Western. As Figure 6 shows, 86% of island respondents are interested in starting a $H_2$ project themselves as 73% of respondents from urban areas are, whereas only 60% of rural participants want to start a project in the near future.

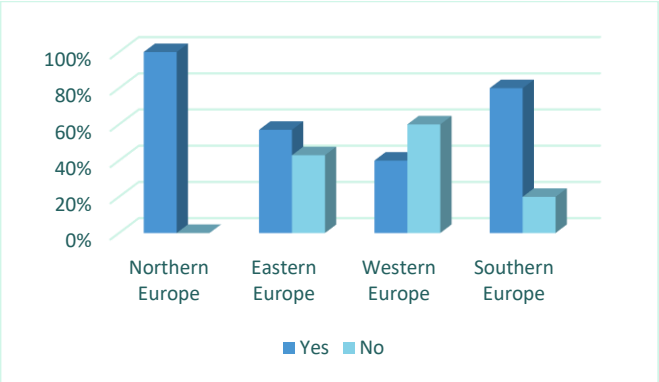



FIGURE 5: INTEREST IN IMPLEMENTING A H2 PROJECT IN THE NEAR FUTURE - REGIONAL CLUSTERING

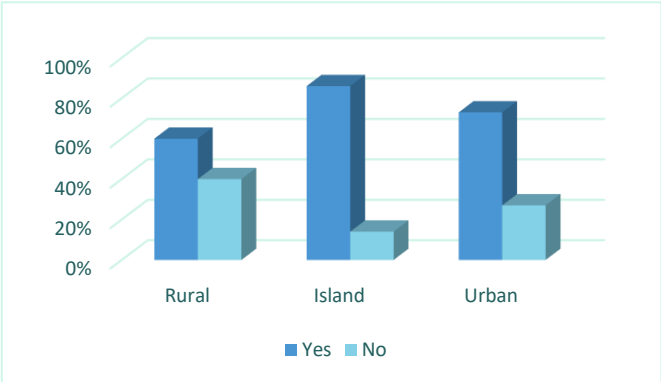



FIGURE 6: INTEREST IN IMPLEMENTING A H2 PROJECT IN THE NEAR FUTURE - LANSCAPE CLUSTERING

## Existing best practices/experience of members

- LIFE3H which is cofounded by the LIFE Programme of EU. The objective of the project is to set up, demonstrate and exploit 3 Hydrogen Valleys starting from the implementation of hydrogen buses (2 per region) fuelled with surplus $H_2$ coming from local industrial productions (circular economy) and the

realization of the related refuelling stations, in three different areas of central Italy: Altopiano delle Rocche (mountainous area and ski resort of Abruzzo Region); city of Terni (Umbria Region); Civitavecchia port (Lazio Region). The project is further co-financed by regional funds and it is foreseen to run minimum 5 hydrogen buses by 2023, as well as to realize/upgrade the hydrogen refuelling station and to produce green hydrogen;

- Zero Emissions valley project was initiated in 2018 by the French **Auvergne-Rhône-Alpes region** (AURA-EE - https://www.h2v.eu/analysis/best-practices/zev-zero-emission-valley) for light vehicles. It will be extended to heavy vehicle in the next years (urban buses, coaches, trucks, snow groomer, garbage trucks) recharging stations along EU corridors;

- $H_2$ ReCoDe Initiative, **Asturias** (FAEN): Implementation of a network of more than 20 electrolyzers with a total capacity of more than 600 MW and a Production of more than 60.000 t $H_2$/year. The hydrogen will be used in the regional transport sector (railway and buses), in the regional industry sector and in the regional energy sector. Green hydrogen will not only be produced in Asturias but will also be exported in other nearby regions through maritime transport;

- **AREC IDF** does not implement $H_2$ projects but they manage the regional ecosystem with the Paris Region Hydrogen Club, and they study the territorial potential for green hydrogen production, the needs for hydrogen infrastructures and the best use cases on the Paris Region;

- R&D work on hydrogen ferries in the **Orkney islands** (UK – **ESIN**): often seen as pioneers of hydrogen technologies, Orkney islands have experience through several projects such as BIG HIT, Surf'n'Turf and now HySeas III. More information on this is available on the recording of our Green Hysland webinar (43' – 58') and Green Hysland Workshop (50'30 – 60'06);

- **Liguria Region** (IT) applied to an open call in the framework of the Italian Recovery Fund regarding the promotion of green $H_2$ in dismissed industrial areas;

- Beginning stages for a Hydrogen Valley in **Mantova Province** (AGIRE).

## Programmes mentioned to be used for the funding of $H_2$ projects

- INTERREG Central Europe

- INTERREG Alpine Space

- Alternative Fuel Facility under Connecting Europe Facility

- NESOI

### 4.1.3 Enacted strategies and objectives on hydrogen

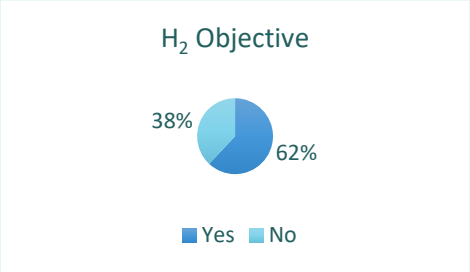



FIGURE 7: SPECIFIC GREEN H2 OBJECTIVE SET IN REGIONAL/NATIONAL ENERGY STRATEGIES

When asked if their region/country set any specific green $H_2$ objective in their energy strategies, 62% answered yes. More exactly: Lombardy Region, Italy; Ile-de-France region, France; Czech Republic; Abruzzo; Germany; Asturias, Spain & national level; Auvergne-Rhône-Alpes region, France; Greece; Castilla y León, Spain; Portugal.

For example, the Lombardy Region through recovery & resilience funds promoted the realization of Hydrogen Valleys on its territory and the realization of the first hydrogen train in the Brescia - Iseo rail route. There is an objective of introducing around 40 hydrogen buses into the city fleet for public transports in the province of Brescia.

In Asturias, Spain, the regional energy transition strategy is foreseeing a demand of hydrogen of more than 150.000 t/year in 2030.

In the Ile-de-France region in France, in 2019 was voted and published the regional strategy "Ile-de-France Hydrogen territory" with a key focus on developing production and use of local and green hydrogen for transport specifically.

Portugal have a Hydrogen National Plan for 2030 with the following targets:

- 0% to 15% green hydrogen injection into natural gas networks
- 2 GW to 2.5 GW of installed capacity in electrolysers
- Creation of 50 to 100 hydrogen filling stations
- 2 to 5% on energy consumption in industry
- 1 to 5% on energy consumption of road transport
- 3 to 5% on energy consumption of domestic maritime transport
- 1,5 to 2% in final energy consumption

Strategies are under development in Croatia; Romania; Wallonia, Belgium; Castilla y León, Spain. The Croatian strategy for hydrogen to 2050 was until recently in public consultation. In Castilla y León, the next Regional Energy Efficiency Strategy 2021-2030 plans to incorporate the Regional Hydrogen Strategy (Roadmap). The objectives of promoting hydrogen throughout its value chain will be aligned with the Spanish and European Strategies. The Romanian and Walloon hydrogen strategies are as well under development in 2022.

Regional distinctions are obvious:

- no respondent from Northern Europe declared that their country/region has set a specific objective in its energy strategies regarding green hydrogen;
- In Western Europe, the situation is the opposite one: all respondents declared a $H_2$ objective has been set;
- In Eastern and Southern Europe, we observe a more balanced situation – although most Southern states and regions seem to also have $H_2$ objectives set.

- The situation per landscape is more balanced: in all cases, a majority of respondents answered that they had set H2 objectives; what changes is the proportion: 60-40% for rural, 57-43% for island, and 80-20% for urban. The latter scenario is thus the same as for the Southern region.

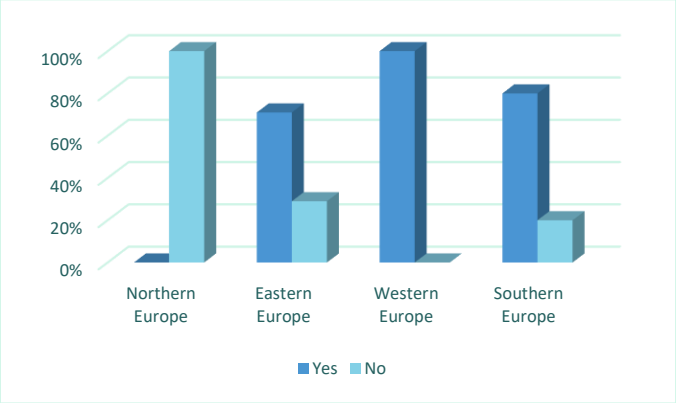



FIGURE 8: SPECIFIC GREEN H2 OBJECTIVE SET IN REGIONAL/NATIONAL ENERGY STRATEGIES - REGIONAL CLUSTERING

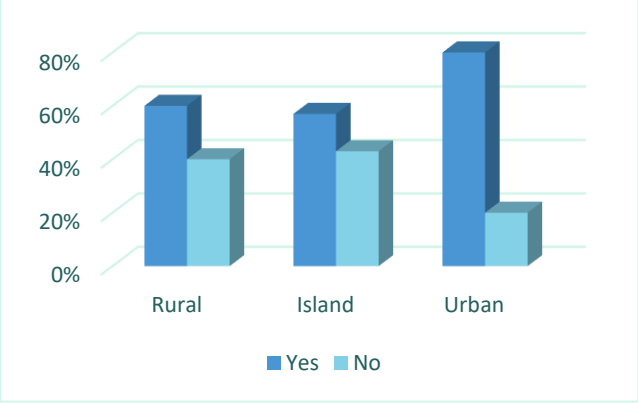



FIGURE 9: SPECIFIC GREEN H2 OBJECTIVE SET IN REGIONAL/NATIONAL ENERGY STRATEGIES - LANDSCAPE CLUSTERING

### 4.1.4 Projected future role of hydrogen in different sectors

Asking more specifically in which sector(s) they think green hydrogen has a role to play in the transition, they mostly answer road/rail transport (30%), power (20%) and industry (20%), as shown in figure 10.

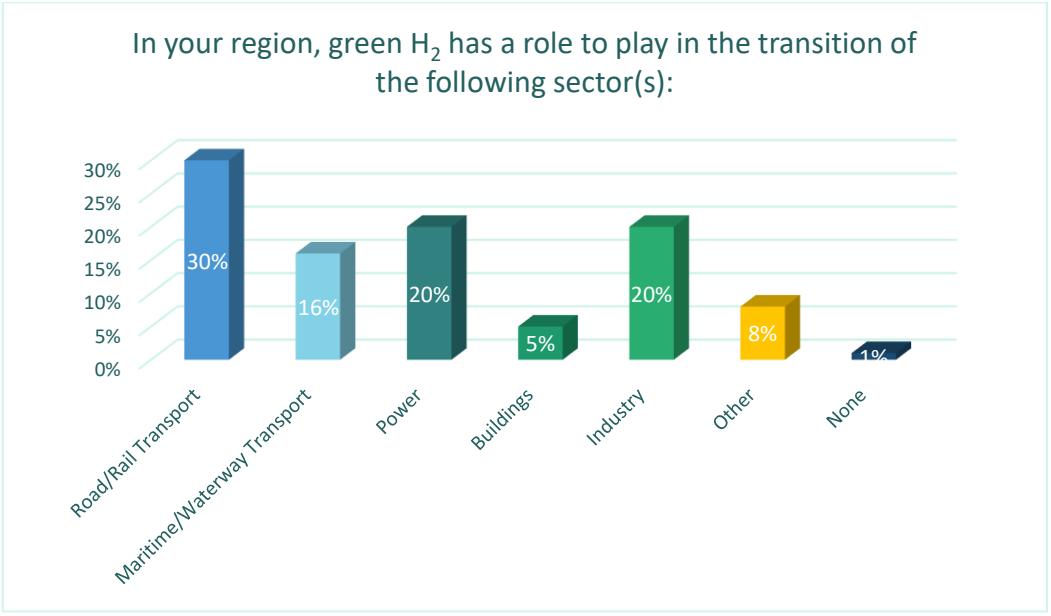



FIGURE 10: PROJECTED ROLE OF GREEN H2 IN THE TRANSITION OF DIFFERENT SECTORS

Maritime/Waterway Transport comes short after (16% of answers), while the building sector does not seem to represent a promising sector for green hydrogen according to FEDARENE members.

Looking at the regional clustering to analyse this question shows a different picture. Indeed, maritime/waterway transport seems to play a much bigger role in Northern Europe than in other parts of Europe, while power holds little sway for Western Europeans compared to others.

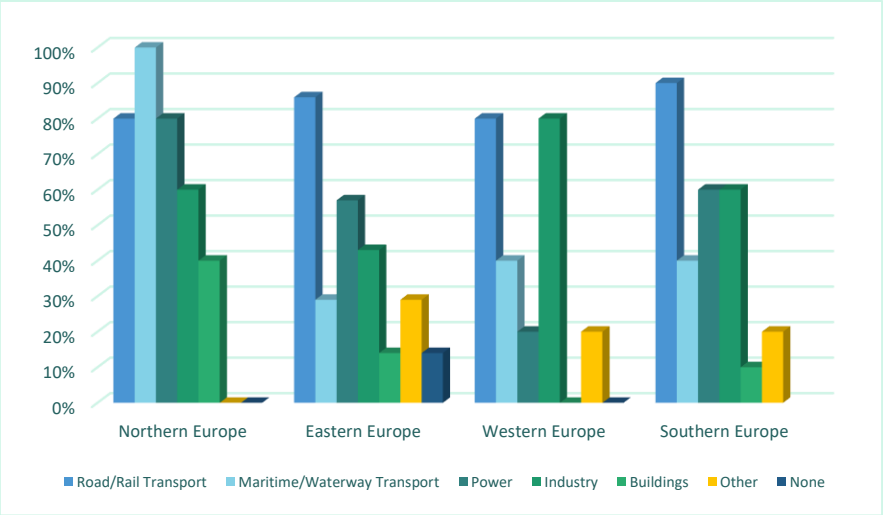



FIGURE 11: PROJECTED ROLE OF GREEN H2 IN THE TRANSITION OF DIFFERENT SECTORS - REGIONAL CLUSTERING

Respondents from urban locations thought more often that green hydrogen had a role to play in industry than people originating from islands or rural areas.

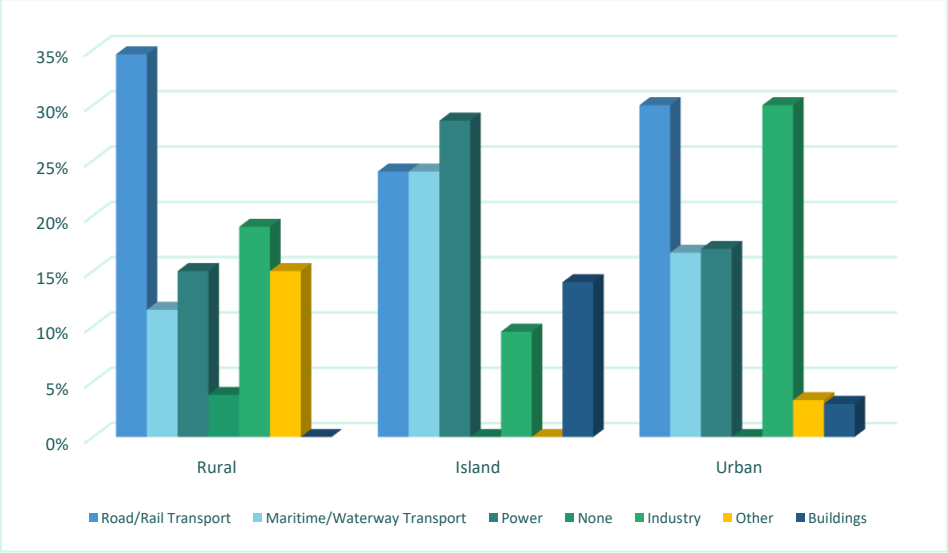



FIGURE 12: PROJECTED ROLE OF GREEN H2 IN THE TRANSITION OF DIFFERENT SECTORS - LANDSCAPE CLUSTERING

Delving deeper into the details provided by respondents, a few trends emerge.

In the Scottish Islands area, hydrogen is considered to be a flexible carrier of green energy that can be used in a variety of cases where electricity or other forms of green energy are not practical. Hydrogen also is considered to have the potential to be produced close it its end use which reduces transport or grid costs and promotes local economic resilience. “The clearest example in the Scottish islands area is in marine transport on which the islands rely for almost all physical communications and trade. These are heavily carbon-intensive and cannot easily be switched to other green energy sources like electricity. The conversion of the Scottish island marine transport links to hydrogen will have the additional benefit of reinforcing the economic resilience of the islands, unlike the current use of marine diesel, all of which has to be imported”.

In other islands settings such as Cyprus, Madeira and Greek islands, the local storage potential for hydrogen is highlighted as a key benefit, enabling to exploit energy which would otherwise be curtailed and coupling sectors with it (mobility, power, industry). In the Greek islands, hydrogen is considered as well to be able to provide a sustainable way of marine transport among the islands and especially in archipelagos.

In Italy, the Province of Mantova has approved an "Address" Act to identify the potential in the territory for the local production and utilization of green hydrogen. A suitable area around the Valdaro inland port has already been identified for the realization of a "Hydrogen Valley". At the moment it will be very soon promoted a "Hydrogen Observatory" for the realization of the activities leading to the implementation of this project. Remaining in the mobility sector in this region, the "Sapio Group" has been producing industrial and medical gases for 100 years. They are pioneering the application of hydrogen as an energy vector and fuel for sustainable mobility. Sapio produces hydrogen generated by natural gas plants capable of recovering CO2 (Carbon Capture) without any emissions into the environment.

In Ireland, a responder explains that as the current Irish electricity system is not very responsive and capacity challenges exist, the opportunity for offshore wind to produce clean energy is a large one for Ireland. As the DSO and TSO cannot cope with the increased demand for electricity (fossil led) of 22% of the total energy balance for Ireland, it will be difficult to cope for the 80% Renewable Electricity set for 2030 with an additional 5-6 GWh of capacity required to match demand. Transporting that energy using green hydrogen through a very young gas network (only 44 years old in Ireland) could be part of the solution.

In west Sweden, a multi-sector approach would enable green hydrogen to be utilised in various configurations:

- Large scale offshore wind parks that are connected to grids and electrolyzers;
- Hydrogen as fuel for their regional large refinery and chemical industries;
- Electrolysers placed within larger district heating systems to utilise heat;
- Ferries from/to Denmark and Norway;
- Hydrogen as carrier to eMethanol production utilised in maritime and industry;
- Biogas production utilised in reformer for hydrogen.

### 4.1.5 Barriers to the fast implementation of hydrogen

When asked about the barriers that prevent the uptake of green hydrogen, the main factor mentioned is the high cost for storage and transport of hydrogen (30%). The immaturity of end-use products arrives in second place with 22%, while competition with other technologies (such as batteries) and the fact that hydrogen would be an unfamiliar technology to end-users both recorded 19% of answers. The small scale of production units (electrolysers) does not seem to be a big challenge for the uptake of green $H_2$.

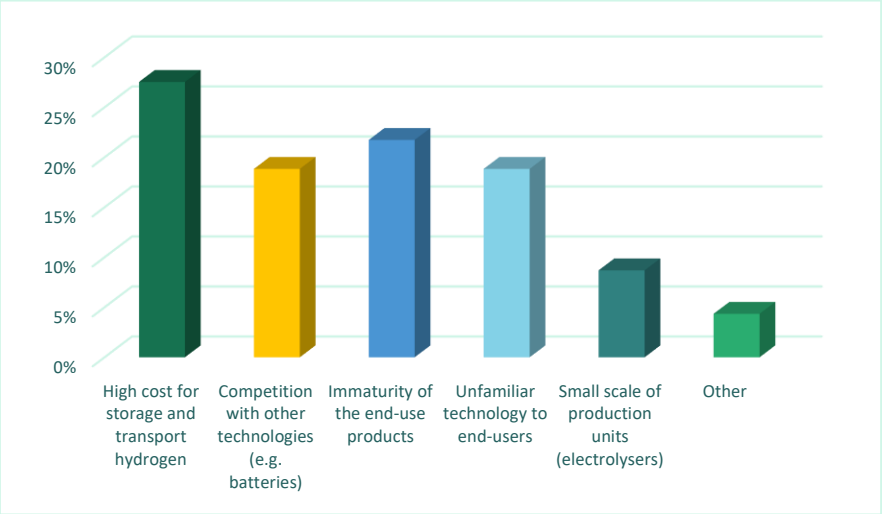



FIGURE 13: BARRIERS PREVENTING THE UPTAKE OF GREEN H2

Indeed, across Europe, the high costs for storage, transport, but also production of hydrogen remain an issue that will have to be faced collectively by raising offer and demand. To be economically viable, a surplus production of green electricity is needed, together with low electricity costs, which is currently not the case in most parts of the continent, although shares of renewables are rising. Members seem to agree that in the future, economies of the scale will be possible.

Other issues are the unreadiness of the infrastructure and the end-users who have not yet seen enough references and best practices to know that they can use hydrogen in their facilities.

A member also raised the attention on the production materials of electrolysers, in particular platinum, which is only produced in South Africa and Russia, and therefore also leads to higher costs.

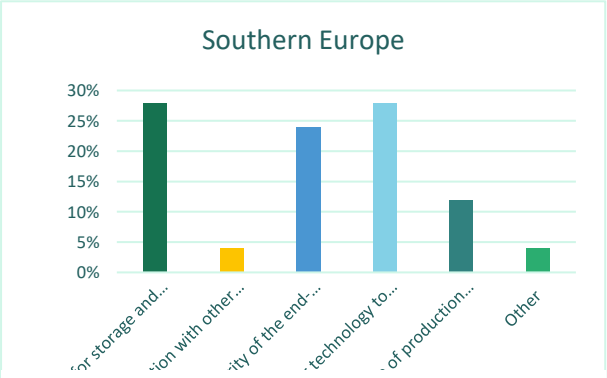



FIGURE 14: BARRIERS PREVENTING THE UPTAKE OF GREEN H2 - SOUTHERN EUROPE

The picture is roughly similar in all regions, except in the South, where respondents consider that the unfamiliarity of end-users is a bigger barrier than the competition with other technologies.

The situation is different again taking into account the density and type of areas. Competition with other technologies is an important challenge in urban areas while it is not in rural and island areas. However, in these areas,

the immaturity of the end-use products is more significant.

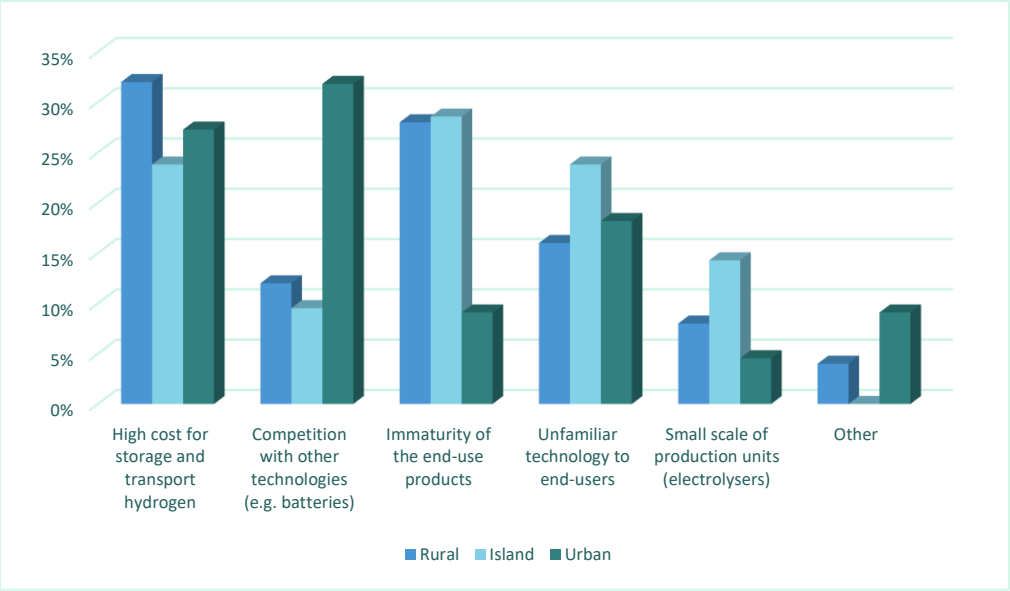
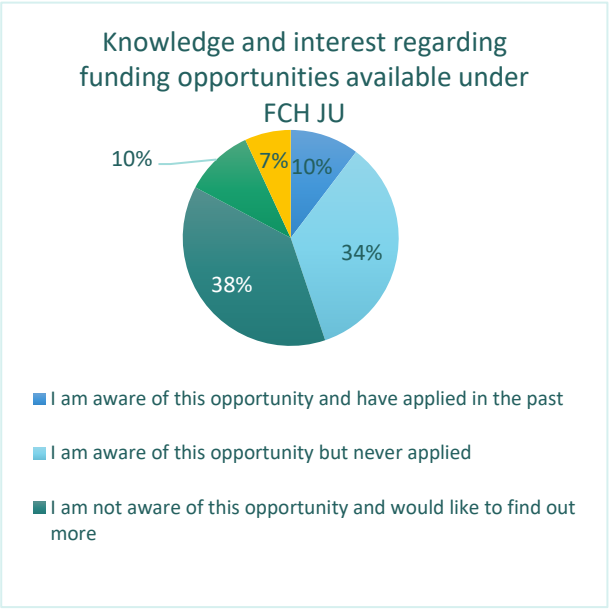



FIGURE 15: BARRIERS PREVENTING THE UPTAKE OF GREEN H2 - LANDSCAPE CLUSTERING

## 4.1.6 Funding opportunities




Although interested in green hydrogen technologies, only a few survey contributors (10%) declare that they have applied for funding under the FCH JU (now Clean Hydrogen Partnership) in the past. Among respondents, 38% are not aware of the opportunities provided by the partnership, which means there is still an information gap to fill both by the partnership directly and by FEDARENE through their communication channels[4].

Important disparities between regions and areas are at play here as well:

- 60% of respondents from Northern Europe were not aware of FCH JU/Clean Hydrogen JU calls;

[4] The call for proposals and activities of the FCH JU and new Clean Hydrogen Partnership have already been disseminated in the bulletin newsletters sent to FEDARENE members bimonthly via email, as well as through the Green Hysland project.

- 43% of Eastern members are not currently looking for EU funding opportunities in this sector;
- 100% of Western respondents declared having never applied themselves to a FCH JU call, 20% because they didn't know about it and 80% even though they were aware of the opportunity;
- Awareness about FCH JU calls is stronger is urban areas (70%) than in rural areas (20%) and islands (43%);
- Overall, island college respondents seem the most interested in the calls.

FIGURE 16: KNOWLEDGE AND INTEREST ON FCH JU FUNDING OPPORTUNITIES

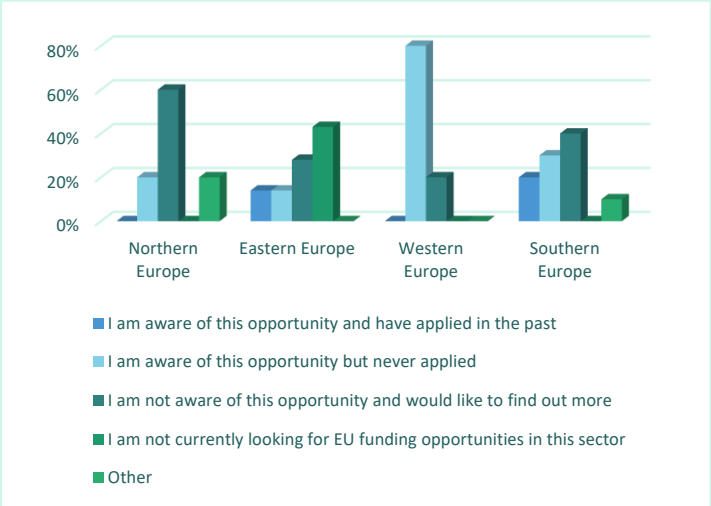



FIGURE 17: KNOWLEDGE AND INTEREST ON FCH JU FUNDING OPPORTUNITIES - REGIONAL CLUSTERING


FIGURE 18: KNOWLEDGE AND INTEREST ON FCH JU FUNDING OPPORTUNITIES - LANDSCAPE CLUSTERING

## 4.2 Road and rail transport

Concerning road and rail transport, the results shown on figure 19 display a potential for green hydrogen mostly in public transport (31%) and freight (27%) applications. Public authorities or private companies' fleet arrives third (16%). These trends were generally confirmed at regional/landscape level.

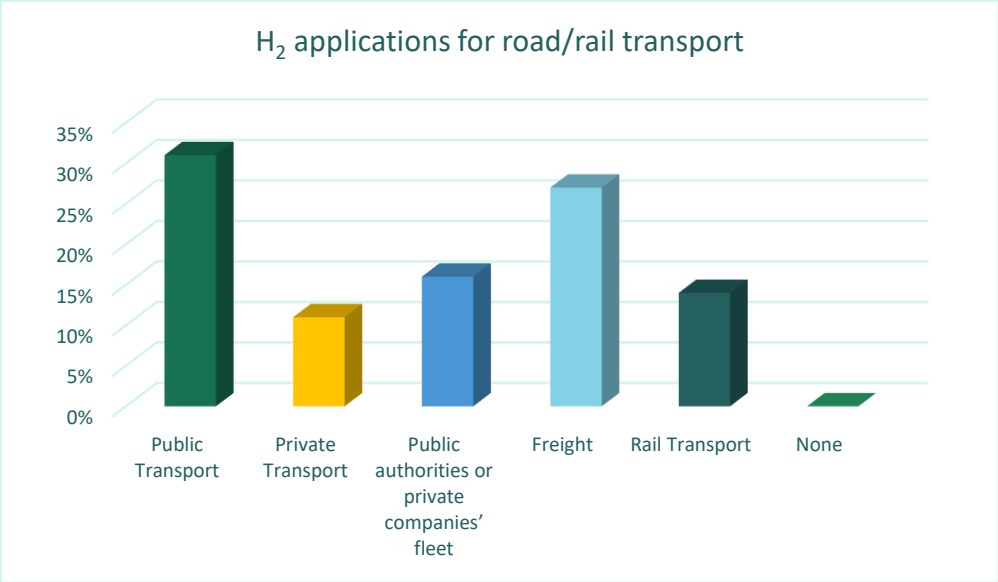



FIGURE 19: POTENTIAL OF GREEN H2 IN ROAD AND RAIL TRANSPORT APPLICATIONS

Some regional/national governments have set $H_2$ objectives for this sector (Hungary, Czech Republic, etc.). Nevertheless, some members question the efficiency of fuel cell technologies for commercial and small vehicles compared to batteries, considered the current energy losses observed, and think that $H_2$ would therefore be more useful for long haul vehicles.

In Auvergne-Rhone-Alpes, the main idea is to have multi-use H2 refuelling stations, for various types of transport. They are also looking at $H_2$ trains as an interesting option for non-electrified lines, which can be big consumers, and can therefore lower the production price.

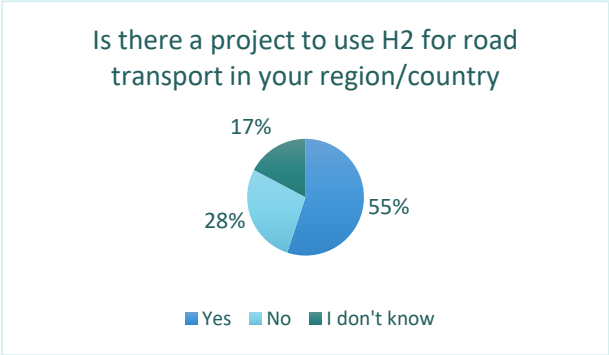



FIGURE 20: AWARENESS ON GREEN H2 PROJECTS FOR ROAD TRANSPORT

A small majority of respondents (55%) are aware of a project to use $H_2$ for road transport in their country/region.

For this question, it is interesting to look at the type of areas of respondents (figure 21), since for island members, the situation is the opposite: 57% declared that no road $H_2$ project was currently implemented (and 29% of them don't know). This could mean there is still a project gap to fill on European islands in this sector.

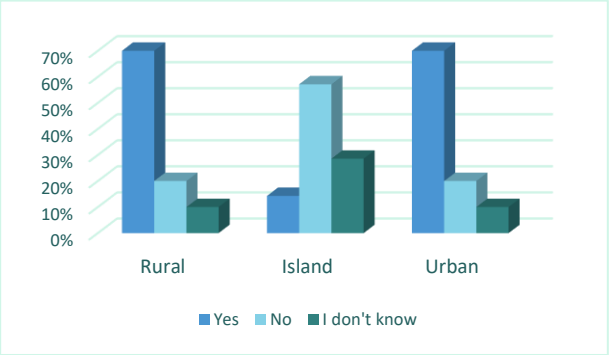



FIGURE 21: AWARENESS ON GREEN H2 PROJECTS FOR ROAD TRANSPORT - LANDSCAPE CLUSTERING

Some examples of projects cited:

- Lombardy Region, Italy: transport applications foreseen in the framework of a Hydrogen Valley funded by Next Generation EU. A first hydrogen train is foreseen between Brescia and Iseo; later around 40 hydrogen buses will be introduced into Brescia's fleet;
- Sweden: Volvo has demonstration projects and vehicles at its technical centre in Eskilstuna;
- Paris region: hydrogen buses in experimentation in Versailles, hydrogen buses fleet in Val-de-Marne near Creteil, retrofit of 2 heavy trucks, private trucks or commercial vehicles fleets…;
- Finland: Several green hydrogen plants in planning;
- Ireland: heavy goods vehicles and food product transportation, shipping for export;
- The HyTruck - Hydrogen Truck Austria research project;
- Military vehicles and hydrogen filling stations in Kranj, Slovenia.

Amongst respondents who answered no, members evoke the lack of pumps (Czech Republic: only 3 for the whole country) or the fact that there are aspirations, but no concrete plans yet (Hungary).

## 4.3 Maritime and Waterway Transport

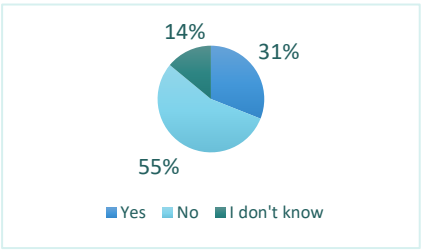



FIGURE 22: AWARENESS ON GREEN H2 PROJECTS FOR MARITIME/WATERWAY TRANSPORT

To the question of whether there was a project to use $H_2$ for maritime/waterway transport in their region/country, 55% replied no, as shown on figure 22. Southern and Rural areas seem to be lagging in this sector and islands are not especially advanced either, as only 14% declared that projects are being implemented this field. The North appears to be leading in maritime and waterway $H_2$ transport experimentations. As an instance, the Gothenburg Port (Sweden) has an electrolyser on4 MW installed.

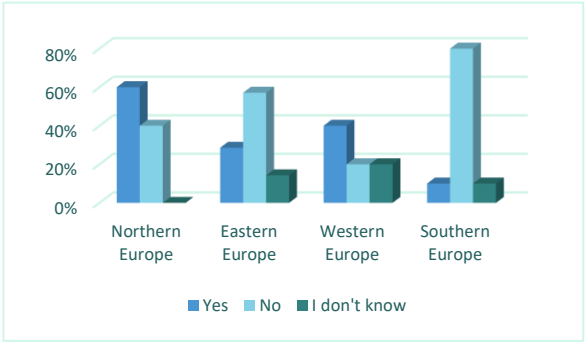



FIGURE 23: AWARENESS ON GREEN H2 PROJECTS FOR

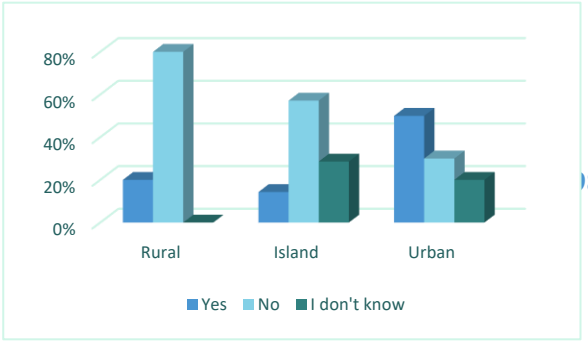



FIGURE 24: AWARENESS ON GREEN H2 PROJECTS FOR

When asked when hydrogen will begin to play a relevant role in maritime transport in their region, country, opinions vary:

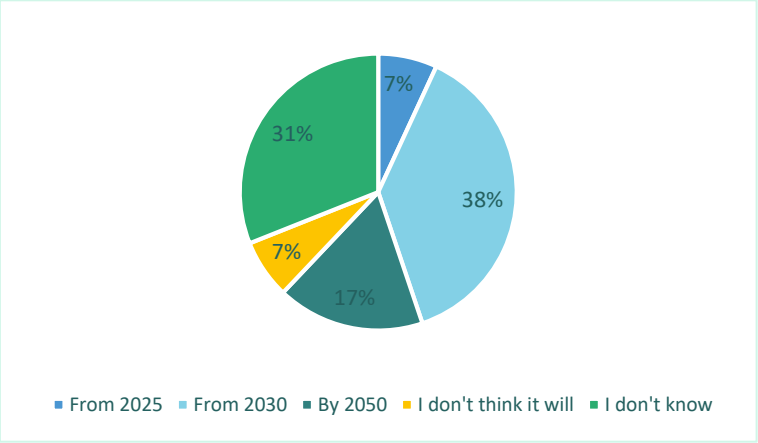



FIGURE 25: PROJECTED RELEVANT ROLE OF H2 FOR MARITIME TRANSPORT

Respondents from Northern Europe and Islands appear more convinced than others that $H_2$ will play a role in this sector, either from 2030 or by 2050.

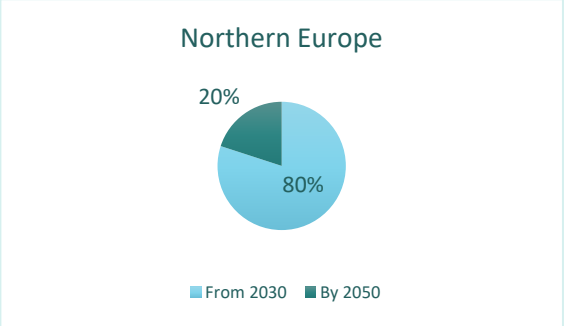



FIGURE 26: PROJECTED RELEVANT ROLE OF H2 FOR MARITIME TRANSPORT - NORTHERN EUROPE

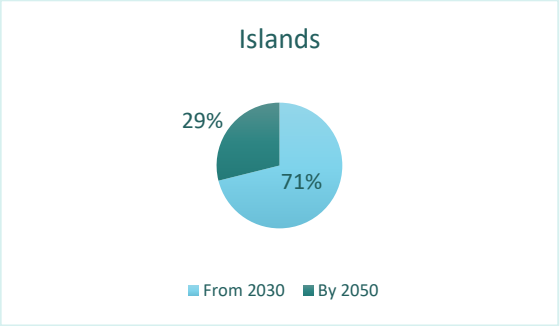



FIGURE 27: PROJECTED RELEVANT ROLE OF H2 FOR MARITIME TRANSPORT - ISLANDS

## 4.4 Power and Buildings

According to the results displayed from figure 30, two main benefits of green hydrogen emerge related to the energy transition: RES penetration (46%) and sector coupling (36%). Indeed, green $H_2$ offers the opportunity to store renewable energy. Sector coupling is also an undeniable advantage, with widespread electrification of end uses with renewable energies underpinning decarbonization.

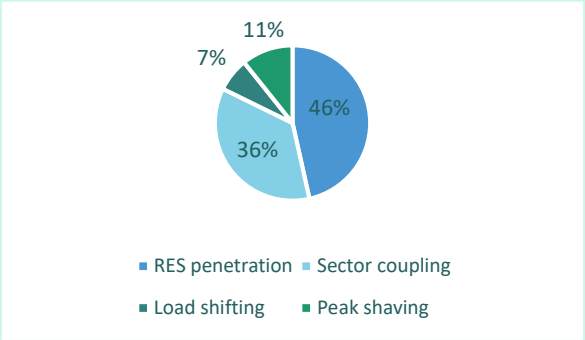



FIGURE 28: MAIN BENEFITS OF GREEN H2 RELATED TO ENERGY TRANSITION

Load shifting carried some weight as well for respondents from Northern Europe (40%), but not in other European regions.

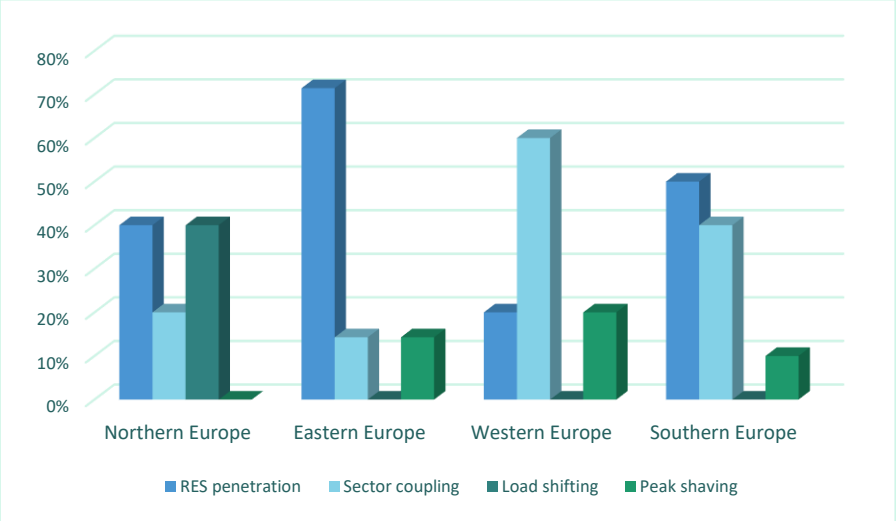



FIGURE 29: MAIN BENEFITS OF GREEN H2 RELATED TO ENERGY TRANSITION - REGIONAL CLUSTERING

# 5. Conclusions

According to the results of the survey green hydrogen is considered to play an important role in the decarbonization of the EU's energy system despite some remaining challenges, and FEDARENE members **consider this technology has a role to play in the energy transition**. Some survey contributors are already involved in **projects** (see section 4.1.2 Projects on p.7-8) or project proposals, and most of them are aware of projects taking place in their regions/countries.

The **main benefits** of green $H_2$ are considered to be:

- Energy storage and RES penetration;
- Sector coupling;
- Flexible carrier of green energy;

- Potential to decarbonize hard-to-abate sectors (steel industry or heavy transport).

The **main barriers**:

- high cost for storage and transport of hydrogen is mentioned several times. Especially in relation to maritime/waterway transport, the high costs of hydrogen and yet-to-be-achieved profitability compared to other technologies and energy sources was often mentioned. This comment from a respondent summarized the situation: "financial mechanisms, business models and legal frameworks have to be established and deployed."
- Immaturity of end-use products arrives in second place due to the fact that the hydrogen value chain is not yet stable and competitive, and with technological barriers and lack of references and best practices. "The greatest technological barriers are found at the end of the value chain, in the use of hydrogen as an industrial product or as a fuel for thermal consumption", writes a respondent." Another declares that there are few equipment ready for the direct use of hydrogen in the market.
- competing technologies (such as batteries) are well developed and widely used and
- hydrogen is considered an unfamiliar technology to end-users.

The different regions of Europe and the densities/types of areas are facing **different situations** and therefore have different visions of the role of green $H_2$ and related benefits. The most striking disparities identified were the following:

- Competition with other technologies is an important challenge in urban areas while in other areas, the immaturity of the end-use products is a bigger issue;
- Overall, interest and readiness for market update for hydrogen technologies seem lower in Eastern Europe than in other regions of Europe;
- Although Northern countries declared that no green $H_2$ objective was set for their region/country, they are still very much interested in the technology and in developing projects. This was especially clear for the maritime/waterway transport sector, where 100% of respondents from the region declared that green H2 had a role to play in the sector (section 4.1.4 Projected future role of hydrogen in different sectors, p.10).

In terms of **future opportunities**, we have noted that urban areas seem more advanced in terms of $H_2$ projects compared to other parts of Europe, which indicates a void yet to fill. Similarly, only 10% of respondents had already applied to FCH JU calls in the past and 38% are not aware of the opportunities provided by the partnership so more projects can be initiated in the future with additional promotion and support for the targeted audience.

Islands are not yet very advanced in green hydrogen, still most of them are very interested in the development of hydrogen projects. Islands should be supported to take the role as testbed of innovative technologies before deploying the solutions on the mainland among others by highlighting opportunities and connecting the essential stakeholders.

# Annex: survey questionnaire


**Welcome to FEDARENE's 2022 Green Hysland survey.**

The goal of this survey is twofold:
1) to assess the awareness and interest of FEDARENE members regarding the use of green hydrogen
2) identify trends at local and regional level across Europe regarding green hydrogen production and uses.

Although this survey is meant to focus essentially on road & maritime transport, responders have the opportunity and are encouraged to provide feedback on other sectors as well.

Another survey will be organised in 2025 at the end of the Green Hysland project to compare results, awareness, interest and trends.

The results of this first survey will also inform upcoming project activities led by FEDARENE targetting island and EU stakeholders working in the field, notably the organisation of yearly webinars and workshops and the development of the project's exploitation strategy.

If you would like to know more about Green Hysland, you can visit the website: https://greenhysland.eu/

If you have questions about the survey before filling it out, you can contact us at fedarene@fedarene.org

## Contact details

* Name

* Email
@

* Organisation

## 1. Assessing interest and awareness on Green Hydrogen

* **1.1.** Do you know the difference between blue, grey, and green hydrogen?
- Yes
- No

*If you answered no and would like to find out about the different types of hydrogen, you can read IRENA's publication on Green Hydrogen (p.8-9).*

* **1.2.** Taking into account EU's 2050 carbon neutrality objective, do you think green hydrogen can contribute to decarbonising EU's energy system?
- Yes
- No

* **1.2 bis.** Please explain your answer

* **1.3.** In your region, green hydrogen has a role to play in the transition of the following sector(s):
- [ ] Road/Rail Transport
- [ ] Maritime/Waterway Transport
- [ ] Industry
- [ ] Power
- [ ] Buildings
- [ ] Other
- [ ] None

**1.3. bis** Please give some examples from your region if possible. If you answered "none", explain why:

* **1.4.** Are you aware of any hydrogen project currently being implemented in your region?
- ( ) None
- ( ) Between 1 and 3
- ( ) More than 3
- ( ) I don't know

**1.4. bis** If possible, please share more details (links are welcomed):

* **1.5.** Did your region/country set a specific objective in its energy strategies regarding green hydrogen?
- ( ) Yes
- ( ) No

**1.5. bis** If possible, please share more details (links are welcomed):

* **1.6** Are you considering implementing such project yourself in the near future?
- ( ) Yes
- ( ) No

**1.6. bis** If not can you explain why? If yes, you are welcome to give also more details here.

*
**1.7.** Which do you believe are the main barriers for the uptake of green hydrogen?

- [ ] High cost for storage and transport hydrogen
- [ ] Small scale of production units (electrolysers)
- [ ] Competition with other technologies (e.g. batteries)
- [ ] Immaturity of the end-use products
- [ ] Unfamiliar technology to end-users
- [ ] Other

**1.7. bis** Please explain your answer

* **1.8.** What is your knowledge and interest regarding funding opportunities available under the Fuel Cells and Hydrogen Joint Undertaking?
- I am aware of this opportunity but never applied
- I am aware of this opportunity and have applied in the past
- I am not aware of this opportunity and would like to find out more
- I am not currently looking for EU funding opportunities in this sector
- Other

**1.8. bis** If other, please specify:

## 2. Green Hydrogen potential in Road and Rail Transport

* **2.1.** In your region/country, for which type of road transport do you see potential applications of hydrogen:
- Public Transport
- Private Transport
- Freight
- Rail Transport
- Public authorities or private companies' fleet
- Other
- None

**2.1. bis** Specify if needed

* **2.2.** Is there a project to use hydrogen for road transport in your region/country?
- Yes
- No
- I don't know

**2.2. bis** Please share more details if possible (links are welcomed:

## 3. Green Hydrogen potential in Maritime and Waterway Transport

* **3.1.** Is there a project to use hydrogen for Maritime/Waterway Transport in your region/country?
- Yes
- No
- I don't know

**3.1. bis** Please share more details if possible (links are welcomed):

* **3.2.** When do you think hydrogen will begin to play a relevant role in the maritime transport in your region/country?
- I don't think it will
- From 2025
- From 2030
- By 2050
- I don't know

**3.2. bis** Please explain your answer

## 4. Green hydrogen potential for Power and Buildings

* **4.1.** Which do you consider the most important benefit for green hydrogen regarding energy transition:

- ○ Load shifting
- ○ Peak shaving
- ○ RES penetration
- ○ Sector coupling

**4.1. bis** Please explain your answer

# GREEN HYSLAND

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info@greenhysland.eu

Clean Hydrogen Partnership

This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No 101007201. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation programme, Hydrogen Europe and Hydrogen Europe Research.