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RENEWABLE  
**THE GREEN**  
**HYDROGEN ENERGY**

**IN SPAIN**

FLANDERS INVESTMENT & TRADE MARKET SURVEY

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# THE GREEN HYDROGEN ENERGY

## IN SPAIN

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# TABLE OF CONTENTS

## EXECUTIVE SUMMARY

<b>1.</b>	Introduction.....	4
<b>2.</b>	Green hydrogen .....	5
2.1	What it is and how it is produced	5
2.2	Key players against climate change	5
<b>3.</b>	Spanish production .....	6
3.1	Spain, a great place for green hydrogen	6
3.2	Spanish and European roadmap	7
<b>4.</b>	Programmes, projects and funding.....	9
4.1	Hydrogen project in Spain	9
4.1.1	HyTunnel-CS	9
4.1.2	Metrology for Hydrogen Vehicles	9
4.1.3	H2 Ports	11
4.1.4	Inn.Balance Automotive Fuel Cell	11
4.1.5	Heaven	12
4.1.6	POCTEFA h2PiyR - Pyrenees, Zaragoza, Fraga and Tarragona	12
4.1.7	Iberdrola Puertollano Plant to Produce Green Hydrogen	13
4.1.8	Whitlee Wind Farm	14
4.1.9	DEMO4GRID	14
4.1.10	Life Sustains Huts - Bachimaña, Aragon	15
4.1.11	Seafuel – Tenerife	15
4.1.12	Sun2HY - Repsol Technology Lab, Móstoles (Madrid)	17
4.1.13	Green Hysland - Island of Mallorca (Balearic Islands)	17
4.1.14	CPV4H2	19
4.1.15	EveryWh2ere	19
4.2	Spanish hydrogen map	20
4.3	Other projects	22
4.3.1	ENDESA	22
4.3.2	ENDESA and NATURGY	23
4.3.3	There H2 Offshore - Maritime Transport	23
4.3.4	Madrid - Fast refuelling	23
4.3.5	Barcelona - Hydrogen Buses	23
4.4	Hydrogen associations and foundations	24
4.4.1	APPICE - Spanish Fuel Cell Association	24
4.4.2	AeH2 - Spanish Hydrogen Association	24
4.4.3	Centro Nacional del Hidrógeno - National Hydrogen Centre	26
4.4.4	AHMUR - Asociación Sectorial del Hidrógeno Verde de la Región de Murcia Green Hydrogen Sector Association of the Murcia Region	27















*Stichting Koninklijk Nederlands Normalisatie Instituut* (Royal Netherlands Standards Institute Foundation); the *National Physical Laboratory* in the UK, where most of the project is carried out; *Air Liquide*, which produces about 1 million tonnes of hydrogen per year for steel, glass and food but mostly for refineries; AP2E which is a producer of gas analysis instruments based on *OFCEAS* (Optical Feedback Cavity Enhanced Absorption Spectroscopy) and *LPS* (Low Pressure Sampling) technologies; *CASCADE Technologies*, a leading manufacturer of gas analysers and monitoring systems using *Quantum Cascade Laser* (QCL) technology, a technology that is a game changer in gas analyser performance thanks to its increased sensitivity, speed of response and fingerprinting capability; the *Spanish Meteorology Centre* which provides the project with facilities and expertise in the preparation of compressed gas mixtures according to the gravimetric method described in the ISO 6142-1 standard, in addition, its analytical facilities consist of *GC-TCD*, *GC-FID*, *GC-MS* and *GC-PDHID* chromatographic techniques together with *FTIR spectroscopy*, *EMPA-Material Science & Technology*, a public research and service institution for materials science and technology; *FORCE Technology*, which is responsible for developing and testing a method to validate filling stations against relevant legal standards and regulations; the *Foundation for the Development of New Hydrogen Technologies* in Aragon, a private non-profit organisation promoted by the Regional Government of the Autonomous Community of Aragon in Spain, other public bodies and private companies, where the foundation's board of trustees is made up of 71 actors belonging to sectors of the economy such as automotive, chemical, energy generation, educational finance, engineering, research and development centres and real estate; *IFE*, which is dedicated to the modernisation, system simulation, design, controls, construction and testing of integrated hydrogen storage systems based on renewable energies, within the project, *IFE* will provide access and utility to *the HYNOR*, a small-scale green hydrogen reporting station and test centre for hydrogen technology; *ITM POWER - Energy Storage & Clean Fuel*, which has experience in building and operating HRS in the UK and the US, will help project partners understand and understand the challenges of real-world metering, in addition to, providing HRS for the development of sampling and testing protocols and providing the *Teddington HRS* as a real-life test site; *Justervesenet*, the *National Institute of Meteorology and Legal Metrology Organisation of Norway*, their expertise in research and application of methodology will be key to the project; *Linde*, one of the world's leading gas suppliers with a very high range of hydrogen activity, from the construction of steam reformers to gaseous tube trailers; *METAS*, the *Swiss National Metrology Institute* which disseminates harmonised units of measurement that are internationally recognised for their accuracy; *NEL-Flow Measurement Services*, holder of the UK national standards for flow measurement and which has a wide range of testing facilities, experience and expertise relevant to the project proposal; *RISE*, *Sweden's national laboratory for volume*, flow and temperature; *Shell*, an Anglo-Dutch energy company with a worldwide presence in an economically, energetically, environmentally and socially responsible manner; *SINTEF*, offering expertise in numerous projects funded by the company's *Fuel Cells and Hydrogen 2 Joint Undertaking (JU) programmes*; *VSL - Dutch Metrology Institute*, providing laboratories with a wide range of primary and secondary flow standards and *CESAME-EXADEBIT*, an internationally renowned laboratory in the field of gas flow measurement.

<https://hidrogenoaragon.org/en/proyectos/metrohyve-en/>

Spanish companies involved in the project: *The Foundation for the Development of New Hydrogen Technologies in Aragon and the Spanish Metrology Centre*.

### 4.1.3 H2 Ports

Logistics infrastructures such as ports, inland waterways, and logistics platforms, among other things, as well as everything related to maritime transport, are essential factors and elements for placing the European Union at the top of the world's developed areas. The importance of this strategic sector is related to the quality of life of European citizens and to the EU's competitive capacity, since, as we have said, maritime transport and the port sector are an important driving force for job creation and for the economic well-being of European countries. Therefore, innovation in efficiency and sustainability of ports is a key issue.

The H2Ports project aims to demonstrate and validate the Port of Valencia in port operations with two innovative solutions based on FC technology and a mobile hydrogen supply station with a design specifically designed for this project.

A Reach Stacker<sup>1</sup> to be tested at MSC Terminal Europe (part of the Grimaldi Group) has been selected as one of the best equipped for the use of Fuel Cells in port facilities. The project aims to put the equipment into daily operation during two years of real operational activity, and, in addition, to analyse the way in which the energy efficiency, performance and safety of the operations with Fuel Cells port equipment is developed. Cross-cutting issues such as the human factor, legislation, future deployment of the technology on a fully commercial basis and awareness of the potential of adopting hydrogen as an alternative fuel in port equipment will be considered.

Funding for the project is provided by the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement No. 826339. It is supported by the European Union's Horizon 2020 research and innovation programme, Hydrogen Europe, and Hydrogen Europe research.

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### 4.1.4 Inn.Balance Automotive Fuel Cell

The main objective of the project is to boost hydrogen mobility by developing a new generation of highly efficient fuel cell balance of plant components. The components are added to a new fuel cell system aiming to achieve improved efficiency and reliability of fuel cell powered vehicles.

The project is funded for four years (January 2017 - January 2021) by the Fuel Cells and Hydrogen 2 Joint Undertaking under grant agreement no. 735969 within the framework of the European Union's research and innovation programme, Horizon 2020.

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<sup>1</sup> Reach Stacker, a reach stacker used for handling intermodal cargo containers in small terminals or medium-sized ports.

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**4.1.5 Heaven**

The H2020 HEAVEN project is based on designing, developing and integrating a high-power fuel cell-based powertrain using cryogenic technology into an existing 2-4 seater aircraft in order to test if it works in flight. In other words, the project proposes to design a modular architecture with modular systems that can be scaled up to other aircraft sizes and UAV applications.

The hydrogen storage will be based on cryogenic technology to try to achieve a gravimetric index of approximately 15% in order to obtain a hydrogen payload of between 10 and 25 kg to provide a range of autonomy to the demonstrator of between 5 and 8 hours.

In addition, the project will seek to leverage existing powertrain components and an aircraft demonstrator to achieve a successful overall LRT<sup>2</sup> at the end of this project.

The HEAVEN consortium is made up of large companies, SMEs and renowned research centres with extensive experience within the development of fuel cell technology for aeronautical applications that is backed up with participation in other relevant past H2020 and national projects.

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**4.1.6 POCTEFA h2PiyR - Pyrenees, Zaragoza, Fraga and Tarragona**

This is a project whose objective is to establish a hydrogen corridor through the Pyrenees thanks to the new stations that have been built and continue to be built in the cities of Zaragoza, Huesca, Fraga and Tarragona, in Andorra and in Pamiers (France). These will join the wings already built in Huesca (in the *Walqa Technology* Park) and Zaragoza (in the Valdespartera district) and the stations in the French towns of Rodez and Albi, which are in the process of being built.

There are 16 hydrogen fuel cell electric vehicles, eight vans, six passenger cars and two buses. These will serve as a demonstration that hydrogen is a good alternative to fossil fuels.

As for its financing, in the 1st call for projects of the Interreg V-A Spain-France-Andorra programme (*POCTEFA* 2014-2020), with a total budget of 3,847,799 euros, of which 2,395,788 euros come from ERDF

<sup>2</sup> Light rail transit (LRT) is a form of passenger urban rail transit characterized by a combination of tram and metro features.









Isolated regions, such as island territories, face specific challenges, such as the high cost of electricity and fuels and their high dependence on mainland infrastructures. The project will mainly focus on these regions, where about 30% of fuel consumption comes from local transport.

Within the project, the steps to be taken are:

- *Research*: studying new materials for seawater splitting with the aim of replacing and improving the efficiency of the process.
- *Hydrogenation*: The aim is to install a pilot hydrogen plant to produce hydrogen and supply vehicles using exclusively renewable energies.
- *Start-up and results*: After studying the viability of the transport system (private or public) and its subsequent conversion to the *SEAFUEL* hydrogen system.

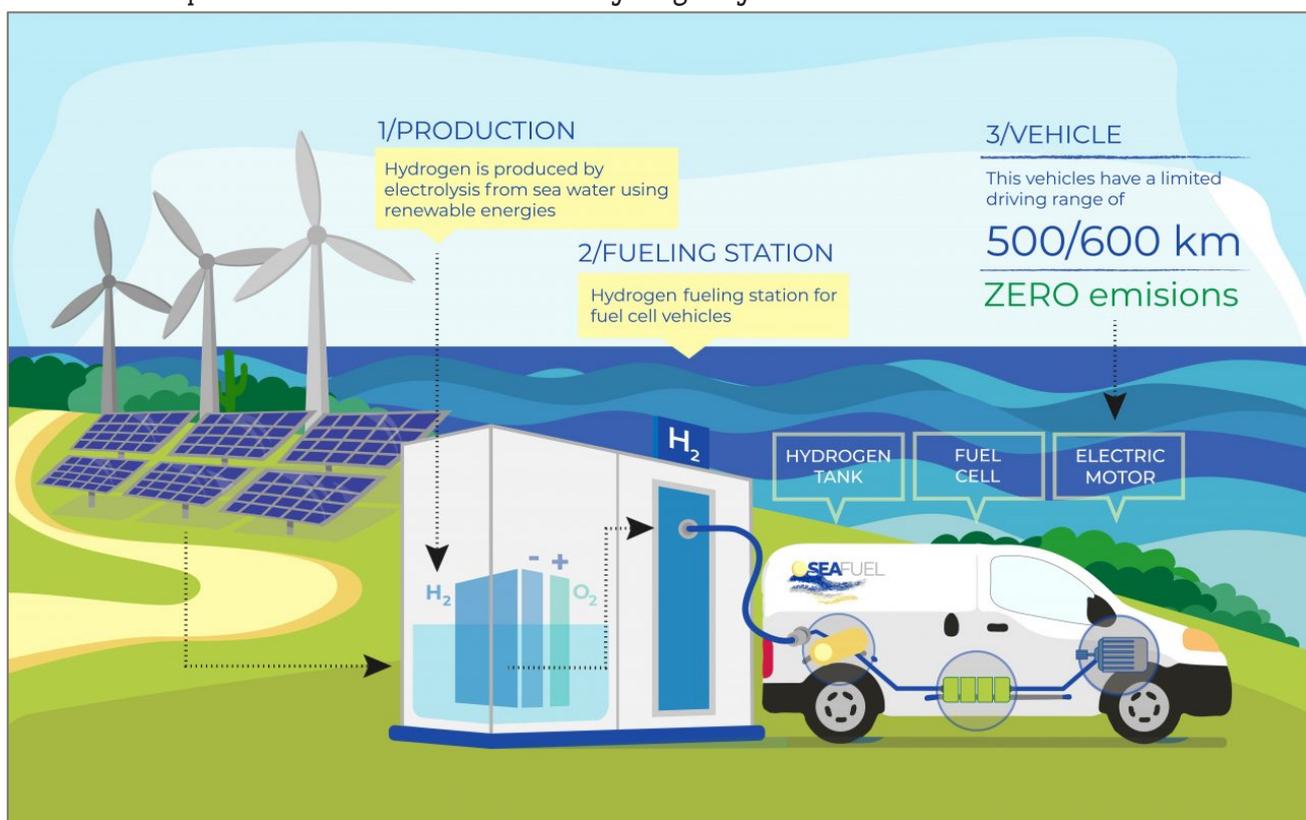


Figure 4. Supply to local transport. Image by SEAFUEL.

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<http://www.seafuel.eu/es/el-proyecto/>



and use of green hydrogen, setting 2030 as the target year for producing 4GW of production capacity and mobilizing a total investment of close to €8.9 billion.

Why Mallorca? The island, part of the Balearic archipelago in the Mediterranean Sea, has become an ideal location for this project. The project includes studies and business models to replicate the project on other islands both inside and outside the European Union.

The hydrogen produced will be prioritized for use in supplying fuel to bus fleets and fuel cell rental vehicles, generating heat and power for commercial and public buildings, supplying auxiliary power to ferries and port operations, and finally, the creation of a refueling station. In addition, the possibility is being considered that part of the hydrogen produced could be fed into the island's gas pipeline network through a Guarantee of Origin System, which would allow the gas supply to be decarbonised.

The investment required for this initiative is approximately 50 million euros, including the generation of renewable electricity and equipment for the end uses of green hydrogen.

The project is coordinated by *Enagás* and promoted by *Acciona*, *Cemex* and *Redexis* as part of a plan to reindustrialise *Cemex's* land in *Lloseta*. The development will be carried out in a green hydrogen generation plant owned by *Acciona* and *Enagás*. The Ministry of Industry, Trade and Tourism, together with the Ministry for Ecological Transition and the Demographic Challenge are supporting the project through the Institute for Energy Diversification and Saving (IDAE) and the Balearic Government. The consortium is made up of up to 30 partners from 11 different countries, nine of them from the European Union plus Chile and Morocco. The target year for developing a renewable hydrogen commendation in Mallorca and the Balearic Islands is 2050 in line with the environmental objectives set for that year. The duration of the project is estimated between 2021 and 2025, serving as an example for other island territories such as Tenerife in Spain, *Maderia* in Portugal, Aran in Ireland, *Ameland* in the Netherlands, and the Greek islands.

Given the economic downturn caused by the impact of COVID-19 within the tourism sector, the initiative will help to boost the diversification of Mallorca's regional economy and create new employment opportunities in the fields of green hydrogen and renewable energies.

The consortium consists of: *Acciona*, *the Dutch municipality ed Ameland*, *AMHYD*, *Aragon Hydrogen Foundation*, *AREAM Madeira*, *Spanish Hydrogen Association (AeH2)*, *Balearia - CEA*, *National Hydrogen Centre (CNH2)*, *Cotenaval*, *DAFNI*, *EMEC*, *EMT Palma*, *Enagás*, *Energy Co-operatives Ireland*, *Energy*, *Fedarene*, *Gasnam*, *H2 Chile*, *HyCologne*, *HyEnergy Transstore*, *Instituto Balears de Energía*, *the municipality of Lloseta*, *New Energy Coalition - NUJ Galway*, *Ports de Balears*, *Redexis*, *Universidad de les Illes Balears*, *Universidad de La Laguna (Tenerife)*.

[www.acciona.com/es/actualidad/noticias/green-hysland-mallorca-primer-proyecto-hidrogeno-verde-pais-mediterraneo-seleccionado-para-recibir-financiacion-europea/](http://www.acciona.com/es/actualidad/noticias/green-hysland-mallorca-primer-proyecto-hidrogeno-verde-pais-mediterraneo-seleccionado-para-recibir-financiacion-europea/)







### 4.3 OTHER PROJECTS

Endesa and the Foundation for the Development of New Hydrogen Technologies in Aragon are the entities most involved in the energy transition towards green hydrogen.

#### 4.3.1 ENDESA

Endesa, which was founded as "Empresa Nacional de Electricistas Sociedad Anónima" whose legal name is Endesa, S.A., is a Spanish company operating in the electricity and gas sectors.

The company submitted to the Ministry for Ecological Transition a series of up to 23 projects related to renewable hydrogen in the different phases of the hydrogen value chain worth more than 2.9 billion euros to start up 340 megawatts (MW) of power in electrifiers fed with 2,000 MW of renewable power. The peninsular electrolysis projects involve an aggregate investment of Euro 2,000 million for the construction of eight 315 MW capacity power plants in As Pontes, Huelva, Teruel, Almería, Tarragona, Valle del Ebro, Compostilla and Seseña.

Endesa estimates that around 620 jobs will be created during construction and 320 in the subsequent operation and maintenance phase (around 20 years). This is in addition to the employment related to the implementation of the renewable generation that will feed the electrifiers.

It is planned to carry out extra-peninsular projects with an investment of 900 million euros and a production of green hydrogen in generation plants such as Barranco de Tirijana, Granadilla and Alcudia through 25 MW electrifiers.

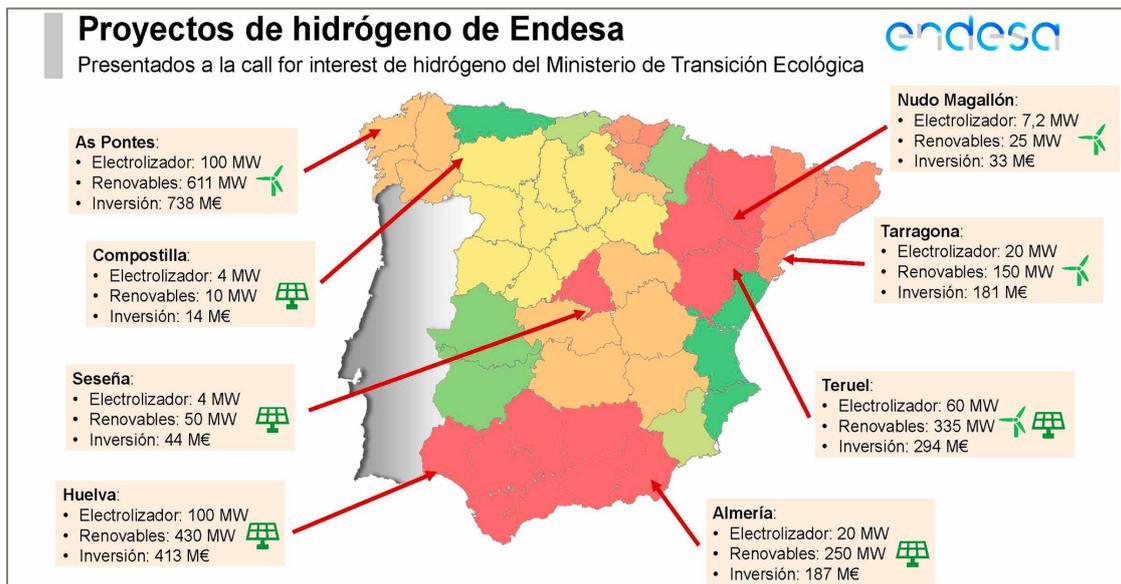


Figure 8. Endesa's hydrogen projects in Spain. Presented to the Ministry of Ecological Transition's Hydrogen Call for Interest. Source: Endesa.



## 4.4 HYDROGEN ASSOCIATIONS AND FOUNDATIONS

### 4.4.1 APPICE - Spanish Fuel Cell Association

“The aim of the Spanish Fuel Cell Association is to promote the scientific and technical development of this technology, to raise awareness of its potential at national and international level and to provide training and information to interested social agents”.

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### 4.4.2 AeH2 - Spanish Hydrogen Association

They encourage, promote and drive the industrial development of hydrogen technologies in Spain.

“The Spanish Hydrogen Association (AeH2) is the voice of the hydrogen sector in Spain. It represents more than 200 members from the entire hydrogen value chain, including renewable energy promoters, equipment and component manufacturers, engineering and EPC, Oil & Gas, industrial gases, transport, organisations linked to the sector, etc. It counts among its members the most active companies, institutions and researchers in Spain in these technologies, who are active in hydrogen and fuel cells and who are convinced that these technologies have great economic potential”.

Its initiatives include:

- Spanish Hydrogen and Fuel Cell Technology Platform

Its mission is to facilitate and accelerate the development and use in Spain of systems based on fuel cells and hydrogen, in their different technologies, for their application in transport, the stationary and portable sectors.

[www.ptehpc.org/](http://www.ptehpc.org/)

- Hydrogen Industry Sectoral Agenda

The Hydrogen Industry Sectoral Agenda aims to be a document agreed with all the agents in the sector, from public institutions, financial entities and standardisation bodies to the organisations that operate in the different links of the hydrogen value chain: production, storage or transport and end use.

[www.agendah2.es/](http://www.agendah2.es/)



3. *Asociación Costarricense de Hidrógeno (ACH2) - Costa Rican Hydrogen Association.*

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#### 4.4.3 Centro Nacional del Hidrógeno - National Hydrogen Centre

"The objectives of the CNH2 include the use of its facilities as a centre for the testing, characterisation, homologation, certification or validation of technological developments obtained by the productive sector to improve the competitiveness of companies and to promote the introduction of hydrogen and fuel cell technologies in the national market".

Among its collaborative projects funded by international organisations are:

1. FCHRAIL
2. areNH3a
3. MACHBETH
4. Electromovilidad Minera
5. Interreg Sudoe
6. H2 Ports
7. Kart H2

Collaborative projects funded by national entities:

1. CO2-DUAL
2. ECOPEM-DUAL
3. TRACA
4. ENHIGMA
5. CONFIGURA
6. INcorportaPEME
7. agrosofc-cim&3d
8. Pirbioclm
9. Hidroam
10. TOGETHER
11. VITALE

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## 5. LEGISLATION AND POLICIES

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### 5.1 REGULATORY INSTRUMENTS

#### - Administrative simplification and removal of regulatory barriers to hydrogen production

Hydrogen production is an industrial activity due to its classification as a chemical industry for the production of inorganic gas. It therefore involves the construction of infrastructures that can only be carried out on land classified as industrial, activities that are subject to environmental impact assessments regardless of the source used for hydrogen generation.

Within the Spanish Hydrogen Roadmap, the measures to address hydrogen production are:

1. “To distinguish the production of hydrogen from industrial processes from the production of green hydrogen, given that its environmental impact is radically different, in accordance with Royal Decree 815/2013, of 18 October, approving the Regulation on industrial emissions and development of Law 16/2002, of 1 July, on integrated pollution prevention and control.”
2. Analyse the different processes for the operation and implementation of small-scale green hydrogen production facilities and thus assess their simplification without undermining environmental protection and ensuring sustainability criteria.
3. Promote the development of regulatory measures to simplify and facilitate the deployment of direct electricity lines dedicated to the production of green hydrogen within the regulatory framework of the electricity sector, as well as hydrogen products transporting green hydrogen within the framework of the hydrocarbon sector regulations.
  - a. *“Initially, the deployment of this type of infrastructure should take into account criteria of proximity between the points of production, storage and supply of renewable hydrogen. It requires a modification of sectoral legislation, avoiding undermining the economic and financial sustainability of the electricity and gas systems.”*

#### - Establishment of a system of Guarantees of Origin (GoO5)

In order to utilise renewable sources in the production of green hydrogen, a mechanism of Guarantees of Origin is required to define the procedures and requirements, as well as the responsible body, for issuing Guarantees of Origin for renewable hydrogen, regardless of its storage route, its transport, and its end use.

4. Create a system of Guarantees of Origin for renewable hydrogen in collaboration with European institutions in order to provide adequate price seals to consumers.

#### - Promoting the competitiveness of green hydrogen

The cost of production is one of the main obstacles to the development of projects within the renewable hydrogen value chain, which is why it is necessary to identify levers and incentives to promote pilot projects, and once the potential and efficiency of these projects have been demonstrated, to promote and











## 7. ANNEX: SPANISH ECOSYSTEM OF COMPANIES WITH REPRESENTATION THROUGHOUT THE HYDROGEN TECHNOLOGY VALUE CHAIN

There are many Spanish companies and institutions, as well as foreign companies based in Spain, that have already worked and are working with hydrogen, so another of the great advantages for Spain is based on experience.

ORIGINAL ELECTROLYSIS EQUIPMENT MANUFACTURERS			
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