

# CATALOG OF TECHNOLOGICAL CAPABILITIES 2023

SPANISH HYDROGEN TECHNOLOGY  
PLATFORM



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# SPANISH HYDROGEN TECHNOLOGY PLATFORM



**The Spanish Hydrogen Technology Platform (PTe H2), called *the Spanish Hydrogen and Fuel Cell Technology Platform (PTE HPC)* until 2022, is an initiative promoted by AeH2 and supported by the Ministry of Science and Innovation (MICINN). Since its launch in 2005, the AeH2 has assumed the role of the PTe H2's Technical Secretariat.**

The **PTe H2** is responsible for **promoting innovation and technological development in the hydrogen industry in Spain**. The Platform promotes the participation of Spanish entities in R&D&I projects (national and international) related to this sector with the aim of developing proprietary knowledge and technology that will place the Spanish industry in a competitive position at international level.

**Its mission is to bring together representatives of the entire hydrogen value chain, building a scientific and technological space where valuable information can be shared.** In the platform, you can find detailed information of R&D&I projects, as well as recommendations and current developments in the field.

**With the support and collaboration of:**



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This report has been written following a thorough research process made by the Spanish Hydrogen Technology Platform (PTe H2).

Its design and layout has been made by ARIEMA Energía y Medioambiente S.L.

Updated in November 2023



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# Letter from the President

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Over the past few years, there has been an unprecedented growth in the global interest in hydrogen as a clean, renewable energy carrier. As a result, hydrogen technology has made great progress in a number of areas and has become essential in the process of decarbonization of emitting economic sectors such as power generation and transportation, amongst others.

In Europe, initiatives such as the REPowerEU Plan emerged, based on the implementation of the "Fit for 55" package, the European Green Hydrogen Strategy, the future European Hydrogen Bank and the Important Projects of Common European Interest (IPCEI). These initiatives have established a favorable framework for developing and advancing hydrogen technologies, recognizing their importance in achieving carbon neutrality and European energy security.

At a national level, the launch of several hydrogen projects are promoting the green hydrogen industry to grow. Among these projects, we can highlight the PERTE ERHA 2022, the +SE Plan (Plan Más Seguridad Energética), the National Integrated Energy and Climate Plan (PNIEC) 2021-2030 and the Hydrogen Roadmap.

The Spanish Hydrogen Technology Platform (PTe H2) has continued to grow and has consolidated itself as a large technological network that brings together organizations belonging to the entire hydrogen value chain, fulfilling its fundamental role of driving innovation and technological development in the field of hydrogen in Spain.

It is important to highlight that the PTe H2 has launched a new chapter in the Spanish Hydrogen Technology Platform (PTeH2)

Thanks to a new grant from the State Research Agency (AEI). This opportunity has led to a restructuring of the Platform and a rebranding that reflects the new accelerated pace of hydrogen activities and projects in Spain.

Regarding initiatives at the national level, PTe H2 has participated, since its foundation, in the creation of the "Alliance for the use of H2 in aviation" promoted by the Ministry of Transport, Mobility and Urban Agenda (MITMA). This alliance highlights our determination to explore new boundaries in the field of aviation through the use of hydrogen.



In addition, the Ministry for Ecological Transition and Demographic Challenge (MITERD) has created the "H2 Renewable Advisory Group" (GAHR), and we are proud to participate in subgroup IV focused on "H2 Technology and Value Chain". This collaboration demonstrates our commitment to a comprehensive approach to the development of hydrogen technologies at the national level.

In the international field, the Ministry of Science and Innovation (MICINN) has joined efforts in the "Mission Innovation" initiative and has entrusted us to lead the "Clean H2 Mission", through coordination with ALINNE (Alliance for Energy Research and Innovation). In this context, our efforts are focused on hydrogen valleys and collaboration with Latin America, promoting innovation and research in these areas. The Platform's contribution to this initiative not only strengthens the position of PTe H2 on the international scene, but also underlines its crucial role in the search for and promotion of advanced and environmentally friendly energy solutions.

Each of these milestones represents a significant step towards building a more sustainable future, with hydrogen as a main player.

In this favorable and demanding context for the development of the hydrogen sector, as president of PTe H2, it is a pleasure for me to present this document in which a catalog of technologies and reference entities, which are part of our Platform, and that make up the structure of the R&D&I ecosystem of the hydrogen sector in our country, is exposed. With it we intend to enhance the purposes of the PTe H2, making known the R&D&I activities carried out by our members, promoting possible projects and collaborations, as well as promoting the technologies that we already have in Spain in the field of hydrogen.

For the elaboration of this catalog, we have had the collaboration of the members of the Platform, to whom I would like to express my gratitude for their experience, knowledge and vision, as well as my congratulations for the great work they do, which is reflected in this document. Their role is essential to place our country in a position of competitive leadership in the international arena in terms of hydrogen technologies.

Finally, on behalf of all the member of the PTe H2, I would like to thank the support of the State Research Agency (AEI) to our platform in particular, as well as to recognize its fundamental work in the strengthening and consolidation of Spanish science and technology, especially in the current context of great momentum that the technologies we promote from PTe H2 are going through.

We are certain that the energy transition is leading us irremediably towards a hydrogen economy, and we can say with certainty that a promising future of great opportunities for our sector is opening up before us.

**Antonio González García-Conde**  
**PTe H2 President**





# CATALOGUE OF MEMBERS AND AVAILABLE TECHNOLOGIES

**PTe H<sub>2</sub>**  
PLATAFORMA TECNOLÓGICA ESPAÑOLA DEL HIDRÓGENO

The Spanish Hydrogen Technology Platform's Technology Capabilities Catalogue has two objectives:

**In the first place, it aims to publicise the member entities of PTe H2 that make up the structure of the R&D&I ecosystem of the Hydrogen Sector.**

In addition, **its participation in each of the working groups of the Spanish Hydrogen Technology Platform** is indicated by means of the symbology added below:



#### **Working Group Hydrogen storage, Transportation and Distribution**

The WG aims to analyse and study the storage capacity of renewable surpluses in the form of hydrogen, as well as the potential use of the national natural gas network for storage, transport and distribution of hydrogen.



#### **Working Group Hydrogen Production**

The WG aims to analyse and study Spain's potential to produce hydrogen, especially from renewable energy sources. Developing and optimizing different methods of hydrogen production will be fundamental to implementing this versatile energy vector on a large scale and to bringing its economic, social and environmental benefits closer to the Spanish society.



#### **Working Group Uses in Mobility**

The WG aims to study hydrogen as an alternative fuel for emission-free transport during its use in fuel cell vehicles. It will also identify the main barriers to the implementation of this zero-emission alternative for mobility and strategies to overcome them.



#### **Working Group Uses in Industry**

The WG aims to study hydrogen as a raw material to produce thermal and electrical energy.



#### **Working Group Other uses for Hydrogen**

The WG aims to analyse the R&D&I needs for hydrogen in all uses not defined in any of the other groups, such as residential projects.

In the second place, the Catalogue seeks to **publicise the technological products or innovative production processes associated with the Hydrogen Sector offered by each entity described above.**

includes a description of every technology and its main data (innovative aspects and advantages, level of technological maturity, industrial property rights, and type of collaboration offered).

**The first and second level technological sectors** in which the described technology is included are indicated, showing at the top of each tab the first level sectors by means of the symbology that is added below:



#### **Hydrogen Production Sector**

Electrolysis of water; Methane Reformed-SMR; Methanol reforming; Biomass; Other.



#### **Hydrogen Storage Sector**

Compressed gas in tanks; Liquid hydrogen; Compressed gas in underground caverns; Metal hydrides; Hydrogen carriers; Other.



#### **Hydrogen Distribution Sector**

Underground gas pipelines; Pipes; Maritime distribution (compressed, liquid or processed gas); Other.



#### **Refuelling Infrastructure Sector**

In situ hydrogen production; Compression; Storage; Dispensed; Other



#### **Transport Sector**

Automobile; Heavy vehicle; Railway; Aviation; Maritime; Other.



#### **Industrial Sector**

Green hydrogen as a raw material; Industrial cogeneration systems (GHP); Heat production in thermal power plants; Other.



#### **Residential/Urban Sector**

Energy use; Thermal use; Microgeneration for domestic use (mCHP); Other.



#### **Energy Sector**

Production and storage of energy coupled to the electricity grid; Injection of H2 into the gas network.



#### **Other Sectors**



Storage, transportation and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

AICIA is a Technological Center linked to the Higher Technical School of Engineering of Seville, whose purpose is to promote, guide and develop industrial research with the basic objective of benefiting society and industry both at Andalusian and international level. It has national and regional qualification as an Innovation and Technology Center (CIT). AICIA's work teams stand out for offering technological and innovation services to companies, as well as enhancing the competitiveness of its clients and contributing to the development of society through R+D+I activities. AICIA has research laboratories in the different branches of its activity, as well as agreements for the joint use of the research laboratories of the Higher Technical School of Engineering of the University of Seville.

## Entity data

**Type:** Technological Center

**Size:** > 100 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU

**National:** CDTI, MITECO, MICINN

**Regional:** PAIDI



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## Activities and experiences in R&D&I

Micro-grid testing of renewable energy integration with battery and hydrogen storage.

Experimental testing and characterization of PEM fuel cells: IV curve, Electrochemical Impedance Spectroscopy (EIS), distribution of temperature and current density, local water content and distributions (Neutron Radiography). Durability analysis.

CFD (Computational Fluid Dynamics) modeling and simulation of reformers, metal hydrides, PEM and SOFC fuel cells, PEM and SOEC electrolysers, cooling systems.

Water management in PEM fuel cells. Design, development and manufacturing of PEM fuel cell prototypes up to 1 kW.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 Million€**

## Technologies offered

Microgrid test bench for integration of renewable energies with battery storage and H<sub>2</sub>.

PEM fuel cell test bench.

SOFC fuel cell and SOEC electrolyser test bench.

Computational Fluid Dynamics (CFD) software for advanced design in hydrogen technologies.

3D bipolar plate utility model for additive manufacturing.



## Description of the national initiatives in which the entity participates

- Spanish Hydrogen Technology Platform (PTe H2)
- Andalusian Hydrogen Cluster (Clúster Andaluz del hidrógeno)
- Alliance for the Use of Green Hydrogen in Aviation (Alianza para el Uso del Hidrógeno Verde en la Aviación)
- Railway Innovation Hub - Hydrogen Strategic Line in the railway sector (Línea Estratégica Hidrógeno en el sector ferroviario)

## Description of the international initiatives in which the entity participates

- European Energy Research Alliance – Joint Programme Fuel Cells & Hydrogen
- International Energy Agency's Advanced Fuel Cells Technology Collaboration Program
- European Clean Hydrogen Alliance
- Task 24 "Wind-hydrogen" of the International Energy Agency's Hydrogen Implementing Agreement

# Microgrid test bench for integration of renewable energies with battery storage and H<sub>2</sub>



## Technology description

AICIA has a microgrid that integrates elements of electrical and thermal energy production through solar energy with energy storage systems in batteries and hydrogen technology. This microgrid makes it possible to analyse energy management strategies, test components and model equipment.

Among the activities carried out, the following stand out:

- Optimisation of energy flows.
- Comparison of short/long-term storage systems.
- Definition and comparison of control strategies and control modes.
- Simple control strategies for microgrids with operational reliability.
- Microgrids and thermal energy storage.
- Integration of renewables in industries with discontinuous processes using microgrids.
- Development of a dynamic simulation tool.
- Effects of solar prediction systems on the behaviour of a microgrid.

## Technology information

**Maturity level:** Laboratory validated

**Industrial property rights:** No

**Type of collaboration offered:** R&D collaboration agreement, service provision agreement

## Applications sectors

- **H<sub>2</sub> Production:** Alkaline Electrolysis
- **H<sub>2</sub> Storage:** Metal hydrides
- **Residential/urban:** Energy use, thermal use, microgeneration





Transport



Residential/  
Urban



Energy

## Technology description

The PEM fuel cell test bench offers the following capabilities:

- Possibility to test single cells and small stacks of up to 7 cells and 500 W maximum.
- Active areas of single cells and stacks from 25 cm<sup>2</sup> to 150 cm<sup>2</sup>.
- Current density range up to 2.5 A/cm<sup>2</sup>.
- Operation in flow-through and dead-end mode.
- Possibility of operating with oxygen or air as oxidant at the cathode.
- Control of cell temperature and gas supply, pressure, flow rate (stoichiometry) and relative humidity of gases.
- Individual cell voltage monitoring.
- EIS/FRA for Electrochemical Impedance Spectroscopy.
- CDM current density sensors for local current density and temperature measurements at different points in the cell.

## Technology information

**Maturity level:** Laboratory validated

**Industrial property rights:** does not apply

**Type of collaboration offered:** Experimental testing and characterisation of PEM fuel cells (single cells and small stacks)

## Applications sectors

- **Transport:** PEM fuel cells in automotive
- **Residential/urban:** PEM fuel cells in micro-CHP systems
- **Energetic:** PEM fuel cell power generation, back-up systems

# Computational Fluid Dynamics (CFD) software for advanced design in hydrogen technologies



Production

Storage

Distribution

Refuelling

Transport

Industry

Residential/  
Urban

Energy

Others

## Technology description

Computational Fluid Dynamics (CFD) is a branch of fluid mechanics that relies on numerical computation to analyse and solve problems involving fluid flow. CFD software runs on computers to solve and predict the behaviour of complex equipment.

CFD modelling and simulation is applied to a wide range of research and engineering problems, including industrial systems design and analysis, fluid flow, heat transfer and chemical reaction.

In hydrogen technologies, CFD is applied to design, evaluate, and generate knowledge in all equipment involving fluids and their coupled phenomena such as heat transfer and chemical or electrochemical reactions, whether in production (reformers, electrolyzers), storage and distribution (compression, injection and blending, dispensing, and hydrogen utilisation (fuel cells, combustion).

The studies are carried out with the real design of the equipment in 3D, and in stationary or transient state, allowing the detailed study of the behaviour of the equipment in different operating conditions and design variants, which constitutes a powerful virtual laboratory for the development of the technology.

## Technology information

**Maturity level:** Commercial software

**Industrial property rights:** does not apply

**Type of collaboration offered:** support for advanced equipment design using Computational Fluid Dynamics (CFD) software.

## Applications sectors

- **H2 Production:** reformers, electrolyzers, solar thermal coupled equipment
- **H2 Storage:** compressed, liquefied, metal hydrides, hydrogen carriers
- **H2 distribution:** compressed, liquefied, blending, hydrogen carriers
- **Refuelling infrastructures:** compression, dispensing  
Transport: fuel cells, tanks
- **Transport:** fuel cells, tanks
- **Industrial:** combustion, cogeneration
- **Residential/urban:** fuel cells, micro-cogeneration
- **Energetic:** combustion, grid injection, blending,
- **Other:** design and evaluation of application components in hydrogen technologies



Production



Transport



Residential  
/ Urban



Energy

## Technology description

This is a bipolar plate design for a PEM fuel cell that has several feed inlets for the reactants.

The design, in addition to the main feed inlet, has a secondary inlet through a variable-section channel with several additional branches that provide flow at different points on the plate. These inlets connect the reactant to the plate surface where the flow channels are machined.

The reactant feed at different points is advantageous compared to a single inlet, as it allows for a more homogeneous and efficient reaction on the plate. The design provides for an adjustable regulator system to split the reactant feed between the main inlet and the secondary inlet.

As an innovative aspect, the PEM fuel cell design has been manufactured by 3D additive manufacturing, so that the main and secondary feed channels are embedded inside the bipolar plate itself.

## Technology information

**Maturity level:** TRL 4 - Component validation in laboratory environment

**Industrial property rights:** Utility model

**Type of collaboration offered:** development of bipolar plates for fuel cells and electrolyzers

## Applications sectors

- **H2 Production:** electrolyzers
- **Transport:** PEM fuel cells
- **Residential/urban:** PEM fuel cells
- **Energetic:** electrolyzers and PEM fuel cells



Production



Industry



Other uses

## Description of the entity

AIJU is a non-profit association whose work as a Technological Institute is focused on the provision of advanced services and the development of R&D&I projects of high added value that allow companies to increase their capacity for innovation and competitiveness.

The Energy Area specializes in the development of electrochemical components and devices, including electrolyzers, fuel cells, supercapacitors and redox flow and lithium-ion batteries, as well as in the development of innovative technologies for obtaining biofuels. It has equipment for the design, development, assembly and testing of electrochemical energy storage devices and hydrogen production technologies (test benches for fuel cells and electrolyzers, etc.), as well as licenses and equipment for the development of advanced electronic systems for the control and automation of processes through microcontrollers or automatons.

## Entity data

**Type:** Technological center

**Size:** 21-120 employees

**Calls of interest for your entity:**

**European:** Horizonte Europa, LIFE

**National:** CDTI, MISIONES, MITECO, MICINN

**Regional:** Valencian Community



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## Activities and experiences in R&D&I

More than 15 years of experience developing demonstration projects focused on different energy technologies, especially in the development of electrolyzers and fuel cells, as well as their integration in different uses or applications. We are currently working and researching in the development of new alkaline and PEM electrolyzers.

- R&D of new materials
- Structural, thermal and fluid dynamic analysis (CAD/CAE).
- Stack test benches
- Development of low and medium power prototypes
- Integration in portable and stationary applications.

**Approximate annual investment in hydrogen and fuel cell R&D&I: < 1 million €.**

## Technologies offered

- Advanced energy storage systems
- Hydrogen technologies - electrolyzers and fuel cells
- Design and development of fuel cell and electrolyzer test beds
- Design and development of pilot plants for energy applications.
- Printing of ceramic parts. Coatings by PVD technology



## Description of the national initiatives in which the entity participates

The main national projects in which AIJU has participated have been the following:

- **IDEAH2 Project (Profit 2007):** R&D of an alkaline electrolyzer for hydrogen production from solar energy. AIJU participated in the design and development of alkaline electrolyzers capable of operating at 15 bars.
- **BIOH2 Project (INNPACTO 2012):** New strategies in the integral use of plant biomass for the sustainable production of hydrogen without carbon dioxide emissions. AIJU participated in the design of a pilot plant for biomass gasification and synthesis gas production, and in the development of a PEM fuel cell integrated in the plant.
- **Biotabacum (INNPACTO 2012):** Production of biodiesel and synthesis gas from oil extracted from "Nicotiana tabacum" seeds.
- **GreenUpGas Project (INTERCONNECTA 2015):** Development of a biological upgrading technology for biomethane production in agro-industrial environments. AIJU carried out the development of an alkaline electrolyzer for hydrogen production with photovoltaic energy.

## Description of the international initiatives in which the entity participates

The European projects in which AIJU has collaborated are the following:

- **LIFE Superbiodiesel (LIFE 2019):** Production of advanced biodiesel from animal waste using supercritical technologies.
- **LIFE Ecoelectricity (LIFE 2015):** Valorization of alcoholic waste to produce H<sub>2</sub> to be used in sustainable electricity generation.
- **SHEL - Sustainable hydrogen evaluation in logistics (2009):** Development of a 30kW alkaline electrolyzer to supply H<sub>2</sub> to a fleet of fuel cell powered forklifts.
- **LIFE Greenzo (LIFE 2013):** development and validation at pre-industrial level of a pilot plant to obtain Zinc oxide from a non-ferrous metal waste such as zamak.



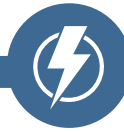
## Description of the national initiatives in which the entity participates

As regional projects, the following are worth mentioning:

- **H2eKart Project:** Development of a hybrid electric vehicle type Go-Kart powered by fuel cell.
- **SMARTH2PEM Project:** Development of a high performance, high pressure and low cost PEM electrolyzer for hydrogen supply.

Currently, as a result of knowledge transfer generated in the Energy Area, a large national engineering company is committed to complete the development of electrolyzers for hydrogen generation based on the knowledge accumulated by AIJU in the field. From the year 2021, large electrolyzers (> 50 kW) are being developed and if a minimum viable product is reached, it is planned to manufacture at industrial level and taking advantage of suppliers and the local industrial fabric.

## Description of the international initiatives in which the entity participates



Other

## Technology description

The types of energy storage systems that AIJU has been working with are as follows:

- Redox flow batteries (vanadium, zinc-air).
- Supercapacitors
- Lithium-ion batteries

We have experience in R&D studies to validate new materials that can act as electrodes, specific test benches to test materials and/or prototypes of electrochemical cells, components, characterization of electrochemical properties such as impedance, energy density, efficiency, cyclability and useful life.

## Technology information

**Maturity Level:** Basic Research - TRL4

**Industrial property rights:** Intellectual property

**Type of collaboration offered:** R&D cooperation agreement, Service provision agreement, Technical cooperation agreement.

## Applications sectors

- **Other:** Electrical energy storage



Production



Industry



Residential  
/ Urban



Energy

## Technology description

PEM and alkaline electrolyzers and PEM fuel cells. We have experience in design and development of different prototypes, cells and stacks, together with structural, thermal and fluid dynamic analysis studies by CAD/CAE software. The work power achieved in R&D projects is:

-Alkaline electrolyzers from 5 to 25kW, with operating pressure up to 15bar.

-PEM electrolyzers from 1 to 3kW, with operating pressure up to 15bar.

-PEM fuel cell from 1 to 5kW.

Currently working for a national company on the development of 50 kW alkaline electrolyzers.

## Technology information

**Maturity Level:** Developed but not marketed, TRL 4-8

**Industrial property rights:** Protected by trade secret - National company collaborating with AIJU

**Type of collaboration offered:** Cooperation agreement for R&D, provision of services and/or technical cooperation, in any case hand in hand with the national company with which AIJU works.

## Applications sectors

- **H2 production:** Water electrolysis - complete plant
- **Industrial:** green H2 as feedstock, heat production (natural gas substitution)
- **Residential/urban:** energy use
- **Energetic:** Energy production and storage coupled to the power grid, injection into the gas grid.



# Design and development of test benches for fuel cells and electrolyzers.



## Technology description

He has the capability and experience to perform balance of plant, HAZOP analysis, and programming of control systems and test bench automation for electrolyzers and/or fuel cells.

The integration of these systems in portable and stationary applications has also been performed: back-up systems, low power electric vehicles and renewable energy storage.

## Technology information

**Maturity Level:** Developed but not marketed, TRL 4-8

**Industrial property rights:** Protected by trade secret - National company collaborating with AIJU

**Type of collaboration offered:** Cooperation agreement for R&D, provision of services and/or technical cooperation, in any case hand in hand with the national company with which AIJU works.

## Applications sectors

- **H2 production:** Water electrolysis - complete plant
- **Industrial:** green H2 as feedstock, heat production (natural gas substitution)
- **Residential/urban:** energy use
- **Energetic:** Energy production and storage coupled to the power grid, injection into the gas grid.



Production



Industry



Other

## Technology description

AIJU has experience in the design and construction of pilot plants, performing risk analysis, equipment design and assembly, and in aspects related to process instrumentation and control.

The pilot plants in which AIJU has been involved deal with different industrial processes: synthesis of biofuels and biostimulants, catalytic reforming of alcohols to produce H<sub>2</sub>, and also obtaining ZnO from zamak waste.

## Technology information

**Maturity level:** Prototype demonstrators, TRL 4-8.

**Intellectual Property Rights:** Intellectual Property among the partners with whom AIJU has collaborated in each project.

**Type of collaboration offered:** R&D cooperation agreement.

## Applications sectors

- **H<sub>2</sub> production:** alcohol reforming, electrolysis of water, biomass
- **Industrial:** various industrial processes
- **Others:** circular economy



Production



Industry



Other

## Technology description

Selective laser sintering (SLS) is a rapid prototyping technique that allows parts of great geometric complexity to be obtained in a short time and without human intervention from 3D models previously designed with computer software. During

During the sintering process, a CO<sub>2</sub> laser beam of micrometric precision is in charge, through software control, of melting or sintering the material in a controlled way, plane by plane, drawing the geometric shape of the previously designed preform.

It is mainly used for the forming of ceramic materials for various applications: catalysts, catalyst support, structural materials, electrodes, etc.

It can work with any type of ceramic material and even mixtures of different composition.

## Technology information

**Maturity Level:** Developed but not commercialized, TRL 7-8

**Industrial property rights:** Patented

**Type of collaboration offered:** Cooperation agreement for R&D, provision of services and/or technical cooperation.

## Applications sectors

- **H<sub>2</sub> production:** catalysts for alcohol reforming
- **Industrial:** catalysts for industrial processes (biomass, propulsion, etc.)
- **Others:** electrodes



Production



Other

## Technology description

PVD (Physical Vapor Deposition) technology is an ultra-high vacuum process in which the coating of a substrate is produced by the controlled evaporation of the material with which the coating is to be prepared. The evaporation of the material can be thermal and carried out by direct heating of the material or by the detachment of atoms from the material by the impact of high energy ions or atoms ("sputtering"). Coatings can be made with inorganic materials (metals, alloys, oxides, nitrides, etc.) on all types of substrates (semiconductor materials, dielectrics, insulators, metals, plastics, ceramics, etc.). Coatings allow surface functionalization of materials to improve: electrical conductivity, thermal conductivity, optical properties, catalytic activity, tribological properties, bactericidal properties, gas barrier properties, etc.

## Technology information

**Maturity Level:** Laboratory Validated - TRL 4

**Intellectual property rights:** AIJU's intellectual property.

**Type of collaboration offered:** R&D projects at national or European level.

## Applications sectors

- **H2 production:** catalyst coatings on membranes, electrodes or other components.
- **Others:** improvement of surface properties of materials



Storage, transportation and distribution



Production



Mobility



Other uses

## Description of the entity

AIMPLAS is a Technology Center with more than 30 years of experience in the plastics sector. We provide solutions to companies in the plastics sector, throughout the value chain: from raw material manufacturers, compounders, recyclers and transformers, to waste managers and end-of-life products.

AIMPLAS offers technological support and advisory services for research, development and innovation in dedicated projects.

AIMPLAS is the first Spanish center offering tests accredited by ENAC according to the UNE-EN ISO/IEC 17025 standard for the plastics industry. We perform analysis and tests on raw materials as well as on intermediate products, final products and plastic waste.

AIMPLAS also offers competitive intelligence services, technology watch, as well as training and related events.



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



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C/ Gustave Eiffel, 4, Parc Tecnològic Valencia

## Activities and experiences in R&D&I

AIMPLAS has an experience of more than 30 years preparing European and international projects. Since 1999, it has participated and/or coordinated more than 120 European cooperation projects.

In 2021, it has carried out 255 R&D&I projects, 69 international and 186 national, involving 417 SMEs, which means a return to the companies of 55.5 M€. AIMPLAS is (co-) applicant in 18 patent applications and has managed 11 exploitation licenses.

It has a team of more than 200 professionals and 10,500 m<sup>2</sup> of facilities with the latest technological advances for the execution of R&D&I projects.

**Approximate annual investment in hydrogen and fuel cell R&D&I: < 1 million €.**

## Technologies offered

The plastic materials and the know-how of the researchers working for AIMPLAS allowed us to provide the following solutions:

- H<sub>2</sub> production from biomass
- Use of H<sub>2</sub> to synthesize compounds (power-to-X)
- Porous electrodes
- Electrically conductive plates
- Plastic tanks for H<sub>2</sub> storage
- Plastic pipes for H<sub>2</sub> distribution
- Advanced materials for physical/chemical storage of H<sub>2</sub>
- Hydrogen storage in organic liquids (LOHCs)

## Entity data

**Type:** Centro Tecnológico

**Tamaño:** > 100 trabajadores

**Calls of interest for your entity:**

**European:** FCH JU Green Deal

**National:** CDTI, MITECO, MICINN

**Regional:** AVI, IVACE

**Others:** PERTE, MINISDEF, etc.



## Description of the national initiatives in which the entity participates

- Participation in CDTI call projects with the AD-GRHID project.
- Participation in projects of AEI calls with the HYDROFIVE and BARRIER projects.
- Participation in regional call projects such as IVACE with the STORACHE, MATENERGYH2 and H2MAP projects.
- Attendance to congresses.
- Participation in interviews/Podcast of REDIT (network of technological institutes of the VC) on hydrogen.
- Organization of a conference on renewable energies.
- Participation in PTeH2 working groups.

## Description of the international initiatives in which the entity participates

- Participation in European projects of the Horizon Europe call with the Overleaf project.
- Attendance to congresses.



Production

## Technology description

Optimal catalyst-assisted valorization of biomass and plastic wastes to obtain energy carriers such as hydrogen. Using optimal waste pretreatment methods and gasification reactor reaction conditions to maximize H<sub>2</sub> flux.

Waste treatment in the presence of catalysts improves the selectivity of the gases formed, as well as maximizes conversion by employing milder conditions. In addition, the solid and liquid fractions can be valorized in applications such as solid adsorbents and fuels, as their composition can be controlled.

With this technology, waste conversion is achieved with a yield to gas fraction of at least 80%, and a H<sub>2</sub> volume ratio of 40% for plastic waste and 20% for biomass.

## Technology information

**Level of maturity:** TRL 6 - 7

**Industrial property rights:** Intellectual property

**Type of collaboration offered:** R&D&I cooperation, provision of services, advisory services.

## Applications sectors

- **H<sub>2</sub> production**



Production



Storage

## Technology description

Development of highly selective polymeric membranes for the selective separation of hydrogen in generation systems, with suitable physicochemical properties.

This technology has an environmental benefit, since the membranes can be regenerated, placed in line as an additional module, save energy at the operational level and have a low environmental footprint.

## Technology information

**Level of maturity:** TRL 6 - 7

**Industrial property rights:** Intellectual property

**Type of collaboration offered:** R&D&I cooperation, provision of services, advisory services.

## Applications sectors

- H2 production
- H2 storage





Storage



Transport

## Technology description

- Development of reinforced thermoplastic polymeric materials of polyamide type through the addition of nanomaterials with good hydrogen permeability. These developed materials are lighter in weight and can be recycled. The use of polymers implies a significant reduction in product emissions.
- Aligned with the needs of storage tanks for transportation, foams are developed as materials for cryogenic hydrogen insulation.
- AIMPLAS produces ½" high quality, unidirectional (UD) long fiber thermoplastic chippings in its thermoplastic, carbon/glass or PP/PA/rPET thermoplastic pultrusion line for novel H2 tanks and pipelines. But also, plastic liners with advanced gas tightness and compatibility with external (reinforcement) layers.

## Technology information

**Level of maturity:** TRL 6 - 7

**Industrial property rights:** Intellectual property

**Type of collaboration offered:** R&D&I cooperation, provision of services, advisory services.

## Applications sectors

- **H2 storage**



Storage



Transport

## Technology description

Development of porous polymeric materials for hydrogen storage.

In these materials the pore size is controlled to effectively store gases as an alternative to high pressure tanks. Some of the materials par excellence for hydrogen storage are MOFs, carbonaceous.

## Technology information

**Level of maturity:** TRL 6 - 7

**Industrial property rights:** Intellectual property

**Type of collaboration offered:** R&D&I cooperation, provision of services, advisory services.

## Applications sectors

- H2 storage
- Transport



Production



Storage



Transport

## Technology description

Plastics are commonly used as electrically insulating materials. Carbon-based or even metallic fillers are used to increase their electrical conductivity. Others are inherently conductive.

In addition, carbon particles are used to increase the porosity of plastic-based inks to act as electrodes or active elements in electrochemical devices.

AIMPLAS develops processable plastics with carbon nanotubes with tailor-made conductivities for bipolar plates, connectors or electromagnetic shielding components.

Carbonaceous species were also used to fabricate porous conductive electrodes on which dedicated catalysts can be deposited.

## Technology information

**Maturity level:**

**Industrial property rights:**

**Type of collaboration offered:**

## Applications sectors

## Description of the entity

Ajusa, dedicated to automotive and industry, was born in 1972.

We manufacture engine components for automotive, industrial and commercial vehicles, as well as specific products for consumer markets.

Ajusa TH has been developing fuel cell technology since 2003 with the aim of designing, producing and manufacturing PEM fuel cell systems and modules.



<https://ajusath.es/>



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ajusa@ajusa.es



Parque Empresarial Ajusa Calle 1, nº 1 Albacete

## Activities and experiences in R&D&I

It designs, develops and manufactures PEM fuel cells, reaching a power output of up to 12kW.

It also develops power systems and modules for stationary and mobility applications. Hydrogen refueling station at 350 bar operational.

Currently developing a 20 kW module and a 100 kW stack.

Completed multiple projects in partnership and alone with public aid for the development of this technology.

**Approximate annual investment in hydrogen and fuel cell R&D&I: 1-5 M€.**

## Entity data

**Type:** PYME

**Size:** >100 empleados

**Calls of interest for your entity:**

European, National y Regional

## Technologies offered

- PEM type fuel cells, up to 12kW
- PEM fuel cells, up to 100 kW (under development)
- Bipolar plates for PEM Fuel Cells
- Sealing gaskets for PEM Fuel Cells
- Stationary systems: mCHP 750 W and UPS 7.5 kW
- Mobility systems: 20 kW module (under development)



**Description of the national initiatives in which the entity participates**

**SUSTAINABLE AUTOMOTIVE TECHNOLOGY PROGRAM PTAS-20211007**

Industrial Research Solution for Hydrogen Propulsion Solution for Light-Duty and Semi-Heavy-Duty Electric Vehicles with Fuel Cells

**AERONAUTICAL TECHNOLOGY PROGRAM FOR THE YEAR 2022 PTAG-20221021**

Cryogenics and Hydrogen Fuel Cells in Aviation

**Description of the international initiatives in which the entity participates**

# PEM Fuel Cell



Transport



Industry



Residential/  
Urban



Energy



Other

## Technology description

PEM batteries are electrochemical devices that produce electrical power and heat continuously.

continuously. They are fed with hydrogen gas and air, and have only water as a by-product.

The stack is composed of cells stacked in series. Each of these cells is composed of three main elements

The stack is composed of three main elements: the bipolar plate, the MEA and the gasket.

AJUSA designs, develops and manufactures PEM fuel cells, reaching a power of up to 12kW. 100 kW stack under development.

Current models:  
FC027, FC028 and FC030.

## Technology information

**Maturity level:** On the market

**Industrial property rights:** Protected by trade secret

**Type of collaboration offered:** Commercial agreement with technical assistance

## Applications sectors

- **Transportation**
- **Industrial**
- **Residential/urban**
- **Energy**
- **Other**

# 20 kW PEM fuel cell module



Transport



Industry



Residential/  
Urban



Energy



Other

## Technology description

20kW range extender module for electric car or truck using Ajusa FC030-250 battery

## Technology information

**Maturity Level:** Laboratory validated

**Industrial property rights:** Protected by trade secret

**Type of collaboration offered:** Technical cooperation agreement

## Applications sectors

- **Transport:**
  - Automobile
  - Heavy vehicles
  - Railroad
  - Aviation
  - Maritime



Producción

### Description of the entity

ARIEMA has been the leading independent company in hydrogen technologies in Spain for more than 20 years. Throughout its trajectory, it has participated in innovation and technological development projects with a clear focus on industrial applications. This has allowed ARIEMA to be the only Spanish company with its own alkaline electrolysis technology and the one that has installed the most hydrogen equipment in Spain.

Based on the profound knowledge of the hydrogen value chain technologies, ARIEMA also offers consulting services, “due diligence”, studies, and technological customer support throughout the different stages of the Project.

### Entity data

**Type:** Pyme

**Size:** 21-50 employee

**Calls of interest for your entity:**

**European:** Horizonte Europa, FCH JU, Green Deal.

**National:** CDTI, IDAE, MITECO, MICINN.



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[info@ariema.com](mailto:info@ariema.com)



Ronda de Pte., 15, Izda, 28760 Tres Cantos

### Activities and experiences in R&D&I

ARIEMA’s growth has been supported since its inception by research, development, and innovation, and it continues to do so. ARIEMA has participated in over 20 R&D&I projects, both national and international, which has allowed them to be at the cutting edge of green hydrogen technologies and lay the foundations for their own developments in electrolysis.

**>10 millions € of active investment in R&D&I projects. Some notable projects include:**

**-IRON NPE:** Design and development of the architectures for the new H2 systems of the AIRBUS zero emission flight program (ZEROe).

**-ECO2Fuel:** Design, manufacturing, and validation of the first low-temperature CO2 conversion system into e-fuels.

### Technologies offered

#### Hydrogen production by alkaline electrolysis

- Lab test benches
- Demonstrator scale electrolyzers
- Industrial scale electrolyzers

#### Specialized hydrogen services

- Strategic Consulting and Feasibility Studies
- Project evaluation
- “Due diligence”
- Entity management
- Event management
- Training: CursoH2 ([www.cursoh2.com](http://www.cursoh2.com))





### Descripción de iniciativas nacionales en las que participa la entidad

- Spanish Hydrogen Association (AeH2).
- Spanish Hydrogen Technological Platform (PTe H2).

### Descripción de las iniciativas internacionales en las que participa la entidad

- Hydrogen Europe.
- ECO2Fuel Project.
- International Energy Agency Hydrogen Technology Collaboration Program (Hydrogen TCP).



Production

## Technology description

ARIEMA has been manufacturing its own alkaline electrolyzers since 2009. For the development of this technology, ARIEMA has received over €15 million in public funding through various R&D grant programs.

Currently, ARIEMA is scaling up its alkaline stacks to 0.5 MW to offer modular and containerized systems of up to 10 MW. This new generation of electrolyzers is configured around the 0.5 MW module, in mono and multi-stack configuration. Facing its industrialization, ARIEMA is planning a factory of around 200 MW/year of production.

In addition to the Demonstration and Industrial electrolyzers, it also has custom-made Test Benches for entities that research materials and processes to improve alkaline electrolysis.

## Technology information

**Maturity level:** In the market

**Industrial property rights:** Protected through trade secrets

**Type of collaboration offered:** Research and development cooperation agreement, manufacturing agreement, commercial agreement with technical assistance, service provision agreement, technical cooperation agreement.

## Applications sectors

**H2 Production:** Modular and containerized plants for the production of hydrogen and oxygen by alkaline electrolysis, compatible with RES. Application to:

- Refueling stations with self-production
  - Land
  - Marine
  - Aerospace
- Decarbonization of non-electric processes.
- Synthetic fuels.
- Grey hydrogen substitution.



Storage, transportation and  
distribution

## Description of the entity

Base systems is an industrial automation engineering focused on Renewable Energies with outstanding importance in Hydrogen Technologies. Our main activities are focused on:

- Basic and detailed engineering
- Integration of Control Systems based on DCS and PLC+SCADA architectures
- .Design and Configuration of industrial networks (PROFINET, Modbus TCP/IP, OPC UA, IEC61850...)
- Design and Manufacture of Control Cabinets
- Definition and Supply of Instruments and Analyzer Systems• Comprehensive “turnkey” solution for Automation Projects

## Entity data

**Type:** SME

**Size:** 21-50 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU, Green Deal

**National:** CDTI, MITECO, MICINN



<https://basesistemas.com/>



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## Activities and experiences in R&D&I

Misiones CDTI Program - Offshore floating wind power + hydrogen generation.

Call for support aid to Innovative Business Groups in order to improve the competitiveness of small and medium-sized companies (call corresponding to the year 2023, within the framework of the Recovery, Transformation and Resilience Plan

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** 60.000€

## Technologies offered

- Control engineering
- Electrical Control Engineering
- Industrial Communications
- Electrical communications
- Liquid / Gas Analytics
- Instrumentation



## Description of the national initiatives in which the entity participates

Active partner for the dissemination and promotion of hydrogen as an energy vector of the present and a main actor in the decarbonization of society. Partners:

- AeH2 – Asociación Española del Hidrógeno
- AAH2 – Clúster Hidrógeno Andalucía
- CLENAR – Clúster de la Energía Aragón

Participant in the main Hydrogen projects at the National level:

- HRS EMT PALMA - Green Hyland
- HRS TMB Iberdrola
- HRS Exolum – TorrejonArdoz

Presence at the company level in the main events, fairs and specific hydrogen training (RENMAD, EHEC, ENERGYEAR, AAH2, AAH2...). Technical personnel trained in the ARIEMA Hydrogen and Fuel Cells course

## Description of the international initiatives in which the entity participates

South African pilot plant engineering for ANGLO AMERICAN mining



Production



Refuelling



Industrial



Industrial



Other

## Technology description

Development of digital twins of H<sub>2</sub> generation plant and NH<sub>3</sub> generation.

Due to the needs of our clients, some of them just starting out in the sector, we are presented with different remains of research on tools that help in the sizing and subsequent operation of the gH<sub>2</sub> plants.

The main advantage is having a virtual model of the plant on which to size the different equipment (electrolyser, compression, storage...) according to the available data. This model will be fed at a later stage with actual plant data and will continue to optimize the process algorithm.

## Technology information

**Maturity level:** Basic research

**Industrial property rights:** Not Decided

**Type of collaboration offered:** Cooperation agreement for R&D

## Applications sectors

- **H<sub>2</sub> Production:** Electrolysis of water
- **H<sub>2</sub> Storage:** Compressed gas in tanks
- **H<sub>2</sub> distribution:** Pipelines
- **Refuelling infrastructures:** In situ hydrogen production
- **Transport:**
- **Industrial:** Green hydrogen as a raw material
- **Residential/urban:** Energy use
- **Energetic:** Production and storage of energy coupled to the electricity grid
- **Other:**



Storage, transportation and distribution



Production



Mobility



Industrial



Other uses

## Description of the entity

We are a Renewable Energies Engineering and Installer business.

Last 15 years our business was Industrial and Residential Photovoltaic Installations.

Those last 2 years we had been contacted by some heavy business interested in Hydrogen Production Plants.

Our objective is to be present in different stages from Hydrogen production to final use.

We believe that the primal objective is to be prepared technically and technologically for Hydrogen installations: production, transport and uses.



[www.bsspain.com](http://www.bsspain.com)



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Calle Juan Carlos I, 31\_Local, 28660, Boadilla del Monte, Madrid

## Activities and experiences in R&D&I

At this moment we are participating in the project of an Hydrogen Production Pilot Plant in Murcia.

Until end of 2023, we will be active in some activities related with Hydrogen Production.

## Entity data

**Type:** Renewables

**Size:** 80 people

**Calls of interest for your entity:**

- Hydrogen production
- Hydrogen transportation
- Hydrogen uses

## Technologies offered

We still don't have any technology. We want to create solutions to potentially photovoltaic customers.



## Description of the national initiatives in which the entity participates

We are committed to create new technologically solutions affordable with hybrids solar-hydrogen installations.

## Description of the international initiatives in which the entity participates

Our intention is to be part of international projects were it could be necessary to implant Hydrogen Technologies



Otros

## Technology description

HYDROGEN PLANTS TECHNOLOGIES

## Technology information

**Maturity level:** Starting

**Industrial property rights:** Hydrogen projects: Documental and technical elaboration.

**Type of collaboration offered:** Hydrogen EPC projects

## Applications sectors

- **H2 Production:**
- **H2 Storage:**
- **H2 distribution:**
- **Refuelling infrastructures**
- **Transport**
- **Industrial**
- **Residential/urban**
- **Energetic**





Storage, transportation and distribution



Mobility

## Description of the entity

The National Metrology Institute of Spain (CEM) is an autonomous body within the General Secretariat for Industry and Small and Medium Enterprises of the Ministry of Industry, Trade and Tourism, being the highest technical body in the field of Metrology in Spain.

The Reference, Energy and Environmental Gas Laboratory of CEM has been participating in international research projects in the field of energy gases during last years, mainly on issues related to biogas, hydrogen and fuel cells, and emissions of polluting gases.



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



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C\ Alfar, 2, 28760 Tres Cantos, Madrid

## Activities and experiences in R&D&I

Participation in European projects within the EMPIR, EURAMET program, such as 15NRM03-HYDROGEN and 16ENG01-MetroHyVe, already completed.

Currently involved in two projects, 20IND06-PROMETH20 and 20IND10-DECARB, developing the preparation of gaseous reference materials, used in the analysis of trace water and in the study of mixtures of hydrogen-enriched natural gas, respectively. And in an EPM project, (European Partnership on Metrology), 21GRD05-MET4H2, within the preparation of gaseous reference mixtures of HCl in hydrogen.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 million €**

## Entity data

**Type:** Public Administration

**Size:** 51-100 employees

**Calls of interest for your entity:**

Horizon Europe, FCH JU, Green Deal

## Technologies offered

Preparation of primary reference gas mixtures for analytical determination of the purity of hydrogen used mainly in fuel cells powered vehicles.

Analysis methods for certification of some of the impurities included in the ISO 14687 standard..



## Description of the national initiatives in which the entity participates

## Description of the international initiatives in which the entity participates

The Euramet European Metrology Research Programme (EMRP) has enabled European metrology institutes, industrial organisations and academia to collaborate on joint research projects within specified fields: industry, energy, environment, health, new technologies and SI units.

The successor programme - European Metrology Programme for Innovation and Research (EMPIR) continued to support measurement research projects in the same fields as the EMRP with additional themes for Fundamental, Normative, Research Potential, Support for Networks and Support for Impact projects.

The European Partnership on Metrology (EPM) builds on the success of EMRP and EMPIR, and additional themes for European Green Deal, Integrated European Metrology, Digital Transformation and Capacity Building projects were included.



## Description of the national initiatives in which the entity participates

## Description of the international initiatives in which the entity participates

### **European Metrology Network for Energy Gases**

This network provides measurement science expertise to society and industry to support the implementation of the energy transition to renewable gaseous fuels. Addressing fundamental challenges to establish renewable gases as a fuel source and energy vector is a vital step in striving towards environmental sustainability. By bridging the gap between end-user communities and acting as a central nucleus for measurement science activities, the EMN for Energy Gases will help to establish and facilitate a reliable, safe and diverse energy network



Refuelling



Transport



Energetic



Other

## Technology description

Preparation of primary reference gas mixtures by gravimetric method and the development of analysis methods for the certification of impurities present in hydrogen gas. The several kind of impurities and their concentration level are included in the ISO 14687 standard.

These are the currently capacities of the laboratory :

For Nitrogen, Argon, Oxygen and Helium: concentration levels according to the requirements of ISO 14687.

For hydrogen chloride (HCl): concentration level from 1000  $\mu\text{mol}\cdot\text{mol}^{-1}$ .

As National Metrology Institute, it is possible to provide traceability to those laboratories that would be able to certify the purity of hydrogen.

## Technology information

**Maturity level:** Basic research / Lab-proven.

**Industrial property rights:** Research project results.

**Type of collaboration offered:** Cooperation agreement for R&D / Service provision agreement / Technical Cooperation Agreement.

## Applications sectors

- **Refuelling infrastructures:** Dispense
- **Transport:** Automobile / Heavy vehicle / Fuel cell
- **Energetic:** Injection into the gas grid
- **Other:** Metrology



Storage, transportation and distribution



Production



Transport



Industrial



Other uses

## Description of the entity

The National Renewable Energy Centre of Spain (CENER) develops applied research in renewable energies, and provides technological support to companies and energy institutions in five areas: wind energy, solar energy technologies and storage, biomass, energy efficiency and generations in buildings and cities, and grid integration, electrical storage and hydrogen. CENER is a technology centre with worldwide recognised prestige, activity and experience.

The Board of Trustees is comprised of the Spanish Ministry of Science and Innovation, Ciemat, the Ministry for the Ecological Transition and Demographic Challenge, and the Government of Navarre.



[www.cener.com/www.bio2c.es/es/](http://www.cener.com/www.bio2c.es/es/)



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Ciudad de la Innovación 7, Sarriguren (Navarra)

## Activities and experiences in R&D&I

- Experimental studies in renewable plants (wind, PV) with electrolyzers and bioprocesses.
- Technology development of H2 value chain: SOEC, SOFC, P2X processes by bioelectrochemical systems.
- Uses of green hydrogen in applications and as feedstock for fuels and renewable chemicals.
- Integration of H2 technologies in renewable energy-based grids. Hybridation of storage and conversion.
- Sustainability (ACV) and techno-economic analysis of green H2 production value chain (from water electrolysis and/or biomass).
- Contribution to the solar thermal roadmap for hydrogen applications.
- Software simulation of a hybrid Renewable Energy plant for the generation of green H2 on a large scale.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1.25 M€**

## Entity data

**Type:** Technology center

**Size:** About 240 people

**Calls of interest for your entity:**

**EU:** Clean Hydrogen Partnership

**ES:** Plan Estatal AEI, PERTE ERHA

**CCAA:** Ayudas I+D Navarra

## Technologies offered

- Materials laboratory for solid state electrolyzers and fuel cells (SOEC/SOFC).
- Modelling Hub for electrochemical systems.
- Energy management system for energy grids integrating hydrogen production by electrolysis.
- Bubbling Fluidized Bed Biomass Gasifier (ABFB).
- P2Gas Biological Methanisation.
- P2X Microbial Electrosynthesis.
- Thermal Simulation and Design.
- Optical Simulation and Design.
- Texturing of Materials and Coatings.
- Development of Innovative Components and Systems.



## Description of the national initiatives in which the entity participates

- **Plataforma Tecnológica Española del Hidrógeno** (Strategy and Planning Group; Hydrogen Production by Electrolysis Subgroup)
- **AEN/ Comité Técnico Nacional CTN 181 “Tecnologías de Hidrógeno” for standardization, with a special focus on GT8 activities** (Hydrogen Generation through Electrolysis Processes).
- **Asociación Española de Hidrógeno (AeH2).**
- **Red Española de Pilas de Combustible, Hidrógeno y Baterías Avanzadas, depending on MEC-SIC** (Hydrogen Production from Wind Power).
- **SusChem-Plataforma Tecnológica y de Innovación de Química Sostenible**

## Description of the international initiatives in which the entity participates

- **European Clean Hydrogen Alliance:** platform for promoting investments on hydrogen and its use at European level.
- **Clean Hydrogen Partnership:** association aiming at accelerating the deployment/development of hydrogen value chain along Europe by promoting R&D.
- **IEA Hydrogen Technology Collaboration Program.** “Renewable Hydrogen” task.
- **EERA Fuel Cells & Hydrogen.** European Energy Research Alliance on Fuel Cells and Hydrogen.
- **EERA Bioenergy:** European Alliance for Energy Research on Sustainable Bioenergy.
- **ETIP Bioenergy:** European Technological and Innovation Platform on Bioenergy.
- **ETIP SNET:** European Platform of Technology and Innovation on Smart Grids for the Green Transition



Production



Transport



Industrial



Residential/  
Urban

## Technology description

CENER focuses its hydrogen production R&D activities on the development of high temperature electrolyzers (SOEC) and solid oxide fuel cells (SOFC). All development stages (optimisation of new functional materials, cells implementation and upscaling/prototyping) are involved.

The lab focuses on the fabrication and upscaling of materials and components for those electrolyzers and fuel cells. It has means of manufacture for functional materials (equipment for synthesis, heat treatment and functional inks preparation) and for producing solid state cells by functional printing, reaching preindustrial scales to foster technological transfer of SOEC/SOEFCE technologies to the industry.

Moreover, the lab has advanced equipment for the characterisation of all developed materials and devices (SEM, XRD, GC, EIS, etc), and several complementary measuring stations for enabling multi-scale testing, from lab-scale proofs of concept (< 1 kW) to pre-commercial prototypes (2-10 kW).

## Technology information

**Maturity level:** Technology under development.

**Industrial property rights:** Protected by industrial secret.

### Type of collaboration offered:

R&D cooperation agreement.

Commercial agreement with technical assistance.

Service provision agreement.

Technical cooperation agreement.

Other.

## Applications sectors

- **H2 Production:** high temperature electrolyser (SOEC/SOEL) for green hydrogen production.
- **Transport:** new SOFC systems for vehicles.
- **Industrial:** use of SOFC for the production of green electricity, from stored green H2.
- **Residential/urban:** use of SOFC as electricity production system from stored green H2.



Production



Transport



Industrial



Residential/  
Urban



Other

## Technology description

This area specializes on modelling of electrochemical systems at several scales (from cells and stacks, to integrated systems based on renewable energies and including such devices):

- Modelling of cells and stacks: it aims at optimizing material properties and cell design (electrode thickness, porosity, gas channels, interconnectors, etc) to imitate the response of cells and stacks within several operation scenarios. This allows optimizing the performance of cells/stacks, thus minimizing experimental, temporal and economic efforts.
- Systems modelling: it allows to obtain their “plant Balance”, that is, to calculate energy and water requirements of electrolysis/fuel cell/storage systems and therefore evaluate their techno-economic feasibility.

Modelling of electrochemical conversion and storage systems is carried out by applying Computational Fluid Dynamics (CFD) together with system modelling. High capacity computers and specific simulation software are used for this purpose.

## Technology information

**Maturity level:** Available for demonstration.

**Industrial property rights:** Protected by industrial secret.

**Type of collaboration offered:**

- R&D cooperation agreement.
- Commercial agreement with technical assistance.
- Service provision agreement.
- Technical cooperation agreement.
- Other.

## Applications sectors

- **H2 Production:** high temperature electrolyser (SOEC/SOEL) for green hydrogen production.
- **Transport:** new SOFC systems for vehicles.
- **Industrial:** use of SOFC for the production of green electricity, from stored green H2.
- **Residential/urban:** use of SOFC as electricity production system from stored green H2.
- **Energetic:** integration of SOFC in renewable-based grids, and hybridisation with other energy conversion/storage technologies.



# Energy management system for energy grids integrating hydrogen production by electrolysis



Production



Distribution



Industrial



Energetic

## Technology description

Hydrogen is an energy vector that allows decarbonizing some sectors that are less prone to electrification, since electrolyzers can generate hydrogen and then it can be stored/distributed/consumed. So, thanks to H<sub>2</sub> part of grid energy can be transferred to other sectors (thermal, mobility, etc). Therefore it plays a key role in energy management within grid distribution systems.

CENER has a very versatile microgrid, where different renewable energy production systems (photovoltaic, wind power, etc) can be combined with conversion and electrochemical storage devices (batteries, supercapacitors, and with a grid emulator that allows analyzing the performance of such devices against grid events.

Furthermore, CENER has developed an Energy Management System (EMS) that can be adapted to any set or combination of technologies.

Those capacities make possible testing and validate new technologies under a controlled grid environment, and also carrying out studies about hybridization and optimization of operation parameters, degradation models, etc.

## Technology information

**Maturity level:** Technology under development.

**Industrial property rights:** Protected by industrial secret.

### Type of collaboration offered:

R&D cooperation agreement.

Commercial agreement with technical assistance.

Service provision agreement.

Technical cooperation agreement.

Other.

## Applications sectors

- **Production of H<sub>2</sub>:** H<sub>2</sub> generation from renewable energy.
- **H<sub>2</sub> distribution:** H<sub>2</sub> storage for use on demand.
- **Industrial:** H<sub>2</sub> availability for multiple industrial applications (feedstock, CHP, etc).
- **Energetic:** P2X technology for energy storage.



Production



Industrial

## Technology description

The gasification unit is a pilot plant with a nominal power of 2 MWt capable of generating a syngas (approx. 1000 Nm<sup>3</sup>/h) suitable for testing downstream cleaning and synthesis processes with the aim of producing hydrogen and/or using syngas with the possible addition of renewable H<sub>2</sub> in Power to X processes.

As an innovative and advantageous aspect it should be noted that this demonstration plant is designed to work with a wide range of biomass, with bulk densities between 80 and 800 kg/m<sup>3</sup> and moisture content below 30%.

The biomass gasifier is based on atmospheric bubbling fluidized bed (ABFB) technology with two modes of operation: using air as the gasifying agent or using steam/oxygen as the gasifying agent.

The rated power is 2MWt and the minimum power is 60%, the operating pressure is 0.3 barg, the bed temperature is in the range of 650 - 950°C and CO<sub>2</sub> is used as the inerting gas.

## Technology information

**Maturity level:** Available for demonstration.

**Industrial property rights:** CENER Infrastructures. Protected by industrial secret.

### Type of collaboration offered:

R&D cooperation agreement.  
Commercial agreement with technical assistance.  
Service provision agreement.  
Technical cooperation agreement.  
Other.

## Applications sectors

- **H<sub>2</sub> Production:** from biomass and wastes.
- **Industrial:** use of syngas and H<sub>2</sub> as feedstock.



Storage



Distribution



Industrial



Residential/  
Urban



Energetic

## Technology description

This is a reactor designed by CENER for the bioconversion of CO<sub>2</sub>/CO and H<sub>2</sub> into methane (CH<sub>4</sub>). The bioconversion process works with mesophilic and thermophilic microorganisms. The reactor can be coupled to an external supply of H<sub>2</sub> from electrolysis or other renewable energy production processes in order to produce renewable gaseous fuels through P2G processes. Laboratory scale bioreactor (10 L) and 100 L operational prototype (pilot plant) available.

Among the innovative aspects and advantages of the technology is that it is an Ad Hoc designed reactor to improve the gas/liquid/solid phase relationship within the reactor system. The bioreactor is fully monitored: gas flow rates, temperature (up to 80°C), gas and liquid sampling, exhaust gases, H<sub>2</sub> injection, etc. and has a flexible configuration. The bioreactor is self-contained and portable, ATEX-configured and complies with all health and safety standards. Moreover, the analysis equipment is integrated and available "in house".

## Technology information

**Maturity level:** Validated at laboratory level (TRL 5) and pilot plant (TRL 6).

**Industrial property rights:** Protected by industrial secret.

**Type of collaboration offered:**

R&D cooperation agreement.

Commercial agreement with technical assistance.

Service provision agreement.

Technical cooperation agreement.

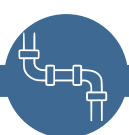
Other.

## Applications sectors

- **H<sub>2</sub> Storage:** in the form of methane (Hydrogen Carrier).
- **H<sub>2</sub> distribution:** distribution in the form of green methane.
- **Industrial:** use of green methane for multiple industrial applications (feedstock, CHP, etc.).
- **Residential/urban:** use of green methane for various applications (CHP).
- **Energetic:** P2X technology for energy storage.



Storage



Distribution



Transport



Industrial



Energetic

## Technology description

This is a 5 L reactor designed by CENER for the production of methanol from CO<sub>2</sub> by means of Microbial Electrosynthesis (MES) processes.

The reactor has a configuration based on conventional fermentation bioreactors with a fixed and mobile cathode based on carbonaceous materials. It has instrumentation and sensors for process monitoring, including gas solubility (CO<sub>2</sub>, O<sub>2</sub>, CH<sub>4</sub>, etc.) and productivity analysis.

Among the innovative aspects and advantages is that it is an Ad Hoc reactor designed to improve the gas/liquid/solid phase relationship within the reactor system in order to maximise mass transfer and also electron transfer in the bio-cathode. The bioreactor is fully monitored: gas flow rates, temperature (up to 80°C), gas and liquid sampling, exhaust gases, CO<sub>2</sub> injection, etc. and has a flexible configuration.

## Technology information

**Maturity level:** Laboratory scale (TRL 4) .

**Industrial property rights:** Protected by industrial secret.

**Type of collaboration offered:**

R&D cooperation agreement.

Commercial agreement with technical assistance.

Service provision agreement.

Technical cooperation agreement.

Other.

## Applications sectors

- **H<sub>2</sub> Storage:** in the form of methanol (Hydrogen Carrier).
- **H<sub>2</sub> distribution:** distribution in the form of green methanol.
- **Transport:** use of green methanol as a fuel for heavy transport, shipping and aviation fuel production.
- **-Industrial:** use of green methanol for multiple industrial applications (chemical sector, etc.).
- **Energetic:** P2X technology for energy storage.



Production



Transport



Industrial



Residential/  
Urban



Energetic

## Technology description

Stationary and transient simulations can be carried out. Using ANSYS simulation software, we are able to carry out very detailed thermal simulations, which allows us, for example, to study the behaviour of a material that is going to be subjected to high temperatures, such as those used in SOEC, and to study the possibility of recovering the excess heat generated in the systems.

On the other hand, complex systems can be simulated using MODELICA. For example, models of complete concentrating solar power plants and their individual components such as the solar field, thermal energy storage and the power block model have been modelled.

## Technology information

**Maturity level:** System complete and qualified (TRL 8).

**Industrial property rights:** Protected by industrial secret.

**Type of collaboration offered:**

R&D cooperation agreement.

Commercial agreement with technical assistance.

Service provision agreement.

Technical cooperation agreement.

Other.

## Applications sectors

- **Development of electrolysers:** thermal simulation of electrolysers, heat exchange and heat recovery strategies. Especially interesting in SOEC.
- **Complex systems.** in any sector where the simulation of complex heat exchange systems is required, especially if the system is combined with solar thermal technologies.



Production



Transport



Industrial



Residential/  
Urban



Energetic

## Technology description

**Climatological datasets - Long-term time series of high temporal and spatial resolution and representative annual datasets.** Long-term climatological time series of high-frequency data adjusted to the specific climatological and geographical characteristics of the location of interest. The data includes solar radiation, wind speed and direction and other weather variables relevant to technologies such as solar and wind or other technologies such as integrated grids or energy storage. High spatial resolution solar energy simulator.

**TONATIUH:** is an open source software based on ray-tracing simulations that can be applied for the detailed estimation of the available solar resource in complex terrain and configurations, such as bifacial PV plants or hybrid renewable energy plants including solar applications. Furthermore, it can contribute to the validation of the configuration of solar energy applications and the design of specific components of such systems, as it provides an estimation of the available solar resource with a high spatial resolution. Photovoltaic system simulator.

**SIMPV:** is a proprietary PV system performance simulation tool with no restrictions on configuration or composition, and is more versatile than other commercial software. SIMPV can be used for the simulation of any PV system, either alone or integrated in other infrastructures, such as hydrogen production plants that include solar energy.

## Technology information

**Maturity level:** System complete and qualified (TRL 8).

**Industrial property rights:** Protected by industrial secret.

**Type of collaboration offered:**

R&D cooperation agreement.  
Commercial agreement with technical assistance.  
Service provision agreement.  
Technical cooperation agreement.  
Other.

## Applications sectors

- **Development of electrolysers:** optical simulation of photocathodes and photoanodes.
- **Complex systems.** in any sector in which the simulation of integrated systems with photovoltaic or solar thermal systems is required.



Production

## Technology description

Texturisation of materials can have several advantages, as varying the morphology of the textured material can change its properties. For example, the contact surface of anodes and cathodes could be increased by texturisation. Optical, thermal, adhesion, etc. properties can also be modified.

In addition, equipment is available for depositing coatings of different materials.

In order to carry out different types of structuring and coating, our facilities include a chemical bench, sputtering, PCVD, RIE, photolithography equipment, e-beam and a thermal evaporation machine.

In addition to the equipment described above, we have characterisation equipment, including: AFM, SEM-EDX, mechanical profiler, four-probe technique, optical characterisation, spectrometry and others.

## Technology information

**Maturity level:** Technology validated in lab (TRL 4).

**Industrial property rights:** CENER infrastructures. Protected by industrial secret.

**Type of collaboration offered:**

R&D cooperation agreement.

Commercial agreement with technical assistance.

Service provision agreement.

Technical cooperation agreement.

Other.

## Applications sectors

- **Development of electrolysers or hydrogen fuel cells:** the texturisation of the surface of materials and/or the application of a coating makes it possible to modify or improve the properties of a material. This may be of particular interest for cathodes and anodes.



Production



Transport



Industrial



Residential/  
Urban



Energetico

## Technology description

We have extensive experience in the development and scaling of prototypes at laboratory level. Relying on simulation capabilities and highly qualified personnel, we have developed prototypes of novel equipment.

We have the capability to design, prototype, test and scale-up.

It is also possible to perform standardised indoor and outdoor testing of new prototypes which is critical to the rapid progress of a technology and its acceptance by industry. The impact of any technological variation can be accurately quantified indoors and under real outdoor exposure. Research areas typically supported by the infrastructure include: integration of Si PV into architectural and lightweight modules, development of Positive Energy Neighbourhoods, and development of advanced diagnostic techniques.

## Technology information

**Maturity level:** Technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies) (TRL 5).

**Industrial property rights:** Protected by industrial secret.

**Type of collaboration offered:**

R&D cooperation agreement.

Commercial agreement with technical assistance.

Service provision agreement.

Technical cooperation agreement.

Other.

## Applications sectors

- **Component design and development:** applicable to many sectors where new components not existing in the market need to be developed or tested.
- **System design and development:** ability to simulate and develop systems that, for example, require the integration of different energy resources of renewable origin.



# CETENMA. Technological Center for Energy and the Environment of the Region of Murcia



Hydrogen storage, Transportation and Distribution



Production



Mobility



Industry



Other uses

## Description of the entity

CETENMA, Technological Center for Energy and the Environment of the Region of Murcia is a private non-profit Business Association, created with the aim of supporting research, development and technological innovation for companies, in everything related to Energy and Environment.

One of its missions is to improve the competitiveness of companies through applied research, technological development, technology transfer and the provision of technological services. CETENMA promote the principles of the circular economy in all the sectors within the scope of its competence among which are water technologies, renewable energies, waste valorization, energy efficiency, bioenergy and the production and use of hydrogen as energy vector.



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## Activities and experiences in R&D&I

CETENMA is recognized nationally as a Technology Center, R&D Entity and as a Research Results Transfer Office (OTRI) and has extensive experience in the development of R&D projects in national and European programs such as H2020, LIFE or Interreg Sudoe.

Related to hydrogen, CETENMA has carried out the SUDOE EnergyPush project that promotes the use of hydrogen in social housing, Hidrogeno Verde, which proposes the use of hydrogen in logistics and the ARCHEA project that validates a new power2gas process using hydrogen as a vector. Currently initiating the GENHESIS project of the PERTE ERHA value chain focused in development new models of electrolyzers

## Entity data

**Type:** Technology or Research Center

**Size:** <10 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU, Green Deal

**National:** CDTI, MITECO, MICINN

**Regional**

## Technologies offered

- Integration of hydrogen as an energy vector
- Biological power-to-gas
- Testing and validation of electrolyzers and fuel cells.
- Use of hydrogen in combustion engines
- Environmental, social and economic impact studies



## Description of the national initiatives in which the entity participates

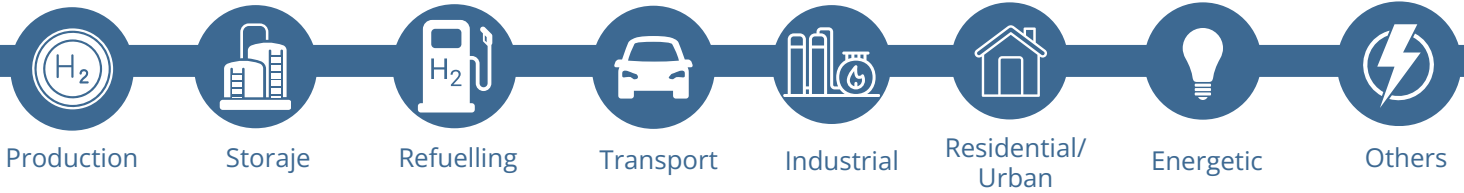
Project GENHESIS ( IDAE Value Chain )

Shyrius Project. Hydrogen Valley of the Region of Murcia

Technical Secretary of the Green Hydrogen Sector Association of the Region of Murcia.  
[www.AHMUR.org](http://www.AHMUR.org)

## Description of the international initiatives in which the entity participates

Proyecto Interreg SUDOE ENERGYPUSH\_



## Technology description

CETENMA has been working for 3 years in the development of different applied research projects related to Power to Gas systems with the aim of storing surplus renewable energy in the form of biomethane, generated through the conversion of carbon dioxide using renewable hydrogen (Sabatier reaction).

The system developed by CETENMA includes its own trickling bed reactor design that allows the production of biomethane through a biological process from an effluent rich in carbon dioxide (biogas) and hydrogen generated with photovoltaic solar energy.

The proposed technology addresses the integration of fluctuating renewables into the power grid, enabling grid-scale energy storage and carbon reuse.

## Technology information

**Maturity level:** Lab-proven

**Industrial property rights:**  
Protected by industrial secret

**Type of collaboration offered:**

- R&D cooperation agreements
- Manufacturing agreement
- Trade agreement with technical assistance
- Service provision agreement
- Technical Cooperation Agreement


## Applications sectors

- **H2 Production:** Electrolysis of water
- **Transport:** Logistic
- **Industrial:** Green hydrogen as a raw material
- **Residential/urban:** Energy use in buildings
- **Energetic:**
  - Production and storage of energy coupled to the electricity grid
  - Injection into the gas grid
- **Others:** Producción of biofuels from renewable hydrogen




## Mobility

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 [cefil@cefil.com](mailto:cefil@cefil.com)

 C/ Pelaya, 37, 28110, Algete (Madrid)

## Description of the entity

Since 1953 Cetil has been active in the market of fuel dispensers and fuel measuring equipment. As the market evolved, so did we and, in the last 20 years we have been developing our own electronic equipment for measuring systems and dispensers, in order to have the best tools available to develop our own ideas.

We are leaders in the design, manufacture and commercialization of transport and measuring equipment for conventional fuels in Spain. We currently offer solutions in the following fields:

- Service stations
- Gantries and tank trucks
- CNG, LNG and hydrogen
- Electric chargers
- Fuel filtering and micro filtering
- Discharge compressors

Our expertise lies on equipment with ATEX, MID/OIML or PED certification, everything under the scope of our ISO9001 certified quality system.

We are members of several technical committees and working groups which are responsible for writing future standards (CEN/TC326, ISO/TC197, CEN/TC393), which allows us to be at the forefront of the market.

We also belong to organizations such as CECOD, GASNAM, NGVA, SEDIGAS, BEQUINOR, AeH2 and IFSF.

## Entity data

**Type:** SME

**Size:** 51-100 employees

**Calls of interest for your entity:**

Horizon Europe, FCH  
CDTI, IDAE

## Activities and experiences in R&D&I

Cetil has its own R+D+i department with up to 9 highly qualified employees with a wide knowledge in different specializations.

Precisely, several R+D+i projects are currently open, most of them related to the hydrogen products. One of them has been recently presented to the CDTI.

Cetil is also exploring the possibility to take part of a consortium in a H2 value chain project at IDEA in the H2 pioneers program.

**Approximate annual investment in R+D+i in hydrogen and fuel cells: < 1 million €**

## Technologies offered

In H2 segment, Cetil offers versatile H2 dispensers for the refueling of Heavy Duty and/or Light Duty hydrogen powered vehicles. The dispensers are available with one or two hoses and, optionally, can integrate a heat exchanger to cool down the hydrogen.

Likewise, for other H2 applications, Cetil offers its experience and measurement background through the H2FS measuring system. It can be used in fixed or mobile installations to load/unload H2 tube trailers, to fill forklifts, and when it comes, to fuel trains, planes and ships.

The expertise of their technicians and engineers give the customer the support required to put their H2 projects into service as smoothly as possible.



## Description of the national initiatives in which the entity participates

Cetil has recently presented at CDTI an investigation and development project which consists in the development of a new H<sub>2</sub> measurement system for its universal refuelling for multiple applications such as the loading and unloading of H<sub>2</sub> tube trailers, the refuelling of fuel-cell forklifts or trains, ships or planes.

## Description of the international initiatives in which the entity participates

Cetil is not participating at this moment in any R&D&I international initiatives. Some of its employees are experts and participate actively in technical working groups of ISO TC197 and CEN TC268 related to H<sub>2</sub>, in which the most advanced H<sub>2</sub> refuelling protocols are being discussed.



## Refuelling

### Technology description

Cetil has its H2 dispenser to be integrated into public or private service stations as a solution for refueling hydrogen vehicles. It is based on EAS2 electronics designed entirely by CETIL.

#### Characteristics:

- ATEX, OIML and PED certification.
- Fulfils those regulations applicable to hydrogen service stations (ISO 19880; IN 17127).
- Compatible with hydrogen filling protocols, such as SAE J2601 or SAE J2601-2.
- Infrared communication with vehicle according to SAE J2799.
- Ability to adapt to the characteristics of the hydrogen service station: different refueling pressures (H35 and H70), different storage banks, direct filling from compressor...
- Delivery with metrological measurement, using Coriolis effect meter.
- Filling control based on pressure ramps.
- Control of the delivery status by monitoring variables such as flow, pressure, and product temperature.
- Easy integration with plant control through Modbus communication protocols.
- Cooling of H2 with internal heat exchanger. Communication available for integration with cooling system.

### Technology information

**Maturity level:** Onthemarket

**Industrial property rights:** Protected by industrial secret

**Type of collaboration offered:** Trade agreement with technical assistance

### Applications sectors

- **Refuelling infrastructures:** Delivery of H2 for light and heavy duty vehicles



Transport



Refuelling

## Technology description

The H2FS measuring system uses the modular and scalable ME4000 electronics designed entirely by CETIL, which brings together the experience gained in the development of all types of legal measuring systems of fuel with the knowhow acquired through the H2 dispenser.

The H2FS measuring system is designed for use in applications related to the loading/unloading of hydrogen tube trailers, as well as the refueling of hydrogen to any means of transport such as ships, planes or trains.

### Characteristics:

- ATEX, OIML and PED certification.
- Delivery with metrological measurement.
- Integrable in loading and unloading panels.
- Configurable for different storage and refueling pressures.
- Control of the delivery status by monitoring variables such as flow, pressure, and product temperature.
- Filling control based on pressure ramps.
- Easy integration with plant control through Modbus communication protocols.
- H2 pre-cooling option.

## Technology information

**Maturity level:** In development

**Industrial property rights:** Protected by industrial secret

**Type of collaboration offered:** Trade agreement with technical assistance

## Applications sectors

- **H2 transport:** H2 measuring system for loading/unloading tube trailers.
- **Refuelling infrastructures:** H2 dispensing to trucks, trains, ships, airplanes, etc.



Storage, transportation and distribution



Production



Mobility



Industry



Other Uses

## Description of the entity

*CIC energigUNE* is an energy storage research center specialized in electrochemical storage (batteries and supercapacitors), thermal energy solutions and hydrogen technologies. *CIC energigUNE* research aims to generate disruptive scientific knowledge in materials and technological solutions related to energy and contributing to improve industry competitiveness and sustainable development. *CIC energigUNE* is member of the Basque Research & Technology Alliance (BRTA) a strategic initiative of the Basque Government and is also supported by the Provincial Council of Alava and the Basque Energy Agency. *CIC energigUNE* produced more than 120 scientific publications per year (80%, in Q1 journals) and participates in >70 industrial projects and 30 European projects. The centre promotes the creation of technology companies, such as, Bcare and Basquevolt.



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## Activities and experiences in R&D&I

Three main research lines to produce green hydrogen:

- Emerging technologies for electrochemical H<sub>2</sub> production: 1) Development of decoupled electrolyzers. 2) Development of electrolyzers for H<sub>2</sub> and H<sub>2</sub>O<sub>2</sub> or Cl<sub>2</sub> co-synthesis.
- Emerging technologies for H<sub>2</sub> production by thermochemical or thermo-catalytic route.
- Catalysts and catalytic supports for the production of new energy carriers and improvement of electrolyzers and fuel cells.

Three transversal activities:

- Atomistic and system modelling.
- Postmortem analysis.
- Raw materials and components recycling.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: >1M€**

## Entity data

**Type:** Research Centre

**Size:** >190

**Calls of interest for your entity:**

Horizon Europe Cluster 4 y 5, CleanHydrogen Partnership, European Innovation Council-Pathfinder, CDTI, PERTE, MICINN, MITECO, regional, etc.

## Technologies offered

- Laboratory for electrochemical evaluation of fuel cells and electrolyzers' components.
- Laboratory for testing thermochemical and thermo-catalytic reactors.
- Electrochemical testing laboratory.
- Design and production of new nanomaterials for catalysts for thermochemical and electrochemical processes.
- Materials and components: Analysis of degradation, failure mechanism and temperature effect.
- Corrosion analysis.





### Description of the national initiatives in which the entity participates

CIC energigUNE is an active member of the most relevant associations and initiatives in the materials and energy storage sector:

**Hydrogen and Fuel Cell Technological Platform:** Partner and member of the industry and national cooperation working groups.

**Materplat:** Partner, contributor to the writing of the research agenda.

**Basque Research and Technology Alliance (BRTA):** Members of the alliance created by the Basque Government to generate synergies between the Basque centers.

**Energy Cluster:** Member of the Cluster participating in sectoral forums related to hydrogen and energy.

**Digital Innovation Hub:** Participants in the advanced materials node to make technological platforms available to the Basque industry for R&D projects, characterization, etc.

**EU Solaris:** Members of the Spanish hub of the European research infrastructure for concentrated solar power.

**Solar Concentra:** Members of the platform.

**BatteryPlat:** Member of the Governing Council and member of several working groups.

### Description of the international initiatives in which the entity participates

CIC energigUNE is an active member of the most relevant associations and initiatives in the materials and energy storage sector:

**Hydrogen Research Europe:** Member of the production, political and transversal working groups.

**Clean Hydrogen Alliance:** Partners of the alliance.

**Energy Materials Industrial Research Initiative (EMIRI):** Members of hydrogen, energy efficient - zero energy buildings, low carbon industries and batteries working groups.

**Sustainable Process Industry through Resource and Energy Efficiency (SPIRE):** Partner and participant in the working groups related to energy and resources and circularity.

**International Energy Agency (IEA):** Participants in energy storage and solar, heating & cooling program.

**European Technology and Innovation Platform Smart Networks for Energy Transition (ETIP-SNET):** Co-chair of storage technologies and system flexibilities.

**EuropeanHeatPump Association (EPHA):** Partners.

**BatteriesEuropePartnership Association (BEPA):** Partners and participants in all working groups.

**BatteriesEurope:** Member of the consortium that manages the initiative and member of all the working groups, in addition to be co-chairing the stationary storage group.

**LiPLANET:** Founders of the network of battery cell pilot lines in Europe, members of the Executive Board and participants in the working groups.



Production



Others

## Technology description

**Emerging technologies for hydrogen production by thermochemical or thermo-catalytic means:**

Main objectives of the research line:  
Development of materials reactive towards water molecule dissociation by simple thermochemical cycles.

-Development of novel catalytic systems for the efficient deconstruction of waste with high hydrogen content by new thermo-catalytic processes.

Main innovations associated to the technology:

-Obtention of reactive materials from solid industrial waste.

-Employment of environmentally polluting waste (e.g., plastics, used mineral oils etc.) in thermo-catalytic processes as hydrogen source.

-Application of non-conventional heating methods for processes activation.

Technology advantages:

-Significant reduction of working temperatures and energy consumption.

-Substantial increase of green hydrogen production rate and purity.

-Cost reduction of hydrogen production.

-Co-generation of decarbonized products with high market added value in thermo-catalytic process.

## Technology information

**Maturity level:** Basic Research (TRL 2-4)

**Industrial property rights:** Under evaluation

**Type of collaboration offered:**

- Cooperation agreement for R&D.
- Service provision agreement.
- Technical Cooperation Agreement.
- Other upon agreement (e.g., risk sharing).

## Applications sectors

**H2 Production:** Specially for companies:

- Generating plastic and/or oil waste.
- Generating solid waste with high content in metal oxides.
- Interested in the chemical recovery of residual heat.
- Demanding highly pure hydrogen (> 97%).
- Dealing with green H2 generation technology by thermal means.

**Others:** Interested in added-value decarbonized products (carbon materials).



Production



Industry



Residential/  
Urban



Energetic



Other

## Technology description

**Emerging technologies for green hydrogen generation by electrochemical means.** The research line has two main areas:

1) Development of decoupled electrolyser.

Main objective of the research area is to improve the efficiency hydrogen generation in acid and alkaline media.

Main innovations:

- The use of redox mediators in organic phase with conductive polymers and polyelectrolytes.

- The use of solid redox mediators with polyvalent metal oxide nanomaterials.

Advantages of the technology:

- More efficient use of intermittent energy sources (solar or wind).

- High nominal power system for green hydrogen generation.

- Increased safety by preventing the formation of explosive gas mixtures.

- Low cost associated to low-maintenance and flexible materials.

2) Development of electrolysers for H<sub>2</sub> and H<sub>2</sub>O<sub>2</sub> or Cl<sub>2</sub> co-generation.

The objective is to reduce the cost of hydrogen generation.

Main innovation is based on new efficient electrode materials based on metal nitrides and carbides.

Advantages of the technology:

- Increased H<sub>2</sub> generation rate.

Added-val

## Technology information

**Maturity level:** Lab-proven (TRL 2-3)

**Industrial property rights:** Underevaluation

**Type of collaboration offered:**

- Cooperation agreement for R&D
- Service provision agreement
- Technical Cooperation Agreement
- Other

## Applications sectors

- **H<sub>2</sub> Production:** Waterelectrolysis. (Components).
- **Industrial:** Green hydrogen as raw material. Co-generation for industrial use (GHP).
- **Residential/urban:** Energy sources.
- **Energetic:** Energy production and storage coupled to the electricity grid. Injection into the gas grid.
- **Other:** Co-generation of value products.



Storage



Transport



Residential/  
Urban

## Technology description

The research line based on the **development of catalysts and catalyst supports for PEMFC and alkaline ammonia fuel cells** has two areas:

1) Development of cathode for PEMFC fuel cells (Proton-exchange membrane fuel cells):

The goal is to improve the durability of polymeric membrane fuel cells.

2) Development of anodes for ammonia fuel cells:

The objective is to increase the efficiency of ammonia fuel cells by reducing the cost associated with the use of precious metal catalysts.

Both research lines has, as their most innovative aspect, the use of new materials based on metal carbides and nitrides, or thin- layers of precious metals in low- cost nanomaterials.

Likewise, the studies include the use of in-situ spectroelectrochemical and microscopy methods to understand the degradation processes of materials.

Main advantages:

- Low cost of the catalysts.
- Greater chemical and electrochemical stability in real operating conditions of fuel cells.
- Use of ammonia as liquid energy vector (better storage and transport of the fuel).

## Technology information

**Maturity level:** Lab-proven (TRL 2-4)

**Industrial property rights:** Underevaluation

**Type of collaboration offered:**

- Cooperation agreement for R&D.
- Service provision agreement.
- Technical Cooperation Agreement.
- Other.

## Applications sectors

- **H2 storage:** Hydrogen carrier, liquid energy carriers.
- **Transport:** Automotive, heavy transport, train, aviation and maritime long distance and cargo. Components and fuel cell testing.
- **Residential/urban:** Energy use.



Storage, transportation and distribution



Production



Mobility



Industry

### Description of the entity

CIDETEC is a private organization for applied research founded in 1997 that seeks to contribute value to companies by harnessing, generating and transferring technological knowledge. Located in the Donostia-San Sebastián site of Gipuzkoa's Scientific and Technological Park and with additional facilities at MUBIL, the Gipuzkoa Electromobility Hub, CIDETEC is comprised of three international technological reference institutes in energy storage, surface engineering and nanomedicine. Each institute has its own offices and installations furnished with top-of-the-line equipment.

CIDETEC, founded in 1997, currently employs a workforce of 260, 54% of whom are PhD holders. Its volume of activity came up to € 18M in 2022.

CIDETEC is a member of BRTA (Basque Research and Technology Alliance).



<https://www.cidetec.es>



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Paseo Miramón, 196 20014 Donostia, Gipuzkoa (Spain)

### Activities and experiences in R&D&I

- More than 20 years of accumulated experience working in the field of hydrogen, fuel cells and related technologies.
- Coordinator and participant in a total of 9 European projects in the field of hydrogen.
- More than 10 hydrogen related projects under direct contract with companies.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 M€**

### Entity data

**Type:** Technology Centre

**Size:** > 100 employees

**Calls of interest for your entity:**

Horizon Europe, Clean Hydrogen JU, Green Deal

### Technologies offered

- PEM electrolysis: catalysis and electrode development.
- PGM-free porous electrodes for PEM and AEM electrolysis.
- Electrochemically driven chemical H2 carriers.
- Hydrogen embrittlement in piping and vessels: coatings and evaluation.
- Polymer-based materials for high pressure H2 container liners. Filament winding for prototyping.
- PEMFC catalysis and electrode development (MEAs).
- Coating for metallic PEMFC bipolar plates.
- Hybridisation of energy systems.



**Description of the national initiatives in wich the entity participates**

- PLATAFORMA TECNOLÓGICA ESPAÑOLA DEL HIDRÓGENO
- BASQUE HYDROGEN CORRIDOR
- SHYNE

**Description of the international initiatives in wich the entity participates**

- HYDROGEN EUROPE RESEARCH
- EUROPEAN CLEAN HYDROGEN ALLIANCE
- EMIRI



Production



Refuelling



Transport



Industrial

## Technology description

### Electrocatalysts and electrode development for PEM and alkaline electrolysis.

CIDETEC Energy Storage and CIDETEC Surface Engineering are developing catalysts and electrodes for hydrogen production by PEM and alkaline electrolysis, both for the hydrogen and oxygen evolution reactions, with improved properties in terms of efficiency, durability and cost. Such catalysts are based on noble metals and alternatives to precious metals and their implementation in the form of electrodes responds to scalability criteria.

## Technology information

**Maturity level:** Developed but not marketed.

**Industrial property rights:** Protected by industrial secret; Other.

**Type of collaboration offered:** Cooperation agreement for R&D; Manufacturing agreement; Technical Cooperation Agreement; Other.

## Applications sectors

- **H2 Production:** Electrolysis of water, Components.
- **Refuelling infrastructures:** In situ hydrogen production.
- **Transport**
- **Industrial**



Storage



Transport

### Technology description

**Sustainable and intrinsically recyclable H2 storage tanks based on a novel epoxy resin.**

CIDETEC Surface Engineering has added to its composite manufacturing process capabilities a new Filament Winding equipment that will allow it to develop a new generation of lightweight (Type IV) hydrogen storage tanks that will be more sustainable by being recyclable thanks to the use of the 3R epoxy resin developed by CIDETEC (its proprietary 3R technology). CIDETEC began in 2013 to study dynamic covalent chemistries, which resulted in the development and patenting of a novel epoxy resin and its composites, which retain all the advantages of conventional epoxies by being reprocessible, repairable and recyclable (3R resins and 3R composites).

### Technology information

**Maturity level:** Developed but not marketed.

**Industrial property rights:** Protected by industrial secret; Other.

**Type of collaboration offered:** Cooperation agreement for R&D; Manufacturing agreement; Technical Cooperation Agreement; Other.

### Applications sectors

- **H2 Storage:** Compressed gas in tanks.
- **Refuelling infrastructures:** Storage.
- **Transport**





Storage



Distribution

### Technology description

#### **Recubrimientos barrera al hidrógeno para tanques y componentes metálicos**

CIDETEC Surface Engineering develops metallic and ceramic coatings that can act as a barrier to hydrogen diffusion. Ceramic materials are an effective barrier to hydrogen diffusion and can be applied with different technologies such as electrophoretic deposition (for pure ceramics) or sputtering (for enamels), depending on the type of component and the base steel. On the other hand, metallic coatings with a nanocrystalline, compact and defect-free microstructure can also act as a barrier to hydrogen diffusion decreasing the risk of hydrogen embrittlement and allowing the use of steels under legacies.

CIDETEC is a reference center in the research and development of wet coating, easily scalable processes for application on large components.

### Technology information

**Maturity level:** Developed but not marketed.

**Industrial property rights:** Protected by industrial secret; Other.

**Type of collaboration offered:** Cooperation agreement for R&D; Manufacturing agreement; Technical Cooperation Agreement; Other.

### Applications sectors

- **H2 Storage**
- **H2 Distribution**



Storage, transportation and distribution



Production



Mobility



Industry



Other Uses

## Description of the entity

The CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas) is a public research body assigned to the Ministry of Science and Innovation under the General Secretariat for Research, focusing on energy and environment and the technologies related to them. It has offices in several different regions of Spain, and its activity is structured around projects which form a bridge between R&D&I and social interest goals.

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

In the Scientific Research Area on Hydrogen Technologies, CIEMAT conducts R&D&D activities from TRL1 to TRL6-7

The overall objective is to consolidate CIEMAT as a center of reference for H2 technologies research, fostering the pathway to their full deployment, all along the value chain, from production to final use, at both national and international level.



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



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Madrid (SPAIN)

## Activities and experiences in R&D&I

Activities are structured on:

- Electrolytic hydrogen production from renewable energy
- Thermochemical Solar Hydrogen Production
- Lowcarbon hydrogen production
- Conditioning, purification and storage
- Fuel Cells
- H2 combustion modelling
- Support actions (LCSA, Social Acceptance, Safety)

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-2 M€ (through Projects in Competitive Calls, Research Contracts and Technical Services)**

## Entity data

**Type:** Public Research Center

**Size:** 1300 employees

**Calls of interest for your entity:**

**International:** Horizon Europe, FCH JU, Green Deal, Erasmus+, International Cooperation with Latin America

**National:** CDTI, MITECO, MICINN, Regional Plans

## Technologies offered

See details on the following pages



## Description of the national initiatives in which the entity participates

**GREENH2-CM.** Posicionamiento estratégico de la Comunidad de Madrid en I+D+i del hidrógeno verde y las pilas de combustible, financed by the European Recovery plan, boosted by NextGenerationEU whose main objectives are the development of two outdoor integrated systems for the green H2 production.

**ECLOSION:** Development of components for anion Exchange membrane electrolyzer, financed by H2B2 Electrolysis Technologies S.L. (service contract).

**ESPAEM:** Development of an Anion Exchange Membrane electrolyzer, financed by H2B2 Electrolysis Technologies S.L. (service contract).

## Description of the international initiatives in which the entity participates

**AURUM:** Development of SOFC/SOEC cells by 3D-printing. Coordinated by the Technological University of Gdańsk-Poland.

**FUNCAP N° 06/2021:** Sistema de geração de hidrogênio verde a partir de energia eólica off-grid com reuso de efluentes industriais. Scientific advice and assessment. Coordinated by the University of the State of Ceará (Brazil).

**Red CYTED H2TRANSEL:** "Hidrogeno: producción y usos en el transporte y el sector eléctrico", coordinated by the Instituto de Tecnologías del Hidrógeno y Energías Sostenibles (ITHSE, Argentina).

**H2EXCELLENCE:** Fuel Cells and Green Hydrogen Centers of Vocational Excellence towards affordable, secure, and sustainable energy for Europe (ERASMUS-EDU-2022-PEX-COVE). This Project will build a platform of Centres of Vocational Excellence (CoVEs) by enabling "skills, knowledge and research ecosystems" for innovation, regional development, smart specialisation, and public support of green hydrogen technologies.



Production



Refuelling



Transport



Industrial

## Technology description

### **Electrocatalysts and electrode development for PEM and alkaline electrolysis.**

CIDETEC Energy Storage and CIDETEC Surface Engineering are developing catalysts and electrodes for hydrogen production by PEM and alkaline electrolysis, both for the hydrogen and oxygen evolution reactions, with improved properties in terms of efficiency, durability and cost. Such catalysts are based on noble metals and alternatives to precious metals and their implementation in the form of electrodes responds to scalability criteria.

## Technology information

**Maturity level:** Developed but not marketed.

**Industrial property rights:** Protected by industrial secret; Other.

**Type of collaboration offered:** Cooperation agreement for R&D; Manufacturing agreement; Technical Cooperation Agreement; Other.

## Applications sectors

- **H2 Production:** Electrolysis of water, Components.
- **Refuelling infrastructures:** In situ hydrogen production.
- **Transport**
- **Industrial**



Storage, transportation and distribution



Production



Mobility



Industry



Other Uses

## Description of the entity

The Iberian Centre for Research in Energy Storage (CIAE) is a centre of excellence in research, development and application of energy storage, including hydrogen and Power-to-X, to facilitate the integration of renewable energy and reduce greenhouse gas emissions. Research covers lab and modelling work at various scales and Technology Readiness Levels (TRLs), as well as innovative pilot plants. CIAE provides a stimulating research environment to work on some of today's most pressing energy, environmental and societal challenges. CIAE benefits from large network including research centres and companies in the Iberian peninsula and abroad.

The final CIAE facilities consist of three different buildings:

- Research building, 7323 m<sup>2</sup>
- Pilotplantbuilding constructed area of 3317 m<sup>2</sup> and open area of 2094 m<sup>2</sup>.

## Entity data

**Type:** Foundation

**Size:** 100 researchers

**Calls of interest for your entity:**

CDTI, Plan Nacional, Horizon Europe, Hydrogen Europe Research, ERC, MSCA, Ramón y Cajal, etc.



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Edificio Tajo, Campus Universitario, Cáceres

## Activities and experiences in R&D&I

**PR&D projects** with our own characterization equipment in strategic areas: SEM, TEM, AFM, TGA, DSC, FTIR, RAMAN, NMR, XRD, XPS, electro spinning, potentiostats, etc.

**Prototype plant** for materials testing, 1 kW AEM and 1 kW SOEC electrolysis, 100 g direct air CO<sub>2</sub> capture unit (DAC) and 100 g catalytic reactors for production of synthetic and chemical fuels.

Pilot plant with integrated technologies, electrolysis AEM 50 kW and SOEC 50 kW, gaseous storage, direct CO<sub>2</sub> air capture unit with a capacity of 10 Tn/year, 100L methanol reactor, 100L ammonia reactor. Integration with pilot plants for thermal, electrical and microgrid storage.

**Transversal lines as,** LCA, techno-economic analysis, regulation and simulation.

**Approximate annual investment in R&D&I in hydrogen and fuel cells > 10 million €**

## Technologies offered

- H<sub>2</sub> production
- H<sub>2</sub> storage
- Mobility
- Industry
- Other uses



## Description of the national initiatives in which the entity participates

CIAE participates in the following initiatives in Spain:

**AEH2:** Asociación Española del Hidrógeno

**PTeH2:** Plataforma Tecnológica Española del Hidrógeno. En todos los comités de la plataforma.

**PTECO2:** Plataforma Tecnológica Española del CO2. La PTECO2 es una asociación sin ánimo de lucro promovida por el sector privado, centros de investigación y universidades españolas.

**PET-MSO-ED:** Plataforma Española de Tecnologías de Modelización, Simulación y Optimización en un Entorno Digital.

**MATERPLAT:** Plataforma Tecnológica Española de Materiales Avanzados y Nanomateriales.

## Description of the international initiatives in which the entity participates

CIAE participates at the European Union level in the following initiatives:

**HER- Hydrogen Europe Research.** HER is a platform of the European scientific community involved in the development of a new industrial ecosystem based on hydrogen, committed to a future circular and carbon neutral economy.

CIAE scientific staff is involved in the development of the roadmap for the Strategic **Research and Development Agenda (SRIA), specifically in the areas of:**

- Electrolysis
- Other modes of hydrogen production
- Role of electrolysis in the energy system -Hydrogen storage
- Large-scale hydrogen storage -Hydrogen carriers
- Hydrogen carriers
- Development of means of hydrogen transport -
- Technology for hydrogen distribution
- Hydrogen distribution technology -Hydrogen refueling stations
- Refueling stations
- Use in shipping
- Use in aviation
- Stationary fuel cells
- Industrial applications
- Public education and awareness
- Regulation, code and standards and safety -
- Hydrogen valleys
- Hydrogen valleys

**EERA - Energy storage.** Covers the full range of low carbon energy technologies and systemic issues.

**CVE- CO2 Value Europe.** International non-profit association representing the Carbon Capture and Utilization (CCU) community in Europe.



Production



Storage



Transport



Industrial

## Technology description

The technologies are described taking into account the capacities according to the TRLs mentioned.

### -H2 production by:

- Low temperature electrolysis (AWE, AEM and PEM)
- High temperature electrolysis and co-electrolysis (SOEC) .
- Photo electrocatalysis

### - Hydrogen gas storage and advanced materials.

### - Direct CO2 capture with sorbents.

- Use of H2 in:
  - Thermal reduction of CO2 to obtain synthetic and environmentally friendly fuels using efficient catalysts.
  - Thermal reduction of N2 to obtain ammonia.
  - Electrochemical reduction of CO2 to obtain synthetic and ecological fuels.
  - High and low temperature fuel cells SOFC and PEMFC

### - Horizontal research lines:

- Prototyping
- Atomistic modeling
- CFD
- LCA and techno-economic analysis
- Circular economy
- Microgrid energy systems analysis
- Regulation
- Pilot plants.

## Technology information

### Maturity level:

Fundamental research (TRL: 2-4), prototype level (TRL: 4-5): materials testing feasibility and pilot plant level (TRL 5-7): pilot plant feasibility, recycling and microgrid simulation of EERR.

### Industrial property rights:

#### Office underdevelopment

### Type of collaboration offered:

- Technical cooperation and R&D agreement
- Trade agreement with technical assistance

## Applications sectors

### H2 Production:

- Low and hightemperature electrolysis
- Photoelectrochemistry.

### H2 Storage:

- Alternative materials,
- Storage and H2 compression

### Transport:

- Synthesis of sustainable aviation fuel, etc.
- Fuel cells

### Industrial:

- CO2 capture and synthetic liquid fuels synthesis
- Methanol and ammonia synthesis
- Fuel Cells



Storage, transportation and distribution



Production



Mobility



Industrial



Other Uses

## Description of the entity

We are a technology centre established in 1993, seeking to provide innovative solutions for SUSTAINABLE DEVELOPMENT.

For this, we have a multidisciplinary, highly qualified team.

We strive to enhance businesses' competitiveness through technology transfer generation via R&D and market-oriented training activities within the scope of resource sustainability and efficiency, energy networks, and renewable energies.



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Zaragoza (España)

## Activities and experiences in R&D&I

CIRCE boasts extensive experience in R&D projects with both public and private funding (directly with companies). Regarding lines of activity, CIRCE works in the following:

- Renewable Energies
- Future Electrical Networks
- Smart mobility
- Industry 4.0
- Energy Efficiency
- Circular Economy and Sustainability

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 M€**

## Entity data

**Type:** Technology Centre

**Size:** >100 employees

**Calls of interest for your entity:**

mainly Horizon Europe, FCH JU, Green Deal

## Technologies offered

- Biomass gasification in bubbling fluidised bed.
- Microwave-assisted pyrolysis/gasification for H2 generation.
- Semi-industrial flexible hydrogen combustion oven.
- Advanced imaging diagnostic laboratory for industrial hydrogen flames.
- Laboratory studies and tests for H2 integration into electrical networks.
- Hydrogen integration in an industrial environment.





## Description of the national initiatives in which the entity participates

CIRCE is active in various associations and platforms that aim to develop the potential of hydrogen in various fields. In this regard, in addition to PTE H2, the following are worth noting:

**FUTURED:** Within the Spanish platform for electric grids, the interaction of the H2 vector with electric grids is analyzed, exploring ways to maximize synergies between both sectors to improve their operation and ensure the green origin of hydrogen.

**BIOPLAT and AVEBIOM:** Biomass is an excellent resource for generating syngas, biofuels, as well as hydrogen or hydrogen-rich gases, which are also addressed in these platforms.

**CLENAR:** Aragon is a region with significant potential for hydrogen generation, transportation, and utilization, something that CIRCE helps explore within the Aragon Energy Cluster.

**Red Cervera H24NEWAGE:** This network of technological centers aims to create an innovation base in Spain capable of accelerating technology transfer related to H2 to national companies.

## Description of the international initiatives in which the entity participates

Internationally, CIRCE is also positioned among some of the most relevant associations in the hydrogen field, such as the Clean Hydrogen Alliance and Hydrogen Europe Research. This has allowed CIRCE to participate in initiatives highlighted below:

**TH2ICINO Project:** The project aims to develop a hydrogen valley in northern Italy, around the Malpensa airport. To achieve this, solutions will be planned and implemented regarding hydrogen production, storage, distribution, and consumption within the ecosystem of companies present in this area.

**FLEXNCONFU Project:** This European project integrates electrolyzers into P2X applications, including the production of both green hydrogen and ammonia, and their integration into combined cycle plants.

**CORALIS Project:** One of the most ambitious European projects regarding industrial symbiosis, which involves the generation and use of green hydrogen in energy-intensive industries.

Finally, CIRCE provides technical assistance to the European Commission to create synergies with Member States and their regions in the development of hydrogen plans.



Production



Industrial

## Technology description

CIRCE possesses various facilities to conduct studies on biomass gasification and/or pyrolysis for hydrogen-rich current generation: Bubbling fluidised bed gasification pilot plant with different gasifying agents (air, steam or mixtures).

Possibility to perform pyrolysis tests with nitrogen as the gasifying agent.

Continuous gas composition measurement.



## Technology information

**Maturity level:** From research to available for demonstration

**Industrial property rights:** None at the moment

**Type of collaboration offered:** Cooperation agreement for R&D, commercial agreement with technical assistance, service provision agreement

## Applications sectors

- **H2 Production:** gasification and pyrolysis
- **Industrial:** Use of hydrogen-rich syngas in industry, energy-intensive industries, for example.



Production



Industrial

## Technology description

CIRCE has various facilities to conduct studies on microwave-assisted pyrolysis or solvolysis.

Microwave technology allows for a selective heating that influences both the energy consumption of the technology and the development of the pyrolysis or solvolysis reaction itself.



## Technology information

**Maturity level:** From research to pilot plant

**Industrial property rights:** None at the moment

**Type of collaboration offered:** Cooperation agreement for R&D, commercial agreement with technical assistance, service provision agreement

## Applications sectors

- **H2 Production:** pyrolysis
- **Industrial:** Use of hydrogen-rich syngas in industry, energy-intensive industries, for example.



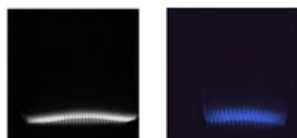
Industrial

## Technology description

Advanced diagnostic laboratory for industrial flames.

This laboratory allows the study of different industrial flames through imaging diagnosis using different cameras and other optical devices.

Its main task is the development of vision algorithms transferable to industrial thermal facilities for the detection of inefficiencies, emission prediction/control, and other correlations of interest.



## Technology information

**Maturity level:** From research to available for demonstration

**Industrial property rights:** None at the moment

**Type of collaboration offered:** Cooperation agreement for R&D, commercial agreement with technical assistance, service provision agreement

## Applications sectors

- **Industrial:** Use of hydrogen in industrial burners, development of algorithms for vision systems.



Industrial

## Technology description

CIRCE has an experimental pilot installation of a flexible industrial oven, which allows studying how modifications in the composition of gaseous fuels affect the oven's operation and heat transfer. It has instrumentation to monitor key operating parameters and to test scenarios representative of different types of industrial ovens.

In addition, the oven has two operating modes, one of which allows virtualising the load through a cooling system and the other allows the introduction of batches of products to emulate the conditions of different industrial processes.



## Technology information

**Maturity level:** From research to available for demonstration

**Industrial property rights:** None at the moment

**Type of collaboration offered:** Cooperation agreement for R&D, commercial agreement with technical assistance, service provision agreement

## Applications sectors

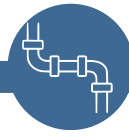
- **Industrial:** Use of hydrogen in industrial burners, burner testing.



Production



Storage



Distribution



Energetic

## Technology description

Studies using simulation to evaluate the impact of H2 installation. Including modelling the facilities and characterising their operation to determine the ancillary services they may offer to the network to maintain its stability.

Electronics validation laboratory for the integration of H2 into the power grid, consisting of two fully controllable 4-quadrant power amplifiers (100 kVA and 27 kVA) AC and DC, real-time simulator for open loop and closed loop HIL (hardware in the loop) and PHIL (Power Hardware in the loop), EMC pre-certification conducted tests. This laboratory allows the study, characterisation, and validation of power electronics converters.

## Technology information

**Maturity level:** From research to available for demonstration and product industrialization

**Industrial property rights:** None at the moment

**Type of collaboration offered:** Cooperation agreement for R&D, commercial agreement with technical assistance, service provision agreement

## Applications sectors

- Power generation
- Power electronics for hydrogen generation and management.
- Integration of hydrogen systems in hybrid AC-DC grids.
- Verification of grid connection requirements.
- Flexibility assessment.
- Ancillary services to the grid.



Production



Storage



Distribution



Industrial

## Technology description

Calculations and sizing of hydrogen integration in an industrial environment.

Experience in regulations and techno-economic feasibility for an optimal inclusion of hydrogen in various energy-intensive use sectors.

Process simulation tools to support the analyses and adapt them to the specific characteristics of the process..

## Technology information

**Maturity level:** From research to available for demonstration and product industrialization

**Industrial property rights:** None at the moment

**Type of collaboration offered:** Cooperation agreement for R&D, commercial agreement with technical assistance, service provision agreement

## Applications sectors

- Hydrogen production: sizing and selection of equipment.
- Hydrogen storage.
- Hydrogen distribution.
- Industrial.

# Center for Research in Technology, Energy and Sustainability (CITES) of the University of Huelva



Production



Storage, transportation and distribution



Mobility



Other

## Description of the entity

The overall mission or objective of the Center for Research in Technology, Energy and Sustainability (CITES), is the promotion of knowledge and research excellence in science and technology, as well as training, innovation and transfer of results, in response to the demands and needs of 21st century society. All this, with a strong intensification in the lines of research that converge in the Center, with a strong link to the field of energy, mainly renewable hybridized with hydrogen technologies. The Center has a strong vocation in the search for sustainability in its broadest sense (environmental and social without renouncing development).

CITES has complete facilities at the University Campus of La Rábida of the University of Huelva: wind and photovoltaic fields, as well as renewable hydrogen production (alkaline and PEM technologies), storage (pressurized gas and metal hydrides) and consumption for direct electricity generation (fuel utilization (turbines and engines).

## Entity data

**Type:** Research Center

**Size:** 25 PhDs, 15 engineers, > 20 personnel in training (doctoral students, specialization courses, researchers doing internships, etc.) and 4 laboratory technicians.

**Calls of interest for your entity:**

**European:** applied research with research organizations and companies.



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<https://goo.gl/maps/eKGKNScYWXdaDrzu6>

## Activities and experiences in R&D&I

- Experience in R&D&I activities for more than 30 years. Experience in H2 technologies for more than 20 years.
- More than 70 R&D&I projects carried out among European, national, regional and direct technology transfer to companies.
- 18 doctoral theses supervised with 9 awards.
- 640 publications in journals, books, book chapters and conferences.
- 20 patents, most of them PCT.
- Belonging to the "Puerta de Europa" green hydrogen cluster, the largest in Spain.
- Coordination of the "storage and distribution" group of the Spanish hydrogen and fuel cell technology platform.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 3 M€**

## Technologies offered

- System for hydrogen production by electrolysis using non-conventional currents to achieve higher efficiency.
- Pilot plant to demonstrate the implementation of hydrogen technologies for energy supply in residential applications. Refrigerated food delivery van hybridized with hydrogen technologies.
- Renewable smart grid hybridized with hydrogen technologies.
- Hydrogen-based power plants for aviation use.
- Design, development and prototyping of PEM fuel cells and PEM, Alkaline and AEM electrolyzers. From the stack to the entire balance of plant.
- Power converters and monitoring, instrumentation and control hardware & software for hydrogen systems (electrolyzers, fuel cells, etc.). Digital twins.



# System for hydrogen production by electrolysis using non-conventional currents to achieve higher efficiency



Production

## Technology description

*The most widespread current systems for hydrogen production based on water electrolysis are alkaline and polymeric membrane (PEM) systems. In both cases, high values of direct current (DC) are required to achieve the decomposition of the water molecule (H<sub>2</sub>O) into hydrogen (H<sub>2</sub>) and oxygen (O<sub>2</sub>). This is a disadvantage from the point of view of the electrical consumption of the system and from the point of view of its maintenance, since this current circulates between the electrodes, the anode and cathode of each cell, with the consequent degradation of the cells and the need to use materials for their construction with particular electrochemical characteristics that make them very expensive.*

*The developed technology uses pulsed currents of variable amplitude and frequency, which reduces the energy consumption of the electrolyzer and improves the life time of its electrodes.*

## Technology information

**Maturity level:** Lab tested

**Industrial property rights:** Non-disclosure agreement

**Type of collaboration offered:** Transfer for development/manufacturing/marketing for

## Applications sectors

- **H<sub>2</sub> production.**
- **H<sub>2</sub> storage.**
- **H<sub>2</sub> distribution.**
- **Refueling infrastructures.**
- **Transportation.**
- **Industrial.**
- **Residential/urban.**
- **Energy.**

# Pilot plant to demonstrate the implementation of hydrogen technologies for energy supply in residential applications



Production

## Technology description

*In Europe and also in Spain there is an investment effervescence to build bigger and bigger plants to produce green hydrogen. But while the availability of hydrogen is undoubtedly the first step, true decarbonization will come from the technology to harness that hydrogen to finally stop emitting GHGs into the atmosphere someday (the sooner the better). In this regard, much remains to be done. In particular, the building sector (housing, hospitals, schools, offices, hotels, etc.) is responsible for about 40% of total GHG emissions in the EU. So the problem to be addressed is: what can we do with green hydrogen to avoid this?*

*The developed plant proposes a complete ecological solution (100% GHG-free) to satisfy, from green hydrogen, the energy needs of buildings: electricity, domestic hot water, heating and cooling. It can also work hybridized with electrical systems from renewable energy, so that it only comes into operation when the renewable electrical resource is not available or is insufficient, or when the energy demand is not of an electrical nature.*

*The plant is equipped with a cogeneration and trigeneration system, which makes it more than 90% efficient.*

## Technology information

**Maturity level:** Lab tested

**Industrial property rights:** Non-disclosure agreement

**Type of collaboration offered:** Transfer for development/manufacturing/marketing

## Applications sectors

- **Residential/urban:** Energy use; Thermal use; Microgeneration for domestic use.
- **Energy:** Energy production and storage coupled to the power grid; hydrogen injection into the gas grid.



Production

### Technology description

*Delivery vans for refrigerated or frozen food in the cities must keep their tractor engine permanently started, in order to avoid that the continuous opening (at each stop) of the refrigerated box doors leads to the breakage of the cold chain and, consequently, to the deterioration of the goods. This results in continuous consumption of fossil fuels throughout the workday, and consequent noise and environmental pollution with the generation of GHGs. The developed system generates cold during stops by means of a fuel cell that supplies the electric compressor of the van's refrigeration equipment. The hydrogen needed for a day's work is stored in the van, in a 200 bar cylinder housed in a cage developed in its chassis. The system developed allows the van's tractor engine to operate only when the van is on the road and never when it is stationary.*

*The prototype is running in a Mercedes model 314 cdi van*

### Technology information

**Maturity level:** Available for demonstration

**Industrial property rights:** Non-disclosure agreement

**Type of collaboration offered:** Transfer agreement for development/manufacturing/marketing

### Applications sectors

- **Transport:** vans and refrigerated trucks



Production

## Technology description

*The renewable hybridized smart grid with H<sub>2</sub> technologies developed automatically connects/disconnects to/from the main power grid, depending on the price of electricity purchase/sale, which is known to its intelligent energy management system (EMS). The smart grid, which has a high-voltage DC bus (420 V), a 230 V single-phase AC bus and a 400 V three-phase AC bus, has as short-term storage systems two banks of lead acid batteries and super capacitors with direct connection to the DC bus, which maintains and stabilizes the DC bus voltage. As a medium-term storage system, it has a lithium-ion battery bank, connected to the DC bus by means of a power converter managed by the EMS. Finally, the long-term storage system, also managed by the EMS consists of a complete H<sub>2</sub> production (alkaline and PEM electrolyzers), storage (gas and metal hydride) and consumption (multi-stack fuel cell systems designed and manufactured in-house) facility. EMS knows, through a proprietary design and manufacturing monitoring system, the degree of degradation of each cell of each stack, which allows it to perform permanent predictive maintenance, making cell wear uniform. The EMS is developed based on a model-based predictive controller. The smart grid is in operation supplying the La Rábida Campus of the University of Huelva, which is the only one in Spain with this technology.*

## Technology information

**Maturity level:** Available for demonstration

**Industrial property rights:** Non-disclosure agreement

**Type of collaboration offered:** Transfer for development/manufacturing/marketing

## Applications sectors

- **Energetics:** Energy production and storage coupled to the electrical grid.



Production

## Technology description

*The introduction of electrification in aviation is set to revolutionize the sector, contributing to the decarbonization of the industry. Recently, the so-called Urban Air Mobility (UAM) has attracted the attention of investors and the general public, with the promise of opening the door to an idea as futuristic as air cabs. This line of research integrates hydrogen-electric battery technologies to develop emission-free electric aircraft power plants. The research and development line works in two main areas: (1) design and development of ground prototypes of the power plant components (test bench) to perform tests and gather essential information for the definition and development of the power plant to be integrated into the electric aircraft; and (2) Functional wind tunnel tests of the power plant integrated into the propeller-engine-nacelle-cooling system-air intakes assembly, as well as the corresponding flight tests.*

## Technology information

**Maturity level:** In development.

**Industrial property rights:** Non-disclosure agreement

**Type of collaboration offered:** Transfer for development/manufacturing/marketing

## Applications sectors

- **Air mobility.**
- **Air transportation.**
- **Air surveillance.**



Production

### Technology description

*Design, development and prototyping of PEM fuel cells from the stack to the entire balance of plant. The stack can also be developed or not, depending on the customer's needs and/or interests, so that a fuel cell can also be developed based on a stack determined by the customer. Design, development and prototyping of electrolyzers (PEM, alkaline and AEM) from the stack to the entire balance of plant. The stack can also be developed or not, depending on the customer's needs and/or interests, so that an electrolyzer can also be developed based on a stack determined by the customer. The design and development include the power and control electronics, as well as all the necessary software. At the customer's request, a digital twin of both the fuel cell and the electrolyzer can also be developed.*

### Technology information

**Maturity level:** In development.

**Industrial property rights:** Non-disclosure agreement

**Type of collaboration offered:** Transfer for development/manufacturing/marketing

### Applications sectors

- **H2 production.**
- **Electricity production using hydrogen.**
- **Backup systems.**
- **Hybridized electric grids with hydrogen technologies.**
- **Transportation.**
- **Mobility.**
- **Industrial.**
- **Residential/urban.**
- **Energy.**



Production

### Technology description

*Ad-hoc design and implementation of one-way or reversible power electronic systems (DC/DC converters, DC/AC inverters, charge controllers, etc.), to connect to DC or AC buses hydrogen systems (electrolyzers and fuel cells) together with others (battery banks, supercapacitors, renewable sources, etc.). Ad-hoc design and implementation of hardware-software monitoring and control systems for hydrogen systems (SCADAs, intelligent energy management systems, fieldbus controllers, systems with connection to local networks and INTERNET, etc.). Digital twins for hydrogen systems (real-time simulators, fault generators/simulators, digital twins, etc.). Monitoring of fuel cells at the cell level, which allows preventive maintenance to be carried out and uniform cell wear to be controlled in a stack. It also warns when one or more cells in a stack need to be replaced to avoid deterioration of adjacent cells*

### Technology information

**Maturity level:** Available for demonstration

**Industrial property rights:** Non-disclosure agreement

**Type of collaboration offered:** Transfer for development/manufacturing/marketing

### Applications sectors

- **H2 production.**
- **Electricity production using hydrogen.**
- **Backup systems.**
- **Hybridized electric grids with hydrogen technologies.**
- **Transportation.**
- **Mobility.**
- **Industrial.**
- **Residential/urban.**
- **Energy.**



Storage, transportation and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

(CNH2), is a national research center, oriented to promote the scientific and technological investigation of hydrogen technologies and fuel cells, being at the service of the entire scientific, technological and industrial community. It was created in 2007 as a Public Consortium between the Ministry of Science and Innovation and Castilla-La Mancha Regional Government, with each entity holding a 50% interest, being located in Puertollano (Ciudad Real).

The CNH2's main goals are driving technology forward, testing and validation of prototypes and equipment, development and escalation of processes and endorsement, certification and verification of components and systems.

CNH2 is equipped with 13 laboratories and 6 additional facilities that carry out the entire hydrogen chain.



<https://www.cnh2.es/>



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Puertollano (Ciudad Real)

## Activities and experiences in R&D&I

ECNH2 is specialized in these activities related to hydrogen technologies:

- Research, integration and scale-up processes and materials in high and low temperature devices.
- Characterization and modeling of electrochemical, thermal and fluid-dynamic phenomena.
- Design and construction of test benches.
- Design, sizing and engineering of facilities and applications.
- Testing and characterization of materials, stacks, cells and systems integrated with renewable generation and microgrids.
- Project consulting and coordination.
- Specialized training

## Entity data

**Type:** Technology and Research Institution

**Size:** 50-100 employees

**Calls of interest for your entity:**

*European: Horizonte Europa, FCH JU, Green Deal, Next Generation EU.*

*National: CDTI, MITECO, MICINN.*

*Regional*

## Technologies offered

- Integration and use of hydrogen in transport.
- Hydrogen injection into natural gas grids.
- Design of green hydrogen facilities: microgrids, modeling and simulation.
- Hydrogen refuelling
- Prototype evaluation, development of test benches and hydrogen systems testing.





## Description of the national initiatives in which the entity participates

**ADV REFORMING:** Understanding efficient CH<sub>4</sub>/CO<sub>2</sub> reforming in advanced solid oxide fuel cells and optimising reforming agents and catalysts. MICIN-AEI

**ANTÁRTIDA H2:** Development and Supply of an H<sub>2</sub>-based Power Supply System for application at Antarctic Seismic Stations. MITMA. IGN

**BIOMOTION:** Technical support, testing and validation for the development of hydrogen-fuelled mobility solutions (bicycle and refuelling station). Development of specific fuel cell for the traction system of the bicycle. MICIN-CDTI.

**DESHEO:** Prospective study of the production, logistics and demand for renewable hydrogen in Spain, in a horizon of high penetration of renewable energies 2020-2050. MITECO. IDAE.

**GREENH2PIPES:** Development of innovative components for hydrogen generation by electrolysis, its injection into the natural gas grid and its transport from liquid carriers. MICIN-CDTI.

**HESCOS:** Hybrid energy storage and control system. MICIN-CDTI.

**H24NEWAGE:** Development of advanced hydrogen production, storage and distribution technologies and their industrial transfer for the new hydrogen era in Spain. MICIN-CDTI.

## Description of the international initiatives in which the entity participates

**H2PORTS:** Implementing Fuel Cells and Hydrogen Technologies in Ports. Fuel Cell Hydrogen and Joint Undertaking (FCH2 JU), H2020-JTI-FCH-2018 (topic FCH-03-1-2018).

**ARENHA:** Advanced materials and Reactors for eEnergy storage through Ammonia. Horizonte 2020. H2020-LC-NMBP-29-2019 (topic LC-NMBP-29-2019).

**IMPROVEMENT:** Integration of combined cooling, heating and power microgrids in zero-energy public buildings under high power quality and continuity of service requirements. Programa Interreg SUDOE y el Fondo Europeo de Desarrollo Regional (FEDER). SOE3/P3/E0901.

**FCH2RAIL:** Fuel Cell Hybrid PowerPack for Rail Application. Fuel Cell Hydrogen and Joint Undertaking (FCH2 JU), H2020-JTI-FCH-2020-1 (topic FCH-01-7-2020).

**GREEN HYSLAND:** Deployment of a H<sub>2</sub> Ecosystem on the Island of Mallorca. Fuel Cell Hydrogen and Joint Undertaking (FCH2 JU), H2020-JTI-FCH-2020-1 (topic FCH-03-2-2020).

**H2 URUGUAY:** Segunda transición energética del Uruguay a partir de la utilización del H<sub>2</sub> como vector energético. Fondo Sectorial de Energía. Agencia Nacional de Investigación e Innovación (ANII) del Uruguay. FSE\_S\_2020\_1\_165530.



## Description of the national initiatives in which the entity participates

**H2TRUCK:** Research and development of a new heavy duty vehicle for urban service applications with hybrid battery - hydrogen fuel cell technology. MICIN-CDTI.

**ICTI-FEAT:** Scientific and Technological Initiative on Infrastructures for the Manufacture of High Temperature Electrolysers (SOEC). MICIN-CDTI.

**OCEANH2:** Offshore green hydrogen generation, storage and distribution. MICIN-CDTI.

**PHOTOHY:** Photocatalytic white hydrogen generation. MICIN-CDTI.

**SHINE-FLEET:** Hydrogen-based technology solutions for the smart and sustainable mobility of autonomous heavy duty fleets. MICIN-CDTI.

**TRANSFER:** Renewable energy storage technologies based on new photovoltaic thermal systems. MICIN-CDTI.

**UNDERGY:** Technologies for the development of seasonal renewable energy storage with green hydrogen integrated into a smart grid. MICIN-CDTI.

**IDEAH2:** Research and development of high temperature systems for co-electrolysis. JCCM.

**PRTR:** development of strategic actions based on hydrogen to transform the current energy paradigm and minimise greenhouse gas emissions. MICIN-Next Generation EU.

## Description of the international initiatives in which the entity participates

**MACBETH:** Membranes And Catalysts Beyond Economic and Technological Hurdles. Horizonte 2020. H2020-NMBP-ST-IND-2018-2020. CE-SPIRE-04-2019.



Storage



Refuelling



Transport

## Technology description

Electrical, gas and control engineering services for the sizing and integration of hydrogen in vehicles, from light applications to heavy duty transport, buses, trains, boats and drones. It is applicable to new design vehicles, retrofitting and range extender systems and testing and validation of equipment and components.

Vehicle laboratory equipped with tools and facilities needed for vehicle modification and their testing and validation on dyno, which it is specially adapted for its use in hydrogen vehicles.

Testing and validation of vehicle refuelling in hydrogen station.



## Technology information

**Maturity level:** Developed but not commercialized

**Industrial property rights:** Protected by trade secret

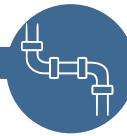
**Type of collaboration offered:** Cooperation and R&D agreement. Manufacturing agreement. Commercial agreement with technical assistance. Service provision agreement. Technical cooperation agreement.

## Applications sectors

- **H2 Storage:** Compressed gas in tanks.
- **Refuelling infrastructure:** Dispensing
- **Transport:** Components testing, fuel cell, tanks, traction systems, power electronics.



Storage



Distribution



Transport



Industrial



Residential/  
Urban



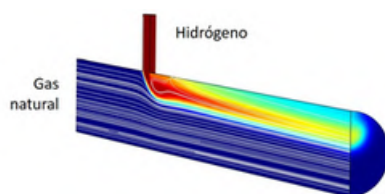
Energetic

## Technology description

The design of hydrogen injection installation into natural gas grids is done by CNH2, which includes:

- Conceptual, basic and detailed engineering.
- CFD modeling and system optimization of hydrogen injection into natural gas grids.
- Fluid dynamic analysis of processes involved in hydrogen/natural gas blending.
- Help in the purchase process and assistance in FAT test.
- Commissioning of the installation.
- Composition analysis of the final blend.

Design of rings for testing blending processes. Study of the behaviour of natural gas grids when injecting hydrogen in different proportions, increasing the percentage of hydrogen from 5% to 100%. Analysis of different types of hydrogen injection into pipelines.. Modeling of the efficiency of the blending process.



## Technology information

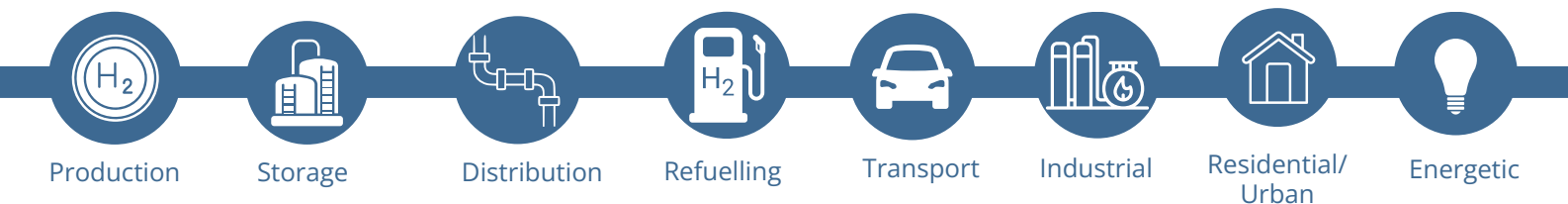
**Maturity level:** Basic research, validated at the laboratory level. Developed, but not commercialized.

**Industrial property rights:** Protected by trade secret

**Type of collaboration offered:** Cooperation and R&D agreement. Service provision agreement. Technical cooperation agreement.

## Applications sectors

- **H2 Storage:** Hydrogen Carriers.
- **H2 Distribution:** Pipes.
- **Transport:** Element testing and natural gas pipelines.
- **Industrial:** Green hydrogen as raw material.
- **Residential/Urban:** Energy and thermal use, microgeneration for domestic use (mCHP)
- **Energetic:** H2 injection into gas grid.



## Technology description

The design of green hydrogen facilities integrated with renewable energy, with storage and its subsequent use in fuel cells or vehicle refuelling is done by CNH2, which includes:

- Conceptual, basic and detailed engineering.
- Technical-economic studies with sensibility analysis of the main parameters, as well as definition of business models.
- Assistance and support on equipment and technology selection.
- Help in the processing of purchases and assistance to the FAT test.
- Local, regional and national processing of permits for the project.
- Search and aid processing at local, regional, national and international level that may be feasible for the specific project.
- Assistance and support on installation commissioning.
- Component simulation of hydrogen cycle and integration with different renewable profiles.

The development of renewable energy integration solutions for hydrogen production in the decarbonization framework of the energy sector through the use of simulation tools and development of microgrid applications for grid balance services.

## Technology information

**Maturity level:** Available for demonstration. On the market

**Industrial property rights:** Protected by trade secret

**Type of collaboration offered:** Cooperation and R&D agreement. Manufacturing agreement. Commercial agreement with technical assistance. Service provision agreement. Technical cooperation agreement.

## Applications sectors

- **H2 Production:** Electrolysis, auxiliary elements, process control, complete plant.
- **H2 Storage:** Compressed gas, liquid hydrogen.
- **H2 Distribution:** Pipelines and maritime distribution.
- **Refuelling infrastructures:** On site hydrogen production, compression, storage, dispensing.
- **Transport:** Components testing, fuel cell, traction systems, power electronics.
- **Industrial:** Green H2 as raw material
- **Residential/Urban:** Energy use.
- **Energetic:** Energy production and storage coupled to the grid.



Storage



Refuelling



Industrial

## Technology description

The design of hydrogen refuelling stations integrated with hydrogen production systems via electrolysis through electrical generation from renewable energy is done by CNH2, which includes:

- Conceptual, basic and detailed engineering.
- Assistance and support on equipment and technology selection.
  - Help in the processing of purchases and assistance to the FAT test.
- Local, regional and national processing of permits for the project.
- Search and aid processing at local, regional, national and international level that may be feasible for the specific project.
- Commissioning of the installation.

Transport sector decarbonisation through on-site hydrogen production coupled with renewable energy.



## Technology information

**Maturity level:** On the market

**Industrial property rights:** Protected by trade secret

**Type of collaboration offered:** Cooperation and R&D agreement. Manufacturing agreement. Commercial agreement with technical assistance. Service provision agreement. Technical cooperation agreement.

## Applications sectors

- **H2 Storage:** Compressed gas, liquid hydrogen and metal hydrides.
- **Refuelling infrastructures:** H2 production on-site. Compression, storage and dispensing
- **Industrial:** Green H2 as raw material.



Production



Transport



Energetic

## Technology description

Consulting and design of low temperature electrolysis cells and stacks (alkaline, AEM and PEM).

- Cell components and materials evaluation and testing.
- Prototypes evaluation according to harmonized measurement protocols or proposed by customer for cells, stacks, modules and complete systems for PEM fuel cells, alkaline electrolyzers and PEM up to 100 kW.
- Conceptual, basic and detailed engineering (BoP, hydrogen production and transformation systems)
- Test benches development for fuel cells and electrolyzers according to customer requirements.
- Prototypes development of power systems based on fuel cells.

Electrolysis cells and stacks design and optimization. Prototypes testing and evaluation according to customer requirements or harmonized testing protocols for electrolysis and fuel cells. Test benches and prototypes development based on fuel cells and electrolyzers. Testing capacities systems up to 100 kW in PEM fuel cells and low temperature electrolyzers (alkaline and PEM).

## Technology information

**Maturity level:** Basic Research, Validated at laboratory level. Developed, but not commercialized.

**Industrial property rights:** Protected by trade secret.

**Type of collaboration offered:** Cooperation and R&D agreement. Manufacturing agreement. Commercial agreement with technical assistance. Service provision agreement. Technical cooperation agreement.

## Application sectors

- **H2 Production:** Electrolysis, auxiliary elements, process control, complete plant.
- **Transport:** Components testing, fuel cell, power plant, power electronics.
- **Energetic:** Energy use.



Production



Industrial



Residential/  
Urban



Energetic

## Technology description

Design and manufacture of cells and stacks of high temperature fuel cells and electrolyzers.

- Development, evaluation and testing of materials and components at cell level.
- Evaluation of prototypes, according to harmonised or customer supplied measurement protocols for cells and stacks up to 1 kW.

Design and optimisation of reversible cells and stacks. Testing and evaluation of prototypes according to customer requirements or according to harmonised testing protocols for electrolysis and fuel cells. Capabilities for testing of systems up to 1 kW in reversible systems (SOFC-SOEC).



## Technology information

**Maturity level:** Research.

**Industrial property rights:** Protected by trade secret.

**Type of collaboration offered:**

Cooperation and R&D agreement. Manufacturing agreement. Commercial agreement with technical assistance. Service provision agreement. Technical cooperation agreement.

## Application sectors

- **H<sub>2</sub> production:** High temperature electrolysis.
- **Industry:** Green H<sub>2</sub> as raw material and electricity production.
- **Residential/Urban:** Energetic use.
- **Energetic:** H<sub>2</sub> and electricity production.





Production



Mobility



Industry



Other uses

## Description of the entity

Coxabengoa is an international company that applies innovative technological solutions for sustainability in the infrastructures, energy and water sectors.

Coxabengoa has 25 years of experience in different hydrogen technologies, with a department dedicated to the execution of both national and international projects, covering different technologies from hydrogen production through electrolysis and reforming to its use in power production with fuel cells, industrial applications, mobility, biofuels and hydrogen derivatives production (ammonia and methanol), among others.

This extensive experience allows Coxabengoa to offer highly innovative solutions in specific sectors of the hydrogen value chain through strategic partnerships with leading manufacturers and technologists.

Coxabengoa offers technical consultancy and assessment services as well as the development of the engineering, purchase and construction (EPC) of the plants, to accompany its customers from the beginning of the Project until the Commercial Operation Day (COD) and the Operation and maintenance of these plants.

## Entity data

**Type:** Large company

**Size:** >100 employees

**Calls of interest for your entity:**

-European: Horizon Europe, CH JU, Green Deal

- National: CDTI, MITECO, MICINN, IDAE

- Regional



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Calle Energía Solar, 1 – Campus Palmas Altas. 41014, Seville (Spain)

## Activities and experiences in R&D&I

-Hydrogen production plants through electrolysis, reforming of hydrocarbons and alcohols and MSW gasification .

-Hydrogen derivatives production (ammonia, methanol and other biofuels).

-Power generation plants based on fuel cells.

-Energy storage plants (thermal and electrical), based on hydrogen and renewable energies.

-Application of hydrogen technologies in maritime and defense sectors.

-Implementation of Hydrogen Refueling Stations.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 million €**

## Technologies offered

- Electrolysis plants for green hydrogen production, as an EPC contractor by integrating hydrogen production plants (and its derivatives) with renewable energy plants.
- Power plants based on different fuel cell technologies. Design, construction, integration, and validation of these plants.
- Maritime and Defense applications, as technologist, integrator, and main supplier of the AIP system.
- Hydrogen Refuelling Stations (HRS), providing EPC services for the development of the HRS.
- Biofuel reforming and MSW gasification systems for hydrogen production.
- Operation and maintenance services for these plants.
- Consultancy and technological advisory service for projects related to the hydrogen and its derivatives.
- Feasibilities studies.



## Description of the national initiatives in which the entity participates

Coxabengoa is the main technologist, integrator, and supplier of the AIP System for the S-80 class submarines in partnership with Navantia, the leading Spanish public company specialized in the design and construction of high-tech ships.

Coxabengoa is in charge of the design, manufacture and validation of the bioethanol processor system, power conditioning system, and AIP control system, as well as the integration of the Fuel Cell Power Module and CO2 Disposal System to guarantee the required performance, functionality, and operability.

## Description of the international initiatives in which the entity participates

Feasibility study for green hydrogen and ammonia production integrated with renewable energy plants in the North of Africa.

Feasibility study and EPC for hydrogen production via MSW gasification and PWA.

Continuation of the European project GRASSHOPPER through an agreement with the fuel cell manufacturer for the operation of the Power Plant based on PEM Fuel Cell technology.



Production



Storage



Refuelling



Transport



Residential/  
Urban



Energetic

## Technology description

Coxabengoa's main technologies include:

- Electrolysis plants for green hydrogen production, as an EPC contractor by integrating hydrogen production plants (and its derivatives) with renewable energy plants.
- Power plants based on different fuel cell technologies. Design, construction, integration, and validation of these plants.
- Maritime and Defense applications, as technologist, integrator, and main supplier of the AIP system.
- Hydrogen Refuelling Stations (HRS), providing EPC services for the development of the HRS.
- Biofuel reforming and MSW gasification systems for hydrogen production.
- Operation and maintenance services for these plants.
- Consultancy and technological advisory service for projects related to the hydrogen and its derivatives.
- Feasibilities studies.

## Technology information

**Maturity level:** Developed but not commercialized

**Industrial property rights:** Protected by trade secret

**Type of collaboration offered:** Cooperation and R&D agreement. Manufacturing agreement. Commercial agreement with technical assistance. Service provision agreement. Technical cooperation agreement.

## Applications sectors

- **H2 Production:**  
Water electrolysis  
Biofuels reforming and MSW gasification
- **Refuelling Infrastructures:**  
On-site hydrogen production, compression, storage and dispensing
- **Transport:**  
Maritime (reforming and fuel cell technologies)
- **Industrial:**  
Green hydrogen production  
Cogeneration power systems
- **Residential/urban:**  
Microgeneration  
Energy and thermal uses
- **Energy sector:**  
Energy production (renewable and hydrogen) and storage



## Mobility

### Description of the entity

CTAG is a Technology Center founded in 2002 and dedicated to R&D&I in advanced technological solutions for the automotive and mobility sector. Legally it is a private and non-profit foundation.

CTAG is a multidisciplinary center with more than 1,000 professionals who develop their activity in R&D&I projects in multiple areas of knowledge such as autonomous, connected and intelligent vehicles, product and process development, testing and validation, passive safety technologies, etc.

It has technological lines that respond to its main challenges, such as connectivity, electronics, ADAS, HMI and interiors, simulation and virtual validation, new materials, electric and hydrogen vehicle battery laboratory and connected and autonomous vehicle.



<https://ctag.com/>



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Pol. Ind. A Granxa 36475 Porriño (Pontevedra) ES

### Activities and experiences in R&D&I

Since its foundation, CTAG participates in numerous European, national and regional R+D+i programs, accumulating a participation in more than 250 collaborative projects, 90 European and of them 50 currently underway and 25 at European level.

It participates in Networks of Excellence for Knowledge Transfer, has a Technology Observatory and industrial and intellectual property management.

Its R&D&I Management System is certified according to the UNE EN 166002 standard and has a Research Results Transfer Office to channel technology transfer to companies.

It has €73M of accumulated investments in scientific-technological equipment, including a Clean Technologies Laboratory for Electric and Hydrogen Vehicles.

### Entity data

**Type:** Technology center

**Size:** > 1.000 researchers

**Calls of interest for your entity:**

**European:** Horizon EU, FCH JU,

**National:** CDTI, MINECO, MICINN

### Technologies offered

Smart Mobility

Autonomous driving and ADAS

Electric and H2 fuel cell vehicles

Battery lab and electric powertrain

V2X connected vehicle

Comfort and interiors

New materials

Circular economy

Product and process development

Industry 4.0

Passive safety systems

Mobility test circuits



## Description of the national initiatives in which the entity participates

CTAG is a member and/or participates in:

Galician Hydrogen Association (**AGH2**), of which it holds the Vice-Presidency and coordinates the Research, Development and Innovation working group.

Spanish Hydrogen Technological Platform (**PTeH2**), participating in the knowledge group of Uses in Mobility, as well as in the National collaboration group.

SERNAUTO Move2Future (**M2F**) - participating in the Electric Propulsion Systems working group, where it co-leads the hydrogen subgroup.

It also maintains links with the Spanish Hydrogen Association (**AeH2**) and the Associação Portuguesa para a Promoção do Hidrogénio (**AP2H2**).

He also participates in several hydrogen value chain development projects focused on Northwest Spain and the Galicia-North Portugal Euroregion.

He regularly attends several regional and national hydrogen events and conferences.

## Description of the international initiatives in which the entity participates

CTAG regularly attends international events and conferences, such as the European Hydrogen Week or the European Hydrogen Energy Conference.



Storage



Refuelling



Transport



Energetic



Other

## Technology description

*Studies using physical and virtual test facilities for electric and hydrogen vehicle evaluation, including batteries, powertrain and fuel cell, with HIL (hardware in the loop) and PHIL (power hardware in the loop) capabilities.*

*Vehicle systems validation labs including:*

- **E-Mast** - multi-axial shaking tables for complete vehicle in climatic chamber, with cooling systems, battery testing and sensorics for complex signal processing.
- **E-Axle** - dynamometer bench for 2-wheel electric motor, combined with battery simulator, cooling units and high frequency power analyzer
- **High Power and Voltage Bench** (up to 1.000V) with 4 VESA-c units, 2 units combined with the E-Mast and 2 units with the high temperature ramp climatic chamber.
- **E-Clima** - complete vehicle chamber for test control with high temperature ramp, combined with VESA-c, cooling units and CAN/LIN communications.

## Technology information

**Maturity level:** Research, development, validation and testing.

**Industrial property rights:** N/A

**Type of collaboration offered:** Cooperation agreement for R&D, Trade agreement with technical assistance, ENAC accredited testing services.

## Applications sectors

### Mobility:

- Batteries.
- Abuse and destructive testing.
- Electric powertrain.
- H2 fuel cell vehicle.
- Bi-directional recharging systems.
- Mobility pilots with vehicles or fleets and electric on-board monitoring



Storage, transportation and distribution



Production



Mobility



Industry

### Description of the entity

Diverxia Infrastructure is a global company with a long track record in the development and execution of large-scale projects, but always related with renewable energy infrastructures.

Diverxia H2 becomes the new energy division for the development, promotion and execution of green hydrogen projects, focused on the deployment of Hydrogen Refuelling Stations (HRS) for the heavy-duty vehicles, but also dedicated to the H2-Blending projects in the current natural gas grid.



[www.diverxia.net](http://www.diverxia.net)



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46980 Paterna, Valencia

### Activities and experiences in R&D&I

No-Conventional Electrolysis Technologies (SOE, AEM...)

Hydrogen Storage Systems (LOHC, NH<sub>3</sub>, CH<sub>3</sub>OH...)

"Diesel + H<sub>2</sub>" DualFuel Systems (H<sub>2</sub>-DDF)

### Approximate annual investment in R&D&I in hydrogen and fuel cells:

< 1 million €

### Entity Data

**Type: Large Company:** Gran empresa

**Size:** 21 – 50 employees

#### Calls of interest for your entity:

- European: Horizon Europe, FCH JU, Green Deal
- National: CDTI, MITECO
- Regional

### Tecnologies Offered

Systems for the green hydrogen production, including the renewable energy facility associated.

Hydrogen Refuelling Station (HRS) for heavy-duty transport sector.

Production centers and injection points for the green hydrogen supply on the natural gas grid or network, in both transport and distribution lines.



### Description of national initiatives in which the entity participates

**Hydrogen Refuelling Station (HRS)** dedicated to the green hydrogen supply for the **heavy-duty mobility sector**.

National plan for the deployment of **HRS network** along the **Mediterranean zone**.

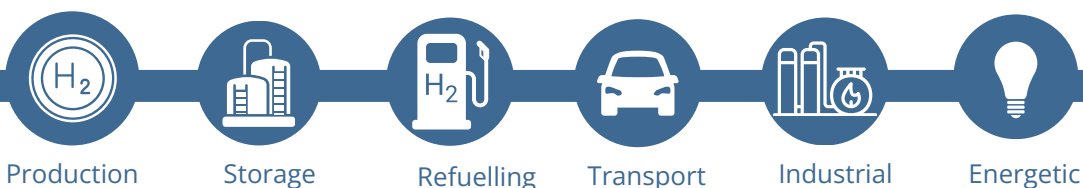
Development of **H2 blending projects** on the **transport ducts** of natural gas.

Development of **H2 blending projects** on the **distribution lines** of natural gas.

Development of **“Diesel+H2” DualFuel Solutions (H2-DDF)** for the application on **heavy-duty vehicles** dedicated to the land transport of goods through a long-distance service.

### Description of international initiatives in which the entity participates





### Technology description

#### H2 REFUELLING STATION (HRS)

Green hydrogen production facility integrated on a Hydrogen Refuelling Station (HRS).

Green hydrogen production centers where the associated renewable energy facility and the electrolysis plant are included. Regarding the electrolysis plant, some auxiliary systems are considered:

Power Converter Station, **PCS**  
(MV Transformer + AC/DC Rectifier)

Water Treatment System, **WTS**  
(Reverse Osmosis, RO + Electro-Deionization, EDI)

Hydrogen Purification System, **HPS**  
(Deoxo + Dryer)

The Hydrogen Refuelling Station has the required stages of storage and accumulation, conditioning and supply of green hydrogen:

**Low pressure** storage (LP Buffer) and **high pressure** accumulation (Cascade tanks system)

Compression stage

**Dispensing points** with **pre-cooling units** for fast refuelling

### Información de la tecnología

**Maturity level:** On the market

**Industrial property rights:** Trademark

**Type of collaboration offered:** Cooperation agreement for R&D, Trade Agreement with technical assistance, Service provision agreement

### Sectores de aplicación

- **H2 Production:** Electrolysis of water (full floor)
- **H2 Storage:** Compressed gas in Tanks, Liquid Hydrogen, Hydrogen Carriers (LOHC, NH<sub>3</sub>, CH<sub>3</sub>OH...)
- **Refuelling infrastructures:** Production + Conditioning + Dispense
- **Transport:** Heavy-Duty Vehicle
- **Industrial:** Green hydrogen as a raw material
- **Energetic:** Injection into the natural gas grid

# DURO FELGUERA GREEN TECH (DURO FELGUERA)



Storage, transportation and distribution



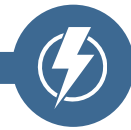
Production



Mobility



Industry



Other uses

## Description of the entity

Company specialized in executing of turnkey projects for the Energy, Mining & Handling and Oil & Gas sectors, as well as a renowned provider of specialized services for industries and expert manufacturer of Capital Goods.

With over 160 years of experience in industrial activities, it executes engineering, supplies, erection, commissioning and its operation and maintenance.

It has established a new specific business line called "Duro Felguera Green Tech, S.A.", focused on the development of Renewable Energies (Photovoltaic and Wind), as well as Production of Green Hydrogen and derivatives (Ammonia and Green Methanol), Energy Storage, Biofuels.

We are currently executing several EPC Projects for the Production of Renewable Hydrogen in Europe of an Industrial nature.

## Entity Data

**Type:** Large Company

**Size:** >100 Employees

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU, Green Deal

**National:** IDAE, MITECO, CDTI

**Regional**



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Parque CyT Gijón. Ada Byron, 90. 33203 - Gijón

## Activiities ans experiences in R&D&I

Our experience makes us the ideal company as an Integrator in H2 Projects, as well as manufacturers of H2 storage solutions, both compressed (Bullets) and liquid (Spheres). Duro Felguera, is also currently developing, as a promoter (together with other partners).

## Approximate annual investment in R&D&I in hydrogen and fuel cells:

1 - 5 millions

## Tecnologies Offered

- Integration of Green Hydrogen Projects.
- Green Ammonia Project Integration.
- Integration of Green Methanol Projects.
- CO2 Capture Projects Integration
- Integration of Renewable Production Projects (PV and Wind) and Energy Storage.
- Storage of H2 Gas in bullets.
- Storage of Liquid H2. (Double-walled spheres)
- Storage of green NH3 (Spheres and Refrigerated Tanks)
- Storage of Green Methanol

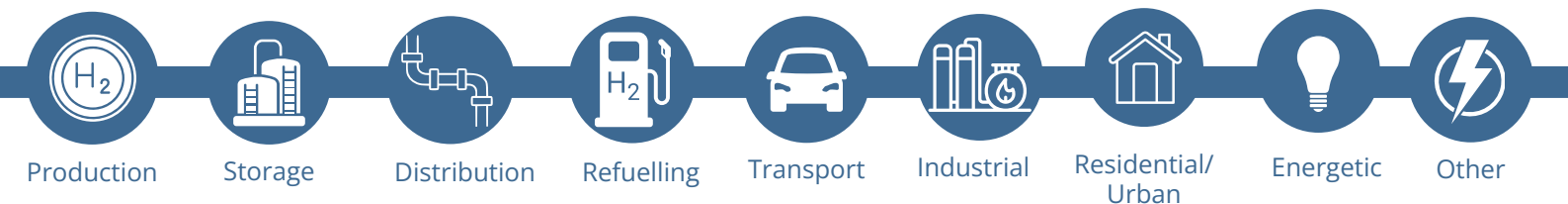


## Description of national initiatives in which the entity participates

- “Pioneros de H2 ” – Spanish Grant Program.
- “Cadena de Valor de H2” – Spanish Grant Program.
- “Energías Renovables Marinas” – Spanish Grant Program.
- Spanish Regional: R+D+i Projects in the Area of Energy and Renewable Hydrogen.

## Description of international initiatives in which the entity participates

- Horizon Europe
- Others



## Technology description

Specialists in the turnkey execution of Renewable H2 Production Plants.

Solution integrator.

Experience in EPC Projects of industrial size of Renewable Hydrogen Production, both in Greenfield and Brownfield.

Examples:

- VIATLE Project: 10 MW Electrolyzer. Production of H2 for distribution, in Alcázar de San Juan; including Renewable H2 Production; compression at 400 barg and filling of tube trailers.
- Project: Production of renewable H2 inside an existing refinery in southern Europe.

## Technology information

**Maturity level:** In market

**Industrial property rights:** N/A

**Type of collaboration offered:** N/A

## Sectores de aplicación

- H2 Production: N/A
- H2 Storage: N/A
- H2 distribution: N/A
- Refuelling infrastructures: N/A
- Transport: N/A
- Industrial: N/A
- Residential/urban: N/A
- Energetic: N/A
- Other: N/A



Production



Storage



Industrial



Energetic



Other

## Technology description

Storage of H2 Gas (30 – 200 Bar) Large format.

Manufacture of bullets (Type 1), horizontal and vertical, in one piece, in the workshop of “CaldereríaPesada” in Asturias, with its own dock and possibility of direct access to the sea.

- Large format for maritime transport and location in port areas or nearby (up to 12 m diameter and 100 m length).
- Road-transportable models (up to 3.5 m diameter and 25 m length).
- Design pressures (10 – 200 Bar).

## Technology information

**Maturity level:** In market

**Industrial property rights:** N/A

**Type of collaboration offered:** N/A

## Application sectors

- H2 Production: N/A
- H2 Storage: N/A
- H2 distribution: N/A
- Refuelling infrastructures: N/A
- Transport: N/A
- Industrial: N/A
- Residential/urban: N/A
- Energetic: N/A
- Other: N/A



Mobility



Industry



Other uses

## Description of the entity

Ecointegral IDP has 25 years of experience in the renewable energy sector. Throughout this time it has carried out the design, construction and commissioning of many photovoltaic and wind installations throughout the Spanish geography, as well as transport, distribution and electric recharging infrastructures for vehicles. Since 2020, Ecointegral IDP has been developing studies for the implementation of green hydrogen as a renewable surplus, as well as its use in the decarbonization of sectors such as industry, transport and waste management. Ecointegral IDP also includes among its services energy improvement audits in which it incorporates hydrogen-based solutions to contribute to the decarbonization of its customers. Finally, the application of BIM methodology and digital twins are also a fundamental part of Ecointegral IDP's expertise.



[www.ecointegral.com](http://www.ecointegral.com)



900 921 929



[info@ecointegral.com](mailto:info@ecointegral.com)



C/ Imprenta La Alborada 124 D, 14014, Córdoba

## Activities and experiences in R&D&I

In recent years, Ecointegral IDP has been awarded more than 35 R&D projects financed by European Union (Horizon Europe, Horizon 2020 and 7th Framework Program for Research and Development) and Spanish Government (Retos, Feder and Misiones) programs in consortium with more than 150 companies and research centers of 23 nationalities, for a value of 15 M€ the part corresponding to our company.

### Approximate annual investment in R&D&I in hydrogen and fuel cells:

750.000 €

## Entity data

**Tipo:** Large company

**Tamaño:** > 100 employees

**Calls of interest for your entity:**

**European**

**National**

**Regional**

## Technologies offered

Ecointegral IDP offers its experience in BIM methodology for the design and execution of digital twins, as well as its knowledge in sectors such as industry, logistics or transport to apply decarbonization methods based on hydrogen technologies.



## Description of national initiatives in which the entity participates

- **BIM4SAFETY project** funded by the Ministry of Economy, Industry and Competitiveness for the use of BIM methodology in the development of a new monitoring system to improve safety in the construction of buildings and civil infrastructures.
- **PISCIA project**, financed by the Ministry of Science and Innovation and consisting of an interoperability platform for water cycle services with the aim of developing an experimental prototype of a BIM environment for the water sector capable of integrating, orchestrating and offering new water management services.
- **STEFAN Project**, classified as a CIEN Strategic Project by the CDTI, aims to promote the development of new technological solutions in the field of materials, tribology and ICTs in relation to the behavior and durability of the rolling stock of operators and railroad tracks.
- **Acrópolis Project**, framed in the call Retos-Colaboración 2019 of the Ministry of Science, Innovation and Universities with the aim of building an aid system for the classification of rafts based on the potential risk, combining GIS and Machine Learning.

## Description of international initiatives in which the entity participates

- **HYBRIS project**, funded by H2020 program, aims at optimizing high efficiency, economical and sustainable hybrid solutions in microgrid applications. It is based on TRL 5-6 hybrid storage systems and their demonstration and validation in 3 use case applications in 3 pilot sites in 3 countries (Italy, Belgium and the Netherlands).
- **DigiCheks project**, funded by Horizon Europe program, is based on a new unified environment of digital technologies enabling interoperability and communication between platforms managing construction permits.
- **SCENARIOS project**, funded by H2020 program, aims to devise a complete set of technological solutions and cutting-edge strategies for the detection, quantification, control and removal of perfluoroalkylated substances (PFAS) from soil.
- **HYPERGRID project**, funded by H2020 program, has as its main objective to develop a set of cost-effective, replicable and scalable technical solutions to integrate technologies based on renewable energy sources in thermal grids, as well as their link with electricity grids.
- **BIM2TWIN project**, funded by H2020 program, aims to build a Digital Building Twin (DBT) platform for construction management that implements LEAN principles to optimize the process, shortening lead times, reducing costs, improving quality and safety, and reducing the carbon footprint.



Production



Refuelling



Energetic

## Technology description

- BIM (Building Information Modeling)** is a collaborative work methodology for project management through a digital model that allows projects to be more efficient and sustainable throughout their life cycle. The BIM allows to obtain the energy model of the facility (either a building or an energy infrastructure) and its subsequent analysis, where the information of the geometry, construction materials and their equipment is used.
- Digital twins** allow a much closer management of real infrastructures than just using traditional systems such as SCADA, BMS and CMMS. In operation and maintenance, it allows, among other things, to visualize the infrastructures in a 3D model with the actual operation and maintenance data. This helps considerably in minimizing the number of physical interventions and rationalizing the ones performed, optimizing the access and performance of each one of them, and allowing the aggregation of activities in a single visit/intervention.

## Technology information

**Maturity level:** on the market

**Industrial property rights:** N/A

**Type of collaboration offered:** N/A

## Application sectors

- H2 Production:** electrolysis (full plant), SMR (full plant), methanol reforming (full plant) and biomass (full plant)
- Refuelling infrastructures:** in-situ hydrogen production, compression, storage and dispense
- Energetic:** Production and storage of energy coupled to the electricity grid





Storage, transportation  
and distribution

## Description of the entity

With 50 years' experience, Enagás is an international leader in the development, operation and maintenance of energy infrastructure.

We contribute to the security of supply and to the global decarbonization process with our know-how and a consolidated infrastructure network.

Enagás is certified as an independent natural gas TSO by the European Union and, moreover, it is the Technical Manager of the natural gas system in Spain.



<https://www.enagas.es/es/>



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Paseo de los Olmos, 19, 28005 Madrid

## Activities and experiences in R&D&I

Development and active participation in R&D&I projects related to the storage and transport in the natural gas chain (including LNG).

Since more than 10 years, Enagás has participated in projects related to the decarbonization of the energy system: biogas/biomethane and hydrogen.

The participation in the projects includes the roll of leader and partner.

Project are funded both internally or with subventions from R&D&I programs.

### Annual investment in R&D&I activities:

~3M€

## Entity data

**Type:** Gran Empresa

**Size:** > 1000 empleados

**Calls of interest for your entity:**

**European**

**National**

## Technologies offered

Facilities for the construction of test benches for the projects.

Testing set up for methane/hydrogen fugitive emissions.

EN ISO 17025 accredited calibration/testing laboratory in the field of flow, gas quality, pressure, temperature and electricity.



## Description of national initiatives in which the entity participates

### GreenH2Pipes

- Development of innovative components for production of H<sub>2</sub> by electrolysis, injection into natural gas grid and transport using liquid carriers. There are several objectives: Development of a new generation PEM electrolyser, Experimental results to facilitated the integration of H<sub>2</sub> in natural gas grid (main Enagás involvement) and Investigation in H<sub>2</sub> liquid carriers.  
Fund: Misiones CDTI.

### StoreNew

- Investigation and integration of a set of technologies and processes related to the utilisation of green H<sub>2</sub> as a strategic energy vector.  
Funds: CDTI Cien.

## Description of international initiatives in which the entity participates

### NNEWGASMET (Finished in 2022)

- Impact of renewable gases (biogas/biomethane, H<sub>2</sub> and blends of H<sub>2</sub> and natural gas) in the accuracy and durability of gas flow meters.  
Funds: EMPIR Call 2018.

### DECARB

- Metrology of flow measurement, quality analysis, physical properties measurement and leak detection, needed for supporting the decarbonisation of gas grid through the transportation of H<sub>2</sub>, both in blends with natural gas or pure, and biomethane.  
Funds: EMPIR Call 2020.

### METHAREN

- Design, construction and testing (1 year) of a biomethane production reactor using syngas from gasification of refused urban waste, combined with H<sub>2</sub> from a SOEC and CO<sub>2</sub> from biogas upgrading.  
Funds: HORIZON-CL5-2021-D3-03-16.

### THOTH

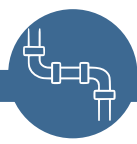
- Development of new methodologies, procedures and installation for testing the metrological behaviour of measurements devices installed in a gas grid carrying natural gas/H<sub>2</sub> blend (up to 30% H<sub>2</sub>) or pure H<sub>2</sub>.  
Funds: Clean Hydrogen Partnership  
AWP 2022-05- 04.

### OPHYCS

- Development of a system for the continuous monitoring and detection of leaks of natural gas/H<sub>2</sub> blends or pure H<sub>2</sub>.  
Funds: HORIZON-JTI-CLEANH2-2022-02-02.



Storage



Distribution

## Technology description

Facilities to support R&D&I projects.

Facilities for the construction of test benches for the projects.

Testing set up for methane/hydrogen fugitive emissions.

EN ISO 17025 accredited calibration/testing laboratory in the field of flow, gas quality, pressure, temperature and electricity.

## Technology information

Enagás is not a company selling technology.

Enagás has facilities to support R&D&I projects.

## Application sectors

Natural gas, biogas/biomethane and hydrogen value chain.



Storage, transportation and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

ENERGYLAB is a private non-profit technological center that develops R&D activities with the aim of improving the competitiveness of the industry through innovative projects to enhance energy performance and reduce environmental impacts.

The center specializes in the development of projects related to the generation, production, storage, and distribution of green hydrogen.

The center actively works within the value chain of H<sub>2</sub>, providing support to the industrial sector to optimize and enhance these technologies. To achieve this objective, EnergyLab offers highly specialized facilities and a multidisciplinary team with extensive experience in various phases of R&D projects.



<https://energylab.es/>



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Vigo, Pontevedra

## Actividades y experiencia en I+D+i

The most significant project in terms of investment is the CONSOLIDATION OF THE MIXED RENEWABLE GAS UNIT (2020-2023), a joint project of Naturgy, ENERGYLAB and EDAR Bens which is financed by Galicia ERDF 2014-20 OP and cofinanced by the Galician Innovation Agency (GAIN).

This project proposes green hydrogen generation through a turbine energy using wastewater effluents and through dark fermentation process, its storage through biological methanation, separation at destination (mixtures of hydrogen and methane) and the evaluation of its impact on current infrastructures and end consumers.

**Approximate annual investment in hydrogen and fuel cell R&D&I: < 1 M €.**

## Entity data

**Type:** Technology center

**Size:** 21-50 employees

**Calls of interest for your entity:**

**European:** EU Horizon, FCH JU, Green Deal

**National:** CDTI, MITECO, MICINN

**Regional:** GAIN

## Tecnologías ofertadas

- Biological pathway for H<sub>2</sub> production through dark fermentation.
- Electrochemical pathway for H<sub>2</sub> production through electrolysis (AEM/PEM). Improvement of anion exchange composite membranes, electrode enhancement, reduction of BOP.
- Impact assessment of H<sub>2</sub> in end uses. Permeability and mechanical stress tests on materials.
- Injection of H<sub>2</sub> into the gas/biogas network and gas separation at the point of consumption.
- Utilization of renewable gases.
- Power2Gas - biological methanation. Syngas enriched in H<sub>2</sub>.

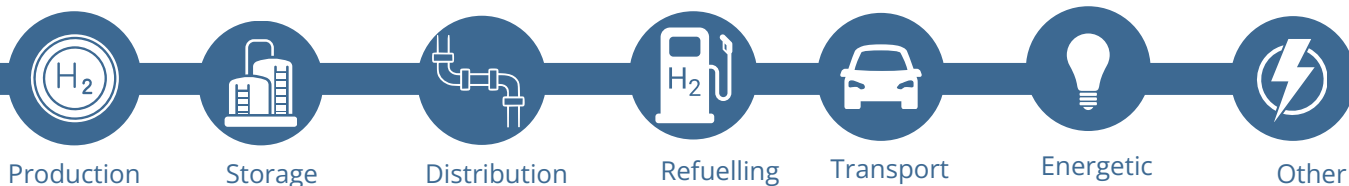


### Description of national initiatives in which the entity participates

- **PTe H2.** Spanish Technological Platform for Hydrogen.
- **AeH2.** Spanish Hydrogen Association.
- **AGH2.** Galician Hydrogen Association.
- **ATIGA.** Intersectoral Technological Alliance of Galicia.
- **AIGH2.** Galician Industrial Hydrogen Alliance.
- **GASNAM.** Iberian Association for the Promotion of Natural and Renewable Gas in Transportation.
- **PTE-EE.** Spanish Technological Platform for Energy Efficiency.
- **CLUERGAL.** Galician Renewable Energy Cluster.
- **ATIGA.** Intersectoral Technological Alliance of Galicia.
- **ACLUNAGA.** Galician Naval Cluster Association.
- **DATALIFE.** Digital Innovation Hub for the Primary, Biotechnological, and Health Sectors.
- **FEDIT.** Spanish Federation of Technological Centers.
- **CEG.** Galician Business Circle.
- **Galician Biomass Cluster.**
- **ACLUXEGA.** Galician Geothermal Cluster Association.
- **Galicia Construe Foundation.** Galician Construction Cluster.

### Description of international initiatives in which the entity participates

- **ECH2A.** The European Clean Hydrogen Alliance
- **EHPA.** European Heat Pump Association. R&I Committee
- **KET4CP.** KET4CleanProduction
- **BIP.** Biomethane Industrial Partnership
- **EARTO.** European Association of Research and Technology.
- **RHC - ETIP.** European Technology and Innovation. Platform on Renewable Heating and Cooling.
- **RIETI.** Ibero-American Network for Industrial Thermal Efficiency, promoted by CYTED.
- **REBIBIR.** Ibero-American Network for Biomass and Rural Bioenergy Technologies, promoted by CYTED.
- **H2TRANSEL.** Hydrogen Network: Production and Uses in Transportation and the Electric Sector, promoted by CYTED.



## Technology description

ENERGYLAB has in EDAR Bens (A Coruña) different pilots related to the UM1 project (under execution)



-Pilot plant for H<sub>2</sub> production by electrolysis Integration of alkaline electrolyzer and PEM-EL. 75KW and 14 Nm<sup>3</sup>H<sub>2</sub>/h.

- Renewable turbine plant: Average flow 150,000 m<sup>3</sup>/h. Power generated 120-140 kW
- Biological methanation pilot plant (Power2Gas). 1 - 5 Nm<sup>3</sup>/h (2 m<sup>3</sup>) biomethane. Biogas requirement 1 - 5 Nm<sup>3</sup>/h, H<sub>2</sub> 2 - 8 Nm<sup>3</sup>/h.
- Biomethane/H<sub>2</sub> mixture accumulator. 70% biomethane - 30% H<sub>2</sub>.
- Membrane separation pilot plant (upgrading). H<sub>2</sub>/CH<sub>4</sub> separation with H<sub>2</sub> recovery > 95% (up to 99,99% with PSA)
- Methane or H<sub>2</sub>/methane blends loading station: compression capacity 36 Nm<sup>3</sup>/h and 1,120 L.
- Grid injection system (Naturgy): Biomethane 65 Nm<sup>3</sup>/h and 17 bar.

## Technology information

**Maturity level:** technologies demonstrated at laboratory scale. Available for demonstration.

**Industrial property rights:** Other.

**Type of collaboration offered:** Technical cooperation agreement. Available for research and prototype validation. External Technological Services.

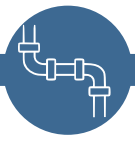
## Application sectors

- Green H<sub>2</sub> production
- Hydrogen production from biomass
- Power to Gas
- Refueling infrastructures: Gas mixture dispenser.

UM Renewable Gases is a joint project of Naturgy, EnergyLab and EDAR Bens S.A. is a joint project of Naturgy, ENERGYLAB and EDAR Bens which is financed by Galicia ERDF 2014-20 OP and cofinanced by the Galician Innovation Agency (GAIN)



Production



Distribution



Transport



Energetic



Other

## Technology description

ENERGYLAB operates two laboratories in its headquarters (Vigo) which comprises the whole hydrogen value chain.



### Energy Technologies Laboratory

- **Permeability bench.** Permeability of H<sub>2</sub>, CH<sub>4</sub> and mixture, in gas pipes.
- **Engine test bench:** Evaluation of diesel/gasoline engines fueled with fuel/H<sub>2</sub> blends.

### Biomass Laboratory

- **Fluidized bed gasifier,** Anaerobic sludge treatment coupled to WGS system for H<sub>2</sub> syngas enrichment.
- **Biological methanation:** Percolated bed type reactor (25 L), operated in thermophilic range and mixed inoculum.
- **Dark fermentation.** Batch and semi-continuous reactors for biological H<sub>2</sub> generation, inoculum pretreatment and evaluation of operating conditions.

## Technology information

**Maturity level:** technologies demonstrated at laboratory scale. Available for demonstration.

**Industrial property rights:** Other

**Type of collaboration offered:** Technical cooperation agreement. Available for research and prototype validation. External Technological Services.

## Sectores de aplicación

- H<sub>2</sub> distribution. Piped distribution networks. Evaluation of distribution regulations.
- Transport Evaluation of hydrogen/methane mixtures in final consumers.
- Hydrogen production from biological route.
- H<sub>2</sub> enrichment of Syngas
- Biological methanation.



## Mobility

### Description of the entity

Évolution Synergétique Automotive S.L. is a leading engineering company specialising in electromobility and zero-emission mobility solutions. We provide innovative technological solutions to the automotive industry, consolidating our position as an essential technological partner for manufacturers and Tiers1, pioneering the development of battery electric vehicles (BEV) and hydrogen fuel cell vehicles (FCEV). We offer turnkey projects and consultancy, covering from design to series production. Our team has worked on more than 40 European electric mobility projects, enabling us to receive recognition as an innovative SME. Our advanced services include embedded software development, hardware, systems, functional safety mechanics, cybersecurity and digitalisation, using technologies such as 5G, IoT, Big Data and Artificial Intelligence.



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### Activities and experience in R&D&I

Among the more than 40 electromobility projects developed by EVO, the validation of the electric propulsion system for a premium passenger car OEM, the development of on-board chargers (OBC) for several Tier 1 and OEMs, testing and validation of inverters for several Tier 1 and OEMs, thermal management for battery systems for passenger cars and heavy-duty applications, battery management system (BMS) development support for a premium OEM, leading technical support for a new emerging OEM, development of a cyber-physical system with 5G to extend battery life and increase battery efficiency, retrofit in H2 bus design, development of a H2 terminal tractor (2023/25).

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 2M€**

### Datos de la entidad

**Type:** Small company

**Size:** 51-100 trabajadores

**Calls of interest for your entity:**

**European**

**National**

**Regional**

### Technologies offered

- Engineering specialising in electromobility, mainly in the areas of software, hardware, systems and mechanics.
- Cyber-physical system with 5G connectivity to extend the life and improve the efficiency of batteries.
- Modular and scalable powertrain control system for battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV).
- Terminal tractor vehicle for ports, airports and logistics centres (available in 2025).





## Description of international initiatives in which the entity participates

### **H2Tractor (2023-2026)**

The H2Tractor project aims to carry out research, design, development, innovation, demonstration and validation of an industrial vehicle in port, airport and logistics environments, focusing on operability, maintainability, reliability, connectivity and safety.

## Description of international initiatives in which the entity participates

### **HYDEA (Interreg, Atlantic Area) (2023-2027)**

The project aims to accelerate the deployment and use of hydrogen-based green technologies in an integrated way in Atlantic Area ports. This will be achieved through the joint development of tools and approaches to prepare energy value chains as cornerstones of port transformation. The project will focus on overcoming barriers and obstacles to hydrogen adoption within the port ecosystem, limited by its uniqueness (e.g. different industrial activities and infrastructures).EVO participates through the piloting of a H2 terminal tractor adapted to warm climate in the Port of Seville.

### **IPCEI (2024-2026)**

Evo's "AH2HUB" project aims at the research, development, innovation and first industrial deployment of a new generation of zero-emission medium and heavy-duty vehicles for hydrogen applications. Furthermore, it aims at effective collaboration with other project partners from the entire hydrogen value chain as well as the dissemination of the results.



Transport

### Technology description

The CPS4EV project (Cyber-Physical System with 5G connectivity to extend the useful life and improve the efficiency of batteries) provides an effective solution for the control of batteries in electric cars, making it possible to extend their useful life, optimise their management and guarantee high levels of efficiency. This innovation has a significant impact, as it contributes to the development of electric vehicles, facilitating better maintenance, increased efficiency, safety, sustainability and cost reduction. The cyber-physical system (CPS) developed also offers competitive advantages by achieving improvements in maintenance and operation strategies, decreasing energy costs and improving fleet availability.

Engineering specialised in electromobility, mainly in the areas of software, hardware, systems and mechanics.

Modular and scalable propulsion control system for battery electric vehicles (BEV) and fuel cell electric vehicles (FCEV).

### Technology information

**Maturity level:** Developed but not marketed

**Industrial property rights:** N/A

**Type of collaboration offered:** N/A

### Application sector

Transport: Heavy vehicle. Component testing, Tractor system, Power electronics.



Production



Mobility



Industry

## Description of the entity

The Asturian Energy Foundation (FAEN) is a public entity dedicated to the promotion, implementation and development of advisory, research and technological demonstration, awareness and training activities in the field of energy and environmental sustainability.

Its action extends to all energy sources and vectors, infrastructures, generation technologies, transformation, transport, storage, final use and regulations, energy and financial markets related to energy.

FAEN carries out activities such as the development of planning instruments, auditing, studies, consulting and advice, demonstration of technologies, promotion of business collaboration, training activities, and dissemination campaigns. FAEN has financial participation in energy facilities and delivers an active work in facilitating the achievement energy goals at regional level.



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



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[faen@faen.es](mailto:faen@faen.es)



43.24, -5.77

## Activities and experience in R&D&I

FAEN works as a facilitator of R+D+i projects in the field of Hydrogen. FAEN is participating as a partner in the Hy2market, H2Asturias, Sea2Hy projects and collaborating for the start-up of consortia and projects in the areas of greatest interest to Asturias such as the production of renewable hydrogen, the use of hydrogen in the transport and the decarbonization of the industrial sector through hydrogen.

FAEN supports partnerships in the conceptual definition, search for partners, in facilitating project applications, technological demonstrations and in searching for funding opportunities.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: N/A**

## Datos de la entidad

**Type:** Public Entity

**Size:** 15 employees

**Calls of interest for your entity:**

**European:** EU Horizon, FCH JU, Green Deal

## Tecnologías ofertadas



## Description of national initiatives in which the entity participates

FAEN participates in two regional R&D initiatives:

- **Sea2Hy Project** – is a project focused on the generation of green hydrogen through an innovative production system from different types of non-pure water, seawater and water from mining uses. Sea2Hy seeks to improve the performance of electrolyzers by using these waters to achieve a clean, efficient and long-lasting electrolysis process. The use of sea water and mine water present challenges and a high degree of innovation, as well as the use of two indigenous resources of high availability in Asturias.
- **H2-Asturias Project:** the objective is to analyse the value chain of the use of hydrogen in an industrial environment, designing and developing a scientific facility for research and demonstration of technologies around the industrial use of green hydrogen, both directly and in combination with different industrial gases.

FAEN is part of the following national hydrogen platforms:

- **Spanish Hydrogen Technological Platform.**

## Description of international initiatives in which the entity participates

FAEN participates in a European R&D initiative:

- **Hy2Market Project** – seeks to advance in the creation of interregional and international value chains to promote the production, transport and use of green hydrogen. Work is being done in different sectors to favor the creation of a value chain at an integral level. The sectors are: hydrogen production, Transport, industrial uses, hydrogen for mobility and knowledge sharing

FAEN is part of different European platforms on hydrogen such as:

- Hydrogen Europe
- Clean Hydrogen AllianceS3
- Hydrogen Valleys partnership
- Vanguard Initiative Hydrogen Pilot.



Storage, transportation  
and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

Promoted by the Government of Aragón, other public bodies and private companies in 2003, FHa's Board of Trustees is made up of entities from all sectors of the economy: automotive, chemicals, energy generation, finance, education, engineering, research and development centres and real estate. FHa carries out R&D&I and consultancy projects in collaboration with regional, national and European companies. In the last 20 years, FHa has supported the regional strategy for the incorporation of H<sub>2</sub> and fuel cell technologies, publishing the Hydrogen Master Plan in Aragón (currently the 4th edition, 2021-2025), and showcasing the entire H<sub>2</sub> value chain. Its facilities include hydrogen production means (PEM, AEL AEM), test benches, and an HRS at 350 bar (soon to be 700 bar).



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## Activities and experiences in R&D&I

- 1. Research and development** projects to promote the production, storage and use of hydrogen as an energy vector.
- 2. Promotion and dissemination** of hydrogen through the organisation of events, seminars, conferences and dissemination activities.
- 3. Training and capacity building** through courses, workshops and online training programmes for professionals and students.
- 4. Consultancy and technical assistance** to organisations interested in hydrogen technologies, including policy and regulatory aspects.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1- 5 M€**

## Entity data

**Type:** Private non-profit foundation

**Size:** 11 – 20 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, Clean Hydrogen Partnership, LIFE, POCTEFA,

**National:** MICINN, PERTE, Innovative Business Clusters

## Technologies offered

- 10 kW alkaline stacks test bench (pilot scale).
- 80 kW electrolysis systems test bed.
- R&D platform for hydrogen injection into the NG grid
- Hydrogen refuelling station (HRS)
- Safety and legislation applicable to hydrogen systems
- Specialised training in hydrogen technologies



## Description of national initiatives in which the entity participates

- **Complementary Plans (MICINN).**LA1.A1.- Optimisation of electrolysis integration LA6.A1.- Digitalisation and quality control of HRS LA6.A3.- Reconditioning of the WALQA HRS at 700 bar LA11.A1.-Dissemination and Training.
- **BossTech-Fostere** (R&D Projects 2020 Research Challenges, PID-2020-115935RB-C41). Innovation in the field of fuel cells fuelled with biogas and methane/hydrogen mixtures.
- **CFD (AEI-010500-2022B-96).** Design and validation of a computational fluid dynamic model of tank filling for hydrogen powered heavy duty vehicles.
- **GREENWINE-2** (AEI-010500-2022B-97). Reducing the carbon footprint of wine production by reducing energy consumption, optimising renewable production and implementing H2 as energy storage.
- **C2MetOH-GreenLifTech** (TED2021-130621B-C44). Production of fuels from sustainable raw materials.

## Description of international initiatives in which the entity participates

- **EVERYWH2ERE** (H2020-JTI-FCH-2017, 779606). Making hydrogen affordable to sustainably operate Everywhere in European cities
- **PROMET-H2** (H2020-NMBP-ST-IND-2019, 862253). Cost-effective PROton Exchange MEbrane WaTer Electrolyser for Efficient and Sustainable Power-to-H2 Technology
- **HEAVENN** (H2020-JTI-FCH-2019, 875090). Hydrogen energy applications in the northern valley environments of the Netherlands.
- **ZEROENERGYMOD** (LIFE19 CCM ES/001327). Zero energy habitable mobile modules in Europe
- **MEFHYSTO** (EMPIR 19, 19ENG03). Metrology for advanced hydrogen storage solutions.
- **eGHOST** (H2020-JTI-FCH-2020, 101007176). Establishment of eco-design guidelines for hydrogen systems and technologies.
- **SH2E** (H2020-JTI-FCH-2020, 101007163). Sustainability assessment of harmonised hydrogen energy systems: Guidelines for life cycle sustainability assessment and prospective benchmarking.
- **GREEN HYSLAND** (H2020-JTI-FCH-2020, 101007201). The first H2 valley in Southern Europe.
- **SPOTLIGHT** (H2020-ICT-2018-20, 101015960). Disruptive photonic devices for highly efficient chemical processes powered by sunlight.
- **4AirCRAFT** (H2020-LC-SC3-2020-NZE-RES-CC, 101022633). Air Carbon Recycling for aviation fuel technology



## Description of national initiatives in which the entity participates

## Description of international initiatives in which the entity participates

- **H2GLOBAL** (COSME-CLUSINT-01-2020, 101035900). European Green Hydrogen Cluster Alliance for Internationalisation
- **HYSTORIES** (H2020-JTI-FCH-2020, 101007176). European Underground Hydrogen Storage.
- **ERASMUS+ UPHYMOB** (2021-1-ES01-KA220-VET-000028038). Re-skilling the European workforce in hydrogen fleets and in the maintenance and operation of their infrastructure.
- **ERASMUS+ GREEN4SKILLS** (101056448). Green Skills For Hydrogen.
- **HYPRAEL** (HORIZON-JTI-CLEANH2-2022-2, 101101452). Advanced alkaline electrolysis technology for pressurised H2 production with potential for near-zero energy loss.
- **HIGGS** (H2020-JTI-FCH-2019, 875091). Hydrogen In Gas GridS: a systematic validation approach at various admixture levels into high pressure grids
- **OPHYCS** (HORIZON-JTI-CLEANH2-2022-3, 101101415). Fibre optic hydrogen leak monitoring systems.
- **SINNOGENES** (HORIZON-CL5-2022-D3-01-11, 101096992). Storage innovations for green energy systems.



Production

## Technology description

This AEL test rig has been designed and assembled to be able to work in high dynamic conditions where the load changes rapidly and abruptly and at the same time it is able to operate up to 60 bar pressure.

As part of its design, its Control and Communication System constitutes a relevant part as it was designed and implemented not only to monitor and control all operating parameters but also to shut down the system by itself to a safe state in case any parameter exceeds the expected value.

The power electronics consists of a power supply (3300A/18V).

Type of tests that can be performed:

- Tests based on JRC protocols for performance characterisation under stationary and dynamic conditions.
- Accelerated Life Testing (ALT) and Accelerated Stress Testing (AST).



## Technology information

**Maturity level:** Lab-proven; Developed but not marketed; Available for demonstration

**Industrial property rights:** Protected by industrial secret

**Type of collaboration offered:** Cooperation agreement for R&D; Service provision agreement; Technical Cooperation Agreement

## Application sectors

- **H2 Production:** Electrolysis of water; Components; Unit; Auxiliary elements; Process control





Production



Storage



Industrial



Energetic

## Technology description

We have a 1,200 m<sup>2</sup> building with offices, laboratories and a workshop that is unique in Europe for working with large hydrogen equipment, with a height of 8.5 m, ATEX safety measures, gas detection and ventilation equipment, etc. This workshop is offered as a location for test platform for electricity production systems of any technology, up to a power of 80 kW.

Our offer:

- Connection and installation in the appropriate area.
- Support in commissioning the equipment
- If necessary, development of a system for monitoring and recording of the installation.
- Assistance in defining the tests to be carried out
- Personnel to carry out the tests

## Technology information

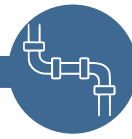
**Maturity level:** Available for demonstration

**Industrial property rights:** N/A

**Type of collaboration offered:** Cooperation agreement for R&D; Trade agreement with technical assistance; Service provision agreement; Technical Cooperation Agreement

## Application sectors

- **H<sub>2</sub> Production:** Electrolysis of water; Unit; Process Control
- **H<sub>2</sub> Storage:** Compressed gas in tanks; Metal hydrides
- **Industrial:** Green hydrogen as a raw material
- **Energetic:** Production and storage of energy coupled to the electricity grid



Distribution



Energetic

## Technology description

This installation recreates the injection of different flows of green hydrogen into a natural gas (carrier) of variable composition, simulating the different gas origins (biogas, synthetic methane / and country limits).

It allows extensive experimental validation under real environment conditions of the main components of the gas network, with continuous monitoring of parameters such as gas quality, impurities, flow rate, pressure, etc.

Low (10%), medium (10-30 vol.%) and high (up to 100%) hydrogen concentrations can be investigated in high pressure natural gas networks (up to 80 bar) with a maximum hydrogen feed rate of 0.8 kg/h and a total gas flow rate in the loop  $\approx 56 \text{ Nm}^3/\text{h}$ .



## Technology information

**Maturity level:** Available for demonstration

**Industrial property rights:** Protected by industrial secret

**Type of collaboration offered:** Cooperation agreement for R&D; Trade agreement with technical assistance; Service provision agreement; Technical Cooperation Agreement

## Application sectors

- **H2 distribution:** Underground gas pipelines; Pipelines
- **Energetic:** Injection into the gas grid



Refuelling



Transport

## Technology description

The current installation consists of the following elements: low pressure tank (30 bar, 4 Nm<sup>3</sup>), membrane compressor (P<sub>suc</sub> >10 bar, P<sub>out</sub>: 350 bar, 1 kg/h), high pressure cylinder tank (350 bar, 18 bottles of 50 L) divided into 3 sets of 6 bottles, control panel and a dispenser with nozzles for distribution to light vehicles and buses (350 bar, 200 bar).

During 2023, work will be carried out to expand the station's capacity to 700 bar.



## Technology information

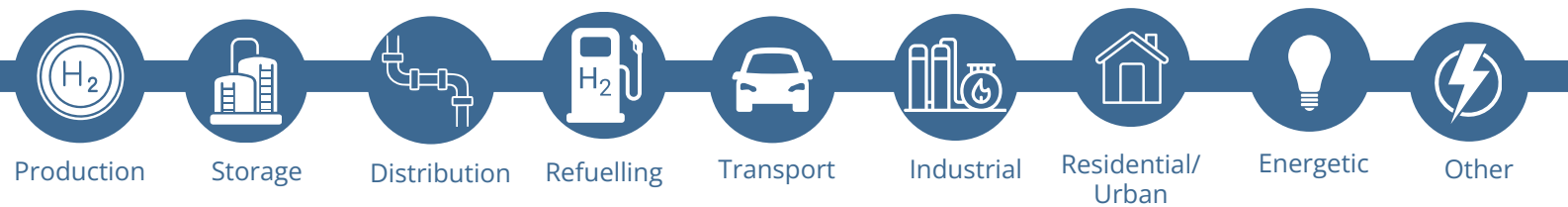
**Maturity level:** Available for demonstration

**Industrial property rights:** Protected by industrial secret

**Type of collaboration offered:** Service provision agreement; Technical Cooperation Agreement

## Application sectors

- **Refuelling infrastructures:** In situ hydrogen production; Compression; Storage; Dispense
- **Transport:Automobile;** Heavy vehicle



## Technology description

When talking about hydrogen installations or equipment, a series of transversal aspects must be taken into account, such as safety and legislation applicable to such systems. Aware of this, at FH a we put our knowledge at the service of our clients, offering support in the following fields:

- **Classification of sites** in potentially explosive atmospheres based on ATEX Directives, as well as the identification of general safety requirements, guaranteeing the safe operation of the client's facilities.
- **Experience in risk analysis** as a tool for assessing the potential danger in process plants.
- **Study of applicable regulations and legislation** according to the client's needs, as well as the necessary procedures to start up a facility or market a certain product.

## Technology information

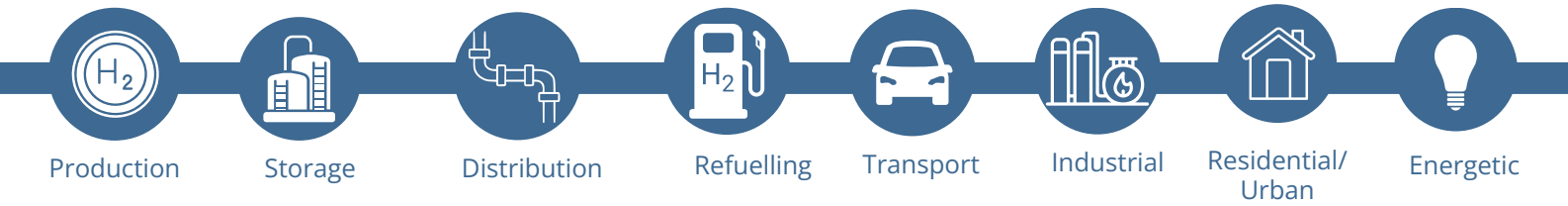
**Maturity level:** N/A

**Industrial property rights:** N/A

**Type of collaboration offered:** Service provision agreement; Technical Cooperation Agreement

## Application sectors

- **H2 Production:** N/A
- **H2 Storage:** N/A
- **H2 distribution:** N/A
- **Refuelling infrastructures:** N/A
- **Transport:** N/A
- **Industrial:** N/A
- **Residential/urban:** N/A
- **Energetic:** N/A
- **Other:** N/A



## Technology description

We work together with SEAS (*Estudios Superiores Abiertos*) to offer a wide range of quality and adapted online training in renewable energies and hydrogen.

- Course on hydrogen processes and fuel cells.
- Advanced course in electric mobility with hydrogen.

We also offer a wide range of on-site training courses at our own facilities, which include:

- **Master's studies.** Our engineers regularly give training in subjects related to fuel cells and hydrogen in different university courses.
- **Practical training.** We carry out eminently practical and specific training in hydrogen and fuel cells, as well as in electric mobility, taking advantage of our complete and well-equipped facilities.
- **Tailor-made courses.** We attend to any training needs demanded, carrying out a tailor-made programme. We train your team in any area related to renewable energies, fuel cells, hydrogen and electric mobility.

## Technology information

**Maturity level:** N/A

**Industrial property rights:** N/A

**Type of collaboration offered:** Service provision agreement; Technical Cooperation Agreement

## Application sectors

- **H2 Production:** N/A
- **H2 Storage:** N/A
- **H2 distribution:** N/A
- **Refuelling infrastructures:** N/A
- **Transport:** N/A
- **Industrial:** N/A
- **Residential/urban:** N/A
- **Energetic:** N/A
- **Other:** N/A



Storage, transportation and distribution



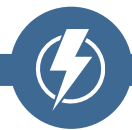
Production



Mobility



Industry



Other uses

## Description of the entity

CIDAUT Foundation was created on 2 February 1993, with the aim of meeting the needs of companies and promoting their competitiveness and industrial development. As a Technology Centre, our work in the field of R&D&I is aimed at positioning ourselves and acquiring scientific and technological excellence, as well as the capacity to transfer this knowledge to companies and society. The development of projects is coordinated between multidisciplinary researchers, whose synergies allow us to respond to very ambitious objectives in short periods of time, framing them within the following operational areas or trends: Energy, Industry 4.0, Circular Economy and Smart, sustainable and safe mobility.

## Entity data

**Type:** Technology Research Centre.

**Size:** Medium

**Calls of interest for your entity:**

**European:** EU Horizon, CHE JU, NextGeneration, Interreg

**National:** CDTI, MITECO, MICINN, IDAE

**Regional:** N/A



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## Activities and experiences in R&D&I

CIDAUT Foundation, develops more than 60,000 h/year (average of the last 8 years) in Hydrogen Technology projects through a multidisciplinary work team that includes researchers on hydrogen generation, storage and use processes, mechanical designers, developers of specific test facilities and developers of safety and control strategies.

Our experience of more than 20 years in H2 R&D projects covers the whole value chain, including projects for the development of fuel cells and H2 generation technologies (reforming, electrolysis and thermochemical cycles), as well as projects for the integration of H2 technologies in different applications in sectors such as mobility and industry.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** < 1 M € annual investment

## Technologies offered

- Experimentation on hydrogen-based electrochemical systems.
- Development of stacks and fuel cells for specific utilisation requirements.
- Integration of H2 and fuel cells in systems for electricity generation with application to the transport, industrial and building sectors.
- Design of combustion systems for pure H2 and mixtures of H2 with other fuels for application in thermal equipment and thermal engines.
- Development of NH3 synthesis processes and their subsequent cracking and use in different thermochemical and electrochemical applications.
- Development of components and systems for water electrolysis.
- Design, development and manufacture of H2 generation systems based on renewable substance reforming technologies.



## Description of national initiatives in which the entity participates

- **PTe H2:** Cidaut is a member of the Steering Group, coordinator of the WG on H2 uses in mobility and vice-coordinator of the WG on H2 uses in industry..
- **AeH2:** Spanish Hydrogen Association. Cidaut is an institutional partner and member of the Board of Directors.
- **H2CyL:** Castilla y León H2 Association.
- **Gasnam-Neutral Transport:** is the sustainable transport association that integrates the gas and hydrogen value chain. CIDAUT is a member of the Board of Directors as a representative of the knowledge centres.
- **AH2A:** Alliance for the use of green hydrogen in Aviation.

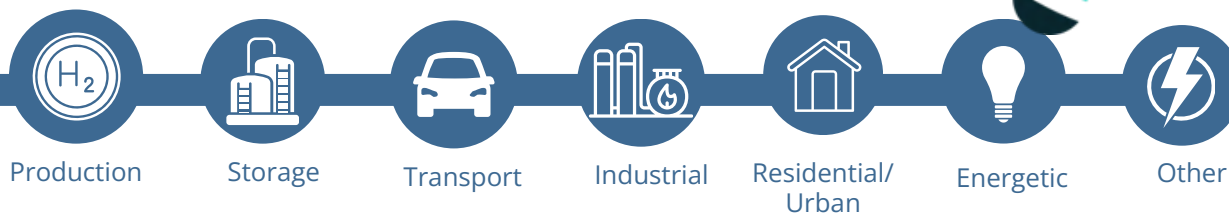
CIDAUT also participates in the main forums related to transport and energy, such as:

- **BioE:** Spanish Bioethanol Association. CIDAUT is a member of the Board of Directors and coordinator of the innovation group.
- **PTFE:** Spanish Railway Technology Platform.
- **A3E:** Association of Energy Efficiency Companies .
- **Sernauto:** Spanish Association of Automotive Suppliers.
- **Asepa:** Spanish Association of Automotive Professionals.
- **Facyl :** Automotive Cluster of Castilla y León.
- **Avebiom:** Spanish Biomass Association.
- **Bioplat:** Spanish Biomass Platform.

## Description of international initiatives in which the entity participates

- **HER:** Cidaut is a member of Hydrogen Europe Research, an association representing research centres active in the European hydrogen and fuel cell sector. HER partners with the European Commission in the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) innovation programme.
- **ECH2A:** European Clean Hydrogen Alliance: Cidaut is member of the European Hydrogen Alliance and participates in the Industry Round Table.
- **European Hydrogen Valleys Partnership S3P:** CIDAUT has participated as technical advisor for the region of Castilla y León and coordinator of the Hydrogen Production working group.
- **ERTRAC:** European Road Transport Research Advisory Council: CIDAUT is a member of the Energy & Environment Working Group.

# Experimentation on hydrogen-based electrochemical systems



## Technology description

CIDAUT has a complete experimental facility to characterize and validate electrochemical devices based on the use of H<sub>2</sub>.

The main characteristics of these facilities, which range from single cells to fuel cells and stacks, are as follows:

- On-site hydrogen generation facility by electrolysis and pressurised hydrogen storage (up to 55 kg H<sub>2</sub>)
- Electrical load emulation up to 250kW
- High precision and high sampling frequency (1-2MHz) V, I measurement equipment.
- Equipment for high power complex impedance testing (current ripple amplitude 60 Amps peak-to-peak) on stacks
- Utilities: Gas lines to work with mixed gases as anode and cathode current. 200kW cooling tower for thermal dissipation, safety PLC.

## Technology information

**Maturity level:** Operational test facilities

**Industrial property rights:** according to type of collaboration

**Type of collaboration offered:** R&D cooperation agreement, service delivery agreement and technical cooperation agreement

## Application sectors

- **Transport:** propulsion systems
- **Industrial:** cogeneration system
- **Residential/urban:** cogeneration system
- **Energeti:** power generation system
- **Other:** fuel cell system





Transport



Industrial



Residential/  
Urban



Energetic



Other

## Technology description

CIDAUT develops stacks and fuel cells tailored to the expected utilisation requirements.

This development focuses on:

- Thermofluidomechanical design of bipolar plates (cooling, pressure drop, durability, reagent balance, etc.).
- Integration of MEAS for specific operating requirements (low Pt, pollutant resistance, durability, etc.).
- Selection of materials for the different elements (corrosion, conduction, manufacturing, sealing).
- Selection and development of manufacturing methods (stamping, moulding, electroplating, coating)
- Development of fuel cell balance of plant equipment to optimize performance according to the application.

## Technology information

**Maturity level:** Mature development methodology.

**Industrial property rights:** according to type of collaboration

**Type of collaboration offered:** R&D cooperation agreement, service delivery agreement and technical cooperation agreement

## Application sectors

- **Transport:** propulsion systems for special land, sea or air vehicles
- **Industrial:** electricity generation system
- **Residential/urban:** cogeneration system
- **Energetic:** power generation system
- **Other:** fuel cell system for the Defence sector



Transport



Industrial



Residential/  
Urban

## Technology description

With the aim of replacing conventional propulsion systems with electric systems based on fuel cells (trams, tourist vehicles, river boats, port cranes, etc.), CIDAUT works in the following areas:

- Sizing adjusted to the use of the elements to be integrated (batteries, fuel cells, supercapacitors, converters, electric motors).
- Development of control strategies (duration, performance).
- Packaging and integration of the components in the vehicle in the space available.
- Performance simulation and validation at scale.

## Technology information

**Maturity level:** Mature development methodology.

**Industrial property rights: according to type of collaboration**

**Type of collaboration offered:** R&D cooperation agreement, service delivery agreement and technical cooperation agreement

## Application sectors

- **Transport:** use of propulsion systems based on fuel cells
- **Industrial:** fuel cell-based electricity generation system
- **Residential/urban:** residential cogeneration system



Industrial

## Technology description

Industry decarbonization involves reducing the use of fossil fuels and the search for alternatives that do not emit CO<sub>2</sub> and other pollutants into the environment. In this line, the use of H<sub>2</sub> as fuel is postulated, as well as mixtures of H<sub>2</sub> with other gases such as natural gas (NG) and ammonia (NH<sub>3</sub>).

The technology offered by CIDAUT involves:

- Evaluation of the properties of H<sub>2</sub> and mixtures with NG, NH<sub>3</sub> and the degree of fuel substitution depending on the requirements of the application.
- Design of combustion systems and modifications using thermofluid-dynamic and thermo-chemical (CFD) simulation tools for different degrees of H<sub>2</sub>, NG, NH<sub>3</sub> mixtures. Study of the impact of the introduction of H<sub>2</sub> in new or existing installations.
- Experimental evaluation of burner designs and validation of the simulation models implemented.
- Definition of the implementation in thermal equipment and thermal engines.
- Risk assessment and definition of safety strategies.

CIDAUT has at its disposal:

- Combustion chambers of different scales.
- Multispectral camera to determine combustion species (TELOPS IRC-FAST-Multispectral M350 16 GB).
- Commercial and in-house fluid dynamic and thermochemical design codes.

## Información de la tecnología

**Maturity level:** Mature development methodology.

**Industrial property rights:** according to type of collaboration

**Type of collaboration offered:** R&D cooperation agreement, service delivery agreement and technical cooperation agreement

## Application sectors

- **Industrial:** Use of H<sub>2</sub> and gas mixtures with NG, NH<sub>3</sub> in thermal equipment, burners and industrial furnaces for heat input in systems with thermal needs for fossil fuel substitution. Stationary combustion processes by diffusion in gas turbines and burners. Cogeneration systems for industrial use and heat production in thermal power plants.

# Development of NH<sub>3</sub> synthesis processes and their subsequent cracking and use in different thermochemical and electrochemical applications



Storage



Transport



Industrial

## Technology description

The use of NH<sub>3</sub> as a H<sub>2</sub> carrier has great advantages due to its high H<sub>2</sub> content, its transport possibilities, as well as its properties as a fuel in sectors that are difficult to decarbonise, such as the maritime sector. Along these lines, CIDAUT is working on NH<sub>3</sub> synthesis processes from renewable H<sub>2</sub>, as well as on subsequent total or partial cracking processes to obtain H<sub>2</sub>, as well as mixtures of H<sub>2</sub>, NH<sub>3</sub> and N<sub>2</sub> that can be used both in fuel cells (with higher purity requirements) and in combustion engines (where H<sub>2</sub>/NH<sub>3</sub> mixtures are a very advantageous fuel).

CIDAUT is working on:

- NH<sub>3</sub> to H<sub>2</sub> catalytic decomposition processes.
- Validation of H<sub>2</sub> separation technologies
- Integration of decomposers and power plant (MCIA, TG, PEMFC)
- Combustion of NH<sub>3</sub> and H<sub>2</sub>/NH<sub>3</sub> mixtures
- NH<sub>3</sub> plant safety (storage and use)

## Technology information

**Maturity level:** Tests at laboratory level. Design of elements and reactors.

**Industrial property rights:** according to type of collaboration

**Type of collaboration offered:** R&D cooperation agreement, service delivery agreement and technical cooperation agreement.

## Application sectors

- **H<sub>2</sub> storage:** Design of delocalised systems with new NH<sub>3</sub> synthesis processes as H<sub>2</sub> storage. Evaluation of new catalysts and operating conditions.
- **Transport:** Substitute NH<sub>3</sub>-based solutions (high energy density) for power plants in transport with tough requirements in terms of power and autonomy. Integration of NH<sub>3</sub> decomposition and PEMFC and integration of NH<sub>3</sub> decomposition and MCIA.
- **Industrial:** use of H<sub>2</sub> from NH<sub>3</sub> in thermal systems for energy supply in the industrial field (burners), as well as H<sub>2</sub>/NH<sub>3</sub> mixtures.



Production



Energetic



Others

## Technology description

CIDAUT develops components and systems for the production of hydrogen from water electrolysis.

This development focuses on:

- Thermofluidomechanical design of components (cooling, pressure drop, durability, reactive balance, etc.).
- Selection of materials for the different elements (corrosion, conduction, manufacturing, sealing).
- Selection and development of manufacturing methods (stamping, moulding, electroplating, coating).
- Development of balance of plant equipment for electrolysers to optimise performance according to the application.
- Development of operating strategies for electrolysis systems.
- Energy integration in electrolysis systems to improve energy efficiency.

## Technology information

**Maturity level:** low-medium (depending on the electrolysis technology)

**Industrial property rights:** according to type of collaboration

**Type of collaboration offered:** R&D cooperation agreement, service delivery agreement and technical cooperation agreement.

## Application sectors

- **H2 Production:** H2 production systems using water electrolysis technologies.
- **Energetic:** production of H2 coupled to the electricity grid.
- **Other:** manufacture of equipment



Production



Energetic



Other

## Technology description

CIDAUT designs, develops and manufactures systems for the production of hydrogen from the wet reforming of renewable substances, such as biogas or bioalcohols.

This development focuses on:

- Thermofluidomechanical design of the components.
- Selection of materials for the different elements (corrosion, conduction, manufacturing, sealing).
- Selection and development of manufacturing methods.
- Development of operating strategies for the reforming system.
- Energy integration to improve the energy efficiency of the reforming process.

## Technology information

**Maturity level:** medium-high (depending on the renewable substance)

**Industrial property rights:** according to type of collaboration

**Type of collaboration offered:** R&D cooperation agreement, service delivery agreement and technical cooperation agreement.

## Application sectors

- **H<sub>2</sub> production:** H<sub>2</sub> production systems from reforming technologies.
- **Energetic:** H<sub>2</sub> production in biorefineries.
- **Other:** manufacture of equipment



Storage, transportation and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

Generaciones Fotovoltaicas de la Mancha SL (GFM) is a company specialized in all kinds of solutions related to renewable energies, especially solar photovoltaic, wind, and storage. Recently, electric mobility and green hydrogen have been added to the portfolio. Specialists in off grid systems, rural electrification and microgrids, self-consumption and solar pumping. Experience in cooperation and consulting projects. Experts in national and international projects.

Currently 7 lines of business are active, providing the client with an integral service until the end of the useful life of the solutions offered.

Self-consumption installations

- Promotion of renewable plants
- Operation and maintenance
- R&D projects
- International
- Training
- Sale of energy in the electricity market

## Entity data

**Type:** small business

**Size:** 21-50 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU, GREEN DEAL

**National:** CDTI, MITECO, MICINN



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## Activities and experiences in R&D&I

- Development of power electronics converters for the creation of a renewable multi-source processing center.
- Development of storage solution based on molten silicon.
- Research on stationary storage technologies based on aluminum air.
- On-site perimeter security solutions
- Solution for obtaining atmospheric drinking water from renewable energy sources.
- Solutions for the development of portable energy solutions based on renewable energy storage and hybridization with the grid/generator set.
- Development of a 1-axis solar tracker, rapidly deployable and integrated in a 20-foot maritime container.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** < 1 million €

## Technologies offered

- Solutions for obtaining hydrogen through electrolyzer from nitrogen compounds.
- Storage solutions based on molten silicon.
- Multi-source renewable energy processing center (hybridization of renewable plants, microgrid, multi-renewable self-consumption).
- Solutions for management and optimization of supply infrastructures that include electric mobility infrastructure.
- Portable energy solutions based on renewables, with grid integration and/or generator set for rural electrification and creation of isolated microgrids.
- Solutions for obtaining atmospheric drinking water from renewable energy sources.
- Self-consumption solutions. Solar pumping. Isolated systems, green hydrogen plants (PV, wind, storage and electrolyzer).



## Description of the national initiatives in which the entity participates

### ONGOING PROJECTS

- **MAGICBOX.** Development of a multi-source energy processing center. Call PID CDTI 2020.
- **ALTERA.** Development of a storage system based on fused silicon. Call for MISSIONS CDTI 2020. In consortium.
- **SHAVINGBOX.** Development of a solution to optimize the connection infrastructure in supplies with electric recharging infrastructure. Call for proposals MOVES SINGULAR PROJECTS IDEA 2022.
- **SMARTGREENERGY.** Development of a renewable, flexible and bidirectional microgrid for EV charging infrastructure in fleets. Call for MISSIONS CDTI 2022. In consortium.

## Description of the international initiatives in which the entity participates

### ONGOING PROJECTS

- **NEON.** Development of new business models for the energy community. Responsible for the Spanish pilot. HORIZON 2020 Call. Call: H2020-LC-SC3-2018-2019-2020. Building a low-carbon, climate resilient future: secure, clean and efficient energy. In consortium





## Description of national initiatives in which the entity participates

### PROJECTS COMPLETED.

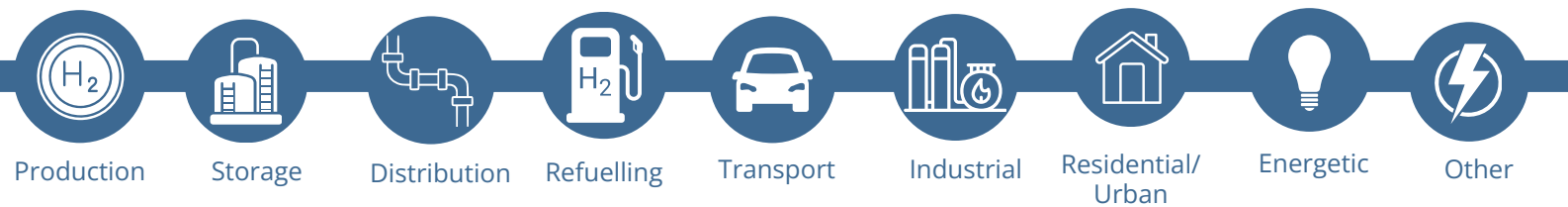
- **WATENERGY.** Development of a system to obtain atmospheric drinking water from renewable energies. Call for proposals INNOVA ADELANTE JCCM 2019
- **ALIENA,** Development of stationary storage system based on aluminum-air. Call for proposals RETOS COLABORACIÓN 2015 AEI. In consortium.
- **GERIS.** Development of monitoring and control systems for solar pumping. Call INNOVA ADELANTE JCCM 2017. In consortium
- **PERIMETER SECURITY,** Development of perimeter security systems on site. Call FEDER INTERCONECTA 2016, CDTI. In consortium
- **GEREFIC.** Development of a system for monitoring and management of consumption and generation in self-consumption systems. Call INNOVA ADELANTE JCCM 2018, In consortium.
- **HIBRICOM.** Hybridization in vehicle with combustion engine installing an electric motor and storage and renewables for integration of a portable energy system in the vehicle. Call INNOVA ADELANTE JCCM 2018, In consortium.

## Description of international initiatives in which the entity participates

### PROJECTS COMPLETED.

- **NGCPV.** Development of ultra-high precision two-axis solar trackers and development of new high-efficiency high-concentration photovoltaic technology. Call for proposals. First EU-Japan R&D project jointly funded by European Commission 7th Framework Programme and Japan's NEDO. Participation in plant operation.
- **SUNINBOX.** Development of portable energy solutions for microgrids, based on renewable energy storage and hybridization with grid/generator set. Development of a single-axis solar tracker integrated in a 20-foot maritime container for rapid deployment. HORIZON 2020 call. In consortium.
- **IDISTRIBUTEDPV.** Development of business models based on distributed generation of PV systems in electrical systems. Convocatoria H2020-SMEInst-2016-2017/H2020-SMEINST-2-2016-2017. In consortium.

# Hydrogen production. Development of electrolyzer from nitrogen compounds.



## Technology description

Hydrogen production through the decomposition of nitrogen compounds in wastewater

## Technology information

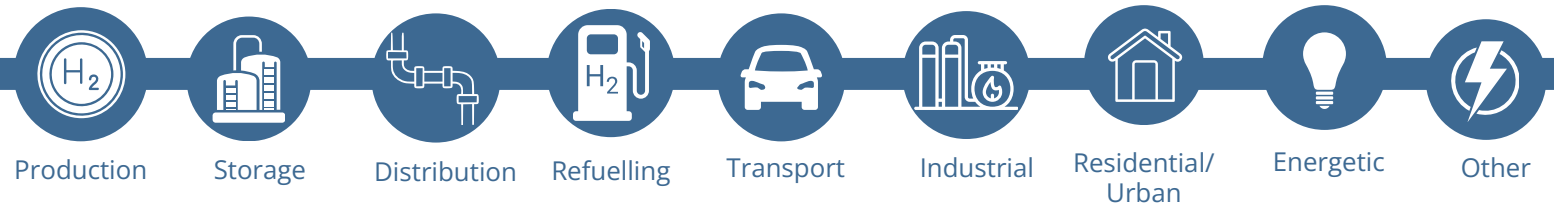
**Maturity level:** Basic research

**Industrial property rights:** Applied for Patent. Collaboration HFC

**Type of collaboration offered:** Cooperation agreement for R&D.

## Application sectors

- **H2 production:** H2 production from nitrogen compounds present in wastewater.
- **H2 storage:** N/A
- **H2 distribution:** N/A
- **Refueling infrastructures:** N/A
- **Transportation:** N/A
- **Industrial:** N/A
- **Residential/urban:** N/A
- **Energetic:** N/A
- **Other:** N/A



## Technology description

Development of green hydrogen plants from the installation of electrolyzers based on water electrolysis and partially powered by solar PV generation systems.

## Technology information

**Maturity level:** On the market

**Industrial property rights:** No

**Type of collaboration offered:** Technical Cooperation aAgreement, Service Provision Agreement

## Application sectors

- **H2 production:** H2 production from nitrogen compounds present in wastewater.
- **H2 storage:** N/A
- **H2 distribution:** N/A
- **Refueling infrastructures:** N/A
- **Transportation:** N/A
- **Industrial:** N/A
- **Residential/urban:** N/A
- **Energetic:** N/A
- **Other:** N/A



Storage, transportation and distribution



Production



Industry

## Description of the entity

Hidrógeno Circular S.L. (GreeneW2H2) is a very recently created company (December 2022), derived from the scientific-technical knowledge related to the thermochemical waste processes of the Greene Enterprise S.L. (Greene) group. The company is located in the Industrial Park of the city of Elche and has its own facilities and personnel.

In GreeneW2H2 we are focused on the material valorization of all types of waste for the production of renewable hydrogen. For this reason, we analyze the nature and origin of those wastes that allow us to obtain hydrogen with Guarantees of Origin, while improving day by day the efficiency of the thermochemical recovery of such wastes to maximize the fraction of renewable hydrogen obtained.



<http://greenew2h2.com/>



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[info@greenew2h2.com](mailto:info@greenew2h2.com)



C/ Martin y Soler, 18. Elche Parque Industrial. 03203

## Activities and experiences in R&D&I

GreeneW2H2 carries out private R&D&I activities developed in its facilities, focused on the study of pyrolysis-gasification-cracking and WGS reaction to obtain hydrogen from different types of waste. The company has facilities (laboratory, small scale and pilot plant) specialized in the material valorization of waste that allow the validation of the R&D&I produced. The Greene group has participated in more than 10 competitive R&D&I projects (regional, state and European), several of them focused on the production of renewable hydrogen from waste.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-5 million €**

## Entity data

**Type:** small business

**Size:** <10 employees

**Calls of interest for your entity:**

**European:** Horizon Europe.

**National:** CDTI, MITECO, MICINN

**Regional:** GVA, AVI, IVACE

## Technologies offered

- GreeneW2H2 has developed a thermochemical pathway (pyrolysis-gasification-cracking) especially for the valorization of waste into simple gases maximizing the hydrogen fraction. Subsequently, the water vapor shift reaction (WGS) has been incorporated to obtain more hydrogen than the original waste contains, transforming water and carbon monoxide into hydrogen.
- Finally, the technology has separation, purification and pressurization stages that allow the gas to be adapted to the required specifications according to its use.



## Description of national initiatives in which the entity participates

- Member of the Spanish Hydrogen Association (**AeH2**).
- Member of the Spanish Hydrogen Technology Platform (**PTeH2**).
- Member of the Energy Cluster of the Valencian Community (**CECV**).
- Member of the Energy Technology Institute (**ITE**) of the Valencian Community.
- Registration as a holder in the platform of Guarantees of Origin Systems for renewable gases (**GoO**).
- Integrated in the Renewable Hydrogen Strategy of the Valencian Community 2030, as invited to sign the protocol as leading members of this strategy.
- Partner of the Spanish CO2 Technology Platform (**pteCO2**).

## Description of international initiatives in which the entity participates

Member of the European Clean Hydrogen Alliance, which supports the large-scale deployment of renewable and low-carbon hydrogen.



Production



Storage



Industrial

## Technology description

The thermochemical technology of GreeneW2H2 with the integration of the WGS reaction and membrane systems with gas separation in the same production reactor can valorize all kinds of waste in the form of H<sub>2</sub> (and CO<sub>2</sub>).

In contrast to traditional systems, where gasification is carried out in a single reactor, in the integrated GreeneW2H2 gasification plant the processes are separated into different reactors. Thanks to this separation (pyrolysis-cracking-gasification), and to a meticulous control over the processes that take place in each of these reactors, it is possible to maximize the production of simple gases, specifically H<sub>2</sub>.

The production of H<sub>2</sub> is determined by the operating conditions imposed in the different stages (pyrolysis-cracking-gasification) being necessary the optimization of each one of them to maximize the production of hydrogen. Subsequently, the incorporation of a WGS catalytic stage allows reaching hydrogen production values that ensure the profitability and scalability of the process.

Finally, the combination of separation and purification stages with membranes and PSA systems, allow to adapt the hydrogen obtained to the technical specifications required for each of the possible applications.

## Technology information

**Maturity level:** Developed but no marketed.

**Industrial property rights:** Patented.

**Type of collaboration offered:** Cooperation agreement for R&D and Technical Cooperation Agreement.

## Application sectors

- **H<sub>2</sub> production:** Biomass
- **H<sub>2</sub> storage:** Compressed gas in tanks
- **Industrial:** Green hydrogen as a raw material
- **Energy:** Injection into the gas grid



Storage, transportation  
and distribution

## Description of the entity

Hiperbaric, born in Burgos in 1999, has been dedicated since its foundation to the designing, manufacturing and marketing of high pressure industrial equipment. for High Pressure Processing (HPP). With more than 1,000 water compressors (up to 6,000 bar) installed in more than 50 countries, it is the world leader in High Pressure Food Processing (HPP), reaching a market share of 60%.

In 2019, Hiperbaric launched the line of industrial equipment for Hot Isostatic Pressing (HIP) and since 2020, it incorporated hydrogen compression technology (up to 1,000 bar) into its business lines, becoming a key player in the Hydrogen economy, and the only Spanish manufacturer with H<sub>2</sub> compression solutions.

The Burgos facilities, with a surface area of 30,000m<sup>2</sup>, house the company's central offices, the R&D center and the only production plant. Hiperbaric has commercial offices in the United States, Mexico, Singapore and Australia.

With a strategy focused on sustainability, Hiperbaric aspires to "Be the world reference company in high pressure technologies".

## Entity data

**Type:** Large Company

**Size:** > 100 employees


**Calls of interest for your entity:**

**European:** Horizon Europe, Clean Hydrogen Europe, IPCEI.

**National:** CDTI, MICINN, MITECO, IDAE, PERTE ERHA.

**Regional:** EREN, ICE, JCyL.

 <https://www.hiperbaric.com/es>

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## Activities and experiences in R&D&I

&D, quality and reliability are present in Hiperbaric's DNA and constitute a transversal area throughout the company. In fact, the first HPP equipment marketed in 2002 was the result of an R&D project. Hiperbaric annually invests up to 10% of the result of each year and commits 25% of the workforce to innovation activities. One of its main assets is its human team, with 63% university graduates, including 10 doctors, 1 doctoral student and more than 25 graduates in technology.

A vast track record of innovation, recognized and awarded internationally, which has resulted in the development of new technologies, the design of reliable, durable and safe solutions and the launch of disruptive innovations on the market, such as Hiperbaric HPP Bulk technology.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** is around 1 million €

## Technologies offered

Hiperbaric is an internationally recognized player in high pressure technologies. Its current lines of business are:

- **Hydrogen compression.** A range of modular, compact, safe and reliable high pressure hydrogen compressors (range 200 - 1,000 bar).
- **HPP.** Equipment for high pressure processing (6,000 bar of water) of packaged products (in-pack) and bulk liquids (in-bulk). Fully automated turnkey solutions for the food industry.
- **HIP.** Equipment for hot isostatic pressing (Argon at 2,000 bar and 1,450°C) of metallic and ceramic components to increase their mechanical performance.



### Description of national initiatives in which the entity participates

Hiperbaric is part of:

- **PTeH2:** Spanish Hydrogen Technological Platform. Participation in H2 Storage, Transport and Distribution GT.
- **AEH2 :** Spanish Hydrogen Association.
- **H2CyL:** Castilian and Leonese Hydrogen Association. Hiperbaric is founding member.

Participates as a member of the **Technical Standardization Committee (CTN) 181**, collaborating in the development of regulations related to hydrogen.

In 2023 Hiperbaric has been selected as a participant in the **MITECO Renewable Hydrogen Advisory Group**, within subgroup IV "TECHNOLOGY AND VALUE CHAIN".

### Description of international initiatives in which the entity participates

Hiperbaric is part of the European Clean Hydrogen Alliance (**ECH2A**) initiative.

In addition, through the H2CyL association, Hiperbaric promotes Castilian-Leonese participation in the European regions project:

- **Hy2Market:** Hydrogen TO enter MARKets reducing carbon Emissions footprint. (Interregional Innovation Investments Instruments (I3))

At international level , Hiperbaric also has a dozencustomers in Europe, as enterprises as Framatome or Lhyfe, among others.





### Description of national initiatives in which the entity participates

On the other hand, it is currently carrying out the following R&D Projects:

- **ValorH2:** Investigation of new technologies, materials and processes associated with the hydrogen value chain. (Missions, CDTI)
- **OnWindH2:** Research into solutions for green hydrogen generation using wind energy at off-grid ground sites. Consortium of three companies. (CdV-P4, IDEA)

Hiperbaric promotes and supports:

- **H2MetAmo:** Technologies, materials and processes for small-scale production of renewable hydrogen carriers (methane and ammonia) for distributed use.
- **Own master's degree in hydrogen technologies.** UBU.

Hiperbaric has several clients in Spain with ongoing projects and equipment already installed. It is worth mentioning the installation of the first compressor at the National Hydrogen Center (CNH2), and another within the Green Hysland project in Mallorca.

### Description of international initiatives in which the entity participates



Storage



Distribution



Refuelling



Industrial



Residential/  
Urban



Energetic

## Technology description

### Group of safe, efficient and reliable Plug&Play compressors up to 1,000 bar.

Hiperbaric's hydrogen compression technology is made up of a range of compressor groups that offer a complete solution, adaptable to any level of production and demand.

Hiperbaric compressors can work in a wide range of inlet pressures (between 20 and 400 bar) and are optimized to offer maximum performance at outlet pressures of up to 500 or 1,000 bar.

The main components of the compressor group are: hydraulic system, refrigeration system, pneumatic circuit, instrumentation and control panel, venting circuit and the multiplier cylinder.

The multiplier cylinder incorporates alternative piston technology, which cycles compression in two stages, including cooling between them.

The main advantages of Hiperbaric compression technology are:

- Maximum purity of hydrogen, thanks to the absence of oil (Oil Free concept) in the pistons.
- Higher efficiency and lower energy requirement.
- Better cooling, due to innovative technology in the multiplier sleeves.
- High adaptability offered by its modular and scalable design
- Completely safe and reliable, thanks to its advanced venting system.

Its compressors are designed and manufactured in accordance with international directives and standards, and can be installed in any country in the world.

## Technology information

**Maturity level:** On the market.

**Industrial property rights:** Trade secret.

### Type of collaboration offered:

- Cooperation agreement for R&D.
- Trade agreement with technical assistance.
- Service provision agreement.
- Technical Cooperation Agreement.

## Application sectors

- **H2 Storage:** Compressed gas in tanks.
- **H2 Storage:** Compressed gas.
- **Refuelling infrastructures:** Compression, Storage and Dispense.
- **Industrial:** Green hydrogen as a raw material.
- Residential/urban: Energy use.
- **Energetic:** Production and storage of energy coupled to the electricity grid, Injection into the gas grid.

# Hydrogen-Refueling Solutions (HRS)



Storage, transportation and distribution



Mobility



Industry

## Description of the entity

Hydrogen-Refueling Solutions (HRS) is Europe's largest manufacturer of hydrogen vehicle refuelling stations (hydroline stations). Founded in 2004, the company is the only one in Europe capable of designing, installing and maintaining low or high capacity stations, compatible with all types of fuel cell vehicles and hydrogen sources. Present in France, Spain, Portugal and Italy, HRS currently has a turnover of 29 million euros for the financial year ending June 2023 and has manufactured 77 hydroline stations throughout Europe, 20% of the total in the region. In 2021, HRS went public on the Euronext Growth Stock Exchange, raising €97 million. In 2023, it opened a new 14,300 m<sup>2</sup> plant with an annual production capacity of 180 high-capacity stations.



<https://www.hydrogen-refueling-solutions.fr/?lang=en>



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Factory 103, Carrer de Mallorca 103 - 08029, Barcelona

## Activities and experiences in R&D&I

HRS was selected to carry out two major hydrogen mobility development projects: RHeadHy (very high speed refuelling for heavy duty vehicles/ <https://rheadhy.eu/>) and H2REF-DEMO (increasing the compression capacity of HRS / <https://cordis.europa.eu/project/id/101101517>), co-financed by the Horizon Europe programme of the European Union in the framework of the "Clean Hydrogen Partnership" initiative.

HRS was respectively the main and the second beneficiary in terms of amounts in these two projects with a total of 2.3 M€ in grants.

## Entity data

**Type:** PYME

**Size:** >100 empleados

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU, Green Deal;

**National:** CDTI, MITECO, MICINN;

## Technologies offered

HRS manufactures different types of hydroliners:

- Smaller capacity hydroliners: HRS14 (up to 300kg/day) - suitable for light and heavy vehicles, easy to install and with the possibility to install in a transportable format - 350 and 700 bar.
- High capacity hydroliners: HRS40 and HRS80 (1 and 2 tonnes/day) - suitable for industrial and heavy vehicles and for intensive use, as they allow the simultaneous charging of several vehicles - 350 and 700 bar.



## Description of the national initiatives in which the entity participates

HRS plans to install 10 hydroline stations in Spain and Portugal over the next two years.

Through its customers, HRS has submitted several projects to MITECO calls for proposals.

## Description of the international initiatives in which the entity participates

Hydroliners manufactured in Europe and the USA: 77. In Europe, HRS has installed 20% of the total in the region.

Ongoing projects:

-Agreement with **BEYOND AERO** to assist in the development of the first hydrogen aircraft, intended for continental flights.

Agreement with **GAIA ENERGY** to jointly develop large-scale hydrogen mobility projects in which HRS will provide hydrogen distribution solutions for the green H<sub>2</sub> produced by Gaia Future Energy in Morocco.

-Agreement with **PLUG POWER** for the supply of 10 hydrogen generators in several countries, including 6 orders at present.

-Agreement with **PHYNIX** to install 8 green hydrogen hydroline stations in Spain.

Agreement with **ENGIE** to implement 15 hydrogen-related projects by 2026.

-Agreement with **CUBOGAS** to develop new initiatives in the field of hydrogen mobility infrastructures in Italy.

-Agreement with **HYPE** for the installation of 7 hydroline stations by 2023

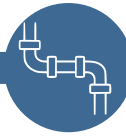
-Agreement with **HAFFNER ENERGY** for the supply of green hydrogen from biomass

-Agreement with **GAUSSIN** for the installation of 36 hydroline stations by 2026.

-Agreement with **HYPULSION** for the supply of 5 stations for "Zero Emission Valley", a pioneering programme in France.



Storage



Distribution



Refuelling



Transport



Industrial

## Technology description

HRS has developed a station that can compress up to 14 kg of hydrogen per hour, distributed at two pressures: 350 and 700 bar.

The station consists of the following elements:

- Connection point to the H<sub>2</sub> source (Electrolyser, tube trailer, storage, pipeline/hydroduct).
- Compression module
- High pressure buffer/storage (cascade)
- Cooling system
- Dispenser/dispenser

The dispenser has 3 lines:

- H35 (350 bar),
- H35HF (350 bar High Flow) for heavy duty vehicles (trucks, buses, coaches, buses...)
- H70 (700 bar) for light commercial vehicles, commercial vehicles and heavy vehicles.

This station is also available in a "transportable" version. Its main advantages are ease of reinstallation and simplicity of civil works.

Certifications: CE, DESP, ATEX, MACHINE Directive.

## Technology information

**Maturity level:** On the market

**Industry property rights:** Trademark

**Type of collaboration offered:**

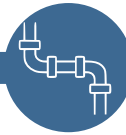
- Commercial agreement with technical assistance
- Service provision agreement (maintenance)
- Technical cooperation agreement
- R&D cooperation agreement

## Applications sectors

- **H<sub>2</sub> storage:** compressed gas in tanks
- **H<sub>2</sub> distribution:** loading tube trailers
- **Refuelling infrastructure:** compression, storage, dispensing
- **Transport:** automotive, heavy-duty vehicle, rail, aviation, maritime



Storage



Distribution



Refuelling



Transport



Industrial

## Technology description

HRS is developing high-capacity stations, which can compress up to 40 (HRS40) and 80 (HRS80) kg of hydrogen per hour. That is 1 and 2 tonnes per day respectively, distributed at 350 bar and 700 bar in each case.

Their design is optimised for simultaneous refuelling and continuous back-to-back vehicle refuelling. They are particularly suitable for heavy vehicles and intensive use.

The station consists of the following elements:

- Connection point to the H<sub>2</sub> source (Electrolyser, tube trailer, storage, pipeline),
- Compression module,
- Medium and high pressure buffer/storage (cascade),
- Cooling system,
- Dispenser/supplier.

Dispensers with 3 lines:

- H35 (350 bar),
- H35HF (350 bar High Flow) for heavy vehicles (lorries, buses, coaches, buses...)
- H70 (700 bar) for light commercial vehicles, commercial vehicles and heavy vehicles.

Certifications: CE, DESP, ATEX, MACHINE Directive.

## Technology information

**Maturity level:** On the market

**Industry property rights:** Trademark

**Type of collaboration offered:**

- Commercial agreement with technical assistance
- Service provision agreement (maintenance)
- Technical cooperation agreement
- R&D cooperation agreement

## Applications sectors

- **H<sub>2</sub> storage:** compressed gas in tanks
- **H<sub>2</sub> distribution:** loading tube trailers
- **Refuelling infrastructure:** compression, storage, dispensing
- **Transport:** automotive, heavy-duty vehicle, rail, aviation, maritime



Storage, transportation  
and distribution



Production



Mobility



Industry

### Description of the entity

The Aragon Institute of Engineering Research (I3A), was created in 2002 being the first of the Universidad Zaragoza.

It consists of 293 PhD researchers (by Dec 2022) and an equivalent number of graduates, engineers and technicians. These are grouped into 34 research groups recognized by the Government of Aragon.

In turn, the groups are distributed in 4 strategic divisions. Of these, the Division of Processes and Recycling and that of Industrial Technologies have competences in the production, purification, storage and use of hydrogen technologies.

The recent creation of the Cutting-Edge Laboratory in Circular Economy (CECE) represents the transversal contribution of different technologies converging on issues related to waste recovery and valorization.

### Entity data

**Type:** University

**Size:** > 100 employees

**Calls of interest for your entity:**

**European:** Horizon Eurpe, FCH JU, Green Deal

**National:** CDTI, MITECO, MICINN

**Regional and others**



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### Activities and experiences in R&D&I

- New reactors for catalytic reforming minimizing coking.
- Selective membranes to increase performance and quality in hydrogen production.
- Biomass gasification to syngas and subsequent downstream.
- Development of systems for hydrogen purification.
- Production of methanol+ from syngas (Power to Liquids).
- Sustainable production of hydrogen from biological waste (biogas and bio-oil).
- Production of synthetic methane (Power to Gas).
- Ammonia as a hydrogen carrier.
- Modeling of its conversion in combustion processes.
- HVO for aircraft industry.

### Technologies offered

- Hydrogen from biomass waste (biogas, biomass and bio-waste).
- Membrane technology for hydrogen separation.
- Upstream (cleaning), reforming and downstream (separation).
- Methanization reactors.
- Modeling of hydrogen conversion.
- Structural integrity and safety in FCEV.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:**

<1 million €



### Descripción de iniciativas nacionales en las que participa la entidad

- Spanish Hydrogen Technology Platform (PTEH2)
- Spanish CO2 Technology Platform (PTECO2)
- Spanish Biomass Tecnology Platform (BIOPLAT)
- Spanish Innovation and Sustainable Chemistry Plarform (SusChem)
- GetHyGA (Aragon Hydrogen Valley)
- Patron (as Universidad Zaragoza) of the Aragon Hydrogen Foundation (FHa).
- Co-Direction (seat) of the Interuniversity Master on Hydrogen Technologies (MITH) ((joint venture with Mondragon Unibertsitatea, Universidad del País Vasco / Euskal Herriko Unibertsitatea, Univeritat Polytechnica de Catalunya y Universidad Rovira i Virgili.

### Descripción de las iniciativas internacionales en las que participa la entidad





Production



Industrial



Energetic

## Technology description

I3A accumulates decades of experience (since 1988) in using of gasification and pyrolysis techniques of different biomasses and waste for the production of syngas. It can be used in internal combustion engines for the joint production of heat and electricity or purified to obtain hydrogen streams. In turn, this hydrogen can be used as a raw material for the production of liquid fuels (such as HVO for the aircraft industry).

The level of technological maturity comes from laboratory-scale developments with specific wastes, up to industrial demonstration plants developed for different Spanish engineering companies.

## Technology information

### Maturity level:

- Basic research
- Lab-proven
- Available for demonstration
- On the market

### Industrial property rights:

- Protected by industrial secret

### Type of collaboration offered:

- Cooperation agreement for R&D

## Applications sectors

### -H2 Production:

- Biomass (gasifier, full plant)

### -Industrial:

- Green hydrogen as a raw material

### -Energetic

- Energy use
- Thermal use



Production

## Technology description

I3A accumulates decades of experience (since past 90s) in the development of selective membrane reactors for the production and separation "in situ" of H<sub>2</sub>. The advantages of this type of reactor are the intensification in the operation of the reactor (displacement of the thermodynamic equilibria) and the increase in the efficiency of separation. Reactor types encompass fixed and fluidized beds in different configurations.

The level of technological maturity is that of scale from laboratory to bench scale.

## Technology information

### Maturity level:

- Basic research
- Lab-proven

### Industrial property rights:

- Patented

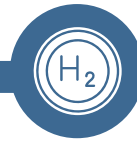
### Type of collaboration offered:

- Cooperation agreement for R&D

## Applications sectors

### -H<sub>2</sub> Production:

- Methane reforming and other HC and alcohols (reactors with in-situ separation)



Producción

## Technology description

*With the knowledge accumulated over decades in the production of hydrogen from renewable sources, the I3A can offer engineering work for the calculation of processes ranging from the conditioning of raw materials, the integration of the elements for transformation of the material (reactors) and their subsequent separation.*

*This type of studies involve sizing of equipment and techno-economic feasibility analysis.*

*This technology is complementary with the rest of the technologies offered by the I3A in this catalog.*

## Technology information

### **Maturity level:**

- Basic research

### **Industrial property rights:**

- Protected by industrial secret

### **Type of collaboration offered:**

- Cooperation agreement for R&D

## Applications sectors

### **-H2 Production:**

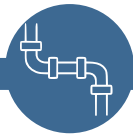
- Methane reforming and other HC and alcohols (reactors with in-situ separation)
- Complete plant (design and technoeconomic analysis)

### **-Industrial:**

- Green hydrogen as a raw material



Storage



Distribution



Industrial



Energetic

## Technology description

Methanation reactors are used for the production of methane from CO<sub>2</sub> and H<sub>2</sub> of electrolytic origin produced in periods of low electricity demand (or isolated systems). As a source of CO<sub>2</sub>, biogas from biological waste (agro-industrial, livestock, food industry, MSW, etc.) can be employed. The product obtained is a Synthetic Natural Gas with properties comparable to a fossil gas. As such it is easily transportable and storable using the current natural gas network.

The developments carried out in the I3A have focused on new catalytic reactor configurations to carry out this transformation effectively affecting the intensification of the process.

## Technology information

### Maturity level:

- Basic research
- Lab-proven

### Industrial property rights:

- Protected by industrial secret

### Type of collaboration offered:

- Cooperation agreement for R&D

## Applications sectors

### -H<sub>2</sub> Production:

- Hydrogen carriers

### -Industrial:

- Heat production in thermal power plants

### -Energetic

- Production and storage of energy coupled to the electricity grid



Storage



Industrial



Energetic

## Technology description

Ammonia can be used as a carrier of electrolytic hydrogen (produced in periods of low electrical demand). It can be used as a raw material for the production of fertilizers, but also as a fuel element, alone or mixed with others such as CH<sub>4</sub>, Natural Gas, etc.

The use of this source of nitrogen, through these new combustion processes not only prevent the formation of NO<sub>x</sub> causing photochemical smog but can contribute to its reduction.

## Technology information

### Maturity level:

- Basic research
- Lab-proven

### Industrial property rights:

- Protected by industrial secret

### Type of collaboration offered:

- Cooperation agreement for R&D

## Applications sectors

### -H<sub>2</sub> Production:

- Hydrogen carriers

### -Industrial:

- Heat production in thermal power plants

### -Energetic

- Production and storage of energy coupled to the electricity grid



Industrial



Energetic

## Technology description

The simulation of the conversion of hydrogen and its mixtures is carried out by using detailed reaction mechanisms that have been validated with numerous experimental results in a wide range of operating conditions: different temperatures, oxygen stoichiometry, reactant concentrations, etc.

The I3A focuses on the development and validation of detailed reaction mechanisms. These mechanisms can be used under different specific conditions of application.

## Technology information

### Maturity level:

- Basic research
- Lab-proven

### Industrial property rights:

- Protected by industrial secret

### Type of collaboration offered:

- Cooperation agreement for R&D

## Applications sectors

### -Energetic:

- Production and storage of energy coupled to the electricity grid

### -Industrial:

- Heat production in thermal power plants
- Green hydrogen as a raw material



Transport

## Technology description

The adaptation of conventional vehicles adapted to the current transport infrastructure (streets, highways, rails, etc.) requires the adaptation of current structures to new ones that take into account the use of hydrogen as a fuel. Additionally, safety stands out as an essential element, both for the occupants of the vehicle, and for third party, including the urban planning in which it is inserted. Particularly interesting is the adaptation of heavy transport (road and rail) for which the fuel cell powered by hydrogen can be a very suitable niche, both for the increase in autonomy and to avoid overweight associated with batteries

## Technology information

### Maturity level:

- Basic research
- Lab-proven

### Industrial property rights:

- Protected by industrial secret

### Type of collaboration offered:

- Cooperation agreement for R&D

## Applications sectors

### -Transport:

- Automobile
- Heavy vehicle
- Railway



Transport



Industrial

## Technology description

We are developing advanced catalytic reactors for CO<sub>2</sub> conversion to methanol and DME, with the aim of achieving yields beyond those possible with a conventional reactor. We are using the Process Intensification technology known as Sorption Enhanced Reaction, that combines the chemical reaction with the sorption of one or more reaction products.

## Technology information

### Maturity level:

- Basic research
- Lab-proven
- Developed but not marked

### Industrial property rights:

- Patented

### Type of collaboration offered:

- Cooperation agreement for R&D

## Applications sectors

### -Industrial:

### -Transporte:

- E-fuels





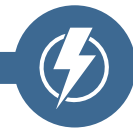
Production



Mobility



Industrial



Uses

## Description of the entity

IMDEA Energy Institute was created in 2006 as non-profit Foundation to promote and carry out R&D&i activities to contribute to the development of a sustainable and decarbonised energy system, it is strongly committed to the transfer of R&D outcomes to the productive sector and to seek joint efforts with other technology research centers and universities, promoting excellence in research on energy issues and complementarity among different entities.

Since its creation, it has been researching hydrogen technologies, its generation and use as an energy vector, as well as in the simulation of production processes, economic analysis of supply chains, life cycle management (life cycle sustainability analysis, including environmental, economic, social and eco-efficiency analysis), social acceptance in Spain and roadmaps.



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## Activities and experiences in R&D&I

Ongoing international R&D projects:

-eGHOST: Establishing Eco-design Guidelines for Hydrogen Systems and Technologies.

-SH2E: Sustainability Assessment of Harmonised Hydrogen Energy Systems: Guidelines for Life Cycle Sustainability Assessment and Prospective Benchmarking.

-PROMETEO: Hydrogen PROduction by MEans of solar heat and power in high TEMperature Solid Oxide Electrolysers.

-C-MOF.cell Novel materials as electrode and electrolyte components in fuel cell technology.

-JUST-GREEN AFRH2ICA: Promoting a JUST transition to GREEN hydrogen in AFRICA.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-5 million €**

## Entity data

**Type:** Technology or Research Center

**Size:** > 100 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, Hydrogen Europe, Green Deal;

**National:** CDTI, AEI, MITECO, MICINN, Regionales y Otras.

## Technologies offered

-Analysis of Energy Systems applied to hydrogen: Simulation of processes, Economic analysis, Life cycle management, Social acceptance and Roadmaps.

-Development of materials for electrolysers and fuel cells.

-Development of new technologies for the production and use of H<sub>2</sub>. Design, manufacture and characterization of thermosolar, photo (electro) chemical, biological and bioelectrochemical reactors.

-Algorithms for sizing and real-time management of hybrid plants with hydrogen production

Laboratory, pilot plant and demonstration facilities to design, optimize and scale processes, ensuring their industrial viability.



### Description of national initiatives in which the entity participates

2-MOF: Membranes based on new generation MOFs for their application in H2 technologies: fuel cells and electrolyzers. Strategic projects TED2021-132092B-C21.

- HYWARE: Renewable hydrogen from waste: a circular solution for landlocked regions. PID2021-124705OB-I00.

- GREENH2-CM: Strategic positioning of the Community of Madrid in R&D&I in green hydrogen and fuel cells. Development of innovative technologies for hydrogen production by low and high temperature electrolysis and other means, increasing the efficiency of hydrogen production by optimising the renewable electricity-electrolyser connection, also allowing off-grid operation, development of technologies to optimise the integration of the fuel cell in various applications and development of technologies for the safe combustion of hydrogen, pure or mixed, in end-use devices (combustors, engines, turbines). Community of Madrid, MCIN/AEI /10.13039/ 501100011033.

- C-MOF.cell: New materials for the development of electrodes and electrolytes as components of efficient, economical and robust fuel cells, working over a wider operational range than currently used materials. MCIN/AEI/10.13039/501100011033.

- BIOMIO: Conversion of bio-waste into hydrogen and microbial oils for biofuel production. MCIN/AEI/10.13039/501100011033.

- H+MOFs: New composites based on MOFs for the development of fuel cells. Ramón Areces Foundation.

### Description of the international initiatives in which the entity participates

PROMETEO: Hydrogen PROduction by MEans of solar heat and power in high TEMperature Solid Oxide Electrolyzers. Integrated system to efficiently convert intermittent heat and power sources into hydrogen. Hydrogen Europe H2020-JTI-FCH-2020-1.

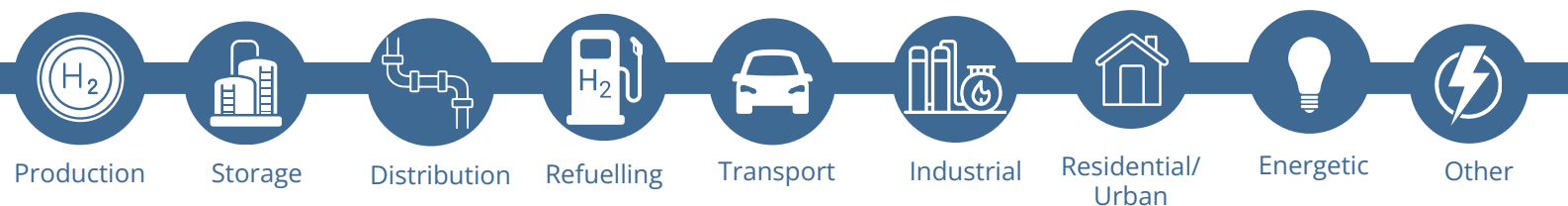
- eGHOST: Establishing Eco-design Guidelines for Hydrogen Systems and Technologies. Development of eco-design criteria in the fuel cell and hydrogen sector. Hydrogen Europe Research H2020-JTI-FCH-2020-1.

- JUST-GREEN AFRH2ICA: Promoting a JUST transition to GREEN hydrogen in AFRICA. Development of a just transition roadmap to green hydrogen to drive the deployment of synergistic EU-AU investments and policies. HORIZON-JTI-CLEANH2-2022-1.

- NOUVEAU: Novel electrode coatings and interconnect for sustainable and reusable SOEC. Advanced coating and modelling methodologies in combination with sustainable design and recycling approaches for solid oxide cells without lanthanum and platinum group metals. HORIZON-CL4-2021-RESILIENCE-01-12.

- SH2E: Sustainability Assessment of Harmonised Hydrogen Energy Systems: Guidelines for Life Cycle Sustainability Assessment and Prospective Benchmarking. Harmonised Multidimensional Framework for Life Cycle Sustainability Assessment of Hydrogen Systems. Hydrogen Europe H2020-JTI-FCH-2020-1.

- HYPOP: HYdrOgen Public OPiniOn and acceptance. Objective: to increase public awareness and confidence in hydrogen technologies and their systemic benefits. Clean Hydrogen Partnership HORIZON-JU-CSA.



## Technology description

### Energy Systems Analysis applied to Hydrogen

- Sustainability assessment of energy systems.
- Process design, simulation and optimization.
- Modeling of energy systems (prospective scenarios).
- Circular economy strategies.
- Hydrogen:
  - Production process simulation.
  - Economic analysis of supply chains.
  - Life cycle management.
  - Social acceptance in Spain.
  - Roadmaps.

Innovative aspects and advantages:

Life cycle management: eco-design and life cycle sustainability analysis, including harmonized environmental, economic, social, eco-efficiency and multi-criteria analysis.

Process feasibility evaluation through thermodynamic analysis, TEA and environmental analysis, Circular economy strategies.

Prospective techno-economic and environmental analysis of hydrogen production technologies.

## Technology information

**Maturity level:** Available for demonstration.

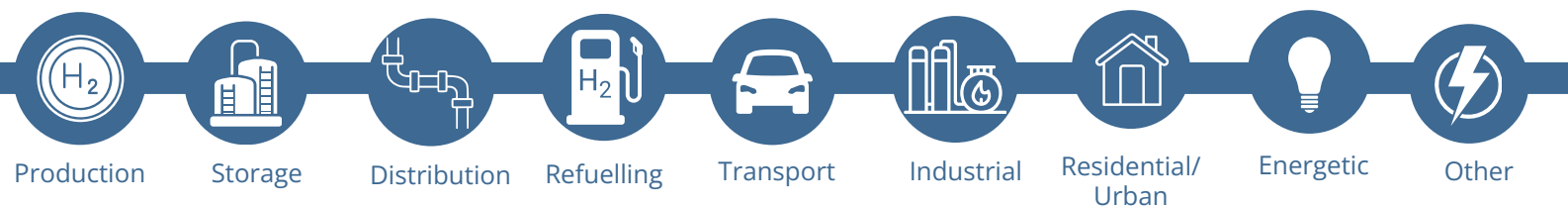
**Industrial property rights:** Copyright registers and trademarks for software. Protected by industrial secret.

**Type of collaboration offered:**

- Cooperation agreement for R&D.
- Service provision agreement.
- Technical Cooperation Agreement.

## Applications sectors

- **H2 Production:** Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass and other technologies.
- **Refuelling infrastructures.**
- **Transport:** Automobile. Heavy vehicle. Railway. Aviation. Maritime.
- **Industrial:** Green hydrogen as a raw material. Industrial cogeneration systems (GHP). Heat production in thermal power plants.
- **-Residential/urban:** Energy use. Thermal use. Domestic microgeneration (mCHP).
- **-Energetic:** Production and storage of energy coupled to the electricity grid. Injection into the gas grid.
- **Other.**



## Technology description

### Development of new technologies for hydrogen production

Hydrogen production by thermosolar pathways.

Production by thermochemical and catalytic routes: methane reforming (SMR) and methanol,...

Production of solar fuels through thermochemical cycles.

Photo(electro)catalytic processes for the production of fuels by means of solar energy.

Use of waste and biomass for the generation of sustainable fuels and hydrogen.

The Institute has R&D infrastructures at the laboratory, pilot plant and demonstration level that allow the design, optimization and scale up of processes, to ensure their industrial viability. The infrastructures are flexible, admitting various raw materials, thermochemical, catalytic, thermosolar, biotechnological and photoactivated processes applicable in different stages of development from the laboratory to the pre-industrial scale.

Innovative aspects and advantages: Development of pathways for hydrogen generation from various raw materials using different processes.

## Technology information

**Maturity level:** Lab-proven, Developed but not marketed, Available for demonstration (depending on topics).

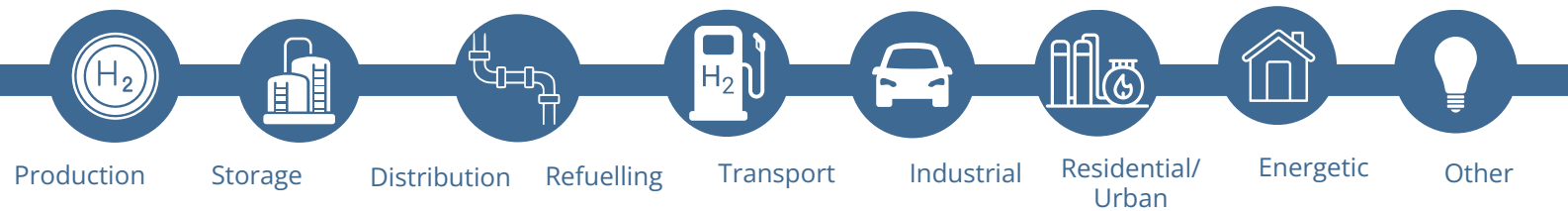
**Industrial property rights:** Patented and Protected by industrial secret.

**Type of collaboration offered:**

- Cooperation agreement for R&D.
- Service provision agreement.
- Technical Cooperation Agreement.

## Applications sectors

- **H2 Production:** Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass and other technologies.
- **Refuelling infrastructures:** In situ hydrogen production.
- **Transport:** Automobile. Heavy vehicle. Railway. Aviation. Maritime.
- **Industrial:** Green hydrogen as a raw material. Industrial cogeneration systems (GHP). Heat production in thermal power plants.
- **Residential/urban:** Energy use. Thermal use. Domestic microgeneration (mCHP).
- **Energetic:** Production and storage of energy coupled to the electricity grid. Injection into the gas grid.
- **Other.**



## Technology description

### Development of new materials applicable to hydrogen technologies

Development, synthesis and characterization of catalysts, adsorbents, materials for high temperatures, electrodes, membranes and microorganisms for the production, purification, use and conversion of hydrogen, applicable to electrolyzers, fuel cells and solar reactors: MOFs, nanofibers, nanoparticles, electrodes,...

Design, manufacture and characterization of reactors for the production and use of hydrogen or its conversion to other products or fuels, at laboratory, pilot plant and demonstrator scale applicable to thermosolar, electrochemical, photochemical, photo (electro) chemical, biological and bioelectrochemical processes.

The Institute has R&D infrastructures at the laboratory, pilot plant and demonstration level that allow the design, optimization and scale up of processes, to ensure their industrial viability. The infrastructures are flexible, admitting various raw materials, thermochemical, catalytic, thermosolar, biotechnological and photoactivated processes applicable in different stages of development from the laboratory to the pre-industrial scale.

## Technology information

**Maturity level:** Lab-proven, Developed but not marketed, Available for demonstration (depending on topics).

**Industrial property rights:** Patented and Protected by industrial secret.

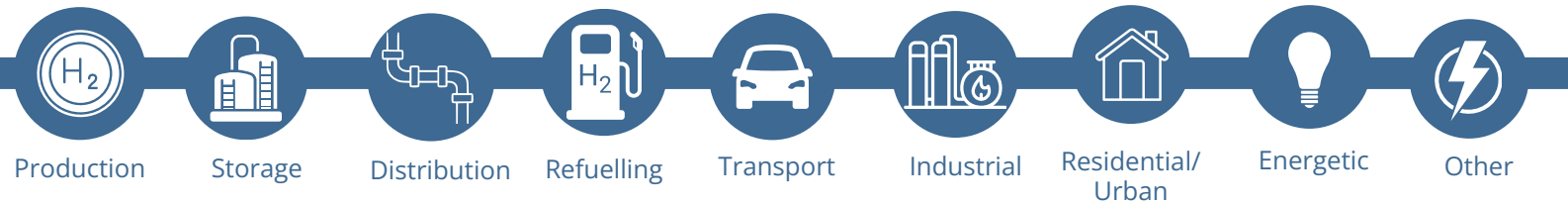
**Type of collaboration offered:**

- Cooperation agreement for R&D.
- Service provision agreement.
- Technical Cooperation Agreement.

## Applications sectors

- **-H2 Production:** Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass and other technologies.
- **Refuelling infrastructures:** In situ hydrogen production.
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- **Energetic:** Production and storage of energy coupled to the electricity grid. Injection into the gas grid.
- **Other.**

# Algorithms for sizing and real-time management of hybrid plants with hydrogen production



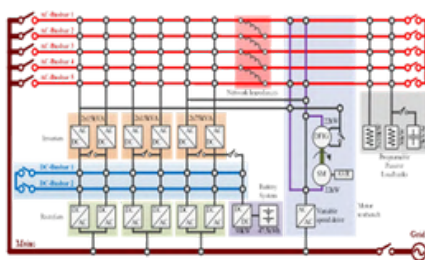
## Technology description

**Multi-objective, optimisation based algorithms for sizing and real-time energy management of hybrid renewable plants with hydrogen production.**

System sizing based on principal user objectives (cost benefits, CO2 emissions, green H2 production etc.), renewable and storage technology parameters, electrolyser parameters, demand and production prediction and market prices.

Real-time optimisation based algorithms for Energy Management that acts on the system monitoring and up-to-date information. The objective is to provide additional gains in real-time operation of hybrid hydrogen production plants.

Proof of concept testing of developed algorithms in "Smart Energy Integration Lab", a unique and dedicated Power-Hardware-In-the-Loop environment. It allows creation of a number of test scenarios and events of plants connected to AC and DC power



"Smart Energy Integration Lab"

## Technology information

**Maturity level:** Lab-proven, Developed but not marketed, Available for demonstration (depending on topics).

**Industrial property rights:** Patented and Protected by industrial secret.

**Type of collaboration offered:**

- Cooperation agreement for R&D.
- Service provision agreement.
- Technical Cooperation Agreement.

## Applications sectors

- **H2 Production:** Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass and other technologies. Plant optimisation and process control for optimised production of green H2.
- **Energetic:** Production and storage of energy coupled to the electricity grid. Control and management of hybrid plants for hydrogen production in both grid-connected and islanded power network (microgrid) configurations.
- **Other.**



Production



Mobility



Industrial

### Description of the entity

IUI CMT-Motores Térmicos is a research institute integrated into the Universitat Politècnica de València (Spain).

As a research and training center it is fully involved in the development of future propulsion systems for mobility and energy systems for stationary generation of heat and electricity, employing more than 100 researchers.

For more than 40 years, the CMT institute has carried out basic research on thermal engines to better understand the relevant thermos fluid-dynamic processes involved, and applied studies to optimize the characteristics of such engines and aid their development.

Hydrogen is a priority research topic and its application is oriented both to combustion in internal combustion engines (ICE) and gas turbines (GT), and to its use in fuel cells (FC).

### Entity data

**Type:** University

**Size:** >100 researchers

**Calls of interest for your entity:**

**European:** Horizon Europe,

CleanHydrogen, JU, Green Deal,

**National:** CDTI, MITECO, MICINN



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Universitat Politècnica Valencia, Edificio 6D

### Activities and experiences in R&D&I

Activities include numerical simulation and experimental tests of FC, ICE, hybrid ICE and GT. In simulation activities, CMT institute has extensive experience in 0D-1D-3D modeling of FC electrochemistry, combustion, thermo- fluid-dynamics of auxiliary components (turbomachinery, cooling systems...), system optimization, integration and simulation under relevant conditions with virtual vehicle models. CMT has a long experience in participating in European and national projects, as well as in research contracts with companies and professional associations.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 million €**

### Technologies offered

- Fuel cell research line: activities comprise the integration, optimization, and application of FC systems, including TCO and LCA estimation, FC degradation diagnosis and implementation of advanced control algorithms.
- Combustion research line: focused on the use of H<sub>2</sub> as single fuel, dual-fuel and blended for internal combustion engines and gas turbines. Combustion activities also include the use of NH<sub>3</sub> as an engine fuel for heavy vehicles and marine propulsion. The activities are aimed to support the development of advanced combustion and engine systems.



### Description of the national initiatives in which the entity participates

- Design and validation of innovative materials for development as proton exchange fuel cell electrolytes in vehicles. Generalitat Valenciana. 2021-25.
- Definition of fuel cell powertrain architectures for the decarbonization of road freight transport supporting the hydrogen economy deployment. Generalitat Valenciana. 2022-25,
- NECEMO: Net-zero CO2 emissions in mobility. REPSOL. 2022-25.
- Design of advanced control strategies for the new generation of fuel cell trucks promoting the decarbonisation of the transport sector. Spain State Research Agency. 2022-24.
- Optimisation of engines using hydrogen as fuel for global decarbonisation. Spain State Research Agency. 2022-24.
- Analysis of the potential of an internal combustion engine fuelled by ammonia and oxygen enriched air for the decarbonisation of the marine propulsion based on a digital model. Spain State Research Agency. 2023-2024.
- Integrating multi-functional exhaust aftertreatment systems in hybrid powertrain vehicles. Spain State Research Agency. 2022-2024.

### Description of the international initiatives in which the entity participates

- Renewable and flexible fuel power generation technology enabling the multi-sectorial decarbonization with zero emissions. Comisión Europea. 2022-26.
- Advanced MEAS ensuring high efficiency HDV. Clean Hydrogen JU. 2023-26.
- 2,0L Multi cylinder test with NH3. ARAMCO. 2022-24.





Transport



Industrial

## Technology description

The CMT institute has developed an advanced methodology for the integration of fuel cells in vehicle propulsion systems, allowing the sizing of the fuel cell-battery-motor assembly.

This methodology includes different optimization strategies for the complete propulsion system, with objectives that may include the minimization of fuel consumption, the fuel cell degradation, and the environmental impact along the life cycle assessment (LCA) .

The optimization methodology through simulation is complemented by the possibility of testing complete fuel cell systems (up to 250 kW peak), with full flexibility and in both stationary and transient conditions.

In addition, there is also a unit cell test bench and a laboratory where several advanced analysis techniques are applied for the evaluation of membrane degradation.

The integration methodology can also be used for the optimization of the characteristics of stationary electricity generation fuel cells

## Technology information

**Maturity Level:** Lab-proven methodology

**Industrial property rights:** Other

**Type of collaboration offered:** Technical cooperation agreement and cooperation agreement for R&D

## Applications sectors

- **Transport:** Automotive, heavy-duty vehicles, Locomotive, Aviation, Maritime
- **Industrial:** Stationary electric and thermal energy generation (CHP)



Transport



Industrial



Energetic

## Technology description

The use of hydrogen in internal combustion engines, both reciprocating (ICE) and gas turbine (GT), is of great interest as a simpler technical alternative and at a much lower cost than the use of fuel cells.

Another important aspect to consider is that the purity level of hydrogen in engines is lower compared to that required in fuel cells (>99.99%), which also reduces costs.

A vehicle with a 100% H<sub>2</sub> engine can be considered zero-emission as it emits <1 g CO<sub>2</sub>/kWh or <1 g CO<sub>2</sub>/km, according to Regulation (EC) No. 595/2009 and 715/2007.

Additionally, the adaptation of aviation GT for the use of hydrogen as fuel allows decarbonizing this transport mode.

The CMT institute is actively working on several European and National Plan projects, as well as with several engine manufacturing companies in the R&D necessary to develop MCIA and GT adapted to the use of hydrogen, with suitable performance and complying with emissions regulations.

## Technology information

**Maturity Level:** Lab-proven methodology

**Industrial property rights:** Other

**Type of collaboration offered:** Technical cooperation agreement and cooperation agreement for R&D

## Applications sectors

- **Transport:** Heavy-duty vehicles, Locomotive, Aviation, Maritime
- **Industrial:** Stationary electric and thermal energy generation (CHP)
- **Energetic:** Stationary electric and thermal energy generation (CHP)



Transport



Industrial

## Technology description

As an alternative to the direct use of hydrogen in MCI and GT, the use of ammonia is very convenient due to its ease of storage. Thus, great advantages are obtained in those applications requiring high fuel energy storage, as in the case of maritime applications.

As a counterpoint, ammonia does not have good characteristics as a fuel, which makes it difficult to integrate it as a direct replacement for conventional fossil fuels in MCI, although it also offers advantages in terms of pollutant emissions.

For all the previous reasons, the CMT Institute is actively working on various research projects and contracts with companies to carry out the R&D necessary to develop combustion systems that allow the use of ammonia as a single fuel or in combination with other fuels (such as hydrogen) in MCI.

In parallel, the CMT Institute is also working on the design and implementation of an ammonia combustion system in GT burners, which can be used for aircraft propulsion and stationary generation.

## Technology information

**Maturity Level:** Lab-proven methodology

**Industrial property rights:** Other

**Type of collaboration offered:** Technical cooperation agreement and cooperation agreement for R&D

## Applications sectors

- **Transport:** Heavy-duty vehicles, Locomotive, Aviation, Maritime
- **Industrial:** Stationary electric and thermal energy generation (CHP)



Transport



Industrial

## Technology description

The development of ICEs based on the combustion of hydrogen or ammonia has great potential for the fulfillment of a carbon neutral transport sector based on a mature and accessible technology.

However, its use poses challenges for the optimization of emission control strategies, in particular to the state of the art of exhaust gas aftertreatment systems. The combustion of hydrogen or ammonia gives rise to exhaust gases of very specific composition, with an absence of pollutants such as carbon monoxide, unburned hydrocarbons or particulate matter, typical of conventional fuels, but with a high concentration of water vapor and the presence of nitrogen oxides (NOx). An optimized aftertreatment system should reduce these emissions to innocuous levels, while providing additional freedom to the development of the combustion, resulting in improved engine performance.

In this context, the CMT Institute is working on the research of the most efficient architectures and control strategies for the aftertreatment systems, adapted to the specific characteristics of the different hydrogen and ammonia combustion strategies currently under development.

## Technology information

**Maturity Level:** Lab-proven methodology

**Industrial property rights:** Other

**Type of collaboration offered:** Technical cooperation agreement and cooperation agreement for R&D

## Applications sectors

- **Transport:** Automotive, heavy-duty vehicles, Locomotive, Aviation, Maritime
- **Industrial:** Stationary electric and thermal energy generation (CHP)
- **Energetic:** Stationary electric and thermal energy generation (CHP)



Production



Mobility



Industry



Uses

## Description of the entity

IITE is a Technological Center, whose purpose is the promotion of research and technological development in the field of energy.

ITE has more than 15 years of experience working in the field of hydrogen in areas such as new materials and hydrogen systems to improve the positioning of the European industry in this field, as well as its remarkable knowledge in electrolyzers and fuel cell integration in the energetical sector, dealing with its application in different areas such as mobility and the decarbonization of industrial processes.

To do this, ITE has various infrastructures, highlighting an H<sub>2</sub> pilot plant, a fuel cell laboratory and a digital energy pilot where it can establish strategies for the incorporation of H<sub>2</sub> as a vector in the grid.



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## Activities and experiences in R&D&I

ITE is present in all sectors, supporting companies and developing research projects based on its four strategic lines: grids of the future, storage, sustainable mobility and circular economy.

ITE carries out research from the integration of hydrogen in future energy infrastructure, modelling and real applications to the development and testing of materials for hydrogen production and fuel cell technologies.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: <1 million €**

## Entity data

**Type:** Technology Institute

**Size:** >100 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU, Green Deal

**National:** CDTI, MITECO, MICINN

## Technologies offered

Development of materials and components for electrolyzer and fuel cell.

-Simulation models of behaviour/performance of electrolyzers and fuel cells.

-Prediction and characterization of performance, aging and degradation processes of systems: electrolyzer and fuel cell.

-Hydrogen use. Grid management with storage and hydrogen use in industry.

-Modelling of converters.

-Life Cycle Assessment (LCA).



## Description of the national initiatives in which the entity participates

- **Estrategia del Hidrógeno Renovable de la Comunitat Valenciana 2030 (EH2CV)**

This initiative comprises ambitious actions planned in a cooperative manner between the actors in the value chain present in the Valencian Region, with the aim of generating a significant impact on improving business competitiveness. The action plan is structured in four axes: generation and demand, technological development, regulatory framework and promotion. ITE is the Technical Secretariat of the Valencian Hydrogen Strategy.

- **Plataforma Española del hidrógeno (PTeH2)**

ITE is an active member of PTeH2 with its participation in the National and International Collaboration Groups; and in the Knowledge Groups: Production, Uses in Industry, Uses in Mobility and Other uses.

## Description of the international initiatives in which the entity participates

- **Energy Materials Industrial Research Initiative (EMIRI)**

ITE is an active member of Hydrogen Focus Group (FG-Hydrogen) whose activity is focused on advanced materials for the production, distribution, storage and uses of hydrogen.

- **EUROPEAN CLEAN HYDROGEN ALLIANCE**

ITE actively participates in the working group dedicated to Hydrogen Production.

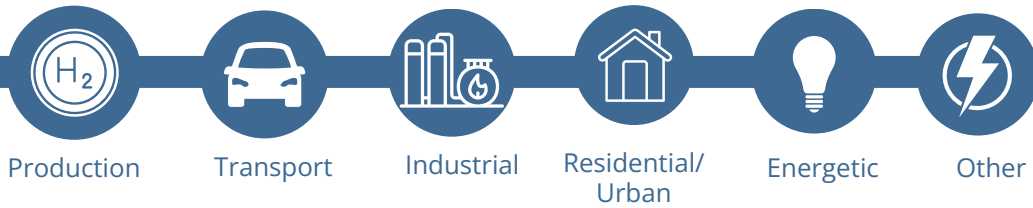
- **HYDROGEN EUROPE RESEARCH**

ITE actively participates in the following Roadmaps:

- Electrolysis
- Role of electrolysis in the Energy system
- Other modes of production
- Hydrogen Valleys
- Supply Chain
- Stationary Fuel Cells
- Heavy Duty Vehicles
- Maritime
- Modelling & Simulation
- Recycling, eco-design & sustainability

- **WORLD HYDROGEN LEADERS**

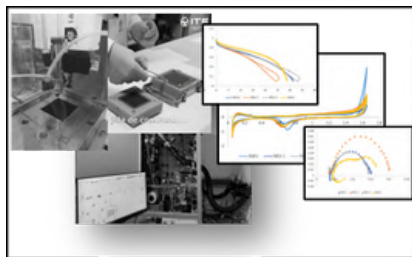
ITE is an active member of this platform that brings together companies in the hydrogen sector.



## Technology description

Development of materials and components: Synthesis and development of new membranes and composites for proton exchange (Nafion), anion exchange (Fumion), inorganic fillers and two-dimensional materials. Development of MEAs. Deposition of catalytic inks on GDL (GDE) and membrane (CCM) using different techniques: Spray, Screen Printing, Inkjet, Aerosol Jet. Characterization of materials and components on a test bench.

Innovative aspects and advantages of the technology: development of ion exchange membranes, polymeric, hybrid, with the appropriate loading of different metal oxides and two-dimensional materials at the nanometric level. The strategy of including inorganic materials improves membrane hydration at elevated temperatures. The use of two-dimensional materials reinforces the membrane, reducing crossover and improving mechanical properties.



## Technology information

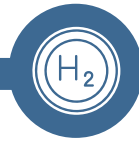
**Maturity level:** Lab-proven

**Industrial property rights:** : Not apply

**Type of collaboration offered:** Cooperation agreement for R&D, Service provision agreement and Technnical Cooperation Agreement

## Applications sectors

- **H2 Production:** electrolysis of water (components, unit, auxiliary elements, process control and full floor).
- **Transport:** testing of components and fuel cells (automobile).
- **Industrial:** green hydrogen as a raw material and hydrogen as flexibility vector.
- **Residential/urban:** green hydrogen as flexibility/vector-energetical communities.
- **Energetic:** production and storage of Energy coupled electrical grid.
- **Other:** testing of components and fuel cells for other applications.



Production



Transport



Energetic



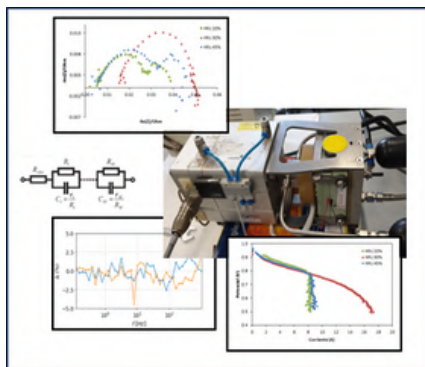
Other

## Technology description

Development of tools for estimating the health status of fuel cells and online electrolyzers.

Tests under failure for degradation study of materials and components integrating hydrogen production technologies and hydrogen use in fuel cells.

Use of non-invasive techniques, such as electrochemical impedance spectroscopy, for the detection of fail operation in electrolyzer and fuel cell.



## Technology information

**Maturity level:** Lab-proven

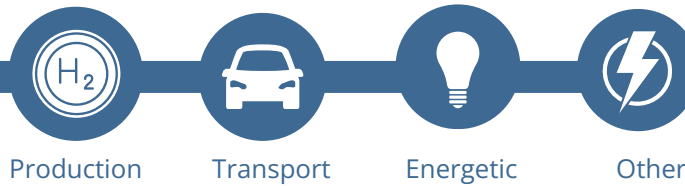
**Industrial property rights:** : Not apply

**Type of collaboration offered:** Cooperation agreement for R&D, Service provision agreement and Technnical Cooperation Agreement

## Applications sectors

- **H2 Production:** electrolysis of water (components, unit, auxiliary elements, process control and full floor).
- **Transport:** component testing, power electronics, state of health estimation and fuel cells (automotive).
- **Other:** testing of components and fuel cells for other applications. Detection, prediction of degradation of materials and components. Modification of materials to mitigate degradation.



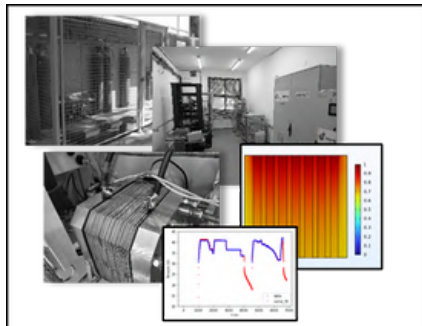


## Technology description

Modelling and digitalization of equipment: development of a Multiphysics model for simulation of the behaviour of electrolyzers and fuel cells. Analysis of the influence of operating parameters (temperature, voltage, density current, etc.) on system performance.

Innovative aspects and advantages of the technology: creation of digital environments for the development of optimization algorithms; energy management strategies; sizing; predictive maintenance and study of degradation in hydrogen production and/or consumption facilities and systems.

o.



## Technology information

**Maturity level:** Lab-proven

**Industrial property rights:** : Not apply

**Type of collaboration offered:** Cooperation agreement for R&D, Service provision agreement and Technnical Cooperation Agreement

## Applications sectors

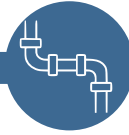
- **H2 Production:** electrolysis of water (components, unit, auxiliary elements, process control and full floor).
- **Transport:** fuel cells for automobile and heavy transport applications.
- **Industrial:** green hydrogen as a raw material.
- **Energetic:** production and storage of Energy coupled electrical grid.
- **Other:** simulation of behaviour, prediction, degradation and digitalization of fuel cell and electrolyzer.



Production



Storage



Distribution



Transport



Industry



Energetic

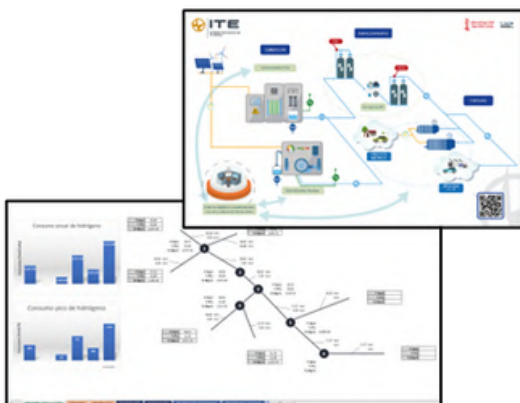


Other

## Technology description

Integration of hydrogen technologies: development and optimization of energy management strategies in energy systems and infrastructures. Technical-economic sizing of renewable hydrogen production facilities. Hybridization strategies in electric vehicle power train using hydrogen fuel cells.

Innovative aspects and advantages of technology: application-specific management systems, reduction of CAPEX and OPEX. Integration in technological platforms. Planning and management of energy production and demand.



## Technology information

**Maturity level:** Lab-proven

**Industrial property rights:** : Not apply

**Type of collaboration offered:** Cooperation agreement for R&D, Service provision agreement and Technnical Cooperation Agreement

## Applications sectors

- **H2 Production:** electrolysis of water (components, unit, auxiliary elements, process control and full floor).
- **Transport:** fuel cells for automobile and heavy transport applications.
- **H2 distribution:** pipelines.
- **H2 storage:** compressed gas in tanks, metal hydrides.
- **Industrial:** green hydrogen as a raw material.
- **Energetic:** production and storage of Energy coupled electrical grid.
- **Other:** integration in management platforms.



Storage, transportation and distribution



Production



Mobility



Industry



Other Uses

## Description of the entity

The Galicia Institute of Technology (ITG) is a private non-profit National Technology Centre located in the Galicia region, in A Coruña. Its aim is to improve the competitiveness of companies, organizations and professionals, through R&D&I and differential technology. Thus, it facilitates their access to research and innovation activities, technical development, and continuous improvement.

IoT, Big Data, industry 4.0, unmanned autonomous systems, augmented reality, and artificial intelligence are among our working tools in industry, energy, water and buildings.

In sustainable construction, ITG operates BREEAM® in the Spanish territory with exclusive license, and is the only organization recognized by IWBI® in Spain for training of WELL®AP's and expanding knowledge of Wellbeing in Buildings in Spain.

## Entity data

**Type:** Technology and Research Centre

**Size:** >100 employees

**Calls of interest for your entity:**

**-European:** Horizon Europe, FCH JU, Green Deal

**-National:** CDTI, MITECO, MICINN



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## Activities and experiences in R&D&I

PITG provides technology, and digital solutions and services, for environmental sustainability. It has participated in over 45 R&D&I national and international projects in the last 3 years, and it has provided services to over 400 customers.

Regarding hydrogen, ITG is oriented towards improving the competitiveness of our clients, through simulation, control and smart energy management, providing innovative solutions based on data analytics and artificial intelligence, oriented towards new business models and decision making.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 million €.**

## Technologies offered

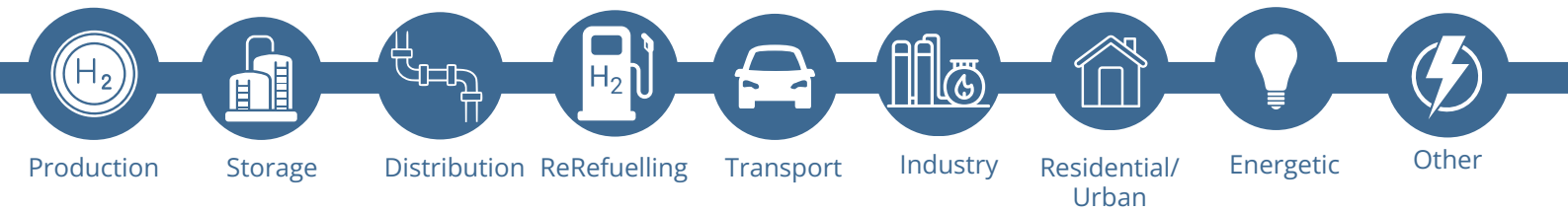
- Smart Energy Management System para la optimización de la gestión de sistemas de producción, almacenamiento y consumo de hidrógeno renovable.
- Diseño, modelado y digitalización de sistemas de producción, almacenamiento y consumo de hidrógeno renovable.



## Description of the national initiatives in which the entity participates

- Spanish Technological Platform for Hydrogen and Fuel Cells (PTEHPC)
- Galician Hydrogen Association (AGH2)
- Galician Industrial Alliance for Green Hydrogen

## Description of the international initiatives in which the entity participates



## Technology description

Software for monitoring, analysis, and advance energy management of hydrogen systems (generation, storage, distribution and consumption). Main features:

- Interface: Multiuser, highly configurable subsystems, GIS,schematic diagram, graphics, tables, queries, alarms, permissions management, etc.
- Real time monitoring of energy processes and variables.
- Data analytics: system behaviour evaluation and KPIs in different scenarios.
- Management: system operation programming.
- Forecasting: Hydrogen demand and renewable energy availability.
- Optimisation: simulation of generation and consumption scenarios, and calculation of optimal operation strategies.

### Innovative aspects and advantages of technology:

Integral management of subsystems; integration with sensors of several manufacturers, protocols and external data; artificial intelligence for optimisation and forecasting.

## Technology information

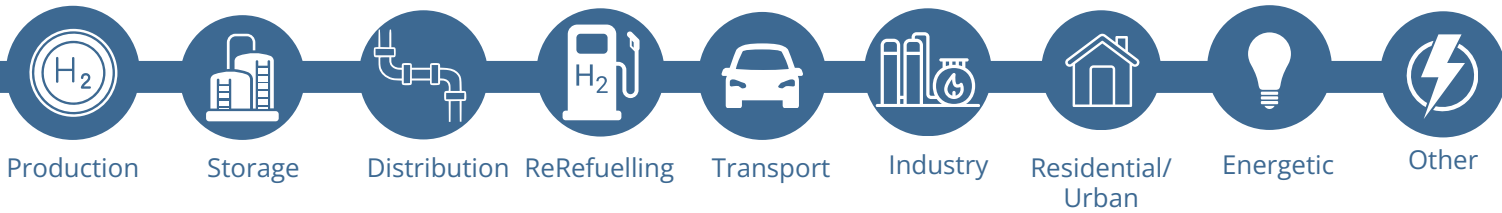
**Maturity level:** Lab-proven

**Industrial property rights:** Protected by industrial secret

**Type of collaboration offered:** Cooperation agreement for R&D, trade agreement with technical assistance, service provision agreement, technical cooperation agreement

## Applications sectors

- **H2 Production:** Process control and full floor in systems by water electrolysis.
- **H2 storage:** Compressed gas in tanks.
- **H2 distribution:** Pipelines.
- **Refuelling infrastructures:** In situ hydrogen production, compression, storage, dispense.
- **Transport:** Fuel cells in automobile and heavy vehicles.
- **Industrial:** Green hydrogen as a raw material
- **Residential/urban:** Energy use.
- **Energetic:** production and storage of Energy coupled electrical grid.
- **Other:** Applications in port areas.



## Technology description

Digital modelling of renewable hydrogen generation, storage and consumption systems: electrolyser, water treatment plant, compressors, storage, vehicles, hydro stations and other consumptions. This allows:

- Dimensioning and design of hybrid infrastructures.
- Energy and economic valuation of hydrogen systems impact in hybrid generation and storage systems.
- Energy elements emulation. Component testing. Algorithms optimisation.
- Operational strategies testing and analysis before system implementation.
- Solutions for renewable energy grid integration and ancillary services.

### Innovative aspects and advantages of technology:

Full system modelling; development and validation with real-time testing platform based on PHIL technology, in Smart Grids ITG Lab.

## Technology information

**Maturity level:** Lab-proven

**Industrial property rights:** : Protected by industrial secret

**Type of collaboration offered:** Cooperation agreement for R&D, trade agreement with technical assistance, service provision agreement, technical cooperation agreement

## Applications sectors

- **H2 Production:** Process control and full floor in systems by water electrolysis.
- **H2 storage:** Compressed gas in tanks.
- **H2 distribution:** Pipelines.
- **Refuelling infrastructures:** In situ hydrogen production, compression, storage, dispense.
- **Transport:** Fuel cells in automobile and heavy vehicles.
- **Industrial:** Green hydrogen as a raw material
- **Residential/urban:** Energy use.
- **Energetic:** Production and storage of Energy coupled electrical grid.
- **Other:** Applications in port areas.



Storage, transportation and distribution



Production



Mobility



Industry



Other Uses

## Description of the entity

Founded in 1906, Leitat has the mission of Managing Technologies to create and transfer sustainable social, environmental, economic and industrial value to companies and entities, through research and Technological processes. Leitat is a Technological Center which collaborates with more than 45 countries and develops more than 215 projects related to the fields of: Biotechnology, Health, Advanced Materials, Industrial Chemistry, Renewable Energies and New Production Processes. Leitat actively participates in Regional, National and European projects both as partner and as coordinator.

Additionally, Leitat also offers flexible collaboration models directly with companies through R&D projects, Laboratory tests and certifications, incubation services and IPR management and exploitation.

## Entity data

**Type:** Technology and Research Centre

**Size:** >100 employees

**Calls of interest for your entity:**

**-European:** Horizon Europe, JTI CleanH2 JU.

**-National:** CDTI, MITECO, MICINN



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## Activities and experiences in R&D&I

Our main activity and experience is focused on: (i) Development and characterization of catalysts, electrodes and membranes for PEM, AEM, SOEC, PEC, MEC systems, and microorganism for H<sub>2</sub> production from biomass (fermentation); (ii) Design, manufacturing and characterization of H<sub>2</sub> reactors (production and use); (iii) Design and manufacturing of components/reactors for piloting; (iv) Development and characterization of materials for H<sub>2</sub> storage and distribution (LOHCs, MOFs, carbons, coatings); and (v) Sustainability: recycling, environmental, social and economic impact and ecodesign.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 million €**

## Technologies offered

- Development of catalysts, electrodes, membranes and microorganism for H<sub>2</sub> production systems.
- Development and characterization of electrochemical, photoelectrochemical, photochemical, biological and bioelectrochemical systems.
- Development of membranes for H<sub>2</sub> purification and separation.
- Development of LOHCs, MOFs, carbons and anticorrosive coatings for H<sub>2</sub> storage and transport



## Description of the national initiatives in which the entity participates

Active member in the following national platforms/associations/clusters:

- **PTeH2** (Plataforma tecnológica Española del Hidrógeno)
- **AeH2** (Asociación Española del Hidrógeno)
- **CEEC** (Clúster de l'Energía Eficient de Catalunya)
- **Secartys**
- **Solartys** (Clúster de Energía Solar y Eficiencia Energética)
- **La Vall d'Hidrogen de Catalunya**

Leitat participates in the following national projects carrying out the stated activities:

- **Regenera (Misiones)**. Water purification, LOHCs, BES, LCA, LCC.
- **Purígeno (PID)**. Dark fermentation integrated with BES for H2 production

## Description of the international initiatives in which the entity participates

MActive member in the following international platforms/associations/clusters:

- **Emiri FG H2**
- **HER** (Hydrogen Europe Research)
- **Waitro**
- **Mission H2**
- **Innoenergy**
- **H2Global**
- **RENMAD**

Leitat participates in the following european projects carrying out the stated activities:

- **NEFERTITI (H2020)**. Photocatalytic flow processes for production and use of H2.
- **FlowPhotoChem (H2020)**. MOFs photocatalysts for HER water splitting. LCC.
- **Vivaldi (H2020)**. Electrodes and membranes development and characterization for BES producing H2.
- **GH2 (HE-Pathfinder)**. Gas separation membranes for H2 collection.
- **ANEMEL (HE-Pathfinder)**. LCC. Electrospun nanofiber mats for production of reinforced anion exchange membranes.



# Development and characterization of materials, components and reactors for producing, storing and using H<sub>2</sub>.



## Technology description

**Development of new materials (catalysts, electrodes, membranes, coatings and micro-organisms).**

Synthesis and characterization of them for production, use and conversion of H<sub>2</sub>. Including synthesis of MOFs, nanofibers, nanoparticles and 3D electrodes with higher activity, increasing its specific surface, porosity, electrical conductivity and mechanical properties, reducing the use of CRM and controlling the doping, and geometry control in case of 3D. As manufacturing techniques, electrospinning, wet-chemistry processes, roll-to-roll, serigraphy and additive manufacturing. For H<sub>2</sub> storage, distribution, purification and separation, manufacturing of adsorbent greener materials (MOFs, nanofibers, porous carbons), LOHCs with new catalytic systems able to work at lower temperature and pressure; functionalized membranes with increased selectivity and permeability and better chemical and mechanical properties (polymeric membranes, hollow-fibers); and anticorrosive coatings for pipelines and tanks.

**Development and characterization of electrochemical, photo-electrochemical, photochemical, biological and bioelectrochemical systems.**

Including design, manufacturing and characterization of the above-mentioned reactors for H<sub>2</sub> production and use or conversion into new fuels/chemicals.

## Technology information

**Maturity level:** Lab-proven

**Industrial property rights:** : Protected by industrial secret

**Type of collaboration offered:** Cooperation agreement for R&D, trade agreement with technical assistance, service provision agreement, technical cooperation agreement

## Applications sectors

- **H<sub>2</sub> Production:** electrolysis of water (components + electrolyzer), photoelectrolysis of water (components + electrolyzer), from biomass (components + electrolyzer).
- **H<sub>2</sub> storage:** LOHCs, MOFs, porous carbons and anticorrosive coatings of pipelines and tanks
- **H<sub>2</sub> distribution:** membranes for purification and distribution. Anticorrosive coatings of pipelines and tanks. Polymeric membranes for deblending.
- **Transport:** automobile (components and testing of fuel cell, advice).
- **Industrial:** green hydrogen as raw material for the production of synthetic fuels.



Producción

## Description of the entity

Lhyfe is a manufacturer and supplier of renewable hydrogen. It is headquartered in Nantes (France) and is present in 11 countries with more than 200 employees.

Lhyfe has experience in the generation and supply of H<sub>2</sub>, thanks to its exclusive dedication to this activity, rapid growth, agility and commitment.

Since September 2021, Lhyfe has a 300kg/day capacity plant in operation in Bouin (France), from where it supplies the hydrogen molecule in containerized trucks to mobility and industrial customers. That same plant will be expanded to 2.5MW at the beginning of 2024. Before that date, Lhyfe will put two 5MW plants into operation.

Lhyfe has already launched the world's first pilot plant for the production of renewable H<sub>2</sub> by means of offshore wind energy.

Lhyfe currently has six plants under construction and an extensive pipeline of projects such that the company has committed to 55MW in operation by the end of 2024, 200MW in 2026, and 3GW in 2030.

For Spain, it is planned to exceed 125MW in operation by 2028.

## Entity data

**Type:** SME

**Size:** <100 employees

**Calls of interest for your entity:**

**-European:** (Horizon Europe, FCH JU, Green Deal)

**-National:** CDTI, MITECO, MICINN



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## Activities and experiences in R&D&I

Development of onshore and onsite renewable hydrogen production plants:

-1MW plant in production in Bouin (France) since 2021. Currently, being expanded to 2,5MW.

-Plants in progress (55 MW) that will be commissioned in 2024.

Development of offshore green hydrogen production plants.

-First 1MW offshore production pilot plant in Saint Nazaire, France.

The specific R&D activities in which we work are:

-Remote control and autonomous plants.

-Optimization of the operation: renewable content of H<sub>2</sub>, cost of electricity, cost of production...

-Delivery optimization: transport costs, storage.

-Maintenance optimization.

-Software improvements to optimize plant operation.

-Study of hardware improvements to improve the operation.

-Research related to ways to improve the environmental impact of our activity.

**IApproximate annual investment in R&D&I in hydrogen and fuel cells: 1-5 million €**

## Technologies offered

- Renewable hydrogen production.
- Renewable hydrogen storage.
- Distribution of renewable hydrogen



## Description of the national initiatives in which the entity participates

LLhyfe Hidrógeno, the subsidiary in Spain of Lhyfe, participates in Spain in the following initiatives:

- **AEH2:** Spanish Hydrogen Association.
- **Clúster Andaluz del Hidrógeno.**
- **PTeH2:** Spanish Hydrogen Technological Platform. Specifically, in the Production Working Group.
- **H2CyL:** Castilian and Leonese Hydrogen Association.

In addition, Lhyfe is studying its incorporation in different Hydrogen Valleys and other Associations at national level.

## Description of the international initiatives in which the entity participates

### Production plants producing renewable hydrogen:

-**H2Ouest:** Project in collaboration with five partners and supported by ADEME. This project has launched the first renewable H2 production plant in Bouin.

-**SeaLhyfe:** the world's first floating marine electrolyser, inaugurated in September 2022. This project is supported by the Pays de la Loire Region, the Pôle Mer Bretagne Atlantique cluster and the industry strategic committee (CSF) for operators of the marine industry.

### Production plants under construction:

-**Bretagne,** France (5MW). Lhyfe's second renewable hydrogen production facility. Start-up during the second semester of 2023, with the support of ADEME.

-**Occitanie,** France (5MW). Start-up at the end of 2023. This project has been the winner in the "H2 Corridor" tender for the Occitania region.

-**Schwabich-Gmund,** Germany (10MW). Commissioning in 2024.

-**Tubingen,** Germany (1MW). It will go live in 2023 as part of Deutsche Bahn and Siemens Mobility's H2goesRail project.

-**GreenHyScale,** Denmark (100MW): Consortium led by GreenLab. The project has been financed through the Horizon 2020 framework program.

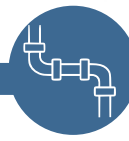
-**Botnia Hydrogen,** Sweden (1.5MW): Commissioning at the end of 2023. It has received support from Klimatkivet.



Production



Storage



Distribution

## Technology description

- Production of renewable hydrogen by electrolysis of water.
- Renewable hydrogen production using seawater and wastewater.
- Renewable hydrogen production on-shore and off-shore.
- Supply of green hydrogen from plants operated, designed and built by the Lhyfe team.
- Renewable hydrogen compression for various applications (from 30 to 900 bar).
- Renewable hydrogen storage.
- Distribution of renewable hydrogen through tube trailers (containerized semi-trailers powered by tractor heads).
- Renewable hydrogen pipeline supply

## Technology information

### Maturity level:

- Available for demonstration
- On the market

**Industrial property rights:** : Protected by industrial secret

**Type of collaboration offered:** Cooperation agreement for R&D, trade agreement with technical assistance, service provision agreement, technical cooperation agreement

## Applications sectors

- **H2 Production:** electrolysis of water (components + electrolyzer), Full floor
- **H2 storage:** Compressed gas
- **H2 distribution:** -Underground gas, pipelines, tube trailer
- **Refuelling Infrastructure:** In-situ hydrogen production, Compression, Storage
- **Transport:** Heavy vehicles, railway, fuel cell.
- **Industrial:** green hydrogen as raw material



Storage, transportation and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

LOMARTOV S.L is an Innovative Environmental Engineering SME. Its mission is to provide high-qualified consultancy services to help companies and R&D organizations in developing innovative and circular solutions, industrial and technological projects to improve their environmental, economic, and social sustainability with a multidisciplinary and holistic approach.

This activity is supported by the experience in the implementation of tools such as environmental and socioeconomic Life Cycle Analysis (LCA), ecodesign, circular economy modelling, environmental regulatory compliance and management for private companies and business associations. The company is also experienced in promotional support and business development aimed at both young companies, new research projects and technological processes, to guide them from the scientific, technical and financial point of view before new proposals, partners and / or end users. LOMARTOV is up-to-date with the latest solutions available in the state of the art of hydrogen technologies, thanks to the scientific background of the technical team, and offers itself to promote ideas and projects in this field, contributing from the definition of the concept to the study of the possible scope and/or exits in the market.

## Entity data

**Type:** PYME

**Size:** 11-20 employees

**Calls of interest for your entity:**

Cluster 4-5-6 of Horizon Europe and the Hydrogen Partnership programme. Everywhere a sustainability analysis though LCA is requested.



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## Activities and experiences in R&D&I

LOMARTOV know-how and expertise is reinforced by the active participation in different European projects and networks, ranging different sectors from advanced materials, renewable energies, batteries, to biobased solutions and technologies applied to the energy, food-agriculture & aquaculture sector.

Since 2017, LOMARTOV has taken part in more 20 European R&I projects ranging different TRL levels (from 3 to 8) and exploring also new hydrogen production routes.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** the company is not a technology provider but supports other companies who are investing in H2 and fuel cells technologies in their sustainability assessment.

## Technologies offered

ECODESIGN and LIFE CYCLE ANALYSIS (TRIPLE IMPACT)

Our technological offer is based on the combined use of ecodesign and Life Cycle Analysis (LCA) to identify and quantify environmental, economic and social impacts that may affect the correct development and implementation of new technologies, in this case production, storage and distribution of hydrogen. Such measurements allow designs and implementations to be carried out from a superior sustainability approach, avoiding agents that contribute to a greater environmental, economic and/or social impact, such as the use of critical raw materials, widely used in catalytic systems for current hydrogen generation.



## Description of the national initiatives in which the entity participates

The SME does not take part in any national initiatives related with H<sub>2</sub> and fuel cells. However, they are constantly collaborating through European initiatives with high level Spanish RTOs who are investigating in H<sub>2</sub> and fuel cells technologies, and all the sectors tackled by the platform.

## Description of the international initiatives in which the entity participates

*Since 2017, the SME has taken part in more than 20 European funded Projects in the framework of Horizon 2020 and Horizon Europe, Horizon 2020, Life and Erasmus+ programmes.*

*Within the field of hydrogen LOMARTOV is taking part in OHPERA Project - "Optimised Halide Perovskite nanocrystalline based Electrolyser for clean, robust, efficient and decentralised production of H<sub>2</sub>", which is developing a proof-of-concept photoelectrochemical cell to simultaneously achieve efficient solar-driven hydrogen production at the cathode and high added-value chemicals from valorization of industrial waste at the anode, through solar energy input. LOMARTOV is leading the sustainability evaluation and validation of the system, along with the communication and dissemination activities.*

*Complementary to the hydrogen field LOMARTOV is also supporting several R&I projects working on battery and energy storage technologies, ranging different applications and TRL level (from 4 to 7), which will be key for the future deployment of H<sub>2</sub> as an energy vector.*



Storage, Transporte and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

MMM Energy develops industrial projects for the subsequent manufacturing and marketing of capital goods related to the sustainable energy sector.

It relies on the MMM group to combine industrial capabilities in the transformation of metal-mechanical components with safety features.

The activities are

- Technological prospecting of concepts from TRL 3 to TRL 5.
- Project scaling from TRL 5 to TRL 8.
- Industrialisation and commercialisation of projects from TRL 8 to 9.



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## Activities and experiences in R&D&I

PTechnical staff with more than 15 years of experience in product development for Automobile Power Train - Fuel Cells and Renewable Energies.

Development of complete systems / components for:

- Hydrogen production from methanol.
- Production of electricity from methanol.
- Production of e-fuels (gas and liquids).
- Capture of CO2 in low concentration streams.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1M€**

## Entity data

**Type:** SME

**Size:** <10 employees

**Calls of interest for your entity:**

HORIZON, National PERTE Funds.

## Technologies offered

Reactors for autothermal reforming of Methanol.  
 Hydrogen purification systems.  
 Equipment for off-grid electricity production.  
 Reactors for bio-fuels manufacturing.  
 Reactors for synthesis e\_fuels.  
 CO2 capture devices.



**Description of the national initiatives in wich the entity participates**

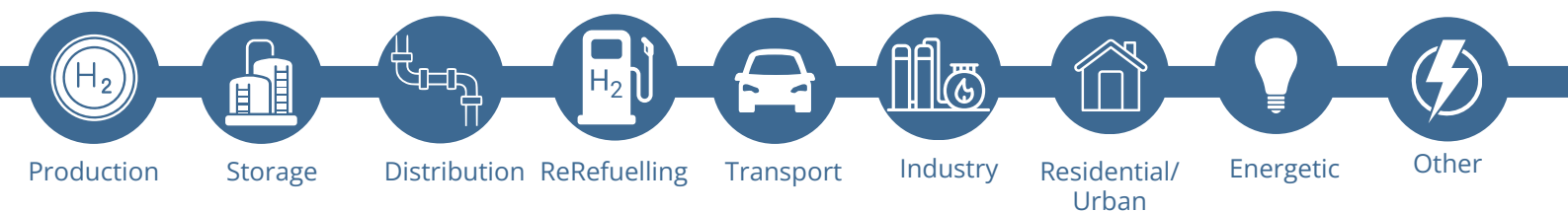
- Member of the Cluster Automotive of Catalonia CIAC.
- Member of the Spanish Hydrogen Association AeH2.
- Member of the Catalonia Hydrogen Valley.
- Member of IN-MOVE by Rail Group.
- Member of the Fundación Empresa y Clima FEC.

**Description of the international initiatives in wich the entity participates**

*Program 2023 - HORIZON-CL5*

- ACHES - Batt4EU
- AXXES
- H2SHIFT
- COMBO GREEN.





## Technology description

Hydrogen generator from methanol with integrated purification to reach ISO 14687 quality.

Compatible hydrogen for use in fuel cells.

Possibility to integrate:

- System to produce electrical energy without grid support.
- Hydrogen compression and dispensing system for FCEV vehicles.
- Industrial systems where hydrogen is used as a protective atmosphere as alternative fuel to Natural Gas.
- Hydrogen production on board in Heavy Duty, Off-road vehicles and marine applications.

## Technology information

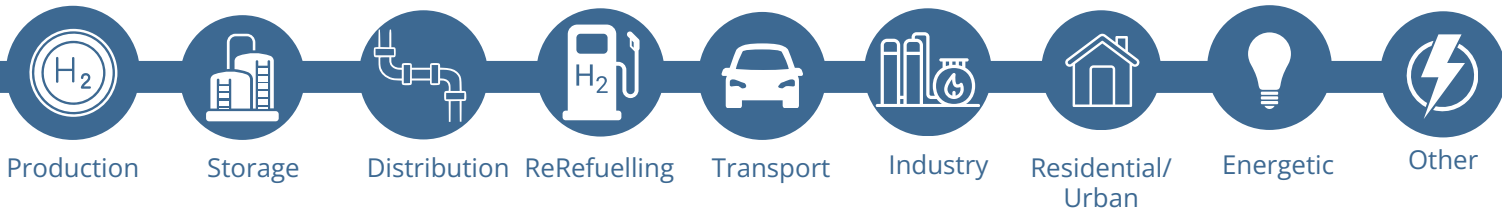
**Maturity level:** On the market

**Industrial property rights:** : Patented

**Type of collaboration offered:** Manufacturing agreement

## Applications sectors

- **H2 Production:** Reformed and purified from methanol
- **Refuelling Infraestructure:** Hydrogen refueling stations (HRS Off grid) for FCEV. Off grid Chargers BEV station
- **Industrial:** off grid hydrogen as a reactive molecule.



## Technology description

Off-grid electric power generator from methanol containerized in 20 feet for power from 200 KWh consisting of:

- Reformer system(s) from methanol to pure hydrogen.
- PEM Fuel Cell system for conversion of hydrogen into electricity.
- Battery storage system for peak power demands or transient loads.
- DC-DC or DC-AC converter(s) system according to demand.
- Hydrogen compression system up to 30 bar to feed compression stations.

Oriented to

- Isolated Quick Chargers for BEV.
- Hydrogen feeding to HRS.
- Support of electric power and/or hydrogen to maritime vessels at port (Shore to Ship).
- Onboard power for Boats, Trains and Heavy-Duty vehicles.
- Electrical power (Carbon neutral and free harmful emissions) in civil events, data centers, remote locations as energy main or backup systems.

## Technology information

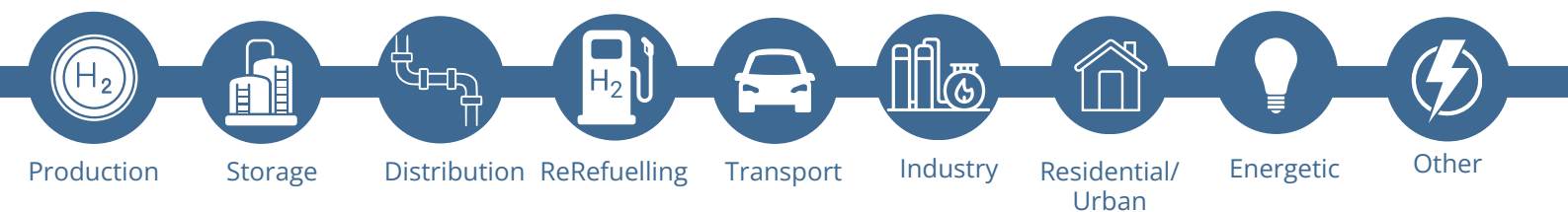
**Maturity level:** Developed but not marketed project.

**Industrial property rights:** : Protected by Industrial Secret

**Type of collaboration offered:** Agreement for Manufacturing.

## Applications sectors

- **Refuelling Infrastructure:** Hydrogen refueling stations (HRS Off grid) for FCEVs and/or for Quick charging of BEVs.
- **Industrial:** Carbon neutral electrical power station (GenSET).
- **Electric power:** Shore to Ship to support hotel function in docked ships
- **Electrical power:** on board for auxiliary devices in Ships.



### Technology description

Modular reactors for manufacture non massives quantities of bio-fuels and/or synthetic fuels by combining CO2 and renewable / carbon neutral hydrogen.

Oriented to valorization of:

- Captured CO2 (biogenic or industrial).
- Biomass waste.
- Livestock waste.
- Urban waste.

### Technology information

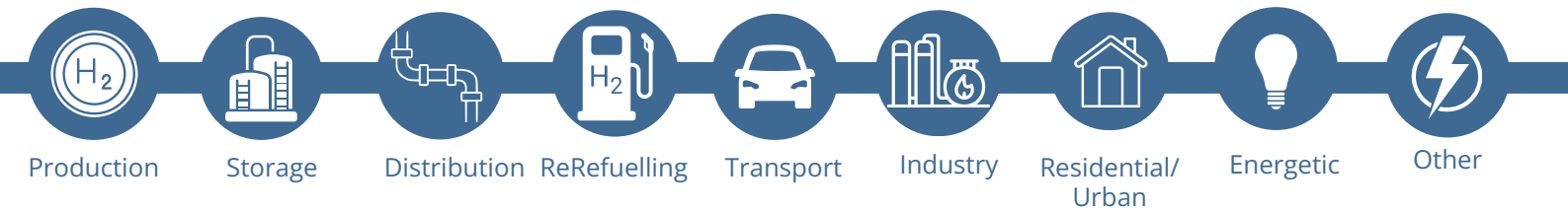
**Maturity level:** Basic research - Laboratory validation

**Industrial property rights:** : Protected by industrial secret.

**Type of collaboration offered:** Cooperation agreement for R&D

### Applications sectors

- Manufacture of biofuels and/or synthetic fuels using hydrogen as a reactive.



## Technology description

Device / components for CO2 capture systems in low concentration streams.

Hybridization of the capture system to use CO2 as feedstock to create higher value-added products, preferably synthetic fuels.

Oriented to:

- Reductions of CO2 levels in the atmosphere.
- Reduction of CO2 emissions in natural gas combustion processes in industrial processes.

## Technology information

**Maturity level:** Basic research - Laboratory validation

**Industrial property rights:** : Protected by industrial secret.

**Type of collaboration offered:** Cooperation agreement for R&D

## Applications sectors

Manufacture of biofuels and/or synthetic fuels using hydrogen and CO2 as reactives.



Production



Mobility

## Description of the entity

PiCoHiMA is a multidisciplinary research group whose research activity seeks to solve the main challenges of sustainable mobility and large-scale power transmission using alternative fuels.

It was formally consolidated in 2017 as a UPM research group, although its senior researchers have been working together since 2006.

To find solutions to the aforementioned challenges, it works on: the study, design and manufacture of DMFC and PEMFC fuel cells and their components; the application of hydrogen technologies such as obtaining hydrogen by electrolysis; the use of alternative fuels, such as hydrogen or methanol; CO<sub>2</sub> capture; and the study and design of alternative polyfuel engines. To this end, it has various equipment and infrastructures, including fuel cell and electrolyser test benches, a polyfuel engine test bench, potentiostat-galvanostat, etc.

The research carried out in these areas enables feasibility studies to be carried out on the application of these technologies, especially in the transport sector.



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## Activities and experiences in R&D&I

The Group's activities fall into four main areas: research and testing of fuel cell and electrolyser components, design and development of stacks, production of H<sub>2</sub> from the electrolysis of seawater and methanol, and techno-economic feasibility studies for the application of fuel cell technology on board and for the transport by sea of large quantities of H<sub>2</sub> and alternative fuels.

PiCoHiMA has experience in the preparation and development of R&D&I projects financed in national and international competitive calls for proposals. It has also collaborated with companies in carrying out studies of interest focused on the applicability of fuel cell technology and the use of alternative fuels (hydrogen, ammonia, methanol) on board.

Regarding training, PiCoHiMA has defended six doctoral theses and is currently working on two more.

**Approximate annual investment in hydrogen and fuel cell R&D&I:**

<1 M€ (depending on calls for research aid programs).

## Entity data

**Type:** : University

**Size:** <10 employees

**Calls of interest for your entity:**

**Europeas:** Horizon Europe, FCH JU, Green Deal

**Nacionales:** CDTI, MITECO, MICINN, IDAE

## Technologies offered

AeroMarine DMFC Designer®

Development and testing of alternative poly-fuel engines.

Comprehensive consultancy for fuel cell systems and hydrogen production by electrolysis in the maritime field.

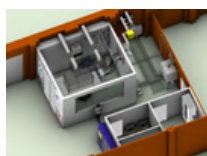
Testing of fuel cells and electrolysers.



### Description of the national initiatives in which the entity participates

**Me2Hi:** "Methanol fuel cell & electrolyser device for on-demand hydrogen production in isolated environments (Me2Hi)". Project funded by MCIN/AEI/10.13039/501100011033 and by "ERDF A way to make Europe". The objective of this project is the development of a portable technology capable of producing high purity hydrogen from e-methanol and air for use in refuelling fuel cell systems. This system is based on the use of a direct methanol fuel cell (DMFC), an aqueous methanol electrolyser (EC-MeOH) and a CO2 capture system (SCCO2).

**GreenH2CM:** "Strategic positioning of the Community of Madrid in R&D&I of green hydrogen and fuel cells". Project financed with Next Generation funds from the European Union through the Recovery and Resilience Mechanism Component 17, Investment 1, of the Spanish Government, Complementary Plans signed with the Autonomous Communities Autonomous Communities for the reform of the Spanish Science, Technology and Innovation System. Within this programme PiCoHiMa is responsible for carrying out the design, construction and operation of a facility for testing power trains integrating fuel cells in the naval and aviation sectors. This facility will allow research into both new fuel cell stacks and research into their hybridisation with secondary power sources.



### Description of the international initiatives in which the entity participates

**POSEIDON:** "POwer StoragE In D Ocean" Topic HORIZON-CL5-2022-D5-01-02 Proposal ID 101096457. The main objective of this project is to demonstrate the applicability of three innovative fast response energy storage systems in maritime transport based on supercapacitors, flywheels and superconducting magnetic energy storage. Within this project PiCoHiMa will analyse potential integrations with other technologies such as hydrogen, rigid sails and reversible hydro-kinetic generators.



Transport

## Technology description

Direct Methanol Fuel Cell (DMFC) stack design software. Aero-Marine DMFC Designer® solves the preliminary optimization of DMFC fuel cell design and sizing, given the nominal power and current of the stack, using a multi-objective function method. The software simultaneously evaluates the mass, volume and fuel consumption of possible designs and derives the optimal feasible fuel cell design based on the importance the designer has given to each of the factors. This tool provides the complete and functional optimal preliminary design as a DMFC solution that meets all the designer's requirements.

Innovative aspects and advantages of the technology: Aero-Marine DMFC Designer® simplifies the DMFC design process for portable and shipborne applications, obtaining optimal preliminary designs to work on in successive stages. This tool aids decision-making during the design and development of systems involving DMFC, such as aircraft, ships, unmanned aerial vehicles, autonomous underwater vehicles, etc.

## Technology information

**Maturity level:** Available for demonstration / On the market.

**Industrial property rights:** Registered Copyright

**Type of collaboration offered:** Trade agreement with technical assistance.

## Applications sectors

- **Transport:** fuel cell
  - Aviation
  - Maritime



Transport

## Technology description

The use of alternative fuels to crude oil derivatives is becoming increasingly important and is forcing technology changes, or adaptations, and market changes. Among the alternative fuels that have attracted most interest in recent years are bio-alcohols, natural gas and H<sub>2</sub>. In order to use them, it is necessary to design the engine with the fuel to be used in mind, or to redesign existing engines to adapt them to these fuels. The process will always involve the design or redesign of the engine from a thermal and mechanical point of view, and the subsequent testing of these engines and their components. Appropriate technology and facilities are available for both the design or redesign of reciprocating engines and their testing.

### **Innovative aspects and advantages of the technology:**

The use of polyfuel engines, which allow both conventional and alternative fuels to be used, will favour the inclusion of alternative fuels. In the case of H<sub>2</sub>, given the scarce distribution and refuelling network, its introduction on the market through its use in mixtures with other fuels such as natural gas or hydrogen could be important. etc.

## Technology information

**Maturity level:** Available for demonstration / On the market.

**Industrial property rights:** Registered Copyright

**Type of collaboration offered:** Trade agreement with technical assistance.

## Applications sectors

- **Transport:**

Automobile  
Heavy Vehicle  
Railway  
Aviation  
Maritime



# Integrated consultancy for fuel cell systems and hydrogen production by electrolysis in the maritime field



Other

## Technology description

PiCoHiMA offers consultancy and technical advisory services for the implementation of fuel cell-based energy production systems and hydrogen production from seawater electrolysis and methanol in the maritime field. These services cover both technical and economic feasibility studies for decision making, which can be complemented by technical consultancy work for the execution of the implementation projects.

### **Innovative aspects and advantages of the technology:**

Thanks to its research character, PiCoHiMA has an up-to-date view of developments in fuel cell and hydrogen-based power generation systems. This is combined with the naval and aeronautical engineering background of its members and the ultimate interest in developing technically and economically viable solutions. The result is studies that provide the recipient with a reliable view of the project it intends to develop and its technical and economic feasibility.

## Technology information

**Maturity level:** On the market.

**Industrial property rights:** N/A

**Type of collaboration offered:** Trade agreement with technical assistance.

## Applications sectors

- **Other:** consultancy services for the implementation of fuel cell technologies and hydrogen production by electrolysis in the maritime field.



Production



Transport

## Technology description

The development and manufacturing of fuel cells and electrolyzers is a complex and constantly evolving field of technology. The need to reduce catalyst loading or increase performance are just two of the objectives to which research centers and companies in the industry devote a large part of their research and development efforts. All these developments need to be tested at different scales, from the laboratory scale of individual components to the prototype scale of final assemblies. These tests require specialized equipment and expertise in order to be able to correctly interpret the results and propose improvements where necessary. PiCoHiMa has the necessary equipment and expertise to carry out these tests.

PiCoHiMa offers a wide range of tests applicable to the development of fuel cells and electrolyzers as well as their main components (electrodes, membranes and bipolar plates):

- Polarization curve tests.
- Electrochemical characterisation tests such as cyclovoltammetry, chronoamperometry or linear sweep voltammetry and impedance frequency response analysis.
- Crossover determination.
- Analysis of the purity of the H<sub>2</sub> produced by gas spectroscopy.

## Technology information

**Maturity level:** On the market.

**Industrial property rights:** N/A

**Type of collaboration offered:** Trade agreement with technical assistance.

## Applications sectors

### -H<sub>2</sub> Production: electrolyzer

- Water electrolysis

### -Transport: fuel cell

- Aviation
- Maritime



Storage, transportation and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

Redexis is an energy infrastructure company committed to energy transition, economic development and focused on growth, investment and value creation in the communities where it operates, through a sustainable and environmentally responsible business model.

The company focuses on the growth of gas infrastructures, the promotion of energy efficiency, including solar self-consumption, and the development of renewable gas projects such as biomethane or renewable hydrogen, both for production and injection into its distribution and transport network, thus contributing to the energy transition, decarbonisation and meeting the objectives of the circular economy.



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## Activities and experiences in R&D&I

Innovation is one of the strategic pillars of Redexis, enabling it to respond to the new challenges and opportunities posed by the energy transition. The strategic lines of innovation are focused on:

- Digitalisation and efficiency so that processes and activities can be improved.
- The integration and hybridisation of consumption technologies with the aim of integrating and adapting customers' installations to decarbonisation technologies.
- The development and integration of renewable gases in current and future activities.

## Entity data

**Type:** : large company

**Size:** >100 employees

**Calls of interest for your entity:**

**Europeas:** Horizon Europe, Clean Hydrogen, Green Deal.

**Nacionales:** CDTI, MITECO, MICINN, IDAE

## Technologies offered



## Description of the national initiatives in which the entity participates

The main national projects in which Redexis is participating include the following:

-MISSIONS OCEANH2 (2020-2024) (Offshore green hydrogen generation, storage and distribution): A modular, flexible and intelligent offshore green hydrogen generation, storage and distribution plant is proposed based on offshore renewable electricity generation, hybridising wind and floating photovoltaic technology. This project is supported by the Ministry of Science and Innovation through the 'Science and Innovation Missions' programme..

**Web:** <https://www.redexis.es/web/guest/sobre-redexis/con-la-innovacion/proyecto-misiones-oceanh2>



## Description of the international initiatives in which the entity participates

Among the main international projects in which Redexis is involved are the following::

-H2020 HIGGS (2020-2023) (Hydrogen In Gas Grids: a systematic validation approach at various admixture levels into high pressure grids): The main objective is to fill knowledge gaps on the impact that different levels of hydrogen could have on gas infrastructure, its components and its management. It includes mapping of technical, legal and regulatory barriers, testing and validation of certain equipment and techno-economic modelling.

**Web:** <https://higgsproject.eu/>



This project has received funding from the Fuel Cells and Hydrogen 2 Joint Undertaking (now Clean Hydrogen Partnership) under Grant Agreement No. 875091 HIGGS. This Joint Undertaking receives support from the European Union's Horizon 2020 Research and Innovation program, Hydrogen Europe and Hydrogen Europe Research.



### Description of the national initiatives in which the entity participates

-MISIONES ZEPPELIN (2021-2024) (Research on Innovative and Efficient Green Hydrogen Production and Storage Technologies based on the Circular Economy): To investigate a flexible set of green hydrogen production and storage technologies based on the use of waste and by-products, seeking to significantly improve the costs and efficiency of the production of this energy vector. This project is supported by the Ministry of Science and Innovation through the 'Science and Innovation Missions' programme.

Web: <https://www.redexis.es/web/guest/sobre-redexis/con-la-innovacion/proyecto-misiones-zeppelin>



Financiado por  
la Unión Europea  
NextGenerationEU



### Description of the international initiatives in which the entity participates

-H2020 Green Hysland (2021-2025) (Deployment of a H2 Ecosystem on the Island of Mallorca): Design and construction of a plant for the production of renewable hydrogen from photovoltaic solar energy, for use in mobility (HRS for the EMT of Palma and rent-a-car vehicles), stationary applications (fuel cell in Lloseta and Port of Palma, cogeneration with fuel cell (CHP FC) in a hotel) and injection into the natural gas transport network.

In this project, Redexis is executing the first hydroproduct in Spain, in Majorca, within the framework of the European Green Hysland project and the installation of the green hydrogen injection system in the position of one of its primary transport pipelines, included in this project. This is the first authorised renewable hydrogen injection facility and will allow hydrogen to be injected into the natural gas network that supplies the entire island of Majorca.

Web: <https://greenhysland.eu/>



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.





### Description of the national initiatives in which the entity participates

-Green Hydrogen Production Plant in Garray: Redexis has been awarded the construction and supply project for a 2.5MW green hydrogen production plant. Along with the project, the plant will be powered directly from the electricity generated by a 5.2MW photovoltaic park and will have a 150m<sup>3</sup> storage system. The production of green hydrogen, which can reach up to 300 tonnes per year, can be used in industrial and mobility applications, as well as being evacuated through a hydro-product.

### Description of the international initiatives in which the entity participates



Production



Industry

### Description of the entity

Repsol company, present throughout the energy value chain, from oil and gas exploration and production, to low-carbon electricity generation, through the production and marketing of energy solutions for the industry, home and mobility. It is currently undergoing a transformation process focused on becoming a net zero emissions company by 2050. To face this challenge, it is necessary to apply a combination of different solutions where research, innovation and technological development play a fundamental role.

One of the key levers in this transformation will be renewable hydrogen. Being the largest producer and consumer of hydrogen in Spain, we have the ambition to increase our renewable hydrogen production capacity to 1.9 GW in 2030.



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### Activities and experiences in R&D&I

Repsol Technology Lab is one of the most cutting-edge private R&D centers in Spain, based on internal talent (233 experts of 17 nationalities) and on an open innovation model, with a network of alliances with technology centers, universities and companies all over the world. With capabilities in multiple fields, such as advanced mobility, bioenergy, low emissions, advanced mathematics, geophysics, process design, among others. We have more than 20 specialized laboratories, test benches and 35 pilot plants.

Repsol has participated in numerous national and international projects.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-5 millions €**

### Entity data

**Type:** Large company

**Size:** >100 employees

**Calls of interest for your entity:**

**European:** HE, FCH JU, Green Deal

**National:** CDTI, MITECO, MICINN, IDAE (PERTE)

### Technologies offered



### Description of the national initiatives in which the entity participates

From the H2 & Synthetics area of the Repsol Technology Lab, Repsol is currently working, among others, on the following projects:

- E-fuels project: synthetic fuel production demo plant project at Petronor (Bilbao).
- EfiSOEC project: project led by Repsol for the development of national SOE technology and the industrial manufacturing necessary for its industrialization and commercialization. Project co-financed by the Misiones CDTI program.
- Zeppelin Project: project co-financed by the Misiones CDTI program, with the aim of investigating a flexible set of green hydrogen production and storage technologies based on the use of waste and by-products.
- CUCO Project: project co-financed by the Misiones CDTI program, whose objective is to investigate the use of quantum computing and its application to strategic industries. As a use case, the production of hydrogen by electrolysis is being explored, among others.

In addition, Repsol leads the SHYNE initiative, the Spanish Hydrogen Network, a multi-sector consortium created to promote the deployment of renewable hydrogen at a national level through public-private collaboration.

### Description of the international initiatives in which the entity participates

In the field of hydrogen, we can highlight:

- Members of Hydrogen Europe, leading the RM17 H2 for Industry.





Industry

## Description of the entity

Sarralle is a private business group founded in 1965 in Azpeitia (Spain), a worldwide leader in industrial engineering in the Environment, Energy and Steel Sectors, along 5 business units: Metallurgy & Casting, Rolling mill, Processing lines, Environment & Energy and Workshop & Storage Systems. Sarralle is an innovative Design, Engineering, Manufacturing and Installation company, with more than 700 dynamic, highly-qualified and multicultural employees located in more than 9 countries worldwide. Sarralle Environment&Energy, is Sarralle's business unit that offers technological solutions for industrial sectors related to the Circular Economy and Energy, including the integration of green hydrogen technologies in the industry.

## Entity data

**Type:** Private company

**Size:** >100 employees

**Calls of interest for your entity:**



<https://www.sarralle.com>



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Azpeitia, Gipuzkoa

## Activities and experiences in R&D&I

Sarralle has decades of experience in helping steelmaking companies overcome the challenges of decarbonization and sustainability, with more than 60 Electrical Arc Furnaces (EAF) built and installed around the world. Through its business unit Environment & Energy, Sarralle has partnered with steel producers, gas suppliers and refractory material manufacturers to develop hydrogen-based technologies for heating equipment aiming net-zero CO2 emissions in the steelmaking industry through the implementation of hydrogen, as an alternative to the consumption of natural gas. Hydrogen technologies allow the complete elimination of CO2 emissions, as only water vapor is emitted through its combustion.

## Technologies offered

Hydrogen combustion technologies (H2/NG dual burners) and hydrogen generation technologies for industrial applications



### Description of the national initiatives in which the entity participates

#### Proyecto H-ACERO

The project H-ACERO, which is funded by the HAZITEK Strategic Program, started in 2021, and has a duration of three years. It is led by SarralleEnvironment&Energy, and has a budget of aprox. 9 M€.

The strategic objective of the project is to contribute to the decarbonization of the steel sector, using hydrogen as an alternative energy source.

The project focuses on the following pillars:

- Equipment: development of technology and new equipment that allow the use of hydrogen in steel processes.
- Consumables: advanced refractories that allow the use of hydrogen in the steel industry, ensuring the useful life of the different equipment.
- Process: development of technological and metallurgical knowledge for application of H<sub>2</sub> on the steel production process.
- Safety: safety requirements and procedures associated with the use of H<sub>2</sub> as an alternative source to conventional energy.

### Description of the international initiatives in which the entity participates

#### Proyecto HyInHeat

The industrial project started in January 2023, and is co-funded by the European Union, within the Horizon Europe program (HyInHeat Project, encompasses 30 partners from 12 European countries).

The use case in which Sarralle will perform all the engineering works, aims to convert the combustion system of an existing industrial walking beam reheating furnace, from natural gas and air combustion to hydrogen oxycombustion. The mentioned use case will be performed in collaboration between ArcelorMittal, Ceit, NipponGases, Sarralle and Tecnalía.



## Description of the national initiatives in which the entity participates

The project is structured in the following development steps:

- CFD Simulations of burners and furnaces
- Furnace Simulators - refractory and metallurgical analysis
- Prototypes (technology at scale)

All the above-mentioned studies are performed for:

- Current equipment and materials with 10-30-50% H<sub>2</sub>/NG mixtures
- New developed equipment and materials with 100% H<sub>2</sub>

## Description of the international initiatives in which the entity participates



Production



Industrial

### Technology description

#### Hydrogen Combustion Technology:

Manufacturing of burners in partnership with NipponGases:

- Manufacturing of 100% H2 burners
- Integration of H2 burners in heating equipment
- Heating equipment modifications to new H2 combustion system
- Burners also operational on NG&H2 (dual functionality in whole range), and other fuels (COG, LPG...)

Applicable to the following heating equipment:

- Reheating Furnace
- Ladle Preheater
- Tundish Preheater
- EAF - Injector
- Oxyfuel Cutting

Hydrogen Generation Technology:

Manufacturing of PEM electrolyzers in partnership with Elogen:

- Manufacturing of electrolyzer skids
- Integration of electrolyzer containers
- Commissioning of electrolyzers in industrial plants
- Supply of greenfield hydrogen production plants

### Technology information

**Maturity level:** Ready for installation in industry

### Applications sectors

- **Industrial:** steel, cement, paper, glass, non-ferrous...industry heating equipment



Production



Mobility

### Description of the entity

As a leading global supplier to the automotive and industrial sectors, the Schaeffler Group has been driving forward groundbreaking inventions and developments in the fields of motion and mobility for over 75 years. With innovative technologies, products, and services for electric mobility, CO<sub>2</sub>-efficient drives, Industry 4.0, digitalization, and renewable energies, the company is a reliable partner for making motion and mobility more efficient, intelligent, and sustain-able.

Hydrogen is a strategic pillar of the Schaeffler group's future strategy, with activities in hydrogen production equipment (electrolysis stacks), fuel cells, and the internal use of green hydrogen.

### Entity data

**Type:** Large company

**Size:** >100 employees

**Calls of interest for your entity:**

Horizon Europe, Innovation Fund, Clean Hydrogen Partnership



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### Activities and experiences in R&D&I

The company is currently focusing on PEM electrolysis stacks, the development and manufacturing of bipolar plates as well as sub-assemblies for PEM fuel cells.

The strategic business field with focus on electrolysis has been established in the beginning of 2021 within the Industrial division of Schaeffler.

Schaeffler is involved in the hydrogen flagship project H2Giga of the German Federal Ministry of Education and Research, as consortium leader of the sub-project "Stack Scale up - Industrialization PEM Electrolysis".

In 2022 Schaeffler founded the joint-venture INNOPLATE together with Symbio and thus shows the strategic importance of Hydrogen.

### Technologies offered

#### Electrolysis

- PEM electrolysis stacks for industrial applications (50 and 100kW)
- Small scale PEM stacks, specifically developed to facilitate research and development activities on membranes, catalyst and electrodes
- development and manufacturing of bipolar plates for PEM electrolysis and fuel cell stacks
- sub-assemblies for PEM fuel cell stacks

#### Fuel Cell

- Bipolar plates for low temperature PEM Fuel Cells
- BoP components for the Fuel Cell System (Hydrogen Ejector, 3-2-way valves, air foil bearings, FC Control Unit, Hydrogen Storage Control Unit,...)



**Description of the national initiatives in which the entity participates**

The Schaeffler Group has been involved in the government funded H2 Giga program since 2021. As the consortium lead with industry and research partners, the company will further develop the future technology of electrolysis stacks, including the corresponding production processes, and promote industrialization through its activity in the Stack Industrialization Electrolysis (StacIE) subproject.

The CEO of the Schaeffler Group's Industrial division is also a member of the German National Hydrogen Council (NWR), which advises the German government on hydrogen issues

**Description of the international initiatives in which the entity participates**

The company is a steering member in the global Hydrogen Council and is involved in additional European initiatives.



### Technology description

The Schaeffler Group’s cross-divisional approach is based on production expertise and further development of fuel cells and electrolyzers. With the industrialized production of these core technologies for green hydrogen, the Schaeffler Group aims to help expand availability and make it more cost-efficient.

#### Fuel Cells

The Schaeffler Group firmly believes that hydrogen will play a key role in the sustainable mobility of the future, which is why the company relies on the fuel cell powertrain and efficient industrialization of the required technology. Collaboration in the “Innplate” joint venture is an important step on this journey.

#### Electrolysis

The Industrial division supplies key components (focus on PEM stacks) for electrolyzers, which are the underlying technology in the production of green hydrogen. The technologies and processes are similar to those associated with fuel cells. Both technologies benefit from the synergies of the jointly developed and used foundation in coating, material, and forming technologies.

### Technology information

**Maturity level:** On the market

**Industrial property rights:** Patented / Applied for Patent

**Type of collaboration offered:**

- Sale of PEM stacks for integration in electrolyzer systems
- Sale of fuel cell components (e.g. BPP, thermal management) for stationary and mobility applications

### Applications sectors

- **H2 Production:**Electrolysis of water
- **Refuelling infrastructures:** In situ hydrogen production
- **Transport:** Fuel Cell components for mobility applications
- **Other: Small PEM stacks for R&D applications**



Storage, transportation and distribution



Production



Mobility



Industry



Other uses

## Description of the entity

*TaiichiO & Wolf Projects is part of the GreenSteel SL corporate group. It is a company specialised in Steel Lean Supply Chain for renewable energy projects. Taiichio & Wolf Projects, together with its Korean partner SeAH Steel, is currently developing technologically leading and productively competitive Steel pipeline solutions for the transport and distribution of hydrogen. Taiichio & Wolf Projects is currently the leader in Spain in the supply of Steel for the offshore wind and solar photovoltaic sectors.*



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## Activities and experiences in R&D&I

Taiichio & Wolf Projects is developing together with its Korean partner SeAH Steel steel pipes for hydrogen transport in pilot applications in South Korea.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 20.000 €**

## Entity data

**Type:** SME

**Size:** 11-20 employees

**Calls of interest for your entity:**

CDTI

## Technologies offered

Hydrogen transport and distribution pipelines.





## Description of the national initiatives in which the entity participates

None at present

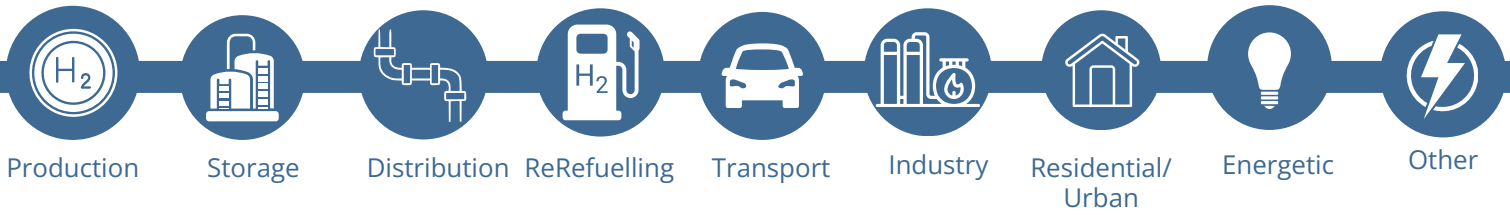
## Description of the international initiatives in which the entity participates

- **POSCO Steeleon Hydrogen Pipeline Project**

SeAH Steel will supply hydrogen pipelines to transfer hydrogen produced by POSCO to POSCO Steeleon Grade X52, 6" (51 MT) & 8" (120 MT)

- **Ansan Hydrogen Pipeline Project**

South Korea has identified 7 hydrogen pilot cities, including Ansan city. SeAH Steel will supply X52 8" (7KM) long hydrogen pipelines to the development of Ansan hydrogen city. Closely collaborating with POSCO's Hydrogen Material Task Force, SeAH Steel was able to receive raw materials at a competitive price.



Production

Storage

Distribution

ReRefuelling

Transport

Industry

Residential/  
Urban

Energetic

Other

## Technology description

Steel pipelines for hydrogen transport and distribution.

## Technology information

**Maturity level:** Available for demonstration

**Industrial property rights:** Protected by industrial secret

**Type of collaboration offered:** Supply

## Applications sectors

- H2 distribution
- Transport



Storage, transportation and distribution



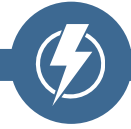
Production



Mobility



Industry



Other uses

### Description of the entity

**TECNALIA is the largest center of applied research and technological development in Spain**, a benchmark in Europe and a member of the Basque Research and Technology Alliance. We collaborate with companies and institutions to improve their competitiveness, people's quality of life and achieve sustainable growth. Our Mission: To transform technological research into prosperity. Our Vision: To be agents of transformation of companies and society for their adaptation to the challenges of a changing future. We are the first private Spanish organisation in contracting, participation, and leadership in the European Commission's Horizon 2020 programme and we are ranked third in European patent applications.



<https://www.tecnalia.com/en/technologies/hydrogen>



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San Sebastián - Spain

### Activities and experiences in R&D&I

TECNALIA has been working since 2002 on the development of various technologies throughout the H2 value chain. Between 2002 and 2010, we worked on the development of technologies such as electrolyzers, fuel cells, etc. Between 2010 and 2020, TECNALIA worked on membranes and membrane reactors for the production/purification of H2 (with TU/e), and ii) compatibility of materials with H2. In 2020, the start-up H2SITE was created for the commercialization of membrane reactor technology for high purity hydrogen production. TECNALIA strategically decided at the beginning of 2021 to reinforce its bet on hydrogen by creating a new "Hydrogen Technologies" department with two objectives: i) coordinate all H2 activities at TECNALIA, ii) development of specific technological solutions for the value chain. TECNALIA is a member of the executive committees of Hydrogen Europe Research and of AeH2.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 6-10 millones €**

### Entity data

**Tipo:** Research Center

**Tamaño:** > 100 employees (1500)

**Convocatorias de interés para su entidad:**

**Europeas:** -Horizon Europe, Clean Hydrogen, etc.

**National:** CDTI, MITECO, MICINN

**Regional:** Hazitek, Elkartek

### Technologies offered

- Electrolyzers
- Membranes and membrane reactors
- Material compatibility in contact with hydrogen
- Hydrogen in Mobility applications
- Industrial use of Hydrogen
- Modelling and simulation of Hydrogen systems



### Description of the national initiatives in which the entity participates

#### Hydrogen production

- H2BASQUE (Elkartek, electrolyzers)
- H2PLAN (Complementary Plans H2)
- H24NEWAGE (Cervera)
- ATMOSPHERE (Misiones)

#### Storage and Distribution of hydrogen

- H2SALT (Hazitek, salt caverns)
- H2SAREA (Hazitek, gas grids)
- EKARRIH2 (Elkartek, Hydrogen carriers)
- ONTZHI (Elkartek, material compatibility with H2)
- HYSHORE (Hazitek)
- H2OCEAN (Hazitek)

#### Infraestructuras de repostaje:

- AVOGADRO (Hazitek)

#### Transporte:

- ERABILH2 / ERABILH2+ (Elkartek)
- PROH2BIO (Elkartek)
- SHINEFLEET (Misiones)

#### Industrial:

- H-ACERO (Hazitek)

### Description of the international initiatives in which the entity participates

#### H2 production

- CLEANHYPRO (Horizon Europe, Electrolyzers)
- SUSTAINCELL (Clean Hydrogen, Electrolyzers)
- MACBETH (Horizon Europe, reforming)

#### Storage and distribution of hydrogen

- HIGGS (Clean Hydrogen, gas grids)
- HYGRID (Clean Hydrogen, gas grids)
- OPTHYCS (Clean Hydrogen, sensors)
- ARENHA (Clean Hydrogen, ammonia)
- AMBHER (Clean Hydrogen, ammonia)



## Production

### Technology description

TECNALIA works on the development of key components of electrolysis technologies. On the one hand, TECNALIA is developing innovative components for more conventional technologies, such as for conventional Alkaline and PEM (Proton Exchange Membrane) electrolysis.

On the other hand, TECNALIA develops key components for AEM electrolysis (Anion Exchange Membrane), such as membranes, electrodes, cells and stacks.

In addition, TECNALIA is working on the development of innovative cells for high-temperature electrolysis (SOEC, solid oxide electrolysis). Apart from the development of the stack components, TECNALIA is working on the development of the BoP (balance of plant) and in particular on the development of power electronics and thermal management.

Finally, it should be noted that TECNALIA has unique test benches for testing stacks and stack components of the different electrolysis technologies mentioned above.

### Technology information

#### Maturity level:

- Between TRL2 and TRL6

#### Type of collaboration offered

- Cooperation agreement for R&D
- Service provision agreement

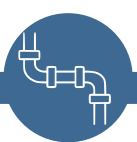
### Applications sectors

#### • H2 Production:

- Water electrolysis



Production



Distribution



Transport



Industrial

## Technology description

TECNALIA is developing membranes and membrane reactors for the production and purification of hydrogen.

On the one hand, membranes for purifying hydrogen from mixtures containing hydrogen (e.g. H<sub>2</sub>-natural gas mixtures, etc.) are developed.

On the other hand, membranes and membrane reactors for the production of hydrogen from different sources (biogas, natural gas, alcohols, ammonia, etc.) are developed.

Finally, TECNALIA is working on the development of the synthesis of Hydrogen carriers such as ammonia and methanol.

## Technology information

### Maturity level:

- Depends on the technology. Between TRL2 and TRL6

### Type of collaboration offered

- Cooperation agreement for R&D
- Service provision agreement

## Applications sectors

### • H<sub>2</sub> production

-Reforming of biogas, alcohols (e.g. methanol), natural gas

-Ammonia cracking

### • Distribution of H<sub>2</sub>

-Hydrogen carriers

### • Transport

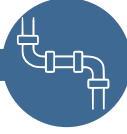
-Hydrogen carriers

### • Industry

-Synthesis of ammonia, methanol, etc.



Storage



Distribution



Refuelling

## Technology description

TECNALIA has large experience on the study of materials in contact with hydrogen. This is relevant for selecting or studying the suitability of materials in contact with H<sub>2</sub> for gas networks (both transport and distribution) and for hydrogen storage tanks, among others.

## Technology information

### Type of collaboration offered

- Cooperation agreement for R&D
- -Service provision agreement

## Applications sectors

### • H<sub>2</sub> production

-Reforming of biogas, alcohols (e.g. methanol), natural gas

-Ammonia cracking

### • Distribution of H<sub>2</sub>

-Hydrogen carriers

### • Transport

-Hydrogen carriers

### • Industry

-Synthesis of ammonia, methanol, etc.



Transport

## Technology description

In the field of mobility, Tecnalía's main capabilities with respect to hydrogen are associated with fuel cell systems, grouped into two main lines: improvement and characterization of stack components and integration and control of fuel cell systems. Regarding the improvement of the stack components, work is being done on coatings to improve the corrosion resistance of the bipolar plates, on minimizing the catalytic content of the MEAs, on improving the design of the stack refrigeration system and on the development of specific power converters for fuel cells. On the integration and control side, at the fuel cell module level TECNALIA has the capabilities to develop control of the plant balance of the stack while, at the power train level, there is the know-how to develop the PMS (Power Management System) and the EMS (Energy Management System). For both cases, a V design process is followed in which the systems are validated through virtual models, MiL tests, SiL tests, HiL tests and, finally, vehicle tests, for which test benches are available. for electric powertrain in which to emulate the entire powertrain.

## Technology information

### Maturity level:

- Devolped but not marked

## Applications sectors

- **Transport (fuel cell ,tractor system and power electronics):**
  - Automobile
  - Heavy vehicle
  - Railway
  - Aviation
  - Maritime





Industrial

## Technology description

TECNALIA works on the development of burner technologies for industrial uses.

- Development, manufacture and testing of hydrogen burners and fuel mixtures based on H<sub>2</sub> or biofuels.

- Study of the flame, determination of the temperature profiles in the oven. Measurement of emissions / gas analysis.

Energy efficiency evaluation.

- Study of the impact on raw materials, equipment and refractories, for their compatibility and optimization with the new energy sources

## Technology information

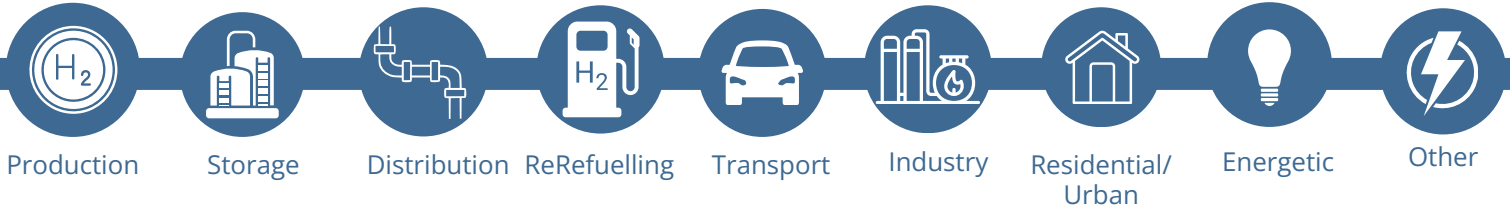
### Type of collaboration offered

- Cooperation agreement for R&D
- Service provision agreement

## Applications sectors

### • Industrial:

-Thermal use



## Technology description

TECNALIA develops advanced process models for the design of hydrogen systems and their corresponding technologies.

These capabilities are used to configure and dimensioning hydrogen equipment and systems (e.g. pilot plants, demonstrators, etc.).

They are also used for optimizing these systems, and to carry out the corresponding cost analysis (CAPEX, OPEX).

Finally, TECNALIA is working on the definition of safety attributes to be able to properly position the components of the hydrogen systems in order to be able to operate safely.

## Technology information

### Type of collaboration offered

- Cooperation agreement for R&D
- Service provision agreement

## Applications sectors

Process modelling can be used for the whole value chain of hydrogen:

- H2 Production
- H2 Storage
- H2 distribution
- Refuelling infrastructure
- Transport
- Industrial
- Residential/urban:
- Energy



Production



Industry

### Description of the entity

Tolsa is a Spanish multinational with more than 65 years of activity.

At Tolsa we extract, process and market innovative mineral solutions to help improve an increasingly better connected world. From day one we have been pioneers in the research and development of mineral applications.

We have our own laboratories and a team of highly qualified professionals, experts in each of the applications developed.

We are continuously developing and launching new products to the market.

Our team of experts works every day to develop applications that can benefit from the properties of our raw materials and to anticipate future needs through new business opportunities.



[www.tolsa.com](http://www.tolsa.com)



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Nuñez de Balboa 51, 1º 28001 Madrid, Spain

### Activities and experiences in R&D&I

- Sorption. We develop projects for the treatment of oils, fuels and water, CO2 capture, etc.
- Rheology. We modify special clays for rheological control in the paint and coatings industry, among others.
- Functionalisation. Design of special additives for specific functionality and complete integration in the material.
- Processing. Optimisation and development of new manufacturing processes for greater processing efficiency and product quality.
- New materials. We research new minerals and their chemical and physical modifications for new applications and improvement of existing ones.

**Approximate annual investment in hydrogen and fuel cell R&D&I:** < 1 million €

### Entity data

**Type:** Large Company

**Size:** >800 employees

**Calls of interest for your organisation**

**European:** Horizon Europe, FCH JU, Green Deal.

**National:** CDTI, MITECO, MICINN.

**International:** Eureka

### Technologies offered

Functionalisation of special clays and other mineral solutions through organic/inorganic modification technologies:

- Proprietary technology for the deposition of oxide/metallic nanoparticles on mineral support.
- Proprietary technology of organic surface modification of mineral materials.
- ADINS® Synergistic flame retardant additives in polymers of different nature and application.
- ADINS® Photocatalysts for decarbonisation in surface technology.



**Description of the national initiatives in which the entity participates**

FORUM OF RENOWNED BRANDS

FEIQUE Spanish Chemical Industry Business Federation (Federación Empresarial de la Industria Química Española)

Aindex (Spanish Association of Extractive and Allied Industries)

COMINROC Spanish Confederation of Industrial Rocks and Minerals

AETOS Spanish Tunnel and Trench Association

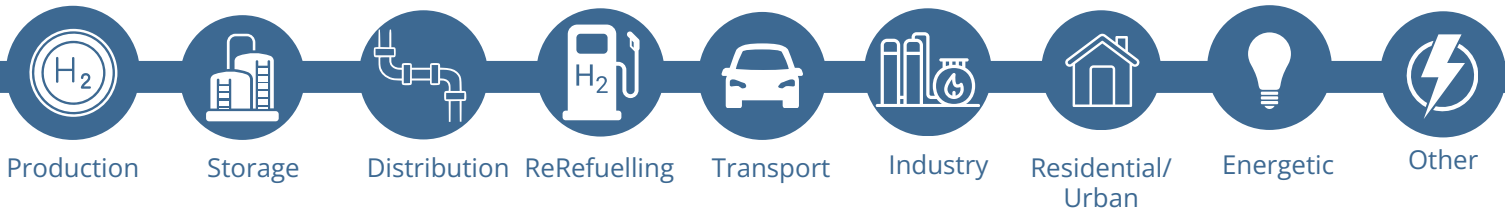
**Description of the international initiatives in which the entity participates**

IMA International Mineralogical Association

SUSCHEM European Technology Platform for Sustainable Chemistry

EUROPEAN BENTONITE ASSOCIATION (EUBA), SECTION of IMA-EUROPE

PINFA Phosphorous Inorganic Nitrogen Flame Retardants Association



## Technology description

Proprietary technology developed to deposit metal oxide and metal nanoparticles using Tolsa's raw materials as a carrier.

The technology allows the size of the deposited particle to be controlled. Depending on the nature of the particle, high concentrations are achieved in the support material.

The carrier acquires relevance in chemical-physical processes that require surface adsorption phenomena or absorption of the material, due to its high specific surface area (external and internal) and chemical nature.

The nanoparticle-carrier interaction allows avoiding or mitigating sintering or agglomeration phenomena of the supported particles in high temperature and pressure processes.

## Technology information

### Maturity level:

Available for demonstration

### Industrial property rights::

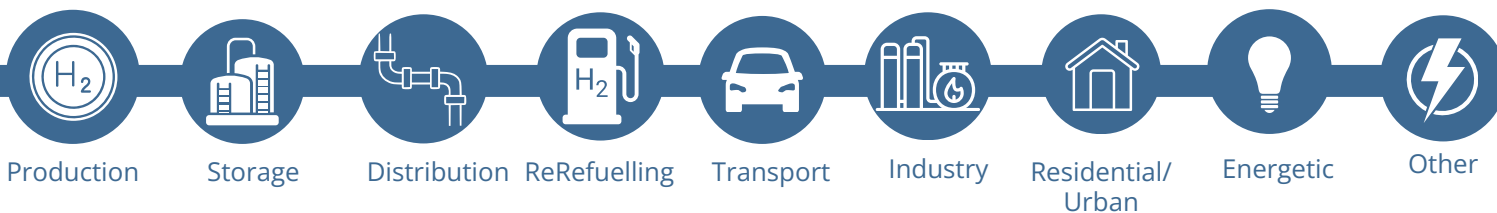
Patented

### Type of collaboration offered:

- R&D cooperation agreement
- Technical cooperation agreement

## Applications sectors

- H2 production
- H2 storage
- H2 distribution
- Refuelling infrastructure
- Transport
- Industrial
- Residential/urban
- Energy
- Other



## Technology description

Proprietary technology developed to modify the surface of the starting materials using organic agents to anchor them to the active centres.

These modifications allow the integration of the material in solvents of a wide range of polarities.

The technology allows control of particle polarity and surface tension. Steric hindrances can be introduced according to the need of the application.

The support material becomes relevant in chemical-physical processes that require surface adsorption phenomena or adsorption of the material, due to its high specific surface area (external and internal) and chemical nature.

Combination of different agents can generate synergistic functionalities for new applications.

## Technology information

### Maturity level:

Available for demonstration

### Industrial property rights::

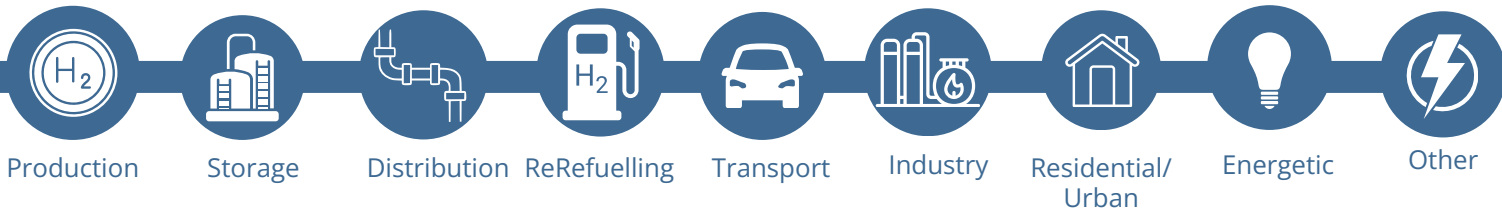
Patented

### Type of collaboration offered:

- R&D cooperation agreement
- Technical cooperation agreement

## Applications sectors

- H2 production
- H2 storage
- H2 distribution
- Refuelling infrastructure
- Transport
- Industrial
- Residential/urban
- Energy
- Other



## Technology description

Plastic components with ADINS® technology have improved fire performance, enabling them to meet the most stringent international health and safety regulations.

ADINS® products act synergistically with most flame retardants contained in polymers and can reduce the consumption of conventional flame retardants such as ATO.

ADINS® products greatly enhance carbon formation during combustion and protect polymers from further fire spread.

ADINS® offers the advantages of a halogen-free inorganic technology that ensures no more toxic fumes and minimal environmental impact.

ADINS® additives are also used in synergy with intumescent additives to improve fire retardant properties in paint and coating formulations. This reduces costs.

ADINS® allows for reduced heat release even at low doses and acts as a smoke suppressant.

## Technology information

### Maturity level:

On the market

### Industrial property rights::

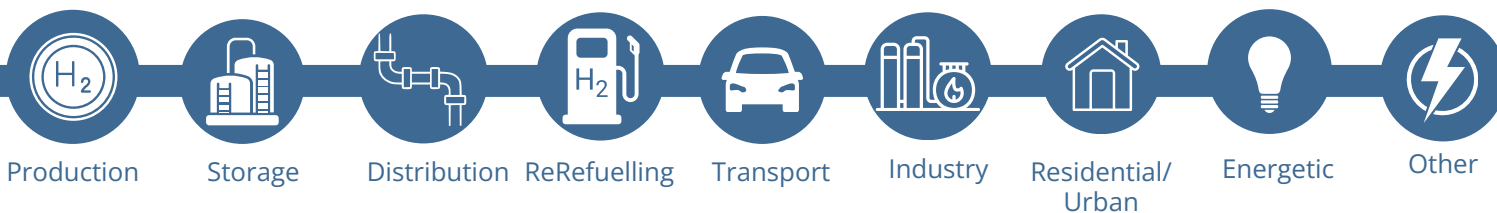
Trademark

### Type of collaboration offered:

- Manufacturing agreement
- Commercial agreement with technical assistance
- Service agreement

## Applications sectors

- H2 production
- H2 storage
- H2 distribution
- Refuelling infrastructure
- Transport
- Industrial
- Residential/urban
- Energy
- Other



## Technology description

ADINS® Clean is a functional additive based on a silicate impregnated with photocatalytic species that gives host systems the ability to remove organic matter from the surface by the action of light.

It incorporates an innovative technology that allows lower doses to be used than photocatalytic products because ADINS®Clean is more active than any other photocatalytic particle, provides an effective solution to avoid the problems of agglomeration and handling of the catalyst particles (TiO<sub>2</sub>) and increases its effectiveness by maintaining the TiO<sub>2</sub> particles on an inorganic substrate, is used to maintain an unaltered aesthetic appearance of surfaces over long periods of time, which reduces maintenance costs and improves the environmental quality of the areas where it is applied.

The photocatalytic additive reduces the concentration of pollutants (NO<sub>x</sub> or VOCs), which are largely generated by the intensity of traffic in large urban centres. ADINS® Clean can be used on cement-based materials, ceramics, enamels and coatings to obtain self-cleaning or decontaminating surfaces.

## Technology information

### Maturity level:

On the market

### Industrial property rights::

Trademark

### Type of collaboration offered:

- Manufacturing agreement
- Commercial agreement with technical assistance
- Service agreement

## Applications sectors

- H2 production
- H2 storage
- H2 distribution
- Refuelling infrastructure
- Transport
- Industrial
- Residential/urban
- Energy
- Other





Storage, transportation  
and distribution

## Description of the entity

Trinity Energy Storage was born in December 2022 through the acquisition of the assets in the Guadalquivir valley area of Petroleum Oil & Gas España S.A. (100% Naturgy group).

The activity of Trinity ES focuses on the management and operation of the underground gas storages of Marismas (included in the national transmission network) and the exploitation of other fields in the area with remaining reserves.

As of 2019, to adapt to the current energy transition, the company's objectives are focused on investigating the feasibility of converting current gas fields, in the process of depletion, into underground storage of renewable gases, mainly green hydrogen and biomethane. Several of these structures have already been tested as perfect natural gas stores pending validation to contain hydrogen. .


## Entity data

**Type:** SME

**Size:** 21-50 employees

**Calls of interest for your entity:**

 <https://trinity-es.com, www.Undergy.eu>

 +34-618-100-338

 [cyuste@trinity-es.com](mailto:cyuste@trinity-es.com)

 C/Quintanadueñas, 6. Madrid 28050

## Activities and experiences in R&D&I

Trinity Energy Storage, through Petroleum Oil & Gas España, is leading the Undergy project.

The project investigates the feasibility of converting the Palancares gas field to an underground hydrogen storage and creation of an integrated network. Among the functions of Trinity is the design, monitoring and management of laboratory analyses, on samples from the deposit, which are being carried out for this purpose. Thus, the possible reactions between fluids and with the storage rock and cover will be studied, as well as the potential methanization in situ through CO<sub>2</sub> injection and bacterial action.

The results will then be integrated into a 4D simulation model of the reservoir.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1 million €**

## Technologies offered

Seasonal storage of hydrogen in the underground



## Description of the national initiatives in which the entity participates

**UNDERGY:** Trinity Energy Storage, through Petroleum Oil & Gas España, leads the Undergy project, partially financed by the CDTI through the Misiones 2021 call for grants, with European Next Generation funds.

The main objective of Undergy is to estimate the hydrogen storage capacity in the subsurface of Spain, test the feasibility of converting the Palancares depleted gas field as an underground hydrogen store, and integrate this information into the construction of an energy management system model.

**UES365:** Trinity Energy Storage, through Petroleum Oil & Gas España, participates in the UES365 project, partially financed by the CDTI through the Misiones 2019 call for grants, with European Next Generation funds.

The main objective of the project is to investigate the technological bases to achieve new competitive systems of stationary storage of underground energy associated with renewable energy sources using compressed air, biogas and green hydrogen for this purpose..

## Description of the international initiatives in which the entity participates



Storage

## Technology description

Study of the feasibility of converting depleted gas reservoirs to underground hydrogen storage.

As a first step, the study is being carried out on a specific depleted reservoir, through laboratory analysis carried out on samples from the same deposit and analogues. The objective is to investigate the behavior and/or effect of hydrogen in several ways:

- interaction with other existing fluids (CH<sub>4</sub> and brine),
- The interaction with the storage and cap rocks and
- The effect of the existing microorganisms, valuing the option of in-situ methanization.

The laboratory results obtained will be transferred to a 4D simulation model to make estimations of potential volumes of hydrogen to be stored and number of cycles.

Based on the conclusions obtained in the study that is currently being undertaken, the objective is to extend the results of this technology to other depleted gas fields in the national territory.

## Technology information

**Maturity level:** Basic investigation

**Industrial property rights:**

**Type of collaboration offered:** Technical collaboration.

## Applications sectors

- **Storage of H<sub>2</sub>:** Storage of compressed gas in the underground (caverns, porous media, or depleted reservoirs)



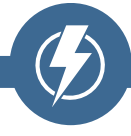
Storage, transportation and distribution



Production



Industry



Other uses

### Description of the entity

**TSK** is a leading business group in the development of engineering and supply of facilities at an international level, providing its own technology. We are one of the Spanish companies with the most references in EPC projects in the following sectors:

Energy

- Renewable electricity generation plants
- Conventional electricity generation plants
- Green hydrogen and e-fuels production plants

Electrical infrastructures

Industry and environment

Materials handling and mining

Oil&Gas

TSK reached sales of around 984 million euros in 2022, with more than 1300 professionals and an international presence in more than 50 countries.

### Entity data

**Type:** Large multinational corporation

**Size:** more than 1000 employees

**Calls of interest for your entity:**



[www.grupotsk.com](http://www.grupotsk.com)



+34 984 49 55 00



[grupotsk@grupotsk.com](mailto:grupotsk@grupotsk.com)



PARQUE CIENTIFICO Y TECNOLOGICO  
C/ Ada Byron 220, 33230 Gijon, Asturias

### Activities and experiences in R&D&I

**PHIVEO Project:** Study, design and optimisation of a green hydrogen plant with off-grid photovoltaic energy.

**HIVE-Red Project:** Stable green hydrogen in microgrids.

**TRINEFLEX Project:** Study of H2 separation in a syngas stream. Study of its use.

**TunOL Project:** Optimisation of a methanol generation plant using the ICPH concept.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 700,000 €.**

### Technologies offered

- Generation of green H2 from renewable sources.
- H2 storage.
- Generation of energy carriers from H2: NH3, urea, e-fuels (methanol, SAF, ...).
- O2 capture for the production of H2 vectors.
- Generation of electrical energy from H2 or blending..



### Description of the national initiatives in which the entity participates

- Spanish Hydrogen Association.
- Spanish Hydrogen and Fuel Cell Technology Platform.
- Spanish Ammonia Association.
- SEALEN.
- BATTERYPLAT.
- Engineering of the HyDeal project property.
- Opportunities in Spain (confidential).

### Description of the international initiatives in which the entity participates

- Collaboration agreements with technologists in the H2 value chain.
- International opportunities (confidential).



Storage, transportation and distribution



Production

## Description of the entity

The Universidad Autónoma de Madrid (UAM) is a public university founded in 1968 and consists of 7 Faculties, 1 Higher Polytechnic School, 4 Affiliated University Schools, and 1 Doctorate School. It currently has more than 30,000 undergraduate and postgraduate students and almost 5,000 professors. It is among the top Spanish universities in the leading international academic and research rankings, the third (UAM, position 215) behind the Universidad Autónoma de Barcelona (UAB, 178) and the University of Barcelona (UB, 184) in the QS World University Rankings 2023, and the first Spanish university (position 65) in the field of Physics and Astronomy in such ranking.

At the UAM, there are more than 200 recognized research groups in the ANEP areas of Science and Medicine, including the MIRE group (Materials of Interest in Renewable Energies).

## Entity data

**Type:**

**Size:**

**Calls of interest for your entity:**

**European:** Horizon Europe, FCH JU, Green Deal

**National:** CDTI, MITECO, MICINN



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



31 94 497 5027/4777



[isabel.j.Ferrer@uam.es](mailto:isabel.j.Ferrer@uam.es) (Grupo MIRE)



Campus de la Universidad Autónoma, Madrid

## Activities and experiences in R&D&I

As a public university, it has extensive experience in basic and applied research as well as in technology transfer to companies and consortia through different formulas. In particular, these aspects are considered in the criteria of the QS World University Rankings 2023, which give it the first place among the Spanish universities in the Physics and Astronomy field in which MIRE Group is found.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: < 1million €**

## Technologies offered

By the MIRE Group:

-Renewable hydrogen production: electrolysis and photoelectrolysis of water. Electrode materials.

-Compression and storage of hydrogen in metal hydrides.

- Optical sensors of hydrogen.



<https://www.uam.es/Ciencias/L%C3%ADneas-de-Investigaci%C3%B3n/1446790542877.htm?language=es>



## Description of the national initiatives in which the entity participates

MIRE Group participates in the following national activities related to its hydrogen research:

-It belongs to the Hydrogen Technology Platform since its creation.

-One of its members is part of the Board of Trustees of the IMDEA Energy Foundation representing the UAM.

-Some of its members participate in the Executive Program in Renewable Hydrogen at the School of Industrial Organization (EOI).

-One of its members participates in the CIEMAT course on "Technologies, operation and applications of electrical energy storage" giving a lecture on hydrogen storage technologies.

-The members of MIRE Group participate in Dissemination Conferences, Science Fairs, Innovation and Transfer Meetings and other knowledge dissemination initiatives organized by the UAM, the Autonomous Community of Madrid and at the state level by the FCyT, Scientific Societies, etc.

## Description of the international initiatives in which the entity participates

MIRE Group participates in the following international activities related to its research on hydrogen:

-One of its members is a member of Task 40: Conversion and accumulation of energy based on hydrogen, of the International Energy Agency (IEA).

One of its members is a member of the Task RE-H2: Production of renewable hydrogen, of the International Energy Agency (IEA).



Production

## Technology description

The Materials of Interest in Renewable Energy Group, since its foundation in the 1980s, focused its Research on the physics of materials for energy conversion and storage. Currently, the MIRE group's Research in hydrogen technologies covers three topics: (i) Materials for the photoelectroassisted generation of hydrogen (photoelectrolysers) from water, (ii) Hydrogen storage and compression based on hydrides and (iii) Hydrogen monitoring by hydrides films.

The research staff of the group coordinates and teaches in the UAM's Master in Energy and Fuels for the Future and is part of the IEA (Task RE-H2: Renewable Hydrogen Production).

Technologies:

1. Research on Materials for the fabrication of electrodes for electrolysers.
2. Research on materials as electrodes in photoelectrolysers.

The Research covers all stages from synthesis by various methods and characterisation of different compounds to prototype fabrication.

## Technology information

**Maturity level:** Basic reserach

**Type of collaboration offered:** Cooperation agreement for R&D

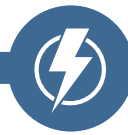
## Applications sectors

- **H2 Production:** Electrolysis and photoelectrolysis of water, (components: electrode materials).





Storage



Others

## Technology description

The Materials of Interest in Renewable Energy Group, since its foundation in the 1980s, focused its Research on the physics of materials for energy conversion and storage. Currently, the MIRE group's Research in hydrogen technologies covers three topics: (i) Materials for the photoelectroassisted generation of hydrogen (photoelectrolysers) from water, (ii) Hydrogen storage and compression based on hydrides and (iii) Hydrogen monitoring by hydrides films.

The group's research staff coordinates and teaches classes in the Master's Degree in Energy and Fuels for the Future of the UAM and is part of the IEA (Task 40: Conversion and accumulation of energy based on hydrogen).

Technologies:

1. Research on materials for hydrogen compression by metal hydrides
2. Research on materials for hydrogen storage in hydrides.
3. Research on hydride films for hydrogen optical sensing.

The research covers all stages from the synthesis by various methods and the characterization of different compounds to the

## Technology information

**Maturity level:** Basic reserach

**Type of collaboration offered:** Cooperation agreement for R&D

## Applications sectors

- **Accumulation and compression of hydrogen**
- **Otros:**Hydrogen optical sensing.





Storage, transportation  
and distribution

## Description of the entity

The Area of Systems Engineering and Automatic Control belongs to the University of Burgos and is part of the "Process Control and Supervision" research group that integrates researchers from the University of Valladolid and the University of Burgos who work on problems related to modeling, optimization and advanced control of processes within what is known as Process and Systems Engineering and Industrial Informatics.

It is a field known internationally as Process Systems Engineering (PSE) and is part of the digital transformation in which the industry is immersed. The objective is to respond to the changes that the process industry is undergoing in a global market with the consequent economic and social repercussions.

## Entity data

**Type:** University

**Size:** <10 employees

**Calls of interest for your entity:**

National: CDTI, MITECO, MICINN.



<http://csp.blogs.uva.es/>



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Escuela Politécnica Superior (campus Vena). Avda. Cantabria, s/n, 09006 (Burgos)

## Activities and experiences in R&D&I

- Industrial Computing.
- Advanced Control and Process Optimization.
- Modeling and Simulation of processes.
- Estimation and Supervision of Processes.
- Teaching of Automatic Control.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** 30000 € *approx.*

## Technologies offered

Development of dynamic models of industrial processes, normally implemented in libraries that facilitate their automatic reuse within a simulation environment. The group has developed numerous libraries for natural gas networks, hydrogen networks in refineries, sugar factories, reverse osmosis desalination, electrical systems, etc.

Optimization of the operation of large-scale processes, improving key performance indexes, liker economic ones, respecting the process and operation constraints, with applications such as optimal management of hydrogen networks and natural gas networks.



## Description of the national initiatives in which the entity participates

At the present we have granted the project "Optimal Management of the Power-to-H2-to-Power Cycle in Real Time (OptiMaPH2P)" which is funded by Spanish Ministry of Science and Innovation in 2021 call for Ecological Transition and Digital Transition Projects.

## Description of the international initiatives in which the entity participates



Production



Mobility



Industry

## Description of the entity

The University of Castilla-La Mancha (UCLM) is the academic institution of reference in the autonomous community of Castilla-La Mancha.

autonomous community that gives it its name and in which it leads the generation and transmission of science, technology, innovation, culture and solidarity. On the other hand, the Department of Chemical Engineering (DIQ) of the UCLM is a University Department of national and international reference in the field of teaching and research related to Chemical Engineering.

Chemical Engineering area.

It publishes around 80 articles on average per year and participates in European, National and Regional R+D+i projects.

National and Regional R&D&I Plan projects.

It also collaborates with numerous national companies through Research and Technological Projects. Finally, the DIQ's mission is to offer quality teaching and to promote R+D+i and knowledge transfer in the fields of chemical and environmental technology.

## Entity data

**Type:** Universidad

**Size:** > 100 employees

**Calls of interest for your entity:**

**European:** Horizon Europe, Clean Hydrogen JU, Green Deal

**National:** CDTI, MITECO, MICINN



<https://diq.uclm.es/>



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## Activities and experiences in R&D&I

The Department of Chemical Engineering of the UCLM is characterised by promoting R&D&I and knowledge transfer in the fields of Chemical and Environmental Technology. The main indicators obtained during the last during the last six-year period (2015-2022) are shown below:

- - More than 2 million euros per year obtained from Official bodies (European Projects, National and Regional Projects) for R+D+i and more than half a million euros per year as a result of research collaborations with companies
- 80 scientific publications on average per year.
- An average of 8 theses per year.

**Approximate annual investment in hydrogen and fuel cell R&D&I:** 1 millón €

## Technologies offered

- Hydrogen production and use
- by means of PEM fuel cells
- Physico-chemical and electrochemical characterisation of membranes, catalysts and/or MEAs.
- Application of EDEN® Technology Study of the life cycle analysis of technologies related to H<sub>2</sub>.

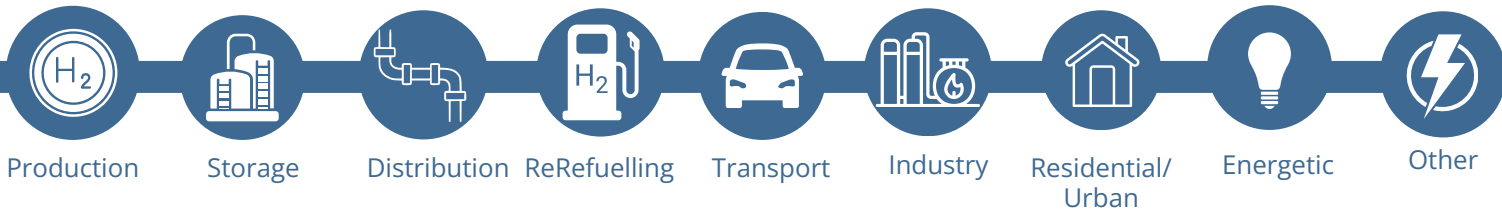


## Description of the national initiatives in which the entity participates

- Regional Project of the JCCM. Sustainable Energy Regulation for the Wine Sector (SER4WINE).
- National Project. Adapting EDEN® technology to reduce the carbon footprint of diesel engines in the transport sector (SetEden2Diesel).

## Description of the international initiatives in which the entity participates

- H2 Pathfinder call project (MacGhyver project). Production of green hydrogen from wastewater from the agri-food industry using microfluidic technology. The electrochemistry laboratory of the TEQUIMA group of the UCLM is responsible for the evaluation of the environmental impact of the developed technology through Life Cycle Analysis, cost analysis and social impact study.



### Technology description

**H2 production:**

- From depolarised electrolysis with SO2. Westinghouse process.
- From chlor-alkali electrolysis. EDEN ® technology.

**Use of H2:**

- In low and high temperature PEM fuel cells.

**Renewable energy storage based on H2:**

- Study of reversible cells. EDEN ® Technology

### Technology information

**Maturity level:** Laboratory validated

**Industrial property rights:**

**Type of collaboration offered:**

- R&D cooperation agreement
- Agreement on the provision of services
- Technical cooperation agreement

### Applications sectors

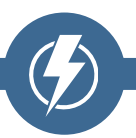
- **H2 production:** Electrolysis of water (chlor-alkali and SO2 depolarised). Components and Unit)
- **Transport:** Automotive, heavy duty vehicle and marine (Component testing and fuel cells)



Production



Industry



Other uses

## Description of the entity

The University of León is a public university located in the city of León (Spain). The ULE is home to 13 faculties and schools, with the technological and biotechnological faculties, such as the Schools of Engineering (Industrial, Energy and Computer Science), standing out. In addition, the ULE has eight research institutes and several Technology Centres with activity in around a thousand projects and 125 working groups dedicated to R+D+i. Its experience in the coordination of international projects is solid and well-established and has been acquired through experience over the years. The IQUMAB Research Group (recognised as a Consolidated Research Unit), is attached to the Institute of Environment, Natural Resources and Biodiversity (IRENA) of the ULE. The researchers of the IQUMAB group focus their research activities on the water-energy binomial, bioprocesses, hydrogen and CO<sub>2</sub> utilisation, design and evaluation of fertilisers. The experience gained from the research work (basic and applied) carried out over the years has allowed the group to increase its contact with private companies.

## Entity data

**Type:** University

**Size:** ~1500 employees



<https://institutos.unileon.es/ingenieria-quimica-ambiental-y-bioprosesos/>



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[rmatg@unileon.es](mailto:rmatg@unileon.es) (Raúl Mateos)



IRENA, Av. Portugal, 41, 24009 León

## Activities and experiences in R&D&I

- Hydrogen production by bioelectrochemical processes
- Hydrogen production by dark fermentation
- Evaluation of green hydrogen production and utilisation processes

## Technologies offered

- Multichannel potentiostats.
- Electrochemical characterisation (including electrochemical impedance spectroscopy (EIS)).
- Scanning electrochemical microscopy (SECM).
- Gas chromatography.
- Flow cells.
- Fermentation



### Description of the national initiatives in which the entity participates

- Public-private partnership projects
- Knowledge Generation Projects
- R&D projects with companies (CDTI)
- CRUSOE Initiative: Working Group "SUSTAINABLE ENERGY".
- CO2 Technology Platforms
- Hydrogen Technology Platform

### Description of the international initiatives in which the entity participates

- H2020 Projects
- Member Biobased Industries (BBI) and Circular Bio-based Europe (CBE)
- Interreg Projects





Production



Industrial



Energetic



Other

## Technology description

The group has laboratory and pilot scale electrochemical and bioelectrochemical systems as well as their associated auxiliary and analytical systems.

On the other hand, fermentation systems are available, also at laboratory and pilot scale, together with their auxiliary and analytical systems, as well as equipment for basic microbiological work.

The aforementioned systems allow the production and consumption of hydrogen within the green hydrogen certification, as well as the simultaneous treatment of waste such as CO<sub>2</sub> or residual organic matter.

## Technology information

**Maturity level:** TRL3 – TRL5

**Type of collaboration offered:**

- I+D
- Project development
- Proofs of concept

## Applications sectors

- H<sub>2</sub> production
- Industrial
- Energetic
- Other uses



Storage, transportation and distribution



Production

## Description of the entity

Catalysis, Reactors, and Control Research Group (CRC), University of Oviedo

Group Leader: Salvador Ordóñez

The Catalysis, Reactors, and Control Group conducts research in the application of chemical processes, particularly catalytic processes, in the field of chemical and environmental technology. As a distinguishing characteristic of our research group, our lines of work have ranged from the molecular level (preparation and characterization of catalysts and adsorbents) to the simulation and control of industrial processes, including the design of chemical reactors and basic operations. The development of sustainable processes, using renewable raw materials (biomass) or unconventional sources (waste, mine ventilation gases, etc.), is another distinguishing feature of the group.

## Entity data

**Type:** University

**Size:** 11-20 researchers

**Calls of interest for your entity:**

Proyectos de investigación básica y aplicada en convocatorias públicas, contratos de investigación con empresas.



<https://crc.grupos.uniovi.es/>



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Facultad de Química, c) Julián Clavería s/n; 33006 Oviedo

## Activities and experiences in R&D&I

The CRC group has experience in:

Purification and physical (MOFs, zeolites) or chemical (LOHCs, formic acid) storage of hydrogen.

Valorization of waste and resulting syngas.

Design, modeling, and simulation of innovative chemical reactors (reverse flow, membrane, trickle bed, catalytic foams, monoliths, etc.).

Development of adsorbents and gas-phase adsorption processes (hydrogen, methane, VOC removal) and aqueous phase (microcontaminant removal).

Production of fuels and chemicals from bioplatfrom molecules

Simulation and control of industrial processes.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: : < 1 millón €**

## Technologies offered

Design of chemical hydrogen storage processes (search for new LOHCs, catalyst design for hydrogenation and dehydrogenation processes).

Hydrogen generation through catalytic reforming processes.

Hydrogen concentration using adsorption processes (PSA, TSA).

Hydrogen purification using adsorption processes



## Description of the national initiatives in which the entity participates

Projects from the National Plan (PID, PDC, CPP) related to chemical hydrogen storage and valorization of biomass and its derivatives.  
Contracts with companies in the same fields

## Description of the international initiatives in which the entity participates

European Research Projects (mainly RFCS).



Storage, transportation and distribution



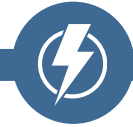
Production



Mobility



Industry



Other uses

## Description of the entity

The Specific Hydrogen Research Centre (CER-H2) brings together the activities of the Universitat Politècnica de Catalunya (UPC) in the field of hydrogen technology. The UPC is a public institution of research and higher education in the fields of engineering, architecture, science and technology, and is one of the leading polytechnic universities in Europe.

CER-H2 aims to cover the research and knowledge transfer needs in the field of hydrogen technologies, with a special effort to align with the Horizon Europe plan and the Next Generation EU recovery plan. It includes technologies for the generation, storage and use of hydrogen in all its fields of application: energy, industry, transport, housing, etc. The Centre is responsible for accompanying the productive system in the development of hydrogen technologies and infrastructures.



<https://cerh2.upc.edu/>



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Vèrtex S1, Plaça d'Eusebi Güell, 6. 08034 Barcelona

## Activities and experiences in R&D&I

PBlue and green hydrogen production; Hydrogen storage and distribution; Uses of hydrogen as a fuel; Integration of hydrogen systems with the rest of the energy system; Monitoring and control systems for hydrogen technologies.

### Projects highlighted:

SINGLE-Electrified single stage NH<sub>3</sub> cracking to compressed hydrogen; H2GLASS-Advancing hydrogen technologies to decarbonise the glass and aluminium sectors; H2ELIOS-Hydrogen lightweight & innovative tank for zero-emission aircraft; HYNTERCAT-Engineering of amorphous/crystalline catalyst interfaces; among others.

**Approximate annual investment in R&D&I in hydrogen and fuel cells: 1- 5 Million €**

## Entity data

**Type:** University

**Size:** >100 investigadores

**Calls of interest for your organisation:**

**European:** Horizon Europe, FCH JU, Green Deal.

**National:** CDTI, MITECO, MICINN

**Regional:** ACCIÓ

## Technologies offered

Procurement and production: Green H<sub>2</sub> production, Electrolysis and Thermolysis, Reforming of biogas, agricultural and industrial waste; Photo and photoelectrocatalysis; NH<sub>3</sub> decomposition; Infrastructures. Storage and distribution: Compressed H<sub>2</sub>, Metal hydrides, Liquefaction at low T°C. H<sub>2</sub> use: Fuel cells, CH&P; Motor fuel, Production of synthetic fuels and products, Grid injection. Integration: DC/DC converters and inverters, Energy grids and microgrids with H<sub>2</sub>; Fuel cell vehicles, Economy and sustainability. Monitoring and control: Modelling, Diagnosis and prognosis, Energy management.



### Description of the national initiatives in which the entity participates

**Projects:**

IDAE  
MICINN  
CDTI  
Doctorados industriales  
ACCIÓ

**Participation in networks:**

Valle de hidrógeno del Ebro  
CEEC  
Xarxa H2CAT  
Vall H2 CAT

### Description of the international initiatives in which the entity participates

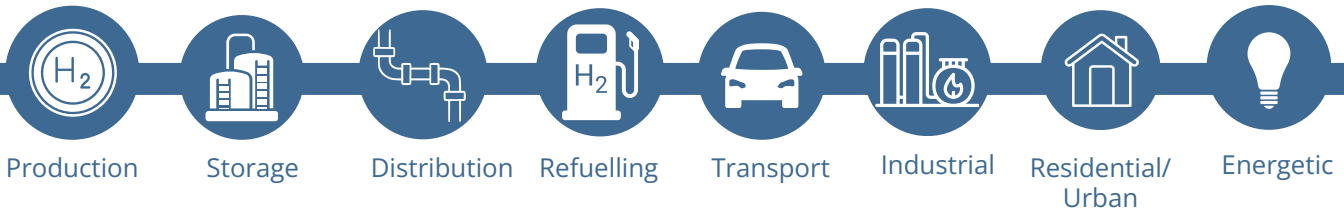
**Projects:**

Horizon Europe y Clean Hydrogen: SINGLE, H2GLASS, H2ELIOS

Doctoral networks

**Networks:**

HER



## Technology description

CAs a polytechnic university, hydrogen technology is approached from different disciplines and with different degrees of maturity.

The collaborations offered are wide-ranging, from R&D projects to challenges and the creation of large consortia.

### Production and production:

Electrolysis and thermolysis, biogas reforming, agricultural and industrial waste.

Photo and photoelectrocatalysis; NH<sub>3</sub> decomposition; Infrastructures.

Storage and distribution:

Compressed H<sub>2</sub>, Metal hydrides, Liquefaction at low T°C, Transport and distribution.

### H<sub>2</sub> use:

Fuel cells; Heat source; Motor fuel; Production of synthetic fuels and products; Grid injection.

Integration: DC/DC converters and inverters, Energy networks and microgrids with H<sub>2</sub> and electricity generation; Fuel cell vehicles, Economy and sustainability.

Monitoring and control: Modelling, Diagnosis and prognosis, Energy management.

## Technology information

**Maturity level:** Basic research, laboratory validated, available for demonstration.

### Industrial property rights:

**Type of collaboration offered:** R&D cooperation agreement. Agreement for the provision of services. Technical cooperation agreement. Others: Business Chairs, challenges, workshops, R&D consortia, Industrial Doctorates, visits, conferences, Networking talent days, negotiation of licensing agreements, and innovation hubs.

## Applications sectors

- **Production:** Water Electrolysis; SMR; Methanol Reforming; Biomass (Components, Ancillaries, Control).
- **Storage:** Compressed H<sub>2</sub>; Liquid Hydrogen; Metal Hydrides; H<sub>2</sub> Carriers
- **Distribution:** H<sub>2</sub> pipelines
- **Hydrogenerators:** On-site hydrogen production; Compression; Storage; Dispensing.
- **Transport:** Automobile, Heavy Duty Vehicle; Rail; Aviation; Maritime (Component testing, fuel cells, tractor system, power electronics)
- **Industrial:** H<sub>2</sub> as feedstock, GHP systems, Heat production in thermal power plants.
- **Residential Urban:** microgeneration
- **Energy:** integration of H<sub>2</sub> into the electricity grid; Injection of H<sub>2</sub> into the gas grid.



Storage, transportation  
and distribution



Production



Industrial



Other uses

## Description of the entity

The SUPREN - SUstainable PROcess ENgineering research group is part of the Department of Chemical Engineering and Environment of the School of Engineering of Bilbao, at the University of the Basque Country UPV/EHU, and is recognised by the Basque Government as a high performance group.

This group specialises in the development of new processes with special emphasis on technologies related to hydrogen and sustainability. This line has been developed since 2008, when they were the organisers of the first Iberian symposium on hydrogen, fuel cells and advanced batteries.

The main research lines and activities are developed in the following lines of work:

- Design of advanced reaction systems.
- Integrated processes in biorefineries.
- Hydrogen technologies.
- Recycling and valorisation of waste.
- Development of hydrometallurgical processes.

## Entity data

**Type:** Public University

**Size:** Ct has 20 centres and 5,723 teachers.

**Calls of interest to your organisation:**



<https://www.ehu.eus/es/web/supren>



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Escuela de Ingeniería - Pl. Ingeniero Torres Quevedo 1,  
Bilbao

## Activities and experiences in R&D&I

SSUPREN In the H<sub>2</sub> production pillar:

- Hydrogen generation from biogas, bio-oils and, bio-alcohols for decentralised production.

SUPREN In the H<sub>2</sub> storage and transport pillar:

- Development of new reaction systems that optimise energy transfer; as well as catalytic systems through the substitution of noble metals in hydrogenation/dehydrogenation technologies using organic carriers.
- Development of new material systems based on perovskites for thermochemical storage.
- Storage and transport of hydrogen in the natural gas grid after methane generation (power to gas technologies).

SUPREN in the uses pillar: Development of technology for the generation of synthetic fuels - methane and/or methanol.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** 1M€

## Technologies offered

Demonstrator of the feasibility of Liquid Organic Hydrogen Carrier (LOHC) technology for the distribution and storage of hydrogen at competitive prices.

H<sub>2</sub> and CO<sub>2</sub> valorisation.



## Description of the national initiatives in which the entity participates

Member of the Spanish Hydrogen Technology Platform - Pte H<sub>2</sub>, the Spanish CO<sub>2</sub> Technology Platform - PTE CO<sub>2</sub> and the Spanish Catalysis Society - Secat.

## Description of the international initiatives in which the entity participates

Member of the Hydrogen Europe Research platform and EERA (programmes: Fuel Cells and Hydrogen, Energy Storage and Bioenergy).





## Technology description

The SuPrEn group works on the development of new processes and technologies related to hydrogen and sustainability.

### Description:

Demonstrating the feasibility of Liquid Organic Hydrogen Carrier (LOHC) technology for hydrogen distribution and storage, as well as reducing the costs of LOHC technology.

Development of new noble metal-free catalytic formulations using non-noble metal based systems; as well as the development of a new catalytic reactor architecture.

-Study of the activity and selectivity of new materials prepared for H<sub>2</sub> storage and generation systems.

-Characterisation, performance and maximum number of charge-discharge cycles.

CO<sub>2</sub> emission-free system.



## Technology information

**Maturity level:** TRL 4

**Industrial property rights:** Proprietary technology

**Type of collaboration offered:**

- Plant for the storage/transport of H<sub>2</sub>, as well as its valorisation.
- Reaction system can operate with fixed bed, CSTR, with membranes or monoliths. On-line product analysis. Hydrogen generation from biogas, bio-oils or bio-alcohols by means of deactivation resistant systems.

## Applications sectors

- **H<sub>2</sub> production:** methane and biogas reforming, from biomass, bio-oils or bio-alcohols.
- **H<sub>2</sub> storage:** carrier-carrier and hydride systems, among others.
- **H<sub>2</sub> distribution:** pipeline.
- **Industrial:** Green H<sub>2</sub> as feedstock-PtX: methane, methanol and ammonia.
- **Energetic:** High temperature energy storage.



Storage, transportation  
and distribution



Production

### Description of the entity

Chemical and Environmental Engineering Group (GIQA)  
Rey Juan Carlos University (URJC)  
Coordinator: Juan Ángel Botas

The Chemical and Environmental Engineering Group (GIQA) of the Rey Juan Carlos University has extensive experience (since 1998) in the fields of: i) Biomass and Bioenergy, ii) Advanced Porous Materials for Catalysis and Adsorption, iii) Valorisation and Characterisation of Waste Materials in the Framework of the Circular Economy, iv) Sustainable Processes for the Treatment of Effluents, v) Sustainable Energy Technologies, and vi) Sustainability Analysis of Processes and Products, including Hydrogen in different lines.

The GIQA has, at the Móstoles Campus of the URJC, the necessary facilities and research equipment for the development of the research projects.

### Entity data

**Type:** Rey Juan Carlos University Research Group.

**Size:** > 100 employees (high performance research group)

**Calls of interest for your organisation:**

European (Horizon Europe, FCH, JU, Green Deal), National (CDTI, MITECO, MICINN)



[www.giqa.es](http://www.giqa.es) / [www.urjc.es](http://www.urjc.es)



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### Activities and experiences in R&D&I

- Hydrogen Production
  - reforming and valorisation of biomass-derived streams
  - decomposition of water by thermochemical cycles
  - Catalytic methane decomposition
- Hydrogen purification
  - Development of highly hydrogen-selective composite membranes for use in separators or membrane reactors.
- Hydrogen storage
  - Development of new porous systems for the storage and transport of hydrogen.
  - Membrane reactors

**Approximate annual investment in hydrogen and fuel cell R&D and innovation:** < 1 million €

### Technologies offered

The technologies offered by the GIQA are:

Production of green hydrogen by reforming biomass-derived streams.

-High purity hydrogen production in membrane reactors.

Production of green hydrogen by decomposition of water by thermo-chemical cycles

-Storage and distribution of hydrogen in porous solids



## Description of national initiatives in which the organisation is involved

1. Production of green hydrogen from biomass waste fractions by auto-thermal reforming in planar geometry membrane reactors. Period: 01/09/2021 to 31/08/2024. Funding entity: State Research Agency. Referencia: PID2020-117273RB-I00.
2. Production of renewable H<sub>2</sub> by dissociation of H<sub>2</sub>O by means of low-temperature solar thermochemical cycles. Period: 01/12/2022 to 30/11/2024. Funding entity: State Research Agency. Referencia: TED2021-132540B-I00.
3. Production of renewable hydrogen by oxidative reforming of aqueous bio-oil fractions using mesostructured and shaped catalysts. Period: 01/12/2022 to 30/11/2024. Funding entity: Agencia Estatal de Investigación. Referencia: TED2021-131499B-I00.
4. Development of multifunctional MOF materials for decarbonisation and energy use. Period: 01/01/2023 to 31/12/2023. Funding entity: Universidad Rey Juan Carlos. Reference: MATER-M3000.
5. Development of non-stoichiometric metal oxides and their macroscopic shaping for the thermochemical production of CO<sub>2</sub>-free hydrogen. Period: 15/06/2022 to 14/06/2024. Funding entity: Comunidad de Madrid. Reference: ONEHYDRO.
6. Design of selective metal-organic materials for CO<sub>2</sub> valorisation and hydrogen storage. Period: 01/01/2019 to 31/12/2022. Funding entity: Ministry of Science and Innovation. Referencia: PGC2018-099296-B-I00.
7. High-strength palladium membranes for process intensification. Period: 01/01/2020 to 30/06/2022. Funding entity: Community of Madrid. Reference: MEMBRESPIP.
8. ACES2030: Concentrated solar thermal energy in the transport sector and in the production of heat and electricity. Period: 01/01/2019 to 30/04/2023. Funding entity: Comunidad de Madrid. Reference: S2018/EMT-4319.



Production

## Technology description

The Chemical and Environmental Engineering Group (GIQA) has more than 20 years of experience in the development and implementation of catalysts for the production of green hydrogen by reforming and valorisation of various biomass-derived streams (bioethanol, bioglycerol, aqueous fraction of bio-oil...).

Reforming of biomass-derived streams:

-Steam, oxidative or autothermal reforming.

-Laboratory tests on automated equipment.

-Adaptation to various feedstocks.

-Approximation to industrial operating conditions.

-Stability tests.

Development of reforming catalysts:  
Preparation of high activity and stability catalysts based on metals (Ni Co, noble metals) supported on high porosity materials.

-From formulation to shaping (agglomeration, extrusion, etc.).

-Development of high porosity supports.

-Characterisation of catalysts.

Analysis of reforming processes:

-Process engineering from raw material input to hydrogen of the required purity.

Techno-economic analysis.

-Sustainability analysis.

## Technology information

**Level of maturity:** Basic/applied research. Laboratory validated.

**Industrial property rights:** -

**Type of collaboration offered:** R&D cooperation agreement. Technical cooperation agreement.

## Applications sectors

- **H2 production:** Steam, oxidative or autothermal reforming processes.



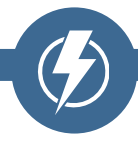
Production



Industrial



Energetic



Others

## Technology description

The Chemical and Environmental Engineering Group (GIQA) of the Universidad Rey Juan Carlos has extensive experience (since 2005) in the development of palladium-based composite membrane modules, highly selective to hydrogen, to be used both as stand-alone purification equipment or in membrane reactors (MR). These, fabricated on porous stainless steel supports with tubular and/or flat geometry, incorporate a thin layer of palladium with a thickness of 10-15 mm incorporated by means of a technique developed by our research group: Electroless Pore-Plating

The combination of these membrane modules with appropriate catalytic systems in a membrane reactor allows an improvement of the hydrogen yield and/or operating conditions due to the equilibrium shift towards the products by the separation of hydrogen from the reaction medium. This allows an intensification of the classical production scheme based on separate reaction and separation units, with consequent economic and maintenance savings.

In summary, we have extensive experience in the use of membrane modules for the selective separation of H<sub>2</sub> from multi-component gas streams as well as by MRI.

## Technology information

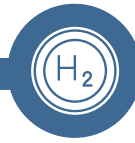
**Level of maturity:** TRL3-5 Validado en laboratorio

**Industrial property rights:** -

**Type of collaboration offered:** Technical consultancy, experimental development (laboratory and/or pilot plant) and partner in national and international projects.

## Applications sectors

- **H<sub>2</sub> production:** reforming of light hydrocarbons (biogas, alcohols, waste fractions...), gasification processes, water gas shift reaction (WGS), dehydrogenation processes of hydrogen-bearing molecules (e.g. methylcyclohexane) and catalytic cracking of ammonia.
- **Industrial:** hydrogen production from waste fractions, generation of renewable hydrogen as feedstock for industrial processes. Intensification of industrial processes by means of membrane reactors.
- **Energy:** use of membranes for separation of hydrogen injected into the gas grid.
- **Others:** obtaining high purity hydrogen for multiple sectors (steel, electronics, etc.).



Production

## Technology description

Development of materials and porous structures for application in solar hydrogen production systems using thermochemical water decomposition cycles. This technology is based on two-stage processes at high temperature, involving the thermal reduction of a metal oxide and its subsequent reoxidation with water, generating H<sub>2</sub> free of CO<sub>2</sub> emissions.

Design of materials with redox capacities for hydrogen production at lower temperatures compatible with the use of waste heat in various industrial processes (exhaust gases from thermal power plants, Generation IV nuclear reactors, among others).

Design of materials and systems for the generation of H<sub>2</sub> and CO (synthesis gas), by means of thermochemical decomposition cycles of H<sub>2</sub>O and CO<sub>2</sub>.

The group has high-temperature reactors of up to 1400 °C at laboratory scale, H<sub>2</sub> and CO analysis systems in gas streams (between 40 and 100 NL/h) and equipment for the synthesis of materials in wet and dry phase and their complete characterisation.

## Technology information

**Level of maturity:** Basic research, laboratory validated

**Industrial property rights:** Patent granted for some materials

**Type of collaboration offered:** Technical consultancy, experimental development and partner in regional, national and international projects.

## Applications sectors

- **H<sub>2</sub> production:**

-Hydrogen production in solar thermal power plants ( $T > 900^{\circ}\text{C}$ ).

-Hydrogen production through the use of waste heat from processes ( $T < 900^{\circ}\text{C}$ ).

-Production of synthesis gas (H<sub>2</sub> and CO) by thermochemical cycles of decomposition of H<sub>2</sub>O and CO<sub>2</sub>, simultaneously or sequentially.



Storage



Distribution



Refuelling



Transport

## Technology description

Storage and distribution of H<sub>2</sub> in porous MOF-type solids.

Development of new porous systems based on metal-organic materials (MOF) for hydrogen storage and transport.

These selective hydrogen adsorbents, with suitable H<sub>2</sub>-MOF interaction forces, allow to increase both the storage capacity at temperatures close to the storage capacity at both near-ambient and cryogenic temperatures, allowing lower operating pressures (700-900 bar) to be applied in compressed hydrogen storage systems in mobile applications.

Among the porous materials for physically adsorbing H<sub>2</sub> at moderate temperatures, there is no competition with MOFs, being far ahead of carbons and siliceous materials.

## Technology information

**Maturity level:** TRL 2-4 Basic research

**Industrial property rights:**

**Type of collaboration offered:**

- R&D cooperation agreement
- Agreement for the provision of services, consultancy
- Technical cooperation agreement

## Applications sectors

- **H<sub>2</sub> storage and distribution:** porous materials for pressurised storage tanks.
- **Transport:** H<sub>2</sub> storage tank systems for mobile applications (land, sea, air and space), using temperatures above liquefied H<sub>2</sub> and pressures < 100 bar.



Storage, transportation  
and distribution



Production



Mobility



Industry

## Description of the entity

Rovira i Virgili University (URV) is the public university of southern Catalonia (Tarragona). It develops undergraduate, postgraduate and doctoral training (1,350 theses, 45% international students), research and knowledge transfer and innovation in most fields of knowledge, especially in chemistry, chemical engineering and energy, food technology and nutrition, tourism, archaeology, computer science. Located in a major industrial context with the largest petrochemical complex in southern Europe and in a region that is a leader in energy production (nuclear, wind, hydro, combined cycle), the URV develops an intense activity in hydrogen and industrial decarbonisation in local, national and international alliances through an interdisciplinary approach that includes experimental sciences, engineering and social sciences. The URV catalysed the creation of the Catalan Hydrogen Valley, which it has been coordinating, made up of 250 entities and which currently has a total of 70 hydrogen deployment projects (industry and mobility), R&D&I and training and socialisation worth €2.3 billion.

## Entity data

**Type:** University

**Size:**

**Calls of interest for your entity:**



<https://www.urv.cat/es/>



629 872 618



[jordi.cartanya@urv.cat](mailto:jordi.cartanya@urv.cat)



C/ de l'Escorxador, s/n, 43003, Tarragona

## Activities and experiences in R&D&I

The URV has 90 research groups in most fields of knowledge with a high capacity for scientific, economic and social impact. 14 of these groups work on topics related to hydrogen including social sciences: economics, law, communication. The URV carries out a wide range of knowledge transfer activities at regional, national and international level. It has recently created the first hydrogen spin-off dedicated to high selectivity sensors. The URV has a network of associated/associated research and technology centres that, together with its internal capacities, allow it to attract talent and access competitive resources. Together with the Catalan Institute for Chemical Research and the Chemical Technologies Unit of the Technology Centre of Catalonia (Eurecat), both in Tarragona, the URV has created a leading technology partnership in hydrogen.

**Approximate annual investment in hydrogen and fuel cell R&D&I: 1-2 M€**

## Technologies offered

**H2 Production Electrolysis:** Catalysts, HT Electrolyser, Photo-reforming of wastewater; Waste/Organic Matter to Hydrogen: Gasification, reforming and photo-reforming of biomass and organic waste; Catalytic, electrocatalytic CO2 reduction

**H2 Distribution and Storage:** Safe storage of H2 at high pressure: Renewable hybrid storage systems; New materials for safe storage of H2 at high pressure; H2 liquefiers; H2 detection and monitoring sensors; Low-cost distribution of green hydrogen: Catalytic cracking of ammonia for transport; Catalytic dehydrogenation of liquid organic hydrogen carriers for transport.

**Development of H2 uses, mobility applications:** Improvements in fuel cell technologies; Economic and market studies.

**Clean energy applications:** Decarbonisation of industry through the use of green H2 and reduction of CO2 emissions;

**Cross-cutting Activities Public understanding of H2;** Legal regime of H2; Socio-economic impact and sustainability assessment.





### Description of the national initiatives in which the entity participates

#### H2 production

- Hydrogen production from biomass
- Biorefinery for high added-value chemicals and hydrogen.
- Catalytic de-polymerisation of plastics for conversion to fuels and hydrogen.
- Nanostructured catalysts synthesis for hydrogen.
- Laser assisted synthesis of single atom photo/electrocatalysts for hydrogen generation.
- Zero-emissions production of H2 and electricity via reversible CH3OH electrolysis for maritime transport.
- Computational catalysis for green chemistry  
Water oxidation catalysis for H2 production

#### H2 integration

- Regulation of community-based energy systems based on storage and flexibility: acceptability, governance
- Integration of hydrogen technologies in distributed energy systems

#### Storage, transportation and distribution H2

- H2 sorption in activated carbon enhanced by ionic liquids
- Green Hydrogen Storage using LOHC

#### H2 detection

- Distributed and autonomous wireless nanosensor networks for gas detection..
- Ultra-sensitive and selective hydrogen detection systems using nanomaterials.

### Description of the international initiatives in which the entity participates

The URV has a broad international dimension with 40% of its 1,882 scientific publications (2022) produced in cooperation with foreign institutions, more than 800 students participating annually in mobility programmes and 35% of master's and doctoral students being international.

#### Aurora Consortium

Formed by the URV and a group of universities that are relevant in research, deeply committed to the social impact of their actions and involved in the communities of their territory. In 2020, Aurora received an important boost when it was recognised as one of the 41 European university alliances (European Universities Initiative) funded to promote European university campuses. This recognition has been revalidated in 2023. Cooperation on H2 issues in the framework of Aurora has started with a joint meeting of the participating universities, which will be followed by the development of other activities and projects.

#### European Network on H2 legislation

The URV coordinates the THERESA Project "Training for a Renewable Energy Society based on the Hydrogen Economy in the Anthropocene". This project is funded by HORIZON EUROPE (1.6 million euros) and is the first European doctoral programme for legal specialists in the field of hydrogen.



## Description of the national initiatives in which the entity participates

**Red X2 CAT:** Network for the valorisation of H2 technologies with the participation of URV (9 research groups), the Polytechnic University of Catalonia, the Technology Centre of Catalonia-Eurecat, the Catalonia Energy Research Institute and the Catalonia Institute for Chemical Research.

### H2 Formation

• **Máster** inter-university degree in Hydrogen Technologies. 2 editions. URV with the universities of Mondragon, Public University of the Basque Country, University of Zaragoza, Polytechnic University of Catalonia.

• **Industrial Doctorates H2:** Hydrogen governance and regulation for a sustainable energy transition; Developing valve & fittings fully tested and compatible with hydrogen according regulations and standards at high pressure.

### H2 Dissemination

Workshop on hydrogen production and uses for the general public (more than 3,000 people); talks in schools: what colour is hydrogen; Talento Joven-H2: final year projects on hydrogen.

## Description of the international initiatives in which the entity participates

### Hydrogen Research Europe

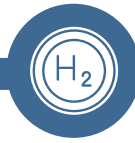
The URV is a member of Hydrogen Europe Research, an international non-profit organisation made up of more than 140 universities and Research & Technology Organisations (RTOs) from 29 countries.

### Cooperation in R&D&I projects in H2

- Integration of hydrogen technologies in distributed energy system: Universidad de Yokohama
- Hydrogen public understanding and social awareness: Buffalo University.
- Production of synthesis gas with high hydrogen content by pyrolysis - gasification of biomass and plastic waste: Escuela Superior Técnica de Chimborazo.
- Zero-emissions production of H2 and electricity via reversible CH3OH electrolysis for maritime and land transport (Hyelmeth-Zero). Múltiples partners nacionales e internacionales: Univ. Bremen, Univ. Bologna, etc.

### H2 transfer projects with international companies

- Hydrogen supply chain modelization in UK - BP
- Wastewater-to-hydrogen under natural sunlight. Múltiples partner nacionales e internacionales: Coca-Cola, Kellogg's, etc.
- Modelization for water oxidation catalysis for H2 production: Total Energies



Production

## Technology description

### Liquid-crystal polymers for proton exchange

Polymers based on polyethers, polyoxazolidines, and other heteroatomic precursors, as an alternative to perfluorinated sulfonic acid polyethylenes (such as Nafion), with liquid-crystal characteristics.

These polymers allow for the transport of protons through an innovative and more selective mechanism. Unlike Nafion-type membranes, these polymers do not require critical moisture content to facilitate protonic conductivity and enable more selective proton transport, reducing issues such as crossover

## Technology information

**Maturity Level:** Basic Research (TRL 3)

**Industrial property rights:** Not protected, open access to scientific articles.

**Type of collaboration offered:** Research and development of new membrane materials.

## Applications sectors

- **H<sub>2</sub> production:** Water electrolysis. Compounds



Production



Other

## Technology description

**Visible light active photocatalysts for wastewater photoreforming and H<sub>2</sub> production**

Design, preparation, and characterization of visible light active photocatalytic materials for hydrogen production from wastewater.

Through experiments using simulated solar light or exclusively the visible part of the spectrum, the expected efficiency of new materials based on innovative formulations is evaluated for hydrogen production and simultaneous wastewater treatment.



## Technology information

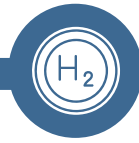
**Maturity level:** Basic research (TRL 2).

**Industrial property rights:** Not protected, pending on future results.

**Type of collaboration offered:** : Research and development of photocatalytic materials.

## Applications sectors

- **H<sub>2</sub> production:** Water electrolysis. Compounds
- **Others:** Wastewater valorisation.



Production



Other

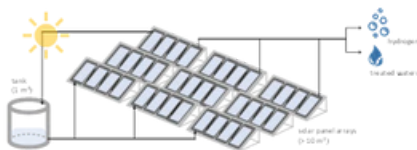
## Technology description

### Solar reactors for green hydrogen production from wastewater

HACDOS project.

Design, construction, and validation of solar photocatalytic reactor panels for green hydrogen production from wastewater.

This technology will enable the treatment of wastewater from various sources including domestic, industrial, and agriculture. Currently, the suitability of the technology for each type of water is being evaluated.



## Technology information

**Maturity level:** Developed, but not commercialized (TRL 5)-

**Industrial property rights:** Patent application filed. Trademark HACDOS registered.

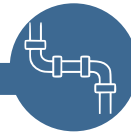
**Type of collaboration offered:** : Viability and applicability studies.

## Applications sectors

- **H2 production:** Waterelectrolysis. Unit (photocatalytic solar reactor).
- **Other:** Wastewater valorisation.



Storage



Distribution

## Technology description

### Wireless sensors for selective detection of H<sub>2</sub>

Nanostructured solid-state sensors that enable selective detection of gases, including hydrogen (H<sub>2</sub>), methane (CH<sub>4</sub>), ammonia (NH<sub>3</sub>), and hydrogen sulfide (H<sub>2</sub>S).

This sensors are installed in interconnected nodes, forming a wireless autonomous network using IoT technology.

Features:

- Autonomous operation to minimize maintenance needs and operator interaction.
- Wireless (IoT technology) to reduce the use of cables and facilitate installation.
- On-grid/Off-grid capability. Battery usage is being studied to enable independent operation regardless of the power grid.
- Competitive: These systems have low ownership costs and low energy consumption.

Highly sensitive, capable of detecting H<sub>2</sub> at ppm concentrations in the environment

## Technology information

**Maturity level:** Validated in laboratory(TRL 4).

**Industrial property rights:** Registered trademark (NanoChronia S.L.)

### Type of collaboration offered: :

- Conducting pilot tests.
- Adapting our prototypes to the specifications of different applications.
- Technology licensing agreements.
- Exploring investment opportunities

## Applications sectors

- **H<sub>2</sub> storage:** Compressed gas in storage tanks.
- **H<sub>2</sub> distribution:** Underground gas pipelines.



Production



Mobility



Industry

## Description of the entity

VODIK, born from the convergence between REGENERA LEVANTE and IDEA INGENIERÍA in May 2021, was created to provide a solution to the energy needs of its customers in a sustainable way by betting on hydrogen technology. VODIK's mission is to promote and implement the use of green hydrogen, from generation to demand, in new and existing business models, with a special focus on industry. VODIK is an expert in the integrated management of energy, renewable and green hydrogen projects, from the engineering phase to construction. VODIK improves the efficiency and sustainability of companies through the implementation of green hydrogen energy solutions, such as:

- . Energy feasibility studies.
- . Consulting
- . Energy solution development (EPC)
- . Execution of all administrative, technical and environmental procedures up to the Ready to Build stage.

## Entity data

**Type:** SME

**Size:** < 10 employees

**Calls of interest for your organisation::**

European and national (Horizon Europe, Green Deal. CDTI, MITECO, MICINN)



<https://www.vodik.es/>



635788749



vfernandez@vodik.es



Calle de Caleruega, 81, Madrid. (CP:28033)

## Activities and experiences in R&D&I

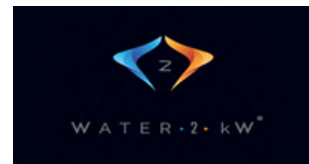
VODIK is currently immersed in the execution of two innovation projects of the CDTI's 'Science and Innovation Missions' programme.

1st SOFC4GREENGRID: it is developing a new SOFC fuel cell system (200 kW). To this end, it is developing cells based on totally innovative materials to improve their electrochemical performance as well as optimising the system's balance of plant (BoP).

2nd GREENHYCELL: development of new PEM-type electrolysers of up to 50 kW. For this, VODIK is designing electrodes with low noble metal content as well as gas diffusion layers (GDLs) of carbonaceous nature for the cathode, as well as bipolar plates (BP) of stainless steels with coatings based on non-noble (or critical) metals.

## Technologies offered

- H2 production
- H2 storage
- Mobility
- Industry
- Other uses



Production



Industry



Other uses

## Description of the entity

Water2kW, S.L. was created in 2020 in order to transfer the entrepreneurial experience in the field of environmental sustainability of its promoter, Juan Suárez Izquierdo, with more than twenty years of experience in renewable energy projects and 100% chemical-free water treatment and production. With an average of 25 years of experience in the energy sector, the team that makes up Water2kW is prepared to face the challenge of bringing a solution like H2umidity® to the market.



[water2kw.com](http://water2kw.com)



911 126 707



[ceo@water2kw.com](mailto:ceo@water2kw.com)



Avenida de Brasil, 6. 28020-Madrid

## Activities and experiences in R&D&I

The activity of Water2kW since its creation has been focused on the development of disruptive technologies for the production of green hydrogen through electrolysis of water:

- Design and development of components and equipment
- Integrated process design and engineering from water collection system to H2 production or green electricity
- Process optimization and automation to maximize efficiency/cost balance
- Establishment of a network of first level contacts of suppliers, partners and collaborators.

**Approximate annual investment in R&D&I in hydrogen and fuel cells:** < 1 MM €

## Entity data

**Type:** SME

**Size:** <10 employees

**Calls of interest for your entity:**

Horizonte Europa

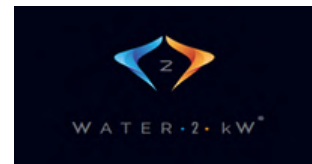
CDTI, MITECO, MICINN

## Technologies offered

Low-cost, scalable, disruptive and 100% sustainable technological solution for the green H2 sector: H2umidity®. H2umidity® allows the production of H2 from air humidity, which gives it a competitive advantage for the production and storage of energy in isolated environments, which require movement or with limitations of connection or supply to the electricity grid.

Possibility of valorization of by-products resulting from the process (heat, oxygen and water). International patent application PCT/ES2021/070087 (Feb2021).





## Description of the national initiatives in which the entity participates

• **Investigo Program:** Recruitment of personnel destined to R+D+i actions in the field of improvement, scalability and efficiency of the technologies patented and commercialized by Water2kW. Project duration, 2 years

• **Programa Stars Canarias:** Proyecto H2UMIDITY® - AEMWE (Desarrollo de un sistema de producción de hidrógeno verde a través de la humedad del aire utilizando membranas de intercambio aniónico para la electrolisis del agua). Concedida. Duración del proyecto 18 meses.

• Opportunities for the development and application of PulviMetalurgia in ion exchange electrolyzers with improved performance for the production of green H<sub>2</sub> (PMEMEL-H<sub>2</sub>) presented to the Call for Public-Private Funding 2022 in collaboration with UC3M and URJC Madrid.

• H<sub>2</sub>umidity®-PEMWE: • Proposal submitted to Neotec 2023 call.

• Application of numerical simulation technologies to electrolysis processes for the production of green H<sub>2</sub>, in collaboration with the Polytechnic University of Madrid within the framework of the PET-MSO-ED. Proposal available.

## Description of the international initiatives in which the entity participates

• Start-up selected for S3ECharge for Growth Start-ups Program. Tailor-made mentoring and networking program of 14 weeks.

• Project validation

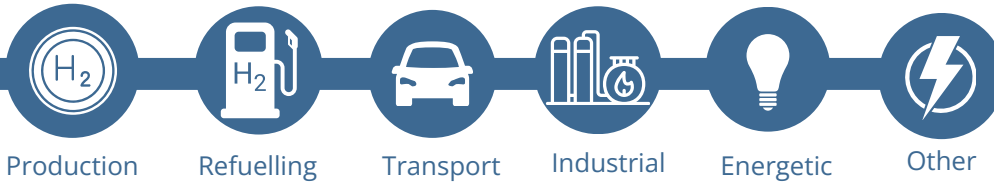
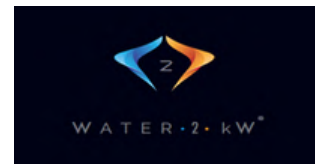
• Development of the business plan ready for investment

• Investment process

[South3E - S3E en LinkedIn: S3E CHARGE Startups | Water2kW](#)

• European Innovation Council: On-going proposal preparation for STEP 1.

• Call HORIZON-MISS-2023-CLIMA-01 (Demonstration of climate resilience solutions in support of the implementation of the Climate Change Adaptation Mission). Water2kW is working on a project proposal for the deployment of H<sub>2</sub>umidity® technology in the agricultural sector. Advanced contacts for networking partners in the project. The final result, among others, proposed for this project is a pilot equipment where full-scale field tests would be carried out.



## Technology description

H2umidity® (PCT/ES2021/070087) combines the capture of water from humid air with a new electrolysis production system for producing and storing green hydrogen as a renewable energy vector. It makes possible to supply water, hydrogen, and green energy with no location restrictions, including remote areas and dry regions, contributing to its development and progress. The solution significantly contributes to carbon dioxide emission reduction climate target using renewable energy as only source and efficient water management as no surface water is extracted in the process. H2umidity is designed in a modular system so it can be easily adapted to many different final user requirements, like just hydrogen supply for mobility, or water, hydrogen and energy supply in remote agriculture or industrial facilities. The process also includes advanced recovery systems to optimize economic and environmental pillars of sustainability in terms of energy, heat, water and by-products valorization.

## Technology information

**Maturity level:** Developed but not marketed

**Industrial property rights:** Applied for Patent  
Trademark

**Type of collaboration offered: :**  
Cooperation Agreement for R&D  
Technical cooperation Agreement

## Applications sectors

- **H2 production:** Waterelectrolysis using PEMWE and AEMWE ion exchange membrane technologies. Full floor
- **Storage of H2:** Compressed gas in high-pressure tanks. Solid-metal hydride storage
- **Transport:** Railway, heavy vehicle, heavy machinery
- **Industrial:** Green hydrogen as an energy storage system - Decarbonisation
- **Energy:** Back-up renewable generation.
- **Other:** Autonomous and self-sufficient water and energy supply of special interest in remote or isolated regions. Sector of interest: Agro.

**ABENGOA**



**aiju**



**AIMPLAS**  
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DEL PLÁSTICO

**ajusa**  
Tecnologías del Hidrógeno

**ariema**

**BaseSistemas**  
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**cetenma**  
Centro Tecnológico  
de la Energía y del  
Medio Ambiente

**CETIL**  
Dispensing Technology

**CIC energí GUNE**  
MEMBER OF  
BASQUE RESEARCH  
& TECHNOLOGY ALLIANCE

**cidetec**  
MEMBER OF BASQUE RESEARCH  
& TECHNOLOGY ALLIANCE

**CIAE** Centro Ibérico  
de Investigación  
en Almacenamiento  
Energético

**circe**

**H** Centro Nacional del  
Hidrógeno

**CTAG**

**Diverxia**  
INFRASTRUCTURE  
Diverxia H<sub>2</sub>

**df**  
Green Tech

**ecointegral**

**enagas**

**energylab**

**évo**  
évolution synergétique!

**FAEN**  
Fundación Asturiana  
de la Energía

**Ha** FUNDACIÓN PARA EL  
DESARROLLO DE LAS NUEVAS  
TECNOLOGÍAS DEL HIDRÓGENO  
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**GFM**  
FOTOVOLTAICA

**greenwzH<sub>2</sub>**

**Hiperbaric**  
HIGH PRESSURE TECHNOLOGIES

**HRS**

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Universidad Zaragoza

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