



CATALOG OF TECHNOLOGICAL CAPABILITIES

2024

PT^ẽ H₂

PLATAFORMA TECNOLÓGICA ESPAÑOLA DEL HIDRÓGENO

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SPANISH HYDROGEN TECHNOLOGY PLATFORM



PLATAFORMA TECNOLÓGICA ESPAÑOLA DEL HIDRÓGENO

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 the Spanish Hydrogen Association (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 2024



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Letter from the President

Dear members and collaborators of the Spanish Hydrogen Technology Platform (**PTe H2**):

It is an honour to present to you the 2024 edition of the Technological Capabilities Catalog. This document reflects the significant progress all our members have made in hydrogen research, development, and innovation.

The hydrogen sector has evolved significantly in recent years, with 2024 proving to be a pivotal year. Following the recent release of the new Integrated National Energy and Climate Plan (NECP), the energy transition is accelerating, and hydrogen stands as one of the key pillars for achieving the ambitious decarbonization and energy security targets. This Catalog highlights the way our members are actively contributing to these objectives through innovative technological solutions.

Throughout 2023 and 2024, we have witnessed the consolidation of strategic collaborations both at national and international levels. The PTe H2's participation in initiatives such as the Clean Hydrogen Mission (CHM), Enagás's "Call for Interest," and the AeH2's Census Project underscores the importance of effective cooperation to maximize the impact of hydrogen on all its key sectors. The collective effort of our members has enabled the development of projects of European common interest, a clear indication of Spain's leadership in the energy transition context.

The Catalog showcases the technological capabilities of our members across the entire hydrogen value chain. From renewable hydrogen production to storage, distribution, and its use in industrial and transportation applications, the document demonstrates how the technologies we are developing contribute to advancing the hydrogen ecosystem. This work is essential for Spain to maintain a competitive position on the international stage. The Catalog showcases the technological capabilities of our members across the entire hydrogen value chain. From renewable hydrogen production to its storage, distribution, and use in industrial and transport applications, this document outlines how the technologies we are developing contribute to advancing the hydrogen ecosystem. This document is essential for Spain to maintain a competitive position on the international stage.

Collaboration is a core element of our platform's success. In this regard, I would like to highlight the increasing involvement of new entities from the industrial, private, and academic sectors.

The innovation projects emerging from these alliances not only strengthen our technological capabilities but also create new opportunities for cooperation among our members, fostering technological development and generating synergies with other platforms and initiatives, such as the Prospectiva Transporte 2050 (MITERD), PLATEA, Green Future Plat, National Hydrogen Valleys Alliance, and GIEC, among others.

Hydrogen continues to gain prominence as an essential energy vector in the transition toward a decarbonized economy. It is remarkable to see that the technologies developed by PTe H2 members are recognized internationally. This Catalog is not only a document that showcases our capabilities but is also a tool to drive new opportunities for collaboration in the near future.

The transition to a hydrogen-based economy is an ambitious challenge that I am confident we will successfully achieve together. The activities of the PTe H2 particularly in R&D&I, will continue to lead the way toward a more independent, cleaner, and competitive energy future.

Finally, I would like to express my sincere gratitude to all members of the Platform for their commitment to the technological development of hydrogen. Moreover, I would like to thank the State Research Agency for the continuous support it has given us, supporting an exemplary public-private collaboration since the foundation of the platform.



Antonio González García-Conde
PTe H2 President



CATALOG OF MEMBERS AND AVAILABLE TECHNOLOGIES

PTe H₂
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 Hydrogen 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 Hydrogen Uses in Industry

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



Working Group Hydrogen Uses in Power Grids, Buildings, Backup, Auxiliary Systems and Power Systems (PGB2+ASPS)

This Working Group focuses on areas such as low- and high-temperature fuel cells, hybrid power grids with hydrogen technologies, hydrogen burners and turbines, etc.

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



Uses in PGB2+ASPS

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 electrolyzers, 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 H2.

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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Spanish Hydrogen Technology Platform (PTe H2 - Plataforma Tecnológica Española del Hidrógeno)
- 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 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 H₂



Production



Storage



Residential
Urban

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

APPLICATION SECTORS

- **H₂ Production:** Alkaline Electrolysis
- **H₂ Storage:** Metal hydrides
- **Residential/urban:** Energy use, thermal use, microgeneration



Transport

Residential
Urban

Energetic

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 cm² to 150 cm².
- Current density range up to 2.5 A/cm².
- 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)

APPLICATION 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



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.

APPLICATION 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

Utility model 3D bipolar additive manufacturing plate



Production

Transport

Residential
Urban

Energetic

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 electrolysers

APPLICATION SECTORS

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



Production



Industry



Uses in
PGB2+ASPS

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 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 (INTERCONECTA 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 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 H₂ to be used in sustainable electricity generation.
- **SHEL - Sustainable hydrogen evaluation in logistics (2009):** Development of a 30kW alkaline electrolyzer to supply H₂ 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 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 INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Others

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.

APPLICATION SECTORS

- **Others:** Electrical energy storage



Production



Industrial



Residential
Urban



Energetic

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.

APPLICATION 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



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.

APPLICATION 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

Industrial

Others

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 H₂, and also obtaining ZnO from zamak waste.

TECHNOLOGY INFORMATION

Maturity Level: Prototype demonstrators, TRL 4-8

Industrial property rights: Intellectual Property among the partners with whom AIJU has collaborated in each project.

Type of collaboration offered: R&D cooperation agreement.

APPLICATION SECTORS

- **H₂ production:** alcohol reforming, electrolysis of water, biomass
- **Industrial:** various industrial processes
- **Others:** circular economy



Production



Others

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

Industrial property rights: AIJU's intellectual property.

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

APPLICATION SECTORS

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



Storage, transportation
and distribution



Production



Mobility



Uses in
PGB2+ASPS

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.



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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 m² 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:

- H2 production from biomass
- Use of H2 to synthesize compounds (power-to-X)
- Porous electrodes Electrically conductive plates
- Plastic tanks for H2 storage
- Plastic pipes for H2 distribution
- Advanced materials for physical/chemical storage of H2
- 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 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 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 H₂ 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 H₂ 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.

APPLICATION SECTORS

- **H₂ 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.

APPLICATION 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.

APPLICATION SECTORS

- **H2 Production**
- **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.

APPLICATION SECTORS

- Transport
- H2 storage



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

Level of maturity: TRL 6 - 7

Industrial property rights: Intellectual property

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

APPLICATION SECTORS

- **Transport**
- **H2 storage**



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

Ajusa, dedicated to the 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 type fuel cell systems and modules.



<https://ajusath.es/>



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Parque Empresarial Ajusa Calle 1, nº 1 Albacete

ACTIVITIES AND EXPERIENCES IN R&D&I

AJUSA designs, develops and manufactures PEM type fuel cells, reaching a power of up to 50 kW. Also develops power systems and modules for stationary and mobility applications. Hydrogen refueling service station at 350 bar operational. AJUSA is currently developing a 100 kW stack.

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

1-5 M€

TECHNOLOGIES OFFERED

- PEM type fuel cells, up to 50 Kw.
- PEM type fuel cells, up to 100 kW (under development)
- Bipolar plates
- Sealing gaskets
- Stationary systems: mCHP and UPS up to 50 kW
- Mobility systems: 20 kW module

ENTITY DATA

Type: Medium Company

Size: > 150 employees

Calls of interest for your entity:

European, National and Regional



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

SUSTAINABLE AUTOMOTIVE TECHNOLOGICAL PROGRAM

PTAS-20211007

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

AERONAUTICAL TECHNOLOGICAL PROGRAM 2022

PTAG-20221021

Cryogenics and Hydrogen Fuel Cells in Aviation

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES



TECHNOLOGY DESCRIPTION

PEM Fuel Cells are electrochemical devices that produce electrical power and heat

They are fueled with hydrogen gas and air, and only have water as a byproduct.

The stack is made up of cells stacked in series. Each of these cells is composed by three main elements: the bipolar plate, the MEA and the joint.

AJUSA designs, develops and manufactures PEM type fuel cells, reaching a power of up to 50 kW.

100 kW stack in development.

Current models:FC030 and FC040

TECHNOLOGY INFORMATION

Maturity level: Prototype TRL7

Industrial property rights: Protected by industrial secret

Type of collaboration offered: Commercial agreement with technical assistance

APPLICATION SECTORS

- Transport
- Industrial
- Residential/urban
- Energetic
- Other



Production

DESCRIPTION OF THE ENTITY

ALTER is a leading engineering company which provides reliable and agile solutions to many of the world's most innovative technologies, such as semiconductors, electronic equipment and geospatial intelligence.

Our company is present in space, aeronautics, drones, automotive, medical, defence, and nuclear among many others.

About TÜV NORD GROUP:

With our knowledge, we stand for safety, independence and quality – everywhere and at all times. We look to the future and dedicate ourselves to making our clients even more successful in the connected world. We protect lives, goods and natural resources. We achieve this by offering services in testing, inspection, certification, engineering and training. We continuously improve knowledge transfer across all areas in the effort to develop the best solutions.

ENTITY DATA

Type: Large Company

Size: ALTER TECHNOLOGY = 256
TÜV NORD GROUP = 14000

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN

Regional and Other



<https://www.altertechnology-group.com/en/home/>



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28760 Tres Cantos - Madrid - SPAIN

ACTIVITIES AND EXPERIENCES IN R&D&I

Verification and validation processes, standardization and conformity assessment, as well as prequalification and analysis for placing on the market.

Intelligent technology makes life simpler in many different ways and can even save lives. From modern electrical systems and intelligent production through to pioneering innovations in energy supply: TÜV NORD offers innovative technological certifications for all sectors.

Technology only serves its purpose if it does not produce any hazards. For more than 150 years TÜV NORD has been helping to minimize risks and hence ensure maximum safety and quality.

Approximate annual investment in R&D&I in hydrogen and fuel cells: n/a

TECHNOLOGIES OFFERED

<https://www.tuev-nord.de/en/company/certification/services/tuev-nord-h2-readiness-label/>

TÜV NORD-H2-Readiness-Label: Certification of Plans, Projects and ProductS



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

In process, participation in:

- Asociación Española del Hidrógeno (Aeh2)
- UNE – Comité Técnico de Normalización CTN 181 - Tecnologías del hidrógeno

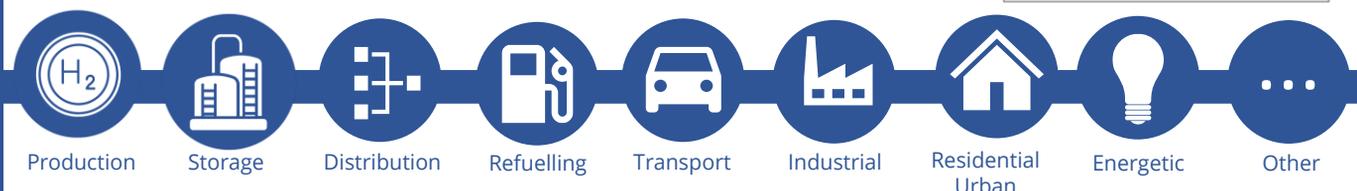
DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Standardization roadmap for hydrogen technologies:

<https://www.din.de/en/innovation-and-research/topics/hydrogen/standardization-roadmap-for-hydrogen-technologies>

HydroHub – Competence for the hydrogen economy run-up

<https://www.hydrohub.de/en/homepage/>



TECHNOLOGY DESCRIPTION

TÜV NORD-H2-Readiness-Label

With the TÜV NORD H2 readiness label, you document that your plans, projects and products are suitable for use in hydrogen applications. This includes production, storage, transport and application of hydrogen. With the TÜV NORD H2 readiness label, the manufacturer or operator is able to provide proof that the necessary requirements are met. With our service you provide proof that your product is H2-ready. The seal bundles internal and external services tailored to your application.

<https://www.tuev-nord.de/en/company/certification/services/tuev-nord-h2-readiness-label/>

TÜV NORD-H2-label

Hydrogen and hydrogen derivatives such as ammonia or methanol play an important role in the energy supply of the future. Because they can be used as energy storage and manufactured in a climate-neutral manner. The possible uses are diverse: hydrogen and its derivatives can be used as fuel, fuel or raw material. They can also be transported over long distances - making it easier to import and export climate-friendly energy. Hydrogen technology is therefore seen as the key to the success of the energy transition.

<https://www.tuev-nord.de/en/company/certification/services/tuev-nord-h2-label/>

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration

Industrial property rights:

- Trademark
- Protected by industrial secret

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

APPLICATION SECTORS

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



Production

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: SME

Size: 21-50 employees

Calls of interest for your entity:

European: Horizonte Europa, FCH JU, Green Deal.

National: CDTI, IDAE, MITECO, MICINN.



www.ariema.com



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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)



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Spanish Hydrogen Association (AeH2)
- Spanish Hydrogen Technology Platform (PTe H2)

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Hydrogen Europe
- ECO2 Fuel 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.

APPLICATION 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 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

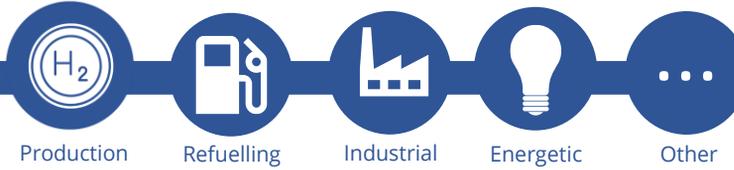
Participant in the main Hydrogen projects at the National level:

- HRS EMT PALMA - Green Hyland
- HRS TMB Iberdrola
- HRS Exolum - Torrejon Ardoz

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 INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

South African pilot plant engineering for ANGLO AMERICAN mining



TECHNOLOGY DESCRIPTION

Development of digital twins of H₂ generation plant and NH₃ 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 gH₂ 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

APPLICATION SECTORS

- **H₂ Production:** Electrolysis of water
- **H₂ Storage:** Compressed gas in tanks
- **H₂ distribution:** Pipelines
- **Refuelling infrastructures:** In situ hydrogen production
- **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



Industry



Uses in PGB2+ASPS

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



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ACTIVITIES AND EXPERIENCES IN R&D&I

Describe your activities and experience in R+D+i of your entity here...

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

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

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

TECHNOLOGIES OFFERED

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

ENTITY DATA

Type: Renewables

Size: 80 people

Calls of interest for your entity:

- Hydrogen production
- Hydrogen transportation
- Hydrogen uses

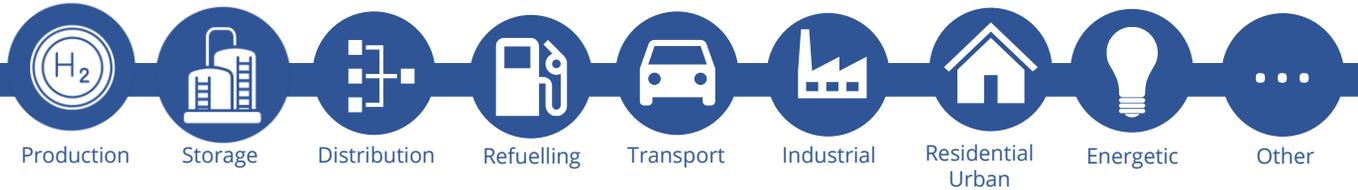


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

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

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

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



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.

APPLICATION SECTORS

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

DESCRIPTION OF THE ENTITY

CDTI-E.P.E. is a Public Entity under the Ministry of Science, Innovation and Universities that promotes **innovation and technological development of Spanish companies**. CDTI provides support for **R & D projects of Spanish companies** both at national and international levels. Therefore, the aim of CDTI is to contribute to the **improvement of the technological level** of Spanish companies through the following activities:

- Technical and economic evaluation and awarding of public funding for R & D projects developed by companies.
- Promotion and management of Spanish participation in international programmes of technological cooperation.
- Promotion of international transfer of technology and support services for technological innovation.
- Support for the establishment and consolidation of technology-based companies.

ENTITY DATA

Type: Public Administration

Size: > 100 employees

Calls of interest for your entity:
not applicable



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



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ACTIVITIES AND EXPERIENCES IN R&D&I

Not applicable

Approximate annual investment in R&D&I in hydrogen and fuel cells: Not applicable

TECHNOLOGIES OFFERED

Not applicable



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



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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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

DESCRIPTION OF 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.

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.

APPLICATION SECTORS

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



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

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 Navarra.

ENTITY DATA

Type: Technology center

Size: about 240 people

Calls of interest for your entity:

European: Clean Hydrogen Partnership

National: Plan Estatal AEI, PERTE ERHA

Regional: Ayudas I+D Navarra



www.cener.com // www.bio2c.es/es/



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Ciudad de la Innovación 7, Sarriguren NA

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€

TECHNOLOGIES OFFERED

- Materials laboratory for solid state electrolyzers and fuel cells (SOEC/SOEFEC).
- 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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Plataforma Tecnológica Española del Hidrógeno – PTe H2 (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 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/SOFC 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.

APPLICATION 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



Energetic

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.

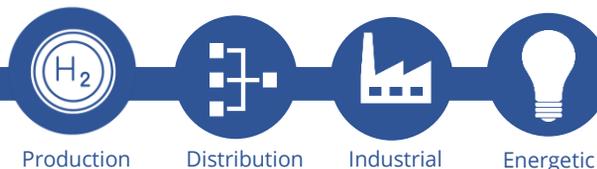
Type of collaboration offered:

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

APPLICATION 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.

ATENEA microgrid: Coupling, integration and testing of electrolyzers and/or fuel cells in controlled grid environment



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 H₂ 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.

APPLICATION SECTORS

- **Production of H₂:** H₂ generation from renewable energy.
- **H₂ distribution:** H₂ storage for use on demand.
- **Industrial:** H₂ availability for multiple industrial applications (feedstock, CHP, etc).
- **Energetic:** P2X technology for energy storage.

2 MWt Bubbling Fluidized Bed Biomass Gasifier (ABFB)



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 Nm³/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 H₂ 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/m³ 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 CO₂ is used as the inerting gas.

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration.

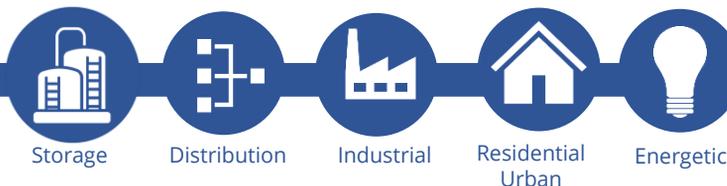
Industrial property rights: CENER Infrastructures. Protected by industrial secret.

Type of collaboration offered:

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

APPLICATION SECTORS

- **H2 Production:** from biomass and wastes.
- **Industrial:** use of syngas and H₂ as feedstock.



TECHNOLOGY DESCRIPTION

This is a reactor designed by CENER for the bioconversion of CO₂/CO and H₂ into methane (CH₄). The bioconversion process works with mesophilic and thermophilic microorganisms. The reactor can be coupled to an external supply of H₂ 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, H₂ 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).

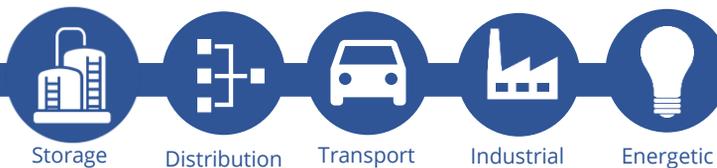
Industrial property rights: Protected by industrial secret.

Type of collaboration offered:

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

APPLICATION SECTORS

- **H2 Storage:** in the form of methane (Hydrogen Carrier).
- **H2 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.



TECHNOLOGY DESCRIPTION

This is a 5 L reactor designed by CENER for the production of methanol from CO₂ by means of Microbial Electrosynthesis (MES) processes.

The reactor has a configuration based on conventional fermentation bio-reactors with a fixed and mobile cathode based on carbonaceous materials. It has instrumentation and sensors for process monitoring, including gas solubility (CO₂, O₂, CH₄, 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, CO₂ 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.

APPLICATION SECTORS

- **H2 Storage:** in the form of methanol (Hydrogen Carrier).
- **H2 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).

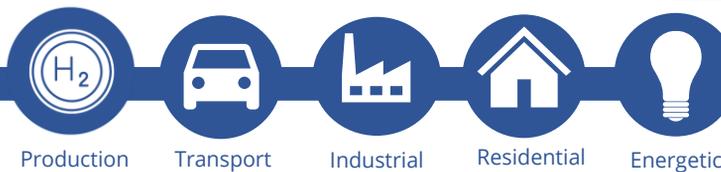
Industrial property rights: Protected by industrial secret.

Type of collaboration offered:

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

APPLICATION 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.*



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.

APPLICATION SECTORS

- **Development of electrolyzers:** 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).

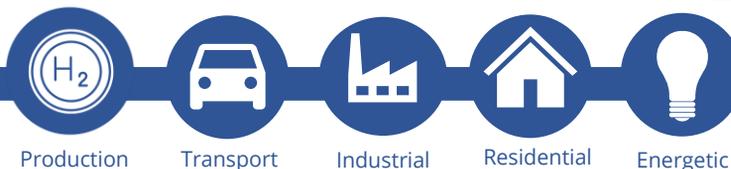
Industrial property rights: CENER infrastructures. Protected by industrial secret.

Type of collaboration offered:

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

APPLICATION SECTORS

- **Development of electrolyzers or hydrogen fuel cells:** the texturization 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.



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.

APPLICATION 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.



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

Moeve is an international company committed to sustainable mobility and energy, with solid technical expertise.

Moeve's 2030 Positive Motion strategy has set goals to reduce scope 1 and 2 CO₂ emissions by 55%, and the carbon intensity index by 15-20%, with the objective of achieving net zero emissions by 2050.

One of the key drivers to achieve this is through the production of green molecules, primarily renewable electrolytic hydrogen, its derivatives (methanol, ammonia, and e-fuels), and advanced biofuels.



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ACTIVITIES AND EXPERIENCES IN R&D&I

The Moeve Innovation Center is equipped with pilot plants capable of replicating all thermocatalytic processes from the company's Energy Parks and chemical plants.

Since 2022, it has had a specific department for Energy Transition Technologies, focused on the development of innovation projects in electrolytic hydrogen, CO₂ capture, e-fuels, energy storage, and sustainable mobility. The equipment operates at TRL levels 4-7, aiming to validate technologies through open innovation schemes and transfer technology to Moeve's business units (Mobility & New Commerce, Commercial and Clean Energies, Energy Parks, Carbon Cycle, etc.).

Approximate annual investment in R&D&I in hydrogen and fuel cells: 1MM€

TECHNOLOGIES OFFERED

- Direct hydrogenation of CO₂ to methanol at pilot scale (bench-scale)
- Pilot plant for the production of e-fuels in 2 stages (fixed-bed reactors, Rx1 reverse water-gas shift and Rx2 Fischer-Tropsch)
- CO₂ capture in vacuum-assisted PSA pilot plant
- Pyrolysis/gasification of biomass in pilot plant
- In progress: test bench for ALK and PEM stacks (<5 kW), evaluation of MEA components for electrolysis

ENTITY DATA

Type: Large Company

Size: > 11,000

Calls of interest for your entity:

European: Horizon Europe, LIFE

National: CDTI (PID), AEI, Misiones, Transmisiones

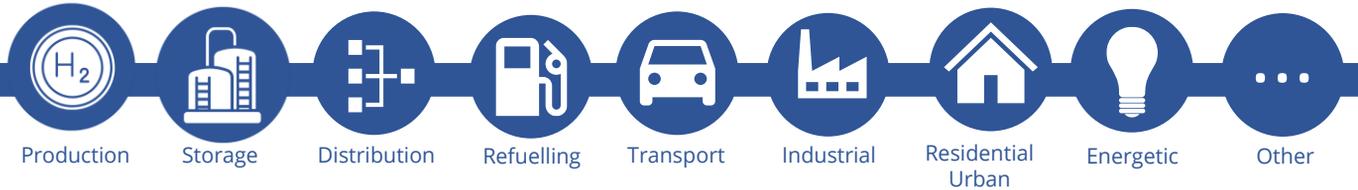


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- LÍNEAS ESTRATÉGICAS COLABORACIÓN 2021. Proyecto SOLFUTURE. Solar catalysis for a renewable energy future
- PID-CDTI 2022. Development of advanced catalysts and processes for transformation of CO₂ into renewable fuels (SYNCO₂)
- Member of the Andalusian Valley of Hydrogen

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- REFOLUTION. Refinery integration, scale-up and certification for aviation and marine biofuels production (Grant Agreement N° 101096780.)
- Production of advanced biodiesel from animal wastes using supercritical technologies. LIFE19 CCM/ES/001189



TECHNOLOGY DESCRIPTION

Moeve is not a technology provider, but aims at installing a significant capacity for:

- Hydrogen by water electrolysis
- CO2 capture
- E-fuels production (e-methanol, eSAF by Fischer-Tropsch route or methanol-to-jet, etc).
- Hydrogen for automotive applications (mobility)
- E-ammonia

Furthermore, Moeve Innovation strategy involves the research in technologies for the mid-term:

- Alternative production of renewable hydrogen (BECCS, gasification, photocatalysis, dark fermentación, etc.).
- Hydrogen carriers: LOHCs, ammonia cracking, solid carriers, etc.).
- Integration of renewable energy, energy storage and green hydrogen technologies

TECHNOLOGY INFORMATION

Maturity level: bench-scale and pilot plant testing facilities (TRL 4-7)

Industrial property rights: -

Type of collaboration offered: participation in R+D+i projects, development and scaling-up thermocatalytic processes, validation of e-fuels and development of new catalysts in the green hydrogen value chain.

APPLICATION SECTORS

- **H2 Production**
- **H2 Storage**
- **H2 distribution**
- **Refuelling infrastructures**
- **Transport**
- **Industrial**
- **Energetic**

Specific Centre for Hydrogen Research



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

The Specific Centre for Hydrogen Research (CER-H₂) of the UPC brings together the activity of the Polytechnic University of Catalonia (UPC) around hydrogen technology. UPC is a public institution for research and higher education in the fields of engineering, architecture, science and technology, and it is one of the leading polytechnic universities in Europe.

The CER-H₂ aims to cover the needs for research and knowledge transfer in the field of hydrogen technologies, making special efforts to align with the Horizon Europe plan and the Next Generation EU recovery plan. This includes technologies for the generation, storage and use of hydrogen in all its fields of application: energy, industry, transport, housing, etc.

The Center is responsible for accompanying the production system in the development of hydrogen technologies and infrastructures.

ENTITY DATA

Type: University

Size: 100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN

Regional: ACCIÓ



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ACTIVITIES AND EXPERIENCES IN R&D&I

Blue and green hydrogen production; Hydrogen storage and distribution; Uses of hydrogen as a fuel in vehicles and industry; Integration of hydrogen systems in energy nets; Monitoring and control systems for hydrogen technologies.

Featured projects:

SINGLE-Electrified single stage NH₃ 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; and others.

Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-5 millions €

TECHNOLOGIES OFFERED

H₂ production: Green hydrogen production, Electrolysis and Thermolysis, Reformation of biogas, agricultural and industrial waste. Photocatalysis and photoelectrocatalysis; decomposition of NH₃. Components and system design. **Storage and distribution:** compressed H₂, metallic hydrides, liquefaction at low T°C, transport and distribution. **Use of H₂:** Fuel cells, CH&P; Fuel in IC motors, Production of products and synthetic fuels, Injection to the network. **Integration:** DC/DC converters and inverters, Networks and micro-networks of energy with H₂ and electricity generation; Vehicles with fuel cell; Economy and sustainability. **Monitoring and control:** Modeling, Diagnosis and prognosis, Energy management.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Projects:

- IDAE
- MICINN
- CDTI
- Industrial doctorates
- ACCIÓ

Networks participation:

- Valle de hidrógeno del Ebro
- CEEC
- Xarxa H2CAT
- Vall H2 CAT
- PTeH2

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Projects:

- Horizon Europe projects & Clean Hydrogen: SINGLE, H2GLASS, H2ELIOS

Doctoral networks:

- Unite.Energy

Networks:

- HER
- NEA - Working Group on Hydrogen Value Chain



Production



Storage



Distribution



Refuelling



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

As a polytechnical university, hydrogen technology is approached from various disciplines and with different degrees of maturity.

The collaborations offered are very broad, from R&D projects, to challenges and the creation of large consortiums.

Obtaining and production:

Electrolysis and Thermolysis, Reformation of biogas, agricultural and industrial waste; Photocatalysis and photoelectrocatalysis; decomposition of NH₃; Infrastructures.

Storage and distribution:

Compressed H₂, Metallic hydrides, Liquefaction at low T°C, Transport and distribution.

Use of H₂:

Fuel cells, Heat source; Fuel in motors, Production of products and synthetic fuels, Injection to the network.

Integration: DC/DC converters and inverters, Networks and micro-networks of energy with H₂ and electricity generation; Vehicles with fuel cell, Economy and sustainability.

Monitoring and control: Modeling, Diagnosis and prognosis, Energy management.

TECHNOLOGY INFORMATION

Maturity level: Basic Research, Lab-proven; Available for demonstration

Industrial property rights:

Type of collaboration offered: Cooperation agreement for R&D; Service provision agreement; Technical Cooperation Agreement; Other: Business chairs, challenges, workshops, R&D consortiums, industrial doctorates, visits, conferences, Networking talent days, negotiation of license agreements, and innovation hubs.

APPLICATION SECTORS

- **H₂ Production:** Electrolysis of water, SMR, Methanol reforming, Biomass (Components, Units, Auxiliary elements, process control).
- **H₂ Storage:** Compressed gas in tanks; Liquid hydrogen; Metal hydrides; Hydrogen carriers.
- **Distribution:** Pipelines
- **Refuelling:** In situ hydrogen production; Compression; Storage; Dispense.
Transport: Automobile; Heavy vehicle; Railway; Aviation, Maritime (Component testing, fuel cell, Deposits, Tractor system, power electronics)
Industrial: Green hydrogen as a raw material; Industrial GHP; Heat production in thermal power.
- **Residential Urban:** Domestic microgeneration
Energetic: Production and storage of energy in the electricity grid, Injection into the gas grid.



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

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.

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:



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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.

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 logistic, **ARCHEA** project that validates a new power2gas process using hydrogen as a vector, CLOEH2 biological production of hydrogen by dark fermentation. Currently initiating the GENHESIS project of the PERTE ERHA value chain focused and ELECTROH2 (public-private partnership) in development new models of electrolyzers.

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

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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Project GENHESIS (IDAE Value Chain)
- ELECTROH2 (public-private partnership)
- 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

DESCRIPTION OF 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

APPLICATION 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

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:

European: Horizon Europe, FCH

National: CDTI, IDAE



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ACTIVITIES AND EXPERIENCES IN R&D&I

Cetil has its own R+D+i department with up to 10 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 industrial measuring system. It can be used in fixed or mobile installations to load/unload H2 MEGC, or to fuel trains 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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Cetil has recently presented at CDTI an research and development project consisting of a new industrial H2 measurement system that controls the filling process with the ME4000 electronic register, for multiple applications such as the loading and unloading of MEGCs and the refuelling of trains or ships.

DESCRIPTION OF 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 H2, in which the most advanced H2 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: On the market

Industrial property rights: Protected by industrial secret

Type of collaboration offered: Trade agreement with technical assistance

APPLICATION SECTORS

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



TECHNOLOGY DESCRIPTION

The H2 industrial measuring system for legal transactions, H2FS, controls the filling process using the modular and scalable ME4000 electronics, designed entirely by CETIL, which combines the experience gained in the development of all types of legal fuel measuring systems with the knowledge acquired from the H2 dispenser.

The H2FS is designed for use in industrial applications related to the loading and unloading of MEGCs and the refuelling of hydrogen trains and ships.

Characteristics:

- ATEX, OIML and PED certification.
- Delivery for legal transactions.
- Possibility of using international protocols such as SAE J2601-5.
- Possibility of using filling control based on pressure ramps if required.
- Hydrogen pre-cooling option.
- Installation in safe area and classified for explosion risk.
- Configurable for different storage and fuelling pressures.
- Easy integration with plant control using Modbus communication protocols.

TECHNOLOGY INFORMATION

Maturity level: In development

Industrial property rights: Protected by industrial secret

Type of collaboration offered: Trade agreement with technical assistance

APPLICATION SECTORS

- **H2 transport:** H2 measuring system loading/unloading MEGCs.
- **Refuelling infrastructures:** H2 dispensing in industrial environments such as for trains and ships.



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

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.

ENTITY DATA

Type: Research centre

Size: >190

Calls of interest for your entity:

European: Horizon Europe Cluster 4 y 5, Clean Hydrogen Partnership, European Innovation Council-Pathfinder

National: CDTI, PERTE, MICINN, MITECO

Regional:



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ACTIVITIES AND EXPERIENCES IN R&D&I

Three main research lines to produce green hydrogen:

- Emerging technologies for electrochemical H₂ production: 1) Development of decoupled electrolyzers. 2) Development of electrolyzers for H₂ and H₂O₂ or Cl₂ co- synthesis.
- Emerging technologies for H₂ 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€

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 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:
- **Spanish Hydrogen 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 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.
- **European Heat Pump Association (EPHA):** Partners.
- **Batteries Europe Partnership Association (BEPA):** Partners and participants in all working groups.
- **Batteries Europe:** 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

Other

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).

APPLICATION 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).



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 H₂ and H₂O₂ or Cl₂ 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 H₂ generation rate.
- Added-value co-generated product.

TECHNOLOGY INFORMATION

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

Industrial property rights: Under evaluation

Type of collaboration offered:

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

APPLICATION SECTORS

- **H₂ Production:** Water electrolysis. (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: Under evaluation

Type of collaboration offered:

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

APPLICATION 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 € 20M in 2023.

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

ENTITY DATA

Type: Technology Center

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, Clean Hydrogen JU, Green Deal



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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€

TECHNOLOGIES OFFERED

- PEM electrolysis: catalysis and electrode development.
- PGM-free porous electrodes for PEM, AE and AEM electrolysis.
- Coatings for BPPs and PTLs for electrolyzers
- 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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- PLATAFORMA TECNOLÓGICA ESPAÑOLA DEL HIDRÓGENO (PTe H2)
- ASOCIACIÓN CLÚSTER DE ENERGÍA DEL PAÍS VASCO (ACE)
- BASQUE HYDROGEN CORRIDOR (BH2C)
- SHYNE

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH 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 Surface Engineering is 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.

APPLICATION SECTORS

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

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



Storage



Refuelling



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.

APPLICATION SECTORS

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



Storage



Distribution

TECHNOLOGY DESCRIPTION

Hydrogen barrier coatings for tanks and metal components

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.

APPLICATION SECTORS

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



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

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.

<https://www.ciemat.es>

In the Scientific Research Area on Hydrogen Technologies, CIEMAT conducts R&D&D activities from TRL1 to TRL 6-7

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.



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ACTIVITIES AND EXPERIENCES IN R&D&I

Activities are structured on:

- Electrolytic hydrogen production from renewable energy
- Thermochemical Solar Hydrogen Production
- Low carbon 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: 0.5-1 M€ (through Projects in Competitive Calls, Research Contracts and Technical Services)

TECHNOLOGIES OFFERED

See details on the following pages

ENTITY DATA

Type: Public Research Center

Size: 1200 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



DESCRIPTION OF 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.
- **ESPAEM:** Development of an Anion Exchange Membrane electrolyzer, financed by H2B2 Electrolysis Technologies S.L. (service contract).
- **ECLOSION:** Development of components for anion Exchange membrane electrolyzer, financed by H2B2 Electrolysis Technologies S.L. (service contract).

Some of the strategic tasks of the Unit exploits their know-how to develop components and qualification of reactor materials to transfer the results to larger scales close to industrial size . Several National project are within these areas, such as:

- “Impulso a la tecnología de producción de hidrógeno por la vía termosolar mediante el desarrollo y validación de nuevos materiales para receptores solares cerámicos de durabilidad mejorada con adición de ferritas”. HIDROFERR. Funding: Plan Nacional. Convocatoria Retos. Duration: 30-09-2021 a 31-12-2024
- Energía solar térmica de concentración en el sector del transporte y en la producción de calor y de electricidad (ACES 2030). Programa de actividades de I+D de entidades de la Comunidad de Madrid (P2018/EMT-4319). Duration: 1 septiembre 2019- 30 Abril 2023.

DESCRIPTION OF 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.

THERMOCHEMICAL SOLAR HYDROGEN

PRODUCTION: the objective is directed towards the demonstration and scale-up of solar-driven thermochemical processes for the production of fuels (e.g. hydrogen, synthesis gas) and industrial processes (e.g. cement, metallurgy, etc.). One of the strategic tasks of the Solar Thermochemistry Unit is directed towards the development of solar reactors and scaling them up to carry out the reactions and also the design of new concentrators to improve process efficiencies. Some examples of projects in which these activities are being developed are:

- Thermochemical HYDROgen production in a SOLar structured reactor: facing the challenges and beyond (HYDROSOL – BEYOND). Funding: H2020-EU.3.3.8.2. Convocatoria H2020-JTI-FCH-2018-1. Ref proyecto: 826379. Duration: 1 de Enero 2019- 31 de Diciembre 2023.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

AEI National Research Plan

CDTI programs with companies On-going Projects:

- ALL-TO-GAS “Biomass and Waste as Precursors of the Coupled Production of Hydrogen and Methane in the New Energy Transition Scenario” PLEC2022-009349
- ZEPPELIN, “Novel Processes for Green H₂ Generation”, CDTI, Programa “Misiones Ciencia e Innovación” 2021, Ref. MIG-20211076, Dic 2021-Nov 2024.
- VAL2H₂: Investigación de nuevas tecnologías para la generación, almacenamiento y uso de H₂ renovable mediante la valorización de biorresiduos, PR-H2CVAL4-C1-2022-0096
- GREENH₂-CM, Strategic Positioning of the Madrid Region on Green H₂ and Fuel Cells. Jan 2022 - Nov 2024
- LFG2JET, Optimized catalyst formulations for Fischer-Tropsch synthesis, 2022-2023
- STORIES “Storage Research Infrastructure Eco-System”, H2020 LC-GD-9-1-2020, 2021-2025

ZEPPELIN “Investigación en Tecnologías Innovadoras y Eficientes de Producción y almacenamiento de Producción y Almacenamiento de Hidrógeno Verde basadas en la Economía Circular”, MIG-20211076

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Solar Facilities for the European Research Area - Third Phase. SFERA III (Ref. 823802). Duration: 01-01-2019 a 31-12-2022
- Concentrated solar power at ultrahigh temperature and solid-state conversion. Better integration of renewable energy and renewable-fuel based solutions (SUNSON). HORIZON- HE-CL5-2021-D3-03-02: “Next generation of renewable energy technologies”. Duration: 30-09-2022 a 31-12-2025

LOW CARBON HYDROGEN PRODUCTION CONDITIONING, PURIFICATION AND STORAGE:

European calls related to thermochemical processes and CO₂ capture.

European calls related to the development of materials for thermochemical processes.

European call for training in hydrogen technologies. Erasmus and other. On-going Projects:

- Red CYTED H₂TRANSEL (Hidrógeno: producción y usos en el transporte y el sector eléctrico)
- Sustainability development and cost-reduction of hybrid renewable energies powered Hydrogen stations by risk-based multidisciplinary approaches, Ref. PCI2022-132997
- STORIES “Storage Research Infrastructure Eco-System”, H2020 LC-GD-9-1-2020



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- **ELHYPORT Project:** 'Hydrogen fuel cells with advanced membrane-electrode assemblies for their integration in low power and portable applications 'PID2019-110896RB-I00'
- **Preparation and characterization of electrodes for proton exchange membrane fuel cells in passive operation** 'TED2021-131620B-C21'
- RED CYTED H2Transel: 'HYDROGEN: PRODUCTION AND USES IN TRANSPORT AND THE ELECTRICITY SECTOR (H2TRANSEL)' - UNE/CTN222 Committee: Normalization in Fuel Cells.
- **H2DRON Energy** : contract, patent licence - Strategic positioning of the Community of Madrid in R + D + I of green hydrogen and fuel cells (GREEN H2 CM)
- Organic liquids carrying hydrogen operated in reversible fuel cells
- Research of new technologies for the generation, storage and use of renewable H₂ through the VALORIZATION of biowaste
- Design, development and validation of a prototype of Spanish anionic membrane electrolyzer (ESPAEM)
- Hydrogen-bearing organic liquids operated in reversible fuel cells
- Research of new technologies for the generation, storage and use of renewable H₂ through the VALORIZATION of biowaste

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- CATALEAST Project: 'Holistic design of fuel cell electrocatalysts for the least power Applications' M-ERA.NET.
- Moses Multiinnovative and sustainable electrolysis system
- EERA FC&H₂
- Hydrogen Europe
- IEC/TC105 committee: "Normalization in fuel cells"
- CYTED networks: H2TRANSEL project (Hydrogen: production and uses in the power generation and transport sectors) and RENUWAL (Iberoamerican network for the treatment of effluents with microalgae).
- Erasmus+ Vocational Education Program in Hydrogen Technologies (H2EXCELLENCE), which will forge a collaborative educational, training and development program in the field of fuel cells and green hydrogen technologies designed to close the existing industry skills gaps.
- Participation in platforms and European associations: Clean Hydrogen Partnership, Hydrogen Europe Research, EERA JP Fuel Cells & Hydrogen, European Research Institute for Gas and Energy Innovation, International Electrotechnical Committee TC 105 – Fuel Cell Technologies.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Organic liquid carriers for the Storage and conversion of Hydrogen in Reversible Electrochemical devices
- Towards Energy Decarbonisation through Direct-biogas Solid Oxide Fuel Cell and Microalgae Technology
- Development of AEM Electrolyzer (ECLOSION)
- Training: Different courses and stays of students.
- Hydrogen uses in transport applications (aerial, marine and terrestrial)(GREEN H2-CM).
- Preparation and characterisation of electrodes for proton exchange membrane fuel cells (PORHYDRO, coordinated project with the University Carlos III (Madrid).
- Energy decarbonisation using directly fed biogas fuel cells using microalgae technology (TEDDY).
- Líquid organic hydrogen carriers as direct fuel for reversible electrochemical devices of zero CO₂ emission (HY·STOR·E).
- Collaboration with companies for power generation assessment using hydrogen fuel cells (HYCOGEN) and PEMFC stacks” manufacture up to 10 kW power (PROTIO).
- Development of surface modification techniques to inhibit hydrogen embrittlement in transmission gas grids and storage tanks. PID2023-146041OB-C22. Convocatoria 2023 de ayudas a «PROYECTOS DE GENERACIÓN DE CONOCIMIENTO»

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Development of SOFC/SOEC cells by using additive manufacture technology (AURUM project, collaboration Gdansk University in Poland with CIEMAT).
- DE-CENTRALIZED CLOUD LABS FOR INDUSTRIALIZATION OF ENERGY MATERIALS (DECODE). Project 101135537 For HORIZON-CL4-2022- RESILIENCE-01-19.
- DECODE strives to build and demonstrate a future lab concept that implements a fully-integrated decentralized modeling-characterization framework, connecting multiple labs, in order to boost effectiveness and speed-up industrialization of clean-energy materials innovation.



TECHNOLOGY DESCRIPTION

The Plataforma Solar de Almería, PSA (www.psa.es), is one of the peripheral centers of CIEMAT.

Its activities are focused on advancing in thermochemical water splitting, in particular thermochemical cycles. Thermochemical cycles rely on heat derived from concentrating solar thermal power (CSP) to drive endothermic gas-splitting reactions, thereby converting solar energy directly into fuel. Consequently, these cycles have the potential to realize greater theoretical efficiency than methods based on photosynthesis, photoelectrolysis, or conventional electrolysis coupled to solar-electric. These processes are expected to reach higher efficiency than water electrolysis since their energy efficiency is not impaired by the intermediate conversion of heat to electricity. Our activity covers the following areas: Solar Hydrogen production, Thermochemical Cycles development, Energy Storage, and Integration of solar technology in chemical processes.

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TECHNOLOGY INFORMATION

Maturity level: 1-7

Industrial property rights:

Type of collaboration offered: PSA has a large and long-lasting international collaboration with many other R+D centres and industries, the main objectives are the contribution to the establishment of a sustainable and clean world energy supply, as well as the technical and scientific promotion of solar thermal technologies and derived solar chemical processes. Our Unit research addresses the demonstration, scale-up, of solar-driven thermochemical processes for the production of fuels (e.g. hydrogen, syngas) and industrial processes (e.g. cement, metallurgy, etc). Our strategic task exploits their know-how to develop suitable solar reactors and components and qualification of reactor materials to transfer the results to larger scales close to industrial size.

APPLICATION SECTORS

- **H2 Production:** Solar and thermochemical cycle development.
- **H2 Storage:** Energy and integration of solar technology in chemical processes.



Production

Storage

TECHNOLOGY DESCRIPTION

- Hydrogen production by bioethanol reforming
- Hydrogen production by direct reforming of biogas
- H₂ production from biomass and waste gasification and pyrolysis
- Gas cleanup and upgrading
- Purification of hydrogen-rich streams by Water Gas Shift (WGS) reaction and selective CO oxidation (COPROX)
- Development of catalysts for these processes
- Physicochemical characterization of catalysts
- Design and development of fuel processors
- Design of catalytic membrane reactors
- Design of sorption-enhanced processes
- Study and assesment of the processes above
- Liquid carriers for the transport, storage and conversion of H₂ (LOHCs)
- Production of SAF and e-fuels from CO, CO₂ and H₂)

Development, synthesis and characterization of catalysts and sorbents for the production and purification of hydrogen from biofuels and residues
3D printing technologies for the synthesis of catalysts, and reactor design.

Design and development of fuel processors for the production of hydrogen, upgrading and separation
Diseño y desarrollo de procesadores de combustible para la producción de hidrógeno, depuración, acondicionamiento

Chemical storage of hydrogen, hydrogenation to fuels, e-fuels
Integration of processes on a pilot scale level

Contacts:

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TECHNOLOGY INFORMATION

Maturity level: 1-7

Industrial property rights:

Type of collaboration offered: Research in Low Carbon Hydrogen Production and Hydrogen Conditioning and Storage is carried out in the Sustainable Thermochemical Valorization Unit, UVTS of the Department of Energy

<http://rdgroups.ciemat.es/web/valer>

And sometimes with collaboration of other Units of CIEMAT.

APPLICATION SECTORS

- H₂ Production
- H₂ Storage



Production

TECHNOLOGY DESCRIPTION

- Low temperature: Fundamental and development studies of PEMFC materials, components, devices and applications.
- High temperature: Preparation and characterization of components for SOFC and SOEC. Characterization of SOFCs under different operating conditions.
- Systems integration: Development of test stations up to 5 kW and commissioning, operation and characterization of SOFC, PEMFC, SOEC, AEL, PEMEL and AEMEL.

Laboratory for the integration of hydrogen with renewables. Development of programs and control systems for equipment and facilities. Communications to congresses, publications and patents. Participation in different Standardization Committees.

PEMFC: electrode manufacturing, moncell studies, small portable cell manufacturing, portable hydrogen and fuel cell applications. Design based on the application, operation and characterization of batteries up to 5 kW. SOFC: Manufacture and testing of components and cell characterization. PEMEL, AEL, AEMEL: Development and characterization of components and characterization of electrolyzers. Integration and characterization of devices in integrated systems.

Contact:

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TECHNOLOGY INFORMATION

Maturity level: 1-7

Industrial property rights:

Type of collaboration offered: Research in Fuel Cells and Systems Integration is carried out in the Unit of Fuel Cells and System Integration of the Department of Energy <http://rdgroups.ciemat.es/web/pilascomb>, with collaboration of other Units of CIEMAT.

APPLICATION SECTORS

- **H2 Production**



Production

TECHNOLOGY DESCRIPTION

- Test and evaluation of Proton Exchange Membrane Fuel Cells (PEMFCs) and Solid Oxide Fuel Cells (SOFCs). Design and development of component: catalysts, electrodes, flow field plates, current collectors, cells and stacks.
- Development of hybrid systems with green hydrogen renewable power for power generation with fuel cells.

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TECHNOLOGY INFORMATION

Maturity level: 1-7

Industrial property rights:

Type of collaboration offered: Research in Materials for Hydrogen and Fuel Cells is carried out in the Unit of Fuel Cells and System Integration of the Department of Energy <http://rdgroups.ciemat.es/web/pilascomb>, with collaboration of other Units of CIEMAT.

APPLICATION SECTORS

- H2 Production



Storage



Distribution

TECHNOLOGY DESCRIPTION

The Energy Materials Division of the Technology Department is involved in the Hydrogen Fragility Research Line in Storage and Distribution components.

- Mechanical testing in hydrogen atmosphere.
- Hydrogen effect advanced characterization.
- Mitigation of embrittlement hydrogen-induced fusing coating and surface modification techniques.
- Research and analysis of the hydrogen embrittlement effect on metal alloys used in storage tanks and distribution pipes.

Innovative Aspects:

- Procedure and detection of hydrogen embrittlement using the Nanoindentation (NI) technique.
- Testing in a hydrogen atmosphere using samples subjected to tension.

Contact:

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TECHNOLOGY INFORMATION

Maturity level: TRL1-TRL4

Industrial property rights:

Type of collaboration offered: Contracts for the Provision of Research Services with Companies.

Consortiums with Research Organizations and Universities for national and international initiatives in competitive projects.

<http://rdgroups.ciemat.es/web/materiales/>

APPLICATION SECTORS

- **H2 Storage:** Feasibility of hydrogen storage tanks made of austenitic stainless steels.
- **H2 distribution:** Feasibility of using API-type pipelines from the current gas pipeline network for future use in the hydrogen distribution network.



TECHNOLOGY DESCRIPTION

The Socio-technical Research Centre, part of the CIEMAT's Environment Department, integrates the knowledge and methods of the social sciences with the socio-technical approach and new approaches to the governance of risk, science and technology. Our mission is to:

Incorporate social science knowledge and methods into environmental and technological risk management.

Promote the social efficiency of technology and socially sustainable technical solutions.

To generate empirical evidence relevant to energy and environmental policy design, implementation and evaluation processes.

We offer technical services related to social research on emerging technologies (risk perception, public acceptance, consumer adoption intention).

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TECHNOLOGY INFORMATION

Maturity level:

Industrial property rights:

Type of collaboration offered:

- **SUSHy:** SUSTainability development and cost-reduction of hybrid renewable energies powered Hydrogen stations by risk-based multidisciplinary approaches. EIG CONCERT Japan actions / AEI (2022-2025)
- **GreenH2CM:** Posicionamiento estratégico de la Comunidad de Madrid en I+D+I del hidrógeno verde y las pilas de combustible. Planes Complementarios con las Comunidades Autónomas previstos en el Plan de Recuperación, Transformación y Resiliencia (2022-2025)

<https://cisot.ciemat.es/>

APPLICATION SECTORS

- **Refuelling infrastructures**
- **Transport**
- **Other**



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

The Iberian Centre for Research in Energy Storage (CIAIE) 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. CIAIE provides a stimulating research environment to work on some of today's most pressing energy, environmental and societal challenges. CIAIE benefits from large network including research centres and companies in the Iberian peninsula and abroad.

The final CIAIE facilities consist of three different buildings:

- Research building, 7323 m²
- Pilot plant building constructed area of 3317 m² and open area of 2094 m²
- Start-ups building, 1953 m²

ENTITY DATA

Type: Foundation

Size: 100 researchers

Calls of interest for your entity:
European: Horizon Europe, Hydrogen Europe Research.

National: CDTI, Plan Nacional, ERC, MSCA.

Regional: Ramón y Cajal, etc.



www.ciaie.org



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Edificio Tajo, Campus Universitario, Cáceres

ACTIVITIES AND EXPERIENCES IN R&D&I

Research lines: High (SOEC) and low (AEM) temperature and photoelectrocatalytic H₂ production. H₂ storage and transport. CO₂ capture and uses. Thermocatalytic, electrocatalytic and photoelectrocatalytic CO₂ and N₂ reduction.

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

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

Participation in R&D projects:

SUPREMAS: Horizon Europe. Partner. 6-10 million €

AEMH2: Industrial research. Partner. < 1 million €

ToweringCO2: Private funding. Partner. < 1 million €

Multisolveq. Private contract. Partner < 1 mill €

ALCHEMHY. Horizon Europe. Partner 6-10 mill €

TECHNOLOGIES OFFERED

Own characterisation equipment: SEM, TEM, AFM, TGA, DSC, FTIR, RAMAN, RMN, XRD, electro spinning, HP-PCT, HP-TGA, potenciostats, etc.

Prototype plant: For materials testing, 1 kW AEM and SOEC electrolysis, 100 g direct CO₂ air capture unit (DAC), gas and vapour adsorption tanks (storage and TES), and 100 g catalytic reactors for production of synthetic and chemical fuels.

Hydrogen pilot plant and power-to-x with integrated technologies, AEM 50 kW and r-SOEC 50 kW electrolysis, gaseous storage, direct CO₂ air capture unit with a capacity of 10 Tn/year, 50 L methanol reactor, 50 L ammonia reactor. Integration with pilot plants for thermal and electrical storage, as well as own microgrid.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

CIAE participates in the following initiatives in Spain:

AeH2: Spanish Hydrogen Association.

PTe H2: Spanish Hydrogen Technology Platform. In all the committees of the platform.

PTECO2: Spanish CO2 Technology Platform. PTECO2 is a non-profit association promoted by the private sector, research centers and Spanish universities.

PET-MSO-ED: Spanish Platform for Modeling, Simulation and Optimization Technologies in a Digital Environment.

MATERPLAT: Spanish Technological Platform for Advanced Materials and Nanomaterials.

Alianza Q-Cero: Alliance for the decarbonisation of thermal demand in Spain

ALL4ZERO: Partnership for decarbonisation

PET MSO ED: Spanish Platform for Modelling, Simulation and Optimisation Technologies in a Digital Environment

AH2A: Alliance for the use of hydrogen in aviation

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

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

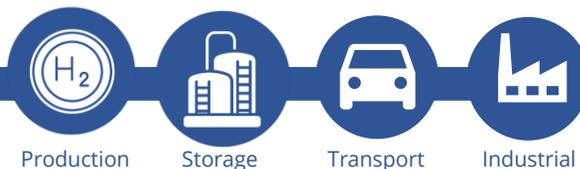
Hydrogen Europe Research (HER). HER represents the European scientific community involved in the development of a new, industrial ecosystem based on hydrogen and committed to moving towards a circular, carbon-neutral economy.

Scientific staff at CIAE are involved in the development of the different roadmaps of the Strategic Research and Innovation Agenda (SRIA), specifically in the following areas:

- Electrolysis
- Other modes of hydrogen production
- Role of electrolysis in the energy system
- Large-scale hydrogen storage
- Hydrogen carriers
- Developing hydrogen transport means
- Key technologies for hydrogen distribution
- Hydrogen refuelling stations
- Maritime
- Aviation
- Stationary fuel cells
- Industrial applications
- Education and public awareness
- Regulation, codes and standards and safety
- Hydrogen valleys

EERA - Energy Storage covers the complete range of low-carbon energy technologies and systematic topics.

CVE- CO2 Value Europe: International and non-profit association legitimate representative of the Carbon Capture & Utilisation (CCU) community in Europe.



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) .
 - Photoelectrocatalysis
- **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.
 - Photoelectrocatalytic production of synthetic and renewable fuels.
 - High and low temperature fuel cells SOFC and AEMFC
- **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 under development

Type of collaboration offered:

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

APPLICATION SECTORS

- **H₂ Production:**
 - Low and high temperature electrolysis
- **H₂ Storage:**
 - Alternative materials: MOFs, metal-hydrides and liquid carriers
 - Gas and liquid H₂
- **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



Industry



Uses in
PGB2+ASPS

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.

ENTITY DATA

Type: Technology Centre

Size: >100 employees

Calls of interest for your entity:
mainly Horizon Europe, FCH JU,
Green Deal



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Zaragoza (Spain)

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€

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 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 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

APPLICATION 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.

APPLICATION SECTORS

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



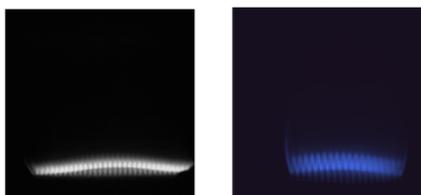
Industrial

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.

APPLICATION 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.

APPLICATION 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.

APPLICATION 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.

APPLICATION SECTORS

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



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

The general mission of 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 society. All this, with a strong intensification in the field of energy, mainly renewable hybridized with hydrogen technologies.

The Center has a strong vocation in the search for environmental and social sustainability without renouncing to economic development. CITES has complete facilities at the La Rábida Campus of the University of Huelva: wind and photovoltaic fields, as well as renewable hydrogen production (alkaline, PEM, AEM and, in development, SOEC technologies), storage (pressurized gas and metal hydrides) and consumption for direct electricity generation (by means of PEM fuel cells and, in development, SOFC), as well as indirect generation with mechanical work involved (turbines and hydrogen engines).

The combination of the different elements working together gives rise in CITES to renewable electricity grids hybridized with hydrogen technology, as well as hydrogen-based cogeneration and three-generation systems.

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: basic and applied research (prototypes) with 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 84 R&D&I projects carried out among European, national, regional and direct technology transfer to companies.
- 18 doctoral theses supervised with 9 awards.
- More than 700 publications in journals, books, book chapters and conferences.
- 20 patents, most of them PCT.
- Stanford University (USA) ranking above the 98% percentile worldwide in the field of energy.
- Coordination of the "H2 Uses in Power Grids, Buildings, Auxiliary Backup and Power Systems" working group of the Spanish Hydrogen Technology Platform.

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

TECHNOLOGIES OFFERED

- Pilot plant for H2 – based energy supply in residential and other applications. Cogeneration and three-generation plants.
- Hybridized refrigerated delivery/food transport van/truck with H2 technology.
- Renewable smart grid hybridized with H2 technologies.
- H2 – based propulsion and auxiliary plants for aeronautical 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 electronics, instrumentation and control for H2 technologies (electrolyzers, fuel cells, etc.). Instrumentation and control software. Digital twins.
- Artificial intelligence-based predictive maintenance of electrolyzers and fuel cells.



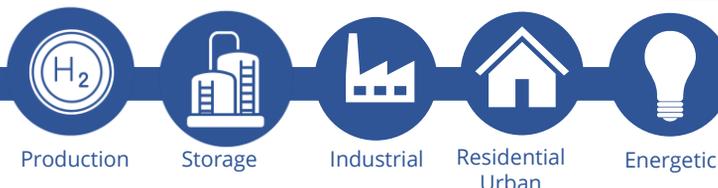
DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Knowledge Generation Projects of the State Plan for Scientific and Technical Research and Innovation.
- State Program to Promote Scientific-Technical Research and its Transfer.
- State Subprogram for Scientific-Technical Infrastructure and Equipment of the State Program to Promote Scientific-Technical Research and its Transfer, within the framework of the State Plan for Scientific and Technical Research and Innovation.
- Aeronautical Technology Program – PTA.
- Spanish Foundation for Science and Technology (FECYT).
- Various CDTI calls.
- Membership in the green hydrogen cluster "Gateway to Europe," the largest in Spain.
- Membership in the Spanish Hydrogen Technology Platform (PTe H₂). Coordination of the working group "Uses of H₂ in Electric Grids, Buildings, Auxiliary Backup and Power Systems."
- Membership in the Spanish Hydrogen Association (AeH₂).
- Membership in the Spanish Committee on Automation.
- Technology transfer contracts with Spanish companies, acting as a subcontractor for national project calls from companies.
- Development of applied research and experimental development projects by the Agents of the Andalusian Knowledge System.
- Membership in the Andalusian Hydrogen Association.
- Membership in the Andalusian Hydrogen Cluster

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Horizon Europe project calls.
- Interreg Spain – Portugal project call.
- EU Erasmus calls for training in Hydrogen technologies at the European level.
- Membership in the "ranking survey program" of King Fahd University in Saudi Arabia.
- Endesa/Enel renewable energy implementation program in South America.
- Partner universities for projects and internships: University of Lorraine (France), Guglielmo Marconi and La Sapienza (Italy), University of Cyprus, University of Applied Sciences of Vienna (Austria), Munster University of Technology and University of Cork (Ireland), and Norwegian University of Science and Technology (Norway).
- Foreign companies involved in projects based on various calls: Dovetail Electric Aviation (Australia), Endesa/Enel (Peru and Colombia), Maytec (France), Elcogen (Finland/Estonia), and Gteam (Czech Republic).

Pilot plant for H₂-based energy supply in residential and other applications. Cogeneration and three-generation plants



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 three generation system, based on hydrogen turbines and high-temperature fuel cells, which makes it more than 90% efficient. Moreover, this technology can be used, on a large scale, to replace existing natural gas-fired combined cycle power plants with 100% environmentally friendly plants based on renewable hydrogen. Depending on the physical characteristics of the plant (location and available surface area), it can manufacture its own hydrogen or work with direct external supply or previously stored in tanks, as is the case today with natural gas.

TECHNOLOGY INFORMATION

Maturity level: Lab-tested

Industrial property rights: Non-disclosure agreement

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

APPLICATION SECTORS

- **H₂ production:** Depending on the physical characteristics of the plant (location and available surface area), it can produce its own hydrogen.
- **H₂ storage:** Whether the plant produces its own hydrogen or whether it comes from outside, it will need to be stored.
- **Industrial:** The development is suitable for application in combined and three-generation cycles. It is a technology that would make it possible to replace current natural gas-based combined cycles.
- **Residential/urban:** It is a viable solution to decarbonize the building sector.
- **Energetic:** It is a solution framed in the energy sector.



Storage



Refuelling



Transport

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 200bar 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.

On the other hand, large refrigerated transport trucks have an auxiliary engine (usually diesel) to power the compressor of the refrigeration system of the cold box. This avoids the tractor engine having to be running when the truck is stationary. However, this auxiliary engine is a nuisance due to exhaust and noise pollution. Moreover, its use is prohibited in many rest stations, so that the refrigeration box has to be connected to an external electrical installation. the solution to all these problems is a hydrogen-powered auxiliary power unit to drive the cold box compressor.

TECHNOLOGY INFORMATION

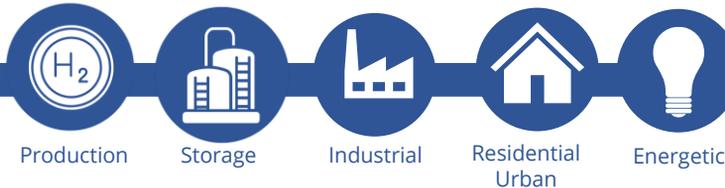
Maturity level: Available for demonstration

Industrial property rights: Non-disclosure agreement

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

APPLICATION SECTORS

- **H₂ storage:** The vehicle must carry hydrogen stored for at least one working day.
- **Refueling:** Se puede estudiar el repostaje en depósitos habilitados para ello en el vehículo o, como se ha diseñado, cambiando las botellas cada día mediante un cierre rápido y un sistema de sujeción sin necesidad de utensilios.
- **Transporte:** Refueling can be studied in tanks provided in the vehicle or as designed, by changing the bottles every day by means of a quick-closing and clamping system without the need for tools.



TECHNOLOGY DESCRIPTION

The developed renewable smart grid hybridized with H₂ technologies 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 a lead acid batteries bank and a super capacitors bank, both 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 H₂ production (alkaline and PEM electrolyzers), storage (pressurized gas and metal hydride) and consumption (multi-stack fuel cell systems designed and manufactured by CITES) facility. EMS knows, also through a designed and manufactured monitoring system by CITES, the degree of degradation of each cell of each stack, which allows it to perform permanent predictive maintenance, making stacks wear uniform. The EMS is developed based on a model-based predictive controller. The smart grid is in operation from 2017 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 agreement for development/manufacturing/marketing.

APPLICATION SECTORS

- **H₂ Production:** the smart grid produces its own hydrogen when there is a surplus of renewables or when the cost of energy in the main power grid is very cheap, or even free.
- **H₂ Storage:** The hydrogen produced in the smart grid is stored for later use.
- **Industry:** The smart grid model developed can be transferred to set up a proprietary power grid in an industry.
- **Residential/Urban:** The smart grid model developed can be transferred to configure a building, block or district's own power grid.
- **Energetic:** It is a solution framed in the energy sector.



Storage



Refuelling



Transport

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 battery electric storage technologies with on-board hydrogen storage. The aircraft engine, which is electric, is powered by both together or separately. In the case of the hydrogen storage through a fuel cell. 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.

The line of research is progressing in two parallel directions: manned and unmanned aircraft.

Of course, along with propulsion systems, auxiliary power units (APU) have been developed, both for aircraft and for other vehicles such as trucks or ships.

TECHNOLOGY INFORMATION

Maturity level: A test bench already developed and available for demonstrations.

Industrial property rights: Non-disclosure agreement

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

APPLICATION SECTORS

- **H2 storage:** The aircraft must carry stored hydrogen. This is an open line of research, since carrying it compressed at very high pressure entails airframe and airworthiness problems and carrying it liquid at very low temperature entails problems in achieving the necessary insulation.
- **Refueling:** Depending on which in-flight storage option prevails, appropriate airport refueling systems will have to be designed.
- **Transport:** Aerial mobility, freight transport, aerial surveillance, etc. All this on manned or unmanned on-board platforms (RPAS/UAS).

Design, development and prototyping of PEM fuel cells and PEM, Alkaline and AEM electrolyzers. From the stack to the entire balance of plant



Production



Transport



Residential
Urban



Other

TECHNOLOGY DESCRIPTION

Design, development and prototyping of PEM fuel cells and PEM, Alkaline and AEM electrolyzers. 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/electrolyzer can also be developed based on a stack determined by the customer.

CITES has its own CNC machining facilities, as well as laser cutters and 3D printers for both filament and resin. This allows any type of stack to be prototyped with high quality, which is also subjected to an exhaustive fluid-dynamic analysis that is made available to the customer.

The design and development includes all the BoP, power and control electronics, as well as all the necessary software, both for the operation of the system and for its maintenance, even offering the possibility of generating failures, breakdowns, accelerated deterioration, etc.

Finally, at the customer's request, a digital twin of both the fuel cell and the electrolyzer can also be developed.

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration.

Industrial property rights: Non-disclosure agreement

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

APPLICATION SECTORS

- **H2 production:** Electrolyzers are the building block for renewable hydrogen production.
- **Transport:** Fuel cell is the fundamental building block for hydrogen-based electric transport.
- **Residential/Urban:** Fuel cells and electrolyzers to play key role in residential and urban hydrogen energy solution.
- **Others:** Any use involving the direct conversion of hydrogen energy into electrical energy.

Power electronics, instrumentation and control for H2 technologies (electrolyzers, fuel cells, etc.). Instrumentation and control software. Digital twins.



TECHNOLOGY DESCRIPTION

Customized design and implementation of unidirectional or reversible power electronics 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.).

Custom design, development and prototyping of monitoring and control hardware-software systems for hydrogen systems (SCADA, 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/electrolyzers 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 agreement for development / manufacturing / marketing.

APPLICATION SECTORS

- H2 production
- H2 storage
- H2 distribution
- Refueling infrastructures
- Transport
- Industrial
- Residential/urban
- Energetic
- Other



TECHNOLOGY DESCRIPTION

For electrolyzers/fuel cells to operate cost-effectively and safely, it is necessary to define an appropriate maintenance strategy. Corrective maintenance (waiting until the failure occurs), does not seem to be the best strategy, taking into account that a plant can be shut down with the problems that this entails (lack of production and profitability, time to receive spare parts, shutdown and start-up times, etc.).

On the other hand, taking into account that we work with technologies that are still in the development phase, it is not easy to draw up a preventive maintenance program, so that maintenance can be performed either too early (unnecessary) or too late, with the costs that both entails. Therefore, the best option is undoubtedly to perform predictive maintenance, which requires as a key element to have the plant perfectly sensorized and, based on the data from the sensors, permanently monitor its status, so that we are able to anticipate the failure or breakdown, avoiding them.

Artificial intelligence-based predictive maintenance developed for fuel cells and electrolyzers allows, even with the failure of physical sensors (an artificial intelligence system replaces them), to predict when a failure in the electrolyzer/fuel cell will occur. With the help of this predictive approach, labor and spare parts are only deployed just before failures occur. The advantage of this type of maintenance strategy is, in addition to the large cost savings, that the electrolyzer/fuel cell can operate for the designed lifespan.

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration

Industrial property rights: Non-disclosure agreement

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

APPLICATION SECTORS

The application sectors are all those requiring the use of electrolyzers and/or fuel cells.

- **H2 production**
- **Transport**
- **Industrial**
- **Residential/urban**
- **Energetic**
- **Other**



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

The Centro Nacional del Hidrógeno (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, Innovation and Universities (MICIU) and Castilla-La Mancha Regional Government (JCCM), 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 3 additional facilities that carry out the entire hydrogen chain.

ENTITY DATA

Type: Technology and Research Institution

Size: 50-100 employees

Announcements of interest for your entity: European, LATAM, National and Regional.



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



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Puertollano (Ciudad Real)

ACTIVITIES AND EXPERIENCES IN R&D&I

CNH2 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 modelling 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.

TECHNOLOGIES OFFERED

- Integration and use of hydrogen in transport.
- Hydrogen refuelling
- Prototype evaluation, development of test benches and hydrogen systems testing.
- High temperature H2 production and transformation.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- **ADV REFORMING:** Understanding efficient CH₄/CO₂ reforming in advanced solid oxide fuel cells and optimizing reforming agents and catalysts. MICIN-AEI.
- **BIOMOTION:** Technical support, testing and validation for the development of hydrogen-fueled 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.
- **PRTR:** development of strategic actions based on hydrogen to transform the current energy paradigm and minimize greenhouse gas emissions. MICIN-Next Generation EU.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- **ARENHA:** Advanced materials and Reactors for eEnergy storage tHrough Ammonia. Horizonte 2020. H2020-LC-NMBP-29-2019 (topic LC-NMBP-29-2019).
- **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 H₂ Ecosystem on the Island of Mallorca. Fuel Cell Hydrogen and Joint Undertaking (FCH2 JU), H2020-JTI-FCH-2020-1 (topic FCH-03-2-2020).
- **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).
- **SAF URUGUAY:** FFS (Sustainable Aviation Fuel) production, analysis and evaluation of production alternatives. Fondo Sectorial de Energía. Agencia Nacional de Investigación e Innovación (ANII) del Uruguay. FSE_S_2023_1_179457.
- **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.
- **MACBETH:** Membranes And Catalysts Beyond Economic and Technological Hurdles. Horizonte 2020. H2020-NMBP-ST-IND-2018-2020. CE-SPIRE-04-2019.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

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

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- **HYPOP:** HYdrogen Public Opinion and accePtance. Supporting hydrogen deployment in Europe, enhancing citizens' participation and providing guidelines to increase confidence in hydrogen deployment. HORIZON-JTI-CLEANH2-2022-2. GA 101111933.
- **INA - COSTA RICA:** Strengthening the technical skills of automotive mechanics in hydrogen and fuel cell technologies in Costa Rica. MIDEPLAN-ACI-OF-0029-2024.



TECHNOLOGY DESCRIPTION

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.

- 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.
- New vehicles hydrogen system designing, retrofitting and range extender systems
- Testing and validation of equipment and components.
- Testing and validation of vehicle refuelling in CNH2 hydrogen refuelling station (HRS).



Fig.: Vehicle Laboratory CNH2

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.

APPLICATION SECTORS

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



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:

- Engineering.
- Add-hoc solutions for refuelling.
- Assistance and support on equipment and technology selection.
- Heavy duty refuelling protocols for road, machinery, rail, ports and airports operations.
- FAT, SAT and Commissioning support.



Fig.: Portable HRS (railway). Project FCH2Rail



Fig.: Mobile HRS (port and maritime). Project H2ports

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.

APPLICATION 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

- Cell components and materials evaluation and testing.
- Balance of Plant (BoP) and Balance of Stack (BoS) engineering.
- Test benches development for fuel cells and electrolyzers according to customer requirements.
- Prototypes development of power systems based on fuel cells.
- 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 400kW.
- Tests in climatic chamber and/or vibrating table.
- Tests in tilt table (hexapod) at different pitch, roll and yaw angles.



Fig.: Fuel cell module testing (aviation requirements)

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.



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 harmonized or customer supplied measurement protocols for cells and stacks up to 1 kW.

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



Fig.: Solid Oxide technology laboratory



Fig.: SOE test bench

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

- **H₂ production:** High temperature electrolysis.
- **Industry:** Green H₂ as raw material and electricity production.
- **Residential/Urban:** Energetic use.
- **Energetic:** H₂ and electricity production.



DESCRIPTION OF THE ENTITY

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

Cox 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, biogas and hydrogen derivatives production (ammonia and methanol), among others.

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

Cox 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, Clean Hydrogen for Europe JU, Green Deal

National: CDTI, MITECO, MICINN, IDAE

Regional



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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 H2 production and its derivatives (ammonia and methanol), as an EPC contractor by integrating H2 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. EPC for maritime propulsion systems.
- Biofuel reforming and Waste Gasification for H2 production.
- Hydrogen Refuelling Stations (HRS), providing EPC services for the development of the HRS.
- Operation and maintenance services for these plants.
- Consultancy and technological advisory service for projects related to the hydrogen and its derivatives.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Cox 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.

Cox is in charge of the design, manufacturing 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 INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

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

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

Modularization of Gasification system.

EPC of Demo plant for producing H₂ and Cryogenic CO₂ through MSW gasification

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



Refuelling



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

Cox'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.
- MSW or RDF Gasification for SAF/MeOH/DME/H₂ 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:

On the market/ Available for demonstration

Industrial property rights:

Protected by industrial secret/ Patented

Type of collaboration offered:

EPC contractor/ Service provision agreement/

Manufacturing agreement/ Technical Cooperation Agreement/

Cooperation agreement for R&D

APPLICATION 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 cells technologies)
- **Industrial:**
 - Green hydrogen production
 - Cogeneration power systems
- **Residential/urban:**
 - Microgeneration
 - Energy and thermal uses
- **Energy sector:**
 - Energy production (renewable and hydrogen) and storage
 - Integration with the grid



Mobility

DESCRIPTION OF THE ENTITY

CTAG is a Technology Centre founded in 2002 and dedicated to R&D and innovation in advanced technological solutions for the automotive and mobility sector.

It is a legal non-profit private foundation.

CTAG is a multidisciplinary centre with more than 1.200 professionals who develop its activity in R&D projects in numerous fields of knowledge as the self-driving, connected and intelligent vehicle, development of products and processes, essays and validation, passive safety technologies, etc.

Several technology lines leverage the main challenges like connectivity, electronics, ADAS, HMI and interiors, virtual simulation and commissioning, new materials, electric battery vehicle and hydrogen vehicle laboratories and connected and self-driving vehicle.

ENTITY DATA

Type: Technological Centre

Size: > 1.200 researchers

Calls of interest for your entity:

European: Horizon Europe, FCH JU,

National: CDTI, MINECO, MICINN



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ACTIVITIES AND EXPERIENCES IN R&D&I

Since its foundation, CTAG participates in numerous european, national and regional R&D programs, totaling more than 250 collaborative projects, 90 european, 50 of them actually running and 25 at european level.

Also belongs to Networks of Excellence in knowledge transfer, has a Technology Observatory and intellectual and industrial property management.

Its R&D Management System is UNE EN 166002 certified and has a R&D Transfer Bureau for companies.

Has an acumulate of 73M€ in scientific and technological equipment, including a Clean Technologies Lab for the electric and hydrogen vehicle.

TECHNOLOGIES OFFERED

- Smart Mobility
- Self-driving and ADAS
- Electric and hydrogen fuel-cell vehicle
- Batteries and electrical powertrain Lab
- Connected vehicle V2X
- Confort and interiors
- New materials
- Circular economy
- Product and process development
- Industry 4.0
- Passive safety systems
- Test tracks for mobility



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

CTAG is member or active participant at:

- Galician Hydrogen Association (AGH2), acting as vicepresident and coordinating the R&D and Innovation working group.
- Spanish Hydrogen Technological Platform (PTeH2), participating in both the Mobility Uses and National Collaboration working groups.
- SERNAUTO Move2Future (M2F) – participating in Electrical Drive Systems working group and co-leading the hydrogen subgroup.

Likewise keep links with the Spanish Hydrogen Association (AeH2) and Associação Portuguesa para a Promoção do Hidrogénio (AP2H2).

Also participates in several hydrogen value chain development projects based in Northwest Spain and the Galicia-North Portugal Euroregion.

Customarily attend several regional and national hydrogen events and conferences.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

CTAG customarily attend several international hydrogen events and conferences, as the European Hydrogen Week or European Hydrogen Energy Conference.



Storage



Refuelling



Transport



Energetic



Other

TECHNOLOGY DESCRIPTION

Studies using both physical and virtual essay facilities, for the electrical and hydrogen fuel cell vehicle validation, including batteries, electrical powertrain and H2 fuel cell.

Electric and H2 Vehicle Powertrain Validation Lab including:

Hydrogen Refuelling Station (HRS) @350 bar with pressurized bottles.

E-Axle dynamometric test bench for electric and hydrogen powertrain, battery tester, e-storage or battery simulator, inverter, cooler and high-frequency data acquisition analyzer.

E-Mast multiaxial vibrating platforms for the whole vehicle in climatic e-Clima chamber, with cooling systems, battery tests and CAN/LIN comms for complex signal analysis.

High Power and Voltaje Test Bench (up to 1.000V) with 4 VESA-c units, 2 units combined with the E-Mast y 2 units combined with high-ramp climatic chambers.

Management Software PUMA 2™, simulation CRUISE M™ (SiL & PHIL) y application ISACT™.

TECHNOLOGY INFORMATION

Maturity level: R&D, innovation, development, essays and validation.

Industrial property rights: Does not apply

Type of collaboration offered: Collaboration agreements for R&D projects, comercial agreements with technical assistance, validation services with ENAC certification.

APPLICATION SECTORS

- **Movilidad:**
 - Batteries.
 - Abuse test and destructive essays.
 - Electrical powertrain
 - Hydrogen fuel cell vehicle.
 - Bidirectional charging systems.
 - Mobility pilots with vehicles or fleets and onboard monitoring systems.



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.



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ACTIVITIES AND EXPERIENCES IN R&D&I

- No-Conventional Electrolysis Technologies (SOE, AEM...)
- Hydrogen Storage Systems (LOHC, LH2, Metal Carbides)
- Synthesis of Derivatives (NH₃, CH₃OH, SAF's...)
- "Diesel + H2" DualFuel Systems (H2-DDF)

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

ENTITY DATA

Type: Large Company

Size: 51-100 employees

Calls of interest for your entity:

European: Connecting Europe Facility, Alternative Fuel Infrastructure Facility

National: CDTI, MITECO

Regional

TECHNOLOGIES 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.
- Tailor-made solutions for the implementation of green hydrogen on several generation processes from the chemical industry (ammonia NH₃ or methanol CH₃OH)



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

- **Hydrogen Refuelling Station (HRS)** dedicated to the green hydrogen supply for the **heavy-duty mobility sector** .
- Development and execution of **strategic projects** to improve **energetic resilience** through off-grid systems based on the green hydrogen ecosystem for the **back-up energy generation**, the availability of a **renewable fuel for passenger’s mobility** and the **supply of heat for medical emergencies**.



TECHNOLOGY DESCRIPTION

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

TECHNOLOGY INFORMATION

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

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water (full floor)
- **H2 Storage:**
 - Compressed gas in Tanks
 - Liquid Hydrogen
 - Hydrogen Carriers and Derivatives
- **Refuelling infrastructures:** Production + Conditioning + Dispense
- **Transport:** Heavy-Duty Vehicle
- **Industrial:** Green hydrogen as a raw material
- **Energetic:** Injection into the natural gas grid



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

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: Horizonte Europa, FCH JU, Green Deal.

National: IDEA, MITECO, CDTI.

Regional



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PCT Gijón. Ada Byron, 90.33203 – Gijón (SPAIN)

ACTIVITIES AND 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

TECHNOLOGIES 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

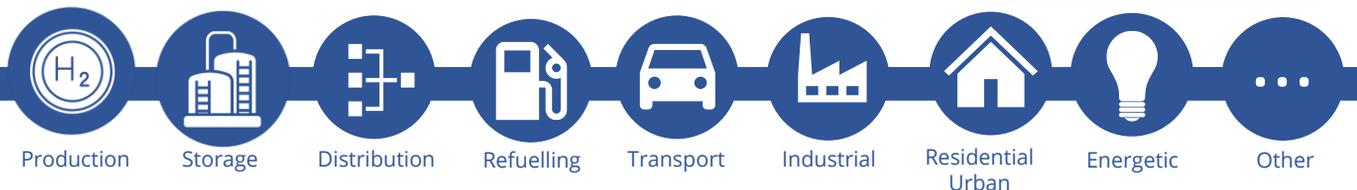


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- “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:

- 1) 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.
- 2) Project: of Production of renewable H2 inside an existing refinery in southern Europe.
- 3) H2 and O2 production inside Industrial existing facilities in Spain, including the distribution and injection of the H2 and O2 to Industrial furnance.

TECHNOLOGY INFORMATION

Maturity level: In market

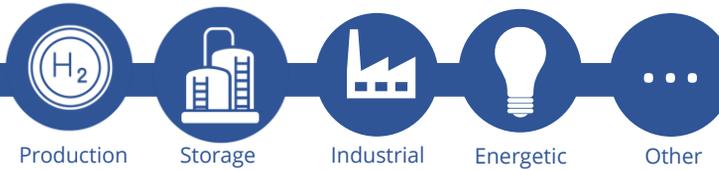
Industrial property rights:

Type of collaboration offered:

Collaboration in desing, execution and commisioning of Projects.

APPLICATION SECTORS

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



TECHNOLOGY DESCRIPTION

Storage of H₂ Gas (30 – 200 Bar)
Large format, for either land or maritime transportation.

Manufacture of bullets (Type 1), horizontal and vertical, in one piece, in the workshop of “Calderería Pesada” 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:

Type of collaboration offered: Collaboration in the desing, execution and commisioning of Projects.

APPLICATION SECTORS

- H₂ Production
- H₂ Storage
- Industrial
- Energetic
- Other



Production



Storage



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Storage of Ammonia (NH₃) in spheres and cooled tanks.

Multiple references. Own design and technology.

TECHNOLOGY INFORMATION

Maturity level: In market

Industrial property rights:

Type of collaboration offered: Collaboration in the desing, execution and commisioning of Projects.

APPLICATION SECTORS

- NH₃ Production
- NH₃ Storage
- H₂ distribution
- Industrial
- Energetic
- Other



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

Ecointegral IDP has over 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.

ENTITY DATA

Type: Large company

Size: >100 employees

Calls of interest for your entity:
regional, national and international



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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 €

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.
- Industr-IA Project bases on new artificial intelligence-based solutions for industrial production efficiency and flexibility.

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: Cooperation agreement for R&D; Technical Cooperation Agreement.

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



Production



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

We are a vertically integrated global services company present in 30 markets, with more than 12,000 employees worldwide, operating across the entire electricity value chain and in the gas supply business, supplying electricity and gas to more than 9 million customers.

More than 75% of the energy we produce comes from renewable sources, we are the world's fourth largest producer of wind energy and we have been recognised as the world's most sustainable electricity company by the Dow Jones Sustainability Index.

In Spain we employ more than 1,550 people, we are a benchmark in the energy market, present in generation, with more than 5,000 MW of installed capacity, 1.3 million electricity distribution supply points and a portfolio of commercialisation to business customers with a consumption of more than 17 TWh/year.

ENTITY DATA

Type: vertically integrated global services company

Size: 5,000 MW of installed capacity in Spain

Calls of interest for your entity: FCH JU, Green Deal, CDTI, MITECO and other calls .



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ACTIVITIES AND EXPERIENCES IN R&D&I

Hy2Market project funded by the Horizon Europe programme.

H2MetalIndustry project funded by the Government of the Principality of Asturias.

Approximate annual investment in R&D&I in hydrogen and fuel cells: 230.000 € in Spain

TECHNOLOGIES OFFERED

As technology users we do not offer technologies.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- PTe H2
- AeH2
- Asturias Regional Hydrogen Board
- Regional Hydrogen Board of Cantabria
- Renewable Ammonia Association
- Andalusian Hydrogen Alliance
- Galician Green Hydrogen Industrial Alliance
- Energy cluster of the Basque Country

Note: only the initiatives most directly related to hydrogen are listed.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Renewable Hydrogen Coalition

Note: only the initiatives most directly related to hydrogen are listed.



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.

In addition, Royal Decree-Law 8/2023 of 27 December 2023 provides that Enagás, as the natural gas Transmission System Operator, may operate as the provisional manager of the hydrogen backbone in Spain. In this regard, the company has developed a proposal for the hydrogen backbone infrastructure, with a ten-year horizon, which it has been presented to the Directorate General for Energy Policy and Mines of the Ministry for Ecological Transition and the Demographic Challenge on 29 April 2024.

ENTITY DATA

Type: Big company

Size: > 1000 employees

Calls of interest for your entity:
National and internacional



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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€

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 H2 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 H2 in natural gas grid (main Enagás involvement).
 - Investigation in H2 liquid carriers.
- Fund: Misiones CDTI.

HyStoreNew

- Investigation and integration of a set of technologies and processes related to the utilisation of green H2 as a strategic energy vector.
- Funds: CDTI Cien.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

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 H2, both in blends with natural gas or pure, and biomethane.
- Funds: EMPIR Call 2020.

THOTH

- Development of new methodologies, procedures and installation for testing the metrological behaviour of measurements devices installed in a gas grid carrying natural gas/H2 blend (up to 30% H2) or pure H2.
- Clean Hydrogen Partnership AWP 2022-05-04.

OPHYCS

- Development of a system for the continuous monitoring and detection of leaks of natural gas/H2 blends or pure H2.
- HORIZON-JTI-CLEANH2-2022-02-02.

FrHyGe

- The aim is to set up a demonstrator at the Manosque underground storage site (France) and to study the replicability of this technology at another site in Germany, and on a broader European scale.
- HORIZON-JTI-CLEANH2-2023-02-01

NHyRA

- To quantify H2 emission through the H2 value chain.
- HORIZON-JTI-CLEANH2-2023-05-03

PilgrHYm

- To develop a laboratory testing programme of specimen to close the gaps about compatibility of current pipeline steel to hydrogen.
- HORIZON-JTI-CLEANH2-2023-02-02



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



Uses in PGB2+ASPS

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**.

ENERGYLAB has been distinguished as **CERVERA excellence centre** by CDTI regarding H₂ production technologies in 2023.

The center actively works within the value chain of H₂, 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.

ENTITY DATA

Type: Technology center

Size: 21 - 50

Calls of interest for your entity:

European: (EU Horizon, FCH JU, Green Deal)

National: (CDTI, MITECO, MICINN)

Regional



<https://energylab.es/>



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Vigo, Pontevedra

ACTIVITIES AND EXPERIENCES IN R&D&I

- H2ENRY (2023-2025). Cervera CDTI. Excellence network focused on Green H₂ technologies.
- Consolidation Mixed Renewable Gas Unit (2020-2023). Joint project of Naturgy, ELAB and EDAR BENS. Financed by the Galician Innovation Agency (ERDF 2014-20).
- HYDEA (2023 - 2026). Interreg Atlantic Area. Promotion of green H₂ in ports.
- HIMOV (2023-2025). Interreg POCTEP. Crossborder ecosystem value chain around green H₂ in mobility applications.

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

TECHNOLOGIES OFFERED

- Biological pathway for H₂ production through dark fermentation.
- Electrochemical pathway for H₂ production through electrolysis (AEM/PEM/SOEC). Improvement of anion exchange composite membranes, electrode enhancement, reduction of BOP.
- Impact assessment of H₂ in end uses. Permeability and mechanical stress tests on materials.
- Injection of H₂ into the gas/biogas network and gas separation at the point of consumption.
- Power2Gas - biological methanation. Syngas enriched in H₂.
- Carbon capture and methanol production.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- PTe H2. Spanish Hydrogen Technological Platform.
- 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
- 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 H₂ production by electrolysis** Integration of alkaline electrolyzer and PEM-EL. 75KW and 14 Nm³H₂/h.
- **Renewable turbine plant:** Average flow 150,000 m³/h. Power generated 120-140 kW
- **Biological methanation pilot plant** (Power2Gas). 1 - 5nm³/h (2 m³) biomethane. Biogas requirement 1 - 5 Nm³/h, H₂ 2 - 8 Nm³/h.
- **Biomethane/H₂ mixture accumulator.** 70% biomethane - 30% H₂.
- **Membrane separation pilot plant** (upgrading). H₂/Ch₄ separation with H₂ recovery > 95% (up to 99,99% with PSA)
- **Methane or H₂/methane blends loading station:** compression capacity 36Nm³/h and 1,120 L.
- **Grid injection system (Naturgy):** Biomethane 65 Nm³/h and 17 bar.

TECHNOLOGY INFORMATION

Maturity level: technologies demonstrated at laboratory scale. Available for demonstration.

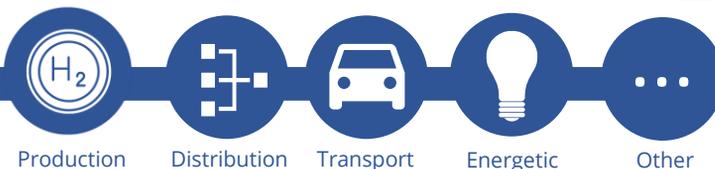
Industrial property rights: Other

Type of collaboration offered: Technical cooperation agreement. Available for research and prototype validation. External Technological Services.

APPLICATION SECTORS

- **Green H₂ production**
- **hydrogen production from biomass**
- **Power to Gas**
- **Refueling infrastructures: Gas mixture dispenser.**

¹UM 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)



TECHNOLOGY DESCRIPTION



Energy Technologies Laboratory

● **Permeability bench.**

Permeability of H₂, CH₄ and mixture, in gas pipes,

● **Engine test bench:** Evaluation of diesel/gasoline engines fueled with fuel/H₂ blends.

● **PEM/AEM test station:** Evaluation of performance of alkaline and proton Exchange membrane electrolyzers.

● **SOEC/SOFC test station:** High-temperature electrochemical characterization & power density evaluation.

● **Catalyst preparation:** Materials synthesis and characterization of materials with tech. Applications.

Biomass Laboratory

● **Fluidized bed gasifier,** Anaerobic sludge treatment coupled to WGS system.

● **Biological methanation:** Percolated bed type reactor (25 L), operated in thermophilic range and mixed inoculum.

● **Dark fermentation.** Batch and semi-continuous reactors for biological H₂ generation.

TECHNOLOGY INFORMATION

Maturity level: technologies demonstrated at laboratory scale. Available for demonstration.

Industrial property rights: Other. n

Type of collaboration offered: Technical cooperation agreement. Available for research and prototype validation. External Technological Services.

APPLICATION SECTORS

- **H₂ distribution. Piped distribution networks. Evaluation of distribution regulations.**
- **Transport Evaluation of hydrogen/methane mixtures in final consumers.**
- **Hydrogen production from biological route.**
- **Hydrogen electrochemical production (AEM/PEM/SOEC)**
- **H₂ enrichment of Syngas**
- **Biological methanation.**



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

The Regional Energy Agency (EREN) is a public body under private law, endowed with legal personality and its own assets, according to Article 10 provided for in Article 16.3 of Law 7/1986, of 23 December, on the Finance of the Community.

Its purpose is to promote and carry out initiatives and programmes of activities for research, study and support of energy technology actions, including renewables, as well as the improvement of energy savings and efficiency, the promotion of the rational use of energy, integrating the protection of the environment and the optimal management of energy resources, in the different economic sectors of Castilla y León, serving, thus, as a support for the promotion and execution of the region's energy policy.



<https://energia.jcyl.es/web/es/energia-mineria-castilla-leon.html>



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ACTIVITIES AND EXPERIENCES IN R&D&I

EREN facilitates the development of R+D+i projects in the field of Hydrogen. It is currently participating as a partner in the Hydrogen Association of Castilla y León H2CyL and collaborating for the implementation of consortia and projects in the areas of greatest interest to Castilla y León, such as the production of renewable hydrogen for the use of hydrogen in industry and the decarbonization of the transport sector through hydrogen.

El EREN da soporte a los Consorcios u otros grupos de interés en la definición conceptual, la búsqueda de socios, en facilitar las aplicaciones y demostraciones tecnológicas y en la búsqueda de financiación.

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

TECHNOLOGIES OFFERED

ENTITY DATA

Type: Public Administration

Size: 21- 50

Calls of interest for your entity:

European: Horizon Europe, Hydrogen Valleys (CHP), Green Deal,

National: IDAE Calls



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

EREN works as a guest advisor in the sub-working group on hydrogen technologies within the "Market Unity" working group that has been established by the Directorate-General for Industry and SMEs of the Ministry of Tourism, Trade and Tourism.

It develops and executes the collaboration agreements that the Autonomous Administration has signed with national entities, for the development of hydrogen activities within the region.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

EREN works in different sectors to promote the creation of a value chain at an integral level, which is why work is being done on:

- Hydrogen production,
- Transport
- Industrial uses
- Hydrogen for mobility
- Knowledge exchange

The EREN is part of different European hydrogen platforms such as:

- Hydrogen Europe
- Clean Hydrogen Alliance
- S3 Hydrogen Valleys partnership



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

We are a leading and benchmark company in the development of electric vehicle charging infrastructures, collaborating in the promotion of sustainable mobility and respect for the environment. With a focus on innovation and efficiency, we offer comprehensive solutions for the installation of state-of-the-art charging stations, adapted to the needs of our customers and thus contributing to the expansion of the electric charging network.

Our commitment to renewable energy is reflected in every project, promoting the use of clean and sustainable sources to power these charging points. With a team of electrical engineering experts and extensive experience in the sector, we guarantee the quality and reliability of our installations, driving the transition to a greener and more responsible future.

ENTITY DATA

Type: Small business

Size: 45 people

Calls of interest for your entity:
Electric mobility/hydrogen



<https://evectra.com/>



931122576



Info@Evectra.com



Passatge Masoliver 32 PB08005 Barcelona

ACTIVITIES AND EXPERIENCES IN R&D&I

We have been part of some consortia for LIFE and Horizon Europe projects. In addition, we started a project for the port of Tarragona with hydrogen boats and a hydrogen plant in the port.

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

TECHNOLOGIES OFFERED

Evectra Mobility Services, is a service, consultancy and engineering company that gives support to take to the real plane any project or prototype that you want to execute. We have the best programs and the best equipment for its elaboration.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Technical, economic and administrative feasibility study for an electric vehicle charging network in the city of Seville.
- Consultancy services for the electrification of 45 bus lines and their recharging system for Barcelona City Council. Other similar services for Infraestructuras ferroviarias de Catalunya, Barcelona de Serveis Municipals.
- Power studies for the Port of Barcelona.
- Action Plan for electric mobility in the Community of Madrid.
- Consultancy and engineering for electrification of Bizkaibus lines and for municipal car parks in Bilbao.
- Engineering services for electric buses for the EMT Madrid, Carabanchel and La Elipa depots.
- Evecra has designed the modification of the electrical installation of the "Muelle del Carbón" for Cartagena City Council.
- Recharging infrastructure projects for Tesla, Ionity, Zunder, EasyCharger, Wenea, Cable Energía, Atlante, ChargeGuru, Acciona, Disa...
- Framework agreements with Iberdrola, TotalEnergies and EDP. Drafting of projects for different airport car parks in Spain with AENA.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Development of the Enabling Framework for charging stations for electric mobility in the Dominican Republic, with FIIAPP.
- Project submitted in April 2024 for Horizon Europe call with international consortium, for bidirectional slow charging points in public car parks. Main pilot project in Barcelona and Milan.



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.

ENTITY DATA

Type: SME

Size: 51-100

Calls of interest for your entity:
European, National and Regional



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ACTIVITIES AND EXPERIENCES 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€

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 NATIONAL 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 (2025-2027)

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:

Type of collaboration offered:

APPLICATION SECTORS

- **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.

ENTITY DATA

Type: Public Entity

Size: 15 employees – 1,5M€

Calls of interest for your entity:



www.faen.es



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ACTIVITIES AND EXPERIENCES 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:

TECHNOLOGIES OFFERED



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 (PT e H2).

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
- 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



Uses in
PGB2+ASPS

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 H₂ and fuel cell technologies, publishing the Hydrogen Master Plan in Aragón (currently the 4th edition, 2021-2025), and showcasing the entire H₂ value chain. Its facilities include hydrogen production means (PEM, AEL AEM), test benches, and an HRS at 350 bar (soon to be 700 bar).

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, Agrupaciones Empresariales Innovadoras



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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€

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 MEmbrane 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 m² 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

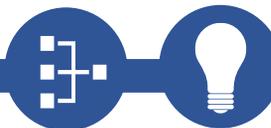
Maturity level: Available for demonstration

Industrial property rights:

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

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water; Unit; Process Control
- **H2 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 Nm³), membrane compressor (P_{suc} >10 bar, P_{out}: 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

FHa. Safety and legislation applicable to hydrogen systems



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 FHa 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

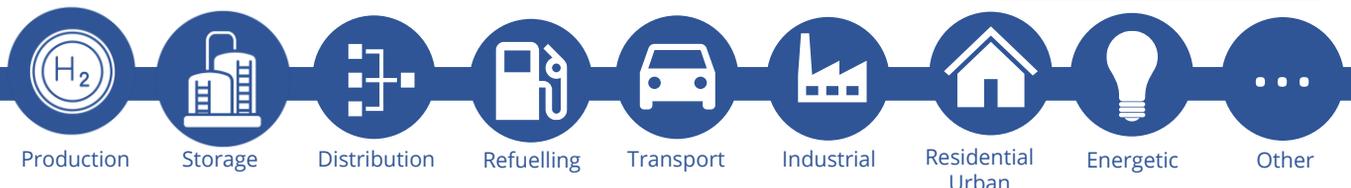
Maturity level:

Industrial property rights:

Type of collaboration offered: Service provision agreement; Technical Cooperation Agreement

APPLICATION SECTORS

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



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:

Industrial property rights:

Type of collaboration offered: Service provision agreement; Technical Cooperation Agreement

APPLICATION SECTORS

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



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

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.



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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.

ENTITY DATA

Type: Technology Research Centre.

Size: Medium

Calls of interest for your entity:

European: Horizonte Europa, CHE JU, Next Generation, Interreg

Nationals: CDTI, MITECO, MICINN, IDAE

Regionals



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.

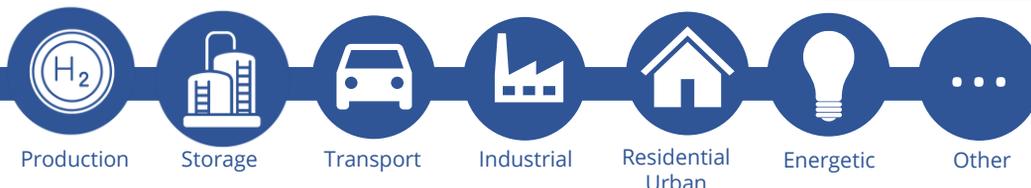
CIDAUT also participates in the main forums related to transport and energy, such as:

- **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 H₂.

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 H₂)
- 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

Development of stacks and fuel cells for specific utilisation requirements



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

Integration of H₂ and fuel cells in systems for electricity generation with application to the transport, industrial and building sectors



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

Design of combustion systems for pure H₂ and mixtures of H₂ with other fuels for application in thermal equipment and thermal engines



Industrial

TECHNOLOGY DESCRIPTION

Industry decarbonization involves reducing the use of fossil fuels and the search for alternatives that do not emit CO₂ and other pollutants into the environment. In this line, the use of H₂ as fuel is postulated, as well as mixtures of H₂ with other gases such as natural gas (NG) and ammonia (NH₃).

The technology offered by CIDAUT involves:

- Evaluation of the properties of H₂ and mixtures with NG, NH₃ 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 H₂, NG, NH₃ mixtures. Study of the impact of the introduction of H₂ 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.

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

- **Industrial:** Use of H₂ and gas mixtures with NG, NH₃ 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 NH₃ synthesis processes and their subsequent cracking and use in different thermochemical and electrochemical applications



Storage



Transport



Industrial

TECHNOLOGY DESCRIPTION

The use of NH₃ as a H₂ carrier has great advantages due to its high H₂ 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 NH₃ synthesis processes from renewable H₂, as well as on subsequent total or partial cracking processes to obtain H₂, as well as mixtures of H₂, NH₃ and N₂ that can be used both in fuel cells (with higher purity requirements) and in combustion engines (where H₂/NH₃ mixtures are a very advantageous fuel).

CIDAUT is working on:

- NH₃ to H₂ catalytic decomposition processes.
- Validation of H₂ separation technologies
- Integration of decomposers and power plant (MCIA, TG, PEMFC)
- Combustion of NH₃ and H₂/NH₃ mixtures
- NH₃ 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

- **H₂ storage:** Design of delocalised systems with new NH₃ synthesis processes as H₂ storage. Evaluation of new catalysts and operating conditions.
- **Transport:** Substitute NH₃-based solutions (high energy density) for power plants in transport with tough requirements in terms of power and autonomy. Integration of NH₃ decomposition and PEMFC and integration of NH₃ decomposition and MCIA.
- **Industrial:** use of H₂ from NH₃ in thermal systems for energy supply in the industrial field (burners), as well as H₂/NH₃ mixtures.



Production

Energetic

Other

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

Design, development and manufacture of H₂ generation systems using renewable substance reforming technologies.



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

- **H₂ production:** H₂ production systems from reforming technologies.
- **Energetic:** H₂ production in biorefineries.
- **Other:** manufacture of equipment



Production

DESCRIPTION OF THE ENTITY

The Advantx Technological Foundation, Funditec, is a private, non-profit foundation with a national scope, founded on February 3, 2003.

In October 2021, Funditec was accredited as a National Technological Center. Funditec participates in research, development, and innovation projects in areas of knowledge aimed at meeting the technological needs of companies and administrations.

We develop new functional materials to improve performance through their design and the use of new and efficient processing techniques.

ENTITY DATA

Type: Technology Center

Size: 21-50

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN

Regional



<https://funditec.es/>



910 91 83 34



research@funditec.es



Laboratorios: C/ Faraday 7, Campus de Cantoblanco 28049 Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

Participation in RIA and IA projects of European Union Programs. Currently, H2020 and Horizon Europe projects.

Participation in national and regional consortium programs (Trans-Missions, Public-Private Collaboration, CAM I+D technologies, etc.). Participation in national programs as a subcontractor: PIDs, Missions, etc.

Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-5 millions €

TECHNOLOGIES OFFERED

Advanced Materials Area – ENERGY:

- Hydrogen and Methanol: storage and production
- Batteries: material alternatives for anodes and cathodes
- Fuel cells: improved materials for electrodes. Modifications of conductive membranes.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- RECIPOL (Cervera Technological Centers Project - CDTI): Collaboration Network for the Research and Development of Technologies that Promote the Recycling and Valorization of Polyurethane Materials and Foster the Circular Economy
- BIOGREEN (CID Project - CDTI): Transformation of Waste Streams into Bioproducts for the Detergent and Plastic Industries through Green Chemistry Processes

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- WATERPROOF: urban WASTE and water Treatment Emission Reduction by utilizing CO₂ for the PROduction Of Formate derived chemicals
- NEFERTITI: Innovative photocatalysts integrated in flow photoreactor systems for direct CO₂ and H₂O conversion into solar fuels
- CATCO₂NVERS: Creating added-value chemicals from bio-industrial CO₂ emissions using integrated catalytic technologies
- CO₂SMOS: Advanced chemicals production from biogenic CO₂ emissions for circular bio-based industries
- RESURGENCE: Industrial water circularity: reuse, resource recovery and energy efficiency for greener digitised EU processes
- FRACTION: Novel lignocellulose fractionation process for high purity lignin, hemicellulose and cellulose valorisation into added value products
- NEMMO: Next Evolution in Materials and Models for Ocean Energy
- NEWSKIN: Innovation Eco-system to Accelerate the Industrial Uptake of Advanced Surface Nano-Technologies
- MOULDTEX: Friction optimisation of seals through advanced laser surface texturing of moulds



Production



Storage

TECHNOLOGY DESCRIPTION

Our Technological Center exclusively possesses the know-how to develop various technologies within the production and storage of H₂, without any existing patents or associated commercial products at present.

TECHNOLOGY INFORMATION

Maturity level:

- Lab-proven
- Developed but not marketed

Industrial property rights: Protected by industrial secret

Type of collaboration offered:

Cooperation agreement for R&D; commercial with technical assistance; provision of services; technical cooperation

APPLICATION SECTORS

- **H2 Production:** Unit (electrolyzer, gasifier) for
 - Water electrolysis
 - SMR (Steam Methane Reforming)
Methanol Reforming
 - Biomass
- **H2 Storage**



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

Generaciones Fotovoltaicas de la Mancha SL (GFM) is a company specialized in all kinds of solutions related to renewable energy, especially solar photovoltaic, wind, and storage. Electric mobility and green hydrogen have recently been added to the portfolio. Specialists in off grid systems, rural electrification and microgrids, self-consumption and solar pumping. Experience in cooperation projects and consultancy. Experts in national and international projects

Currently, 7 business lines are active that provide the client with a comprehensive service until the end of the useful life in solutions offered:

1. Self-consumption facilities
2. Renewable plants promotion
3. Operation and maintenance
4. R&D projects
5. International
6. Training
7. Sale of energy electricity market

ENTITY DATA

Type: SME

Size: 21-50 employees

Calls of interest for your entity:

European: HORIZONTE EUROPA, FCH JU, GREEN DEAL

National: CDTI, MITECO, MICINN

Regional



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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 a storage solution based on molten silicon.
- Research stationary storage technologies based on aluminum air
- Perimeter security solutions on site
- Solution for obtaining atmospheric drinking water from renewable energy sources
- Solutions for the development of portable energy solutions based on renewable storage and hybridization with the network / generator set.
- Development of a 1-axis solar tracker, for rapid deployment integrated into a 20-foot shipping container.

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

TECHNOLOGIES OFFERED

- Solutions for obtaining hydrogen through an electrolyser from nitrogenous compounds
- Molten Silicon-Based Storage Solutions
- Multi-source renewable energy processing center (hybridization of renewable plants, microgrid, multi-renewable self-consumption)
- Solutions for the management and optimization of supply connection infrastructures that include electric mobility infrastructure.
- Portable energy solutions based on renewables, with integration into the grid 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 electrolyser)



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

CURRENT PROJECTS:

NITRO D CELL. Development of a prototype electrolyzer for H₂ generation from nitrogen derivatives present in wastewater. H₂ VALUE CHAIN. PROGRAM 4. IDAE

SHAVING BOX. Development of a solution to optimize connection infrastructure in supplies with electrical recharging infrastructure. Call MOVES SINGULAR PROJECTS IDEA 2022

SMARTGREENERGY. Development of a renewable, flexible and bidirectional microgrid for EV charging infrastructure in fleets. Call MISSIONS CDTI 2022. In consortium.

FULFILLED PROJECTS.

MAGICBOX. Development of a multi-source energy processing center. Call PID CDTI 2020

ALTERA. Development of a storage system based on molten silicon. Call MISSIONS CDTI 2020. In consortium.

WATENERGY. Development of a system for obtaining atmospheric drinking water from renewable sources. INNOVA AHEAD JCCM 2019 Call

ALIENA, Development of a stationary storage system based on aluminium-air. Call for COLLABORATION CHALLENGES 2015 AEI. In consortium.

GERIS. Development of monitoring and control systems for solar pumping. INNOVA AHEAD JCCM 2017 call. In consortium

PERIMETER SECURITY, Development of perimeter security systems on site. Call FEDER INTERCONECTA 2016, CDTI. in consortium

GERIS. Development of a monitoring and management system for consumption and generation in self-consumption systems. INNOVA AHEAD JCCM 2018 Call, In consortium.

HIBRICOM. Hybridization in a vehicle with a combustion engine installing an electric motor and storage and renewables for the integration of a portable energy system in the vehicle. INNOVA AHEAD JCCM 2018 Call, In consortium.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

CURRENT PROJECTS:

NEON. Development of new business models for energy communities. 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

FULFILLED PROJECTS:

NGCPV. Development of high-precision two-axis solar trackers and development of new high-efficiency photovoltaic concentration technology. Announcement. First EU-Japan R&D project jointly funded by the European Commission 7th Framework Program and Japan's NEDO. Participation in plant operation.

SUNINBOX. Development of portable energy solutions for microgrids, based on renewable storage and hybridization with grid/generator. Development of a single-axis solar tracker integrated into a 20-foot shipping container for rapid deployment. HORIZON 2020 call. In consortium.

IDISTRIBUTEDPV. I develop business models based on distributed generation of PV systems in electrical systems. Call H2020-SMEInst-2016-2017/H2020-SMEINST-2-2016-2017. In consortium.



Production

TECHNOLOGY DESCRIPTION

Hydrogen production through the decomposition of nitrogenous compounds present in wastewater

TECHNOLOGY INFORMATION

Maturity level: Basic research

Industrial property rights: Applied for Patent. Collaboration HFC

Type of collaboration offered: Cooperation for R&D

APPLICATION SECTORS

- **H2 Production:** Obtaining H₂ from nitrogenous compounds present in wastewater



Production

Distribution

Refuelling

Industrial

Energetic

TECHNOLOGY DESCRIPTION

Development of green hydrogen plants from the installation of electrolysers based on the electrolysis of water and partially fed by solar PV generation systems

TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: NO

Type of collaboration offered: Service provision agreement, technical cooperation agreement

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water
- **H2 distribution:** Pipelines, underground pipelines
- **Refuelling infrastructures:** In situ hydrogen production
- **Industrial:** Green hydrogen as a raw material
- **Energetic:** Injection into the gas grid



Storage, transportation
and distribution



Production



Industry

DESCRIPTION OF THE ENTITY

Greene W2H2 S.L. is a company (December 2022), derived focused on the scientific-technical development related to thermochemical waste processes of the Greene Enterprise S.L. group. (Green). The company is located in the Industrial Park of the city of Elche and has its own facilities and staff. At GreeneW2H2 we are focused on the material recovery of all types of waste for the production of renewable hydrogen. For this reason, the nature and origin of those residues that allow obtaining a hydrogen with the Guarantees of Origin are analyzed, at the same time that the efficiency of the thermochemical recovery of said residues is improved day by day to maximize the fraction of hydrogen. renewable obtained.



<http://greenew2h2.com/>



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ACTIVITIES AND EXPERIENCES IN R&D&I

GreeneW2H2 carries out private R&D activities developed at 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 (at the laboratory, small-scale and pilot plant level) specialized in the material recovery 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 (autonomous, 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 millions €

TECHNOLOGIES OFFERED

GreeneW2H2 has developed a thermochemical route (pyrolysis-gasification-cracking) especially for the recovery of waste in simple gases, maximizing the hydrogen fraction. Subsequently, the water vapor displacement reaction (WGS) has been incorporated to obtain a greater amount of hydrogen than the original residue 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 based on its use.

ENTITY DATA

Type: SME

Size: <10 employees

Calls of interest for your entity:

European: Horizon Europe

National: CDTI, MITECO, MICINN

Regional: GVA, AVI, IVACE



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Member of the Spanish Hydrogen Association (AeH2).
- Member of the Spanish Hydrogen Technology Platform (PTe H2).
- Member of the Valencian Community Energy Cluster (CECV).
- Member of the Technological Institute of Energy (ITE) of the Valencian Community.
- Registration as a holder in the platform of Systems of Guarantees of Origin for renewable gases (GdO).
- Integrated in the **Renewable Hydrogen Strategy of the Valencian Community 2030**, as guests to the signing of the protocol as prominent members of said strategy.
- Member 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 low-carbon, renewable hydrogen.



TECHNOLOGY DESCRIPTION

GreeneW2H2 thermochemical technology with the integration of the WGS reaction and membrane systems with gas separation in the same production reactor can be recovered in the form of H₂ (and CO₂) all types of waste. Unlike traditional systems, where gasification is carried out in a single reactor, in the GreeneW2H2 integral gasification plant the processes are separated in different reactors. Thanks to this separation (pyrolysis-cracking-gasification), and meticulous control over the processes that take place in each of these reactors, the production of simple gases, specifically H₂, can be maximized. The production of H₂, is determined by the operating conditions imposed in the different stages (pyrolysis-cracking-gasification) being necessary the optimization of each of them to maximize the production of hydrogen. Subsequently, the incorporation of a WGS catalytic stage allows reaching the 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 the hydrogen obtained to be adapted to the technical specifications required for each possible application.

TECHNOLOGY INFORMATION

Maturity level: Developed but not marketed

Industrial property rights: Patented

Type of collaboration offered: Cooperation agreement for R&D and Technical Cooperation Agreement

APPLICATION SECTORS

- **H₂ Production:** Biomass full plant
- **H₂ Storage:** Compressed gas in tanks
- **Industrial:** Green hydrogen as a raw materia
- **Energetic:** Injection into the gas grid



Storage, transportation
and distribution



Production



Industry



Uses in
PGB2+ASPS

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:

European, National and Regional



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PARQUE CIENTIFICO Y TECNOLOGICO
C/ Ada Byron 220, 33230 Gijon, Asturias

ACTIVITIES AND EXPERIENCES IN R&D&I

HIVEO 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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Spanish Hydrogen Association (AeH2).
- Spanish Hydrogen Technology Platform (PTe H2).
- Spanish Ammonia Association.
- SEALEN.
- BATTERYPLAT.
- Engineering of the HyDeal project property.
- Opportunities in Spain (confidential).

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Collaboration agreements with technologists in the H2 value chain.
- International opportunities (confidential).



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

H2B2 is a technology company that promotes, develops, finances, designs, integrates, builds, operates and maintains hydrogen production systems based on water electrolysis, providing complete solutions for generation, compression, storage, commercialization, refilling stations and all other uses of renewable hydrogen.

Provides in-house capabilities to develop turnkey solutions, acting as EPC (Engineering, Procurement, Construction).



www.h2b2.es



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2 41700 Dos Hermanas (Sevilla) España

ACTIVITIES AND EXPERIENCES IN R&D&I

- Emerging electrolysis technologies (AEM, SOEC)
- Efficiency improvement through Balance of Plant optimization (BoP)

Involvement in national and international associations and working groups. In addition to its leadership in the Spanish Hydrogen Association and this Technology Platform, it participates in the standardization committees CTN 181 and CTN 222 and is a member of Hydrogen Europe and the Hydrogen Production Roundtable of the European Clean Hydrogen Alliance (ECH2A).

Approximate annual investment in R&D&I in hydrogen and fuel cells: from €1 to €5 millions

TECHNOLOGIES OFFERED

H2B2 designs, develops and manufactures water electrolyzers. From 0.5-2 Nm³/h H₂ cabin electrolyzers to plants from 10 to 100 MW, containerized or on skids-mounted and scalable up to GW:

- Containerized equipment (10-20 ft), on the range 10-60 Nm³/h H₂ (20-140 kg/day H₂; 50-330 kW_e)
- MW-scale equipment (40 ft container), on the range 100-800 Nm³/h H₂ (200-1,700 kg/day H₂; 0.5-4 MW_e)
- 10s-100s MW plants, both modular and skid-mounted design.

The solutions developed by H2B2 do maximize aspects as integrability, response time, automatic operation, maintainability, modularity, lifetime, and intrinsic safety.

ENTITY DATA

Type: SME

Size: 51-100 employees

Calls of interest for your entity:

European, Nationals and Regionals.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

CDTI Misiones 2021

Proyectos Regenera, Undergy, Eclasion.

CDTI Misiones 2022 (Grandes empresas)

Proyecto AD-GRHID.

IPCEI Hy2Tech

Proyecto Tecnopropia.

HORIZON-JU-CLEANH2-2022-1

Proyecto HyP3D.

IDAE Cdv Subprograma 1b

Proyecto TeStack H2

CDTI Misiones 2020

Proyecto UES365

IDAE Cdv Subprograma 4

Proyecto ESPAEM

HORIZON-CL5-2023-D2-01

H2SHIFT

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Involvement in national and international associations and working groups.

In addition to its leadership in the Spanish Hydrogen Association and this Technology Platform, H2B2 participates in the standardization committees CTN 181 and CTN 222, and is a member of Hydrogen Europe and the Electrolyser Partnership, and national representative in Clean Hydrogen Mission (Mission Innovation).

Renewable hydrogen production. Electrolyzers. H₂ utilization solutions, including refueling stations

H2B2
Electrolysis Technologies



TECHNOLOGY DESCRIPTION

H2B2 is a technology company that promotes, develops, finances, designs, integrates, builds, operates and maintains hydrogen production systems based on water electrolysis, providing complete solutions for generation, compression, storage, commercialization, refueling stations and all other uses of renewable hydrogen.

Brings forward in house capabilities for developing turnkey solutions, acting as EPC (Engineering, Procurement, Construction).

H2B2 designs, develops and manufactures water electrolyzers.

- On cabinet equipment, on the range 0.5-2 Nm³/h H₂ (1-5 kg/day H₂; 3-12 kW_e).
- Containerized equipment (10-20 ft), on the range 10-60 Nm³/h H₂ (20-140 kg/day H₂; 50-330 kW_e).
- MW-scale equipment (40 ft container), on the range 100-800 Nm³/h H₂ (200-1,700 kg/day H₂; 0.5-4 MW_e).
- 10s-100s MW plants, both modular and skid-mounted design.

H2B2 also sizes, designs and provides comprehensive solutions for hydrogen refueling stations, from production to the dispenser, considering the specific needs, uses, and vehicle types to be refueled.

The solutions developed by H2B2 do maximize aspects as integrability, response time, automatic operation, maintainability, modularity, lifetime, and intrinsic safety.

TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: Patented

Type of collaboration offered: Cooperation agreements for R&D, manufacturing, trade and technical assistance, service provision, technical cooperation, and other typologies

APPLICATION SECTORS

- **H2 Production:** Water electrolysis, covering the full plant
- **H2 Storage:** Compressed gas in underground caverns; Hydrogen carriers
- **H2 distribution:** hydrogen injection in gas grid
- **Refuelling infrastructures:** On site hydrogen production, compression, storage and dispensing, handling all types of vehicles (road, rail, maritime...); both stationary and portable hydrogen refueling stations
- **Transport:** H2 gas in tubetrailer
- **Industrial:** Renewable hydrogen as a raw material, industrial cogeneration systems (CHP), heat production in thermal power plants, and other industrial uses
- **Energetic:** Hydrogen injection into the gas network



Production

DESCRIPTION OF THE ENTITY

H2Greem is a technology company and manufacturer of PEM electrolyzers with its own technology, consolidating ourselves as a pioneer company in hydrogen technologies at the service of the energy transition together with its clients and partners.

We offer small and medium scale equipment (up to 1 MW), developing comprehensive solutions with our own technology that adapt to all types of client and project needs, following international standards and regulations.

To achieve this degree of technological development, we have completely developed, tested and evolved our systems, with a strong commitment to the research and development of technological improvements.

ENTITY DATA

Type: Pte. Ltd.

Size: SME under 50 FME

Calls of interest for your entity:

Technological development of PEM electrolysis.



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ACTIVITIES AND EXPERIENCES IN R&D&I

H2Greem is in continuous innovation, research and development of synthesis and deposition methods of catalysts, with the aim of improving the efficiencies of our stacks.

Approximate annual investment in R&D&I in hydrogen and fuel cells: 10% of annual global budget.

TECHNOLOGIES OFFERED

H2Greem has proton exchange membrane technology equipment.

Indicate here the name of your entity...



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

The global objective of the GREENH2PIPES project is research into new materials and manufacturing processes focused on the generation, storage and transport of hydrogen in a competitive manner. To this end, research will be carried out on new materials and manufacturing processes for the development of innovative components that allow the manufacture of a new generation of PEM electrolyzers, based on national technology, reducing technology costs (CAPEX €1,500/kW) and maintaining efficiency (55 kWh/kg) and durability.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Tentatively a LIFE Project in 2022.



Production

TECHNOLOGY DESCRIPTION

At H2Greem, our electrolyzers are based on cutting-edge PEM (Proton Exchange Membrane) technology. Our units are built with proprietary technology, combined with in-house catalyst and membrane prepared using renowned global brands, enables customized solutions.

Our stacks offer 2 active surfaces (25 cm² and 400 cm²), with a maximum unitary output of 50 kW per stack and we engineer and assemble a customized balance of plant to serve each project individually, including all required measurement elements if so requested.

TECHNOLOGY INFORMATION

Maturity level: TRL 9

Industrial property rights:

Type of collaboration offered: Development of all aspects related to PEM technology

APPLICATION SECTORS

- H2 Production



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 H₂ compression solutions.

In 2024 Hiperbaric has sold more than 30 hydrogen compressors installed in more than 10 different locations throughout Europe.

The Burgos facilities, with a surface area of 30,000m², 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



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ACTIVITIES AND EXPERIENCES IN R&D&I

R&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".

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 a compressor at the National Hydrogen Center (CNH₂), and another one within the Green Hysland project in Mallorca.

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 dozen customers in Europe, as enterprises as Framatome or Lhyfe, among others.



Storage



Distribution



Refuelling



Transport



Industrial



Residential
Urban



Energetic



Other

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 Distribution:** Compressed gas, underground pipelines, pipelines.
- **Refuelling infrastructures:** Compression, Storage and Dispense.
- **Transport:** Automobile, Heavy vehicle, Railway, Aviation, Maritime.
- **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.



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 m² plant with an annual production capacity of 180 highcapacity stations.

ENTITY DATA

Type: PYME

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Grean Deal

National: CDTI, MITECO, MICINN



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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>), cofinanced 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.

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 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 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 H2 produced by Gaia Future Energy in Morocco.
- Agreement with **PLUG POWER** for the supply of 10 hydrogenerators 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 **HYMPULSION** for the supply of 5 stations for "Zero Emission Valley", a pioneering programme in France.



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 H₂ 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

Industrial property rights: Trademark

Type of collaboration offered:

- Commercial agreement with technical assistance
- Service provision agreement (maintenance)
- Technical cooperation agreement
- R&D cooperation agreement

APPLICATION SECTORS

- **H₂ storage:** compressed gas in tanks
- **H₂ distribution:** loading tube trailers
- **Refuelling infrastructure:** compression, storage, dispensing
- **Transport:** automotive, heavy-duty vehicle, rail, aviation, maritime



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 H₂ source (Electrolyser, tube trailer, storage, pipeline).
- Compression module
- Medium and high-pressure buffer/storage (cascade)
- Cooling system
- Dispenser/dispenser

Dispenser 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 and heavy vehicles.

Certifications: CE, DESP, ATEX, MACHINE Directive.

TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: Trademark

Type of collaboration offered:

- Commercial agreement with technical assistance
- Service provision agreement (maintenance)
- Technical cooperation agreement
- R&D cooperation agreement

APPLICATION SECTORS

- **H₂ storage:** compressed gas in tanks
- **H₂ 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 Aragón Institute of Engineering Research (I3A), was created in 2002 being the first of the Universidad Zaragoza.

It consists of 305 PhD researchers (by Dec 2023) and an equivalent number of graduates, engineers and technicians. These are grouped into 34 research groups recognized by the Government of Aragón.

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 Hydrogen Technologies (H2CEL) 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.

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

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.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Spanish Hydrogen Technology Platform (PTE H2)
- Spanish CO₂ Technology Platform (PTECO2)
- Spanish Biomass Tecnology Platform (BIOPLAT)
- Spanish Innovation and Sustainable Chemistry Platform (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, Universitat Politècnica de Catalunya y Universidad Rovira i Virgili)
- Founding member of the GetHyGA project (Hydrogen Valley of Aragon)

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES



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

APPLICATION 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_2 . 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*

APPLICATION SECTORS

H2 Production:

- Methane reforming and other HC and alcohols (reactors with in-situ separation)



Production

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

APPLICATION SECTORS

• H2 Production:

- Methane reforming and other HC and alcohols (reactors with in-situ separation)
- Complete plant (design and techno-economic 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_2 and H_2 of electrolytic origin produced in periods of low electricity demand (or isolated systems). As a source of CO_2 , 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

APPLICATION SECTORS

• H2 Storage:

- 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_4 , Natural Gas, etc.

The use of this source of nitrogen, through these new combustion processes not only prevent the formation of NO_x 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

APPLICATION SECTORS

• H2 Storage:

- 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

APPLICATION 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
- Developed but not marketed

Industrial property rights:

- Protected by industrial secret

Type of collaboration offered:

- Cooperation agreement for R&D

APPLICATION SECTORS

• Transport:

- Automobile
- Heavy vehicle
- Railway



Transport



Industrial

TECHNOLOGY DESCRIPTION

We are developing advanced catalytic reactors for CO₂ 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 marketed

Industrial property rights:

- Patented

Type of collaboration offered:

- Cooperation agreement for R&D

APPLICATION SECTORS

- **Transport:**
 - e-fuels
- **Industrial**



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

ITC-AICE is a research center close to ceramic sector companies, with thorough knowledge and understanding of the ceramic manufacturing process. Moreover, ITC-AICE is formed by highly qualified professional team that has the infrastructure and appropriate technical and scientific equipment to carry out R&D&I projects and technology transfer to companies, with a view to generating innovation and enhancing the international strategic positioning of the ceramic sector.

ITC-AICE works in ceramic processing, energy efficiency, environmental footprint and circularity assessment, in addition to the improvement of functional ceramic surfaces properties and development of new technical features in the ceramic products. Process simulation to optimise products and processes, waste and pollutant minimisation studies, and the development of energy efficient processes are included among its activities.

ENTITY DATA

Type: Technological Center

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, LIFE, INTERREG

National: CDTI, MITECO, MICINN

Regional:



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ACTIVITIES AND EXPERIENCES IN R&D&I

Its strategic lines of R&D focus on circular economy, energy efficiency and optimization of resources and technologies. In the last 5 years, 570 R&D&I and technological advisory projects have been developed, financed with public funds or by companies. 180 articles with impact index and 54 institutional bibliographic references have been published. Likewise, 16 industrial property patents have been applied for, and 5 awards have been received that recognize the impact of the transfer of R&D and technology to the ceramic cluster. In the energy field, the work on optimizing the firing stage and improving combustion stands out, as well as the analysis of the energy transition towards a low carbon ceramic process.

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

TECHNOLOGIES OFFERED

- Combustion chamber adapted to work with controlled mixtures of natural gas and hydrogen.
- High temperature furnace (up to 1800 °C) with atmosphere simulation for the study of its effects during the thermal treatment of materials.
- Development of high efficiency burners for gaseous fuels.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Combustion chamber adapted to work with controlled mixtures of natural gas and hydrogen. Burner development



Industrial

TECHNOLOGY DESCRIPTION

There is a combustion chamber in which it is possible to study the combustion of gaseous fuels, completely adapted for the combustion of controlled mixtures of natural gas and hydrogen. The camera is sensorized, and it allows the measurement of the flows of each fuel, and the oxidizer provided to the installed burner, the analysis of the flame produced, and the study of the flue gases (composition, temperature, flow, etc.).

The knowledge acquired in combustion has allowed the development of a research line for the design and development of high efficiency burners for gaseous fuels.

TECHNOLOGY INFORMATION

Maturity level: Validated in laboratory and pilot plant

Industrial property rights: Not applicable

Type of collaboration offered:

- R&D Cooperation Agreement

APPLICATION SECTORS

- **Industrial:** Use of Hydrogen as a fuel for heat supply at medium and high temperature processes in thermal energy intensive industries. Design and development of high efficiency burners for gaseous fuels.

Controlled atmosphere furnace (temperatures up to 1800 °C) for the study the thermal treatment of materials



Industrial

TECHNOLOGY DESCRIPTION

In order to study the influence of the change the atmosphere on the behaviour in the thermal treatment of materials, and the possible attack that an atmosphere rich in water vapour can cause on the refractory of the furnaces, a controlled atmosphere electric furnace capable of reaching temperatures of up to 1800 °C is available. This is an electric furnace that allows atmospheres to be simulated to reproduce the gases that would result from combustion, in the case of hydrogen, from the combustion of mixtures of natural gas and H₂ (CO₂, O₂, N₂ and water vapour).

TECHNOLOGY INFORMATION

Maturity level: Kiln developed and service offered

Industrial property rights: Not applicable

Type of collaboration offered:

- R&D Cooperation Agreement
- Material testing service with different atmospheres

APPLICATION SECTORS

- **Industrial:** Study of the effect of changing the atmosphere during hydrogen combustion on the quality of processed treated products.



Storage, transportation and distribution



Production



Industry



Uses in PGB2+ASPS

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.

ENTITY DATA

Type: Technology or Research Center

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, Hydrogen Europe, Life. EDF

National: CDTI, AEI, MITECO, MICINN

Regional and Others.



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<https://goo.gl/maps/FrseyTdcspT8iiVs5>

ACTIVITIES AND EXPERIENCES IN R&D&I

Ongoing international R&D projects:

- HyPEF Promoting an environmentally-responsible Hydrogen economy by enabling Product Environmental Footprint studies.
- NIMPHEA Next generation of improved High Temperature Membrane Electrode Assembly for Aviation.
- PROMETEO: Hydrogen PROduction by MEans of solar heat and power in high TEMperature Solid Oxide Electrolysers.
- MOF-PEMs Design Proton-Conducting Metal Organic Frameworks based membranes for Proton Exchange Membrane Fuel Cell Applications .

Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-5 million €

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 H₂. 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.

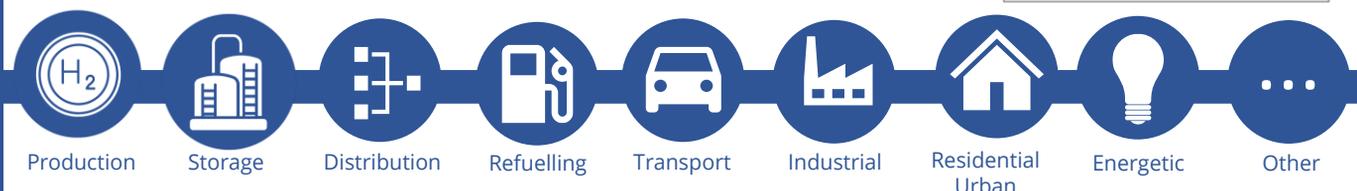


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- BIOMIO: Conversion of biowaste into hydrogen and microbial oils for biofuel production, MCIN/ AEI PID 2020.
- GREENH2-CM Strategic positioning of the Community of Madrid in R&D&I of green hydrogen and fuel cells, CM-MCIN/AEI .
- H2-MOF Membranes based on new generation of MOFs for application in H2 technologies: fuel cells and electrolyzers, MICIN NextGenerationEU PRTR.
- HYLIOS Innovative photocatalytic systems for the production of green hydrogen from wastewater, MICIN NextGenerationEU PRTR.
- HYWARE Renewable hydrogen from waste: a circular solution for regions without land availability, MICIN-FEDER-UE .
- NITRO-D-CELL New electrolyzer based on urea derivatives, IDAE NextGenerationEU PRTR.
- SOL-Future: Solar Catalysis for a renewable energy future, MCIN NextGenerationEU PRTR.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- HyPEF Promoting an environmentally-responsible Hydrogen economy by enabling Product Environmental Footprint studies, HORIZON-JTI-CLEANH2-2023-1
- HYPOP HYDrOgen Public OPiniOn and acceptance, HORIZON-JTI-CLEANH2-2022-2
- HySolChem: Hybrid Reactor for Solar CO2 and N2 Conversion Coupled to WasteWater Treatment, H2020-FETPROACT-2020 (coordinador)
- JUST-GREEN AFRH2ICA Promoting a JUST transition to GREEN hydrogen in AFRICA, HORIZON-JTI-CLEANH2-2022-1
- MOF-PEMs Design Proton-Conducting Metal Organic Frameworks based membranes for Proton Exchange Membrane Fuel Cell Applications HORIZON-MSCA-2021-PF-01
- NIMPHEA Next generation of improved High Temperature Membrane Electrode Assembly for Aviation, HORIZON-JTI-CLEANH2-2022-1
- NOUVEAU Novel electrode coatings and interconnect for sustainable and reusable SOEC, HORIZON-CL4-2021-RESILIENCE-01-12
- PROMETEO Hydrogen PROduction by MEans of solar heat and power in high TEmpperature Solid Oxide Electrolyzers, H2020-JTI-FCH-2020-1.



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.

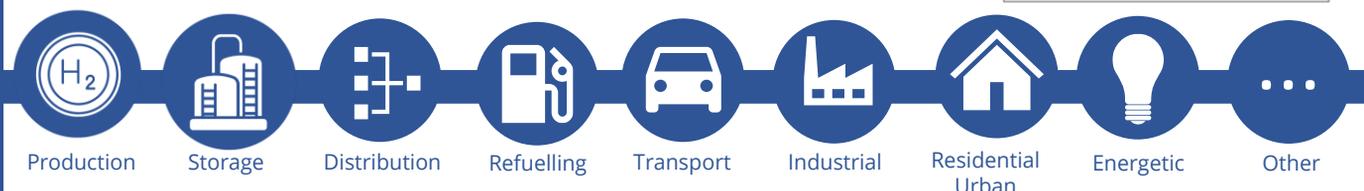
Industrial property rights: Copyright registers and trademarks for software. Protected by industrial secret.

Type of collaboration offered:

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

APPLICATION 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).

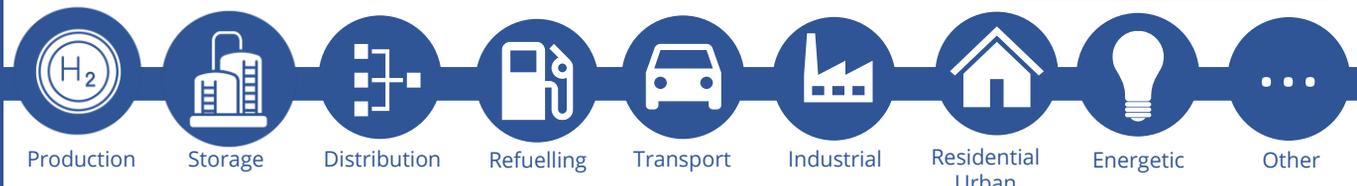
Industrial property rights: Patented and Protected by industrial secret.

Type of collaboration offered:

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

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass and other technologies.
- **Refuelling infrastructures:** In situ hydrogen production.
- **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, photocatalysts,, adsorbents, materials for high temperatures, electrodes, membranes and microorganisms for the production, purification, use and conversion of hydrogen, applicable to electrolysers, fuel cells and solar reactors: MOFs, conjugated porous polymers, inorganic semiconductors, 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 (depending on topics).

Industrial property rights: Patented and Protected by industrial secret.

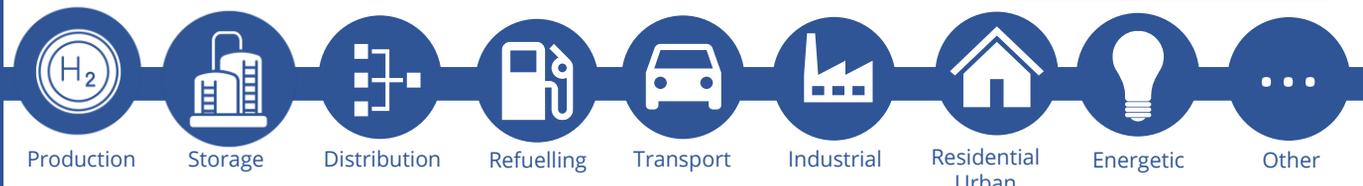
Type of collaboration offered:

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

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass and other technologies.
- **H2 Storage:** Hydrogen carriers.
- **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**

Algorithms for sizing and real-time management of hybrid plants with hydrogen production



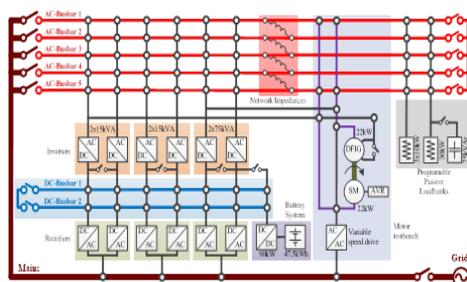
TECHNOLOGY DESCRIPTION

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 networks and microgrids.



TECHNOLOGY INFORMATION

Maturity level: Lab-proven, Developed but not marketed (depending on topics).

Industrial property rights: Patented and 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 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**



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

INTA is a Public Research Organization under the Ministry of Defense, specializing in aerospace research and technological development, as well as encompassing R&D areas in terrestrial, naval, and defense fields.

Among its main functions are the acquisition, maintenance, and continuous improvement of new application technologies; the performance of all types of homologation and certification tests for materials, components, equipment, and systems; technical advice and the provision of services to industrial, technological companies and public organizations.

Activities related to H2 are carried out in different areas of the Aeronautical Subdirectorate, particularly in the Energy and Environment Area, the Composite Materials Area, and the Chemical Propulsion Area.

ENTITY DATA

Type: Public Research Organization

Size: 1500 employees

Calls of interest for your entity:



www.inta.es



915202005 - 915201446



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Torrejón de Ardoz (Madrid) / Arenosillo (Huelva)

ACTIVITIES AND EXPERIENCES IN R&D&I

- Integration, testing, optimization, and evaluation of high and low temperature PEM single cells, stacks, and complete fuel cell systems under different operating and environmental conditions (temperature, humidity, altitude, vibration, EMC, etc.).
- Research and development of algorithms that solve reactive flows in complex configurations. Development, implementation, and validation of CFD tools (BERTA). Study of physical phenomena occurring in H2 combustion.
- Techniques for manufacturing cryogenic tanks (-253 °C), material characterization (conventional and novel), geometry design, and sensor installation to monitor the state of the tanks.

Approximate annual investment in R&D&I in hydrogen and fuel cells: €500,000

TECHNOLOGIES OFFERED

- Integration, evaluation, and optimization of single cells, stacks, and complete systems.
- Characterization, mechanical, environmental, and EMC testing.
- Homologation and certification of equipment for aerospace, marine, and terrestrial applications, following both civil and military standards.
- Characterization testing of materials, equipment, and tanks under cryogenic and H2 conditions.
- Characterization of micro-grid components with renewable production and storage in batteries and hydrogen.
- Simulation and testing of hydrogen combustion and hydrogen mixtures with other fuels.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- GREEN H2: CAM. Installation for cryogenic and material testing. Installation for H2 combustion testing.
- Testing of bottles for storing gaseous and liquid H2 developed by Spanish and foreign industries at facilities in León.
- Testing of components and cells, as well as training of national industry personnel in cell testing.
- Training in hydrogen technologies through various collaboration programs and networks.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- FASTERH2: Horizon Europe, Clean Aviation, 2023 – 2026. Study of H2-compatible materials for use in commercial aircraft, cryogenic and H2 environment testing.
- R&D&I projects in collaboration with MINISDEF: INDY and NOMAD.
- National representative of the IEA H2TCP.
- Development of guidelines and analysis of regulations for the implementation and certification of technologies in aviation (CS 23 and CS 25, DO160) with liquid and gaseous hydrogen, safety, risks. Participation in EUROCAE WG80.
- Participation in RTO groups on the implementation of these technologies in combat (RTO SET 270).
- Participation in the Association of European Research Establishments in Aeronautics (EREA).

Micro-grid with renewable production and storage in batteries and hydrogen.



Instituto
Nacional
de Técnica
Aeroespacial



Production



Storage



Refuelling



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

The INTA micro-grid integrates renewable energy generation systems (photovoltaic fields and wind turbine), energy storage systems, and various loads, both mobile (electric vehicles) and stationary. This micro-grid allows for the characterization and evaluation of components and technologies, at a pilot plant scale, under real operating conditions.

TECHNOLOGY INFORMATION

Maturity level: Developed and validated. Available for demonstration.

Industrial property rights:

Type of collaboration offered: Cooperation agreements for R&D and technical services, technical advice and service provision to entities and official organizations, as well as to industrial and technological companies.

APPLICATION SECTORS

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

Test benches for high and low temperature PEM fuel cells, electrolyzers, and batteries.



Instituto
Nacional
de Técnica
Aeroespacial



Production



Storage



Transport



Industrial



Residential
Urban

TECHNOLOGY DESCRIPTION

The available test benches are used for the characterization and evaluation of electrochemical systems and technologies for: (i) hydrogen generation through electrolysis and biofuel reforming, (ii) energy conversion using cells, stacks, and high and low temperature PEM solid polymer fuel cell systems, and (iii) energy storage using batteries and supercapacitors.

The experience and the available scientific and technological equipment enable participation in numerous R&D&I projects focused on the definition, development, and evaluation of innovative solutions and technologies in energy storage, conversion, and management for mobile and stationary applications, as well as the testing and characterization of innovative energy storage and conversion components and systems: batteries, supercapacitors, fuel cells, electrolyzers, H₂ storage systems, reformers for H₂ production, DC/DC and DC/AC converters, etc.

TECHNOLOGY INFORMATION

Maturity level: Developed and validated. Available for demonstration.

Derechos de la propiedad industrial: N/A

Type of collaboration offered: Cooperation agreements for R&D and technical services, technical advice and service provision to entities and official organizations, as well as to industrial and technological companies.

APPLICATION SECTORS

- **H₂ Production**
- **H₂ Storage**
- **Transport**
- **Industrial**
- **Residential/urban**



Storage



Transport

TECHNOLOGY DESCRIPTION

Study of H₂-compatible materials for use in commercial aircraft, cryogenic and H₂ environment testing. Testing of new components for aviation use under cryogenic conditions (valves, evaporators, tanks, etc.). Testing of bottles for storing gaseous and liquid H₂ (León facilities).

TECHNOLOGY INFORMATION

Maturity level: Developed. Testing laboratory.

Industrial property rights: N/A.

Type of collaboration offered: Cooperation agreements for R&D and technical services, technical advice and service provision to entities and official organizations, as well as to industrial and technological companies.

APPLICATION SECTORS

- H₂ Storage
- Transport



Transport



Industrial



Other

TECHNOLOGY DESCRIPTION

BERTA is a CFD (Computational Fluid Dynamics) code developed entirely at INTA. It allows the resolution of 3D, compressible, stationary and non-stationary, laminar and turbulent, non-reactive and reactive flows. Its modular nature allows the addition of new capabilities based on the physical phenomena to be studied. Currently, BERTA has the ability to resolve 3D combustion with combustion models for methane-air and hydrogen-air mixtures. Its extension to the combustion of other types of mixtures is immediate by adding a new module with its combustion model.

This software has been used in projects involving INTA and in obtaining results for several publications and conference presentations. It has the capacity to resolve H₂-air combustion under partial and total confinement conditions for the study and characterization of phenomena such as auto-ignition, flame flashback and transition to detonation, thermoacoustic instabilities, and reaction front propagation. An experimental facility for its validation with H₂ is being developed.

TECHNOLOGY INFORMATION

Maturity level: Developed and validated. Available for demonstration.

Industrial property rights: Registered copyright.

Type of collaboration offered: Cooperation agreements for R&D and technical services, technical advice and service provision to entities and official organizations, as well as to industrial and technological companies.

APPLICATION SECTORS

- **Transport**
- **Industrial**
- **Residential/urban**
- **Other:** H₂ Combustion Engine



Production



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

ITE 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 H2 pilot plant, a fuel cell laboratory and a digital energy pilot where it can establish strategies for the incorporation of H2 as a vector in the grid.

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

Regional



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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 €

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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- **Alianza de Hidrógeno Renovable de la Comunitat Valenciana (AH2CV)**

The mission of the AH2CV is to bring together all stakeholders in the regional industrial and technological ecosystem in renewable hydrogen technology. The aim is to develop and support a competitive regional value chain oriented towards the industrial development in the Valencian Community through the creation of a technological development ecosystem that involves the industries and research centers of the Valencian Region. ITE is the Technical Secretariat of the Renewable Hydrogen Alliance of the Valencian Region (AH2CV).

- **Plataforma Tecnológica Española del hidrógeno (PTeH2)**

ITE is an active member of PTeH2 through its participation in the National and International Collaboration Groups; and in the Knowledge Groups:

- Production
- Storage and distribution
- Uses in Industry
- Uses in Mobility
- Power grids, buildings, auxiliary, back-up and power systems

DESCRIPTION OF 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.

- **Hydrogen Europe Research**

ITE actively participates in the following technical committees, working groups and Roadmaps:

Pillar 1. H2 production

- Electrolysis
- Role of electrolysis in the Energy system
- Industrial applications

Pillar 2. H2 storage, transport and distribution

- Developing existing H2 transport means
- H2 refueling stations

Pillar 3. End-uses

- Fuel cell electric vehicles technology building blocks
- Road heavy duty vehicles
- Stationary fuel cells
- H2 turbines and burners
- Industrial applications

Cross-cutting group

- H2 Valleys

Policy Working Group

Low-TRL Research Working Group



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

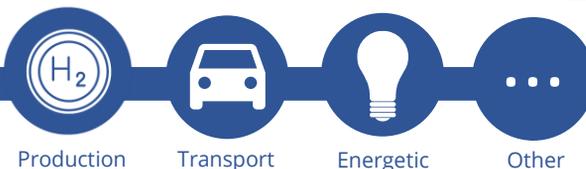
Maturity level: Lab-proven

Industrial property rights: not apply

Type of collaboration offered: Cooperation agreement for R&D, Service provision agreement and Technical Cooperation Agreement

APPLICATION 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.

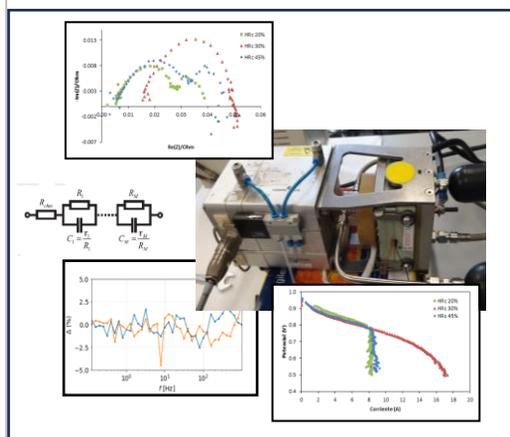


TECHNOLOGY DESCRIPTION

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

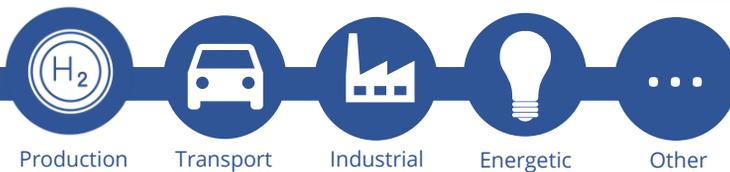
Maturity level: Lab-proven

Industrial property rights: not apply

Type of collaboration offered: Cooperation agreement for R&D, Service provision agreement and Technical Cooperation Agreement

APPLICATION SECTORS

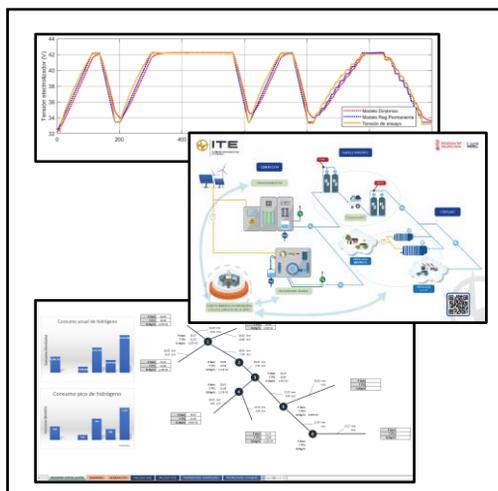
- **H2 Production:** electrolysis of water (components, unit, auxiliary elements, process control and full floor).
- **Transport:** component testing, power electronics, state of health estimation and fuel cells (automotive).
- **Other:** testing of components and fuel cells for other applications. Detection, 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.



TECHNOLOGY INFORMATION

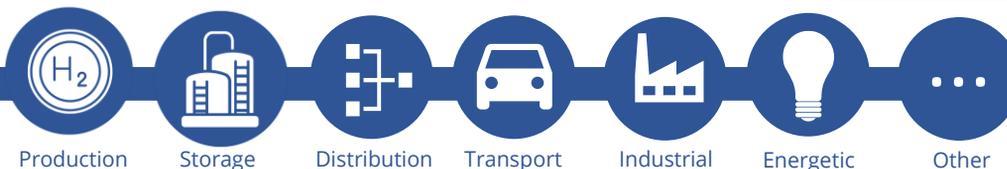
Maturity level: Lab-proven

Industrial property rights: not apply

Type of collaboration offered: Cooperation agreement for R&D, Service provision agreement and Technical Cooperation Agreement

APPLICATION SECTORS

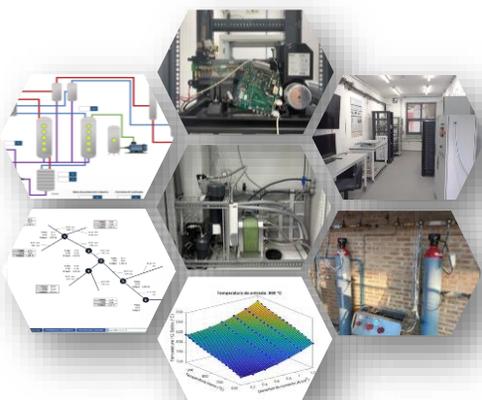
- **H2 Production:** electrolysis of water (components, unit, auxiliary elements, process control and full floor).
- **Transport:** fuel cells for automobile and heavy transport applications.
- **Industrial:** green hydrogen as a raw material.
- **Energetic:** production and storage of Energy coupled electrical grid.
- **Other:** simulation of behaviour, prediction, degradation and digitalization of fuel cell and electrolyzer.



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; Developed but not marketed

Industrial property rights: not apply

Type of collaboration offered: Cooperation agreement for R&D, Service provision agreement and Technical Cooperation Agreement

APPLICATION SECTORS

- **H2 Production:** electrolysis of water (components, unit, auxiliary elements, process control and full floor).
- **H2 Storage:** compressed gas in tanks, metal hydrides.
- **H2 distribution:** pipelines.
- **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:** integration in management platforms.



Production



Mobility



Industry

DESCRIPTION OF THE ENTITY

CMT-Clean Mobility&Thermofluids is a research institute integrated in 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:

International: Horizon Europe, Clean Hydrogen JU, Green Deal, International Cooperation,

National: CDTI, MITECO, MICINN

Regional.



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Universitat Politècnica de València, 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 H2 as single fuel, dual-fuel and blended for internal combustion engines and gas turbines. Combustion activities also include the use of NH3 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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Design and validation of innovative materials for development as proton exchange fuel cell electrolytes in vehicles (INNOMAT-H2). Generalitat Valenciana. 2021-25.
- Definition of fuel cell powertrain architectures for the decarbonization of road freight transport supporting the hydrogen economy deployment (DEFIANCE). 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 (DIVERGENT). Spain State Research Agency. 2022-24.
- Optimisation of engines using hydrogen as fuel for global decarbonisation (BIOH2-FUEL). 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 (DIGIAMONIA). Spain State Research Agency. 2023-2024.
- Integrating multi-functional exhaust aftertreatment systems in hybrid powertrain vehicles. Spain State Research Agency. 2022-2024.
- Feasibility study for hydrogen-fuelled engines RETROFIT-H2. Renault Group-Dimsport, 2022-24

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Renewable and flexible fuel power generation technology enabling the multi-sectorial decarbonization with zero emissions (ALL-IN ZERO). Project Coordinator. European Commission. 2022-26.
- Advanced MEAS ensuring high efficiency HDV (MEASURED). Clean Hydrogen JU. 2023-26.
- 2,0L Multi cylinder test with NH3. ARAMCO. 2022-24.
- MEDAS 5030 V validation for reciprocating H2 combustion engines. Horiba Europe 2023.
- Numerical H2-MCE investigation for achieving power density targets. Volvo Trucks. 2023.



Transport



Industrial

TECHNOLOGY DESCRIPTION

CMT-Clean Mobility& Thermofluids 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

APPLICATION 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% H₂ engine can be considered zero-emission as it emits <1 g CO₂/kWh or <1 g CO₂/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

APPLICATION SECTORS

- **Transport:** Automotive, heavy-duty vehicles, Locomotive, Aviation
- **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 ICE 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-Clean Mobility&Thermofluids 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 ICEs.

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

APPLICATION SECTORS

- **Transport:** Heavy-duty vehicles, Locomotive, Maritime, Aviation
- **Industry:** 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 (NO_x). 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

APPLICATION SECTORS

- **Transport:** Automotive, heavy-duty vehicles, Locomotive, Maritime
- **Industrial:** Stationary electric and thermal energy generation (CHP)
- **Energetic:** Stationary electric and thermal energy generation (CHP)



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

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.



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ACTIVITIES AND EXPERIENCES IN R&D&I

ITG 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 for optimisation of renewable hydrogen generation, storage and use.
- Design, modelling and digitalisation of renewable hydrogen generation, storage and consumption systems.

ENTITY DATA

Type: Technology and Research Centre

Size: >100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU

National: CDTI, MITECO, MICIN



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

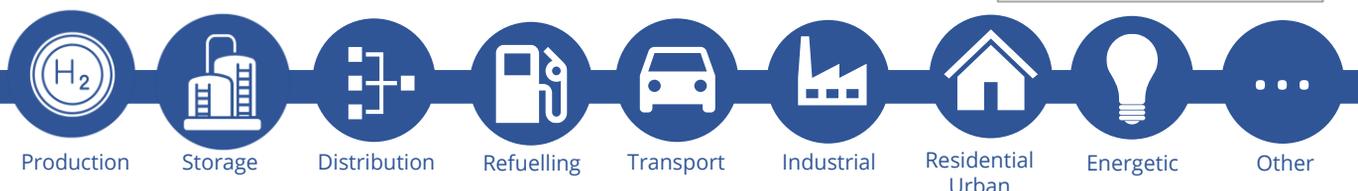
- Spanish Hydrogen Technological Platform (PTe H2)
- Galician Hydrogen Association (AGH2)
- Galician Industrial Alliance for Green Hydrogen

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

AIHRE Project. POCTEP. Spain – Portugal

AIHRE project aims to establish a technological and business network to take advantage of the potential of renewable hydrogen generation in Spain and Portugal. This network will allow the boosting of the economic potential of the POCTEP region around the renewable hydrogen value chain.

<https://aihre.eu/en/>



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

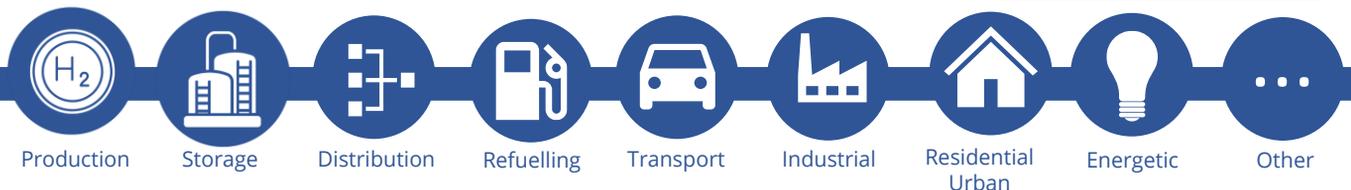
Maturity level: Lab-proven

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

APPLICATION 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 to the electricity 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 optimization.
- 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 ITG iPower 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

APPLICATION SECTORS

- **H2 Production:** Process control and full floor in systems by water electrolysis.
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- **Other:** Applications in port areas.



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

Founded in 1906, Leitrat 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. Leitrat 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. Leitrat actively participates in Regional, National and European projects both as partner and as coordinator.

Additionally, Leitrat 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 Center

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, JTI CleanH2JU.

National: CDTI, MITECO, MICINN.

Regional.



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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; (ii) Design, manufacturing and characterization of H₂ reactors and pilots for H₂ production (PEM, AEM, PEC, MEC DF) and H₂ use (fuel cell and hydrogenations); (iii) Development and characterization of materials for H₂ storage and distribution (LOHCs, MOFs, carbons, coatings); and (iv) 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

- Research and development of catalysts, electrodes, and membranes for H₂ production and use systems.
- Development and characterization of electrochemical, photoelectrochemical, photochemical, biological and bioelectrochemical systems.
- Development of membranes for H₂ purification and separation.
- Development of LOHCs, MOFs, carbons and anticorrosive coatings for H₂ storage and transport.



DESCRIPTION OF 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)
- **La Vall d'Hidrogen de Catalunya**
- **Red H2CAT**

Leitat participates in the following national projects carrying out the stated activities:

- **Regenera (Misiones).** Water purification, LOHCs, BES, LCA, LCC.
- **StackAEM.** Research and Development of materials and components for AEM stack of 5 kW.
- **Lupyplast.** Synthesis of modified carbons and characterization as electrodes for H2 production and use.
- **H2Enry.** Research, development and transference network to impulse the renewable hydrogen value chain.
- **DisTech2.** Research and development of materials and components for new generation of modular quasi-solid photoelectrolizers.

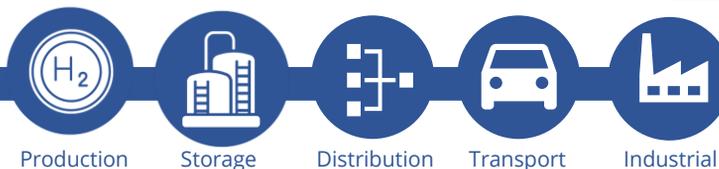
DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Active member in the following international platforms/associations/clusters:

- **Emiri FG H2**
- **HER** (Hydrogen Europe Research)
- **Waitro**

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.
- **X-SEED (HE-CHP).** Development of a disruptive electrolyzer operated with water under supercritical conditions.
- **SH2AMROCK (HE-CHP).** Deployment of Ireland's first hydrogen valley and H2 multi-modal transport hub in Galway.



TECHNOLOGY DESCRIPTION

Development of materials (catalysts, electrodes, membranes, coatings).

Synthesis and characterization of them for **production, use and conversion of H₂**. 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, spray, serigraphy and additive manufacturing. For **H₂ 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.

Design, manufacturing and characterization of the above-mentioned reactors and prototypes, at laboratory scale, for H₂ 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. Service provision agreement. Technical cooperation agreement.

APPLICATION SECTORS

- **H₂ Production:** Through electrolysis and photoelectrolysis of water. From biomass through bioelectrochemical and biological reactors (dark fermentation).
- **H₂ Storage:** LOHCs, MOFs, porous carbons and anticorrosive coatings.
- **H₂ distribution:** membranes for purification and distribution. Anticorrosive coatings of pipelines and tanks. Polymeric membranes for deblending.
- **Transport:** Development of components for fuel cells and electrochemical tests.
- **Industrial:** green hydrogen as raw material for the production of synthetic fuels. Biomass hydrodeoxygenation for added value chemicals production.



Production

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 H₂, 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 H₂ 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

Regionals



<https://www.lhyfe.com/>



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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 H₂, 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.

TECHNOLOGIES OFFERED

- Renewable hydrogen production.
- Renewable hydrogen storage.
- Distribution of renewable hydrogen.

Approximate annual investment in R&D&I in hydrogen and fuel cells: 1 - 5 millions €



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Lhyfe Hidrógeno, the subsidiary in Spain of Lhyfe, participates in Spain in the following initiatives:

- AeH2: Spanish Hydrogen Association.
- Andalusian Hydrogen Cluster.
- 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 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:**

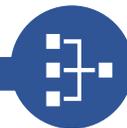
- **Bretagne, France (5MW).** Lhyfe's second renewable hydrogen production facility. Start-up during the second semester of 2023, with the support of ADEME.
- **Occitanie, France (5MW).** Start-up at the end of 2023. This project has been the winner in the "H2 Corridor" tender for the Occitania region.
- **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
- Manufacturing agreement
- Trade agreement with technical assistance
- Service provision agreement
- Technical cooperation agreement

APPLICATION SECTORS

- **H2 Production:**
 - Electrolysis of water
 - Full floor
- **H2 Storage:**
 - Compressed gas
- **H2 distribution:**
 - Underground gas pipelines
 - Pipelines
 - Tube trailer
- **Refuelling infrastructures:**
 - In-situ hydrogen production
 - Compression
 - Storage
- **Transport:**
 - Heavy vehicle
 - Railway
 - Fuel cell
- **Industrial:**
 - Green hydrogen as raw material



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

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: SME

Size: 11-20 employees

Calls of interest for your entity:

Cluster 4-5-6 of Horizon Europe and the Hydrogen Partnership programme. Every call where a sustainability analysis through LCA is requested.



<https://lomartov.com/>



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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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

The SME does not take part in any national initiatives related with H2 and fuel cells. However, they are constantly collaborating through European initiatives with high level Spanish RTOs who are investigating in H2 and fuel cells technologies, and all the sectors tackled by the platform.

DESCRIPTION OF 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 H2", 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 H2 as an energy vector.



Production



Mobility



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

Metalor Technologies S.A. (METALOR) is a Swiss multinational, founded in 1852, which belongs to the Japanese group TANAKA KIKINZOKU KOGYO K.K.

METALOR and TKK are world leaders in the manufacturing of “products” based on precious metal (PM) chemistry, which are used in multiple sectors, such as electronics, fine chemicals, petro-chemicals, aerospace, semiconductors, luxury, automotive, pharmaceutical, manufacturing, energy and decarbonization.

TKK leads the Japanese decarbonization market with the most advanced technologies and products for H2 production, purification and utilization.

“We use our knowledge and experience to develop innovative products and support our customers by working on collaborative partnerships, including product customization.

Our R&D centers are located in Europe, America and Asia to provide advice and assistance to our clients, thus enabling solid and lasting relationships. Our catalyst production plants are located in Japan and Switzerland.”

ENTITY DATA

Type: Company

Size: 1.500 Metalor Group
+5.000 TKK Group

Calls of interest for your entity:



www.metalor.com



+34 913 757 480



Metalor.es@metalor.com



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ACTIVITIES AND EXPERIENCES IN R&D&I

- Supplying technologies for R&D purposes,
- From a few grams till hundreds of kg.
- High industrial production capacity.
- No scaling-up problems
- Pilot plant for catalyst trials

<https://tanaka-preciousmetals.com/en/showroom/movie/?fc-en>

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

TECHNOLOGIES OFFERED

- Precursors for the manufacturing of PM-based catalysts.
- Water Electrolysis: Catalysts, electrodes...
- Chemical conversion, catalysts for:
 - SRM
 - W.G.S.
 - PROX
 - Ammonia Cracking
 - Methanol Reforming
- Membranes for H2 and catalysts for gas purification.
- Catalysts for fuel cells (PEFCs)
- Recycling of catalysts and production wastes.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES



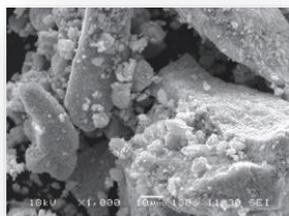
Production

TECHNOLOGY DESCRIPTION

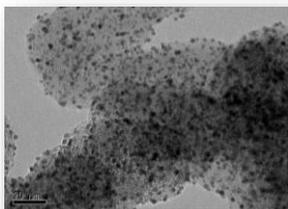
We develop catalysts for polymer electrolyte membrane water electrolysis (PEM) for the Membrane Electrode Assembly (MEA) manufacturing.

ELECTROLYSERS PEM

- TEC77XXX SERIES (Anodic Catalysts (**IrO₂**)):
 - Crystalline/Amorphous
 - High SSA



- TEC10XXX SERIES (Cathodic Catalysts (**Pt/C**)):
 - Diferent %Pt
 - Various C-type
 - Special Surface treatment



TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H₂ Production:** Water Electrolysis



Production

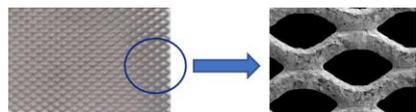
TECHNOLOGY DESCRIPTION

Water electrolysis is one of the optimal methods to produce green hydrogen using renewable energy. Using our developed coating technology through insoluble electrodes, we provide water electrolysis electrodes (Power Feeder, GDL and PTL) with excellent electrical conductivity, durability and gas diffusion.

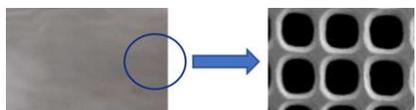
ELECTRODES FOR PEM/PEMFC

Coated with Pt, PtIr, IrO₂+PtIr+IrO₂

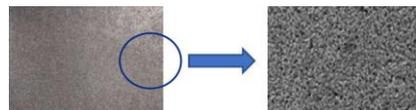
Titanium expandido



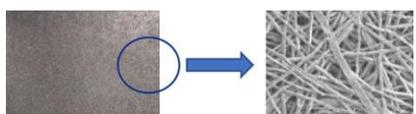
Titanium micromesh



Titanium sintered - powder



Titanium sintered- fiber



TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H2 Production:** Water Electrolysis



Production

TECHNOLOGY DESCRIPTION

The chemical conversion of different gases generates high purity H₂ that can be used in fuel cells and chemical synthesis. To carry out this conversion, different reactions are usually combined, such as reforming (SRM), Shift-Reaction (WGS) and preferential oxidation (PROX):

REFORMING CATALYST

- TRC10/413 SERIES
 - Ru
 - Pellet type

PROX CATALYST

- TSSA SERIES
 - Ru
 - Pellet type

WATER GAS SHIFT CATALYST

- TSC30A SERIES
 - Pt
 - Pellet type



TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H2 Production:** Chemical Conversion



Production

TECHNOLOGY DESCRIPTION

Ammonia (NH₃) can become the main energy carrier for H₂.

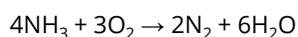
We provide ammonia reforming catalysts that break down ammonia to generate hydrogen, as well as catalysts to suppress/reduce nitrogen oxides (NO_x) and nitrous oxide (N₂O) on the exhaust gases containing ammonia.

AMMONIA CRACKING & PURIFICATION

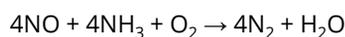
- TRC10GA SERIES
 - Ru
 - Pellet type



- APC1-30 SERIES
 - Supported catalysts for purification of unconverted ammonia



- Supporte catalyst for NO_x conversión



TECHNOLOGY INFORMATION

Maturity level: TRL8

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H2 Production:** Chemical Conversion



Transport



Industrial



Residential
Urban



Energetic



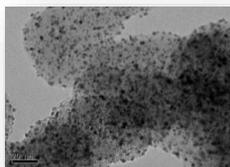
Other

TECHNOLOGY DESCRIPTION

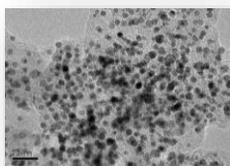
TKK is a world leader in the supply of fuel cell catalysts, different technologies and catalyst are available.

PEMFC FUEL CELLS

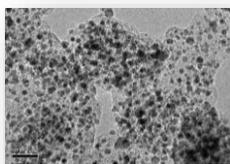
- **TEC10XXX SERIES (Pt/C):**
 - Different %Pt
 - Various C brackets
 - Special treatments



- **TEC36XXX SERIES (PtCo/C):**
 - Different %Pt
 - Different Pt-Co ratios



- **TEC61XXX SERIES (PtRu/C):**
 - Different %Pt
 - Different Pt-Ru ratios
 - CO tolerance



TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

Development of fuel-cells for different sectors like:

- **Transport**
- **Residential/Urban**
- **Energy**
- **Other**



Production

TECHNOLOGY DESCRIPTION

PM PRECURSORS FOR THE DEVELOPMENT AND PRODUCTION OF CATALYSTS, ELECTRODES...

- Salts, Dispersion, Disolutions, Powders&Flakes of
 - Platinum (Pt)
 - Palladium (Pd)
 - Iridium (Ir)
 - Ruthenium (Ru)
 - Silver (Ag)
 - Gold (Au)
- Various alternatives in function of processes and/or customer needs

TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Chemical product

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H2 Production**



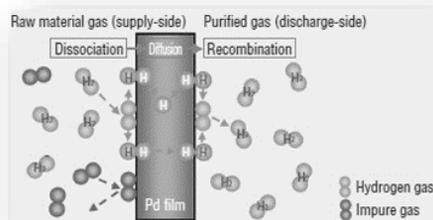
Production

TECHNOLOGY DESCRIPTION

The high-purity ultrathin film production technology developed by TKK allows us to offer hydrogen-permeable films based on Pure Pd and Pd alloyed that obtain a very pure gas to be used in PEMFC and synthesis.

HYDROGEN PURIFICATION

- Pd-X MEMBRANE
 - Pd
 - Pd-X: Cu/Pt/Ag/REE
 - Dimen: 110 x 1000



TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H2 Production:** H₂ purification



Production

Industrial

Other

TECHNOLOGY DESCRIPTION

We contribute to solving the problem of climate change by providing methanation catalysts, as well as shift catalysts, which generate CO and hydrogen that serve as chemical raw materials.

CO₂ RECYCLING

- TRC10 SERIES
 - CO₂ reformed gas (H₂O)
 - Type Ru
- TRC40 SERIES
 - CO₂ reformed gas (O₂)
 - Rh type
- TRS30 SERIES
 - Reverse Shift
 - Pt Type
- TRC10 SERIES
 - Methanation
 - Pt Type

TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H₂ Production:** CO₂ reduction



Production

Industrial

Other

TECHNOLOGY DESCRIPTION

We offer metal honeycomb catalysts and pellet catalysts that oxidize and decompose gases, such as volatile organic compounds (VOCs), which are harmful to the human body and the environment, into harmless water and carbon dioxide.

GAS PURIFICATION

- Metal Honey Comb
 - MP catalysts dispersed in a ceramic matrix on a metal substrate.
 - Different geometries
- TOC30 SERIES
 - Pt
 - Pellet type

TECHNOLOGY INFORMATION

Maturity level: TRL9

Industrial property rights:

Patented Product/Technology

Type of collaboration offered:

Products supply:

Laboratory testing, R&D, Development of demonstrators, Production of industrial equipment.

APPLICATION SECTORS

- **H2 Production:** Gases Purification



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

MMM Energy develops industrial projects to manufacture and sale equipments related to the sustainable energy sector.

Supported on the MMM group to combine industrial capabilities in the transformation of metal components with safety characteristics.

The activities are:

- Technological prospections of concepts from TRL 3 to TRL 5.
- Project scaling from TRL 5 to 8.
- Industrialization and commercialization of projects from TRL 8 to 9.



<https://mmm.es/energy-systems/>



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jmartin@mmmenergy.es



C/ Miquel Torelló i Pagès, 25 08800 Molins de Rei

ACTIVITIES AND EXPERIENCES IN R&D&I

Technical 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 NATIONAL INITIATIVES IN WHICH 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 INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Program 2023 - HORIZON-CL5

- ACHES - Batt4EU
- AXXES
- H2SHIFT
- COMBO GREEN.



Production

Refuelling

Industrial

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.

APPLICATION SECTORS

- **H2 Production:** Reformed and purified from methanol
- **Refuelling infrastructures:** 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.

APPLICATION SECTORS

- **Refueling infrastructures:** 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.

Other

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

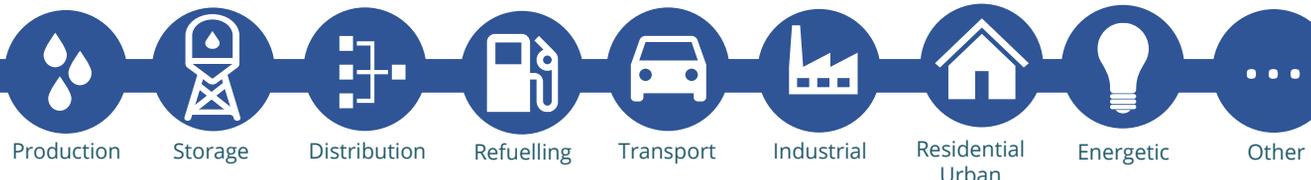
Maturity level: Basic research - Laboratory validation

Industrial property rights: Protected by industrial secret.

Type of collaboration offered: Cooperation agreement for R&D

APPLICATION SECTORS

- **Other:** 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

APPLICATION SECTORS

- **Other:** Manufacture of biofuels and/or synthetic fuels using hydrogen and CO₂ as reactives.



Storage, transportation
and distribution



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

NEUWALME is a global provider of value-added solutions for industrial motion applications, based on Oil-Hydraulic, Pneumatic, and Mechatronic Technologies. For more than four years, NEUWALME has been working on a new business line associated with H2 as a "new energetic vector", applying its own solutions for storage, distribution, dispensing systems, and gas mixing skids for industrial use.



www.neuwalme.com



986 494 922



h2@neuwalme.com



c/ Fragoiño 32-34, Sárdoma 36214 Vigo

ACTIVITIES AND EXPERIENCES IN R&D&I

We are currently involved in several projects with associated European funds, where we design, develop, and manufacture:

- High-pressure storage systems, H2 distribution, and dispensing in airport environments.
- High-pressure storage systems, H2 distribution, and dispensing in port environments for land and maritime mobility.
- Auxiliary H2 and H2O filtration systems.

Additionally, we participate in various projects by proposing our own solutions in gas mixing skids for industrial use.

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

TECHNOLOGIES OFFERED

Technologies associated with high-pressure storage systems, gas distribution, gas state control, dispensing, and mixing units for industrial use. We are truly prepared for the design, development, and manufacturing of any installation and equipment for hydrogen treatment, both for mobility and industrial uses.

ENTITY DATA

Type: SME

Size: 21-50 employees

Calls of interest for your entity:

Any call for European/ National / Regional Funds

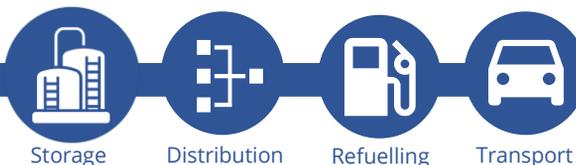


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- PTAS Project
- Julio Verne Project
- H2 Meirama Project
- Development, design, and manufacturing of gas mixing skids for industrial use

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Development, design, and manufacturing of gas mixing skids for industrial use



TECHNOLOGY DESCRIPTION

Our AID-35 hydrogen dispenser is designed for refueling at flow rates from 60g/s to 190g/s, allowing large volumes to be refueled in short periods of time. It incorporates control software designed by Neuwalme to perform refueling in accordance with the SAE J2601/2 standard. It allows refueling of vehicles equipped with IR communication as well as those without it, and the entire range is prepared to incorporate the pre-cooling system heat exchanger within its own structure. One of its main advantages is its installation, which is done via its base, allowing for a simpler and safer installation. Additionally, it only requires an electrical supply, with no need for compressed air for operation. Certifications: CE and ATEX.

TECHNOLOGY INFORMATION

Maturity level: 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

APPLICATION SECTORS

- **H2 Storage:** Compressed gas in tanks
- **H2 Distribution:** Tube trailer refueling
- **Refuelling infrastructures:** Dispense
- **Transport:** Automobile Heavy vehicle and Maritime.



Storage



Distribution



Refuelling



Transport

TECHNOLOGY DESCRIPTION

The cascade distribution system consists of an instrumentation cabinet for gas management and distribution, and an electrical control cabinet.

The equipment controls the H₂ supply parameters from the compressor to the cylinder sets and manages the gas output to the dispensers independently.

This custom control system allows for the detection of unforeseen events with full operational reliability, interacting at all times with the AID-35 dispensers.

The objective of the cascade system is to improve the utilization of hydrogen stored in high-pressure cylinders.

Certifications: CE and ATEX.

TECHNOLOGY INFORMATION

Maturity level: 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

APPLICATION SECTORS

- **H₂ Storage:** Compressed gas in tanks
- **H₂ Distribution:** Tube trailer refueling
- **Refuelling infrastructures:** Dispense
- **Transport:** Automobile Heavy vehicle and Maritime.



Storage



Distribution



Industrial



Energetic

TECHNOLOGY DESCRIPTION

Our injection skids control and regulate the injection of H₂ over high-pressure pipes carrying other gases, allowing for highly precise regulation of industrial mixtures.

They consist of high-quality valves and systems, which provide increased safety during injection.

These designs enable injection at flow rates exceeding 30g/s and pressures greater than 100bar. Certifications:

CE and ATEX.

TECHNOLOGY INFORMATION

Maturity level: 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

APPLICATION SECTORS

- **H₂ Storage:** Compressed gas in tanks
- **H₂ Distribution:** Pipes
- **Industrial:** Green hydrogen as a raw material and industrial cogeneration systems
- **Energetic:** Injection of H₂ into the gas network.



Production



Industry

DESCRIPTION OF THE ENTITY

Since 1995, NUTAI, a Valencian SME, has been developing industrial automation projects and research and development in the automotive industry, facilitating the adoption of innovative technologies in the sector. With an extensive track record in innovation, in 2016 they applied advanced AI techniques in Computer Vision and robotics, earning that same year the Innovative SME seal awarded by the Spanish Government. Since 2020, they have achieved significant results in energy systems, including digital twins, battery second life, and green hydrogen solutions. At NUTAI, we are dedicated to advancing green hydrogen technologies and their application to create a more sustainable and clean energy future. Our commitment is reflected in the development of innovative solutions in the green energy field, offering a comprehensive experience that drives research and development in more efficient energy technologies.

ENTITY DATA

Type: SME

Size: 21 – 50 employes

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal, InvestEU, LIFE Programme

National: CDTI, MITECO, MICINN, AEI, IDEA, Red.es, EOI, PERTE de Energía

Regional: IVACE and IVACE+i



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ACTIVITIES AND EXPERIENCES IN R&D&I

- Study, development, and manufacturing of testing benches using SOEC, SOFC, PEM, and/or AEM systems.
- Automatic green hydrogen production systems following the value chain.
- Monitoring, control, and data recording through proprietary software integrated into the system.
- 2022 - Public Innovative Procurement Tender (Green Hydrogen): Supply and installation of an automated testing bench for electrochemical module testing for the Mixed Institute of Chemical Technology (ITQ, UPV-CSIC).

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

TECHNOLOGIES OFFERED

- Banco de pruebas para el testeo y la caracterización de sistemas SOEC / SOFC, PEM y/o AEM.
- Ingeniería de control, desarrollo software y redes de comunicación industrial.
- Ingeniería eléctrica y de instrumentación.
- Ingeniería de Innovación y Desarrollo.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

As an active company in the hydrogen sector, we are committed to its promotion, development, and energy transition. We participate in notable national projects, such as the installation of an automated testing bench for electrochemical modules in collaboration with the Mixed Institute of Chemical Technology (ITQ) at UPV-CSIC.

Additionally, we maintain a significant presence at specialized industry events, such as REDMAD, Emobility Expo, and EHC, to share innovations in green hydrogen and energy.

We are advancing hydrogen technology, actively working on innovative projects, and strengthening our technical capacity to contribute significantly to a more sustainable future.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

In the context of the conference "CT Consulting, Energy Transition and Technologies: Developing a New Frontier," at NUTAI, we are involved in initiatives aimed at exchanging ideas and strengthening collaboration between Spain and Nepal in the field of hydrogen technology.



Production



Industrial



Energetic

TECHNOLOGY DESCRIPTION

ELYGREEN H2 is an advanced and complete test bench designed for the research and development of more efficient technologies in the field of clean and sustainable energy. This bi-directional system provides a specialised environment for the testing and characterisation of solid oxide systems, being reversible and allowing the characterisation of cells in both electrolyser (SOEC) and fuel cell (SOFC) modes.

Some key features of ELYGREEN H2:

- Performance and degradation analysis to optimise the design of new SO cells.
- Ability to operate with up to 6 gases, including O₂, H₂, H₂O, allowing a wide range of tests and experiments.
- Flexibility for various humidification conditions, adapting to different operating scenarios.
- Operational capability in temperature ranges up to 1000°C and pressure up to 50 bar.

TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: Other

Type of collaboration offered:

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

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water (component, unit (electrolyzer), auxiliary elements, process control, full floor).
- **Industrial:** Green hydrogen as a raw material.
- **Energetic:** Production and storage of energy coupled to the electricity grid.



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; CO₂ 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.

ENTITY DATA

Type: University

Size: < 10 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN
Regional

Other: Private research and/or engineering initiatives



<https://blogs.upm.es/picohima>



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Escuela Técnica Superior de Ingenieros Navales;
Avenida de la Memoria, 4; 28040, Madrid

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 H₂ 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 H₂ 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).

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 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 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.

APPLICATION 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 H₂. 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 H₂, 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.

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration / On the market.

Industrial property rights: Registered Copyright

Type of collaboration offered: Trade agreement with technical assistance.

APPLICATION SECTORS

• **Transport:**

- Automobile
- Heavy Vehicle
- Railway
- Aviation
- Maritime

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.

APPLICATION 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 H₂ 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.

APPLICATION SECTORS

- **H₂ Production:** electrolyzer
Water electrolysis
- **Transport:** fuel cell
Aviation
Maritime



Storage, transportation and distribution



Production



Mobility



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

Prematecnica is a company founded in 1961, with extensive experience and knowledge of process and energy industries.

We are experts in the design and manufacture of combustion equipment, as well as in the selection, assessment and integration of dynamic and static equipment and instrumentation, with technical assistance service included.

Its range of products, specialized in process industries (chemical, refinery, petrochemical, oil&gas, among others) and energy (biogas, biomass, nuclear, combined cycles, among others), allows us to offer the best solutions to our customers from our two Business Units: Combustion and Equipment.



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ACTIVITIES AND EXPERIENCES IN R&D&I

PREMATECNICA has collaborated with Madariaga Official Laboratory (LOM) in an enclosure design and testing to house the ignition transformer, together with the combustion chamber, whose function is to create a combustible mixture of air and gas and ignite it through an ignition source.

Participation for third parties in H2020 projects both at national level and in other EU countries.

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

TECHNOLOGIES OFFERED

In the different areas of storage, distribution, production, transport, refueling, industrial, energy, PREMATECNICA can offer the following technology:

- Safe hydrogen combustion.
- Igniters and flame detectors.
- Safety in distribution with hydrogen flame arresters.
- Membrane or piston hydrogen compressor.
- Heliflow® heat exchangers.
- Combustible gas detection.
- Gas treatment.

ENTITY DATA

Type: PYME

Size: 21-50 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal.

National: CDTI, MITECO, MICINN.

Others: Recovery, transformation and resilience plan.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Horizon Europe
- Horizon 2020



Production



Distribution



Refuelling



Energetic

TECHNOLOGY DESCRIPTION

Thermal oxidation under controlled operating conditions using flare combustors or thermal oxidizers with different percentages of hydrogen and other gases, such as natural gas or synthesis gases.

Innovative aspects and advantages of the technology:

It provides safety in the plants, studying existing infrastructure, validating it or indicating pertinent changes. We also have state-of-the-art CFD simulation tools to optimize products and process.

Participation in a renewable gas project in Cartagena;

<https://www.gasrenovable.org/proyecto/cartagena>

Carbon footprint is reduced, replacing methane burners with H2 from electrolyzer.

TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: Trademark

Type of collaboration offered: Manufacturing agreement, Trade agreement with Technical Assistance, Service provision agreement and technical cooperation agreement.

APPLICATION SECTORS

- **H2 Production:** Experience in the treatment of synthesis and pyrolysis gases from gasification, e.g. biomass.
- **H2 Distribution:** LNG plants
- **Refuelling infrastructures:** Storages
- **Energetic:** H2 injection into the gas grid.



Storage



Distribution



Refuelling



Industrial



Energetic

TECHNOLOGY DESCRIPTION

Medium and high-pressure hydrogen compression.

Compression technologies available: diaphragm, reciprocating piston and screw (the latter two, lubricated or oil-free).

Manufacturers with more than 100 years of experience, such as Burton Corblin® and Thomassen®. Also Mehrer® compression systems for small flows and medium-high pressures, skid mounted or containerized.

Innovative aspects and advantages of the technology:

Diaphragm:

- Discharge pressures above 1000 bar.
- Low maintenance.
- High volumetric efficiency. 0% product losses.

Reciprocating piston:

- Very high flow rates at medium-high pressures.
- Proven technology.
- Robust equipment, high specification. Screw Medium flows and pressures.
- Very high reliability and low maintenance.

TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: Copyright registered and Trademark.

Type of collaboration offered: Trade agreement with technical assistance, Service agreement and Technical cooperation agreement.

APPLICATION SECTORS

- **H2 Storage:** Compressed gas in tanks and compressed gas in subway caverns.
- **H2 Distribution:** Offshore distribution (compressed, liquid or transformed gas).
- **Refueling infrastructures:** High-pressure hydrogen compression.
- **Industrial:** Hydrogen as a raw material.
- **Energetic:** Energy production and storage coupled to the power grid and hydrogen injection into the gas grid.



Storage



Distribution



Refuelling



Industrial



Energetic

TECHNOLOGY DESCRIPTION

Smart hydrogen and fuel gas detector.

Innovative aspects and advantages of the technology:

We have an intelligent gas sensor with many advanced functions to provide fast and reliable warnings of hydrogen or other combustible gas concentrations when the levels of these gases become potentially explosive.

TECHNOLOGY INFORMATION

Maturity level: On the market.

Industrial property rights: Copyright registered and Trademark.

Type of collaboration offered: Manufacturing agreement, Trade agreement with technical assistance, Service provision agreement, Technical cooperation agreement.

APPLICATION SECTORS

- **H2 Storage:** Compressed gas in tanks and compressed gas in underground caverns.
- **H2 Distribution:** Underground gas pipelines
- **Refuelling infrastructures:** Compression and Storage.
- **Industrial:** Hydrogen as raw material
- **Energetic:** Production and storage of energy coupled to the electricity grid and injection into the gas grid.



Production



Refuelling



Transport



Industrial

TECHNOLOGY DESCRIPTION

Helical heat exchangers for hydrogen.

Heliflow® heat exchangers have a parallel design, which allows achieving high exchange efficiencies in a compact design, being able to reach pressures above 1,000bar. These units have years of proven service in thousands of applications worldwide.

Innovative aspects and advantages of the technology:

Heliflow heat exchangers are used for cryogenic fluids because of their high capacity to absorb thermal stresses and their performance in low temperature applications.

They have proven experience in hydrogenerators with high efficiency.

They also have the following technical advantages:

- Compact design.
- High efficiency and reliability.
- Easy maintenance.
- Supports pressures up to 15,000 psig (>1,000 bar).
- Withstands 260°C between fluids.
- Customized solutionsd for each Application.
- Suitable for low flow rates.
- Variety of materials available.

TECHNOLOGY INFORMATION

Maturity level: On the market.

Industrial property rights: Copyright registered, Trademark protected by industrial secret.

Type of collaboration offered: Trade agreement with technical Assistance, Service provision Agreement and Technical Cooperation Agreement.

APPLICATION SECTORS

- **H2 Production:** Auxiliary elements (electrolysis of water, SMR (Methane Reform), Methanol reforming and Biomass).
- **Refuelling infrastructures:** In situ hydrogen production. Storage and Compression.
- **Transport H2:** Fuel cell (automobile)
- **Industrial:** Green hydrogen as a raw material.



Production



Storage



Distribution



Refuelling



Energetic

TECHNOLOGY DESCRIPTION

Gas treatment solutions: filter separators, droplet separators and multi-cyclone separators.

De-oxygenators and dryers.
Measuring skids.

Innovative aspects and advantages of the technology:

Specialists in high pressure natural gas, hydrogen and blending.

Study and revamping of existing natural gas installations for use with hydrogen injection.

TECHNOLOGY INFORMATION

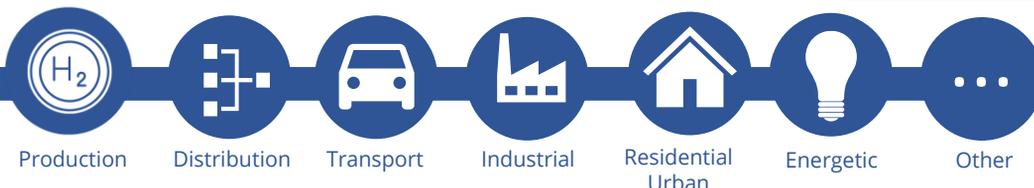
Maturity level: On the market

Industrial property rights: Copyright registered and Trademark.

Type of collaboration offered: Trade agreement with Technical Assistance, Service provision agreement and Technical Cooperation Agreement.

APPLICATION SECTORS

- **Production:** Technologies: Water electrolysis. SMR (Methane reforming). Methanol reforming. Biomass.
- **H2 Storage:** Compressed gas in tanks and Compressed gas in underground caverns.
- **H2 Distribution:** Underground gas pipelines and pipelines
- **Refuelling infrastructures:** Compression
- **Energetic:** Hydrogen Injection into the gas grid



TECHNOLOGY DESCRIPTION

For all applications where gas quality is required, MEMS develops and optimizes low-cost sensor solutions to optimize the full potential of gas.

MEMS' gasQS technology uses microthermal sensors to analyze gas quality. By measuring physical parameters of the stream such as thermal conductivity, specific heat and sound velocity by correlation, parameters such as hydrogen concentration in natural gas, density, specific heat, Wobbe index, methane number, etc., can be determined at very high pressure and in a short time.

OIML R140 certified.

Technical advantages:

- Accuracy
- Size
- Modbus/Wireless communication
- Very low operating and maintenance costs

TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: Trademark

Type of collaboration offered: Trade greement with technical assistance, Service provision agreement and Technical Cooperation Agreement.

APPLICATION SECTORS

- **H2 production:** Technologies: Water electrolysis. SMR (Methane reforming). Methanol reforming. Biomass.
 - **Area:** Process control.
- **H2 Distribution:**
 - **Area:** Underground gas pipelines. Pipelines.
- **Transportation: Technologies:** Automobile. Heavy vehicle. Railroad. Aviation. Maritime.
 - **Area:** Fuel cell.
- **Industrial: Area:** Cogeneration systems for industrial use (GHP). Heat production in thermal power plants. Glass and ceramics.
- **Residential/urban:** Areas: Energy use. Thermal use. Microgeneration for domestic use (Mchp).
- **Energetic:** Area: Injection into the gas network.



Production



Distribution



Industrial



Other

TECHNOLOGY DESCRIPTION

Leader in combustion technologies, DURAG Group has developed ignition systems and pilot burners to meet the special requirements of hydrogen combustion.

DURAG Group also has other solutions such as flame detectors.

Solutions developed for H₂:

- Cameras for visualization of process combustion, open fire, combustion chambers, among others.
- Flame monitors for all types of flames and fuels, including complex applications in multi-burner processes.
- Burners and hydrogen pilots for NG+H₂ or 100%H₂ mixtures, up to 4.5MW.

TECHNOLOGY INFORMATION

Maturity level: In the market

Industrial property rights: Trademark

Type of collaboration offered: Commercial agreement with technical assistance, service agreement and technical cooperation agreement.

APPLICATION SECTORS

- **H₂ Production:** Water electrolysis. SMR (Methane reforming). Methanol reforming. Biomass.
 - Area: Auxiliary elements
- **H₂ Distribution:** Area: Underground gas pipelines. Offshore distribution (compressed, liquid or transformer gas).
- **Industrial:** Heat production in thermal power plants. Glass and ceramics.
- **Other:** Security systems. Hydrogen flares.



Distribution

TECHNOLOGY DESCRIPTION

Fittings for repair and maintenance of leaks in hydrogen transport and distribution pipelines, among other applications. Designed for emergency repairs of onshore and subsea high-pressure pipelines and for routine pipeline maintenance applications.

Designed and manufactured to meet the highest quality standards, following ASME/ANSI codes and adhering to our strict Quality Control program.

TECHNOLOGY INFORMATION

Maturity level: In the market

Industrial property rights: Trademark

Type of collaboration offered: Commercial agreement with technical assistance, service agreement and technical cooperation agreement.

APPLICATION SECTORS

- **H2 Distribution:** Area: Gas pipelines, both onshore and offshore



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

PRF Gas Solutions is a company specializing in technology, engineering, construction, operation, and maintenance of fuel gas infrastructure.

With 33 years of experience, we have become a national reference in hydrogen technology and renewable energies.

We are involved in various projects, including industry initiatives, blending and injection of hydrogen into the natural gas network, and developing hydrogen filling stations. Hydrogen's versatility allows for its production, storage, and transportation, offering solutions to decarbonize sectors such as transport and the chemical industry.

PRF Gas Solutions recognizes these changes and provides alternative energy solutions, including hydrogen and biogas, to meet future energy demands.



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Leiria, Portugal

ACTIVITIES AND EXPERIENCES IN R&D&I

- Hydrogen blending units (natural gas and hydrogen mixer)
- Hydrogen refuelling station for heavy and light duty vehicles
- Hydrogen storage
- Hydrogen storage for transportation and distribution (Trailers)
- Hydrogen production and H2 turnkey solutions

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

TECHNOLOGIES OFFERED

PRF is capable of developing tailor-made hydrogen solutions for our clients on a turnkey basis.

ENTITY DATA

Type: Public Limited Company

Size: Medium

Calls of interest for your entity:

Promotion of our H₂ customizable products and solutions for mobility, industry, and engineering.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Green Pipeline project in Seixal, Portugal: blends up to 20% green H₂ with natural gas.

H₂ ÉVORA: Located in Évora, Portugal. PRF handles the solution design after hydrogen production, including storage, compression, and process control.

DRHYVE: Designed by PRF, provides safe and high-quality fueling at 350 bar pressure. The station.

The "Ecocerâmica e Cristalaria de Portugal" program, part of an innovation agenda, involves PRF's contribution to decarbonize the industry industry using H₂ as a tool.

HRS CASCAIS: Under construction, this fixed public green hydrogen refueling station with local production in Cascais will serve both light-duty (700 bar) and heavy-duty vehicles (350 bar).

Development and construction of two portable HRS for heavy vehicles for the central and northern regions of Portugal.

Under construction, two green hydrogen production units in Portugal (Rio Maior and Paços de Ferreira). Hydrogen for distribution and injection on natural gas grid.

PRF was awarded this year with the National Sustainability Award, in the Decarbonization category for our MIXEO project - Hydrogen Mixing and Injection Unit.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Concluded projects:

A fixed hydrogen refueling station in Madrid, Spain, designed by PRF, will provide fuel for heavy-duty vehicles (350 bar).

DRHYVE: Portable hydrogen refuelling station for motorsports - built for Dakar Rally in Saudi Arabia (2023/2024) to refuel the heavy and light vehicles.

DRHYVE: Portable hydrogen refuelling station (HRS) for Paris Olympic Games;

On going projects:

Development and construction of four units of stationary HRS and a portable HRS for light and heavy vehicles in Poland.

Development and construction of a portable HRS for light vehicles and boats in Holand.

Development and construction of MEGC ´s (tube trailers)



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPCIÓN DE LA ENTIDAD

Redexis is an energy infrastructure company committed to the energy transition, economic development and focused on growth, investment and the generation of value 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 for injection into its distribution network and transport, thus contributing to the energy transition, decarbonization and meeting the objectives of the circular economy.



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ACTIVIDADES Y EXPERIENCIA EN I+D+i

Innovation is one of the strategic pillars of Redexis, which allows it to respond to the new challenges and opportunities posed by the energy transition. The strategic lines of innovation are focused on:

- Digitization and efficiency so that processes and activities can be improved.
- The integration and hybridization of consumer technologies with the aim of integrating and adapting customer facilities to decarbonisation technologies.
- The development and integration of renewable gases in current and future activities.

DATOS DE LA ENTIDAD

Type: Large Company

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, Clean Hydrogen, Green Deal.

National: CDTI, MITECO, MICINN, IDAE.

Regional.

TECNOLOGÍAS OFERTADAS



DESCRIPCIÓN DE INICIATIVAS NACIONALES EN LAS QUE LA ENTIDAD PARTICIPA

Among the main national projects in which Redexis participates, the following stand out:

- **MISIONES OCEANH2 (2020-2024) (Generation, storage and distribution of offshore green hydrogen):** A modular, flexible and intelligent offshore green hydrogen generation, storage and distribution plant is proposed from offshore renewable electricity generation, hybridizing wind technology and floating photovoltaic. This project is supported by the Ministry of Science and Innovation through the 'Misiones Ciencia e Innovación' program.

Web:

<https://www.redexis.es/web/guest/sobre-redexis/con-la-innovacion/proyecto-misiones-oceanh2>



DESCRIPCIÓN DE INICIATIVAS INTERNACIONALES EN LAS QUE LA ENTIDAD PARTICIPA

Among the main international projects in which Redexis participates, the following stand out:

- **H2020 HIGGS (2020-2023) (Hydrogen In Gas Grids):** a systematic validation approach at various mixture levels into high pressure grids): The main objective is to cover the knowledge gaps of the impact that different levels of hydrogen could have on the infrastructure gas, its components and its management. It includes the mapping of technical, legal and regulatory barriers, testing and validation of certain equipment and techno-economic modeling.

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.



DESCRIPCIÓN DE INICIATIVAS NACIONALES EN LAS QUE LA ENTIDAD PARTICIPA

- **MISIONES ZEPPELIN (2021-2024) (Research on Innovative and efficient Green Hydrogen Production and Storage Technologies based on the Circular Economy):** 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 'Misiones Ciencia e Innovación' program.

Web:

<https://www.redexis.es/web/guest/sobre-redexis/con-la-innovacion/proyecto-misiones-zeppelin>



Financiado por
la Unión Europea
NextGenerationEU



DESCRIPCIÓN DE INICIATIVAS INTERNACIONALES EN LAS QUE LA ENTIDAD PARTICIPA

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 Puerto de Palma, fuel cell cogeneration (CHP FC) in a hotel) and injection into the natural gas transmission network.

In this project Redexis executes the first hydroduct in Spain, in Mallorca, 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 gas pipelines, encompassed within this project. This is the first authorized renewable hydrogen injection facility and will allow hydrogen to be injected into the natural gas network that supplies the entire island of Mallorca.

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.





DESCRIPCIÓN DE INICIATIVAS NACIONALES EN LAS QUE LA ENTIDAD PARTICIPA

- **Green Hydrogen Production Plant in Garray:** Redexis has been awarded the construction and supply project for a green hydrogen production plant with a capacity of 2.5 MW. In conjunction with the project, the plant is planned to be directly powered by the electricity generation from a 5.2 MW photovoltaic park, and it will have a storage system with a capacity of 150m³. The production of green hydrogen, which could reach up to 300 tons per year, can be used for industrial and mobility purposes, as well as be transported through a hydrogen pipeline.

DESCRIPCIÓN DE INICIATIVAS INTERNACIONALES EN LAS QUE LA ENTIDAD PARTICIPA



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

REGENERA was funded in 2007 in Murcia, Spain. REGENERA's activities include technical consultancy in the energy field, energy management, projects and renewable energies installations, PV power stations building, green hydrogen plants and hydraulic works among others.

REGENERA offers complete solutions to improve energy efficiency, helping in energetic transition and reducing impact on the environment.

REGENERA's organization includes 6 departments, being one of them the R&D department.

REGENERA's activity is mainly developed in Spain but it has started a strategy to reach potential clients abroad.



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ACTIVITIES AND EXPERIENCES IN R&D&I

REGENERA's experience includes different R&D projects with the goal of achieving energetic transition to green energy sources and improving energy efficiency.

Some of them include pilot projects with fuel cells, the development of fuel cells and electrolyzers using new materials that reduce manufacturing costs or applying hydrogen technologies in order to improve energy demand flexibility through energy communities.

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

TECHNOLOGIES OFFERED

• At the moment:

Complete solutions to improve energy efficiency, to help in energetic transition using renewable energies and green hydrogen while reducing impact on the environment and to improve our clients' competitiveness.

• Under development:

Fuel cells (SOFC) and electrolyzers (PEMWE) using new cheaper materials.

ENTITY DATA

Type: SME

Size: 51 – 100 employees

Calls of interest for your entity:

European: Horizon Europe

National: CDTI, PERTEs ERHA and Descarbonización



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- CDTI – SOFC4GreenGrid (MIP-20221025): Development and integration of solid oxide fuel cells to provide energy to microgrids based on green hydrogen. Materials study and new manufacturing methods.
- CDTI – Green HY CELL (MIP-20221044): New prototypes for green hydrogen generation using alternative materials.
- CDTI SOS AGUA XXI (MIG-20211026): Use case of hydrogen for blending with natural gas in industrial applications. The produced oxygen will be used in wastewater treatment.
- PERTE – GENHESES (PR-H2CV4L4-C1-2022-0081): Development and validation of a complete pilot system including generation, storage and use of green hydrogen as energy vector. Development of a AEMWE electrolyzer, PEM open cathode fuel cell and validation of both equipments.
- DEVELOPMENT OF H2 PLANTS

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- HORIZON 2020 - VPP4ISLANDS (957852): Development of intelligent virtual power plants (VPP) for islands in Europe. Green hydrogen application as a way to store energy in energy communities.



Production



Refuelling

TECHNOLOGY DESCRIPTION

Solid Oxide Fuel Cells (SOFC) and Proton Exchange Membrane Water Electrolyzers (PEMWE) with new materials to reduce costs associated with equipment acquisition.

TECHNOLOGY INFORMATION

Maturity level : Investigación básica

Industrial property rights: Otro: Desarrollo de producto con consorcio público-privado

Type of collaboration offered:

- R&D cooperation agreement
- Service provision agreement
- Technical cooperation agreement

APPLICATION SECTORS

- **H2 Production:** Water Electrolysis. Components, electrolyzer.
- **Refuelling infrastructures:** On-site hydrogen production.



Production



Industry

DESCRIPTION OF THE ENTITY

REPSOL is a global multi-energy 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.

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)

Regional.



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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 €

TECHNOLOGIES OFFERED



DESCRIPTION OF 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 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: 700 employees

Calls of interest for your entity:



<https://www.sarralle.com/en>



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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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

H-ACERO Project (1/2)

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 Sarralle Environment&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 H₂ on the steel production process.
- **Safety:** safety requirements and procedures associated with the use of H₂ as an alternative source to conventional energy.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

HyInHeat Project

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 Tecnia.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

H-ACERO Project (2/2)

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% H₂/NG mixtures
- New developed equipment and materials with 100% H₂

DESCRIPTION OF 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 instalation in industry

APPLICATION SECTORS

- **H2 Production**
- **Industrial:** steel, cement, paper, glass, non-ferreous...industry heating equipment



Production



Mobility

DESCRIPTION OF THE ENTITY

The Schaeffler Group has been driving forward groundbreaking inventions and developments in the field of motion technology for over 75 years. With innovative technologies, products, and services for electric mobility, CO₂-efficient drives, chassis solutions, Industry 4.0, digitalization, and renewable energies, the company is a reliable partner for making motion more efficient, intelligent, and sustainable – over the entire life cycle. The Motion Technology Company manufactures high-precision components and systems for drive train and chassis applications as well as rolling and plain bearing solutions for a large number of industrial applications. The Schaeffler Group generated sales of EUR 16.3 billion in 2023. With around 83,400 employees, Schaeffler is one of the world's largest family-owned companies and one of Germany's most innovative companies.

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: ~84.000 employees global

Calls of interest for your entity:

Horizon Europe, Innovation Fund, Clean Hydrogen Partnership



<https://www.schaeffler.es>



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Elgoibar, Spain

ACTIVITIES AND EXPERIENCES IN R&D&I

The company is focusing on the development and manufacturing of PEM electrolysis stacks as well as metallic bipolar plates and sub-assemblies for PEM fuel cells.

The business unit "Hydrogen Industrial" with focus on electrolysis has been established in the beginning of 2021 within the Division Bearings & Industrial Solution 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 2024 Schaeffler opened INNOPLATE, a joint-operations with Symbio and thus shows the strategic importance of Hydrogen.

TECHNOLOGIES OFFERED

Electrolysis

- PEM electrolysis stacks for industrial applications (50 and 100kW, 500kW and 1MW)
- 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

Fuel Cell

- Bipolar plates for low temperature PEM Fuel Cells
- BoP components for the Fuel Cell System (Hydrogen Ejector, FC Control Unit, Hydrogen Storage Control Unit, Cathode valves, hydrogen sensors...)
- sub-assemblies for PEM fuel cell stacks



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

The Schaeffler Group has been involved in the government funded H2 Giga program. 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.

DESCRIPTION OF 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 strategy is grounded in its industrialization expertise and the continued development of fuel cells and electrolyzer technologies. By focusing on the industrial-scale production of these core technologies for green hydrogen, the Schaeffler Group aims to enhance both the availability and efficiency of green hydrogen production.

Fuel Cells

The Schaeffler Group firmly believes that hydrogen will play a key role in the sustainable mobility of the future. With its excellence in high quality and high volume production technologies the company supports the electrification of primary heavy duty vehicles. The collaboration in the "Innoplate" joint venture is an important step on this journey.

Electrolysis

The Bearings & Industrial Solutions Division of Schaeffler is providing core components for electrolyzer systems (PEM stacks), playing a crucial role in the production of green hydrogen.

Schaeffler is leveraging the synergies from fuel cell and electrolysis activities within the Schaeffler Group, drawing on our core expertise in coating, materials, forming technologies, and series production.

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, control units, Hydrogen sensors, cathode valves) for stationary and mobil applications

APPLICATION 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 Mobility

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.

Since 2021, TaiichiO has been carrying out activities aimed at developing **specific products for the hydrogen transport and distribution** sector together with its Korean partner SeAH Steel.

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

Development of technologically advanced and productively competitive welded carbon steel and stainless steel pipelines for **hydrogen transport and distribution**:

Characteristics:

- ASME B31.12 Opt B certification in RINA.

Completion of the process:

- Testing phase at 3 casts > Q1 2024
- Certification Phase > Q2 of 2024.

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

TECHNOLOGIES OFFERED

Welded carbon steel and stainless steel pipelines for the transport and distribution of hydrogen.

ENTITY DATA

Type: SME

Size: 11-20 employees

Calls of interest for your entity:
CDTI



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

None at present.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

We are indirectly involved in the projects:

POSCO Steeleon hydrogen welded carbon steel pipe project.

Object:

Supply of welded carbon steel piping for Hydrogen through the TaiichiO-SeAH Steel partnership.

Purpose:

Piping of hydrogen produced at POSCO to the POSCO Steeleon factory

Scope:

Grade X52, 6' (51 MT) and 8' (120 MT).

Ansan hydrogen carbon steel welded pipe Project

South Korea has identified 7 hydrogen pilot cities, including Ansan City.

Scope:

Supply of 8" (7 km) long X52 hydrogen carbon steel welded pipes for the development of Ansan hydrogen city, in close cooperation with POSCO's hydrogen materials Task Force.



Distribution



Transport

TECHNOLOGY DESCRIPTION

Welded carbon steel and stainless steel pipelines for hydrogen transport and distribution.

Tests performed in the RINA laboratory, following a test procedure based on **ASME B31.12 Option B** (material stress intensity factor threshold qualification).

The threshold of the stress intensity factor range ΔK_{th} is a value below which fatigue crack propagation is negligible.

Several HF-ERW and SAWL pipes are being tested to determine their fracture toughness properties in a 100% hydrogen environment after 1,000 hours exposure.

The tests include API 5L grades up to X70M. Threshold tests (minimum value) have now been passed for samples of both weld types (HF-ERW and SAWL) of 1 cast with satisfactory results for both Base Material and weld and HAZ.

It is expected to complete the 3-cast testing process in Q1 2024 and certification in Q2 2024.

TECHNOLOGY INFORMATION

Maturity level:

Available for demonstration

Industrial property rights:

Protected by industrial secret

Type of collaboration offered:

Supply

APPLICATION SECTORS

- **H2 Distribution**
- **Transport**



Storage, transportation
and distribution



Production



Mobility



Industry



Uses in
PGB2+ASPS

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.

ENTITY DATA

Type: Research Center

Size: > 100 employees (1500)

Calls of interest for your entity:

Europe: Horizon Europe, Clean Hydrogen, etc.

National: CDTI, MITECO, MICINN, etc.

Regional: Hazitek, Elkartek, etc.



<https://www.tecnalia.com/en/technologies/hydrogen>



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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 millions €

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 NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Hydrogen production

- HIDRURA (Elkartek, electrolyzers)
- H2BASQUE (Elkartek, electrolyzers)
- H2PLAN (Complementary Plans H2)
- H24NEWAGE (Cervera)
- ATMOSPHERE (Misiones)
- H2INTEGRA (Hazitek)
- ECOFOSS (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 INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Hydrogen production

- CLEANHYPRO (Horizon Europe, Electrolyzers)
- SUSTAINCELL (Clean Hydrogen, Electrolyzers)
- AEMELIA (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)
- SHIMMER (Clean Hydrogen, material compatibility with H2)
- CANDHY (Clean Hydrogen, material compatibility with H2)
- ARENHA (Clean Hydrogen, ammonia)
- AMBHER (Clean Hydrogen, ammonia)
- ANDREAH (Clean Hydrogen, ammonia)
- APOLO (Horizon Europe, 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:

Depends on the Technology. Between TRL2 and TRL6

Type of collaboration offered:

- Cooperation agreement for R&D
- Service provision agreement

APPLICATION SECTORS

• H2 Production:

- Water electrolysis



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. H₂-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

APPLICATION SECTORS

- **H2 Production**
 - Reforming of biogas, alcohols (e.g. methanol), natural gas
 - Ammonia cracking
- **H2 Distribution**
 - 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 H₂ 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

APPLICATION SECTORS

- **H₂ Production**
 - Reforming of biogas, alcohols (e.g. methanol), natural gas
 - Ammonia cracking
- **H₂ Distribution**
 - 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:

- Developed but not marketed

APPLICATION SECTORS

- **Transport:** Mobility applications (fuel cell, power train and power electronics),
 - **Light-duty vehicles**
 - **Heavy-duty vehicles**
 - **Trains**
 - **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 H₂ 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

APPLICATION 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

APPLICATION 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**



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

Técnicas Reunidas is a leading Spanish multinational company in engineering, construction and operation of infrastructure. For over 65 years, the company has developed extensive experience in sectors such as energy, industrial, civil infrastructure and the environment. Its business model is based on offering comprehensive solutions to its clients, from conception and design to construction and operation of complex projects. This allows them to offer a personalized service adapted to the needs of each client. Técnicas Reunidas has carried out projects in more than 50 countries, becoming a global benchmark in its sector. Its commitment to innovation, sustainability and safety has positioned it as a leading company in the development of infrastructure that contributes to social and economic progress.

ENTITY DATA

Type: Large Enterprise

Size: > 100 employees

Calls of interest for your entity:

European: Horizonte Europe, FCH JU, Green Deal, LIFE, Inn. Fund

National: CDTI, MITECO, MICINN, IDEA (PERTE)



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ACTIVITIES AND EXPERIENCES IN R&D&I

The José Lladó R&D&I Technology Center is a national reference as a research and development center in the private sector in Spain. The Center develops and commercializes technologies in the sectors of metal extraction and critical raw materials, biorefinery, circular economy, energy transition and decarbonization, providing its clients with engineering services, technology licensing, technical assistance and supply of proprietary equipment for industrial plants based on its own technologies. To this end, it has over 5,000 m² of industrial and analytical laboratories, pilot plant facilities and a mechanical workshop, equipped with state-of-the-art equipment and software, and all at the disposal of a highly qualified multidisciplinary and multinational technical and scientific team.

Approximate annual investment in R&D&I in hydrogen and fuel cells: Aprox. € 2M

TECHNOLOGIES OFFERED

- Green Hydrogen production via water electrolysis with AEM, SOEC and PCEC technologies.
- Green Hydrogen Peroxide production via double electrode.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Project Misiones - Hy2DEC:

Research, development, and validation of technologies for the production of green hydrogen at low and medium temperatures with AEM and PCEC configurations, respectively, and for CO₂ capture with Vacuum Calcium Looping (V-CaL) at laboratory scale.

Project Misiones - efiSOEC:

Research, development, and validation of a high-temperature SOEC technology electrolyzer for the supply of green hydrogen in the petrochemical industry.

Member of the **Spanish Hydrogen Association (AeH2)**.

Member of the **Spanish Hydrogen Technology Platform (PTe H2)**.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Horizon Europe Project - Power2Hype:

Research, implementation and validation of a new electrochemical technology for the production of green hydrogen peroxide at low temperature and using renewable reagents and energy.

Member of **Hydrogen Europe**.



Production



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Técnicas Reunidas develops an electrolyzer equipment for green hydrogen production with its own technology. The technological core of this equipment is in the stack in AEM configuration of innovative design and owned by TR, which will be the modular basis for a future implementation of high power electrolysis plants at reduced costs compared to the market and the state of the art.

TECHNOLOGY INFORMATION

Maturity level: TRL 5

Industrial property rights: In preparation

Type of collaboration offered: co-development, industrialization, demonstration.

APPLICATION SECTORS

- **H2 Production:** wáter electrolysis.
- **Industrial:** green hydrogen source for production processes in intensive industries.
- **Energetic:** renewable energy storage for large industries



Production



Industry

DESCRIPTION OF THE ENTITY

Tolsa is a **Spanish multinational company** with over 65 years of activity.

At Tolsa, we extract, process, and commercialize **innovative mineral solutions** to help improve a world that is increasingly and better connected. 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 developed applications. We continuously develop and launch **new products** to the market.

Our team of experts works daily to develop applications that can benefit from the properties of our raw materials and to anticipate future needs through new **business opportunities**.



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ACTIVITIES AND EXPERIENCES IN R&D&I

- Sorption. We develop projects for the treatment of oils, fuels, and water, as well as CO₂ capture, etc.
- Rheology. We modify special clays for rheological control in the paint and coatings industry, among others.
- Functionalization. We design special additives for specific functionality and complete integration into the material.
- Processing. We optimize and develop 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 the improvement of existing ones.

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

TECHNOLOGIES OFFERED

Functionalization of special clays and other mineral solutions through organic/inorganic modification technologies:

- Proprietary technology for the deposition of oxide/metallic nanoparticles on a mineral support.
- Proprietary technology for the organic surface modification of mineral materials.
- ADINS® Synergistic flame-retardant additives for polymers of different types and applications.
- ADINS® Photocatalysts for decarbonization in surface technology.

ENTITY DATA

Type: Large Company

Size: > 800 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal.

National: CDTI, MITECO, MICINN

Regional: Eureka

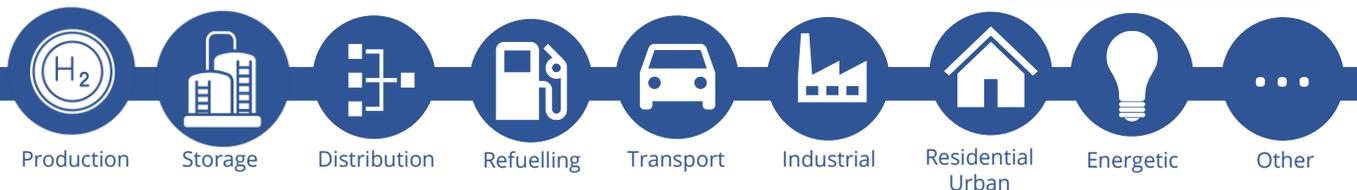


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- FORO DE MARCAS RENOMBRADAS
- FEIQUE Federación Empresarial de la Industria Química Española
- Aindex (Asociación Española de Industrias Extractivas y Afines)
- COMINROC Confederación Española de Rocas y Minerales Industriales
AETOS Asociación española de tuneles y zanjas

DESCRIPTION OF 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 carrier.

The technology allows to control the size of the deposited particle. Depending on the nature of the particle, high concentrations are achieved in the carrier material.

The carrier becomes relevant in chemical-physical processes that require surface adsorption or absorption phenomena 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

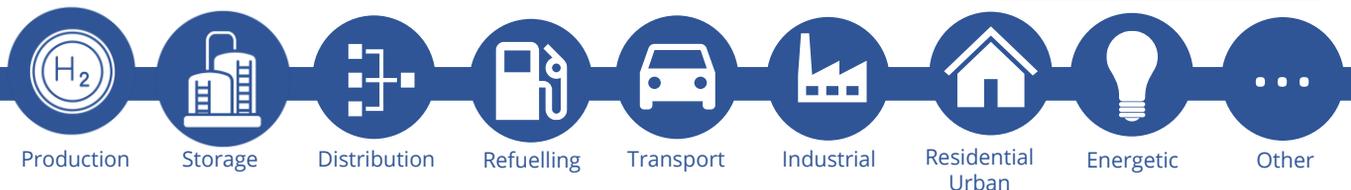
Type of collaboration offered:

- R&D collaboration agreement
- Technical cooperation agreement

APPLICATION SECTORS

Potential development applications to be explored:

- **Producción de H2**
- **Almacenamiento de H2**
- **Distribución de H2**
- **Infraestructuras de repostaje**
- **Transporte**
- **Industrial**
- **Residencial/urbano**
- **Energético**
- **Otros**



TECHNOLOGY DESCRIPTION

Proprietary technology developed to modify the surface of the starting materials using organic agents for anchoring to the active centers.

These modifications allow the integration of the material in solvents of a wide range of polarities.

The technology allows to control the polarity of the particle and its 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 or adsorption phenomena of the material, due to its high specific surface area (external and internal) and chemical nature.

Combination of different agents can generate synergic functionalities for new applications.

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration

Industrial property rights: Patented

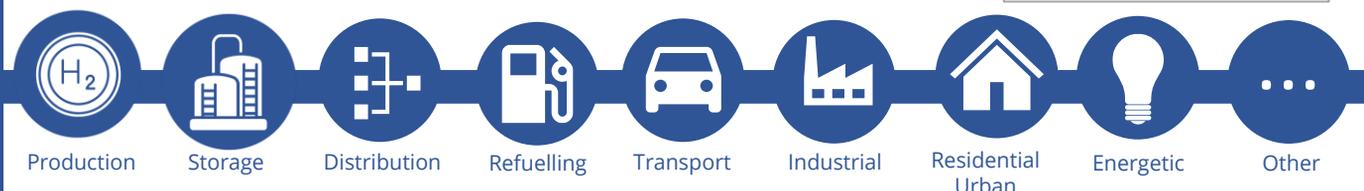
Type of collaboration offered:

- R&D collaboration agreement
- Technical cooperation agreement

APPLICATION SECTORS

Potential development applications to be explored:

- **Producción de H2**
- **Almacenamiento de H2**
- **Distribución de H2**
- **Infraestructuras de repostaje**
- **Transporte**
- **Industrial**
- **Residencial/urbano**
- **Energético**
- **Otros**



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 the use of lower doses than photocatalytic products because ADINS®Clean is more active than any other photocatalytic particle.

It provides an effective solution to avoid the problems of agglomeration and handling of the catalyst particles (TiO₂) and increases its effectiveness by maintaining the TiO₂ particles on an inorganic substrate

The photocatalytic additive makes it possible to reduce the concentration of pollutants (NO_x or VOCs), which are largely generated by the intensity of traffic in large urban centers. 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

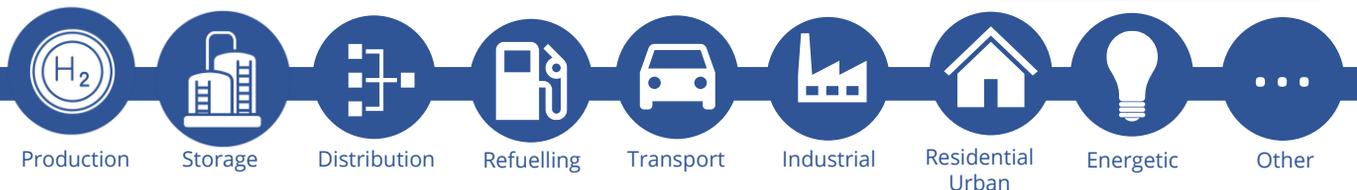
Type of collaboration offered:

- R&D collaboration agreement
- Technical cooperation agreement

APPLICATION SECTORS

Potential development applications to be explored:

- **Producción de H₂**
- **Almacenamiento de H₂**
- **Distribución de H₂**
- **Infraestructuras de repostaje**
- **Transporte**
- **Industrial**
- **Residencial/urbano**
- **Energético**
- **Otros**



TECHNOLOGY DESCRIPTION

Plastic components with ADINS® technology have enhanced fire performance, enabling compliance with the most stringent international health and safety regulations. ADINS® products act synergistically with most flame retardants included 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 heat release to be reduced 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:

- R&D collaboration agreement
- Technical cooperation agreement

APPLICATION SECTORS

Potential development applications to be explored:

- **Producción de H2**
- **Almacenamiento de H2**
- **Distribución de H2**
- **Infraestructuras de repostaje**
- **Transporte**
- **Industrial**
- **Residencial/urbano**
- **Energético**
- **Otros**



Storage, transportation
and distribution

DESCRIPTION OF THE ENTITY

TRINITY ENERGY STORAGE (TES) is a company that promotes and develops green energy storage, with significant research activity in hydrogen storage projects.

The storage of energy from renewable sources is the key factor in achieving the total decarbonisation of the economy, ensuring energy supply in a carbon-neutral scenario.

Trinity is committed to the potential offered by green hydrogen as a means of mass energy storage, with the commitment to contribute to the energy transition and the decarbonisation of the economy.

For this reason, it has decided to promote the Aljarafe project, the first green H₂ storage in Spain. The project is located to the SW of the province of Seville, taking advantage of a series of depleted deposits, with excellent qualities as UGS.

ENTITY DATA

Type: SME

Size: 21 – 50 employees

Calls of interest for your entity:
European, National and Regional



<https://trinity-es.com>, www.undergy.eu, EUH2STARS



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ACTIVITIES AND EXPERIENCES IN R&D&I

TES participates in three research projects aligned with its strategic objectives on underground storage of green hydrogen at the Aljarafe project sites.

The UNDERGY and UES365 projects, funded by the CDTI within the Missions Programme, and mainly the EUH2STARS project, funded by the European Union with €20M within the Horizon Europe 2023 programme, will demonstrate the economic and technical feasibility of a complete large-scale underground hydrogen storage system.

It is also involved in a project funded by the IDAE (PureH₂) for storage in saline cavities.

Approximate annual investment in R&D&I in hydrogen and fuel cells: < 2 million €

TECHNOLOGIES OFFERED

Seasonal storage of hydrogen in the underground



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

1. ALJARAFE STORAGE PROJECT: The excellent geological performance of the Aljarafe deposits as storage, and its strategic geographical location, next to the future hydrogen backbone network and in an area where large H2 production projects are located, make it an ideal candidate to be the first green H2 storage facility in Spain.

2. UNDERGY: Research project funded by the CDTI through the Misiones 2021 call for grants. Improvement of the competitiveness of energy storage from renewable sources through underground storage systems, using green H2 as a vector.

3. UES365: Research project funded by the CDTI through the Misiones 2019 call for grants.

It investigates the technological bases to achieve new competitive systems for stationary underground energy storage associated with renewable energy sources using compressed air, biogas and green hydrogen for this purpose.

4. PureH2: TES participates in the project together with Enagás, Iberpotash, CRS and H2Site. It is funded by the IDAE in the incentive program for the innovative value chain and knowledge of renewable H2. The main objective is to develop a solution for the purification of H2 stored in saline cavities.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

1. EUH2STARS: Research project selected by the European Union to receive €20M in funding within the Horizon Europe 2023 grant programme.

EUH2STARS aims to demonstrate the technical and economic feasibility of mass hydrogen storage in depleted reservoirs, facilitating the energy transition of future European energy systems.

The project began in January 2024 and will end up in 2029.

The project, one of the most ambitious in Europe in hydrogen storage, has the participation of 12 partners from 5 countries and is led by the company RAG, a pioneer in the storage of H2 in depleted deposits.

Starting from four injection-extraction cycles at the Rubensdorf demonstrator in Austria, a complete underground hydrogen storage system will be certified. The lessons learned in the demonstrator will be applied at 2 Austrian sites and 3 European replicators, one of them being the Aljarafe storage.



TECHNOLOGY DESCRIPTION

Development of underground hydrogen storage, both in depleted deposits and in saline cavities.

Technical feasibility studies based on laboratory analysis and numerical models. 3D geological model.

Technical feasibility analysis. I calculate storage capacity using 4D simulation models, operating flows, necessary infrastructures (number of wells, compression capacity, gas purification equipment, etc.)

Study of industrial risks in storage facilities. Well integrity control. Geological risk analysis and design of monitoring networks (hydrogeology, seismicity, subsidence, etc.)

TECHNOLOGY INFORMATION

Maturity level: Basic Investigation

Industrial property rights:

Type of collaboration offered: Technical collaboration

APPLICATION SECTORS

- **H2 Storage:** Storage of compressed gas in the underground (caverns, porous media, or depleted reservoirs)



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: University

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN

Regional and Private Foundations



www.uam.es



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isabel.j.Ferrer@uam.es (MIRE Group)



Universidad Autónoma Campus, 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: < 1 million €

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 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 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 research

Industrial property rights:

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

APPLICATION SECTORS

• H₂ Production:

Electrolysis and photoelectrolysis of water, (components: electrode materials)





Storage



Other

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 manufacture of prototypes.

TECHNOLOGY INFORMATION

Maturity level: Basic research

Industrial property rights:

Type of collaboration offered: Cooperation agreement for R&D

APPLICATION SECTORS

- **H2 Storage:**
 - Accumulation and compression of Hydrogen
- **Other:**
 - Hydrogen optical sensing.





Storage, transportation
and distribution

DESCRIPTION OF THE ENTITY

The University of Burgos is a public university, recognized among the best young universities in the world, which develops its mission based on the provision of comprehensive and quality teaching, very close to the student and focused on internationalization.

Founded in 1994, the UBU is already a benchmark for Spanish university research and the transfer of knowledge to the business field.

It currently offers 26 degrees, 5 of them taught in dual online and face-to-face modality and 2 bilingual in English and Spanish, 7 double degrees, 27 master's degrees, 13 doctoral programs and 16 own degrees.

ENTITY DATA

Type: University

Size: >1200

Calls of interest for your entity:

European, National (CDTI, MITECO, MICINN) and Regional.



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ACTIVITIES AND EXPERIENCES IN R&D&I

The University of Burgos currently has more than 10 active projects on topics related to hydrogen technologies, which cover both national and international projects, as well as different collaborations with leading companies in the sector.

Approximate annual investment in R&D&I in hydrogen and fuel cells: in 2023-2024 about 1.000.000 €

TECHNOLOGIES OFFERED

There are several research groups related to hydrogen that offer different technologies and services:

- Hydrogen Technologies Laboratory managed by Research Group in Structural Integrity (GIE).
- Research Group in Automation, Robotics, Control and Optimization (ARCO).
- Research Group AMIDO-RUCA.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Hydrogen Technologies Laboratory:

“Evaluación de la integridad estructural de los materiales de la red de gas para un transporte seguro de hidrógeno (SafeH2) funded by Junta de Castilla y León.

“Estudio de la susceptibilidad a la fragilización por hidrógeno de aceros dúplex producidos mediante fabricación aditiva para su uso en componentes en ambiente de hidrógeno” funded by Spanish Research Agency.

“Modelado de efectos y aplicaciones del hidrógeno en aceros de fabricación aditiva” funded by Spanish Research Agency.

Plan Complementario de Materiales Avanzados: MA2TEC funded by Junta de Castilla y León.

Research Group ARCO:

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 (call for Ecological Transition and Digital Transition Projects).

Research Group AMIDO-RUCA:

“Desarrollo de catalizadores para la reducción de dióxido de carbono utilizando hidrógeno como agente reductor” en el marco del Proyecto “Investigación de nuevas tecnologías, materiales y procesos asociados a la cadena de valor del hidrógeno (Valor H2)” funded by CDTI and Adisseo España, S.A.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Hydrogen Laboratory:

“Pre-normative research on integrity assessment protocols of gas pipes repurposed to hydrogen and mitigation guidelines” funded by European Commission (2024-2027).

Hydrogen Technologies Laboratory and AMIDO-RUCA:

Planes complementarios de I+D+i, “Tecnologías, materiales y procesos para producción a pequeña escala de portadores de Hidrógeno Renovable (Metano y Amoniac) para aprovechamiento distribuido en CyL” funded by Junta de Castilla y León.



TECHNOLOGY DESCRIPTION

Type of collaboration offered:

- Characterization tests of materials in a pressurized hydrogen environment
- Numerical simulation of material behaviour and development of models for permeation, diffusion and embrittlement studies.
- Study of new materials and advanced manufacturing techniques, as well as their properties in hydrogen environments
- Study of the effectiveness of coatings for use in hydrogen environments
- Master's Degree in Hydrogen Technologies

Tests available:

- Tensile tests with smooth or notched specimens
- Fracture toughness and fatigue tests
- Both electrochemical and gaseous permeation
- LECO Analyzer for Hydrogen Content Measurement
- Standardized rupture disk test

TECHNOLOGY INFORMATION

The Hydrogen Technologies Laboratory (H2-Lab) of the University of Burgos, has the necessary equipment to study and test the behaviour of materials in the H₂ environment and the susceptibility to embrittlement of various alloys. This equipment allows a wide variety of standardized tests to be carried out in a hydrogen gaseous environment at high pressure (up to 300 bar) and high temperature (up to 300 °C).

APPLICATION SECTORS

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



Distribution



Industrial



Energetic

TECHNOLOGY DESCRIPTION

Type of collaboration 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, wind turbines and wind farms.

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, natural gas networks and wind farms.

Research lines:

- First principles modeling, data based modeling and hybrid modeling of industrial processes. Design and develop of digital twins.
- Advanced control and optimization methods applied to the operation of processes and systems in the industrial sector, including the management of uncertainty in decision making.
- Artificial intelligent in automation and control.
- Industry 4.0. Automation and control using IoT systems.

TECHNOLOGY INFORMATION

The research group in Automation, Robotics, Control and Optimization (ARCO) integrates researchers who work on problems related to Process and Systems Engineering (PSE) and Industrial Informatics.

Process Systems Engineering (PSE) is part of the digital transformation in which the industry is immersed and its objective is to respond to the changes that the process industry is undergoing in a global market with the consequent economic and social repercussions.

APPLICATION SECTORS

- **H2 distribution:**
- **Industrial:**
- **Energetic:**
- **Other:** Training



Storage



Energetic

TECHNOLOGY DESCRIPTION

Type of collaboration offered:

- Synthesis of inorganic and organic compounds
- Electrochemistry measurements (Cyclic voltammetry, controlled potential coulometry).
- Multinuclear Magnetic Resonance at variable temperature
- Photocatalytic processes.
- Monocrystal characterization.
- DFT quantum chemical calculations.
- Basic spectroscopic techniques (FT-IR, UV-Vis).

Research lines:

- Syntheses and characterization of coordination and organometallic compounds.
- Study of their photocatalytic properties.
- Study of their antiproliferative properties.
- Catalytic hydrogenation of different substrates.
- DFT molecular modeling.

TECHNOLOGY INFORMATION

The AMIDO-RUCA research team consists of researchers working inside the Inorganic Chemistry field. Their interests has been centered on the study of coordination and organometallic compounds of Platinum Group Metals developing basic research.

The efforts of the group have been centered on the syntheses of new compounds and the study of their electrochemical, photophysical, anti-proliferative and catalytic properties. Quantum chemical calculations are used to help the understanding of the experimental results.

APPLICATION SECTORS

- **H2 Storage**
- **Energetic**



Production



Mobility



Industry

DESCRIPTION OF THE ENTITY

The University of Castilla-La Mancha (UCLM) is the leading academic institution in the autonomous community from which it takes its name. It leads in the generation and transmission of science, technology, innovation, culture, and solidarity. On the other hand, the Department of Chemical Engineering (DIQ) at UCLM is a nationally and internationally recognized university department in teaching and research related to the field of Chemical Engineering. It publishes an average of 80 articles per year and participates in European, National, and Regional R&D&I Projects. Additionally, it collaborates with numerous national companies through Research and Technological Projects. Lastly, the DIQ's mission is to provide quality education and to promote R&D&I and knowledge transfer in the fields of Chemical and Environmental Technology.

ENTITY DATA

Type: University

Size: > 100

Calls of interest for your entity:

European: Horizon Europe, Clean Hydrogen JU, Green Deal

National: CDTI, MITECO, MICINN

Regional



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ACTIVITIES AND EXPERIENCES IN R&D&I

The Department of Chemical Engineering at UCLM is known for promoting R&D&I and knowledge transfer in the fields of Chemical and Environmental Technology.

The main indicators obtained over the last six-year period (2015–2022) are as follows:

- Over 2 million euros annually from official bodies (European, National, and Regional Projects) for R&D&I and more than half a million euros annually from research collaborations with companies.
- An average of 80 scientific publications per year.
- An average of 8 doctoral theses per year.

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

TECHNOLOGIES OFFERED

- Hydrogen production and its use through PEM fuel cells
- Physicochemical and electrochemical characterization of membranes, catalysts, and/or MEAs
- Application of EDEN® Technology
- Life cycle analysis of H₂-related technologies

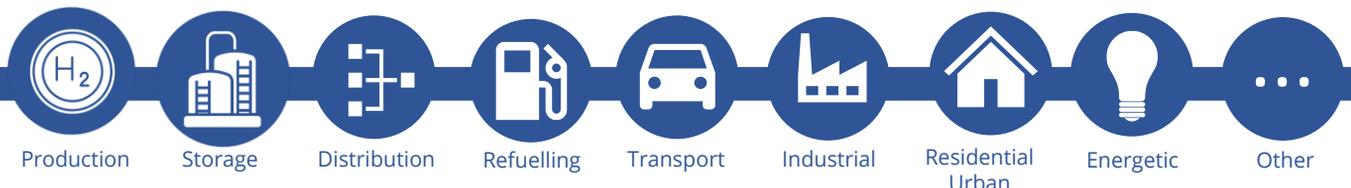


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- 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 transportation sector (SetEden2Diesel)

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Project from the H2 Pathfinder call (MacGhyver Project).
- Green hydrogen production from wastewater in the agri-food industry using microfluidic technology.
- The electrochemistry laboratory of the TEQUIMA group at UCLM is responsible for assessing the environmental impact of the developed technology through Life Cycle Analysis, cost analysis, and social impact study.



TECHNOLOGY DESCRIPTION

H2 Production:

- From SO_2 -depolarized electrolysis: Westinghouse Process.
- From chlor-alkali electrolysis: EDEN® Technology.

H2 Uses:

- In PEM fuel cells, both low and high temperature.

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 collaboration agreement
- Service provision agreement
- Technical cooperation agreement

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water (chlor-alkali and SO_2 depolarised). Components and Unit)
- **Transport:** Automobile, heavy vehicle and maritime (Component and fuel cell testing)



Production



Industry



Uses in
PGB2+ASPS

DESCRIPTION OF THE ENTITY

Universidad de León is a Public University sited in the city of León (Spain). This university has a 35 years history, during which has proved to have a great initiative and an innovative character. ULE harbours 13 faculties and schools, highlighting the technological and biotechnological faculties, as the the Schools of Engineering (Industrial, Energy and Computer). Furthermore, ULE has eight research institutes and several Technology Centres with activity place in about a thousand projects and 125 work groups dedicated to R&D and innovation. Their experience in the coordination of international projects is sound and well established and has been acquired through experience over the years. The Research Group IQUMAB (recognized as Consolidated Research Unit), is associated to the Institute of Environment, Natural Resources and Biodiversity (IRENA) at ULE. The researchers of the IQUMAB group focus their research activities in water-energy binomial, bioprocesses, hydrogen and CO₂ utilization, design and evaluation of fertilizers. The experienced gained with the research work (basic and applied) performed over the years has allowed the group to increase the contact with private companies.

ENTITY DATA

Type: University

Size: ~1500 employees

Calls of interest for your entity:
I+D projects



<https://institutos.unileon.es/ingenieria-quimica-ambiental-y-bioprocessos/>



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ACTIVITIES AND EXPERIENCES IN R&D&I

- Bioelectrochemical hydrogen production
- Hydrogen production by dark fermentation
- Evaluation of green hydrogen production processes and uses

TECHNOLOGIES OFFERED

- Multichannel potentiostats
- Electrochemical characterization (including electrochemical impedance spectroscopy(EIS)).
- Scanning electrochemical microscopy (SECM).
- Gas chromatography.
- Flow cells
- Fermentation



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Public-private collaboration projects
- Knowledge Generation Projects
- R&D projects with companies (CDTI)
- CRUSOE Initiative: Working group "SUSTAINABLE ENERGY"
- CO2 technology platforms
- Hydrogen technology platform

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- H2020 projects
- Members of Biobased Industries (BBI) and Circular Bio-based Europe (CBE)
- Interreg projects



Production



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

The research group possess laboratory and pilot scale electrochemical and bioelectrochemical systems, as well as the auxiliary and analytical systems associated with them. On the other hand, fermentation systems are available, also on a 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 treatment of waste such as CO₂ or residual organic matter simultaneously.

TECHNOLOGY INFORMATION

Maturity level: TRL3 – TRL5

Type of collaboration offered:

- R&D
- Project development
- Proof of concept

APPLICATION SECTORS

- H2 Production
- Industrial
- Energetic
- Other



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:

European: Horizon Europe, RFCS

National: MICINN, CDTI



<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 sorption 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 Million€

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 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 INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- European Research Projects (mainly RFCS).



Storage, transportation and distribution



Production



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

The SUPREN SUSTainable PROCESS ENgineering research group is integrated in the Department of Chemical and Environmental Engineering of the Bilbao School of Engineering at the University of the Basque Country UPV/EHU. It has been recognized as a high capacity research group by the Basque government.

This group is specialized in the development of new processes with special emphasis on technologies related to hydrogen and sustainability. This research line has been developed since 2008, the year in which the first Iberian symposium on hydrogen, fuel cells and advanced batteries was organized by SUPREN.

The main research activities are the following lines of R&D:

- Design of innovative reaction systems.
- Development of biorefinery processes
- Hydrogen technologies.
- Waste to resource (W2R).
- Development of hydrometallurgical processes.

ENTITY DATA

Type: Public university

Size: more than 20 faculties and 5,723 professors

Calls of interest for your entity:

Autonomic, national and internationals



<https://www.ehu.eus/en/web/supren>



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laura.barrio@ehu.eus



Escuela de Ingeniería- Pl. Ingeniero Torres Quevedo 1, Bilbao

ACTIVITIES AND EXPERIENCES IN R&D&I

SUPREN In the **H2 production pillar**:

- Hydrogen generation from biogas, bio-oils obtained from pyrolysis processes and bio-alcohols for decentralized production.

SUPREN In the **H2 storage and transport pillar**:

- Development of new reaction systems that optimize energy management; as well as catalytic systems by replacing noble metals in hydrogenation/dehydrogenation technologies using organic carriers.
- Development of new material systems based on perovskites for thermochemical storage.
- Storage and transportation of H2 in the natural gas network prior to 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 FCs:1M€

TECHNOLOGIES OFFERED

- Demonstrate Liquid Organic Hydrogen Carrier (LOHC)-based technology for hydrogen distribution and storage.
- Valorization of H₂ and CO₂. to: methane, SAFs, etc.
- Hydrotreating, hydrodeoxygenation, of bio oils.

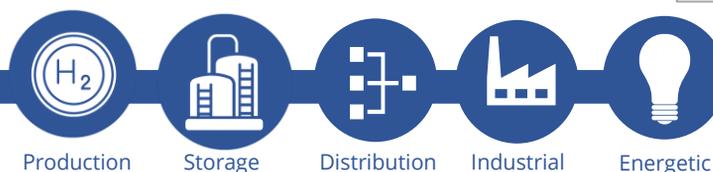


DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Member of the platforms:
Spanish Hydrogen Technological Platform (PTE H₂), and Spanish CO₂ Technological Platform (PTE CO₂) and Spanish Society of Catalysis (Secat).

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Member of Hydrogen Europe Research and EERA (JPs: Fuel cells and Hydrogen, Energy Storage and Bioenergy).



TECHNOLOGY DESCRIPTION

SuPrEn group works on the development of new processes and technologies related to hydrogen and sustainability.

Description:

Demonstrate the feasibility of Liquid Organic Hydrogen Carrier (LOHC)-based technology for hydrogen distribution and storage, as well as reduction of LOHC technology costs.

- Development of new catalyst formulations free of noble metals and development of a new catalytic reactor architecture.
- Study of the activity and selectivity of prepared new materials for H₂ storage and generation systems.
- Characterization, performance and maximum number of charge-discharge cycles.
- CO₂ free technology.



TECHNOLOGY INFORMATION

Maturity level: 4

Industrial property rights: own technology

Type of collaboration offered:

- Lab-scale plant: for H₂ storage or generation.
- Reaction systems that can operate with fixed bed, CSTR, with membranes or monoliths. Analysis of online products.
- Generation of hydrogen from biogas, bio-oils or bio-alcohols through structured catalytic systems resistant to deactivation.

APPLICATION SECTORS

- **H₂ Production:** methane and biogas reforming and production from biomass, bio-oils and bio-alcohols.
- **H₂ Storage:** H₂ carriers, hydrides and others.
- **H₂ Distribution:** pipes.
- **Industrial:** Green H₂ as raw material-PtX: methane, metanol and ammonia.
- **Energy sector:** High temperature heat 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 experience (since 1998) in the fields of: i) Biomass and Bioenergy, ii) Advanced Porous Materials for Catalysis and Adsorption, iii) Recovery and Characterization of Residual Materials within the Framework of the Circular Economy, iv) Sustainable Processes for Effluent Treatment, v) Sustainable Energy Technologies, and vi) Analysis of Sustainability of Processes and Products, including Hydrogen in different research lines.

The GIQA has, on the URJC's Móstoles Campus, the necessary research facilities and equipment for the development of research projects.

ENTITY DATA

Type: Research Group of the Rey Juan Carlos University

Size: >100 employees (high performance research group)

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN
Regional and Other



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c/ Tulipán s/n 28933 Móstoles (Madrid)

ACTIVITIES AND EXPERIENCES IN R&D&I

- Hydrogen Production
 - reforming and valorization of streams derived from biomass
 - decomposition of water through thermochemical cycles
 - catalytic decomposition of methane
- Hydrogen Purification
 - development of highly hydrogen-selective membranes for use in separators or reactors
- Hydrogen Storage
 - development of new porous systems for the storage and transport of hydrogen
- Membrane reactors

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

TECHNOLOGIES OFFERED

Technologies offered by GIQA are:

- Green hydrogen production by reforming biomass-derived fractions
- Ultra-pure Hydrogen Production in Membrane Reactors
- Green hydrogen production by thermochemical water splitting
- Storage and distribution of H₂ in porous solid materials



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

1. Production of green hydrogen from residual fractions of biomass by auto-thermal reforming in flat geometry membrane reactors. Period: 09/01/2021 to 08/31/2024. Funding entity: Spanish State Research Agency. Reference: PID2020-117273RB-I00.
2. Production of renewable H₂ by dissociation of H₂O through low-temperature solar thermochemical cycles. Period: 12/01/2022 to 11/30/2024. Funding entity: Spanish State Research Agency. Reference: TED2021-132540B-I00.
3. Production of renewable hydrogen by oxidative reforming of aqueous fractions of bio-oil using mesostructured and shaped catalysts. Period: 12/01/2022 to 11/30/2024. Funding entity: Spanish State Research Agency. Reference: TED2021-131499B-I00.
4. Development of multifunctional MOF materials for decarbonization and energy use. Period: 01/01/2023 to 12/31/2023. Funding entity: Rey Juan Carlos University. Reference: MATER-M3000.
5. Development of non-stoichiometric metal oxides and their macroscopic conformation for the thermochemical production of CO₂-free hydrogen. Period: 06/15/2022 to 06/14/2024. Financing entity: Regional Government of Madrid. Reference: ONEHYDRO.
6. Design of selective metal-organic materials for CO₂ recovery and hydrogen storage. Period: 01/01/2019 to 12/31/2022. Funding entity: Spanish Ministry of Science and Innovation. Reference: PGC2018-099296-B-I00.
7. High resistance palladium membranes for process intensification. Period: 01/01/2020 to 06/30/2022. Financing entity: Regional Government 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 04/30/2023. Financing entity: Regional Government of Madrid. Reference: S2018/EMT-4319.



Production

TECHNOLOGY DESCRIPTION

The Grupo de Ingeniería Química y Ambiental (GIQA) has more than 20 years of experience in the development and implementation of catalysts for hydrogen production by reforming and valorization of various biomass-derived streams (bioethanol, bioglycerol, aqueous fraction of bio-oil...).

Reforming of biomass-derived fractions:

- Steam reforming, oxidative reforming or autothermal reforming.
- Laboratory-scale tests on automated equipment.
- Adaptation to various raw materials.
- Approach to industrial operating conditions.
- Stability tests.

Development of reforming catalysts: Preparation of highly active and stable catalysts based on metals (Ni Co, noble metals) supported on highly porous materials:

- From formulation to shaping (agglomeration, extrusion...).
- Development of high porosity supports.
- Catalyst characterization.

Reforming process analysis:

- Process engineering from raw material input to hydrogen of the required purity.
- Techno-economic analysis.
- Environmental sustainability analysis

TECHNOLOGY INFORMATION

Maturity level:

Applied basic research. Validated in laboratory

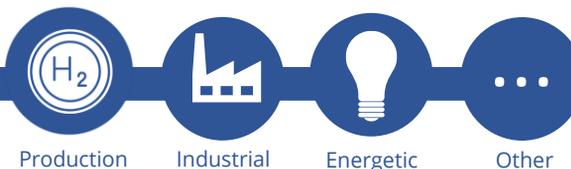
Type of collaboration offered:

I+D cooperation agreement. Technical cooperation agreement.

APPLICATION SECTORS

- **H₂ Production:** Steam reforming, oxidative or autothermal, processes.

Ultra-pure Hydrogen Production in Membrane Reactors



TECHNOLOGY DESCRIPTION

The Environmental and Chemical Engineering Group (GIQA) of Rey Juan Carlos University relies on large experience (from year 2005) in developing Pd-based membrane modules. They can be applied to independent purification units or membrane reactors.

The membrane module, prepared onto Porous Stainless-Steel supports with both tubular and planar geometry, incorporates a thin palladium film with thickness within 10-15 mm. This layer is deposited by the technique Electroless Pore-Plating, developed and optimized by our research group.

The combination of these membrane modules with appropriate catalysts in the well-known membrane reactors lets to increase the hydrogen yield and/or operating conditions due to the shift of the chemical equilibrium by continuous extraction of hydrogen from the reactant phase. It provides a process intensification to save capital and maintenance costs.

In summary, we account large experience in developing membrane modules to be used in hydrogen separations from multi-component gas streams with almost complete selectivity, as well as combined with solid catalysts in membrane reactors.

TECHNOLOGY INFORMATION

Maturity level:

TRL3-5 Validated in laboratory

Type of collaboration offered:

Technical assistance, experimental development (laboratory and/or pilot plant) and partner for national or international research projects.

APPLICATION SECTORS

- **H₂ Production:** light hydrocarbons reforming (biogas, alcohols, wastes...), gasification, water gas shift reaction (WGS), dehydrogenation of hydrogen carriers (i.e., methylcyclohexane) and catalytic cracking of ammonia.
- **Industrial:** hydrogen production from wastes and green hydrogen as feedstock for industrial processes. Process intensification for industry through membrane reactors.
- **Energetic:** use of membranes for hydrogen separation from methane in gas grid.
- **Other:** production of ultra-pure hydrogen for multiple industrial applications (iron and steel industry, electronics...).



Production

TECHNOLOGY DESCRIPTION

Development of materials and macrostructures for application in green hydrogen production by solar thermochemical water splitting. 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, producing H₂ with zero CO₂ emissions.

Design of materials with redox capacities for hydrogen production by thermochemical water splitting at lower temperatures compatible with the use of waste heat produced in several industrial processes (exhaust gases from thermal power plants, Generation IV nuclear reactors, etc.).

Design of materials and systems for the generation of H₂ and CO (syngas), by thermochemical decomposition of H₂O and CO₂.

The group has high-temperature reactors (working up to 1400 °C) at laboratory scale, H₂ and CO analyzers compatible with gases streams up to 40-100 NL/h, and equipment for the synthesis of materials in wet and solid phase and their complete characterization.

TECHNOLOGY INFORMATION

Maturity level: Basic research , lab-proven

Industrial property rights: Some materials Patented

Type of collaboration offered: Technical assistance, experimental development and partner in national and international projects

APPLICATION SECTORS

- **H₂ Production:** by thermochemical water splitting:
 - Hydrogen production in solar thermal power plants (T > 900°C).
 - Hydrogen production through the use of waste heat from different processes (T < 900 °C).
 - Production of syngas (H₂ and CO) by thermochemical H₂O and CO₂ splitting, simultaneously or sequentially.

Storage and distribution of H₂ in porous solid materials



Storage



Distribution



Refuelling



Transport

TECHNOLOGY DESCRIPTION

Storage and distribution of H₂ in porous solid materials, such as MOFs

Development of new porous systems based on metal-organic frameworks materials (MOFs) for hydrogen storage and transport.

These selective hydrogen adsorbents, with suitable H₂-MOF interaction forces, allow for an increase in both storage capacity at near-ambient temperature and a reduction in the operating pressures currently being applied (700-900 bar) in compressed hydrogen storage systems for mobile applications.

Among porous materials for physically adsorbing H₂ at moderate temperatures, there is no competition with MOFs, as they are far superior to 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 and technical advice
- Technical cooperation agreement

APPLICATION SECTORS

- **H₂ Storage:** porous materials for pressure storage recipients
- **Transport:** H₂ storage tank systems for mobile applications (land, maritime, aviation and space), using temperatures higher than liquefied H₂ and pressures <100 bar.



Storage, transportation
and distribution



Production



Mobility



Industry

DESCRIPTION OF THE ENTITY

The Rovira i Virgili University (URV) is the public university in southern Catalonia (Tarragona). It offers undergraduate, postgraduate, and doctoral programs (1,350 theses, 45% international students), as well as research, knowledge transfer, and innovation in most fields of knowledge, with strengths in chemistry, chemical engineering and energy, food technology and nutrition, tourism, archaeology, and computer science.

Located in a major industrial area with the largest petrochemical complex in southern Europe and a leading region in energy production (nuclear, wind, hydroelectric, and combined cycle), URV actively engages in hydrogen and industrial decarbonization efforts through local, national, and international alliances, adopting an interdisciplinary approach that includes experimental sciences, engineering, and social sciences.

URV catalyzed the creation of the Hydrogen Valley of Catalonia, which it has been coordinating. This initiative includes 250 entities and currently comprises 70 hydrogen deployment projects (industry and mobility), R&D&I, and training and socialization efforts, with a total investment of €2.3 billion.

ENTITY DATA

Type: University

Size: > 1000 employees

Calls of interest for your entity:

European, nationals, regionals.



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ACTIVITIES AND EXPERIENCES IN R&D&I

URV has 90 research groups in a wide range of knowledge areas, with a strong capacity for scientific, economic, and social impact. Fourteen of these groups work on hydrogen-related topics, including social sciences such as economics, law, and communication. URV conducts extensive knowledge transfer activities at the regional, national, and international levels. Recently, it created the first hydrogen-focused spin-off dedicated to high-selectivity sensors. URV has a network of affiliated technology and research centers, which, together with its internal capabilities, enable it to attract talent and access competitive resources. Together with the Catalan Institute of Chemical Research and the Chemical Technologies Unit of the Technology Center of Catalonia (Eurecat), both in Tarragona, URV has established a leading technological partnership in hydrogen.

Approximate annual investment in R&D&I in hydrogen and fuel cells: 1-2 M€

TECHNOLOGIES OFFERED

- Hydrogen Production Electrolysis: Catalysts, High-Temperature Electrolyzer, Photoreforming of Wastewater. Waste/Organic Matter to Hydrogen: Gasification, Reforming and Photoreforming of Biomass and Organic Waste; Catalytic and Electrocatalytic CO₂ Reduction.
- Hydrogen Distribution and Storage: Safe H₂ Storage at High Pressure: Renewable Hybrid Storage Systems; New Materials for Safe High-Pressure H₂ Storage; H₂ Liquefiers; Detection and Monitoring Sensors for H₂. Low-Cost Distribution of Green Hydrogen: Catalytic Ammonia Cracking for Transportation; Catalytic Dehydrogenation of Liquid Organic Hydrogen Carriers for Transport.
- Hydrogen Applications: Mobility Applications, Enhancements in Fuel Cell Technologies; Economic and Market Studies.
- Clean Energy Applications: Industrial Decarbonization using Green H₂ and CO₂ Emission Reduction.
- Cross-Cutting Activities: Public Understanding of H₂; Legal Framework for H₂; Socioeconomic Impact and Sustainability Assessment.



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Hydrogen Research Projects in Development (Examples):

H2 Production

- Hydrogen production from biomass.
- Biorefinery for high-value chemicals and hydrogen.
- Catalytic depolymerization of plastics for conversion to fuels and hydrogen.
- Nanostructured catalyst synthesis for hydrogen.
- Laser-assisted synthesis of single-atom photo/electrocatalysts for hydrogen generation.
- Zero-emission 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 energy systems based on storage and flexibility: acceptability, governance.
- Integration of hydrogen technologies in distributed energy systems.

H2 Storage, Transport, and Distribution

- H₂ sorption in activated carbon enhanced by ionic liquids.
- Green hydrogen storage using LOHC.

H2 Detection

- Wireless nanosensor networks for distributed and autonomous gas detection.
- Ultra-sensitive and selective hydrogen detection systems using nanomaterials.

H2 Networks

- X₂ CAT Network: A hydrogen technology valorization network with participation from URV (9 research groups), Polytechnic University of Catalonia, Technology Center of Catalonia-Eurecat, Catalonia Institute for Energy Research, and Catalonia Institute for Chemical Research.

H2 Training

- Inter-university Master's in Hydrogen Technologies. 2 editions. URV in collaboration with Mondragón University, Public Country of the Basque Country, University of Zaragoza, and Polytechnic University of Catalonia.
- Industrial PhDs in H₂: Hydrogen governance and regulation for a sustainable energy transition; Developing fully tested valves & fittings compatible with hydrogen per high-pressure regulations and standards.

H2 Outreach

- Workshop on hydrogen production and uses for the general public (over 3,000 attendees); school talks: "What color is hydrogen?"; Young Talent-H₂: high school final projects on hydrogen.

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

URV's International Scope The URV has a broad international dimension, with 40% of its 1,882 scientific publications (2022) conducted in cooperation with foreign institutions, more than 800 students participating annually in mobility programs, and 35% of master's and doctoral students being international.

Aurora Consortium Formed by the URV and a group of research-relevant universities, deeply committed to the social impact of their actions and involved in their local communities. In 2020, Aurora received a major boost when recognized as one of the 41 European University Alliances (European Universities Initiative), funded to promote European university campuses. This recognition was renewed in 2023. Cooperation on H₂ topics within the Aurora framework began with a joint meeting of participating universities, which will continue with 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, funded by HORIZON EUROPE (€1.6 million), is the first European doctoral program for legal specialists in the field of hydrogen.

Hydrogen Research Europe The URV is a member of Hydrogen Europe Research, an international nonprofit organization comprising over 140 universities and Research & Technology Organizations (RTO) from 29 countries.

R&D&i Cooperation Projects on H2

- Integration of hydrogen technologies in distributed energy systems: Yokohama University.
- Hydrogen public understanding and social awareness: Buffalo University.
- Production of syngas with high hydrogen content via biomass and plastic waste pyrolysis-gasification: Chimborazo Higher Technical School.
- Zero-emission production of H₂ and electricity via reversible CH₃OH electrolysis for maritime and land transport (Hyelmeth-Zero). Multiple national and international partners: Univ. of Bremen, Univ. of Bologna, etc.

H2 Transfer Projects with International Companies

- Hydrogen supply chain modelization in the UK - BP.
- Wastewater-to-hydrogen under natural sunlight. Multiple national and international partners: 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.

APPLICATION SECTORS

- **H2 Production:** Water electrolysis. Compounds.



Production

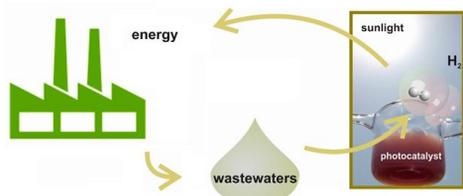
Other

TECHNOLOGY DESCRIPTION

Visible light active photocatalysts for wastewater photoreforming and H₂ 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.

APPLICATION SECTORS

- **H₂ Production:** Water electrolysis. Compounds.
- **Other:** Wastewater valorisation.



Production

Other

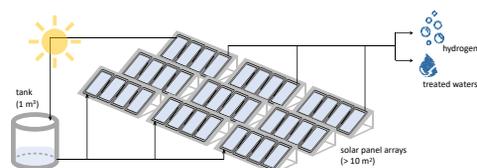
TECHNOLOGY DESCRIPTION

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.

APPLICATION SECTORS

- **H2 Production:** Water electrolysis. Unit (photocatalytic solar reactor).
- **Other:** Wastewater valorisation.



Storage



Distribution

TECHNOLOGY DESCRIPTION

Wireless sensors for selective detection of H₂

Nanostructured solid-state sensors that enable selective detection of gases, including hydrogen (H₂), methane (CH₄), ammonia (NH₃), and hydrogen sulfide (H₂S).

These 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 H₂ at ppm concentrations in the environment.

TECHNOLOGY INFORMATION

Maturity level: Validated in laboratory (TRL 4).

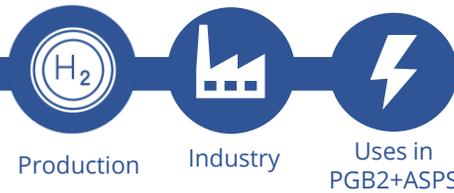
Industrial property rights: Registered trademark (NanoChronia S.L.)

Type of collaboration offered:

- Conducting pilot tests.
- Adapting our prototypes to the specifications of different applications.
- Technology licensing agreements.
- Exploring investment opportunities.

APPLICATION SECTORS

- **H₂ Storage:** Compressed gas in storage tanks.
- **H₂ Distribution:** Underground gas pipelines.



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
-  91 126 707
-  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 €

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).

ENTITY DATA

Type: SME

Size: 10 employees

Calls of interest for your entity:

European: Horizon Europe

National: CDTI, MITECO, MICINN

Regional



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

- Investigo Program/ Innova Canarias call: Recruitment of personnel destined to R&D activities in the field of improvement, scalability, and efficiency of the technologies patented and commercialized by Water2kW. 1-2 years.
- Public Entity ICEX Spain. Recruitment of one engineer (Chile). 1 year.
- Stars Canarias Program: H2UMIDITY® Project - AEMWE (Development of a green hydrogen production system through air humidity using AEM-WE. 18 months.
- Opportunities for the development and application of PulviMetalurgia in ion exchange electrolyzers with improved performance for the production of green H2 (PMEMEL-H2) presented to the Call for Public-Private Funding 2022 in collaboration with UC3M and URJC Madrid. 3 years
- 2nd call of the incentive program for the innovative and knowledge value chain of renewable hydrogen within the framework of the PRTR (H2umidity®-PLUS). 3 years



DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

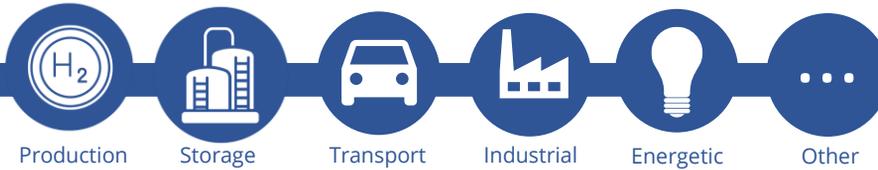
- Start-up selected for S3ECharge for Growth Start-ups Program. Tailor-made mentoring and networking program of 14 weeks.
 - Project validation
 - Development of the business plan ready for investment
 - Investment process

[South3E - S3E en LinkedIn: S3E CHARGE Startups | Water2kW](#)

- Start-up selected for the Rural Spain ClimAccelerator Program. A customized 20-week program aimed at innovative entrepreneurial solutions, with international mentors and keynote speakers, to address the challenges of rural areas in Spain.
- European Innovation Council: Proposal approved in Step 1.



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION
GLOBAL AWARDS 2023
First Prize Green Hydrogen Technology



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

APPLICATION SECTORS

- **H2 production:** Water electrolysis 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.



Storage, transportation
and distribution



Production



Industry

DESCRIPTION OF THE ENTITY

A leading global provider of professional project and asset services in the energy, chemicals, and resources sectors driven by a common purpose of delivering a more sustainable World. Our Madrid office is home to a key Center of Excellence in **Green Hydrogen** and **Renewables**.

Worley works across the **green hydrogen** value chain and its **derivatives** to help customers understand their options and challenges. Worley offers global experience for all stages of the project lifecycle from **early Consultancy and Advisory services**, through **FEED, EPCm, and OE and PMC** Support.

We have an In-depth knowledge of **electrolysis** and strong relations with major OEMs. Through the years of experience, we have acquired expertise also for **water treatment, grid connection, hydrogen compression, purification and storage**. Our bespoke approach optimizes **CAPEX/OPEX/LCOH**.

ENTITY DATA

Type: Large Company

Size: >100 employees

Calls of interest for your entity:
National and International calls



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ACTIVITIES AND EXPERIENCES IN R&D&I

What Worley Consulting offers:

Pre-Notice to Proceed Services:

- Market studies; Technical Due Diligence.
- Technical Advisory and Consultancy services: Planning; Technology agnostic assessment & OEM selection; Site assessment; Power systems simulations and modelling; Geotechnical support; Risk Analysis; HSE studies.
- Feasibility studies, Conceptual Design/Pre-FEED and Cost Estimate Class IV.
- Integration/Interconnection; Environmental studies
- Independent Engineering Services for Lenders.

Post-Notice to Proceed Services:

- Owner's Engineering & PMC, O&M Technical Support.

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

TECHNOLOGIES OFFERED

What Worley Services offers:

- Basic Design; Pre-FEED/FEED
- EPCm; Owner's Engineering and PMC
- Class III and Class II Cost Estimates
- Engineering Revamps; Integrated Solutions
- Asset Performance Management
- Roadmaps



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Green Hydrogen Program - Optimize Plus OSBL

Customer: BP Energy - Spain

Description: Establishment of a 175MW plant for electrolytic hydrogen production. The electrolyser is designed to operate continuously to ensure a steady supply of green hydrogen. The power required for this operation will be sourced from renewable energy supplied by the national grid, supplemented with grid power during periods when renewable power is insufficient. The necessary electrical supply facilities will be provided by the Transmission System Operator in the adjacent electrical substation. This project is a significant step towards sustainable energy solutions.

TIC: ≈ 400.000.000 €

New Green H2 Plant Huelva Pre-FEED

Customer: Confidential

Description: As part of their decarbonization program, the client plans to develop multiple green hydrogen projects in the south of Spain. Their flagship project is a 400 MW green hydrogen plant, which will be later be expanded to have a capacity of 1 GW.

Worley Consulting developed the pre-FEED study of this opportunity.

TIC: ≈ 800,000,000 €

Green Hydrogen Plants in North of Spain FS

Customer: Enagas Renovable

Description: Worley Consulting was retained to assess the deployment of 3 green hydrogen plants (> 1GW in total) which shall produce a total of 140,000 t/year of hydrogen to be supplied to a steel plant in the North of Spain. Our scope included Project Configuration definition and Feasibility Study and Conceptual Design.

TIC: Confidential

Hydric Pre-FEED

Customer: Repsol-RIC

Description: Installation of a 30 MW green hydrogen plant at Sevillana thermal power station in Puertollano. This project arises from a sustainable initiative for the generation of renewable hydrogen through electrolysis and its subsequent transportation via a hydrogen pipeline to consumers. The consortium formed by RIC Energy and Repsol also proposes the possibility of expanding the plant in the future up to 200 MW. The objective of this contract is to provide Pre-FID Engineering services for the 30 MW hydrogen plant and subsequently, PMC services (pending award).

TIC: Confidential

BP Project Azahar

Customer: BP

Description: Installation of a 25 MW green hydrogen containerized plant in Castellón. Project funding: IDAE. Concept, Pre-FEED, FEED, EPC tendering.

TIC: ≈ 75,000,000 €

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

UNITED KINGDOM

Cadent / Uniper Hydrogen Village (East Midlands & Humber) FS

Cadent / EDF (Sizewell C): Hydrogen Village (East Anglia) FS

Ineos: H2 Pilot Plant

Philips 66, Gigastack: 100MW FEL 2

Kintore: 500MW FEED (Phase 1)

Confidential: 30MW Pre-FEED

IRELAND

EiH2: Green Marlin Scoping Study

EiH2: Blue Mackerel 60 MW CD

Confidential: Up to 2 GW, Concept

MOROCCO

Innovx: Tarfaya Program 1 Million ton of ammonia, 1.5 GW of Electrolyser capacity.

Innovx: Jorf Hydrogen Project as Tarfaya Project's pilot.

PORTUGAL

Smartenergy: Galileu GH2 + SAF & Site Selection

Smartenergy: Oporto GH2 + SAF & Site Selection

Madoqua P2X (CIP): OE GH2 Plant

Hytlantic: 96MW

FRANCE

Confidential: 50MW Green H2 project EU Innovation fund application support and CD

Confidential: 120MW FEED + OEM Selection

BELGIUM

Plug Power: 100MW Pre-FEED, FEED

NETHERLANDS

HyCC: 20MW FEED

HyCC: 50MW, 100MW Pre-FEED

Total Terneuzen: 150MW Pre-FEED

ShellHH1: 200MW Pre-FEED, FEED to EPCm

Ørsted: 100MW Permit + Concept

RWE Furec: 150MW Pre-FEED

Koninklijke Vopak NV: Puffin Project FEED

GERMANY

Shell: 10MW supports all phases, 100 MW FEL 2

Bp Lingen: 100MW Pre-FEED, FEED

RWE: Aquaductus Concept

DENMARK, NORWAY, SWEDEN

Fortum: Project Odin 100MW Pre-FEED

Confidential: Workshop: scaling up green H2

Hoest P2X: pre-FEED assessment

Confidential: H2 20MW Pre-FEED

Confidential: Verification of concept design of a GH2 plant

Inovyn: 30MW concept

Confidential: GH2 and GNH3 400MW Pre-FEED

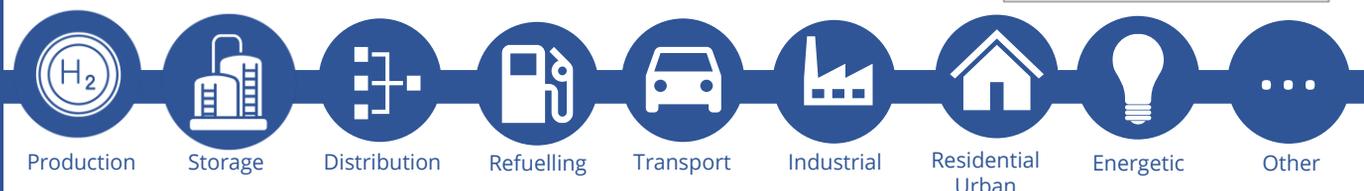
Confidential: GH2 Production Unit Review - OE FEL2

Uniper: Project Air, 30MW FEED, roll-over EPC

Confidential: FEL 3 for 720MW FEED

Confidential: DRI 720MW FEED

Uniper: SAF Pre-FEED



TECHNOLOGY DESCRIPTION

Integration

Power to X projects requires a proper integration between the **renewable energy source**, the **hydrogen production**, the **green derivative/synthesis plant** and the **utilities**.

Worley is a **technology independent integrator**: Our delivery model provides a solution for exactly the needs the markets is facing in delivering integrated projects since Worley counts on SME experts and teams with experience on developing engineering of RES, green hydrogen and its derivatives. Worley is **technology agnostic** which allows to select the most suitable option for each unit.

Reduction of levelized cost of green hydrogen

Minimising the levelized cost is the key parameter for every green hydrogen project business case to be profitable.

Optimisation (and modelling) from early concept development & proper technology selection, applying a **bespoke approach** according to the characteristics and drivers of each particular project, searching for the most suitable solution to minimise the levelised cost. Our **executive approach** also allows to **reduce cost and time** which eases to pass the FID.

TECHNOLOGY INFORMATION

Maturity level: Worley holds expertise in developing technologies from **concept** to **pilot** and **commercial** scale and are involved in both advanced execution of moderate scale and developing very large-scale green hydrogen projects.

Industrial property rights: NA

Type of collaboration offered: Engineering and consulting in the whole value chain. Balancing between the economy of scales and project risks and limitations allows to find the right approach with regard to the potential project phasing in terms of investment.

APPLICATION SECTORS

- **H2 Production:** Whole Plant
- **H2 Storage:** Whole Plant
- **H2 Distribution:** Whole Plant
- **Refuelling infrastructures:** Whole Plant
- **Industrial:** Power to X (methanol, ammonia, etc): Whole Plant
- **Energetic:** Whole Plant



Storage, transportation and distribution



Production



Mobility



Industry



Uses in PGB2+ASPS

DESCRIPTION OF THE ENTITY

Zoilo Ríos S.A. is an Aragonese company founded in 1927, managing 18 service stations.

In addition to the attended supply of fuels and energies at the service station or home delivery, the Group's activities also include car washing, quick repair workshops, convenience stores, guarded parking for trucks, hazardous goods, and motorhomes, as well as consulting and developing IT systems.

A member of the Aragón Hydrogen Foundation's Board of Trustees since its creation in 2003, the Zoilo Ríos Group actively participates in the energy transition for mobility with low or zero emissions such as electricity, green hydrogen, renewable fuels, and biomethane.



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ACTIVITIES AND EXPERIENCES IN R&D&I

It has participated in projects with other companies and specific R&D entities (Fha, CIRCE, CSIC, UNIZAR, ITAINNOVA), such as:

OPTILYSER: testing and validation of optimal dispatch software for electrolyzers based on massive data processing for the production of green hydrogen.

CFD: development and validation of a fluid dynamic filling model for hydrogen tanks.

PREVERH: study of legal, regulatory, and legislative requirements applicable to hydrogen dispensing, as well as the preventive and regulatory maintenance to be applied in the installation.

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

TECHNOLOGIES OFFERED

Zoilo Ríos, S.A. does not offer technology as such but rather its extensive experience in managing traditional service stations. It understands customer needs and finds commercial agreements with the end user.

Additionally, it has experience in incorporating new energies that have emerged in recent years (gases, renewable liquids, EV charging, etc.), as well as managing two hydrogen refueling stations, in 2008 and 2024.

ENTITY DATA

Type: SME

Size: >100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, PIONEROS

Regional: MOVES



DESCRIPTION OF NATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

Project with CSIC for a hydrogen station at El Cisne Service Station (NextGenerationEU): installation of an on-site production system and dispensing of green hydrogen for mobility. The project includes the installation of photovoltaic panels, a storage system with second-use batteries, and dispensers at 350 and 700 bar. Additionally, it will feature an intelligent control system that will provide production and demand predictions.

ECOASIS Project: together with CIRCUTOR and CIRCE. This project aims to make it possible to build a service station with ultra-fast charging for electric or hydrogen vehicles anywhere in the country, without the need for a connection to the electrical grid, using photovoltaic panels, batteries, and a fuel cell.

Refueling of hydrogen buses with a mobile hydrogen station at El Cisne Service Station through the use of a portable hydrogen storage and dispensing plant for vehicles at 350 bar (project with Alsa and Repsol).

Collaborations and development of pilot projects with:

- **CEEES:** Spanish Confederation of Service Station Entrepreneurs (Responsible for Incorporation of New Energies)
- **CLENAR:** Energy Cluster of Aragon (Mobility Working Group)

DESCRIPTION OF INTERNATIONAL INITIATIVES IN WHICH THE ENTITY PARTICIPATES

CATALOG OF TECHNOLOGIES CAPABILITIES 2024

SPANISH HYDROGEN
TECHNOLOGY PLATFORM