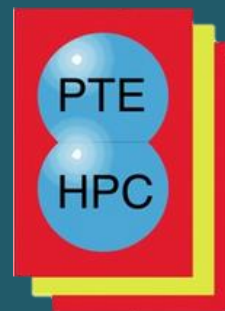


HYDROGEN AND FUEL CELLS

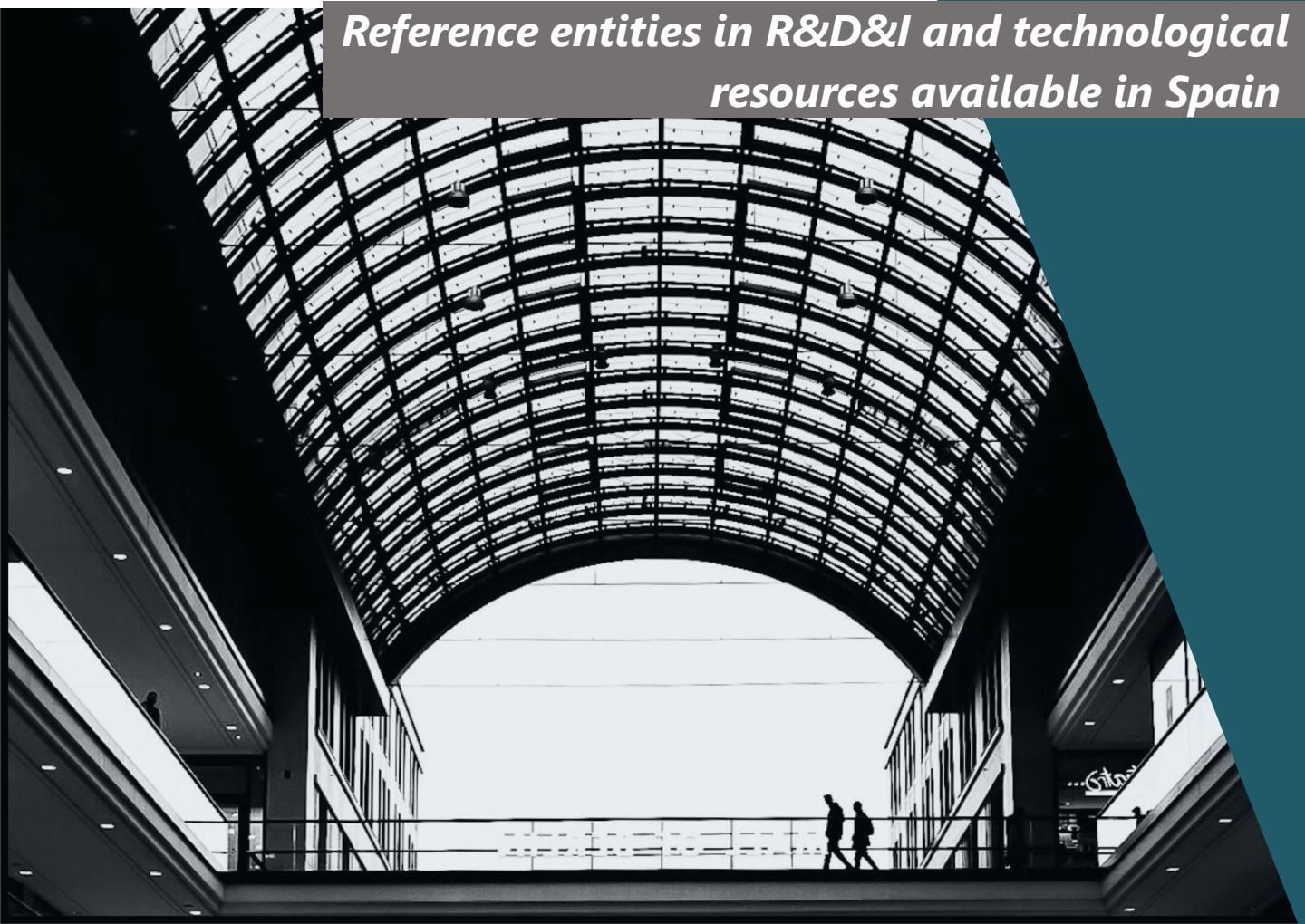
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CAPABILITES CATALOGUE



SPANISH HYDROGEN
AND FUEL CELL
TECHNOLOGY
PLATFORM

JULY
2022

*Reference entities in R&D&I and technological
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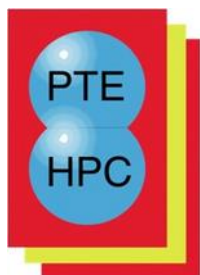
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PRESENTATION

SPANISH HYDROGEN AND FUEL
CELL TECHNOLOGY PLATFORM

Spanish Hydrogen and Fuel Cell Technology Platform



The Spanish Hydrogen and Fuel Cell Technology Platform (PTE HPC) is an initiative promoted by the **Spanish Hydrogen Association** and protected by the **State Research Agency (Ministry of Science and Innovation)**.

Since its launch in 2005, the PTE HPC has been responsible for **promoting innovation and technological development in the hydrogen and fuel cell sector in Spain**. The PTE HPC boosts the participation of Spanish entities in R&D&I projects (national and international) related to hydrogen and fuel cells with the aim of developing its own knowledge and technology that allows the Spanish industrial fabric to be placed in a competitive position at an international level.

In general, the Platform provides entities with opinion about innovation, provides them with valuable information and facilitates their integration into a privileged position in the national hydrogen and fuel cell sector.

With the support and collaboration of:



Project with reference number:

PTR-2020-001220

Platform website

www.ptehpc.org

Edition

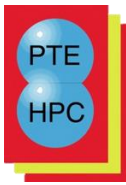
This report has been made after a process of information collection by the Spanish Technology Platform for Hydrogen and Fuel Cells (PTE HPC).

Design and layout

ARIEMA Energía y Medioambiente S.L.

Update

2022



PRESENTATION

Letter from the president

In the process of **energy transition** and the path towards **climate neutrality** in which we find ourselves, the diversity of **hydrogen applications** makes it a key technology for the **decarbonisation** of emission-intensive economic sectors such as electricity generation, transport, industry and construction.

Spain is in a privileged position in relation to the use of hydrogen as an energy vector, as it **has great potential for renewable hydrogen generation** and the expectations for growth are very high. It is a time in which, despite of the rapid growth in the implementation and deployment of the technology, R&D&I efforts continue to be very necessary. The development and optimisation of existing processes, cost reduction, or the development of alternative applications will allow better use of renewable hydrogen and it will soon reach the conditions of competitiveness with respect to fossil-based production alternatives.

Since its creation, the **Spanish Hydrogen and Fuel Cell Technology Platform (PTE HPC)** has been growing and consolidating until it has established itself as a large technological network that brings together entities belonging to the entire hydrogen value chain. The agents that make up the network cooperate with the aim of generating hydrogen-based energy solutions that respond to the challenges posed by the energy transition towards a carbon neutral scenario and, at the same time, boost the strategic development of the national industrial and technological services sector.

The "Fit for 55" set of climate policy initiatives, presented by the European Commission in July 2021, provides an additional boost that will enable the scaling up of renewable hydrogen technology, through the role it plays in the review of the renewable energy directives (RED II) and the energy tax, as well as in the regulation of alternative fuels for transport (land, sea and air) or the review of the emissions trading system, among others.

In this context, as president of the PTE HPC, it is a pleasure for me to present this document which sets out a catalogue of technologies and reference entities, which are part of our Platform, and which make up the structure of the R&D&I ecosystem of the hydrogen sector in our country. We intend to promote the aims of PTE HPC, publicising the R&D&I activities carried out by our members, promoting possible projects and collaborations, as well as promoting the hydrogen and fuel cell technologies already available in Spain.

For the elaboration of this catalogue, we have had the collaboration of PTE HPC members, to whom I would like to express my gratitude for their experience, knowledge and vision, as well as my congratulations for the great work they carry out, which is reflected here. Their role is fundamental to place our country in a position of competitive leadership in the international hydrogen and fuel cell technologies field.

Finally, on behalf of all of you, I would like to thank the *Agencia Estatal de Investigación AEI* (State Research Agency) for its support to our platform in particular.

I would also like to acknowledge AEI's fundamental work on the strengthening and consolidation of Spanish science and technology, especially in the current context of great momentum that the technologies we promote from PTE HPC are going through. We are sure that the energy transition is leading us irremediably towards a hydrogen economy, and we can affirm with certainty that a promising future with great opportunities for our sector is opening up ahead of us.



Antonio González García-Conde
PTE HPC's President



CATALOGUE OF MEMBERS

SPANISH HYDROGEN AND FUEL
CELL TECHNOLOGY PLATFORM

CATALOGUE OF MEMBERS

This first block aims to publicize the member entities of the PTE HPC that make up the structure of the R & D + i ecosystem of the Hydrogen and Fuel Cell Sector.

Included in each file are the most important data of each of the participants in this Catalogue of Technological Capabilities (contact details, description of the activity and type of entity, including at this point its annual investment ceiling in hydrogen and fuel cell projects and interest in the different Public Calls at the regional level, national and international).

It also shows a synthesis of the R&D&I activity carried out by the different entities.

In addition, their participation in each of the working groups of the Spanish Hydrogen and Fuel Cell Technology Platform is indicated, through the symbology that we add below:

GT HYDROGEN PRODUCTION



The objective of the Technical Working Group is the analysis and study of Spain's potential to produce hydrogen, especially from renewable energy sources. Developing and optimizing different methods of hydrogen production will be fundamental to be able to implement this versatile energy vector on a large scale and bring its economic, social and environmental benefits closer to the whole of Spanish society.

GT HYDROGEN STORAGE AND DISTRIBUTION



The objective of this Technical Working Group is the analysis and study, given its strategic nature for national energy security, of the storage capacity of renewable surpluses in the form of hydrogen (study of large-scale storage systems), as well as the potential of the use of the national gas network, both for storage and distribution.

GT TRANSPORT (VEHICLES AND INFRASTRUCTURE)



The objective of this Technical Working Group is the analysis and study of the use of hydrogen in all types of vehicles and the infrastructures necessary to supply this fuel. Work is also being done to identify the barriers to the implementation of this zero-emission alternative in transport, as well as to design the strategies to overcome them.

GT USES OF HYDROGEN



The objective of this Technical Working Group is the analysis and study of the different applications and uses of hydrogen, which we divide into three main categories: as a raw material, for the production of thermal energy and for the production of electrical energy.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

AENOR is a professional services company that identifies and helps to correct the competitiveness gaps in the economic fabric of the societies of which we are a part. In the long term, it provides the differential value that is expressed in its purpose: to contribute to the transformation of society by creating trust between organizations and people, based on knowledge, values and competitiveness, which allows the different economic agents to acquire levels of efficiency and compete on equal terms. AENOR provides conformity assessment services (certification, inspection and testing), training and information. AENOR's certifications range from management systems to products and people. In the field of training, it offers the best range of management tools in Spanish, and its information activities range from the distribution of standards to valued technical publications, as well as the distribution of sectorial information.

ENTITY DATA

Type: Large Company

Size: >100 employees

Calls of interest for your entity:

National



www.aenor.com



(+34) 914 326 000



info@enor.com



C/ Génova, 6. 28004 Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

The Research and Innovation activities carried out by AENOR allows Companies, Supporting Innovation Bodies and Public Administrations to know the degree of novelty and technological maturity of the Research and Innovation Projects as well as the adequacy of the budgets and expenses allocated to them.

Since 2006, AENOR has been issuing technical reports for the evaluation of different Research and Innovation funding calls and programs at regional, national and international level in more than 90 scientific-technological areas.

Since 2007 AENOR has been providing its certification services in energy management and leading the market according to ISO 50001.

TECHNOLOGIES OFFERED

The Research and Innovation activities carried out by AENOR allows Companies, Supporting Innovation Bodies and Public Administrations to know the degree of novelty and technological maturity of the Research and Innovation Projects as well as the adequacy of the budgets and expenses allocated to them.

Energy Certifications: Solutions to demonstrate and ensure savings, improved performance and reduced the emission of pollutants from an activity. Verification of the origin of renewable energies.

Validation "do no significant harm" (DNSH) principle to the environmental objectives of the Taxonomy Regulation 2020/852.



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

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

AIMPLAS offers technological support and advice 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 carry out analyzes and tests on both raw materials and intermediate products, final products and plastic waste.

AIMPLAS also offers competitive intelligence services, technological watch, in addition to those related to training and related events.

ENTITY DATA

Type: Technology Center

Size: >100 employees

Calls of interest for your entity:

European (Horizon Europe, FCH JU, Green Deal); National (CDTI, MITECO, MICINN); Regional (AVI, IVACE); Other (MINISDEF, Eureka, Erasmus)



www.aimplas.net



+34 961 366 040



info@aimplas.es



C/ Gustave Eiffel, 4, Parc Tecnològic Valencia

ACTIVITIES AND EXPERIENCES IN R&D&I

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

In 2021, it carried out 255 R&D projects, 69 international and 186 national, involving 417 SMEs, which represents a return to companies of 55.5 M€

AIMPLAS is (co-) applicant, in 18 patent applications and it 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 R&D&I in hydrogen and fuel cells: < 1 million €

TECHNOLOGIES OFFERED

The plastic materials and the know-how of the researchers who work 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 hydrogen storage.*
- *Plastic pipes for H₂ distribution.*
- *Advanced materials for physical/chemical storage of H₂.*



Transport



Uses

DESCRIPTION OF THE ENTITY

Ajusa, dedicated to the automotive 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.

ENTITY DATA

Type: SME

Size: >100 employees

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



<https://ajusath.es/>



34 967 216 212



ajusa@ajusa.es



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 12kW. It also develops power systems and modules for stationary and mobility applications.

Hydrogen refueling service station at 350 bar in operation.

It is currently developing a 20 kW module and a 100 kW stack.

Completed multiple Projects in association and alone with public aid for the development of this technology.

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

TECHNOLOGIES OFFERED

PEM Fuel Cells, up to 12kW.

PEM Fuel Cells, up to 100 kW (under development).

Bipolar plates for PEM FC.

Gaskets for PEM FC.

Stationary systems: mCHP 750 W and UPS 7.5 Kw.

Mobility systems: 20 kW module (under development).



Production

DESCRIPTION OF THE ENTITY

ARIEMA, a leading Spanish company in hydrogen and fuel cell technologies, with 30 years of experience in the sector, we offer from training and consulting to the commissioning of equipment and facilities.

ARIEMA is a technological Spin-Off of the National Institute of Aerospace Technology (INTA) born in 2002.

ARIEMA is also one of the main companies promoting innovation projects, technological development and the management of public-private collaboration activities to promote joint research and business technological development; with more than 100 R&D projects executed.

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.



www.ariema.com



+34 91 804 53 72 / +34 91 241 95 31



info@ariema.com



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

ACTIVITIES AND EXPERIENCES IN R&D&I

ARIEMA's growth has been supported from its origins in research, development, and innovation and continues to do so. ARIEMA has participated in more than 20 national and international R&D&I projects that have allowed it to be at the forefront of green hydrogen technologies and to lay the foundations for its developments in electrolysis.

< 1 million € annual investment.

Some outstanding projects:

Green SMS: Integral solution for sustainable mobility in airports and eco-designed vehicle for emission reduction.

Ocean H2: Design and experimental validation of the first offshore green hydrogen plant based on floating wind and photovoltaic technology.

TECHNOLOGIES OFFERED

Electrolysis

Product range	Technology		Commercially available
< 0,5 MW	ALK	ARIEMA	yes
	PEM	ARIEMA (B.O.P.)	yes
	AEM	Third parties	yes
0,5 a 10 MW	ALK	ARIEMA	3Q-2023
> 10 MW	ALK	Hydrogen-Pro	yes

Small size PEM fuel cells (max 5 kW) of third-party technology.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

CARTIF is a horizontal, private and non-profit research institution, arising from Valladolid University, whose main mission is to offer innovative solutions to companies for improving their competitiveness and creating new business opportunities.

CARTIF is a multidisciplinary centre that develops its activity in R&D&I projects in multiple areas of knowledge focused on almost all economic sectors: energy, agrifood, industry, construction and infrastructures, health and environment, with technological lines that respond to the main challenges in each of them such as smart grids, smart cities, energy efficiency, cultural heritage, life quality, circular economy, natural resources and biotechnology.

ENTITY DATA

Type: Technological Centre

Size: >100 employees

Calls of interest for your entity:

Horizon Europe, FCH JU, Green Deal, CDTI, MITECO, MICINN
Open calls of international cooperation with Latin America and Africa



www.cartif.es



+34 983 54 65 04



jesmar@cartif.es, luibuj@cartif.es



Parque Tecnológico de Boecillo, 205, 47151

ACTIVITIES AND EXPERIENCES IN R&D&I

Since its creation in 1994 has participated in several projects of a wide range of scales and in different work fields. In 2022, CARTIF is involved in 149 on going projects (52% international, 48% with companies) and has more than 230 customers. It has laboratories that provide analytical services through a wide range of tests in areas such as Energy, Agrifood, Material Manufacture and 3D Digitalization.

At the hydrogen area, CARTIF is a member of the Cervera Excellence Network – H24 NewAge (CER-20211002), the network CYTED H2TRANSEL and the projects OCEANH2 and ECLOSION of the programme MISIONES science and innovation

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

TECHNOLOGIES OFFERED

- *Modelling and simulation of use and generation of hydrogen in an integrated energy system for their design, long term planning and advance control.*
- *Test bench of hydrogen technologies applied to residential environment.*
- *Development of catalysts for the production of hydrogen by biomethane reforming.*
- *Production of biohydrogen as of residual wet biomass.*
- *Production of biohydrogen by cultivation of microalgae.*
- *Separation of gas mixtures (H₂/CH₄/CO₂) using gas-liquid membrane contactors.*



Storage and
distribution



Transport

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.

ENTITY DATA

Type: Public Administration

Size: 51-100 employees

Calls of interest for your entity:

Horizon Europe, FCH JU, Green Deal



www.cem.es



918074700



cem@cem.es



C\ Alfar, 2, 28760 Tres Cantos, Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

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

Currently involved in two projects, 20IND06-PROMETH20 and 20IND10-DECARB, developing the preparation of gaseous reference materials, used in the analysis of trace water and in the study of mixtures of hydrogen-enriched natural gas, respectively.

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

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.



Production



Storage and distribution



Uses

DESCRIPTION OF THE ENTITY

The National Renewable Energy Centre of Spain (CENER) develops applied research in renewable energies, and provides technological support to companies and energy institutions in six areas: wind, solar thermal and photovoltaic solar energy, biomass, smart and efficient buildings and districts, and grid integration of energy. CENER is a technology centre with worldwide recognised prestige, activity and experience.

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

ENTITY DATA

Type: Technology center

Size: ~200 people

Calls of interest for your entity:

EU: Clean Hydrogen Partnership

ES: Plan Estatal AEI, PERTE ERHA

CCAA: Ayudas I+D Navarra



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ACTIVITIES AND EXPERIENCES IN R&D&I

- Experimental studies in renewable plants (wind, PV) with electrolyzers and bioprocesses.
- Technology development of hydrogen value chain: SOEC, SOFC, P2X processes through bioelectrochemical systems.
- Uses of green hydrogen in various applications and as feedstock for the production of fuels and renewable chemicals.
- Integration of hydrogen technologies in renewable energy-based grids. Hybridation of different storage and conversion technologies.
- Analysis of sustainability (ACV) and techno-economics of green hydrogen production value chain, obtained through water electrolysis and/or biomass.

TECHNOLOGIES OFFERED

- High temperature electrolysis (SOEC)
- Solid oxide fuel cells (SOFC)
- Bubbling Fluidized Bed Biomass Gasifier (ABFB).
- P2Gas Biological Methanisation



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The Specific Centre for Hydrogen Research (*CER-H₂*) 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



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-



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ACTIVITIES AND EXPERIENCES IN R&D&I

Blue and green hydrogen production; Hydrogen storage and distribution; Uses of hydrogen as fuel; Integration of hydrogen systems with the rest of the energy system; Monitoring and control systems for hydrogen technologies.

Featured projects:

BIKE-Bimetallic catalyst knowledge-based development for energy applications; **DOVELAR**-Control and energy management in hybrid electric vehicles with fuel cells; **MECATEN**-Mechanochemical preparation of catalysts for energy applications.

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

TECHNOLOGIES OFFERED

H₂ obtaining and production: Electrolysis and Thermolysis, Reformation of biogas, agricultural and industrial waste. Photo and photoelectrocatalysis; decomposition of NH₃; Infrastructures. **Storage and distribution:** compressed H₂, metallic hydrides, liquefaction at low T, 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.



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The Technological Center for Energy and the Environment of the Region of Murcia (CETENMA), 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 nationally recognized as a Technological Center, an R&D Entity and as an Office for the Transfer of Research Results (OTRI) . It has extensive experience in the development of R&D&i projects in national and European programs such as H2020, HE, LIFE or Interreg Sudoe.

*Related with hydrogen, CETENMA is currently involved in 3 projects: **EnergyPush**, promotes the use of hydrogen in social houses; **Hidrogeno Verde**, uses hydrogen in logistics and **ARCHEA** project that validate a new process to convert renewable electricity and carbon dioxide into pipeline-grade renewable natural gas using hydrogen as vector.*

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

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, LCA.



Production



Storage and
distribution



Uses

DESCRIPTION OF THE ENTITY

CETIM is a private non-profit R&D&I center recognized as a Technological Center by the Ministry of Science, Innovation and Universities with Registration No. 129. Its mission is to develop research, technology and innovation from its three Knowledge Areas: **Advanced Materials**, **ECO BIO Technologies** and **Digital Industry**. Focusing on Technologies, it applies its know-how and expertise to different industrial and economic sectors: CETIM is a **Multisector Technological Center**. CETIM is located in the Alvedro Business Park (A Coruña). It has facilities of more than 2,000 m² in which it has 8 laboratories (Chemistry, Bioprocesses, Microbiology, Electrochemistry and Batteries, Digital Industry, Construction, Polymers and Climatic Chambers) and areas for Pilot Plants, from where research and services are offered to their clients.

ENTITY DATA

Type: Technology Centre

Size: 51-100 employees

Calls of interest for your entity:

European (Horizon Europe, FCH JU, Green Deal, etc.), National (CDTI, MITECO, MICINN, etc.), Regional, Others



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St/H n 20, Alvedro Business Park, A Coruña

ACTIVITIES AND EXPERIENCES IN R&D&I

CETIM has 3 areas of knowledge: **ADVANCED MATERIALS** (New lignocellulosic materials, New polymeric materials & coatings, New materials for sustainable construction, Materials for energy storage), **ECO BIO TECHNOLOGIES** (Water and air treatment. Emerging bio-based technologies, Biorefineries and new value chains) and **DIGITAL INDUSTRY** (Digital Systems, Internet of Things).

The Center has extensive experience in direct research with industry, and in research projects in public calls: regional, national (MISIONES, CIEN, RETOS, Cervera, etc.) and international (H2020, Horizon Europe, LIFE, etc.).

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

TECHNOLOGIES OFFERED

Hydrogen production

- Biological production.
- Production by photocatalysis.
- Water pre-treatment technologies for electrolysis.

Hydrogen storage

- Eco-sustainable porous systems based on nanocellulose.
- Liquid Organic Based Hydrogen Carrier Systems (LOHC).
- Porous materials based on high internal phase emulsions (PolyHipes).



Production



Storage and distribution



Transport



Industrial



Uses



Energetic



Other

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 700 scientific publications (80% of them placed in impact or Q1 journals) and participates in more than 40 industrial projects per year. The centre promotes the creation of technology companies. It has two spin-offs: Bcare and Basquevolt.

ENTITY DATA

Type: Research Center

Size: >100 employees

Calls of interest for your entity :

European: Horizon Europe, Clean Hydrogen Partnership

National: CDTI, MITECO, MICINN, Spanish Research Agency, Regional and and other



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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.*
- *Development of new thermochemical or thermo-catalytic methods for the generation of green H₂.*
- *Catalysts and catalytic supports to produce new energy vectors and improvement of electrolyzers and fuel cells.*

Three transversal activities:

- *Atomistic and system modelling.*
- *Post-mortem analysis.*
- *Raw materials and components recycling.*

TECHNOLOGIES OFFERED

- *Electrochemical testing laboratories.*
- *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.*

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



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

CIDAUT Foundation was created on 2 February 1993, with the aim of meeting the needs of companies and promoting their competitiveness and industrial development. As a Technology Centre, our work in the field of R&D&I is aimed at positioning ourselves and acquiring scientific and technological excellence, as well as the capacity to transfer this knowledge to companies and society. The development of projects is coordinated between multidisciplinary researchers, whose synergies allow us to respond to very ambitious objectives in short periods of time, framing them within the following operational areas or trends: Energy; Mobility and Connectivity; Circular Economy and Sustainability; and Information and Communication Technologies.

ENTITY DATA

Type: Technology Research Centre.

Size: >100 employees

Calls of interest for your entity:

Europeas: Horizonte Europa, CHE JU, Next Generation

Nacionales: CDTI, MITECO, MICINN.



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ACTIVITIES AND EXPERIENCES IN R&D&I

CIDAUT Foundation, develops more than 50,000 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

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

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.



Production



Transport



Uses

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 215, 80% of whom are university graduates and 40% PhD holders. Its volume of activity came up to € 15M in 2021.

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:

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 million €

TECHNOLOGIES OFFERED

-Development and scale-up of catalysts for low temperature electrolysis and PEMFC.

-Design and manufacture of electrodes for PEM and PEMFC electrolysers; Design and assembly of MEAs for membrane electrolysers and fuel cells.

-Development of coatings for bipolar plates (electrolyser and FCs).

-Assembly of PEMFC stacks, design of sealing and fluid management systems. Design and assembly of prototype PEMFC systems for portable and mobility applications.

-Modelling; hybridisation of energy systems.

-Synergy with current battery capabilities.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The overall mission or objective of the Center for Research in Technology, Energy and Sustainability (CITES), is the promotion of knowledge and research excellence in science and technology, as well as information, training, innovation and transfer of results, in response to the demands and needs of 21st century society.

All this, with a strong intensification in the lines of research that converge in the Center, with a strong link to the field of energy, mainly renewable hybridized with hydrogen technologies. The Center has a strong vocation in the search for sustainability in its broadest sense (environmental and social without renouncing development).

CITES has complete facilities at the University Campus of La Rábida of the University of Huelva. These consist of wind and photovoltaic fields, as well as renewable hydrogen production, storage and consumption for direct electricity generation (fuel cells) or thermal utilization (turbines and engines).

ENTITY DATA

Type: Research Center

Size: 51 – 100 employees

Calls of interest for your entity: applied research with research organizations and companies.



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

ACTIVITIES AND EXPERIENCES IN R&D&I

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

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

TECHNOLOGIES OFFERED

- System for hydrogen production by electrolysis using non-conventional currents to achieve higher efficiency.
- Pilot plant to demonstrate the implementation of hydrogen technologies for energy supply in residential applications.
- Refrigerated food delivery van hybridized with hydrogen technologies.
- Renewable smart grid hybridized with hydrogen technologies.
- Power converters and monitoring, instrumentation and control hardware&software for hydrogen systems (electrolyzers, fuel cells, etc.). Digital twins.



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Clantech (Clan Tecnológica S.L.) is an EPC Engineering company specialised in the design, development of basic and detailed engineering, implementation and start-up of renewable Hydrogen projects, for industry in general and for mobility based on vehicles powered electrically with Fuel Cells.

We have carried out 6 Hydrogen Stations (HRS) projects, and we have become leaders in this field.



www.clantech.es



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ACTIVITIES AND EXPERIENCES IN R&D&I

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

TECHNOLOGIES OFFERED

ENTITY DATA

Type: SME

Size: 11-20 employees

Calls of interest for your entity:

National CDTI; MITECO...



Production



Transport



Uses

DESCRIPTION OF THE ENTITY

IUI CMT-Motores Térmicos is a research institute integrated into the Universitat Politècnica de València (Spain).

As a research and training center it is fully involved in the development of future propulsion systems for mobility and energy systems for stationary generation of heat and electricity, employing more than 100 researchers.

For more than 40 years, the CMT institute has carried out basic research on thermal engines to better understand the relevant thermos fluid-dynamic processes involved, and applied studies to optimize the characteristics of such engines and aid their development.

Hydrogen is a priority research topic and its application is oriented both to combustion in internal combustion engines (ICE) and gas turbines (GT), and to its use in fuel cells (FC).

ENTITY DATA

Type: University

Size: 160 researchers

Calls of interest for your entity:

Horizon Europe, Clean Hydrogen JU, Green Deal, CDTI, MITECO, MICINN, International Cooperation



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Universitat Politècnica Valencia (Spain)

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.*



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The National Hydrogen Centre (CNH2), is a national research center, oriented to promote the scientific and technological investigation of hydrogen technologies and fuel cells, being at the service of the entire scientific, technological and industrial community.

It was created in 2007 as a Public Consortium between the Ministry of Science and Innovation and Castilla-La Mancha Regional Government, with each entity holding a 50% interest, being located in Puertollano (Ciudad Real).

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

CNH2 is equipped with 13 laboratories and 5 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: Horizonte Europa, FCH JU, Green Deal. National: CDTI, MITECO, MICINN. Regional



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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 modeling of electrochemical, thermal and fluid-dynamic phenomena.
- Design and construction of test benches.
- Design, sizing and engineering of facilities and applications.
- Testing and characterization of materials, stacks, cells and systems integrated with renewable generation and microgrids.
- Project consulting and coordination.
- Specialized training

TECHNOLOGIES OFFERED

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



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Ecointegral Ingeniería S.L. is a independent professional services company with main office in Córdoba wich, for more tan 20 years, has been collaborating as engineers in major energy and telecommunications infrastructure projects. During this time, we have had the privilege of working with large companies for the technological transformation of our areas of influence and, thus, contributing every day to the protection of our planet and to the improvement of people's lives.

In 2022, IDP Ingeniería Merged with Ecointegral Ingeniería. IDP Ingeniería is a top reference in civil engineering, food industry development & construction, data center development. Pioneered using BIM technology introduction across Europe.. IDP Ingeniería is nowadays working in more tan 51 projects around the world.

ENTITY DATA

Type: Large Company

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

- *Developing new business unit for the production and storage of green hydrogen, with qualified persons and field experience.*
- *Member of the certification group of hydrogen.*
- *Hydrogen Technology Collaboration Programme (HTCP) member in the Renewable Hydrogen area.*
- *Pilot project of a Refuelling station with photovoltaic power.*
- *Production, storage and distribution project of green hydrogen.*

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

TECHNOLOGIES OFFERED

- *Design of green hydrogen facilities: detailed equipment sizing, components, control and security process integration.*
- *Hydrogen refuelling station.*
- *Site engineering.*
- *Economic and environmental feasibility.*
- *Concept, basic and detail engineering.*
- *BIM & Digital twin engineering design.*
- *Authorizations process and permits.*
- *EPC/O&M contracts.*
- *Supervision and work management.*



Production



Storage and
distribution



Transport

DESCRIPTION OF THE ENTITY

EA is a world-leading engineering company, committed to innovation and to providing creative solutions to our many customers. Our more than 1000 engineers bring to the table the knowledge gained in 62 GW of power projects carried out in over 40 countries. As a company, EA strives to stay at the forefront of engineering, focussed on the future and eagerly tackling new technological challenges from the solid foundations we have built on more than 50 years of success. Early on, our commitment to R&D&I led EA to develop its own simulation software (EcosimPro®). This tool provides added value to our work and differentiates us from our competitors. It is now used by companies worldwide in a range of industrial applications and is an excellent tool for studying the behaviour of H₂ injection into gas networks. Over the years, EA has participated in many R&D&I programmes, which has allowed us to apply everything we have learned as the engineers of renewable energy projects to cutting-edge H₂ projects.

ENTITY DATA

Type: Large company

Size: > 100 employees

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



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ACTIVITIES AND EXPERIENCES IN R&D&I

EA first began working in hydrogen projects in 1998, when we took part in the EU project for the development of the MCFC process and the auxiliary systems engineering of a 1 MW fuel cell pilot plant. We then acquired broader knowledge of the technologies involved through our participation in the CO₂ Capture and H₂ Production Pilot Plant project for the Puertollano Integrated Gasification Combined Cycle (IGCC) Power Plant (Elcogas). In 2015, EA took part in the ADEL-H2020 project, aimed at integrating renewable sources with intermediate temperature solid oxide electrolysers (ITSE). That same year we also participated in the HYNET and INNOHYP projects. We are now working in the H2020 GEMINI+ project, developing engineering in small nuclear reactors. This project includes high temperature electrolysis for hydrogen production.

TECHNOLOGIES OFFERED

To tackle these and future projects, EA set up a specific section in our company staffed with a group of multidisciplinary engineers expert in H₂ technologies. Just in the last year, EA has carried out the engineering of seven H₂ production plant projects (electrolysis) and we are now providing the engineering for converting the Atacama (941 km in length) and Taltal (226 km) gas pipelines in Chile to 100% hydrogen transportation pipelines.

EA also has experience in blending projects for gas turbines and thanks to our EcosimPro® software, we can dynamically reproduce the behaviour of the H₂ and natural gas mixture in any component.



Uses

DESCRIPTION OF THE ENTITY

The scientific activity of the Energy Applications Group is carried out in the Department of Physics of Polymers, Elastomers and Energy Applications of the Institute of Polymer Science and Technology (CSIC). The research group has extensive experience in the synthesis of conductive polymers (ionic and electronic) for energy generation and storage devices, such as proton exchange membrane fuel cells (PEMFC) and rechargeable metal-ion batteries.

ENTITY DATA

Type: Public research institution

Size: < 10 employees

Calls of interest for your entity:

European, national and regional



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ACTIVITIES AND EXPERIENCES IN R&D&I

Development and characterization under operating conditions of low-cost ion exchange polymer membranes for fuel cells based on functionalized commercial polymers as well as hybrid membranes synthesized by the combination of polymer science and sol-gel chemistry.

The research activity of the group in the area of fuel cells has been and is also currently framed in various research projects and in collaborations with other national and international research groups.

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

TECHNOLOGIES OFFERED

- Fuel Cell Testing Hardware.
- Fuel Cell Test System.
- Potentiostat-galvanostat.
- Fluid dispenser robot for catalytic layer deposition.
- Hydraulic presses for thermoplastics and elastomers for MEA's manufacture.
- Electrochemical impedance spectroscopy (EIS).
- Dielectric relaxation spectroscopy (DES).



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

ENERGYLAB is a private, non-profit technology center specialized in the development of R&D&I activities aimed to generation, storage, distribution and use of green hydrogen from renewable energies and/or the valorization of waste through biological and thermochemical processes.

The center works actively in H2 value chain giving support to the industrial sector, to optimize and promote these technologies.

ENERGYLAB has several highly specialized laboratories, whose equipment allows to support different R&D&I activities.



<https://energylab.es/>



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Vigo, Pontevedra

ACTIVITIES AND EXPERIENCES IN R&D&I

The most significant project in terms of investment is the CONSOLIDATION OF THE MIXED RENEWABLE GAS UNIT (2020-2023), a joint project of Naturgy, ENERGYLAB and EDAR Bens which is financed by Galicia ERDF 2014-20 OP and cofinanced by the Galician Innovation Agency (GAIN).

This project proposes green hydrogen generation through a turbine energy using wastewater effluents and through dark fermentation process, its storage through biological methanation, separation at destination (mixtures of hydrogen and methane) and the evaluation of its impact on current infrastructures and end consumers.

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

TECHNOLOGIES

OFFERED

Biological routes of H2 production by dark fermentation.

Electrochemical route of H2 production by electrolysis. Evaluation of hydrogen impact on end uses. H2 injection into the gas/biogas grid, Impact of H2/Methane mixtures in distribution. Effect of fuel/H2 mixtures in internal combustion engines.

Use of renewable gases. Power2Gas - biological methanation. H2-enriched Syngas. BioH2 for bacterial protein generation.

ENTITY

DATA

Type: Technology center

Size: 21-50 employees

Calls of interest for your entity:

European (EU Horizon, FCH JU, Green Deal, Spanish (CDTI, MITECO, MICINN), Regional



TECHNOLOGY DESCRIPTION

Promoted by the Regional Government of Aragón, other public bodies and private companies in 2003, the Board of FHa is now formed by 89 stakeholders belonging to all the economy sectors: automotive, chemistry, power generation, financial, educational, engineering, research and development centres and real estate. Its team of experienced and young professionals performs R&D&i and consultancy projects in the cooperation with regional, national and European companies. Over the last 19 years, FHa has been supporting the regional strategy for the uptake of hydrogen and fuel cell technologies, publishing the Hydrogen Master Plan in Aragón (2007-2010, 2011-2015, 2016-2020 and currently 2021-2025), and showcasing the whole hydrogen chain from production to the efficient use, obtaining the primary energy from renewable sources by means of processes currently available, e.g., photovoltaic and wind. The facilities include hydrogen production means (PEM, alkaline and AEM electrolyzers), storage, dispensing at 200 and 350 bar and ultimately the use in fuel cells, including a FCHEV Hyundai Nexu. Contributing to the wider awareness and dissemination of knowledge as well as training at all levels - from students to technicians - and dissemination is in the vision of the FHa.



<https://hidrogenoaragon.org/en/>



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TECHNOLOGY INFORMATION

Maturity level: *Basic research; Lab-proven; Developed but not marketed; Available for demonstration*

Industrial property rights: *Applied for Patent.*

Type of collaboration offered: *Cooperation agreement for R&D; Manufacturing agreement; Trade agreement with technical assistance; Technical Cooperation Agreement.* **Approximate annual investment in R&D&i in hydrogen and fuel cells:** *1-5 millions €*

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water - PEMEL, AEL, AEMEL, SOEC, other routes of green hydrogen production - at Components; Unit; Auxiliary elements; and Process control level.
- **H2 Storage:** Compressed gas in tanks; Liquid hydrogen; Compressed gas in underground caverns.
- **H2 distribution:** Pipelines; Tube-trailers.
- **Refuelling infrastructures:** In situ hydrogen production; Compression; Storage; Dispense.
- **Transport:** Automobile; Heavy vehicle; Railway at Component testing; Fuel cell; Deposits; and Tractor system level.
- **Industrial:** Green hydrogen as a raw material; Industrial cogeneration systems (GHP).
- **Residential/urban:** Energy use; Thermal use; Domestic microgeneration (mCHP).



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The Department of Industry, Competitiveness and Business Development, among other responsibilities, is responsible for organizing, managing and promoting industrial promotion and support for SMEs, industrial safety, energy and mines.

The promotion of hydrogen technologies has been a fundamental strategic line since 2003, of the successive Governments of our Autonomous Community, in energy matters and, particularly in matters of industrial policy, with a clear commitment to SMEs and sectors such as manufacturing of vehicles and transport material, chemical, energy.



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ACTIVITIES AND EXPERIENCES IN R&D&I

The Foundation for the Development of New Hydrogen Technologies in Aragón, a private entity set up in 2003, is the main initiative promoted by the Government of Aragón in relation to the promotion of hydrogen technologies, with a character clearly oriented towards industrial development, as a factor for intersectoral business cooperation serving the entire value chain in the energy-industrial field. The Government of Aragón has financed since 2007 the actions corresponding to the regional plans for the promotion of hydrogen technologies, currently the fourth regional plan "Director Plan for Hydrogen in Aragón 2021-2025". The Government of Aragón is part of the European Hydrogen Valleys S3 Partnership and the Hydrogen Europe Regional Pillar.

TECHNOLOGIES OFFERED

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

ENTITY DATA

Type: Public Body

Size: > 100 employees

Calls of interest for your entity:

Horizon Europe, Clean Hydrogen Joint Undertaking, Green Deal, MITECO, MINCOTUR, MICINN, CDTI



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Grupo Antolin is one of the leading interior manufacturers worldwide with over 150 plants in 26 countries. We have achieved this strong industry presence through over seventy years of working with our customers in order to develop a complete cycle of component manufacturing, from their conception and design, through the development and validation stages, to their industrialization and sequenced delivery.



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Burgos

ACTIVITIES AND EXPERIENCES IN R&D&I

The company's innovation activities seek to give a creative response to the great trends that redefine the conception of mobility on a daily basis. As part of its Smart Integrator strategy, Antolin offers solutions to provide smart vehicle interiors.

Innovation in Grupo Antolin is a cross-divisional area, therefore R&D&I activities are carried out in any of the company's centres and affect, not only its technical management, but also a large team of external partners.

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

ENTITY DATA

Type: Large Company

Size: > 100 employees

Calls of interest for your entity:

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

TECHNOLOGIES OFFERED

Proton-exchange membrane fuel cells (PEMFC).



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

H2B2 is a technology company established in 2016 by Javier Brey, its CTO, with a team of 20 people that accumulate more than 200-years experience on hydrogen production, renewable energies and technology development, with strong capabilities on engineering and project finance, and present both in Europe and USA.

H2B2 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 green hydrogen.

H2B2 holds the flexibility to develop ad hoc solutions, focused on high demand markets as energy storage, fuel for transportation, and industrial applications.

ENTITY DATA

Type: SME

Size: 21-50 employees

Calls of interest for your entity: European (Horizon Europe, Green Deal, Clean Hydrogen Partnership); National (CDTI, IDAE, MITECO, MICINN); Regional; Other.



www.h2b2.es https://twitter.com/H2B2_Inc
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ACTIVITIES AND EXPERIENCES IN R&D&I

- Hydrogen production by means of electrolysis
- Renewable energy integration for hydrogen production
- Hydrogen utilization on industrial, mobility and energy sectors

H2B2 gets involved on associations and working groups, at both national and international level. In addition to its leadership within the Spanish Hydrogen Association and this same Technology Platform, it participates in CTN 181 and CTN 222 standardization committees, and is 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: 1-5 millions €

TECHNOLOGIES OFFERED

- Electrolyzers and solutions for renewable hydrogen production
- Design engineering for hydrogen installations
- Hydrogen supply systems, including refueling stations
- Turnkey solutions for hydrogen production and utilization, including the full EPC (Engineering, Procurement and Construction)
- Operation and Maintenance (O&M) services for such solutions
- Project promotion and commercialization of renewable hydrogen



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

H2SITE is a Deep-tech company that produces competitive, local and renewable hydrogen for small and medium-sized consumers in the industry and mobility segments using advanced membrane reactors, very versatile with respect to the raw material they use as input.

Established in March 2020, H2SITE emerged as a spin-out of two technology centers: TECNALIA and the Eindhoven University of Technology (TUE), each providing IP respectively in membranes and in integrated reactors. The French multinational ENGIE completes the panel of shareholders.

Among the main milestones achieved by the company are the construction of a membrane manufacturing plant that is unique in the world, the closing of contracts for hydro-generators from ammonia in different European countries, and the growth of the teams from 3 to 30 people.

ENTITY DATA

Type: SME

Size: 11 – 20 employees

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



<https://www.h2site.eu/en/>



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ACTIVITIES AND EXPERIENCES IN R&D&I

H2SITE is a company with a strong connection to R&D. We currently participate in 3 European projects, 1 national project and 2 regional projects. All of our R&D is focused on product development, covering both membranes and reactors. 50% of our staff have a doctorate, and we have agreements with 3 research centers to remain at the forefront of product innovation.

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

TECHNOLOGIES OFFERED

Advanced membrane reactors and separators allow the separation or generation of fuel cell purity hydrogen in situ without greenhouse gas emissions for small and medium consumers. Starting from molecules with a simple and known logistics chain (renewable ammonia, biomethanol, bioethanol, biogas, syngas, DME, formic acid...), this equipment generates hydrogen with an energy efficiency of 10 to 20% higher than current standards, through of a simultaneous cracking and separation process.



Production



Storage and
distribution



Transport



Uses

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 350 HPP machines installed in 48 countries, it is the world leader in this sector, reaching a market share of 60%.

Two other lines of business have since been added; in 2019, Hiperbaric launched its line of industrial equipment for Hot Isostatic Pressing (HIP) and in 2020, it launched the hydrogen compression technology (up to 1,000 bar), and is currently the only Spanish manufacturer of H₂ compressors.

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.

ENTITY DATA

Type: Large Company

Size: > 100 employees

Calls of interest for your entity:

- European: Horizon Europe, Clean Hydrogen Europe, IPCEI.
- National: CDTI, MICINN, MITECO, IDAE, PERTE ERHA.
- Regional: EREN, ICE, JCyL.



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



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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 financial year and commits 25% of the workforce to innovation activities. One of its main assets is its human team, with 60% university graduates, including 9 doctors, 2 doctoral students and more than 25 graduates in technology. A vast track record of innovation, recognized and awarded internationally, such as Hiperbaric HPP Bulk technology.

Approximate annual investment in R&D&I in hydrogen and fuel cells: < 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).*
- *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.*



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The Aragon Institute of Engineering Research (I3A), was created in 2002 being the first of the Universidad Zaragoza.

It consists of 281 PhD researchers (XII/2021) and an equivalent number of graduates, engineers and technicians. These are grouped into 34 research groups recognized by the Government of Aragon.

In turn, the groups are distributed in 4 strategic divisions. Of these, the Division of Processes and Recycling and that of Industrial Technologies have competences in the production, purification, storage and use of hydrogen technologies.

The recent creation of the Cutting-Edge Laboratory in Circular Economy (CECE) represents the transversal contribution of different technologies converging on issues related to waste recovery and valorization.

ENTITY DATA

Type: University

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN
Regional and Others



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Calle de Mariano Esquillor Gómez, s/n, Zaragoza

ACTIVITIES AND EXPERIENCES IN R&D&I

- *New reactors for catalytic reforming minimizing coking.*
- *Selective membranes to increase performance and quality in hydrogen production.*
- *Biomass gasification to syngas and subsequent downstream.*
- *Development of systems for hydrogen purification.*
- *Production of methanol+ from syngas (Power to Liquids).*
- *Sustainable production of hydrogen from biological waste (biogas and bio-oil).*
- *Production of synthetic methane (Power to Gas).*
- *Ammonia as a hydrogen carrier.*
- *Modeling of its conversion in combustion processes.*
- *HVO for aircraft industry.*

TECHNOLOGIES OFFERED

- *Hydrogen from biomass waste (biogas, biomass and bio-waste).*
- *Membrane technology for hydrogen separation.*
- *Upstream (cleaning), reforming and downstream (separation).*
- *Methanization reactors.*
- *Modeling of hydrogen conversion.*
- *Structural integrity and safety in FCEV.*

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



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

IGNIS is an integrated energy company, active throughout the value chain from the development to the operation of assets and the provision of specialized energy services.

Since its inception in 2015, IGNIS has developed a portfolio of photovoltaic and wind energy projects of about 14 GW in Spain and 8 GW in Europe, North America, Latin America and Asia Pacific. Specifically in Aragon, IGNIS has developed 832 MW of photovoltaic that are already in operation and currently has 700 MW of photovoltaic and wind in the process of development. Additionally, IGNIS manages, today, 3.9 GW of operating plants that represent 5% of the electricity generated in Spain.



www.ignisenergia.es



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c/ Cardenal Marcelo Spinola 4, Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

IGNIS is currently present in multiple initiatives aimed at promoting new generation and storage technologies, through green hydrogen projects, among others.

Hydrogen is the commitment of IGNIS as an energy vector to achieve an economy free of CO2 emissions.

TECHNOLOGIES OFFERED

-

ENTITY DATA

Type: Large Company

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, Clean Hydrogen Partnership, Green Deal (LIFE), CINEA

National: CDTI, IDAE, AEI

Regional



Production



Storage and
distribution



Transport

DESCRIPTION OF THE ENTITY

The IIE, approved by the Polytechnic University of Valencia (UPV) on 10 April 2001, has the following objectives:

- Multidisciplinary approach to the different areas of R+D+I in the field of energy.
- Energy foresight and evaluation.

The IIE's activity is structured according to five main areas of work, each of which has an Area Manager:

- THERMAL AREA
- ELECTRICITY SYSTEMS AND MARKETS AREA
- ELECTRICAL EQUIPMENT AND INSTALLATIONS AREA
- NUCLEAR AREA
- RENEWABLES AND ADVANCED ENERGY SYSTEMS AREA

It is within this last area where studies on hydrogen technologies are carried out, both in mobile and stationary applications.

ENTITY DATA

Type: Research University Institute

Size: >100 employees

Calls of interest for your entity:

European calls

National calls

Recovery and resilience funds



<http://www.iie.upv.es/inicio>



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Valencia

ACTIVITIES AND EXPERIENCES IN R&D&I

The IIE has participated in a total of 21 projects financed by the European Commission in its different programmes, has obtained competitive funding from the Ministry in 15 research projects and in 9 research projects financed by the Generalitat Valenciana. It has also participated in 27 research projects funded by private companies.

The experience in participating in European, national and regional research projects facilitates the transfer of technology to companies, as the figures shown above indicate.

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

TECHNOLOGIES OFFERED

- Evolutionary algorithms for sizing and control of grid-connected hybrid renewable production systems with energy storage and green hydrogen production.
- Design of hydrogen-based power generation systems for unmanned aerial vehicles (UAVs).
- Advice on the design of hydrogen production systems from renewable sources, storage and dispensing for heavy transport.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

IMDEA Energy Institute was created in 2006 as non-profit Foundation to promote and carry out R&D&i activities to contribute to the development of a sustainable and decarbonised energy system, it is strongly committed to the transfer of R&D outcomes to the productive sector and to seek joint efforts with other technology research centers and universities, promoting excellence in research on energy issues and complementarity among different entities.

Since its creation, it has been researching hydrogen technologies, its generation and use as an energy vector, as well as in the simulation of production processes, economic analysis of supply chains, life cycle management (life cycle sustainability analysis, including environmental, economic, social and eco-efficiency analysis), social acceptance in Spain and roadmaps.

ENTITY DATA

Type: Technology or Research Center

Size: > 100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal. National: CDTI, MITECO, MICINN. Regional and Other.



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

ACTIVITIES AND EXPERIENCES IN R&D&I

Ongoing international R&D projects:

- *eGHOST: Establishing Eco-design Guidelines for Hydrogen Systems and Technologies.*
- *SH2E: Sustainability Assessment of Harmonised Hydrogen Energy Systems: Guidelines for Life Cycle Sustainability Assessment and Prospective Benchmarking.*
- *PROMETEO: Hydrogen PROduction by MEans of solar heat and power in high TEMperature Solid Oxide Electrolysers.*
- *C-MOF.cell Novel materials as electrode and electrolyte components in fuel cell technology.*

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

TECHNOLOGIES OFFERED

- *Analysis of Energy Systems applied to hydrogen: Simulation of production processes, Economic analysis of supply chains, Life cycle management, Social acceptance in Spain 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, electrochemical, photo (electro) chemical, biological and bioelectrochemical reactors.*

Laboratory, pilot plant and demonstration facilities to design, optimize and scale processes, ensuring their industrial viability.

DESCRIPTION OF THE ENTITY

With more than 30 years of experience, more than 600 qualified specialists and offices in Spain, Portugal, USA, Brazil, Chile, Colombia, Peru and India, INERCO has in-depth knowledge of the industry to offer comprehensive and personalized services. As well as technologies that respond to the needs in H₂ production, energy storage, emission reduction, energy efficiency, renewable energy, energy hybridization, industrial water treatment and noise and vibration control. Additionally, INERCO also provides support to the industrial and energy sectors with consultancy in the fields of sustainability, environment, occupational health and industrial safety, and training in emergencies.

ENTITY DATA

Type: Large Company

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

R&D is part of INERCO's specific work and business strategy, and it dedicates a high percentage of its resources to it; funds largely derived from the reinvestment of its profits. Additionally, and within INERCO's extensive experience and tradition in innovation, there is a large list of projects carried out in different European, national and regional calls. In this sense, INERCO has around 40 co-financed R&D projects to its credit. A large number of which have developed technologies related to the energy transition and decarbonisation of industry and electricity production, including green hydrogen lines and energy storage.

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

TECHNOLOGIES OFFERED

Hydrogen engineering and consulting services; Design and manufacture of electrolyzers; Control system (EMS); Industrial safety studies for hydrogen; Biomass gasification technology.



Transport



Uses

DESCRIPTION OF THE ENTITY

University Institute of Automobile Research is a centre belonging to Technical University of Madrid (UPM).

The INSIA is a centre dedicated to scientific and technical Research and Development in the context of automotive vehicles and their impact on safety and the environment.

INSIA also carries out postgraduate and specialised training activities, and provides technological support for companies and public administrations, by providing technological services that materialize in R&D&I tasks, consultancy, tests and certifications. The Institute is accredited by the Spanish Ministry of Industry as the Technical Service for homologation in accordance with various United Nations Regulations and European Directives regarding vehicles and their systems and parts, particularly in the area of bus and coach safety.

ENTITY DATA

Type: Academia

Size: 51-100 employees

Calls of interest for your entity:

HORIZON-CL5-2022-D5-01-08:

Modular multi-powertrain zero-emission systems for HDV (BEV and FCEV) for efficient and economic operation.



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[INSIA](#). Campus Sur UPM. Ctra. Valencia, Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

The Institute's main activities are:

Research and Development in the context of automotive vehicles and their impact on safety and the environment. We are currently working on five lines of research.

To provide technological support for companies and public administrations, by providing technological services that materialise in R&D&I tasks, consultancy, tests and certifications.

Postgraduate and specialised training.

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

TECHNOLOGIES OFFERED

To develop hybrid propulsion systems with hydrogen-powered fuel cells focused on applications in industrial and special vehicles in order to optimise consumption and reduce pollutant emissions.

These are focused on their application in industrial in special vehicles.

To develop methodologies to determine emission factors linked to vehicles, propulsion technologies and fuels.

Study and development of different improvement alternatives related to thermal engines - post-treatment systems, biofuels, calibrations, dual-fuel, etc. - that imply a lower environmental impact of the same.



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The Institut de Robòtica i Informàtica Industrial is a Joint Research Center of the Spanish Council for Scientific Research (CSIC) and the Technical University of Catalonia (UPC). The Institute has three main objectives: to promote fundamental research in Robotics and Applied Informatics, to cooperate with the community in industrial technological projects, and to offer scientific education through graduate courses.

In the Institute, the Automatic Control Group develops basic and applied research in automatic control, with special emphasis on modelling, control and supervision of nonlinear, complex and/or large-scale systems. The group has acquired specific expertise in the application of advanced control techniques to environmental resources management, specifically in the water and energy fields. The main aspects considered in energy systems are efficiency, degradation, parameter estimation, diagnosis and prognosis.

ENTITY DATA

Type: Institute (CSIC-University)

Size: 51-100 employees

Calls of interest for your entity:

- European: Horizon Europe, FCH JU, Green Deal
- National: MITECO, MICINN
- Regional and local



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<https://goo.gl/maps/arevSFsw6Fwift7b9>

ACTIVITIES AND EXPERIENCES IN R&D&I

The theoretical knowledge of the group is applied to real/industrial cases. We have recently participated in several research projects applied to hydrogen systems. For instance, in a European Project for the development of optimized components for fuel cell vehicles, we have designed the control and supervisión system of the propulsión system; in a CSIC project, we are developing the management of flows system for a hydrogen station; in other projects, we have contributed to the development of prototypes of solid oxide fuel cell and electrolizer systems and Redox Flow Batteries. The role of the group is to design and implement automatic control systems, parameter observation-estimation systems and experimental characterisation.

TECHNOLOGIES OFFERED

- Design of controllers.
- Design of observers and parameter estimation systems.

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



Uses

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: Technology or Research 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.

TECHNOLOGIES OFFERED

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

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

< 1 million €



Production



Uses

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 decarbonisation 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, modeling 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 electrolyser and fuel cell (PEM-type).

-Simulation models of behaviour/performance of electrolyzers and fuel cells.

-Prediction and characterization of performance, aging and degradation processes of systems: electrolyser and fuel cell.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The Galicia Institute of Technology (ITG) is a private non-profit National Technology Centre located in the Galicia region, in A Coruña. Its aim is to improve the competitiveness of companies, organizations and professionals, through R&D&I and differential technology. Thus, it facilitates their access to research and innovation activities, technical development, and continuous improvement.

IoT, Big Data, industry 4.0, unmanned autonomous systems, augmented reality, and artificial intelligence are among our working tools in industry, energy, water and buildings.

In sustainable construction, ITG operates BREEAM® in the Spanish territory with exclusive license, and is the only organization recognized by IWBI® in Spain for training of WELL®AP's and expanding knowledge of Wellbeing in Buildings in Spain.

ENTITY DATA

Type: Technology and Research Centre

Size: 51-100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN



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ACTIVITIES AND EXPERIENCES IN R&D&I

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.*



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The University Materials Institute (IUMA) is a research institute which was created in 2004 at the University of Alicante. It is focused on fundamental and applied research in the field of Materials Science. It is composed of members from 5 research groups working on different theme areas in the area of Materials Science, which enhances the multidisciplinary character of the research performed therein. Concerning this, IUMA researchers are highly active and participate both in public calls from different funding bodies as well as in private projects with enterprises at local, national, and international level. Within the different research areas tackled by IUMA, those related to energy constitute both a basic and priority subject.

ENTITY DATA

Type: University

Size: >100 employees

Calls of interest for your entity:

European: Horizon Europa, FCH JU, Green Deal; National: CDTI, MITECO, MICINN; - Regional



<https://iuma.ua.es/>



(+34)965909820-965909223



iuma@ua.es



San Vicente del Raspeig, Alicante

ACTIVITIES AND EXPERIENCES IN R&D&I

The industry sector related with Materials Science and Technology has a considerable relevance at the Alicante province. This has boosted research at the IUMA to be highly relevant within this field. IUMA researchers have ample experience in the development of public research projects, including European projects, in the filing of patents, and in R&D&i-related collaborations with different research centers as well as with national and international companies. For example, IUMA members have co-authored more than 40 patents, and some of them are founding members of spin-off companies generated at the University of Alicante.

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

TECHNOLOGIES OFFERED

Hydrogen and fuel cell technologies. Photocatalysts and electrocatalysts for hydrogen production and hydrogen storage in porous solids.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Entity that develops its own products through R&D projects.

We are a technology transfer company, and we base our development on the research of new and efficient products, which are technically and economically competitive.

We also offer engineering services with the purpose of reducing energy consumption within companies and homes by producing energy from renewable sources. This results in a balance between environmental preservation and energy demands satisfaction

The constant search for ways to develop processes is a constant in all our activities, so now we also opt for the momentum of green hydrogen and continue to comply with the balance.

ENTITY DATA

Type: SME

Size: 11 – 20 employees

Calls of interest for your entity: CDTI, PERTE and European Funds.



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



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c.rebollo@blubik.es



Polígono Dominicano, calle A, 1AA

ACTIVITIES AND EXPERIENCES IN R&D&I

- *Sizing and industrial design of mobile energy production systems. From 1 KWp to 300 KWp in a container or trailer. The purpose of these systems is to achieve electrification in remote areas.*
- *Design of an autonomous system for charging electric and hydrogen vehicles. Construction of a demonstration plant to supply electricity to electric and hydrogen vehicles.*

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

TECHNOLOGIES OFFERED

*Hybrid energy systems for electric and hydrogen cars.
Electric car recharging and hydrogen car refueling.*



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Our consultancy arises after detecting the need for expert people in a growing market such as renewable hydrogen. We offer technical-economic feasibility studies for projects, support in the bidding phase, market studies, key players in the sector, and industrial safety and regulatory studies.

We offer innovative design solutions in hydrogen production projects through electrolysis and service stations and construction, Commissioning, and O&M based on a deep knowledge of technology and experience.

We are a company formed by a multidisciplinary team that covers the entire value chain, from engineering to commissioning, with more than 30 years of accumulated experience in industrial electrolysis and fuel cell projects.

ENTITY DATA

Type: SME

Size: < 10 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN



leanhydrogen.com



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C/Brújula 4 - Mairena del Aljarafe - 41927

ACTIVITIES AND EXPERIENCES IN R&D&I

At Lean Hydrogen, we are committed to innovating throughout the hydrogen value chain. Our extensive experience allows us to detect the needs of the sector and invest in those needs, with the conviction of being able to provide a product tailored to the client's needs.

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

TECHNOLOGIES OFFERED

In this line, Lean Hydrogen has developed two lines of innovation:

- The **hydrogen blender** with Natural Gas achieves homogeneous mixtures of hydrogen and natural gas with 99.9%.

- The **hydrogen refilling station checker** allows you to test service stations before testing them with commercial vehicles.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Founded in 1906, Leitat has the mission of Managing Technologies to create and transfer sustainable social, environmental, economic and industrial value to companies and entities, through research and Technological processes. Leitat is a Technological Center which collaborates with more than 45 countries and develops more than 215 projects related to the fields of: Biotechnology, Health, Advanced Materials, Industrial Chemistry, Renewable Energies and New Production Processes. Leitat actively participates in Regional National and European projects both as partner and as coordinator.

Additionally, Leitat also offers flexible collaboration models directly with companies through R&D projects, Laboratory tests and certifications, incubation services and IPR management and exploitation.

ENTITY DATA

Type: Technology Center

Size: >100 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal. **National:** CDTI, MITECO, MICINN. **Regional.**



www.leitat.org



93 788 23 00



hydrogentech@leitat.org



c/ de la Innovació, 2, Terrassa (Barcelona) SPAIN

ACTIVITIES AND EXPERIENCES IN R&D&I

Our main activity and experience is focused on: (i) Development and characterization of catalysts, electrodes and membranes (PEM, AEM, SOEC, PEC, MEC and hydrogen fuel cells), and microorganism for H₂ production from biomass (fermentation); (ii) Design, manufacturing and characterization of H₂ reactors (production and use); (iii) Simulation, design and manufacturing of components/reactors for piloting; (iv) Development and characterization of materials for H₂ storage and distribution (LOHCs, MOFs, carbons, coatings); and (v) Sustainability: recycling, environmental, social and economic impact and ecodesign.

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

TECHNOLOGIES OFFERED

- Development of catalysts, electrodes, membranes and microorganism for H₂ production 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.



Production



Storage and distribution



Transport



Uses

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 more than 2,500 professors. It is among the top Spanish universities in the leading international academic and research rankings, the second behind the University of Barcelona (UB) in the QS World University Rankings 2022, and the first Spanish university in the field of Physics and Astronomy in this ranking. At the UAM, there are more than 200 recognised 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



34 91 497 5027/4777



isabel.j.ferrer@uam.es



Campus de la Universidad Autónoma, Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

As a public university, it has extensive experience in basic and applied research as well as in technology transfer to companies and consortia through different formulas, aspects reflected in the criteria of the QS World University Rankings 2022.

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. Electrodes.
- Compression and storage of hydrogen in metal hydrides.



<https://www.uam.es/Ciencias/L%C3%ADneas-de-Investigaci%C3%B3n/1446790542877.htm?language=es>



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

The entity Petroleum Oil & Gas España S.A. is fully owned by Naturgy Energy Group, S.A.

Its main objective is the exploration, investigation and exploitation of reservoirs and underground hydrocarbon storages, either liquid or gases in the Spanish territory. It has several assets in operation in the Guadalquivir valley, in the South of Spain.

In recent years Petroleum is turning its interest into the growing development of renewable gas and in green energy storage as established in the PNIEC (Spanish Energy and Climate Plan).

In this sense, it is leading the Undergy Project (beneficiary of the Misonos-21 Aid Program, of the CDTI) to investigate the potential storage of green H₂, in percentages from 20% to 100% of H₂, in a depleted natural gas field. In addition to this, the possible methanization in situ by CO₂ injection will be investigated.

ENTITY DATA

Type: Large Company

Size: > 100 employees

Calls of interest for your entity:
European, Nacional and regional



www.naturgy.com / www.undergy.eu



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cyuste@naturgy.com



Avd. San Luis, 77. Madrid 28003

ACTIVITIES AND EXPERIENCES IN R&D&I

Granted with the Missions 2021 Call, Petroleum will lead the Undergy Project that will integrate renewable generation and seasonal energy storage of high-capacity using green hydrogen into a smart grid.

In addition to managing the global project, Petroleum has selected an underground structure that will serve to study on a laboratory scale the potential seasonal storage of green H₂ in depleted gas fields.

Thus, several laboratory analyses will be carried out in order to investigate the possible reactions at P and T reservoir conditions between the different existing fluids (CH₄, H₂, brine and CO₂) and the rock (both the storage rock and the cover). 3D and 4D models of the selected reservoir will be made simulating injecting and extracting cycles.

TECHNOLOGIES OFFERED

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



Production



Transport



Uses

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 and fuel cells.

It was formally consolidated in 2017 as a UPM research group, although the senior researchers have worked together since 2006.

To find solutions to the aforementioned challenges, work is being done on: the study, design and manufacture of DMFC and PEMFC fuel cells and their components; the application of hydrogen technologies such as obtaining hydrogen through electrolysis; the use of alternative fuels, such as hydrogen or methanol; the capture of CO₂ and the study and design of alternative multi-fuel engines. To do this, it has various equipment and infrastructures including fuel cell and electrolyser test benches, multi-fuel engine test bench, potentiostat-galvanostat, etc.

ENTITY DATA

Type: University

Size: <10 employees

Calls of interest for your entity:

European: Horizonte Europa, FCH JU, Green Deal

National: CDTI, MITECO, MICINN

Regional; Other: private initiatives on research and/or engineering



<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 focus on the field of hydrogen and fuel cells, encompassing three main lines: research and testing of fuel cell components, design and development of stacks and feasibility studies.

PiCoHiMA has experience in the preparation and development of R+D+i projects financed in competitive calls for both national and international aid. Likewise, it has collaborated with companies in carrying out studies of interest.

In its training facet, PiCoHiMA has defended six doctoral theses and another two in development.

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

TECHNOLOGIES OFFERED

- AeroMarine DMFC Designer®.
- Development and testing of alternative multi-fuel engines.
- Comprehensive consulting of fuel cell systems and hydrogen production by electrolysis in the maritime field.
- Fuel cell and electrolyser tests.



Production



Storage and distribution



Transport



Uses

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.

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.



www.prematecnica.com



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prematecnica@prematecnica.com



C/ Laguna del Marquesado, 14. Puerta 2 28021 Madrid.

ACTIVITIES AND EXPERIENCES IN R&D&I

PREMATECNICA has collaborated with the 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.



Production



Storage and distribution



Uses

DESCRIPTION OF THE ENTITY

Higher Education-Research.

One of the most outstanding aspects of the vision of the University of Malaga (UMA) is to achieve a commitment to the business world, new technologies, the Andalusia Technology Park and the economic, social, cultural and environmental environment of the province of Malaga.

The UMA has in its departments more than 300 research groups, framed in a global Campus of International Excellence, with a technological offer that includes the lines of research and the services that the Research groups can offer to Society.

ENTITY DATA

Type: University

Size: >100 employees

Calls of interest for your entity:

- European: Green Deal
- National: CDTI, MITECO, MICINN
- Regional: Junta Andalucía
- Other: Initiatives and Contracts with Companies



<https://procat.uma.es/>



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36.71610385153564, -4.472857500327728

ACTIVITIES AND EXPERIENCES IN R&D&I

It carries out its activities in the laboratories of the Department of Chemical Engineering of the Faculty of Sciences and focuses on the advancement and improvement of knowledge, the development of processes, technologies and catalytic strategies in the industrial field and generating advancement in technological knowledge in the area. of energy conversion and the environment.

Its activity is focused on the production of Blue Hydrogen with renewable precursors (biomass and underutilized waste) through thermoconversion processes and the improvement and purification of streams enriched in hydrogen: to feed fuel cells, co-injection in thermal engines and catalytic processes for the production of eco-fuels and chemicals.

TECHNOLOGIES OFFERED

Improved processes for hydrogen production. Decarbonization and Mobility: coinjection of H₂, purification of streams containing. Advanced Catalytic Gasification Technology and Chemical Storage of Hydrogen .



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Schunk Iberica is a Company of the Schunk Group and a global leader in the development, manufacture and application of carbon and ceramic solutions.

We combine innovativeness and outstanding service to create a unique range of offerings on the market like no other company out there.

You'll find our technological expertise and extensive manufacturing and sales network in 36 locations around the world, bundled in four comprehensive areas of application:

- Mechanical Carbon.
- Electrical Carbon.
- Thermal Carbon.
- Technical Ceramics.

ENTITY DATA

Type: Large Company

Size: > 100 employees

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



www.schunk-group.com



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mail@schunk.es



C/ Horcajo, 6 – PI Las Arenas – Pinto (Madrid)

ACTIVITIES AND EXPERIENCES IN R&D&I

All our knowledge and actions are focused on the fascinating element of carbon and its versatile applications. With our highly specialized technology portfolio, we offer solutions for a broad industrial spectrum from the automotive industry to semiconductor technology.

Every part, every component and every system is faced with technical limitations which are often the result of the material chosen for the job. Constantly redefining performance limits is what drives us. The materials we develop from carbon, graphite, ceramic, carbon and ceramic composites, silicon carbide, break ground in areas where conventional materials just can't cut it.

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

TECHNOLOGIES OFFERED

*Graphite Bipolar Plates for fuel cells.
Extruded bipolar plates.*



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Founded in 1897, Carburos Metálicos has been serving the industry of our country for more than 120 years. It is currently the leader in the industrial and medical gases sector in Spain and a benchmark in the chemical sector in terms of safety, innovation and sustainability. Carburos Metálicos has a daily production capacity of more than 1,200 tons of liquefied gas (mtpd), 12 production plants, 14 packaging plants, 2 high purity gas laboratories and an R&D center. Since 1995 we have belonged to the US group Air Products, the largest hydrogen producer in the world with a market share of over 50%. In addition, Carburos Metálicos has been developing for decades all the technologies for refueling H2 fuel cell vehicles and has a large portfolio of patents in this field. Since 1993, Air Products has participated in more than 250 projects in more than twenty countries in Europe and abroad.

ENTITY DATA

Type: Large Company

Size: >100 empleados

Calls of interest for your entity:

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



www.carburos.com



930 009 960



MKTG@carburos.com



Avd. de la Fama, 1 – Cornellà de Llobregat (Barcelona)

ACTIVITIES AND EXPERIENCES IN R&D&I

- +250 H2 supply projects around the world.
- 50 patents related to hydrogen fueling.
- +15 years of safe refueling.

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

TECHNOLOGIES OFFERED

-H2 production from different sources and according of to customer requirements.

-H2 generation onsite to reduce production costs.- Production of renewable or low carbon H2 for sustainable mobility.

-Storage and distribution of H2 in a reliable and safe way: compressed and liquid H2.

-Hydrogen supply and equipment for emission-free mobility: proprietary technology refueling stations and mobile dispensers.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Solarig is a leading renewable energy company founded in 2004, which develops, builds and operates on a global scale, as well as in hybriding with other technologies, batteries and the generation of green hydrogen projects.

At present, in the 14 countries in which we operate, we have more than 9GW under management, more than 800 MW built and a pipeline of more than 6GW under development.

We promote the decarbonisation of the economy, energy independence and the expansion of renewable energy sources based on responsibility and commitment to the planet and future generations.

Solarig's culture is dominated by initiative, collaborative work, commitment to our responsibilities and a constant search for challenges, always committed to Sustainable Progress within a framework of compliance with internationally recognised ESG criteria.

ENTITY DATA

Type: Large Company

Size: >100 employees

Calls of interest for your entity:

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



<https://solarig.com/>



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C. de la Ribera del Loira, 28, 28042 Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

Solarig has always been committed to innovation in different fields:

- Performance comparisons of different solar production technologies, including non-conventional technologies (thin-film and CPV).
- High degree of digitalisation in the preventive and corrective maintenance processes of renewable assets (thermographic drones, robotics in module cleaning), as well as operational management and monitoring with a proprietary computer system in continuous evolution, which includes, predictive maintenance of equipment thanks to "big data".

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

TECHNOLOGIES OFFERED

- *Integration of all the necessary technologies: Energy Storage Systems, Wind Turbines, Solar and Green Hydrogen.*
- *Define Business Models and Feasibility Studies for any project, Greenfield, projects with GPS problems, Brownfield, etc.*
- *Strategic partnerships for trade and transport with Green Hydrogen offtakers for the domestic and foreign market.*
- *Promoters of national and international initiatives for the development of green hydrogen.*



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Tecnatom mission is to ensure that the energy facilities are operated efficiently, safely and to a high level of excellence.

Tecnatom owns a wide portfolio of products and services including training, operation, simulation, digitalization and inspection.

In the hydrogen sector, several fields should be highlighted:

- *Maintenance and inspection of infrastructures and equipment related to H₂, thanks to the vast experience of Tecnatom in the nuclear sector.*
- *Simulation to optimize the planification and exploitation of H₂ facilities by means of interrelating energetic, economic and degradation processes.*
- *Training focused on the complete H₂ value chain, with emphasis on security aspects.*
- *Identification and safeguard of the critical knowledge by means of the e-learning platform SOUL energy.*

ENTITY DATA

Type: Large Company

Size: >100 employees

Calls of interest for your entity:

- EU: Horizon Europe, FCH JU, Green Deal, EURATOM
- National: CDTI, MITECO, MICINN
- Regional



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Av. Montes de Oca 1, S. S. de los Reyes (Madrid)

ACTIVITIES AND EXPERIENCES IN R&D&I

- *Inspection and testing, development of Non-Destructive Techniques (NDTs) and materials degradation analyses.*
- *Robots for monitoring and inspection.*
- *Technical and economical feasibility analyses for H₂ facilities (production plants with electrolysis, Hydrogen Refueling Stations).*
- *Simulation of processes in H₂ facilities (production plants, Hydrogen Refueling Stations).*

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

TECHNOLOGIES OFFERED

- *Time of Flight Diffraction (ToFD) for inspections.*
- *Smart Hybrid Plan (planification and feasibility studies of H₂ plants and HRS).*
- *Tecnatom proprietary simulation solution TEAM Suite (simulation of H₂ processes).*
- *e-Learning platform (SOUL energy) with a specific course of the H₂ value chain with a special focus on safety.*



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

Técnicas Reunidas is one of the leading companies worldwide, with more than 60 years of experience, more than 1,000 industrial plants designed and built in more than 50 countries. TR's activity focuses on plants for clean fuels, natural gas and chemical products production, and on solutions linked to the energy transition, the circular economy and decarbonization (renewable hydrogen, biofuels, waste recovery, sequestration and CO2 capture, etc).

It has extensive references in Hydrogen (production, management and use), where it has a high activity in low carbon emissions (green and blue). Its more than 6,800 employees, most of them highly qualified engineers, its commitment to constant innovation and participation in different research programs, make TR a center of excellence in engineering in Spain for the whole world.

ENTITY DATA

Type: Large Company

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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Av.De Burgos 89 – Adequa 5, 3rd floor, 28050, Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

Técnicas Reunidas has the José Lladó Technological Center, one of the most modern in Spain, where it develops R&D projects. It has more than 5,000 m2 of state-of-the-art facilities and equipment that allow activities to be carried out at any level, from the laboratory to the pilot plant, completing the entire value chain.

TR's Product Development and Technology department is focused on hydrogen technologies and circular economy. Competencies range from plants of g/h to those of tens of Tons/h of hydrogen, within hydrogen production, supply, consumption and distribution.

Approximate annual investment in R&D&I in hydrogen and fuel cells: 6-10 millions €

TECHNOLOGIES OFFERED

TR is a reference in plants for the production, treatment and use of hydrogen, both in the industrial and in transport sectors, offering the following technologies:

TR – Hydrogen reforming technologies.

TR – Syngas purification technologies.

TR – Hydrogen Refueling Stations (HRSs).

TR – Renewable hydrogen production.

TR – Hydrogen uses in the iron and steel sector.

TR – Hydrogen uses in the industrial sector.

TR – Hydrogen carriers.

TR – Green hydrogen production via Electrolysis .



Production



Storage and
distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

TEKNIKER is an application-oriented research centre with the mission of improving competitiveness of companies through technological innovation, research and development.

Our research activities are organised in three main specialization field:

- *Processes and manufacturing facilities.*
- *Surface engineering and materials*
- *Information and communication technology, control, automatization, and electronics.*

These three main research fields are supported by a transversal one, product engineering, facilitating the generation of assets, allowing to offer integral solutions to companies.

ENTITY DATA

Type: Research center

Size: > 100 employees

Calls of interest for your entity:

- European: Horizon Europe, FCH JU,
- National: CDTI, MITECO, MICINN
- Regional: SPRI



<https://www.tekniker.es/en>



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ACTIVITIES AND EXPERIENCES IN R&D&I

- *Development of innovative electrolyzers (PEM, AEM, AE), components, design and control.*
- *Development of new systems for organic liquids for H₂ storage.*
- *Tecno- economic optimization of the renewable energy storage in hybrid plant combining batteries and electrolyzers.*
- *Advanced sensors to evaluate components degradation and to improve safety for transport solutions.*
- *Power electronic development and control for transport solution and renewable energy plants.*
- *Materials and components characterization.*

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

TECHNOLOGIES OFFERED

- *Development of electrolyzer prototypes, testing and validation in test bench.*
- *Protective coatings deposited by magnetron sputtering technologies for bipolar plates and porous transport layers for PEM electrolyzers and fuel cells.*
- *Energy management system for renewable hybrid plans with storage and production of hydrogen by electrolysis.*



Production



Storage and distribution



Uses

DESCRIPTION OF THE ENTITY

TSK is a global Engineering Company and EPC contractor with more than 35 years of experience in 50 countries, specialized in the development of technological solutions for industry and the energy sector: conventional energy, renewable energy, electrical infrastructures, industrial plants, energy storage, oil&gas, water treatment and mining&handling.

TSK provides proprietary technology, engineering and management capacity for complex projects, as well as O&M services.

TSK is committed with sustainability, circular economy and decarbonization, including a dedicated Sustainable Solutions Division that combines all engineering and construction knowledge, with a fully optimized solution for each project.

ENTITY DATA

Type: Large Company

Size: > 100 employees

Calls of interest for your entity:

European, National or Regional



www.grupotsk.com/en/



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Parque Científico y Tecnológico 220, 33203, Gijón

ACTIVITIES AND EXPERIENCES IN R&D&I

TSK has wide experience in R&D projects, including:

- Energy Storage systems based on molten salts.
- Energy Storage systems based on liquid air.
- Energy management for renewables.
- Technologies hybridation.
- Waste advanced valorization.
- Circular economy.
- Digitalization, cybersecurity and Data management.
- Maintenance solutions for solar plants.
- Water treatment.
- Project management and EPC cost reduction.

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

TECHNOLOGIES OFFERED

Green H2 production

- Mature technologies (Alkaline, PEM).
- Alternative technologies (AEM, SOEC, PEC).

Uses of H2

- Green NH3 synthesis.
- CO2 recovery and E-fuels synthesis.
- Blue/Green Urea synthesis.
- H2 to power (fuel cells, gas turbines, gas engines, burners).

H2 plant utilities

- Power generation (PV, CSP, Wind, geothermal, biomass).
- Energy storage (BESS; TES, e-TES, LAES).



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

From its foundation (1985) UCLM has grown at a high rate, attracting qualified human resources and providing the people in the region with high education skills. UCLM integrates 36 academic departments offering 45 degree qualifications. UCLM has two peculiar features: a) it is multi-disciplinary, undertaking work in practically all branches of knowledge; and b) its activities are very wide-ranging, embracing the spectrum from basic research to technological development. Moreover, promoting collaborations between industry and academia and favouring the dissemination of technological advances are part of our University's missions, demonstrating the strong commitment that UCLM has with the productive sectors of the region. The Knowledge and Technology Transfer Office is the structure within the University that strongly collaborates in this task.

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
- Private collaboration



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C/Altagracia 50, 13001, Ciudad Real

ACTIVITIES AND EXPERIENCES IN R&D&I

- Preparation and characterisation of heterogeneous catalysts.
- Study of catalytic reactions for hydrogen production (reforming, partial oxidation, etc.).
- Preparation of electrodes and MEAS for water and biomass electrolysis.
- Integration of H₂ production and storage systems to renewable sources and subsequent use in fuel cells.
- Process simulation and optimisation.
- CDTI project of the MISIONES call.
- Collaboration contracts ART. 83
- <https://doi.org/10.1016/j.renene.2019.09.034>

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

TECHNOLOGIES OFFERED

- Sustainable hydrogen storage by electrochemical technologies.
- Green hydrogen production by new catalytic and electrocatalytic technologies.
- Additive Manufacturing.
- SOFC/SOEC fuel cells/electrolyzers.
- PEM.
- EERR-H₂ integration.
- Advanced powder-based manufacturing technologies, characterization and design of materials.
- Analysis of H₂ production processes.



Production



Storage and
distribution

DESCRIPTION OF THE ENTITY

*Catalysis, Reactors and Control (CRC) Research group
University of Oviedo*

Main researcher: Salvador Ordóñez

The research aim of Group of Catalysis, Reactors and Control is the application of chemical processes (mainly catalytic) to the fields of chemical and environmental technology. Our research involves from the molecular level (synthesis and characterization of catalysts and adsorbents) to the design of chemical processes and unit operations and to scaling-up and simulation of industrial processes. The use of renewable (biomass) or unconventional (wastes, mine ventilation emissions) raw materials is another distinctive feature of our research.

ENTITY DATA

Type: Research group of a University

Size: 11 – 20 employees

Calls of interest for your entity: Horizonte Europe, Geen Deal, CDTI, MICINN. (Including basic research and proof of concept)



<https://crc.grupos.uniovi.es/en/investigacion/lineas>



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43.35565379277266, -5.86975097356875

ACTIVITIES AND EXPERIENCES IN R&D&I

- Purification and physical (MOFs, zeolites) or chemical storage (LOHCs, FA) of hydrogen.
- Waste recovery and waste-derived syngas upgrading
- Design, modeling and simulation of innovative chemical reactors (reverse flow, membrane, monoliths, foams).
- Development of adsorbents and adsorption processes in both gas (H₂, CH₄, VOCs, CO₂) and liquid (micropollutants) phase.
- Catalytic processes for obtaining biofuels 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

The group has been working for more than a decade in the field of the hydrogen economy. Both in hydrogen manufacturing processes through reforming reactions and water gas displacement reactions (both in the development of catalysts and innovative reactors), and in the separation of hydrogen through adsorption and membrane processes. Concentration and storage processes using physical adsorption (non-microporous carbons and MOFs as adsorbents), or chemical storage of hydrogen using liquid organic carriers (LOHCs) are also considered in our research.



Production



Storage and distribution



Transport



Uses

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).

ENTITY DATA

Type: University

Size: 51-100 employees

Calls of interest for your entity :
National, Regional



<https://www.ehu.eus/en/web/supren>



94 601 7282



laura.barrio@ehu.eus



Escuela de Ing. Bilbao- Pl. Ing.Torres Quevedo 1

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 using organic carriers.
- 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

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

TECHNOLOGIES OFFERED

Demonstrate Liquid Organic Hydrogen Carrier (LOHC)-based technology for hydrogen distribution and storage.



Production



Storage and distribution



Transport



Uses

DESCRIPTION OF THE ENTITY

With an average of 25 years of experience in the energy sector, the Water2kW team is prepared to tackle multidisciplinary projects in the field of Hydrogen. Thanks to the previous experience of our team in senior management positions in energy multinationals with a global presence, we have solid knowledge in the technological, economic, legal and commercial fields. Currently focused on the hydrogen and renewable energy sector.



www.water2kw.com



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Avenida de Brasil, 6, 28020 Madrid

ACTIVITIES AND EXPERIENCES IN R&D&I

In addition to the internal R+D+i work and in order to deepen the technological offer that we currently offer, we have closed collaboration agreements with different companies and technology centers, both in Spain and abroad. Within this line of innovation, Water-On, a sister company of Water2kW, provides our projects with its patented EcOsmosis® solution for the production and treatment of 100% chemical-free water. This allows us to have a real technological offer, for the production and use of 100% green hydrogen in each and every one of its phases.

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

ENTITY DATA

Type: LTD

Size: 21-50 employees

Calls of interest for your entity:

National and international R+D+i calls. National and international H2 Project, development and execution calls.

TECHNOLOGIES OFFERED

*We have patented two processes and systems, for the generation of hydrogen and the total recycling of its by-products in the plants themselves. **H2umidity®** produces green hydrogen in almost any circumstance, even in environments and processes where water is not available. For its part, **EcOsmosisH2®** produces green hydrogen in environments with available water that must be previously treated, using a 100% chemical-free process.*



Production



Storage and distribution



Uses

DESCRIPTION OF THE ENTITY

Zona Eólica Canaria S.A. is a company based in the Canary Islands, whose main objective is to provide a response to the national and international electricity market through the promotion of the renewable energy sector and R+D+i oriented to energy sustainability.

Zecsa is dedicated to the development of renewable projects of all kinds, as well as R&D initiatives and energy storage (including hydrogen).

In the process of growth abroad, the company has diversified its fields of action in the search for a consolidation and stabilization approach in all sectors related to the use and study of energy, always with a strong renewable character.

ENTITY DATA

Type: SME

Size: <10 employees

Calls of interest for your entity:

European: Horizon Europe, FCH JU, Green Deal

National: CDTI, MITECO, MICINN



www.zecsa.org



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C/ Veintinueve de Abril, 35007, Las Palmas G.C.

ACTIVITIES AND EXPERIENCES IN R&D&I

- *Design of hydrogen accumulators coupled to renewable energy generation systems.*
- *Analysis of systems that combine sea energy with hydrogen utilization.*
- *Study on the applicability of hydrogen and ammonia as fuel for large ships and cargo vessels.*
- *Collaboration in technical experiments on hydrogen production, purification and compression for medium-large scale hydrogen storage.*

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

TECHNOLOGIES OFFERED

Study of facilities for hydrogen production, management, use and storage.

Design of strategies for integration of renewable energies with hydrogen storage systems.



CATALOGUE OF AVAILABLE TECHNOLOGY

SPANISH HYDROGEN AND FUEL
CELL TECHNOLOGY PLATFORM

AVAILABLE TECHNOLOGY CATALOGUE

This second block aims to publicize the technological products or innovative production processes associated with the Hydrogen and Fuel Cell Sector, offered by each entity described above.

Included in each sheet is the detailed description of each technology and its main data (innovative aspects and advantages, level of technological maturity, industrial property rights and the type of collaboration offered). Each technology is also associated with the entity that offers it and its contact details.

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.



SECTOR INDUSTRIAL

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



Production



Storage



Distribution



Refuelling



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

Integrated Solutions of Information, Training and Conformity Assessment disciplines of R+D+i, Energy, Renewable Energies, DNSH.

Description:

The purpose of AENOR is to build trust between organizations and people. Working day by day in this framework of trust, we have analyzed on the one hand the current concerns of society and its needs, and on the other, we have connected them with those sectors to which from AENOR we are going to give a specialized response.

The result of this analysis has allowed us to identify the objectives of the organizations that AENOR assumes as its own and turns them into Trusted Platforms. These platforms integrate a group of solutions, directed and designed to help companies achieve these objectives, demonstrating to their main stakeholders that they have achieved them.

They are our integrated Information, Training and Conformity Assessment Solutions (certifications, inspections, laboratory analytics and management software).



www.aenor.com



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C/ Génova, 6. 28004 Madrid

TECHNOLOGY INFORMATION

Maturity level: *In the market.*

Industrial property rights: *National, European, international standards.*

Type of collaboration offered: *Technical cooperation agreement.*

APPLICATION SECTORS

Others and transversal to all sectors:

- *Conformity assessment of projects, generation, distribution and consumption of H₂.*
- *Development of technical specifications of requirements and their interpretation on the previous themes.*
- *Issuance of Certificates, declarations, reports,.... compliance*
- *Information, training and dissemination activities in a transversal way to the sector in the indicated disciplines.*

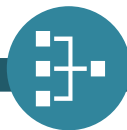
Plastic materials and catalysts with advanced properties



Production



Storage



Distribution



Refuelling



Transport



Other

TECHNOLOGY DESCRIPTION

AIMPLAS developed several conductive plastic formulations that can be processed using conventional techniques for use as bipolar plates, interconnectors and electromagnetic shielding components.

AIMPLAS developed a thermoplastic pultrusion line through the melt impregnation process of long fiber reinforcements (carbon or glass) with thermoplastic matrixes (polypropylene, polyamide or recycled PET). AIMPLAS produces high quality long fiber pellets and 1/2" unidirectional tapes applicable as light reinforcements for tanks and pipes.

AIMPLAS is developing inner layers (liners) with advanced impermeability and resistance properties for hydrogen tanks and pipelines.

AIMPLAS participates in several projects where different tailor-made catalysts are designed for the production of value-added chemical compounds from CO₂ and H₂ (power-to-X). And also to maximize the generation of H₂ from plastic waste and biomass.

AIMPLAS is advanced in the development and optimization of porous electrodes as catalytic supports.

AIMPLAS also applies its knowledge in the design of MOFs/COFs as alternatives to the physical/chemical storage of H₂.



www.aimplas.net



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C/ Gustave Eiffel, 4, Parc Tecnològic Valencia

TECHNOLOGY INFORMATION

Maturity level: *Developed but not marketed.*

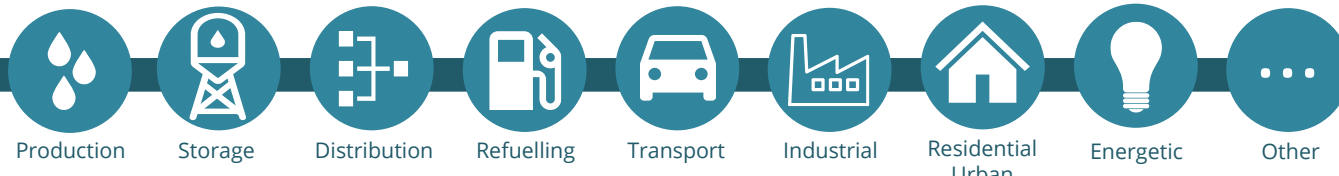
Industrial property rights: *Applied for Patent; Protected by industrial secret; Other: license of exploitation.*

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

APPLICATION SECTORS

- **H2 Production:** (COMPONENTS) SMR (Methane Reform); Biomass.
- **H2 Storage:** Compressed gas in tanks; Hydrogen carriers.
- **H2 distribution:** Pipelines.
- **Refuelling infrastructures:** Storage.
- **Transport:** (DEPOSITS) Automobile; Heavy vehicle; Railway; Aviation; Maritime.
- **Other:** Tailored materials for physical/chemical storage; Isolation systems for cryogenic transport; Green hydrogen as a raw material (power-to-X).

PEM Fuel Cells



TECHNOLOGY DESCRIPTION

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

They are fed with hydrogen gas and air, and only have water as a by-product. 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 12kW. 100 kW stack under development.

Current models: FC027, FC028 and FC030



<https://ajusath.es/>



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ajusa@ajusa.es



Parque Empresarial Ajusa Calle 1, nº 1 Albacete

TECHNOLOGY INFORMATION

Maturity level: *On the market.*

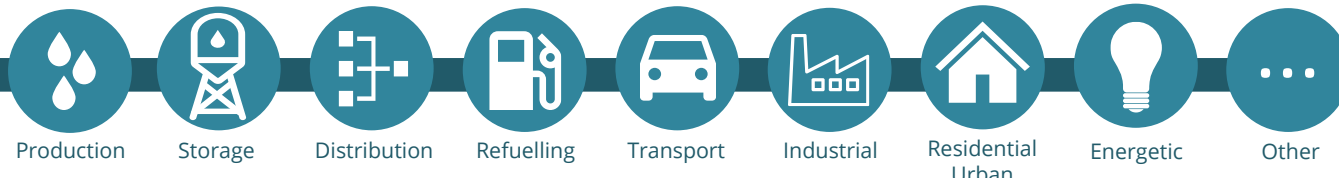
Industrial property rights: *Protected by industrial secret.*

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

APPLICATION SECTORS

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

PEM Fuel Cell 20 kW Module



TECHNOLOGY DESCRIPTION

20kW range extender module for electric vehicle or truck using an Ajusa FC030-250 Fuel Cell.



<https://ajusath.es/>



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Parque Empresarial Ajusa Calle 1, nº 1 Albacete

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

- **Transport.**



Production

TECHNOLOGY DESCRIPTION

In ARIEMA, we have been manufacturing our own alkaline technology electrolyzers since 2009. For the development of this technology, ARIEMA has received public funding of more than €6 million through various R&D aid programmes.

ARIEMA is currently scaling its alkaline stacks to 0.5 MW, to configure systems of up to 5 MW. With a view to its industrialization, ARIEMA is planning a factory of about 200 MW/year of production.

This new alkaline stack is expected to be commercially available in the second half of 2023.

On the other hand, for systems of more than 10 MW, ARIEMA also offers alkaline technology from its exclusively represented Hydrogen-Pro, a leading Norwegian company in its market.

In the same way, in external technologies, ARIEMA has manufactured and installed PEM technology electrolyzers for various applications and is also capable of proposing AEM electrolysis systems.



http://www.ariema.com/web2/?page_id=66652



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

TECHNOLOGY INFORMATION

Maturity level: *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: *Electrolyzer (Electrolysis of water).*

Modelling and simulation of hydrogen generation and solutions in an Energy System of use



Production



Storage



Industrial



Residential Urban



Energetic

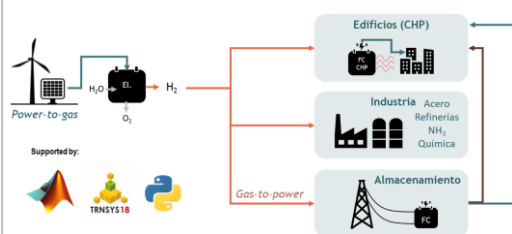


Other

TECHNOLOGY DESCRIPTION

Modelling and simulation of integrated solutions that use H₂ as a central energy vector.

Detailed dynamic simulations in TRNSYS with the possibility of connection to other environments with additional capabilities (MATLAB, HOMER, Python frameworks, GenOpt) to assess the viability of hydrogen as an intermediate storage element in renewable generation systems (medium and large). Furthermore, large scale energy system models are being used to assess the impact of hydrogen integration and application on a regional or national energy system.



Contribution to the design and development of sector coupling solutions and energy system integration contributing to the 2030 targets and roadmaps set at a European and national level.



<https://www.cartif.es/en/research-areas/energy-systems/>



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Parque Tecnológico de Boecillo, 205, 47151

TECHNOLOGY INFORMATION

Maturity level: *Basic /applied research.*

Industrial property rights: *Depending on the type of contract.*

Type of collaboration offered: *By agreement: of cooperation for R&D, of provision, of service or of technique cooperation.*

APPLICATION SECTORS

Development of models of:

- **H2 Production:** *by electrolysis integrating renewables.*
- **H2 Storage:** *both in metallic hydrides and pressurised.*
- **Residential/urban:** *energy use, thermal use, microgeneration...*
- **Industrial:** *green hydrogen as raw material, industrial use cogeneration systems (GHP) and heat production in thermal power plants.*
- **Energetic:** *production and storage of energy coupled to the electric grid.*
- **Other:** *Development of optimal control strategies.*

Test bench of hydrogen technologies applied to residential environment

CARTIF



Production



Storage



Residential Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

Test bench for the analysis of different storage technologies (batteries, metallic hydrocarbons, thermal) and its integration with renewable energy generation, electrolysis, and revalorization for its use in low power environments such as residential one, using fuel batteries as cogeneration elements, coupled to heat bombs.



With the bench you can test different demand and generation profiles.

The results can be extrapolated to real facilities, contributing criteria to their design and sizing, and the implementation of advance controls that maximize the utilization of the renewable energy.



<https://www.cartif.es/en/research-areas/energy-systems/>



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Parque Tecnológico de Boecillo, 205, 47151

TECHNOLOGY INFORMATION

Maturity level: Applied research.

Industrial property rights: Depending on the type of contract.

Type of collaboration offered: By agreement: of cooperation for R&D, of provision, of service or of technique cooperation.

APPLICATION SECTORS

The bench test allows the evaluation of the next systems:

- **H2 Production:** implementation of AEM electrolyzers (Anion Exchange Membrane) of low power.
- **H2 Storage:** use of metallic hydrocarbons as low pressure systems.
- **Residential/urban:** simulation of thermal and electric demand curves.
- **Energetic:** evaluation of energy performance indicators (returns, density, etc.).
- **Other:** Development of optimal control strategies.



Production

TECHNOLOGY DESCRIPTION

Development of catalysts for H₂ production as of biomethane reforming.

The technology is based in the development of new catalysts that allow carrying out the production of H₂ as of biomethane from biogas.



This development is focused on the synthesis of specific catalysts, supported by low-cost zeolites and hydrotalcites to reduce the operating costs of the process.



<https://www.cartif.es/en/research-areas/circular-economy/>



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TECHNOLOGY INFORMATION

Maturity level: *Basic research.*

Industrial property rights: *Depending on the type of contract.*

Type of collaboration offered: *By agreement: of cooperation for R&D, of provision, of service or of technique cooperation.*

APPLICATION SECTORS

- **H₂ Production:** *production from biomethane.*



Production

TECHNOLOGY DESCRIPTION

Production of biohydrogen from residual wet biomass (pig slurry, high load effluents, etc.).

Residual wet biomass treatment by two-phase anaerobic digestion, being the first phase of dark fermentation where biohydrogen is produced.



It promotes the growth of acetic or butyric acid producing microorganisms, as they generate biohydrogen as a product, and inhibits the growth of propionic acid producing microorganisms, whose hydrogen consumption in their metabolism is undesirable. It has the advantage that solar light isn't a requirement, it doesn't require much space and the production is not affected by the climatic conditions of the place.



<https://www.cartif.es/en/research-areas/circular-economy/>



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Parque Tecnológico de Boecillo, 205, 47151

TECHNOLOGY INFORMATION

Maturity level: *Basic research.*

Industrial property rights: *Depending on the type of contract.*

Type of collaboration offered: *By agreement: of cooperation for R&D, of provision, of service or of technique cooperation.*

APPLICATION SECTORS

- **H2 Production:** *production with residual wet biomass.*



Production

TECHNOLOGY DESCRIPTION

Production of biohydrogen as of photo-heterotrophic and/or mixotrophic cultivation of microalgae.

Microalgae get nutrients contained in residual effluents.



It has the advantage that is a method more efficient and less expensive than the other methods developed previously for producing green hydrogen, that requires solar energy generation or eolic, distilled water and precious metals.



<https://www.cartif.es/en/research-areas/circular-economy/>



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Parque Tecnológico de Boecillo, 205, 47151

TECHNOLOGY INFORMATION

Maturity level: *Basic research.*

Industrial property rights: *Depending on the type of contract.*

Type of collaboration offered: *By agreement: of cooperation for R&D, of provision, of service or of technique cooperation.*

APPLICATION SECTORS

- **H2 Production:** *production from effluents of low toxicity (agrifood industry or similar).*

Separation of gas mixtures (H₂/CH₄/CO₂) using diaphragm contactors

gas mixtures using gas-liquid

CARTIF



Production

TECHNOLOGY DESCRIPTION

Separation of gas mixtures (H₂/CH₄/CO₂) using gas-liquid diaphragm contactors.



A laboratory and pilot plant is available that can treat up to 50 m³/h of incoming gas stream and obtain a gas purity of over 99%.

This technology combines conventional phase contact operation in membranes with absorption and therefore the benefits of both technologies can be fully exploited. In the absorption process organic solvents are not used (which are the ones used in the traditional absorption processes), which are corrosives, has high vapour pressure and needs high energy for the regeneration.

It has the advantage that works at low pressure (2 bar), with which investment, operative and security costs are lower than the ones for gas-gas membrane systems.



<https://www.cartif.es/en/research-areas/circular-economy/>



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Parque Tecnológico de Boecillo, 205, 47151

TECHNOLOGY INFORMATION

Maturity level: *Basic research.*

Industrial property rights: *Depending on the type of contract.*

Type of collaboration offered: *By agreement: of cooperation for R&D, of provision, of service or of technique cooperation.*

APPLICATION SECTORS

- **Others:** *upgrading of gaseous streams.*

Preparation of primary reference gas mixtures for analytical determination of hydrogen purity



Refuelling



Transport



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.



www.cem.es



918074700



cem@cem.es



C\ Alfar, 2, 28760 Tres Cantos, Madrid

TECHNOLOGY INFORMATION

Maturity level: Basic research / Lab-prove.

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.

Other: Metrology.



Production



Energetic

TECHNOLOGY DESCRIPTION

CENER focuses its activities related to hydrogen production in the development of high temperature electrolyzers (SOEC). R&D activities cover all the steps of the technology development, from the optimization of new functional materials up to their implementation at cell level and the stacking of these in prototypes in the kW range. Moreover, CENER carries out activities related to multi-scale modeling of electrolyzers (cell, stack and system).

SOEC technology is characterized by its high operating temperature (>650°C), opposed to other electrolysis technologies (AWE, PEMEL). This fact makes the technology very appealing in terms of theoretical efficiency, much higher than competitors, thanks to favored thermodynamics. On the contrary, the high operating temperature implies specific technology requirements and important challenges related to its hybridization with other technologies and processes.



www.cener.com



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igarbayo@cener.com



Pol. Ind. Rocafort, Parcelas G2-H1 31400 Sangüesa NA

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

- **Producción de H₂:** Electrolizador de alta temperatura para producción de hidrógeno verde.
- **Industrial:** Hibridación de SOEC con procesos de alta temperatura para aprovechamiento del calor.
- **Energético:** Integración de SOEC en redes basadas en energías renovables e hibridación con otras tecnologías de conversión y almacenamiento energético.



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

SOFC technology is based on the same principle as SOEC electrolysis. In fact, a single SOFC device is fully reversible, allowing its use for both hydrogen production and its reconversion to electricity on demand.

In terms of electrical efficiency, SOFC presents important advantages versus other fuel cell technologies. Likewise, the main technological challenge relates to the heat management. As a result, the main application of SOFC nowadays is residential, although important advances are being accomplished towards the integration of SOFC systems in mobility or other uses.



www.cener.com



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Pol. Ind. Rocafort, Parcelas G2-H1 31400 Sangüesa NA

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

- **Transport:** Integration of SOFC 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 energy-based grids and hybridization with other energy conversion and storage technologies.

Energy management system for energy grids integrating hydrogen production by electrolysis



CENER

CENTRO NACIONAL DE
ENERGÍAS RENOVABLES



Production



Distribution



Industrial



Energetic

TECHNOLOGY DESCRIPTION

Hydrogen appears as an energy vector capable of decarbonize hard-to-abate sectors, such as thermal processes in industry, mobility, etc.

Electrolyzers allow to generate hydrogen when there is surplus of energy, or cheap, to then be stored and distributed to consume in demand.

This way, electrolyzers contribute to the storage of energy, playing a key role on the energy management systems distributed through the grid; transforming part of the energy consumption in dispensable consumption that can be optimized through a local energy management system.



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TECHNOLOGY INFORMATION

Maturity level:

Industrial property rights:

Type of collaboration offered:

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

APPLICATION SECTORS

Elimine los sectores que no apliquen en este caso...

- **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)



CENER

NATIONAL RENEWABLE ENERGY CENTRE



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.



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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

- Remove the sectors that do not apply in this case...
- **H₂ Production:** from biomass and wastes
- **Industrial:** use of syngas and H₂ as feedstock



Storage



Distribution



Industrial



Residential
Urban



Energetic

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. The bioreactor is currently being worked on at laboratory scale (10 L) and an operational prototype (pilot plant) of 100 L is planned for 2023.

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".



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TECHNOLOGY INFORMATION

Maturity level: Validated at laboratory level (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

- **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

Plurality of innovative hydrogen technologies



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH
Centre Específic de Recerca de l'Hidrogen



Production



Storage



Refuelling



Transport



Industrial



Energetic

TECHNOLOGY DESCRIPTION

As a polytechnic 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, Photo and photoelectrocatalysis; decomposition of NH_3 ; Infrastructures.

Storage and distribution:

Compressed H_2 , Metallic hydrides, Liquefaction at low $T^\circ\text{C}$, Transport and distribution.

Use of H_2 :

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 H_2 and electricity generation; Vehicles with fuel cell, Economy and sustainability.

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



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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

- **H_2 Production:** Electrolysis of water, SMR, Methanol reforming, Biomass. (Components, Units, Auxiliary elements, process control).
- **H_2 Storage:** Compressed gas in tanks; Liquid hydrogen; Metal hydrides; Hydrogen carriers.
- **Refuelling infrastructures:** 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 cogeneration systems GHP; Heat production in thermal power.
- **Energetic:** Production and storage of energy coupled to the electricity grid, Injection into the gas grid.



Production



Transport



Industrial



Residential Urban



Energetic



Other

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.



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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:** Production of biofuels from renewable hydrogen.



Storage

TECHNOLOGY DESCRIPTION

Adsorbent materials for hydrogen storage.

Strategies based on:

- **Eco-sustainable systems based on porous materials based on nanocellulose**

Porous materials based on the use of micro/nanometric sized cellulose with controlled porosity subjected to soft carbonization processes.

Advantages: eco-sustainable materials, of renewable origin, non-toxic and with controlled porosity.

- **Organic liquid-based hydrogen carrier systems (LOHC)**

Low melting point liquid or solid organic compounds that can be reversibly hydrogenated and dehydrogenated at elevated temperatures in the presence of a catalyst, leading to the ability to bind and release.

Advantages: non-hazardous and non-flammable compounds, storage capacities up to 5 times higher than standard technology.

- **Porous materials based on high internal phase emulsions (PolyHipes)**

Formation mechanisms based on the addition of a dispersed phase over a continuous phase, polymerization and elimination of the internal.

Advantages: ability to design tailor-made structures in terms of porosity, interconnections, morphologies and mechanical properties.



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A Coruña - SPAIN

TECHNOLOGY INFORMATION

Maturity level: Basic research

Industrial property rights: -

Type of collaboration offered:

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

APPLICATION SECTORS

H2 Storage:

- Liquid hydrogen.
- Hydrogen carriers.



Production

TECHNOLOGY DESCRIPTION

Bioelectrochemical systems for the production of H₂

These systems are made up of a cell with 2 chambers (cathodic and anodic) separated by a membrane. Thanks to the biocatalytic activity of the microorganisms that are deposited on the anode, the production of H₂ in the cathode takes place with a potential significantly lower than that of conventional electrolysis, consuming less energy (theoretically 8.7 times less).

Additionally, the anode oxidation reaction can be used to oxidize organic matter from a waste stream, making it possible to use it as a technology for treating wastewater and hydrogen simultaneously.

Dark fermentation

Fermentative process in which a set of anaerobic microorganisms degrade organic matter producing H₂.

This technology allows H₂ to be obtained from a wide range of residual currents (agricultural, food, urban sector waste...), thus being a recovery route.



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A Coruña - SPAIN

TECHNOLOGY INFORMATION

Maturity level: Lab- proven.

Industrial property rights: -

Type of collaboration offered:

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

APPLICATION SECTORS

H₂ Production.



Production

TECHNOLOGY DESCRIPTION

H₂ production by photocatalysis

Hydrogen production from aqueous solutions by photocatalytic processes. Combination with organic compound removal processes (e.g., wastewater treatment).

Conversion of organic substrates for H₂ production (photocatalytic reforming of ethanol).



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A Coruña - SPAIN

TECHNOLOGY INFORMATION

Maturity level: *Lab- proven.*

Industrial property rights: -

Type of collaboration offered:

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

APPLICATION SECTORS

H₂ Production.



Production

TECHNOLOGY DESCRIPTION

Electrochemical technologies and membranes for the treatment of different types of water (wastewater, water from secondary treatment of WWTP, desalination, etc.) for application in EA-PEM systems. Membrane distillation stands out among them, due to its ability to use renewable energy sources or residual heat sources to eliminate ions and other contaminants in water currents, with lower energy consumption than technologies such as reverse osmosis.



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TECHNOLOGY INFORMATION

Maturity level: *Lab- proven.*

Industrial property rights: -

Type of collaboration offered:

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

APPLICATION SECTORS

H2 Production.



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., 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.



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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).



Production



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

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

1) Development of decoupled electrolyser.

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

Main innovations:

- The use of redox mediators in organic phase with conductive polymers and polyelectrolytes.
- The use of solid redox mediators with polyvalent metal oxide nanomaterials.

Advantages of the technology:

- More efficient use of intermittent energy sources (solar or wind).
- High nominal power system for green hydrogen generation.
- Increased safety by preventing the formation of explosive gas mixtures.
- Low cost associated to low-maintenance and flexible materials.

2) Development of electrolysers for H_2 and H_2O_2 or Cl_2 co-generation.

The objective is to reduce the cost of hydrogen generation.

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

Advantages of the technology:

- Increased H_2 generation rate.
- Added-value co-generated product.



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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

H_2 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.

Development of catalysts and catalyst supports for PEMFC and alkaline ammonia fuel cells

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Production



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).



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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.

Experimentation on hydrogen-based electrochemical systems



Producción



Transport



Industrial



Residential
Urban



Energetic



Other

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.*



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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

Experimentation and characterization of electrochemical components and systems for all areas of use:

- **H2 Production.**
- **Transport.**
- **Industrial.**
- **Residential/urban.**
- **Energetic.**
- **Other.**

Development of stacks and fuel cells for specific utilization requirements



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

CIDAUT develops stacks and fuel cells tailored to the expected utilisation requirements.

This development focuses on:

- Thermofluidomechanical design of bipolar plates (cooling, pressure drop, durability, reagent balance, etc.).
- Integration of MEAS for specific operating requirements (low Pt, pollutant resistance, durability, etc.).
- Selection of materials for the different elements (corrosion, conduction, manufacturing, sealing).
- Selection and development of manufacturing methods (stamping, moulding, electroplating, coating)
- Development of fuel cell balance of plant equipment to optimize performance according to the application.



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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 vehicle.*
- **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.



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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.



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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 NH_3 synthesis processes, subsequent cracking and use in different thermochemical and electrochemical applications.



Storage



Transport



Industrial

TECHNOLOGY DESCRIPTION

The use of NH_3 as a H_2 carrier has great advantages due to its high H_2 content, its transport possibilities, as well as its properties as a fuel in sectors that are difficult to decarbonise, such as the maritime sector. Along these lines, CIDAUT is working on NH_3 synthesis processes from renewable H_2 , as well as on subsequent total or partial cracking processes to obtain H_2 , as well as mixtures of H_2 , NH_3 and N_2 that can be used both in fuel cells (with higher purity requirements) and in combustion engines (where H_2/NH_3 mixtures are a very advantageous fuel).

CIDAUT is working on:

- NH_3 to H_2 catalytic decomposition processes.
- Validation of H_2 separation technologies.
- Integration of decomposers and power plant (MCIA, TG, PEMFC)
- Combustion of NH_3 and H_2/NH_3 mixtures.
- NH_3 plant safety (storage and use).



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TECHNOLOGY INFORMATION

Maturity level: Tests at laboratory level. Design of elements and reactors.

Industrial property rights: according to type of collaboration.

Type of collaboration offered: R&D cooperation agreement, service delivery agreement and technical cooperation agreement.

APPLICATION SECTORS

- **H_2 storage:** Design of delocalised systems with new NH_3 synthesis processes as H_2 storage. Evaluation of new catalysts and operating conditions.
- **Transport:** Substitute NH_3 -based solutions (high energy density) for power plants in transport with tough requirements in terms of power and autonomy. Integration of NH_3 decomposition and PEMFC and integration of NH_3 decomposition and MCIA.
- **Industrial:** use of H_2 from NH_3 in thermal systems for energy supply in the industrial field (burners), as well as H_2/NH_3 mixtures.

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



Production

TECHNOLOGY DESCRIPTION

The most widespread current systems for hydrogen production based on water electrolysis are alkaline and polymeric membrane (PEM) systems. In both cases, high values of direct current (DC) are required to achieve the decomposition of the water molecule (H₂O) into hydrogen (H₂) and oxygen (O₂). This is a disadvantage from the point of view of the electrical consumption of the system and from the point of view of its maintenance, since this current circulates between the electrodes, the anode and cathode of each cell, with the consequent degradation of the cells and the need to use materials for their construction with particular electrochemical characteristics that make them very expensive.

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



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

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:** Electrolysis of water.

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



Production

TECHNOLOGY DESCRIPTION

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

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

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



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

TECHNOLOGY INFORMATION

Maturity level: *Lab-tested.*

Industrial property rights: *Non-disclosure agreement.*

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

APPLICATION SECTORS

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



Production

TECHNOLOGY DESCRIPTION

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

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



<https://controlyrobotica.com/>



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

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

- **Transportation:** Automobile; heavy vehicle.



Production

TECHNOLOGY DESCRIPTION

The renewable hybridized smart grid with H₂ technologies developed automatically connects/disconnects to/from the main power grid, depending on the price of electricity purchase/sale, which is known to its intelligent energy management system (EMS). The smart grid, which has a high-voltage DC bus (420 V), a 230 V single-phase AC bus and a 400 V three-phase AC bus, has as short-term storage systems two banks of lead acid batteries and super capacitors with direct connection to the DC bus, which maintains and stabilizes the DC bus voltage. As a medium-term storage system, it has a lithium-ion battery bank, connected to the DC bus by means of a power converter managed by the EMS. Finally, the long-term storage system, also managed by the EMS consists of a complete H₂ production (alkaline and PEM electrolyzers), storage (gas and metal hydride) and consumption (multi-stack fuel cell systems designed and manufactured in-house) facility. EMS knows the degree of degradation of each cell of each stack, which allows it to perform permanent predictive maintenance, making cell wear uniform. The smart grid is in operation supplying the La Rábida Campus of the University of Huelva, which is the only one in Spain with this technology.



<https://controlyrobotica.com/>



619175693



andujar@uhu.es



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

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

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



Production

TECHNOLOGY DESCRIPTION

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



<https://controlyrobotica.com/>



619175693



andujar@uhu.es



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

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration.

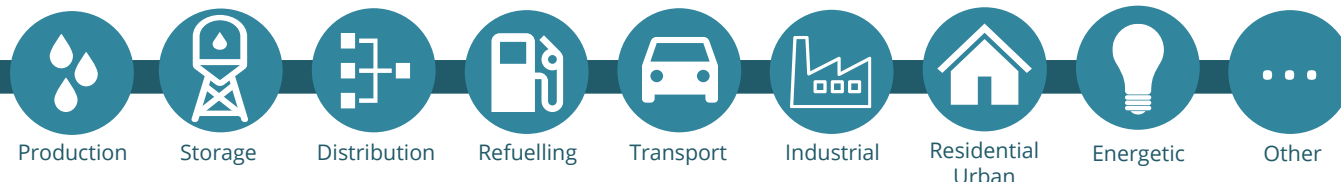
Industrial property rights: Non-disclosure agreement.

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

APPLICATION SECTORS

- H2 production.
- H2 storage.
- H2 distribution.
- Refueling infrastructures.
- Transportation.
- Industrial.
- Residential/urban.
- Energy.

Design and optimization of refuelling processes



TECHNOLOGY DESCRIPTION

Clantech has designed and continues to optimise the refuelling processes for light and heavy duty vehicles in order to reduce the costs of hydrogen plants and to reduce the amount of hydrogen stored in order to improve the safety levels of these facilities.



www.clantech.es



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Info@clantech.es



C/ Industria 5, Planta 1, Módulo 15 Sevilla, Spain

TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Trademark*

Type of collaboration offered: *Service Provision agreement*

APPLICATION SECTORS

- **H2 Production**
- **H2 Storage**
- **H2 distribution**
- **Refuelling infrastructures**
- **Transport**
- **Industrial**
- **Residential/urban**
- **Energetic**
- **Other:** *We integrate the necessary technologies for the production of green H2 and subsequent refuelling of heavy vehicles, light vehicles, trains, etc...*



Transport

TECHNOLOGY DESCRIPTION

The CMT institute has developed an advanced methodology for the integration of fuel cells in vehicle propulsion systems, allowing the sizing of the fuel cell-battery-motor assembly.

This methodology includes different optimization strategies for the complete propulsion system, with objectives that may include the minimization of fuel consumption, the fuel cell degradation, and the environmental impact along the life cycle assessment (LCA).

The optimization methodology through simulation is complemented by the possibility of testing complete fuel cell systems (up to 250 kW peak), with full flexibility and in both stationary and transient conditions.

In addition, there is also a unit cell test bench and a laboratory where several advanced analysis techniques are applied for the evaluation of membrane degradation.

The integration methodology can also be used for the optimization of the characteristics of stationary electricity generation fuel cells.



www.cmt.upv.es



96 387 76 59



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Universitat Politècnica Valencia (Spain)

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
- **Energetic:** Stationary electric and thermal energy generation (cogeneration)

Use of hydrogen as fuel in internal combustion engines and gas turbines



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.



www.cmt.upv.es



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Universitat Politècnica Valencia (Spain)

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 (cogeneration)
- **Energetic:** Stationary electric and thermal energy generation (cogeneration)

Use of ammonia as fuel in internal combustion engines and gas turbines



Transport



Industrial

TECHNOLOGY DESCRIPTION

As an alternative to the direct use of hydrogen in MCI and GT, the use of ammonia is very convenient due to its ease of storage. Thus, great advantages are obtained in those applications requiring high fuel energy storage, as in the case of maritime applications.

As a counterpoint, ammonia does not have good characteristics as a fuel, which makes it difficult to integrate it as a direct replacement for conventional fossil fuels in MCI, although it also offers advantages in terms of pollutant emissions.

For all the previous reasons, the CMT Institute is actively working on various research projects and contracts with companies to carry out the R&D necessary to develop combustion systems that allow the use of ammonia as a single fuel or in combination with other fuels (such as hydrogen) in MCI.

In parallel, the CMT Institute is also working on the design and implementation of an ammonia combustion system in GT burners, which can be used for aircraft propulsion and stationary generation.



www.cmt.upv.es



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Universitat Politècnica València (Spain)

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
- **Energetic:** Stationary electric and thermal energy generation (cogeneration)



Storage



Refuelling



Transport

TECHNOLOGY DESCRIPTION

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

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

Testing and validation of vehicle refuelling in hydrogen station.



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



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Puertollano (Ciudad Real)

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.

Hydrogen injection into natural gas grids



Storage



Distribution



Transport



Industrial



Residential
/Urban



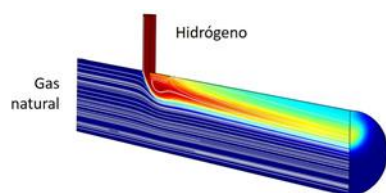
Energetic

TECHNOLOGY DESCRIPTION

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

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

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



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Puertollano (Ciudad Real)

TECHNOLOGY INFORMATION

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

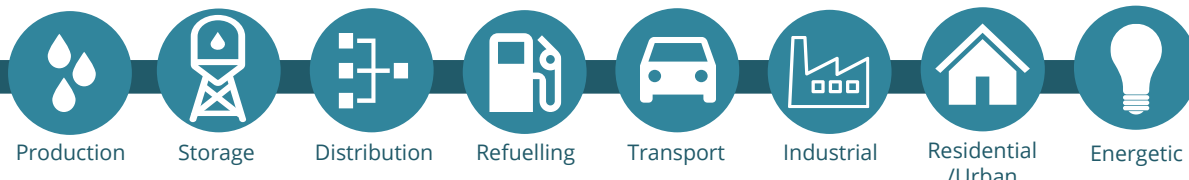
Industrial property rights: Protected by trade secret

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

APPLICATION SECTORS

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

Design of green hydrogen facilities: microgrids, modeling and simulation



TECHNOLOGY DESCRIPTION

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

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

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



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



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Puertollano (Ciudad Real)

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration. On the market

Industrial property rights: Protected by trade secret

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

APPLICATION SECTORS

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



Storage



Refuelling



Industrial

TECHNOLOGY DESCRIPTION

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

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

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



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



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Puertollano (Ciudad Real)

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

Prototype evaluation, development of test benches and testing of hydrogen systems



Production



Transport



Energetic

TECHNOLOGY DESCRIPTION

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

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



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



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Puertollano (Ciudad Real)

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.

Demonstration scale pilots - Joint Unit (UM) Renewable Gas



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: Representative pilots. TRL 6 -8.

Industrial property rights: not applicable.

Type of collaboration offered: R&D&I cooperation agreements. Use of pilots. Collaboration for industrial end uses.

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)

H2 Lab - Prototype development and validation



Production



Distribution



Transport



Energetic



Other

TECHNOLOGY DESCRIPTION

ENERGYLAB operates two laboratories in its headquarters (Vigo) which comprises the whole hydrogen value chain.



Mobility 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.

Biomass Laboratory

- **Fluidized bed gasifier,** Anaerobic sludge treatment coupled to WGS system for H₂ syngas enrichment.
- **Biological methanation:** Percolated bed type reactor (25 L), operated in thermophilic range and mixed inoculum.
- **Dark fermentation.** Batch and semi-continuous reactors for biological H₂ generation, inoculum pretreatment and evaluation of operating conditions.



<https://energylab.es/>



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Vigo, Pontevedra

TECHNOLOGY INFORMATION

Maturity level: technologies demonstrated at laboratory scale (TRL 5-6).

Industrial property rights: not applicable.

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.
- **H₂ enrichment of Syngas.**
- **Biological methanation.**

Proton-exchange membrane fuel cells (PEMFC)



Production



Transport

TECHNOLOGY DESCRIPTION

Proton-exchange membrane fuel cells (PEMFC).



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Burgos

TECHNOLOGY INFORMATION

Maturity level: *Basic research.*

Industrial property rights: *Applied for Patent.*

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

APPLICATION SECTORS

- **H2 Production:** *Electrolysis of water.*
- **Transport:** *Automobile, fuel cell.*

TECHNOLOGY DESCRIPTION

The Energy Applications group (ENAP) belongs to the ICTP (CSIC) and carries out the following research activities:

- Research on new membranes for PEMFC and DMFC.
- Preparation of electrodes and MEA's.
- Availability of the scientific equipment required for the preparation, testing and electrochemical characterization of PEMFC components and MEA's.



<http://www.ictp.csic.es/ICTP2/>



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Juan de la Cierva, 3 28006 Madrid

TECHNOLOGY INFORMATION

Maturity level: -

Industrial property rights: -

Type of collaboration offered: Characterization of PEMFC components at laboratory scale.

APPLICATION SECTORS

Other: Synthesis and characterization of PEMFC components.



Production



Storage



Refuelling



Industrial



Energy

TECHNOLOGY DESCRIPTION

H2B2 promotes projects and commercializes renewable hydrogen, focused on its application on the industrial and mobility sectors.

Brings forward in house capabilities for developing turnkey solutions, covering the full EPC (Engineering, Procurement, Construction) of such hydrogen plants.

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.



www.h2b2.es https://twitter.com/H2B2_Inc
<https://www.linkedin.com/company/h2b2/>



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41703 Dos Hermanas (Seville) – Spain

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*
- **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*
- **Industrial:** *Green hydrogen as a raw material, industrial cogeneration systems (CHP), heat production in thermal power plants, and other industrial uses*
- **Energy:** *Energy production and storage coupled to renewable sources and/or the electrical grid; injection into the gas grid*

Hydrogen Membrane Reactors and Separators

H2 SITE
Membrane reactors for H2 generation



Production



Storage



Distribution



Refuelling



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

Advanced membrane reactors and separators allow the separation or generation of fuel cell purity hydrogen in situ without greenhouse gas emissions for small and medium consumers. Starting from molecules with a simple and known logistics chain (renewable ammonia, biomethanol, bioethanol, biogas, syngas, DME, formic acid...), this equipment generates hydrogen with an energy efficiency of 10 to 20% higher than current standards, through of a simultaneous cracking and separation process. By combining them, the technology makes it possible to maximize the conversion of the hydrogen carrier molecule by shifting the equilibrium of the reaction towards the product zone according to Le Chatelier's principle. In this way, membrane reactors and separators produce pure hydrogen in a single process stage, without moving parts and in units that are between 2 and 4 times more compact than current solutions.



<https://www.h2site.eu/en/>



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Camino Gogorrena 2, 48180, Loiu

TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Patented*

Type of collaboration offered: *R&D cooperation agreement via consortia, commercial agreement, technical collaboration .*

APPLICATION SECTORS

- **H2 Production:** *ammonia cracker, low temperature reforming of ethanol, DME; toluene, syngas, biogas, methanol...*
- **Industrial:** *green hydrogen as raw material.*
- **Energetic:** *H2 separation (unblending) and H2 purification in the gas network.*
- **Other:** *H2 separation from gas blends (Steel industry gases, syngas or other gas blends).*

Hydrogen Compression at high pressure



Storage



Refuelling



Industrial



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.*



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



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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.*
- **Refuelling infrastructures:** *Compression, Storage and Dispense.*
- **Industrial:** *Green hydrogen as a raw material.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid, Injection into the gas grid.*

Hydrogen from biomass wastes (biogas, biomass and biowastes)



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.



<https://i3a.unizar.es/en>



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i3a@unizar.es



Calle de Mariano Esquillor Gómez, s/n, Zaragoza

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 H₂. 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.



<https://i3a.unizar.es/en>



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Calle de Mariano Esquillor Gómez, s/n, Zaragoza

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).

Upstream (cleaning), reforming and downstream (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.



<https://i3a.unizar.es/en>



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Calle de Mariano Esquillor Gómez, s/n, Zaragoza

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



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.



<https://i3a.unizar.es/en>



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Calle de Mariano Esquillor Gómez, s/n, Zaragoza

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.



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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.



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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.



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Calle de Mariano Esquillor Gómez, s/n, Zaragoza

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.

Algorithms for the sizing and control of on-grid hybrid renewable energy production systems



Production



Storage



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

Evolutionary algorithms for the sizing and control of hybrid renewable energy production systems connected to the grid, with energy storage and green hydrogen production.

Hybrid energy production systems using renewable sources are as variable as the source used (sun, wind, etc.). In grid-connected hybrid systems, the decision of where to send the energy to optimise the behaviour of the overall system may not be simple.

The evolutionary algorithms developed at the IIE allow hour-by-hour decisions on what to do with the energy produced to be made on the basis of factors that may include technical aspects but also economic aspects.



<http://www.iie.upv.es/inicio>



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Valencia

TECHNOLOGY INFORMATION

Maturity level: 5-6

Industrial property rights: Protected by industrial secret.

Type of collaboration offered: Development of control systems for renewable energy and hydrogen production systems.

APPLICATION SECTORS

- H2 Production.
- H2 Storage.
- Industrial.
- Residential/urban.
- Energetic.
- Other.



Refuelling



Transport

TECHNOLOGY DESCRIPTION

Design of hydrogen power generation systems for Unmanned Aerial Vehicles (UAV)

We are developing a hydrogen-powered quadcopter drone power system. In a first stage, we will use commercial fuel cell systems and storage tanks to demonstrate the utility of the system.

In a second stage, which will be developed in parallel, we will implement new high-conductivity membranes to reduce the size of the fuel cell as much as possible and thus increase the energy density of the system.

The development of this type of system can be extrapolated to any other vehicle where the weight criteria are not as demanding as those of quadcopter drones.



<http://www.iie.upv.es/inicio>



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Valencia

TECHNOLOGY INFORMATION

Maturity level: 3-4

Industrial property rights: *Protected by industrial secret.*

Type of collaboration offered: *Development of hydrogen-based electric vehicle power systems.*

APPLICATION SECTORS

- **Refuelling infrastructures.**
- **Transport.**

Renewable-based production systems, storage and dispensing for heavy transport hydrogen



Production



Storage



Refuelling



Transport

TECHNOLOGY DESCRIPTION

Advice on the design of hydrogen production systems from renewable sources, storage and dispensing for heavy transport.

Using evolutionary algorithms, different scenarios of green hydrogen production systems for dispensing in hydrogenators for heavy transport can be considered and the optimal one chosen according to different technical and economic criteria.



<http://www.iie.upv.es/inicio>



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Valencia

TECHNOLOGY INFORMATION

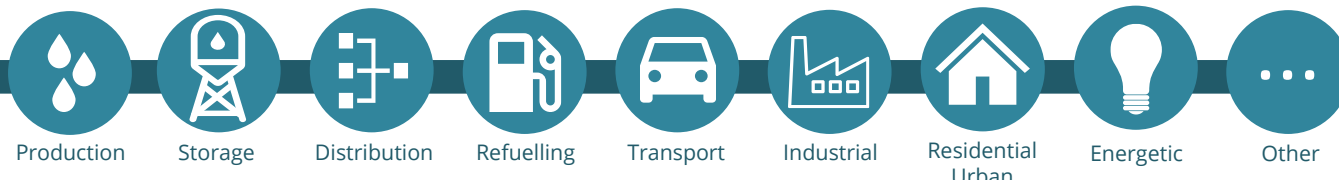
Maturity level: 7-8

Industrial property rights: -

Type of collaboration offered: *Advice on the design of systems for the production of hydrogen from renewable sources.*

APPLICATION SECTORS

- H2 Production.
- H2 Storage.
- Refuelling infrastructures.
- Transport.



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.



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

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration.

Industrial property rights: Copyright registered for software. Protected by industrial secret.

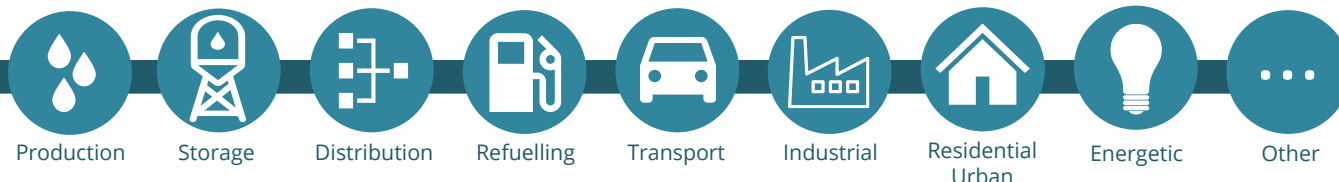
Type of collaboration offered:

- 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.**

Development of new technologies for hydrogen production



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.



<https://www.energy.imdea.org/>



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

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.

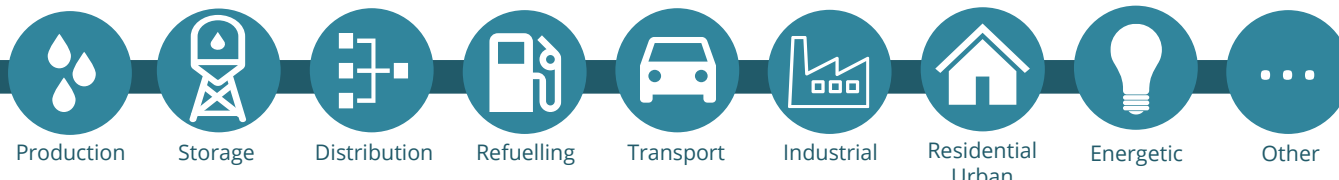
Type of collaboration offered:

- 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.**

Development of new materials applicable to hydrogen technologies



TECHNOLOGY DESCRIPTION

Development of new materials applicable to hydrogen technologies

Development, synthesis and characterization of catalysts, adsorbents, materials for high temperatures, electrodes, membranes and microorganisms for the production, purification, use and conversion of hydrogen, applicable to electrolyzers, fuel cells and solar reactors: MOFs, nanofibers, nanoparticles, electrodes,...

Design, manufacture and characterization of reactors for the production and use of hydrogen or its conversion to other products or fuels, at laboratory, pilot plant and demonstrator scale applicable to thermosolar, electrochemical, photochemical, photo (electro) chemical, biological and bioelectrochemical processes.

The Institute has R&D infrastructures at the laboratory, pilot plant and demonstration level that allow the design, optimization and scale up of processes, to ensure their industrial viability. The infrastructures are flexible, admitting various raw materials, thermochemical, catalytic, thermosolar, biotechnological and photoactivated processes applicable in different stages of development from the laboratory to the pre-industrial scale.



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

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

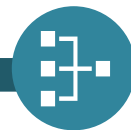
- **H2 Production:** Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass and other technologies.
- **H2 Storage:** Hydrogen carriers.
- **Refuelling infrastructures:** In situ hydrogen production.
- **Transport:** Automobile. Heavy vehicle. Railway. Aviation. Maritime.
- **Industrial:** 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.



Production



Storage



Distribution



Refuelling



Industrial



Energetic

TECHNOLOGY DESCRIPTION

INERCO offers various technologies directly related to hydrogen;

- *Hydrogen engineering and consulting services; These services cover the entire process of the hydrogen plant from its technical-economic conception to its start-up.*
- *The design and manufacture of electrolysers; INERCO designs and builds Ad Hoc electrolysers that adapt to the specific needs of the client.*
- *Control system (EMS); Design and implementation of expert control systems and optimized management of energy production, storage and consumption for H2 plants and hybrid installations (PV, wind, BESS).*
- *Industrial safety studies for hydrogen; INERCO offers, both for the construction and operation of the H2 plant, design integrity services (distance report, HAZID, EAC, HAZOP, SIL), operation integrity and asset integrity.*
- *Biomass gasification technology; This technology allows different types of biomass to be valorised and gasified, allowing H2 to be obtained in the process together with other gas streams.*



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Tomas Alba Edison 2, 41092 SEVILLA

TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Trademark*

Type of collaboration offered: *Other: commercial agreement.*

APPLICATION SECTORS

- **H2 Production:** *Electrolysis of water, SMR (Methane Reforming), Methanol Reforming, Biomass.*
- **H2 Storage:** *Compressed gas in tanks, Hydrogen carriers.*
- **H2 distribution:** *Pipelines.*
- **Refuelling infrastructures:** *On-site hydrogen production, Compression, Storage, Dispense.*
- **Industrial:** *Green hydrogen as raw material, Industrial cogeneration systems (GHP), Heat production in thermal power plants.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid, Injection into the gas grid.*

Design of controllers, observers and parameter estimation systems



Production



Storage



Distribution



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

The Automatic Control Group develops model-based controllers for the energy optimization and component degradation minimization of fuel cell or electrolyzer based systems. Moreover, the group objectives include minimization of sensors, and thus, our solutions include observers and real time parameter estimation systems. Because the electrochemical systems (fuel cells, electrolyzers, batteries, Redox Flow Batteries) are complex and non-linear, observation and parameter estimation is itself a relevant topic for which the group has acquired important experience. The information obtained from the estimation systems permits to update the control models, to know the state of health of the components and to diagnose possible faults or even prognose life time.

The main techniques used by the research group include model predictive control, robust control, sliding mode control.



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<https://goo.gl/maps/arevSFsw6Fwift7b9>

TECHNOLOGY INFORMATION

Maturity level: validated in the laboratory.

Industrial property rights: -

Type of collaboration offered:

Development of management and control systems for hybrid systems/nets with hydrogen: vehicles, residential sector, hydrogen stations, energy sector...

Development of diagnosis and prognosis systems based on parameter estimation.

APPLICATION SECTORS

- **H2 Production.**
- **H2 Storage.**
- **H2 distribution.**
- **Transport.**
- **Industrial.**
- **Residential/urban.**
- **Energetic.**

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



Industrial

TECHNOLOGY DESCRIPTION

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

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.).



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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.

Development of materials and components for electrolyzer and fuel cells PEM type



Production



Transport



Industrial



Residential Urban



Energetic

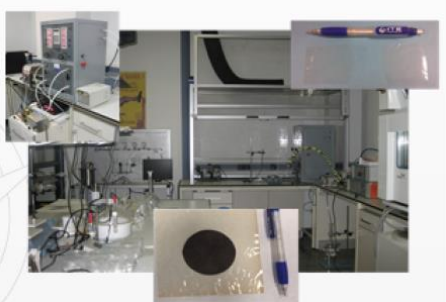


Other

TECHNOLOGY DESCRIPTION

Development of materials and components: Synthesis and development of new membranes based in Nafion and composites of inorganic fillers and 2D-materials. Development of MEA. Deposition of catalytic inks on GDL and membrane using different techniques: Spray, Screen printing, Inkjet and Aerosol Jet. Characterization of materials and components in a test bench.

Innovative aspects and advantages of the technology: development of hybrid polymeric membranes with the suitable charge of different metal oxides and 2D-materials at nanometric level. The strategy of including inorganic materials improves the hydration of the membrane at high temperatures. The use of 2D-materials supposes a reinforcement in the membrane, reducing the crossover and improving its mechanical properties.



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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.*

Simulation models behaviour/performance electrolyzer and fuel cell

of
of



Production



Transport



Industrial



Residential
Urban



Energetic



Other

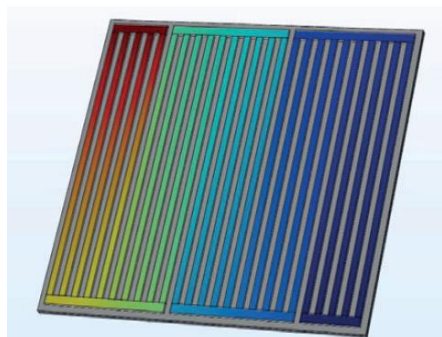
TECHNOLOGY DESCRIPTION

Development of models for the simulation of electrolyzer and fuel cell performance.

Complex electrochemical models at component level, allowing the influence of operating parameters on their performance to be studied (catalyst, flow of reagents (gases, water), temperature, voltage, operating current, etc...).

Multiphysical models of complete equipment, grouping electrical, simplified electrochemical, energetic and thermal simulation, validated in commercial solutions.

Innovative aspects and advantages of the technology: simulation allows optimization of equipment operation. In addition, it can be used as a tool for production planning, ageing prediction and electrolyzer and fuel cell degradation.



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TECHNOLOGY INFORMATION

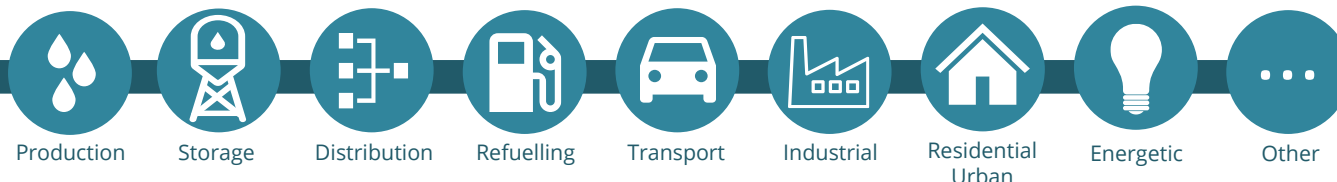
Maturity level: *Lab-proven*

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, power electronics and fuel cells (automotive, railway, heavy duty).*
- **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:** *Simulation of behaviour, prediction of degradation of fuel cells and electrolyzers.*



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.



www.itg.es



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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.



Production



Storage



Distribution



Refuelling



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

Digital modelling of renewable hydrogen generation, storage and consumption systems: electrolyser, water treatment plant, compressors, storage, vehicles, hydro stations and other consumptions. This allows:

- *Dimensioning and design of hybrid infrastructures.*
- *Energy and economic valuation of hydrogen systems impact in hybrid generation and storage systems.*
- *Energy elements emulation. Component testing. Algorithms optimisation.*
- *Operational strategies testing and analysis before system implementation.*
- *Solutions for renewable energy grid integration and ancillary services.*

Innovative aspects and advantages of technology:

Full system modelling; development and validation with real-time testing platform based on PHIL technology, in Smart Grids ITG Lab.



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Cantón Grande 9, Planta 3, 15003, A Coruña (España)

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:** *Component testing and 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.*



Production



Storage



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

The technology developed at the University Materials Institute of Alicante (IUMA) includes three topics: 1) Hydrogen storage in porous solids, which involves the development of materials (mainly carbon materials) with adequate porosity for the efficient storage of this molecule. 2) Hydrogen production by photocatalytic and electrocatalytic water splitting and photocatalytic reforming of biomass and biomass-derived products. 3) Use of hydrogen in fuel cells. For this latter topics efficient electrocatalysts are being developed to perform the necessary reactions both at the anode and the cathode.

Among the most innovative aspects of this technology, we would like to highlight the development of photocatalysts and electrocatalysts based on non-precious transition metals. We are currently developing on the one hand, titania-based photocatalysts modified with transition metals and carbon materials (for hydrogen production) and, on the other hand, electrocatalysts (anode and cathode) for fuel cells.



<https://iuma.ua.es/>



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San Vicente del Raspeig, Alicante

TECHNOLOGY INFORMATION

Maturity level: Basic and laboratory and Lab-proven.

Industrial property rights: Not apply

Type of collaboration offered:

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

APPLICATION SECTORS

- **H2 Production:** Electrolysis of water and biomass reforming.
- **H2 Storage in porous solids.**
- **Industrial:** Green hydrogen as a raw material.
- **Energetic:** Production and storage of energy coupled to the electricity grid.

HYBRID ENERGY SYSTEM WITH HYDROGEN AND STORAGE



Production



Storage



Refuelling



Transport

TECHNOLOGY DESCRIPTION

Thanks to hybrid energy technology with storage, we can recharge electric and hydrogen vehicles using only clean energy generated by photovoltaic and wind sources. Once the photovoltaic and wind power plant produces the energy, we have:

In one hand, the stored green energy in lithium batteries is used for electric cars recharging through chargers installed on site.

On the other hand, this clean energy is used to produce hydrogen by electrolysis of water on site, which is then compressed to the required pressure for refueling. This involves a framework of production, purification, compression and storage of this green fuel.

In short, a system that encompasses an autonomous framework for the supply of electricity and hydrogen for electric vehicles.



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Polígono Dominicano, calle A, 1AA

TECHNOLOGY INFORMATION

Maturity level: Available for demonstration

Industrial property rights: Protected by trade secret and/or NDAs.

Type of collaboration offered: Commercial agreement with technical assistance.

APPLICATION SECTORS

- **H2 production:** Electrolysis of water. Electrolyzer + hydrogen purification.
- **H2 storage:** Compressed gas in tanks.
- **Refueling infrastructures:** On-site hydrogen production, compression, storage and dispensing.
- **Transportation:** Heavy-duty vehicle.



Distribution



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

The blender is a system for mixing hydrogen with natural gas, developed from the different projects that Lean Hydrogen has developed for the gas sector.

The blender allows the mixing of hydrogen with natural gas with a degree of homogeneity of 99.9%.

The blender is designed for various pressures and perfectly coupled to regulation and measurement stations or gas-intensive industries that progressively seek to decarbonize their factories.

The blender monitors and regulates the flows of hydrogen and natural gas to guarantee a mixture in the desired percentage. In addition, it analyzes the composition of electrolytic hydrogen to avoid renewable gas quality problems.



leanhydrogen.com



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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 distribution:** *RMS.*
- **Industrial:** *Burners and ovens.*
- **Residential/urban:** *Burners and ovens.*
- **Energetic:** *ICE and turbines.*



Refuelling

TECHNOLOGY DESCRIPTION

The verifier is an HRS testing system that allows monitoring and verifying the operating parameters of the hydrogen service station.

The verifier acts as if it were a car and makes the station believe that there is a car to refuel. Thanks to all the sensors installed in the verifier, it is possible to analyze whether the refueling is correct in terms of pressure, temperature, flow rate, and hydrogen quality.

The tester is portable and movable by van to any service station that requires testing.



leanhydrogen.com



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TECHNOLOGY INFORMATION

Maturity level: *Developed but not marketed.*

Industrial property rights: *Protected by industrial secret.*

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

APPLICATION SECTORS

- Refuelling infrastructures: *Test bench for service station.*



Production



Storage



Distribution



Transport

TECHNOLOGY DESCRIPTION

Development of new materials (catalysts, electrodes, membranes, coatings and micro-organisms).

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, roll-to-roll, 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.

Including design, manufacturing and characterization of the above-mentioned reactors at lab-scale for H₂ production and use or conversion into new fuels/chemicals.



www.leitat.org



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c/ de la Innovació, 2, Terrassa (Barcelona) SPAIN

TECHNOLOGY INFORMATION

Maturity level: Basic research. Lab-proven.

Industrial property rights: Protected by industrial secret .

Type of collaboration offered: Cooperation agreement for R&D. Manufacturing agreement. Service provision agreement. Technical cooperation agreement.

APPLICATION SECTORS

- **H₂ Production:** electrolysis of water (components + electrolyzer), Photoelectrolysis of water (components + electrolyzer), from biomass (components + electrolyzer).
- **H₂ Storage:** LOHCs, MOFs, porous carbons and anticorrosive coatings of pipelines and tanks.
- **H₂ Distribution:** membranes for purification and distribution. Anticorrosive coatings of pipelines and tanks.
- **Transport:** automobile (fuel cell selection advice).



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 two topics: (i) Materials for the photoassisted generation of hydrogen (photoelectrolysers) from water and (ii) Hydrogen storage and/or compression in metallic alloys.

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 40: Hydrogen-based energy conversion and storage).

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.



www.uam.es/Ciencias/L%C3%ADneas-de-Investigaci%C3%B3n/1446790542877.htm?language=es



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TECHNOLOGY INFORMATION

Maturity level: *Basic research.*

Industrial property rights: *Not apply.*

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

APPLICATION SECTORS

- **H2 Production:** *Electrolysis and photoelectrolysis of water, electrode materials*





Storage

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 two topics: (i) Materials for the photoassisted generation of hydrogen (photoelectrolysers) from water and (ii) Hydrogen storage and/or compression in metallic alloys.

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 40: Hydrogen-based energy conversion and storage).

Technologies:

- 1. Materials research for hydrogen compression using metal hydrides.*
- 2. Research on materials for hydrogen storage in metal hydrides.*

The research covers all stages from synthesis by various methods and characterisation of different compounds to prototype fabrication.



www.uam.es/Ciencias/L%C3%ADneas-de-Investigaci%C3%B3n/1446790542877.htm?language=es



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Campus de la Universidad Autónoma, Madrid

TECHNOLOGY INFORMATION

Maturity level: *Basic research*

Industrial property rights: *Not apply*

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

APPLICATION SECTORS

- **H2 Storage:** *Metal hydrides, storage and compression.*



H2 storage in natural gas depleted fields



TECHNOLOGY DESCRIPTION


Petroleum, through the Undergy project, is focused on investigating the feasibility of converting depleted gas fields into green H₂ storages.

To this end, it is focused on a depleted gas field, of which it is the operator. This reservoir has been proved to be an excellent gas natural storage, with several injection and extraction cycles.


The existing information from this gas storage, in addition to the availability of fresh rock samples, will be used in the research. Thus, laboratory tests will be carried out to investigate the possible reactions between the different fluids and with the storage and cover rock as well as geomechanical studies. To carry out these tests, Petroleum is counting on important research organizations and universities, such as IGME, UPM, Univ. of Salamanca and CNH2.


The results of this research will be used to create a 4D simulation model in which the injection and extraction cycles of green H₂ are attempted to be reproduced in accordance with the needs of the system.

The ultimate objective will be trying to scale the results to similar reservoirs to estimate the total storage potential of H₂ in this type of reservoirs in Spanish territory.

 www.naturgy.com / www.undergy.eu

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TECHNOLOGY INFORMATION

Maturity level: *Basic Research*

Industrial property rights: *Not apply*

Type of collaboration offered: *Technical Cooperation Agreement.*

APPLICATION SECTORS

- **H2 Storage:** *Compressed gas in the underground (caverns, porous media, depleted field).*



Transport

TECHNOLOGY DESCRIPTION

Direct Methanol Fuel Cell (DMFC) stack design software. Aero-Marine DMFC Designer® solves the preliminary optimization of the design and dimensioning of DMFC fuel cells, given the nominal power and current of the cell, through a multi-objective function method. The software simultaneously evaluates the mass, volume, and fuel consumption of potential designs and derives the optimal viable fuel cell design based on the weight the designer placed on each factor. This tool provides the complete and functional optimum preliminary design as a solution of a DMFC that satisfies all the requirements of the designer.

Innovative aspects and advantages of the technology:

Aero-Marine DMFC Designer® simplifies the DMFC design process for portable and shipborne applications, providing optimal preliminary designs to work on in successive stages. This tool helps in decision making during the design and development of systems in which DMFC is included, such as airplanes, ships, unmanned aerial vehicles, autonomous underwater vehicles, etc.



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



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Avenida de la Memoria, 4; 28040, Madrid

TECHNOLOGY INFORMATION

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

Industrial property rights: *Copyright registered*

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

APPLICATION SECTORS

- **Transport:** *fuel cell.*
 - *Aviation.*
 - *Marine.*

Development and testing of alternative multi-fuel engines of



Transport

TECHNOLOGY DESCRIPTION

The use of alternative fuels is gaining importance and is forcing to change technologies, or adapt them, and to modify the market. Among the alternative fuels that have appeared the most interest in recent years are bio-alcohols, natural gas and H₂. To use them, it is necessary to design the engine taking into account the fuel to be used, or to redesign existing engines to adapt them to those fuels. The process will always involve the design or redesign of the motor from a thermal and mechanical point of view, and the subsequent testing of these motors and their components. The appropriate technology and facilities are available to proceed both with the design or redesign of reciprocating engines and with their testing.

Innovative aspects and advantages of the technology:

The use of multi-fuel engines, which allow the use of both conventional and alternative fuels, will favor the inclusion of the latter. In the case of H₂, given the limited distribution and refueling network, its introduction on the market through its use in mixtures with other fuels such as natural gas or hydrogen may be important.



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TECHNOLOGY INFORMATION

Maturity level: Available for demonstration / On the market

Industrial property rights: n/a

Type of collaboration offered: Service Agreement / Technical Cooperation Agreement

APPLICATION SECTORS

- **Transport:**
 - Automobile.
 - Heavy vehicle.
 - Railway.
 - Aviation.
 - Maritime.

Comprehensive consulting of fuel cell systems and hydrogen production by electrolysis in the maritime field



Other

TECHNOLOGY DESCRIPTION

PiCoHiMA offers consultancy and technical advice services for the implementation in the maritime field of energy production systems based on fuel cells and hydrogen production based on seawater and methanol electrolysis. These services cover both technical and economic feasibility studies for decision making, which can be complemented with technical advisory work for the execution of implementation projects.

Innovative aspects and advantages of the technology:

Thanks to its investigative nature, PiCoHiMA has an up-to-date vision of advances in power generation systems based on fuel cells and hydrogen. This is combined with the naval and aeronautical engineering base of its members and the ultimate interest in developing both technically and economically viable solutions. The result is studies that allow the recipient to have a reliable vision of the project that it intends to develop and its technical and economic feasibility.



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TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Not applied*

Type of collaboration offered: *Service Agreement / Technical Cooperation Agreement*

APPLICATION SECTORS

- **Other:** *consulting services for the implementation of fuel cell technologies and hydrogen production by electrolysis in the maritime field.*



Production



Transport

TECHNOLOGY DESCRIPTION

The development and manufacture of fuel cells and electrolyzers is a complex and constantly evolving field of technology. The need to reduce the load on the catalysts or increase performance are just two objectives to which research centers and companies in the sector dedicate a large part of their research and development efforts. All these developments need to be tested at different scales, from the laboratory scale of each one of the components to the prototype scale of the final assemblies. These tests require equipment and specialized knowledge to be able to correctly interpret the results and propose improvements if necessary. PiCoHiMA has the necessary equipment and knowledge to carry out these tests.

PiCoHiMA offers a wide range of tests applicable to the development of both fuel cells and electrolyzers as well as their main components (electrodes, membranes and bipolar plates):

- *Polarization curve tests.*
- *Electrochemical characterization tests such as cyclovoltammetry, chronoamperometry or linear sweep voltammetry and impedance frequency response analysis.*
- *Crossover determination.*



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TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Not applied*

Type of collaboration offered: *Service Agreement / Technical Cooperation Agreement*

APPLICATION SECTORS

- **H2 Production:** *electrolyzer.*
 - *Electrolysis of water.*
- **Transport:** *fuel cell.*
 - *Aviation.*
 - *Maritime.*



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 burners from electrolyzer.



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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

High-pressure hydrogen compression with oil-free piston and diaphragm. Technology with more than 100 years of experience (Burton Corblin®). Mehrer® skid mounted or containerized solutions.

Innovative aspects and advantages of the technology: Diaphragm advantages.

- Discharge pressures above 1000 bar.
- Low maintenance due to relatively low operating speed and temperatures.
- Product purity remains unchanged throughout the process.
- High volumetric efficiency. 0% product losses.



www.prematecnica.com / www.howden.com/
www.mehrer.com



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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 underground caverns.
- **H2 distribution:** Maritime distribution (compressed, liquid or transformed gas).
- **Refuelling infrastructures:** Compression.
- **Industrial:** Hydrogen as a raw material.
- **Energetic:** Production and storage of energy coupled to the electricity grid. Injection into the gas grid.

-

Fixed hydrogen detector

PREMATECNICA

Equipos e instalaciones para las industrias de proceso y energía



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.



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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 hydrogen generators 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 solutions for each Application.
- Suitable for low flow rates.
- Variety of materials available.



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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.
-



Storage



Distribution



Refuelling



Energetic

TECHNOLOGY DESCRIPTION

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

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.



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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

- **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
-



Production



Distribution



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

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

MEM's gasQs technology uses microthermal sensors to analyze gas quality. By analyzing the physical properties of the correlation stream, parameters such as hydrogen concentration in natural gas, density, specific heat, Woobe index or methane number, among others, can be determined quickly.



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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: Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass.
 - Area: Process control
- **H2 distribution:** Underground gas pipelines. Pipelines.
- **Transport:** Technologies: Automobile. Heavy vehicle, railway, Aviation, Maritime.
 - Area: Fuel cell
- **Industrial:** Area: Industrial cogeneration systems (GHP). Heat production in thermal power plants.
- **Residential/urban:** Areas: Energy use. Thermal use. Domestic microgeneration (Mchp)
- **Energetic:** Area: Injection into the gas grid.
-



Production



Distribution



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 offers other solutions such as flame detectors.



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TECHNOLOGY INFORMATION

Maturity level: On the market

Industrial property rights: Trademark

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

APPLICATION SECTORS

-

- **H2 Production:** Technologies: Electrolysis of water. SMR (Methane Reform). Methanol reforming. Biomass.
 - Area: Auxiliary elements.
- **H2 distribution:** Area: Underground gas pipelines. Maritime distribution (compressed, liquid or transformed gas)
- **Other:** Safety systems. Hydrogen flares.



Production



Storage



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

Improved catalytic processes for the production of blue hydrogen by reforming with CO₂ and H₂O.

Decarbonization and Mobility: generation and co-injection of H₂ in thermal engines, purification and mixing of streams containing hydrogen.

Advanced Catalytic Gasification for the production of streams enriched in H₂.

Catalytic processes for the production of ecofuels and chemicals.

Development of hybrid energy systems and chemical storage of Hydrogen



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36.71610385153564, -4.472857500327728

TECHNOLOGY INFORMATION

Maturity level:

- Basic research
- Lab-proven
- Developed but not marketed

Industrial property rights: *Not applied*

Type of collaboration offered:

- Cooperation agreement for R&D.
- Trade agreement with technical assistance.
- Technical Cooperation Agreement.

APPLICATION SECTORS

H2 Production: *Units and Simulation, Reformers, Biomass Conversion and advanced systems for CO₂-steam reforming.*

H2 storage: *Systems for chemical storage and transport of H₂.*

H2 distribution: *mixtures and pipes.*

Transportation: *Automobile.*

Industrial: *H₂-green as raw material.*

Residential/urban: *Microgeneration and storage from renewables.*

Energy: *Production and storage of energy coupled to the electricity grid. - Injection into the gas network.*

Graphite Bipolar Plates for Fuel Cells



Storage



Refuelling



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

Our graphite bipolar plates for fuel cells are being manufactured especially for the Proton Exchange Membrane Fuel Cell; and Direct Methanol Fuel Cell types.

Through many years of development work, we have succeeded in transforming the outstanding material properties of our materials into cost-effective production for high volumes.

Our compression molded bipolar plates with integrated flow field are first choice for use in mobile and stationary applications, wherever extreme durability, reliability, high cycle stability and power density are required. In addition, our bipolar plates are used in redox flow batteries made by leading manufacturers. We are available as a development partner from the prototype stage to large volume series production. Features:

- *Excellent corrosion resistance*
- *High electrical conductivity*
- *Very good mechanical strength*
- *Customer-specific compound formulations on request*
- *Own tool design and own toolmaking shop*
- *Prototypes made according to customer requirements from blanks, milled or compression-molded*
- *Standard plates for fast material qualification - Complete value creation at Schunk from the raw material to the finished product.*



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C/ Horcajo, 6 - PI Las Arenas - Pinto (Madrid)

TECHNOLOGY INFORMATION

Maturity level: *On the market.*

Industrial property rights: *Protected by industrial secret.*

Type of collaboration offered:

- *Manufacturing agreement.*
- *Trade agreement with technical assistance.*
- *Service provision agreement.*
- *Technical Cooperation Agreement.*

APPLICATION SECTORS

- **H2 Production.**
- **H2 Storage.**
- **Refuelling infrastructures.**
- **Industrial.**
- **Residential/urban.**
- **Energetic.**



Refuelling



Transport

TECHNOLOGY DESCRIPTION

H2fM Mobile Refueller: A simple solution for hydrogen vehicle demonstrations.

Our mobile dispenser allows flexible, emission-free refueling of vehicles with minimal installation.

-We can supply hydrogen for small fleet refueling or test demonstrations.

This portable, low-cost technology can be easily installed and adapted to the needs of your location.

-Fully automatic refueling.

-Remote monitoring of the H₂ source so Carbueros Metalicos can offer you 24/7 assistance.

-H₂ capacity: Up to 600 kg for refueling.

-Pressure of the dispensers: Up to 350 bar.



www.carbueros.com



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Avd. de la Fama, 1 - Cornellà de Llobregat (Barcelona)

TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Patented*

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

APPLICATION SECTORS

Refuelling infrastructures.



Production



Storage



Refuelling



Energetic



Other

TECHNOLOGY DESCRIPTION

SHP is a digital solution based on data analytics and algorithms that helps in the strategic decision making during the planification and design phase of a H2 facility.

SHP can be applied to multiple use cases: new / existing power plant (wind farm, solar PV...) to be hybridized with an electrolyzer, Hydrogen Refuelling Station (HRS) (either with onsite / offsite H2 production).

SHP is commercialized as a consulting service. Customer specifies needs and requirements to develop the use case.

SHP methodology consists of:

- *Inputs gathering: H2 delivery requirements (final use, purity, quantity, pressure, frequency...), brownfield / greenfield, power plant specs, grid evacuating limit, markets selection for trading the surplus electricity...*
- *Algorithms, boundary conditions: models of energetic / economic / degradation processes, sensitivity analyses, project lifetime...*
- *Results: optimal sizing of assets (electrolyzer, compressor, storage), operational strategy depending on technical parameters (generation availability, electrolyzer operating curves) and economic parameters (H2 selling price - LCOH vs electricity market prices), right time to invest, profitability threshold, lifetime economic analysis*



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TECHNOLOGY INFORMATION

Maturity level:

On the market

Industrial property rights:

Trademark

Type of collaboration offered:

Service provision agreement

APPLICATION SECTORS

- **H2 Production:** *electrolysis, components and facility sizing*
- **H2 Storage:** *compressed gas in tanks*
- **Refueling infrastructures:** *in situ hydrogen production, compression, storage, dispense*
- **Energetic:** *production and storage of energy coupled to the electricity grid*
- **Other:** *feasibility analyses, economic analyses, planification, operating strategies, strategic decision making*



Production



Storage



Refuelling



Energetic



Other

TECHNOLOGY DESCRIPTION

Tecnatom is proprietary of a suite of simulation tools (TEAM_SUITE) that generates a code from a graphic friendly interface to make simulators of multiple energy facilities adapted to each customer requirements.

Tecnatom has developed simulators in the energy sector for multiple technologies: nuclear, thermosolar, thermal... and now we are focusing on the H2 sector.

One of the applications that could be highly benefited by applying simulation technologies is the Hydrogen Refuelling Station (HRS) one. A HRS simulator allows to interrelate its multiple processes, to comply with the refuelling protocol requirements maintaining a reasonable safety margin, to maximize the incomes, to optimize the HRS operation depending on different demand patterns and what-if scenarios...

Tecnatom's simulators are subject to a strict configuration and version control process as well as a strict internal verification and validation process, in accordance with the standards of each sector (including the nuclear ones with a high level of exigency).



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TECHNOLOGY INFORMATION

Maturity level:

Basic reasearch

Industrial property rights:

Copyright registered

Type of collaboration offered:

- *Trade agreement with technical assistance.*
- *Service provision agreement.*
- *Technical Cooperation Agreement.*

APPLICATION SECTORS

- **H2 Production:** *electrolysis, components sizing, simulation.*
- **H2 Storage:** *compressed gas in tanks.*
- **Refueling infrastructures:** *In situ hydrogen production, Compression, Storage, Dispense.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid.*
- **Other:** *replica simulator, operating strategies, what-if scenarios, safety analyses, training.*

TECHNOLOGY DESCRIPTION

Comprehensive course (40h) about the H2 value chain available on Tecnatom's e-Learning platform SOUL energy.

Training is focused on B2B y B2C clients, either professional or non-professional, enabling their self-training with periodic tests to check their advances without disregarding their routine work tasks.

Alumni obtain a diploma once they finish and pass the tests.

Course topics cover all the H2 application sectors, with a special focus on safety

- *H2 properties and their relationship with safety.*
- *H2 impact on materials, inspection and characterization techniques.*
- *H2 production methods, low and high temperature electrolysis, BOP and auxiliary systems.*
- *H2 storage: physical chemical and Power-to-X.*
- *H2 transport and distribution, blending.*
- *H2 final uses, H2 refueling stations (HRS), Fuel Cells (FC)*
- *Regulation and technical comitees.*

<https://learningwithsoul.com/es/stor e/programs/energy/programa-de-cadena-de-valor-del-hidrogeno-verde-1>



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TECHNOLOGY INFORMATION

Maturity level:

On the market

Industrial property rights:

Trademark

Type of collaboration offered:

Service provision agreement

APPLICATION SECTORS

- **Other:** *training about the H2 value chain, safety.*

Inspection technique: Time of Flight Diffraction (ToFD)



Storage



Distribution



Refuelling



Other

TECHNOLOGY DESCRIPTION

ToFD allows detecting smaller defects than other techniques with just one scanning.

ToFD can be used in multiple applications but it is especially suitable for hydrogen storage and transport / distribution infrastructures made of steel.

ToFD combines hardness and metallography analyses to detect micro cavities due to the interaction of hydrogen with steels.



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TECHNOLOGY INFORMATION

Maturity level:

On the market

Industrial property rights:

Protected by industrial secret

Type of collaboration offered:

Service provision agreement

APPLICATION SECTORS

- **H2 Storage:** *Compressed gas in tanks.*
- **H2 Distribution:** *Pipelines.*
- **Refueling infrastructures:** *Storage.*
- **Other:** *Inspection, Materials.*

Hydrogen reforming technologies



Production



Transport



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

*Hydrogen reformers:
Generation of low carbon footprint hydrogen from biofuels (bioethanol, biogas) and fossil fuels coupled with CO2 capture technologies.
Scales from g/h to ton/h.*

Proprietary technology in compact and highly efficient reformers, with the possibility of on-board production. Large-scale hydrogen production, under license from other technologists, for large industrial plants.

Experience in integration of hydrogen generation plants with a PEM fuel cell. BoP design of the fuel cell and test bench for cells up to 25kW.



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TECHNOLOGY INFORMATION

Maturity level:

Compact reformers: TRL 9

Industrial reformers: TRL 9

Industrial property rights: *Trade secret*

Type of collaboration offered:

EPC, turnkey supply of "Ad Hoc" H2 reformers.

APPLICATION SECTORS

- **H2 Production.**
- **Transport.**
- **Industrial.**
- **Energetic.**



Production



Transport



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Systems for syngas purification:

- *PrOx: Preferential oxidation with O₂*
- *WGS*
- *SEWGS*
- *Methanation*
- *Washing/Absorption towers*
- *PSA*

TR can design and build tailor-made syngas purification systems, depending on the client's needs, eliminating one or several gases or pollutants, depending on the target application.

Proprietary technology for small-scale and compact distributed generation plants, or licensed by other technologists, for large industrial plants.



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TECHNOLOGY INFORMATION

Maturity level: *TRL 8-9*

Industrial property rights: *Trade secret*

Type of collaboration offered:

EPC, turnkey supply of "Ad Hoc" H₂ reformers.

APPLICATION SECTORS

- **H₂ Production.**
- **Transport.**
- **Industrial.**
- **Energetic.**

Hydrogen Refueling Stations (HRSs)



Production



Refuelling



Transport



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Hydrogen compression, storage and dispensing facilities (Hydrogen Refueling Stations, HRSs).

Basic and detailed engineering, procurement and construction capabilities.

Ability to carry out safety and integration studies between the hydrogen plant and other units (hydrogen production unit, upstream, or units where hydrogen is used, downstream).



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TECHNOLOGY INFORMATION

Maturity level: TRL 8-9

Industrial property rights: Trade secret

Type of collaboration offered:

Conceptual engineering, basic engineering, EPC (turnkey supply), feasibility studies.

APPLICATION SECTORS

- **H2 production.**
- **Refuelling.**
- **Transport.**
- **Industrial.**
- **Energetic.**



Production



Transport



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Renewable hydrogen production facilities, in an "EPC" type contract (Engineering, Procurement and Construction), integrating technologies and third party equipment.

Técnicas Reunidas is a supplier of renewable hydrogen production plants, from a few kg/h to tons/h, for industrial and transport uses.

Técnicas Reunidas is the supplier of the plant, assuming all the guarantees, carrying out all the safety studies and the upstream and downstream integration.

Possibility of supplying own technology in high-efficiency pressurized alkaline electrolysers up to 1 MW, for specific applications.



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Av.De Burgos 89 – Adequa 5, 3rd floor, 28050, Madrid

TECHNOLOGY INFORMATION

Maturity level: TRL 8-9

Industrial property rights: Trade secret

Type of collaboration offered:

Conceptual engineering, basic engineering, EPC (turnkey supply), feasibility studies.

APPLICATION SECTORS

- H2 Production.
- Transport.
- Industrial.
- Energetic.



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Technology for metallic iron (DRI) production from iron oxides, by reducing them using syngas or hydrogen.

With this type of plant steel production with a low CO2 footprint is possible, an alternative to the blast furnace route.

TR has experience in other uses of hydrogen in the steel sector, as well as for thermal uses or in other processes.



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TECHNOLOGY INFORMATION

Maturity level:

TRL 6-7 – DEMO plant in an industrial environment

TRL 9 – Thermal uses

Industrial property rights: *Trade secret*

Type of collaboration offered:

Demo in industrial environment

APPLICATION SECTORS

- Industrial.
- Energetic.



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

TR has experience in industrial plants for the use of hydrogen for the chemical, petrochemical, refining, ammonia and fertilizers plants, among others.

In particular, TR is a reference in hydrotreatment plants (hydrodesulfurization, hydrocracking) in the refining sector, where hydrogen is used to improve the quality of hydrocarbons through the reaction with hydrogen.

TR has experience with the world's largest licensors and clients.



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Av.De Burgos 89 – Adequa 5, 3rd floor, 28050, Madrid

TECHNOLOGY INFORMATION

Maturity level:

Mature technology: TRL 8-9

Industrial property rights: *Trade secret*

Type of collaboration offered:

Conceptual engineering, basic engineering, EPC (turnkey supply), feasibility studies.

APPLICATION SECTORS

- Industrial.
- Energetic.



Production



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Processes that permit the use of hydrogen, including hydrogen from renewable sources, to manufacture products with a high added value, such as methanol, ammonia, or liquid organic hydrogen carriers (LOHC).

Técnicas Reunidas can design and build plants that produce chemical compounds from hydrogen with a low carbon footprint.

TR has extensive experience in the production of ammonia and methanol from conventional fuels. Ongoing projects include the production of "green ammonia" and "green methanol", with the same quality as its "grey" equivalent, but with a low carbon footprint. Hydrogen is produced from electrolysis (powered by renewable energy) or from biomass.

Técnicas Reunidas is collaborating with renowned licensors and technologists for the design and supply of these plants.



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TECHNOLOGY INFORMATION

Maturity level:

Mature technology: TRL 8-9

Industrial property rights: *Trade secret*

Type of collaboration offered:

Conceptual engineering, basic engineering, EPC (turnkey supply), feasibility studies.

APPLICATION SECTORS

- **H2 production.**
- **Industrial.**
- **Energetic.**

Green hydrogen production by electrolysis



Production



Industrial



Energetic



Other

TECHNOLOGY DESCRIPTION

Green hydrogen production by electrolysis: Técnicas Reunidas participates in the design and construction of electrolysis systems of both high temperature (SOEC) and low temperature (AEM) using modelling tools and advanced engineering design and scale-up know how.

TR has extensive experience in the fields of design and construction of pilot plants including electrochemical reactors such as fuel cells, flow batteries, hydrometallurgy applications, water electrolyzers and electrochemical conversion, along with their balance of plant.

TR collaborates with other tier one companies, public research organizations and research centers to co-develop these technologies.



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TECHNOLOGY INFORMATION

Maturity level: *Lab-proven, Developed but not marketed, Available for demonstration.*

Industrial property rights:

Patented, 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 (Components, Auxiliary elements, Process Control, Full floor).*
- **Industrial:** *Green hydrogen as a raw material.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid.*

Development of electrolyzer prototypes, testing and validation in test bench



Production



Refuelling



Industrial



Energetic

TECHNOLOGY DESCRIPTION

Testing and evaluation of components for alkaline, PEM and AEM electrolyzers.

Cells and stack design for alkaline, PEM and AEM electrolyzers.

Conceptual and detailed engineering design, balance of plants for the different types of electrolyzers.

Degradation evaluation and testing of prototypes.



Consultancy and partnership for electrolyzer manufacturers.

Consultancy for electrolyzer end-users by evaluation and comparison of commercial systems.



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TECHNOLOGY INFORMATION

Maturity level: *Developed but not marketed*

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.*
- **Refuelling infrastructures:** *In situ hydrogen production.*
- **Industrial:** *In situ hydrogen production.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid.*

Protective coatings for bipolar plates and porous transport layers for PEM electrolyzers and fuel cells.



Production



Refuelling



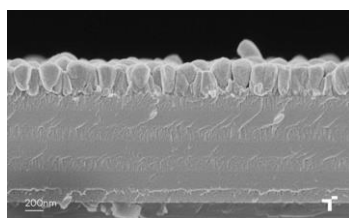
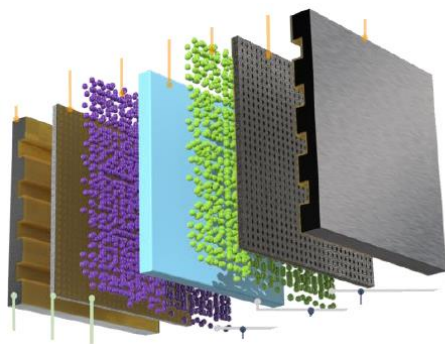
Industrial



Energetic

TECHNOLOGY DESCRIPTION

Protective coatings for bipolar plates and porous transport layers based on stain steel and metallic alloys deposited by magnetron sputtering and by HiPIMS (High Power Impulse Magnetron Sputtering) with high corrosion resistance and high electrical conductivity. These coatings are based on multilayers structures of conductive oxides and carbon base layers.



Development of innovative bipolar plates and porous transport layers as components for PEM water electrolyzer and fuel cells based on stain steel with reduction of the manufacturing cost by reducing the uses of titanium.



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TECHNOLOGY INFORMATION

Maturity level: *Developed but not marketed*

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.*
- **Refuelling infrastructures:** *In situ hydrogen production.*
- **Industrial:** *In situ hydrogen production.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid.*

Energy management system for renewable hybrid plants with storage and production of hydrogen by electrolysis.



Production



Storage



Refuelling



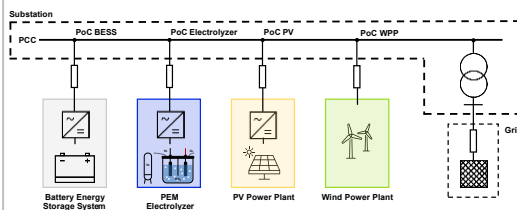
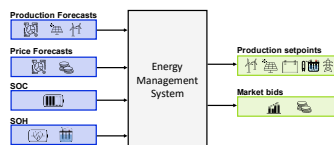
Industrial



Energetic

TECHNOLOGY DESCRIPTION

The energy management systems allows to determine production parameters based on production prediction and market prices. It uses optimization methods based on heuristic algorithms. The performed optimization is multi objective maximizing economic benefits of the production plant and minimising degradation of the storage systems and electrolyzers. It can be used for operation purpose and for plant design.



It optimises the operation of hybrid plants combining electricity production, storage and Hydrogen production. It can manage different electricity production technologies and different storage technologies.



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TECHNOLOGY INFORMATION

Maturity level: *Developed but not marketed*

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.*
- **Storage:** *Compressed gas in tanks.*
- **Refuelling infrastructures:** *In situ hydrogen production.*
- **Industrial:** *In situ hydrogen production.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid.*



Production



Energetic



Other

TECHNOLOGY DESCRIPTION

Energy storage in molten salts by electrical heating.

Applicable to Renewable Power to Hydrogen projects that require high temperature for its process.

Special application to

- *PV-H2 projects with SOEC electrolysis*
- *PV-CSP-H2 projects*
- *PV-CSP-H2-CO2-e-fuels projects.*



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TECHNOLOGY INFORMATION

Maturity level: *Available for demonstration*

Industrial property rights: *Patented*

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

APPLICATION SECTORS

- **H2 Production:** *Electrolysis of water auxiliary elements.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid.*
- **Other:** *CO2 recovery and e-fuels synthesis.*



Production



Energetic

TECHNOLOGY DESCRIPTION

Electrical energy is stored in form of liquid air.

When power is needed, it expands the liquid air into an inert gas which can produce hours, days, or weeks of constant green energy.

This state-of-the-art cryogenic technology is protected and has been developed over the last fifteen years and is ready to be deployed at grid-scale today.

Applicable to Renewable Power to Hydrogen projects that require clean energy storage alternative to classical batteries.



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TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Patented*

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

APPLICATION SECTORS

- **H2 Production:** *Electrolysis of water auxiliary elements.*
- **Energetic:** *Production and storage of energy coupled to the electricity grid.*

Sustainable hydrogen storage by electrochemical technologies



Production



Transport



Industrial



Residential
Urban



Energetic

TECHNOLOGY DESCRIPTION

E3L-TEQUIMA (Environmental and Electrochemical Engineering Lab-Chemical and Environmental Technology Research Group).

*PEM electrolyzers
Westinghouse thermo-
electrochemical Process for
hydrogen production.*

*EDEN® Process for Energy storage
based on chlor-alkali
electrochemistry and carbon dioxide
fixation.*

High temperature PEM Fuel cells.

*Coupling solar photovoltaic and
wind turbine with electrolysis.*

*Life cycle assessment in
Electrochemical systems.*

*Development of cells and
components (catalyst, membranes).*

Bioelectrochemical devices.



<https://diq.uclm.es/tequima-laboratorio-de-ingenieria-electroquimica-y-ambiental/>



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TECHNOLOGY INFORMATION

Maturity level:

Lab-proven. TRL 3 – 5.

Industrial property rights:

EDEN ® Process.

Type of collaboration offered:

Consultancy, experimental development and partnership in national and international projects.

APPLICATION SECTORS

- **H2 Production.**
- **Transport.**
- **Industrial.**
- **Residential/urban.**
- **Energetic.**



Production

TECHNOLOGY DESCRIPTION

Catalysis and materials laboratory of the Chemical and Environmental Technology Group, TEQUIMA.

Development of sustainable hydrogen production processes through catalytic and electrocatalytic techniques:

- *Catalytic decomposition of ammonia. Use of ammonia as a hydrogen carrier molecule to contribute to the decarbonisation of the energy system.*
- *Electrolysis of water, bioalcohols and liquid biomass for the production of green hydrogen with renewable energy.*
- *Valorization of biomass using thermochemical techniques: gasification, pyrolysis and production of adsorbents of interest.*
- *Preparation of novel catalysts (aerogels, graphenes, carbon nanostructures...).*



<https://diq.uclm.es/tequima-laboratorio-de-catalisis-y-materiales/>



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TECHNOLOGY INFORMATION

Maturity level:

Basic research. TRL: 2 - 4.

Type of collaboration offered:

Consultancy, experimental development and partnership in national and international projects.

APPLICATION SECTORS

- H2 Production.



Production



Storage



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

"Materials for Energy and 3D Printing Laboratory" Research Group.

Additive Manufacturing for the development of fuel cell/electrolyser components and complementary technologies: we have patented a procedure for the production of filaments loaded with any ceramic and/or metal.

Additive manufacturing allows the generation of non-conventional geometries that may lead to devices exhibiting higher volumetric energy density.

Our group has been actively working in fuel cell and hydrogen technologies for over 20 years and therefore, we have specialised in applying additive manufacturing technologies to this research field.



<https://www.uclm.es/centros-investigacion/ier/pilas>



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TECHNOLOGY INFORMATION

Maturity level:

Available for demonstration.

Industrial property rights:

Patented.

Type of collaboration offered:

Cooperation R&D agreement, Manufacturing agreement, Service provision agreement.

APPLICATION SECTORS

- H2 Production.
- H2 Storage.
- Industrial.
- Residential/urban.
- Energetic.
- Other.



Production



Storage



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

"Materials for Energy and 3D Printing Laboratory" Research Group.

Our research group offers specialist skills in high temperature technologies based on solid oxide cells with over 20 years of experience.

- Synthesis and characterisation of SOC components (electrodes, electrolytes, interconnectors).
- Testing of single cells and small stacks (up to 50 W).
- Processing of components, including additive manufacturing.



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TECHNOLOGY INFORMATION

Maturity level:

Lab demonstrators. In the case of stack development, pre-commercial stage.

Type of collaboration offered:

Cooperation R&D agreement, Manufacturing agreement, Service provision agreement.

APPLICATION SECTORS

- H2 Production.
- H2 Storage.
- Industrial.
- Residential/urban.
- Energetic.
- Other.



Production



Storage



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

"Materials for Energy and 3D Printing Laboratory" Research Group.

Our research group has been working in the development of components and PEM systems, even for industrial applications

- Development and characterisation of PEM components (electrocatalysts, GDLs, membranas, etc).
- Cell and stack testing (up to 50 W).
- Stack development (up to 5 kW).
- Integration of battery-fuel cell stack hybrid systems.



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TECHNOLOGY INFORMATION

Maturity level:

Lab demonstrators. In the case of stack development, pre-commercial stage.

Type of collaboration offered:

Cooperation R&D agreement, Manufacturing agreement, Service provision agreement.

APPLICATION SECTORS

- H2 Production.
- H2 Storage.
- Industrial.
- Residential/urban.
- Energetic.
- Other.

Integration RES-H2



Production



Storage



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

"Materials for Energy and 3D Printing Laboratory" Research Group.

Experience in coupling hydrogen production and storage systems with RES and further use in fuel cells

- Integration RES-electrolyzer.
- H2 storage via metal hydrides.
- Battery-Fuel cell hybrid systems to power small to medium applications (50W-1,5 kW).



<https://www.uclm.es/centros-investigacion/ier/pilas>



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TECHNOLOGY INFORMATION

Maturity level:

Lab demonstrators.

Type of collaboration offered:

Cooperation R&D agreement, Manufacturing agreement, Service provision agreement.

APPLICATION SECTORS

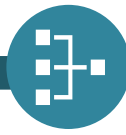
- H2 Production.
- H2 Storage.
- Industrial.
- Residential/urban.
- Energetic.
- Other.



Production



Storage



Distribution



Residential Urban

TECHNOLOGY DESCRIPTION

Advanced manufacturing:

The implementation of 3D printing technologies by filament or molten pellets has advantages in the development of SOFC and SOEC systems: (i) use of low-cost, simple and accessible printers, (ii) greater geometric complexity for better sealing and increased durability; (iii) implementation of porosity patterns and (iv) industrial implementation through another mature advanced technology, Powder Injection Molding (PIM), in which the group has a track record of almost 20 years.

Possibility of producing complex metallic or ceramic parts by printing or injection with improved properties, also applicable to H₂ storage and distribution sectors.



<http://uclm-pim.com>; <https://blesoltech.com>



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TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Protected by industrial secret and spin off for industrial exploitation*

Type of collaboration offered:

- Cooperation agreement for R&D
- Manufacturing agreement
- Trade agreement with technical assistance

APPLICATION SECTORS

- **H₂ Production:** *Electrolysis of water (components of high T electrolyzer).*
- **H₂ Storage:** *Compressed gas in tanks.*
- **H₂ distribution:** *Pipelines.*
- **Residential/urban:** *Domestic microgeneration mCHP.*



Production



Storage



Distribution



Residential Urban

TECHNOLOGY DESCRIPTION

Characterization and analysis:

Capacity of analyzing in-service failure due to different phenomena during system operation (H₂ embrittlement of metals, behavior under oxidizing atmospheres, mechanical properties at different T, microstructural analysis...).



<http://uclm-pim.com>; <https://blesoltech.com>



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TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Not applied*

Type of collaboration offered:

- *Cooperation agreement for R&D*
- *Manufacturing agreement*
- *Trade agreement with technical assistance*

APPLICATION SECTORS

- **H₂ Production:** *Electrolysis of water (components of high T electrolyzer).*
- **H₂ Storage:** *Compressed gas in tanks.*
- **H₂ distribution:** *Pipelines.*
- **Residential/urban:** *Domestic microgeneration mCHP.*



Production



Storage



Distribution



Residential Urban

TECHNOLOGY DESCRIPTION

Design of tailored materials:

Experience in the adjustment of metal alloy elements through advanced powder metallurgy technology to modify their behavior and generate microstructures with improved properties, possibility of using bimetals and generating synergies through metal alloys design.



<http://uclm-pim.com>; <https://blesoltech.com>



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TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Protected by industrial secret and spin off for industrial exploitation*

Type of collaboration offered:

- *Cooperation agreement for R&D*
- *Manufacturing agreement*
- *Trade agreement with technical assistance*

APPLICATION SECTORS

- **H2 Production:** *Electrolysis of water (components of high T electrolyzer).*
- **H2 Storage:** *Compressed gas in tanks.*
- **H2 distribution:** *Pipelines.*
- **Residential/urban:** *Domestic microgeneration mCHP.*



Production



Industrial

TECHNOLOGY DESCRIPTION

Analysis of H2 production processes (modelling, parametrization, simulation, optimization, etc.)



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TECHNOLOGY INFORMATION

Maturity level:

Developed but not marketed.

Type of collaboration offered:

Cooperation agreement for R&D.

APPLICATION SECTORS

- **H2 Production.**
- **Industrial.**



Industrial

TECHNOLOGY DESCRIPTION

Digital Twins (AI)



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TECHNOLOGY INFORMATION

Maturity level:

Developed but not marketed.

Type of collaboration offered:

Cooperation agreement for R&D.

APPLICATION SECTORS

- **Industrial.**



Production



Storage



Distribution



Refuelling



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

Business models and cost evaluation (CAPEX and OPEX) and their impact on the final price of H₂.



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Ada. Camilo José Cela, Campus Univ, Ciudad Real

TECHNOLOGY INFORMATION

Maturity level:

Developed but not marketed.

Type of collaboration offered:

Cooperation agreement for R&D.

APPLICATION SECTORS

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



Production



Storage

TECHNOLOGY DESCRIPTION

Describe your technology here (title, description, innovative aspects, advantages,...).

Liquid Hydrogen Carriers (LOHCs)

Carriers selection, estimating the key properties by experimental methods or using molecular simulation packages. Key interest into identifying industrial by products (carbochemical, biomass processing) useful for this purpose.

Determination of optimum catalysts and operation conditions for the hydrogenation and dehydrogenation reactions. Kinetics and deactivation studies.

Design and simulation of reactors and auxiliary operations for both steps.

Reforming reactions

Design of reactors for reforming reactions (both methane and other renewable organic compounds). Development of new reactor configurations (hybrid reactor-membrane and reactor-adsorption processes)

Photocatalysis

Development of photocatalysts for hydrogen generation reactions.



<https://crc.grupos.uniovi.es/en/investigacion/lineas>



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43.35565379277266, -5.869750973568759

TECHNOLOGY INFORMATION

Maturity level: *Basic research*

Industrial property rights: *Not applied*

Type of collaboration offered:

- *Cooperation agreement for R&D*
- *Service provision agreement*
- *Technical cooperation agreement*

APPLICATION SECTORS

- **H2 Production:** *SMR, methanol reforming and biomass.*
- **H2 Storage:** *hydrogen carriers .*



Storage



Distribution



Other

TECHNOLOGY DESCRIPTION

This 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.



<https://www.ehu.es/es/web/supren>



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Escuela de Ing. Bilbao- Pl. Ing.Torres Quevedo 1

TECHNOLOGY INFORMATION

Maturity level: TRL4

Industrial property rights: Own tech.

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 Storage:** by organic carriers.
- **H₂ distribution:** by organic carriers.
- **Other:** H₂ valorization to generate methanol, methane and other high value compounds.

Hydrogen Production Technology



Production



Storage



Refuelling



Transport



Industrial



Residential
Urban



Energetic



Other

TECHNOLOGY DESCRIPTION

We have patented two processes and systems, for the generation of hydrogen and the total recycling of its by-products in the plants themselves.

H2umidity® produces green hydrogen in almost any circumstance, even in environments and processes where water is not available.

EcOsmosisH2® produces green hydrogen in environments with available water that must be previously treated, using a 100% chemical-free osmosis process, so there are no discharges or dangerous rejections for the environment.



www.water2kw.com



911126707



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Avenida de Brasil, 6, 28020 Madrid Spain

TECHNOLOGY INFORMATION

Maturity level: TRL 6 /7

Industrial property rights: PCT International Patent (proprietary technology).

Type of collaboration offered: We offer technical and technological collaboration for green hydrogen generation projects. Mainly those where the environmental protection factor and the surrounding circumstances make the generation and use of hydrogen difficult.

APPLICATION SECTORS

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

Planning and execution of hydrogen production facilities projects.



Production



Storage



Refuelling



Industrial



Other

TECHNOLOGY DESCRIPTION

Planning and execution of projects for hydrogen production facilities, generated from renewable energies. Including generation, storage and subsequent use as a sustainable fuel.

Services:

- *Advice and consultancy for the implementation of hydrogen generation facilities from renewable sources.*
- *Preliminary study and engineering of H2 storage systems.*
- *Detailed engineering of H2 storage facilities.*
- *Technical, Administrative, Legal and Economic Due Diligence of green hydrogen projects.*
- *Supervision during the construction, operation and maintenance phases of facilities.*
- *Analysis of monitoring data of Energy Storage Facilities.*
- *Definition of strategies for singular and research and development projects that incorporate hydrogen as an energy vector.*



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TECHNOLOGY INFORMATION

Maturity level: *On the market*

Industrial property rights: *Not applied*

Type of collaboration offered: *Service provision agreement.*

APPLICATION SECTORS

H2 Production: *Electrolysis of water (Full floor).*

H2 Storage: *Compressed gas in tanks.*

Refuelling infrastructures: *In situ hydrogen production.*

Industrial: *Green hydrogen as a raw material.*



SPANISH HYDROGEN AND FUEL CELL TECHNOLOGY PLATFORM

TECHNOLOGICAL CAPABILITIES CATALOGUE
MAY 2022