Catalog of Technological Capabilities 2024



H2ENRY

Red Cervera



PRODUCTION



STORAGE



DISTRIBUTION



REFUELING



TRANSPORT



INDUSTRY



URBAN/RESIDENTIAL



ENERGY



OTHERS

This catalog showcases the advanced technological services offered by each partner of the H2ENRY program, associated with the Cervera Priority Technology (TC) for Energy Transition: TC10 – Renewable Hydrogen (H2) Technologies. This initiative aims to promote the development of disruptive technologies in the areas of generation, purification, storage, and transportation of renewable hydrogen, with the objective of facilitating the decarbonization of the Spanish economy.

Each service description includes a detailed explanation of the technological service, its main data, and application sectors. Additionally, each technological service is linked to the entity offering it, along with its contact information.

The technological services are grouped by themes, comprising a total of 27 service descriptions listed below:

TECHNOLOGIES FOR RENEWABLE HYDROGEN PRODUCTION 5

DEVELOPMENT AND TESTING OF CELLS FOR SOLID OXIDE ELECTROLYSIS 6
UTILITY MODEL: 3D BIPOLAR PLATE ADDITIVE MANUFACTURING 8
EXPERIMENTATION ON ELECTROCHEMICAL SYSTEMS BASED ON HYDROGEN 10
DEVELOPMENT OF COMPONENTS AND SYSTEMS FOR WATER ELECTROLYSIS 11
SYNTHESIS AND CHARACTERIZATION OF CATALYSTS, MEMBRANES, AND ELECTRODES FOR HYDROGEN PRODUCTION 12
ELECTROCHEMICAL TESTS OF MATERIALS, COMPONENTS, CELLS, AND STACKS OF ELECTROLYZER AND FUEL CELL 14
DEVELOPMENT OF HYDROGEN TECHNOLOGY COMPONENTS 16
TESTING OF HYDROGEN TECHNOLOGIES 17
PHOTOELECTROCHEMICAL TESTS OF MATERIALS, COMPONENTS, CELLS, AND PEC REACTORS 18
ELECTROCHEMICAL TESTS OF MATERIALS, COMPONENTS, CELLS, AND STACKS OF ELECTROLYZERS AND FUEL CELLS 20
DEVELOPMENT OF CATALYSTS AND ELECTRODES FOR HYDROGEN PRODUCTION 22
BIOELECTROCHEMICAL SYSTEMS FOR HYDROGEN PRODUCTION FROM WASTEWATER 23
PHOTOELECTROCHEMICAL SYSTEMS FOR RENEWABLE H_2 PRODUCTION 25
PHYSICOCHEMICAL CHARACTERIZATION OF SUBSTRATES, H_2 POTENTIAL (BHP), AND OPTIMIZATION OF BIO-H_2 PRODUCTION PROCESS PARAMETERS 27
HYDROGEN PRODUCTION VIA BIOMASS/WASTE GASIFICATION 29

TECHNOLOGIES FOR TRANSPORT, STORAGE, AND DISTRIBUTION OF RENEWABLE H2 31

MICROGRID TEST BENCH FOR RENEWABLE ENERGY INTEGRATION WITH BATTERY AND H2 STORAGE 32
DESIGN, DEVELOPMENT, AND MANUFACTURING OF H_2 GENERATION SYSTEMS USING REFORMING TECHNOLOGIES FOR RENEWABLE SUBSTANCES 34
DETERMINATION OF HYDROGEN PERMEABILITY IN PIPES 36
GAS SEPARATION SYSTEM: EVALUATION OF POLYMERIC MEMBRANES 38

CROSS-FUNCTIONAL TECHNOLOGICAL SERVICES 39

COMPUTATIONAL FLUID DYNAMICS (CFD) MODELING/SIMULATION SERVICE 40
ANALYSIS AND CONSULTANCY ON HYDROGEN GENERATION FACILITIES 41
LIFE CYCLE ANALYSIS OF HYDROGEN PRODUCTION, STORAGE, DISTRIBUTION, AND USE PROCESSES 42
TRAINING COURSES: HYDROGEN PRODUCTION AND USES DARK FERMENTATION SEMINAR 43
TAILORED AND SPECIALIZED TRAINING IN HYDROGEN TECHNOLOGIES 44
SIZING AND INTEGRATION OF HYDROGEN TECHNOLOGIES IN RELEVANT ENVIRONMENTS 45
SIMULATION, ENERGY MANAGEMENT, AND OPTIMIZATION OF HYDROGEN TECHNOLOGIES 46
H2ENRY TRAINING COURSES 47

Technologies for Renewable Hydrogen Production



Description of the service and/or technology

Development of materials and electrochemical cells for reversible SOEC/SOFC electrolysis, both through conventional techniques and the fabrication of perovskite-type materials via mechanochemistry, as well as through novel techniques such as glancing/oblique angle magnetron sputtering.

It is possible to manufacture thin, nano-structured films with unique characteristics that are not achievable by most conventional techniques, particularly in terms of micro and mesopore density, designed to absorb stresses created between components with different coefficients of thermal expansion, such as the electrode (anode and cathode) and the electrolyte, and therefore with great robustness against delamination due to thermal cycling.

The developed cells are characterized for both their mechanical and electrochemical properties, including durability.

Application Sectors

Hydrogen Production: SOEC (Solid Oxide Electrolysis Cell) electrolyzers for renewable hydrogen production. Development of materials and electrochemical cells for SOEC electrolysis, and experimental characterization. TRL 2-4.

Energy: Reversible SOEC/SOFC electrolysis, renewable hydrogen production, and power generation. Development of materials and electrochemical cells for reversible electrolysis (SOEC/SOFC), and experimental characterization. TRL 2-4.

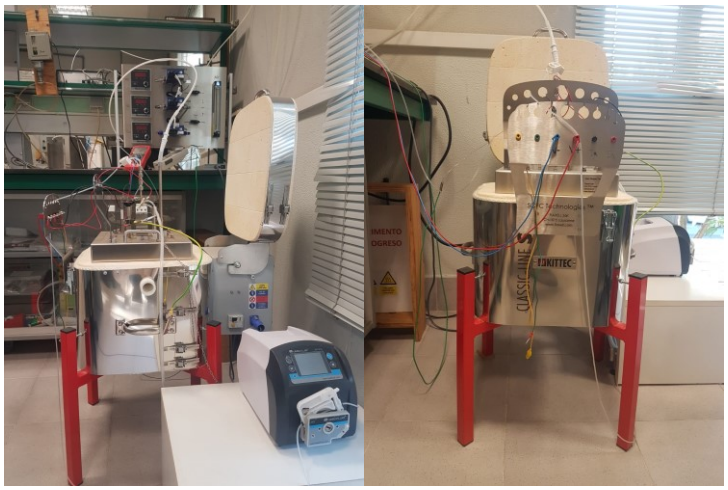
954 486 122 – 954 488 145

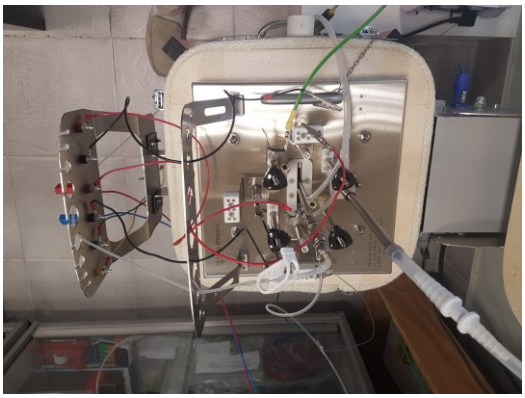
https://aicia.es

Building ETSI. Camino de los Descubrimientos, s/n ,41092 Sevilla

airanzo@us.es

Figure of the technology.





Relevant projects where the technology has been used

- Development of materials and electrochemical cells for reversible SOEC/SOFC electrolysis and stack engineering based on CFD numerical simulation models (NEOSOLAR-SOEC-STACK): https://investigacion.us.es/sisius/sis_proyecto.php?idproy=36110
- CFD simulation of the SOEC/SOFC electrolyzer stack and characterization of cell and stack materials (NEOSOLAR-SOEC): https://investigacion.us.es/sisius/sis_proyecto.php?idproy=35691

954 486 122 – 954 488 145

Building ETSI. Camino de los Descubrimientos, s/n ,41092 Sevilla

https://aicia.es

airanzo@us.es

Description of the service and/or technology

Development, prototyping, and experimental validation of bipolar plates for fuel cells and electrolyzers, based on designs developed through CFD (Computational Fluid Dynamics) simulation. Development of designs in active areas of 25-200 cm^2, including prototype fabrication and testing.

The utility model involves a bipolar plate design for PEM-type fuel cells that features multiple reactant supply entries. A secondary reactant feed is incorporated through a channel with a variable cross-section and several additional branches that provide flow at different points of the plate. These entries connect the reactant to the plate surface, where the flow channels are machined. Feeding the reactant at multiple points is advantageous compared to a single entry, as it allows for a more homogeneous and efficient reaction on the plate. The design includes an adjustable regulating system that divides the reactant supply between the main and secondary entries. As an innovative aspect, the bipolar plate design has been manufactured using 3D additive manufacturing, allowing the main and secondary supply channels to be embedded within the bipolar plate itself.

An optimized second design is currently in the process of being patented, with experimental results surpassing those of conventional designs.

Application Sectors

Development of bipolar plates for fuel cells and electrolyzers, with TRL 5-7, for several application sectors:

Hydrogen Production: Electrolyzers

Transportation: PEM and AEM fuel cells

Residential: PEM and AEM fuel cells

Energy: Electrolyzers and PEM and AEM fuel cells

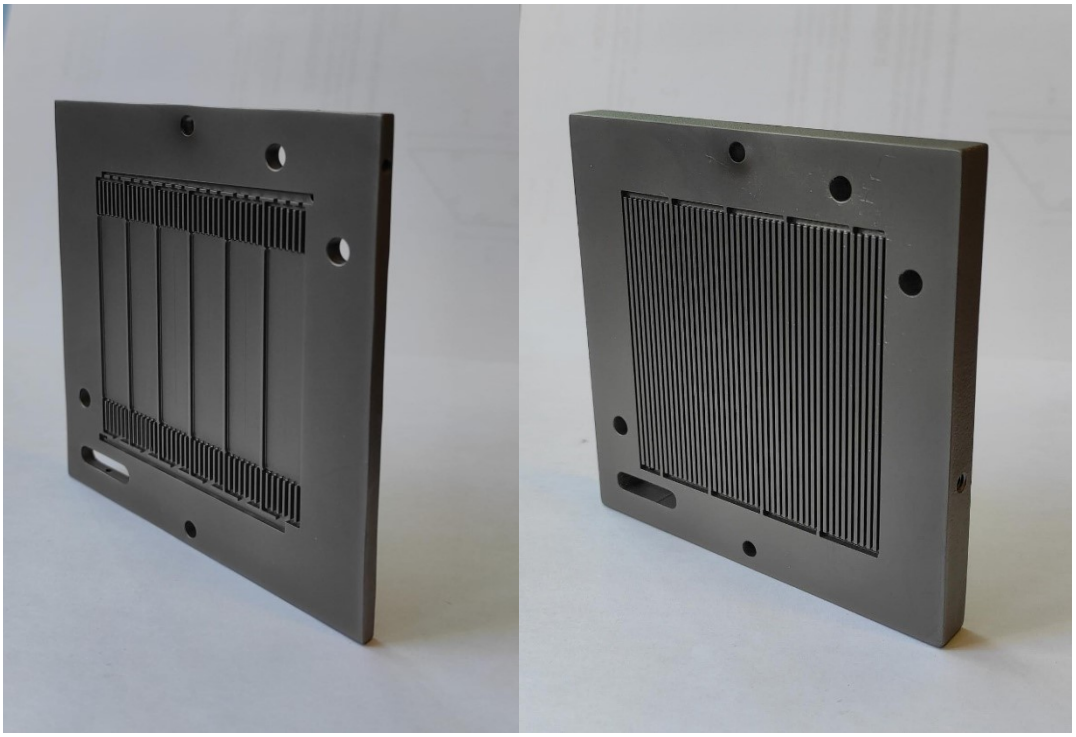
954 486 122 – 954 488 145

Building ETSI. Camino de los Descubrimientos, s/n ,41092 Sevilla

https://aicia.es

airanzo@us.es

Imágenes del servicio y/o tecnología



Relevant projects where the technology has been used

Development of bipolar plates based on three-dimensional structures for PEM fuel cells PY20 (PY20 RE 026 AICIA): https://proyectodesarrollo3dpem.com/

STACK - Development of low-power fuel cell stacks (ES-0302/2010): https://investigacion.us.es/sisius/sis_proyecto.php?idproy=17797/

Modeling of bipolar plates for PEM fuel cells (PI-0424/2009): https://investigacion.us.es/sisius/sis_proyecto.php?idproy=17797/

954 486 122 – 954 488 145

https://aicia.es

Building ETSI. Camino de los Descubrimientos, s/n ,41092 Sevilla

airanzo@us.es

Description of the service and/or technology

CIDAUT has a comprehensive experimental facility to characterize and validate electrochemical devices based on H2.

The main features of these facilities, which cover testing from single cells to complete systems, including stacks, are:

- Hydrogen generation on-site through electrolysis and hydrogen storage at pressure (up to 55 kg of H2)
- Electric load emulation up to 250 kW
- High-precision voltage (V) and current (I) measurement equipment with high sampling frequency (1-2 MHz)
- Equipment for performing high-power complex impedance tests (current ripple amplitude of 60 Amperes peak-to-peak) on stacks
- Other auxiliary equipment in the facility: gas lines; 200 kW cooling tower for thermal dissipation, safety PLC, and gas control unit.



Application Sectors

Development of components and operation strategies for fuel cells and electrolyzers for several application sectors:

- Hydrogen Production: Electrolyzers
- Transportation: Fuel cells
- Industrial: Fuel cells and electrolyzers
- Residential: Fuel cells and electrolyzers
- Energy: Fuel cells and electrolyzers

+34 983 548 035

Parque Tecnológico de Boecillo, Plaza Vicente Aleixandre Campos nº 2, 47151 Boecillo (Valladolid)

www.cidaut.es

info@cidaut.es

Description of the service and/or technology

CIDAUT develops components and systems for hydrogen production through water electrolysis.

This development focuses on:

- Thermofluid-mechanical design of components (cooling, pressure loss, durability, reactive balances, etc.)
- Material selection for the different elements (corrosion, conductivity, manufacturing, sealing)
- Selection and development of manufacturing methods (stamping, molding, electrodeposition, coating)
- Development of balance-of-plant equipment for electrolyzers to optimize performance based on the application
- Development of system operation strategies for electrolysis
- Energy integration in electrolysis systems to improve energy efficiency





Application Sectors

- **Hydrogen Production:** Hydrogen production systems using water electrolysis technologies.
- **Energy:** Hydrogen production integrated with the electrical grid.
- **Other:** Equipment manufacturing.

+34 983 548 035

www.cidaut.es

Parque Tecnológico de Boecillo, Plaza Vicente Aleixandre Campos nº 2, 47151 Boecillo (Valladolid)

info@cidaut.es

Description of the service and/or technology

Development of functionalized catalysts and electrodes for H2 production through electrochemical methods, both at high and low temperatures, with direct application in fuel cells (PEM, AEM, SOEC/SOFC).

Synthesis of ceramic materials for SOEC/SOFC: Conventional solid-state methods, chemical synthesis (sol-gel style) via combustion-assisted methods, and hydrothermal synthesis.

Synthesis of polymeric membranes: Conventional methods and electrospinning. Fabrication of membranes with controlled porosity and fiber size distribution, tailored to specific chemical characteristics.

Synthesis of electrodes for electrolyzers and low-temperature fuel cells (60-70 °C) by deposition on carbon cloth, nickel mesh, or similar materials using drop casting.

Chemical synthesis and structural/microstructural modification of materials for applications in electrochemical catalysis.

Morphological characterization of nanomaterials and membranes using techniques such as HRSEM-EDS, TEM, XRD, Raman, XPS, electrical conductivity, TGA-DSC, and more.

Application Sectors

- **Hydrogen Production:** Water-splitting.
- **Transportation:** Fuel cells.
- **Industrial:** Nanocatalysts for hydrogenation in the production of chemicals.
- **Residential:** Fuel cells.
- **Energy:** Fuel cells.



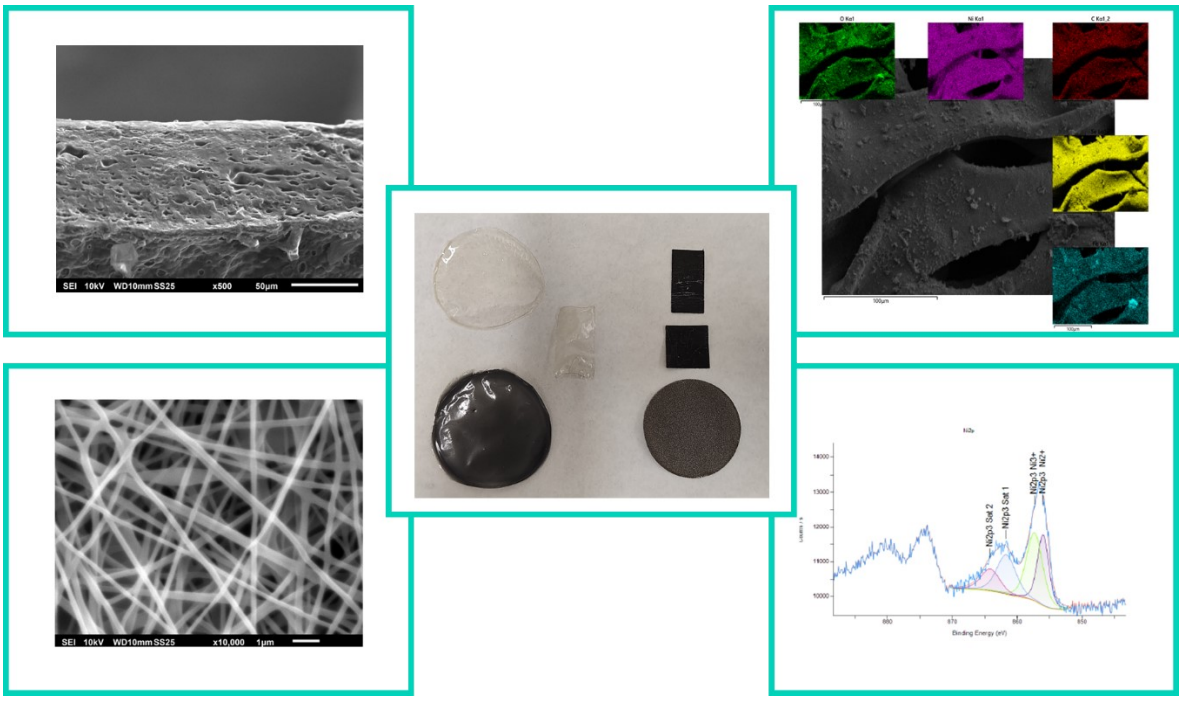
+34 986 120 450

Building CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

www.energylab.es

info@energylab.es

Images of the Service and/or Technology



Relevant projects where the technology has been used

This technology has been used within the framework of the HI_MOV Project https://energylab.es/listado/himov/ , whose main objective is to create a cross-border ecosystem that promotes the emerging hydrogen value chain in the Galicia-North Portugal Euroregion, contributing to sustainable mobility based on renewable sources.

This technology has also been implemented in various private projects offered as technological services to companies.

+34 986 120 450

Building CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

www.energylab.es

info@energylab.es

Description of the service and/or technology

Electrochemical characterization of catalysts, electrodes, and membranes up to devices (electrolyzers, fuel cells) to determine their efficiency and performance. Characterization of materials in three-electrode cells, including LSV, CV, EIS, IV, CA, and CP curves.

At the device level, polarization curves are performed to determine performance, energy efficiency, and operation of the device at constant or cycled current or voltage to assess stability. A testing bench with laboratory-scale balance-of-plant equipment is available for testing commercial electrolyzers.

ENERGYLAB's laboratory is equipped with a PEM electrolysis testing station with a capacity of up to 5 kW, enabling the evaluation of modified laboratory electrolyzers' performance and comparison against commercial equipment in real operating environments.

The aforementioned electrochemical experimental techniques provide insights into fundamental aspects of the kinetics and thermodynamics of oxygen and hydrogen production reactions.

Application Sectors

- **Hydrogen Production:** Electrolyzer
- **Transportation:** Fuel cell
- **Industrial:** Electrolyzer, fuel cell
- **Energy:** Electrolyzer, fuel cell

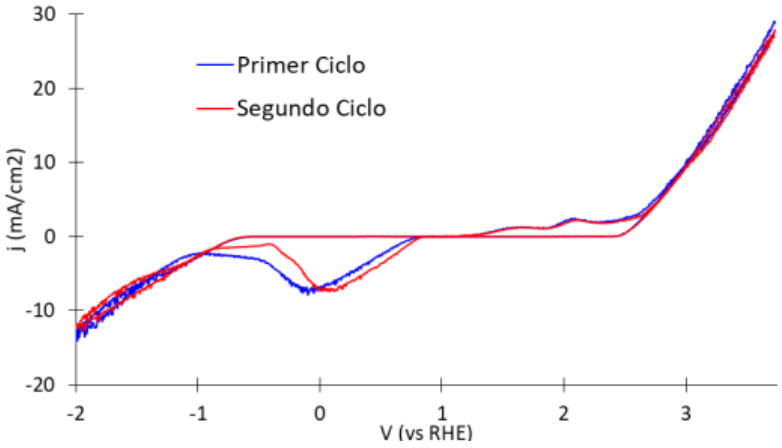
+34 986 120 450

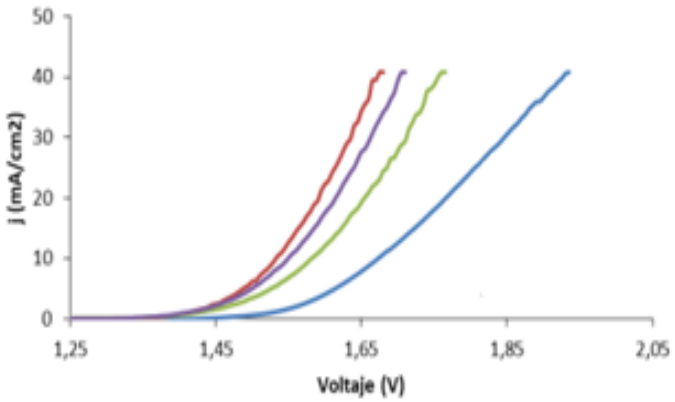
Building CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

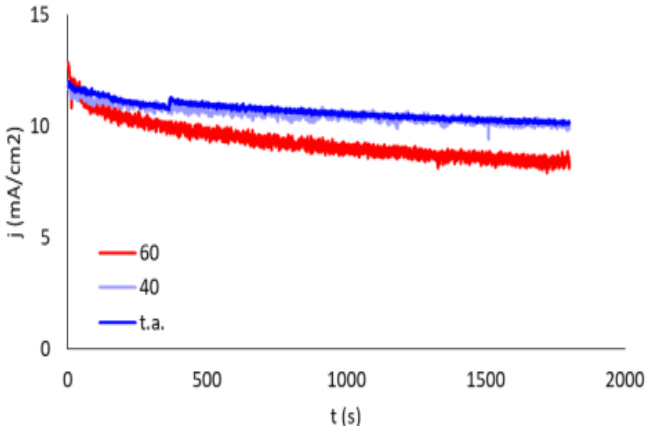
www.energylab.es

info@energylab.es

Images of the Service and/or Technology







Relevant projects where the technology has been used

This technology has been used within the framework of the HI_MOV project: https://energylab.es/listado/himov/ , aimed at developing technological solutions for the use of hydrogen in mobility.

Various private projects offered as technological services to companies.

+34 986 120 450

Building CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

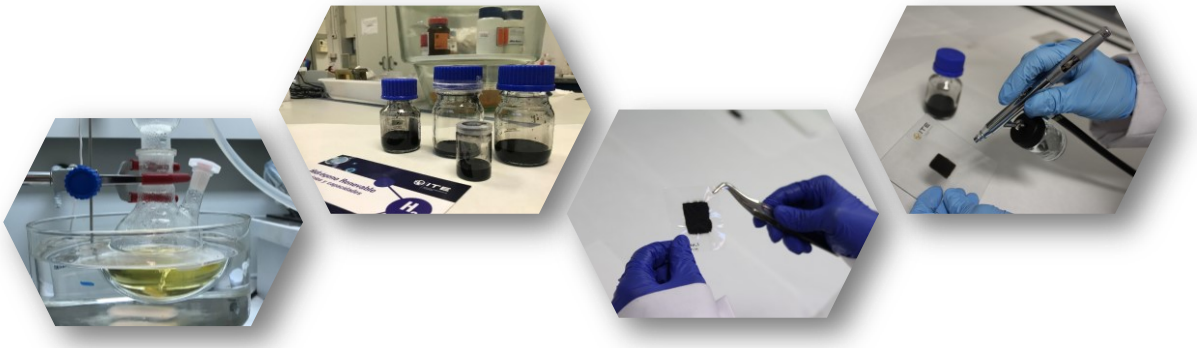
www.energylab.es

info@energylab.es

Descripción del servicio y/o tecnología

ITE has specialized laboratories for the synthesis, development, and characterization of materials and components for hydrogen technologies. The services offered are listed below:

- **Synthesis of advanced materials:**
  - Catalysts for PEMEL, PEMFC, PEC, and AEM.
  - Polymers for ion-exchange membranes for PEMEL, PEMFC, PEC, and AEM.
  - Composites for coatings of gaseous hydrogen storage systems.
- Formulation of catalytic inks for PEMEL, PEMFC, PEC, and AEM.
- Advanced deposition techniques: spin coating, spray-coating, screen printing, Doctor Blade, Inkjet, etc.
- Development of components: membranes, electrodes, coatings, etc.
- Physicochemical characterization of materials and components.
- Electrochemical characterization of developed components: electrodes and ion-exchange membranes.



Application Sectors

- **Hydrogen Production:** Hydrogen production systems through electrolysis.
- **Hydrogen Storage:** Gaseous hydrogen storage systems.
- **Transportation:** PEM fuel cells.
- **Residential**: Stationary PEM fuel cells.
- **Energy:** Hydrogen production systems through electrolysis coupled to the grid.

961 366 670

Carrer de Juan de la Cierva y Codorniu, 24. Parque Tecnológico Paterna (Valencia)

https://www.ite.es/

ite@ite.es

Description of the service and/or technology

ITE has laboratories and testing benches for the testing and characterization of components and equipment for hydrogen technologies. The services offered are listed below:

- Integration of developed and commercial components into cells: ion-exchange membranes and electrodes: PEMEL: 25 cm^2, PEMFC: 5, 25, and 50 cm^2, and PEC: 1 cm^2.
- Electrochemical testing of developed components: 1 kW PEMEL testing bench and 100 W PEMFC testing bench.
- Testing under various operating conditions: temperature, flow, pressure, stoichiometry, etc.
- Testing under different scenarios: stationary, dynamic, failure testing, degradation, etc.
- Testing of hydrogen production equipment: 6 kW PEM and 6 kW AEL.
- Testing of hydrogen utilization equipment: fuel cells of 1, 2, and 4 kW.



Application Sectors

- **Hydrogen Production:** Hydrogen production systems through electrolysis.
- **Transportation:** PEM fuel cells for mobility applications.
- **Residential:** Systems for generating electricity from hydrogen (fuel cells).
- **Energy:** Hydrogen production systems through electrolysis coupled with renewable energy sources (RES).

961 366 670

Carrer de Juan de la Cierva y Codorniu, 24. Parque Tecnológico Paterna (Valencia)

https://www.ite.es/

ite@ite.es

Description of the service and/or technology

Electrochemical and photoelectrochemical characterization of semiconductors used as photoelectrodes, co-catalysts, and membranes in photoelectrochemical devices to determine their efficiency, performance, and stability. Both photoelectrodes and co-catalysts are tested individually in three-electrode H-type cells under illuminated and dark conditions. The performance of the reaction is evaluated by quantifying the products generated: H2 (photocathode) and O2 (photoanode) in the case of water splitting, as well as products from alternative oxidation reactions and CO2 reduction. A complete (photo)electrochemical characterization is performed, including linear voltammetry, cyclic voltammetry, chronoamperometry, chronopotentiometry, and impedance measurements. LEITAT has various climate chambers that allow stability tests under controlled conditions of temperature, humidity, and radiation.

At the device level (two-electrode cells, with or without membrane depending on the design and/or reactions to be studied), a complete (photo)electrochemical characterization is again performed, and the generated products are quantified, both under static and flow conditions, allowing the determination of performance and system stability under operating conditions.

LEITAT has over 40 potentiostat channels capable of operating up to 400 mA and ±20V; up to 1.5 A and ±20V, as well as a booster that allows operation up to 10A. LEITAT also has 5 channels dedicated to EIS (Electrochemical Impedance Spectroscopy).

Application Sectors

- **Hydrogen Production:** Yes, through photoelectrochemical systems.
- **Recycling Infrastructure:** Yes, waste valorization from the chemical/petroleum industry.
- **Industrial:** Hydrogen in fuel cells, technology for waste valorization.
- **Residential:** Hydrogen in fuel cells.
- **Energy:** Hydrogen in fuel cells.
- **Other:** Treatment and valorization of low-value by-products.



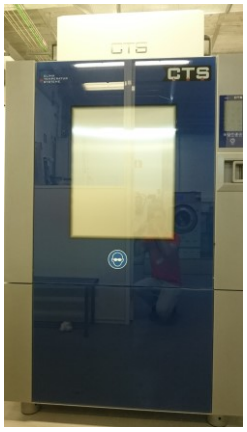
+34 937882300

C/ de la Innovació 2, 08225 Terrassa (Barcelona)

www.leitat.org

Ainhoa Cots, PhD (acots@leitat.org)

Images of the Service and/or Technology






Relevant projects

- ALGAESOL (HORIZON-CL5, GA nº 101147112). Sustainable aviation and shipping fuels from microalgae and direct solar bioelectrochemical technologies.
- PHOENIX (HORIZON-CL5, GA under signature). Photo-electro integrated next-generation energy technologies.
- DisTecH2 (PERTE ERHA, subcontratado). Tecnologías disruptivas de generación y uso de H2.

+34 937882300

c/ de la Innovació 2, 08225 Terrassa (Barcelona)

www.leitat.org

Ainhoa Cots, PhD (acots@leitat.org)

Service and/or Technology Description

Electrochemical characterization from catalysts, electrodes, membranes to devices (electrolyzers, fuel cells) to determine their efficiency and performance. At the catalyst and electrode level, using a three-electrode cell, Leitat can evaluate the performance of the hydrogen evolution reaction (HER), oxygen reduction reaction (ORR) for cathodic materials, and oxygen evolution reaction (OER) for anodic materials. At the device level, polarization curves are performed to determine the performance, energy efficiency, and operation of the device at constant current or voltage, or cycled to assess stability.

Leitat has over 30 potentiostat channels up to 400 mA and -20 to +20V; 8 potentiostat channels up to 1.5 A and -20 to +20V, with a booster that includes one 10 A channel and two 2 A channels. Five of these channels are equipped with Electrochemical Impedance Spectroscopy (EIS). There is also an electrochemical cycler with 16 channels of 1.5 A and 0 to 10 V with EIS. Additionally, there are other voltage sources, including a 190 A, 130 V power supply.

This enables:

- Determining the electrochemical performance and stability of catalysts, electrodes, current collectors, membranes, etc.
- Determining the energy efficiency and stability of materials (electrodes, catalysts, membranes, bipolar plates, MEAs) when operated in an electrolyzer or fuel cell.

Sectors of Application

- Hydrogen Production: Yes
- Recycling Infrastructure: Recovery of catalysts through electrochemical methods
- Transport: Fuel cell
- Industrial: Electrolyzer, fuel cell
- Residential: Fuel cell
- Energy: Electrolyzer, fuel cell

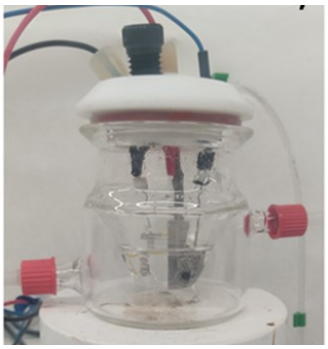
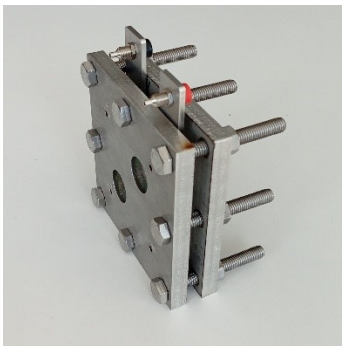
+34 937 882 300

C/ Innovació, 2. 08225 Terrassa (Barcelona)

www.leitat.org

Pau Bosch Jimenez pbosch@leitat.org

Images of the Service and/or Technology


Relevant Projects

- X-SEED (HORIZON Europe): eXperimental Supercritical ElEctrolyser Development.
- Vivaldi (Horizon H2020): InnoVative bIo-based chains for CO2 VALorisation as added-value organic acids.
- REGENERA (CDTI-Misiones): Research on hybrid storage technologies and predictive models to transform industries into decentralized points for renewable energy management.
- StackAEM (AEI – PCPP): Development of high-efficiency AEM electrolyzer components.
- LupyPlast (AEI – PCPP): Synthesis of new lubricants and carbon-modified materials from plastic waste pyrolysis.

+34 937 882 300

C/ Innovació, 2. 08225 Terrassa (Barcelona)

www.leitat.org

Pau Bosch Jimenez pbosch@leitat.org

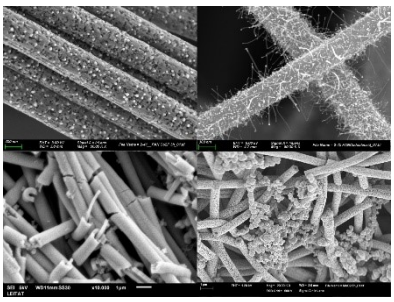
Description of the service and/or technology

Development of Nanocatalysts and Electrodes for Hydrogen Production by Water Electrolysis and Their Use in Fuel Cells (PEM, AEM, SOEC/SOFC, BES).

Manufacturing, modification, and physicochemical characterization of nanocatalysts and electrodes: carbon nanofibers (films), perovskite nanorods, metallic nanomaterials, and metal oxides. These are obtained from wet chemical processes (co-precipitation, sol-gel, solvothermal, etc.). Characterization of the obtained nanomaterials to study morphology and size (HRSEM-EDS, TEM, DLS, Mastersizer), composition (XRD, ICP-MS, elemental analysis, Raman, XPS), electrical conductivity, porosity (BET, porosimetry), thermal stability (TGA-DSC), etc.

The new nanomaterials have a higher surface area compared to conventional materials, improving catalytic activity. They are also obtained by reducing metal content and using scalable processes.

Carbon nanofibers produced by electrospinning technology allow their direct use as electrodes in the form of films. Additionally, non-agglomerated nanoparticles are produced, homogeneously distributed over the carbon nanofibers, with a high surface area and significant nanoporosity. Biobased materials such as lignin can be used as a carbon source.



Application Sectors

- **Hydrogen Production:** Water-splitting
- **Transport:** Fuel cells
- **Industrial:** Nanocatalysts for hydrogenation in chemical production
- **Residential:** Fuel cells
- **Energy:** Fuel cells

937 882 300

C/ Innovació, 2. 08225 Terrassa (Barcelona)

www.leitat.org

sandramartinez@leitat.org

Description of the Service and/or Technology

Bioelectrochemical systems (BES) are an innovative technology resulting from the synergy between electrochemistry and biotechnology. BES integrate electrodes (anode and cathode) within biological reactors. Instead of using inorganic-based catalysts at both electrodes, BES utilize microorganisms that act as biological catalysts to carry out various oxidation reactions at the anode and/or reduction reactions at the cathode. BES reactors can be used for different applications, including hydrogen (H2) production. In this application, organic matter in wastewater is oxidized at the anode instead of water electrolysis, and hydrogen evolution occurs at the cathode. BES can also be used for converting CO2 into CH4 (using H2 as an intermediary) and can be integrated with dark fermentation processes to enhance their performance.

Waste valorization (wastewater, sewage sludge, etc.) through hydrogen generation.

Increased energy efficiency in hydrogen production. The operating cell voltage ranges from 0.75-1.3 V, which translates to an efficiency of 20-35 kWh/kgH2.

Wastewater is used as the anolyte, and microorganisms act as catalysts, eliminating the need for pure water and the use of critical raw materials.

Application Sectors

- Hydrogen Production: Yes
- Recycling Infrastructure: Yes
- Industrial: Yes
- Energy: Yes
- Other: Wastewater treatment and valorization

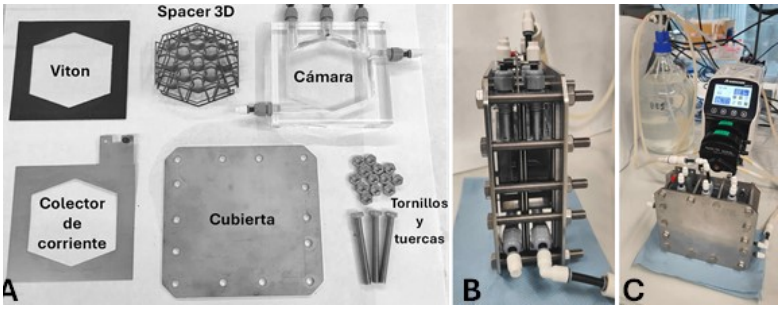
937 882 300

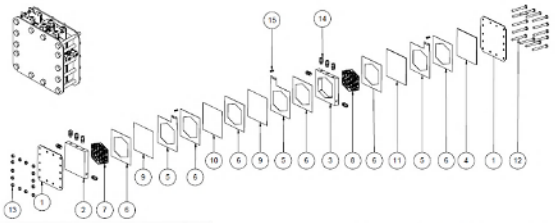
C/ Innovació, 2. 08225 Terrassa (Barcelona)

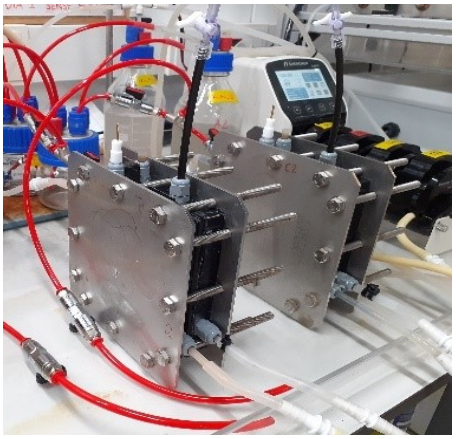
www.leitat.org

Pau Bosch Jimenez pbosch@leitat.org

Images of the Service and/or Technology







Relevant Projects

- Vivaldi (Horizon H2020): Innovative Bio-based Chains for CO2 Valorization as Added-Value Organic Acids
- REGENERA (CDTI-Misiones): Research on Hybrid Storage Technologies and Predictive Models to Transform Industries into Decentralized Renewable Energy Management Points
- Nimbi (AEI-PCPP): Integration of Nitrogen Recovery and Biogas Enrichment in Wastewater Treatment Plants (WWTPs) Using Bioelectrochemical Technologies
- Fuels-C (Horizon Europe): An Integrated Platform of Novel Cost and Energy-Efficient Conversion Technologies Producing Liquid and Gaseous Biofuels from Sustainable Biogenic Residues, Validated for Direct Use in Fuel Cells

937 882 300

www.leitat.org

C/ Innovació, 2. 08225 Terrassa (Barcelona)

Pau Bosch Jimenez pbosch@leitat.org

DESCRIPTION OF THE SERVICE AND/OR TECHNOLOGY

Artificial photosynthesis is a promising technology not only for capturing solar energy but also as a means of energy storage through the production of high-energy fuels such as H_2 from water or hydrocarbons from CO_2.

LEITAT is developing a new generation of modular, quasi-solid-state photoelectrolyzers that operate under continuous flow conditions and solar concentration. These systems can produce green hydrogen without the need for an external energy source. Furthermore, LEITAT takes it a step further by replacing the water oxidation reaction to O_2 with alternative reactions whose by-products have added value for the industry.

These systems allow us to:

- Enhance the energy recovery of waste (biomass, plastics, impure water).
- Produce low-cost hydrogen.
- Manufacture high-value-added chemicals.
- Utilize abundant materials from the Earth's crust, reducing or eliminating the use of Critical Raw Materials (CRM).
- Develop modular photoelectrochemical reactors, facilitating technology scaling.

APPLICATION SECTORS

- H_2 Production: Waste and water valorization for renewable H_2 production.
- Recycling Infrastructure: Treatment of biomass, plastics, and impure water through PEC systems.
- Industrial: Production of high-value-added products from biomass and plastics (cosmetics, petrochemicals, chemicals, among others) and renewable H_2 production.
- Residential: Treatment of residential water for renewable H_2 production and subsequent energy generation via fuel cells.
- Energy: Production of renewable H_2 for use in fuel cells to generate green energy.
- Others: Treatment and valorization of low-value surpluses.

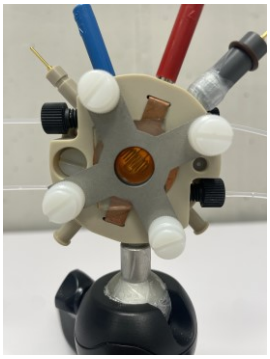
+34 937882300

c/ de la Innovació 2, 08225 Terrassa (Barcelona)

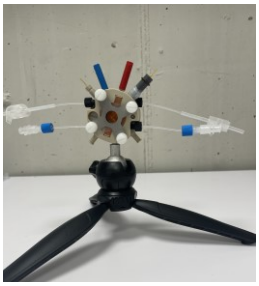
www.leitat.org

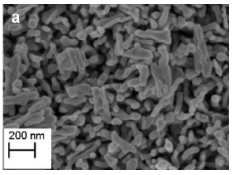
Ainhoa Cots, PhD (acots@leitat.org)

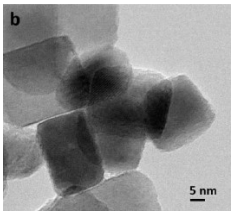
Images of the Service and/or Technology











Relevant Projects

- ALGAESOL (HORIZON-CL5, GA nº 101147112): Sustainable aviation and shipping fuels from microalgae and direct solar bioelectrochemical technologies.
- PHOENIX (HORIZON-CL5, GA under signature): Photo-electro integrated next-generation energy technologies.
- DisTecH2 (PERTE ERHA, subcontracted): Disruptive technologies for hydrogen generation and use.

+34 937882300

c/ de la Innovació 2, 08225 Terrassa (Barcelona)

www.leitat.org

Ainhoa Cots, PhD (acots@leitat.org)

DESCRIPTION OF THE SERVICE AND/OR TECHNOLOGY

Physicochemical characterization of waste streams, including the determination of:

- Total solids (TS), volatile solids (VS), and the VS/TS ratio: Indicators of organic matter content and biodegradability.
- pH and electrical conductivity (EC): Key parameters influencing substrate conditioning.
- Chemical Oxygen Demand (COD): Total and soluble COD.
- Lipids, proteins, and carbohydrates (CH): Crucial for predicting substrate suitability.
- Phosphorus (P), potassium (K), and Total Kjeldahl Nitrogen (TKN): Essential nutrients for microorganisms.

Hydrogen Production Potential (BHP) Determination:

BHP is evaluated through batch tests using automated equipment with waste streams. Laboratory-scale tests are conducted on the streams and a control, in triplicate, using inoculated and adapted microorganisms following a standardized protocol. The equipment includes:

- Thermostat-controlled baths for stirred reactors.
- CO_2 fixation traps, flow meters, and data logging software.
- Final gas composition analysis via chromatography.

Results are expressed as ml H_2/g substrate, ml bioH_2/g COD. Additionally: ml biogas/g substrate and gas composition (% bioH_2).

H_2 Production Optimization:

Residual stream hydrogen production is optimized by determining operating parameters and identifying limiting factors (e.g., inhibitions, mechanical issues). Continuous reactor monitoring covers: Gas phase: H_2, CO_2, CH_4, H_2S and feed and effluent streams. Process performance is reported in terms of: ml H_2/kg residue, ml H_2/g CH, ml H_2/g COD, and ml biogas/kg residue. Additionally, the service provides: Optimal operating conditions, operational recommendations, and pretreatment or conditioning needs for waste utilization by photoorganisms (FO). Effluent characterization: Volatile Fatty Acids (VFAs), COD, TS, VS, pH, EC. Potential applications and valorization pathways. Mass and energy balances.

Application Sectors

- H_2 Production: Assessment of potential new resources.
- Recycling Infrastructure: Management of organic waste streams from industrial sources.
- Industrial: Handling of organic waste streams from industrial processes.
- Energy: Exploration and evaluation of potential new resources.
- Other: Environmental applications (treatment plants, WWTPs).



+34 986 120 450

Edificio CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

www.energylab.es

info@energylab.es

Images of the Service and/or Technology







Relevant Projects Utilizing the Technology

These technological services were implemented in the RE-FISH project (https://energylab.es/re-fish-to-food/), which focused on the recovery of effluents from the canning industry.

In this project, a new technology was developed that combined anaerobic digestion and dark fermentation processes for the production of gases (biogas, bioCH_4, and bioH_2) to feed a bioreactor for the production of microbial protein (SCP).

+34 986 120 450

Edificio CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

www.energylab.es

info@energylab.es

DESCRIPTION OF THE SERVICE AND/OR TECHNOLOGY

Evaluation of the potential of various biomasses and/or solid wastes as biofuels in thermochemical valorization processes through gasification.

Physicochemical Characterization: The first step involves determining the physicochemical properties of the input material(s). If deemed suitable for the process, the next step involves studying the gasification process.

Gasification Process Analysis: The syngas (synthesis gas) produced during gasification is analyzed to quantify its thermal energy, electrical energy, and/or hydrogen production potential.

Technology and Equipment:

Pilot Plant: Includes a fluidized bed reactor capable of operating at temperatures up to 1,000°C, with a feed capacity of up to 0.20 kg/h depending on the biofuel.

Secondary Reactor: Designed for the water-gas shift (WGS) reaction, operating at temperatures between 300–500°C. An appropriate catalyst promotes the conversion of CO in the syngas into CO_2 and H_2.

Microchromatography: Used to monitor syngas composition in real time, enabling the calculation of its calorific value, process efficiency, and hydrogen yield.

Assessment Parameters: For a given biomass or waste material, viability as a biofuel in gasification processes can be determined by analyzing:

- Syngas composition and hydrogen content.
- Calorific value of the syngas.
- Specific gas production.
- Gas yield.
- Carbon yield.

Application Sectors

- **H_2 Production:** Evaluation of potential new resources for hydrogen generation.
- **Recycling Infrastructure:** Management and valorization of residual streams.
- **Industrial:** Processing and utilization of industrial waste streams.
- **Energy:** Assessment and development of new energy resources.
- **Others:** Chemical synthesis, upgrading processes, and grid injection.

+34 986 120 450

Edificio CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

www.energylab.es

info@energylab.es

Images of the Service and/or Technology





Relevant Projects Utilizing the Technology

- **ZEPPELIN Project** (https://www.naturgy.com/innovacion/nuestros-proyectos/proyecto-zeppelin/): Focused on researching a flexible set of green hydrogen production and storage technologies based on the utilization of waste and by-products. The project aims to significantly improve the cost and efficiency of producing this energy vector.
- **Renewable Gas Joint Unit Project** (https://energylab.es/listado/consolidacion-unidad-mixta-gas-renovablea/): Aimed at advancing knowledge not only of biogas and biomethane but also of other renewable gases such as green hydrogen and syngas. The project also evaluates their impact on current infrastructures and end consumers.

+34 986 120 450

Rúa Fonte das abelleiras s/n. 36310 Vigo

https://energylab.es/

info@energylab.es

Transport, Storage and Distribution of Hydrogen



DESCRIPTION OF THE SERVICE AND/OR TECHNOLOGY

The microgrid integrates electric and thermal energy production elements using solar energy, combined with energy storage systems utilizing different battery technologies and hydrogen technology (AEM electrolyzer, 0.5 N/m^3). The microgrid consists of:

- Lead-acid batteries.
- Lithium-ion batteries and a bidirectional converter.
- Electronic rack, electrolyzer, and purifier.
- Hydrogen storage and fuel cell.
- Photovoltaic field and a control and supervision PC.

This microgrid enables energy management strategy analysis, component testing, and equipment modeling. Specific functionalities include:

- Energy flow optimization.
- Comparison of short-term and long-term storage systems.
- Definition and comparison of control strategies and modes.
- Simple control strategies for operationally reliable microgrids.
- Microgrids and thermal energy storage integration.
- Incorporation of renewables in industries with intermittent processes using microgrids.
- Development of dynamic simulation tools.
- Analysis of the effects of solar prediction systems on microgrid performance.

Application Sectors

- **Technology Validation:** Laboratory validation and integration of technologies, including operational modes and strategies (TRL 5-7).
- **H_2 Production:** AEM electrolysis integrated with renewable energy sources.
- **H_2 Storage**: Using metal hydrides for hydrogen storage.
- **Residential:** Applications in energy use, thermal use, and microgeneration systems.



954 486 122 – 954 488 145

Building ETSI. Camino de los Descubrimientos, s/n ,41092 Sevilla

https://aicia.es

soporte@aicia.es

Images of the Service and/or Technology







Relevant Projects Utilizing the Technology

- **HyBuildings** (https://aicia.es/hybuildings-diseno-dimensionado-y-control-de-micro-redes-hibridas-termico-electricas-basadas-en-hidrogeno-y-energias-renovables-para-aplicacion-en-el-sector-de-la-edificacion/): Focused on the design, sizing, and control of hybrid thermal-electric microgrids based on hydrogen and renewable energy for applications in the building sector (PY18-RE-0028).

954 486 122 – 954 488 145

Building ETSI. Camino de los Descubrimientos, s/n ,41092 Sevilla

https://aicia.es

soporte@aicia.es

SERVICE AND/OR TECHNOLOGY DESCRIPTION

CIDAUT designs, develops, and manufactures systems for hydrogen production from the steam reforming of renewable substances, such as biogas or bioalcohols.

This development focuses on:

- Thermofluidomechanical design of components
- Selection of materials for various elements (corrosion, conduction, manufacturing, sealing)
- Selection and development of manufacturing methods
- Development of reforming system operation strategies
- Energy integration to improve the energy efficiency of the reforming process

Application Sectors

Hydrogen Production: Hydrogen production systems using reforming technologies.

Energy: Hydrogen production in biorefineries.

Others: Equipment manufacturing.

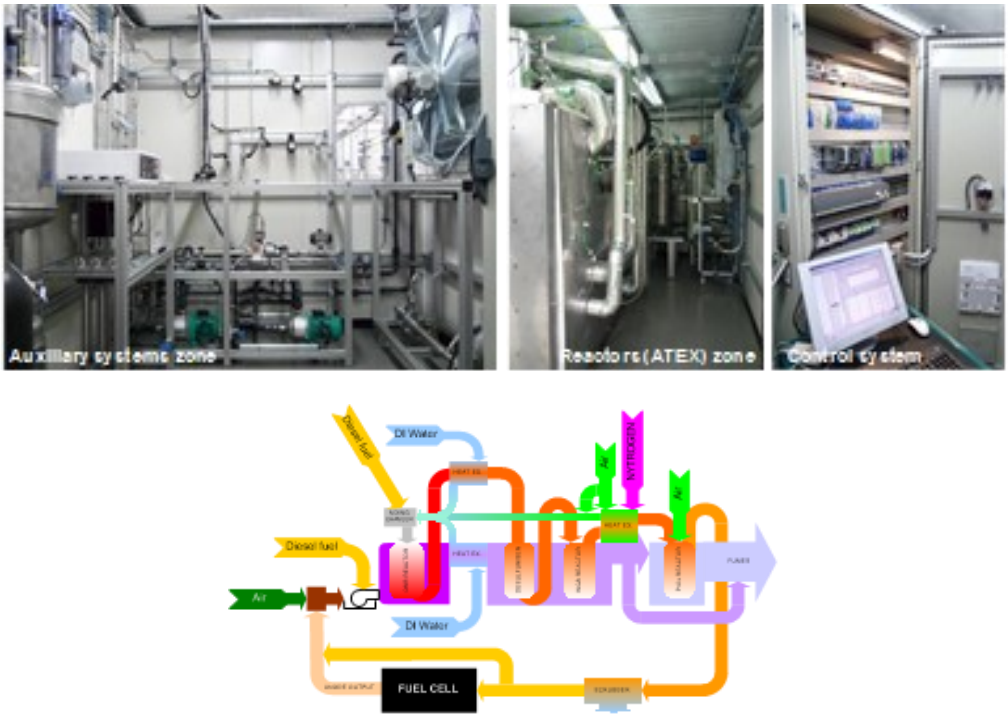
+34 983 548 035

Parque Tecnológico de Boecillo, Plaza Vicente Aleixandre Campos nº 2, 47151 Boecillo (Valladolid)

www.cidaut.es

info@cidaut.es

Images of the Service and/or Technology



Relevant Projects Where the Technology Has Been Used

REFORDI Project: Development and construction of a diesel reformer. Developed in collaboration with INTA, the Institute of Catalysis and Petrochemistry of the CSIC, and AICIA (Association for Research and Industrial Cooperation in Andalusia).

SPB Project: Development of key ethanol reforming technologies for the AIP group (air-independent propulsion system) within the S80 Submarine Development Program.

COLHIBRI Project: Research on new technologies for clean cogeneration using green hydrogen from biogas. PERTE ERHA.

H2ENRY Project: Research on hydrogen production processes from renewable molecules that can be easily stored via methanol reforming.

+34 983 548 035

Parque Tecnológico de Boecillo, Plaza Vicente Aleixandre Campos nº 2, 47151 Boecillo (Valladolid)

www.cidaut.es

info@cidaut.es,

Service and/or Technology Description

Testing under controlled conditions of the permeability of pure hydrogen or mixtures through pipelines made of different materials, while monitoring the variables involved in the process (flow rate, temperature, etc.).

Evaluation of pipeline permeability in hydrogen transportation at different pressure levels, particularly important for polymer materials recommended for low pressures, where the hydrogen permeability rate is higher compared to methane.

At Energylab, we have a gas permeability measurement bench that allows testing of pipes with various compositions to assess their behavior in transporting pure hydrogen (or hydrogen-gas mixtures). This includes analyzing the reduction of any component or pressure loss due to permeability to the outside. This equipment allows testing at temperatures ranging from 0 to 40 ºC and can work with pressures up to 16 bar.

Application Sectors

- **Hydrogen Storage:** Reuse of hoses/pipes.
- **Hydrogen Distribution:** Reuse of hoses/pipes.
- **Recycling Infrastructure:** Reuse of hoses/pipes.
- **Industrial:** Reuse of hoses/pipes.



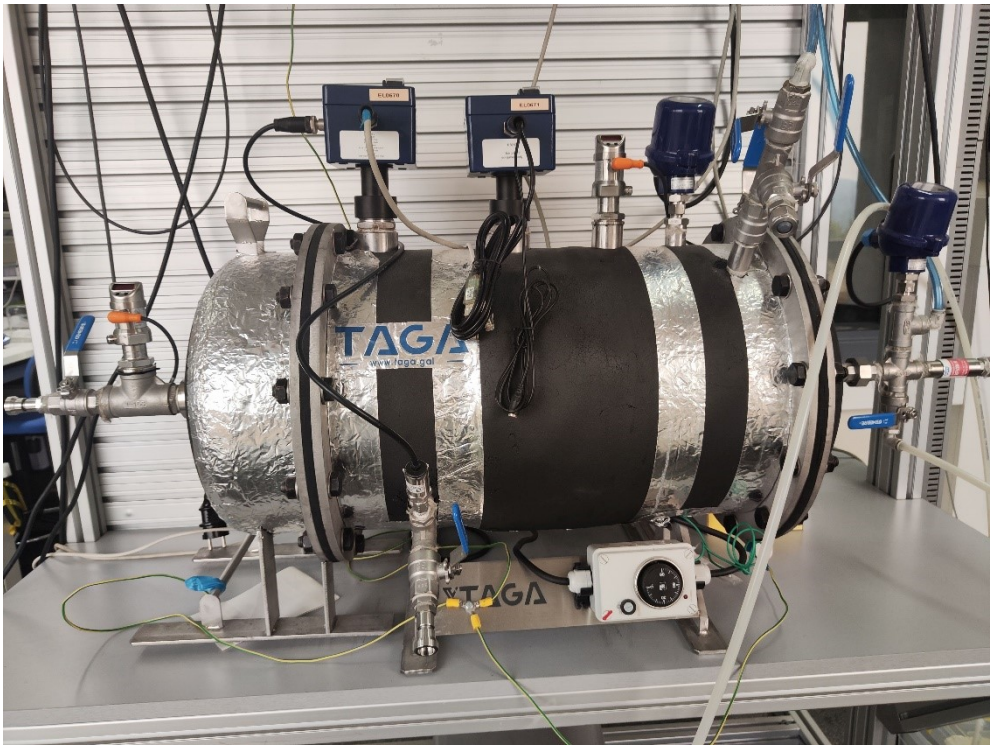
+34 986 120 450

Building CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310

www.energylab.es

info@energylab.es

Images of the Service and/or Technology



Relevant Projects Where the Technology Has Been Used

This technology has been employed in the **Unidad Mixta Gas Renovable** project: Unidad Mixta Gas Renovable. The Renewable Gas Mixed Unit is a joint project by Naturgy, the EnergyLab Technological Center, and EDAR Bens, a public company that provides wastewater treatment services for the municipalities of A Coruña, Arteixo, Cambre, Culleredo, and Oleiros.

The Consolidation of the Renewable Gas Mixed Unit focuses on increasing knowledge not only about biogas and biomethane but also about other renewable gases such as green hydrogen and syngas, as well as evaluating their impact on current infrastructure and end consumers.

+34 986 120 450

Building CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

www.energylab.es

info@energylab.es

Service and/or Technology Description

The gas separation system using polymeric membranes available at Leitat enables the evaluation of gas permeability through a membrane for various gases (H2, CO2, CH4, N2, O2, Ar, etc.). Gas permeability is measured by monitoring the gas flow through the membrane under constant feed pressure and temperature. The membranes can be flat, tubular, or hollow fiber, and modules are available for each configuration.

As versatile features of the system, it is possible to:

- Evaluate membranes with pure gases or binary gas mixtures
- Evaluate dry or humidified gases
- Evaluate two membranes in parallel
- Modify feed pressure and temperature
- Connect inline to a gas chromatograph

All these capabilities provide a fast and flexible evaluation system to assess the separation capacity of membranes made from new materials or to determine membrane stability under more realistic operational conditions. Additionally, it can be connected inline with the gas generation system to be treated.

Application Sectors

Hydrogen Production: Hydrogen purification

Industrial: Treatment of gas streams

+34 937 882 300

C/ Innovació, 2. 08225 Terrassa (Barcelona)

www.leitat.org

sandramartinez@leitat.org

Cross-functional Technology Services



Service and/or Technology Description

Computational Fluid Dynamics (CFD) is a branch of fluid mechanics that uses numerical calculation to analyze and solve problems involving fluid flow. CFD software runs on a computing system to solve and predict the behavior of complex equipment.

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

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

Studies are conducted using the actual 3D design of the equipment, in both steady-state and transient conditions, allowing detailed analysis of the equipment's behavior under different operating conditions and design variations. This creates a powerful virtual laboratory for technology development.

Application Sectors

- Modeling and simulation using Computational Fluid Dynamics for the technological development of equipment (TRL 6-8)
- **Hydrogen Production**: Reformers, electrolyzers, chemical reactors
- **Hydrogen Storage**: Compressed, liquefied, metal hydrides, hydrogen carriers
- **Hydrogen Distribution**: Compressed, liquefied, blending, hydrogen carriers
- **Refueling**: Compression, dispensing, pre-cooling
- **Transport**: Fuel cells, filling/emptying of storage tanks
- **Industrial**: Combustion, cogeneration
- **Residential**: Fuel cells, micro-cogeneration
- **Energy**: Combustion, grid injection, blending
- **Others**: Design and evaluation of components and equipment in hydrogen technologies



954 486 122 – 954 488 145

https://aicia.es

Building ETSI. Camino de los Descubrimientos, s/n ,41092 Sevilla

soporte@aicia.es

Service and/or Technology Description

CIDAUT has extensive experience in specialized consultancy and advisory services, offering solid expertise in a range of key services for the analysis and consultancy of hydrogen generation facilities. This service can include:

- Feasibility Study: Technical and economic evaluation to determine the feasibility of the installation.
- Process Design: Optimization of the generation system (electrolysis, reforming, etc.).
- Technology Selection: Recommendation of the most suitable equipment and methods.
- Environmental Impact Analysis: Life cycle assessment and emissions evaluation.
- Regulatory Compliance: Ensuring that the facility complies with current regulations.
- Energy Optimization: Improving efficiency and reducing operational costs.
- Maintenance and Operation: Planning strategies to maximize performance.

Application Sectors

- **Hydrogen Production**: Hydrogen production systems using different technologies such as electrolysis, thermochemical processes, biological processes, etc.
- **Hydrogen Storage**: Evaluation of the impact of different hydrogen production systems on gaseous hydrogen storage systems coupled with production systems.
- **Hydrogen Distribution**: Theoretical sizing and feasibility studies for the distribution of produced hydrogen and the design of refueling systems coupled with production systems.
- **Transport**: Integration of hydrogen production systems onboard for transportation applications.
- **Industrial**: Feasibility of hydrogen use in industrial sectors coupled with production systems.
- **Residential**: Feasibility of hydrogen use for domestic applications coupled with production systems.
- **Energy**: Integration of hydrogen production and use systems in the energy system.



+34 983 548 035

Parque Tecnológico de Boecillo, Plaza Vicente Aleixandre Campos nº 2, 47151 Boecillo

www.cidaut.es

info@cidaut.es

Service and/or Technology Description

Application of the Life Cycle Analysis (LCA) methodology for the characterization and evaluation of hydrogen production and use systems from an environmental perspective, in accordance with international standards ISO 14040 and ISO 14044. The specific applications include:

- Development of the environmental profile of the process
- Identification of critical points and proposal of improvement alternatives
- Evaluation of the implementation of improvement alternatives or alternative scenarios through sensitivity analysis
- Comparative evaluation with other equivalent processes from a functional perspective
- Definition of key process indicators from an environmental viewpoint
- Contribution to increasing knowledge for the development of regulations and policies in this field.

Energylab has a team of specialized researchers with extensive experience in conducting LCA (Life Cycle Analysis) and Carbon Footprint calculations using international standards. To carry out these studies, EnergyLab uses various software tools and well-known databases, such as SimaPro and **Ecoinvent.**

Application Sectors

- **Hydrogen Production, Storage, and Distribution**: Comparative analysis of process configuration alternatives and/or equivalent hydrogen production, storage, or distribution technologies; evaluation of performance and eco-efficiency of processes and subprocesses in the value chain; optimization of hydrogen systems and processes.
- **Recycling Infrastructure**: Valuation of multifunctional processes, waste valorization, and process circularity.
- **Transport and Energy**: Evaluation of hydrogen deployment scenarios in the energy sector and mobility; assessment of direct and indirect emission reductions.
- **Industrial**: Evaluation of hydrogen uses in different sectors and processes, implementation of innovative processes, process optimization, definition of KPIs, and strategic planning.
- **Residential**: Decision-making criteria for implementing new energy production technologies.
- **Others**: Provision of environmental information for the development of policies, regulations, and financing mechanisms; harmonization of LCA studies for hydrogen systems; development of tools for calculating environmental impact and/or carbon footprint of hydrogen production systems and processes.

+34 986 120 450

Building CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo

www.energylab.es

info@energylab.es

Service and/or Technology Description

Training Courses Offered

1. **ELECTROCHEMICAL HYDROGEN PRODUCTION AND USES:**
    - **Objective**: To provide students with basic knowledge of hydrogen production technologies and their applications.
    - **Course Content**: The course is structured in three training modules:
        - Fundamentals of hydrogen and its value chain
        - Hydrogen production technologies and their applications
        - Fuel cells
2. **HYDROGEN PRODUCTION THROUGH DARK FERMENTATION:**
    - **Objective**: To introduce participants to the basic concepts of Dark Fermentation (DF).
    - **Course Content**:
        - Review of anaerobic digestion characteristics
        - Similarities between dark fermentation and anaerobic digestion, and differences between them.

Mode: In-person with an online exam
Visits: Practical sessions at the EnergyLab laboratories are included.
At the end of the course, students will receive a questionnaire to evaluate the knowledge acquired, which must be submitted by email within a week.
Target Audience: University graduates and energy sector professionals wishing to enhance their careers in hydrogen technologies.
Location: EnergyLab Headquarters, CITEXVI Building, Fonte das Abelleiras S/N, Vigo University Campus, 36310, Vigo, Pontevedra.
For dates, visit: EnergyLab Training Courses

Course Content with Application to:

- **Hydrogen Production**: Electrochemical pathways (Electrolysis, etc.)
- **Hydrogen Storage**: Storage systems (permeability, metal hydrides, etc.)
- **Transport**: Fuel cells in transportation applications
- **Industrial**: Fuel cells for industrial applications
- **Residential**: Fuel cells for residential applications
- **Energy**: Fuel cells in energy systems (e.g., power generation)
- **Other**: Energy storage systems (e.g., hydrogen as a form of energy storage)



+34 986 120 450
Edificio CITEXVI, Local 1 R/ Fonte das Abelleiras, s/n. Campus Universitario de Vigo 36310 Vigo
www.energylab.es
info@energylab.es

Service and Technology Description

• Specialized training courses in hydrogen technologies, covering the entire value chain

- Hydrogen production pathways
- Hydrogen storage systems and methods
- Hydrogen distribution and transportation
- Fuel cells
- Industrial applications
- Mobility applications
- Other hydrogen uses

Application Sectors

- **Hydrogen Production**: Electrolyzer, various technologies.
- **Hydrogen Storage**: Hydrogen storage systems.
- **Hydrogen Distribution**: Systems and networks for hydrogen distribution.
- **Transport**: Hydrogen uses in mobility.
- **Industrial**: Hydrogen as a raw material in industrial applications.
- **Residential**: Potential uses of hydrogen in residential applications.
- **Energy**: Integration of hydrogen into the current energy system.



961 366 670

Carrer de Juan de la Cierva y Codorniu, 24. Parque Tecnológico Paterna (Valencia)

https://www.ite.es/

ite@ite.es

Service and Technology Description

ITE has extensive experience in consulting and specialized advisory services in the following areas:

- Technical-economic sizing of hydrogen production and consumption facilities
- Feasibility analysis of hydrogen production plants
- Advisory services for the implementation of Hydrogen Valleys
- Basic design of hydrogen refueling systems
- Integration of fuel cells in hydrogen-powered vehicles

Application Sectors

- **Hydrogen Production**: Hydrogen production systems through electrolysis.
- **Hydrogen Storage**: Hydrogen gas storage systems coupled with production systems.
- **Hydrogen Distribution**: Theoretical sizing and feasibility studies for the distribution of produced hydrogen and design of refueling systems.
- **Transport**: Integration of fuel cells for hydrogen-powered vehicles.
- **Industrial**: Feasibility of using produced hydrogen in industrial sectors.
- **Residential**: Feasibility of using produced hydrogen in domestic applications.
- **Energy**: Integration of hydrogen production and usage systems into the energy system.
- **Other**: Hydrogen Valleys.

961 366 670

Carrer de Juan de la Cierva y Codorniu, 24. Parque Tecnológico Paterna (Valencia)

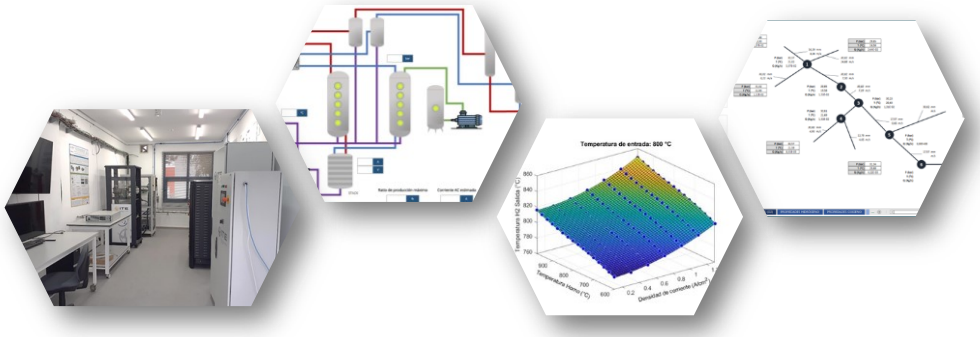
https://www.ite.es/

ite@ite.es

Service and Technology Description

ITE has experience in energy management systems for infrastructures, offering the following services:

- Development of multifysical behavior models: fluid dynamic, electrochemical, and thermodynamic models for PEMEL, AEL, and SOEC.
- Digitalization and monitoring of hydrogen production and consumption equipment
  - Data analysis and degradation study
  - SCADA system design and development
- Energy management of hydrogen production and consumption plants
  - Development and integration of EMS
  - Hybridization of hydrogen technologies with batteries and renewable energy sources
- Hydrogen production optimization
  - Development of optimization algorithms.



Application Sectors

- **Hydrogen Production**: Hydrogen production systems through electrolysis.
- **Hydrogen Storage**: Hydrogen gas storage systems.
- **Industrial**: Use of produced hydrogen in industrial sectors.
- **Residential**: Fuel cells for domestic hydrogen use.
- **Energy**: Integration of hydrogen use and consumption into the energy system.

961 366 670

Carrer de Juan de la Cierva y Codorniu, 24. Parque Tecnológico Paterna (Valencia)

https://www.ite.es/

ite@ite.es

H2ENRY Training

The H2ENRY network has developed a comprehensive training program, focused on key topics addressed by its members. We offer joint courses delivered by our five partner centers, covering various areas of specialization. This collaborative approach ensures a thorough and high-quality education, prepared for the current challenges in the sector.

- Renewable hydrogen production technologies using biological systems (Leitat, Energylab)
- Renewable hydrogen production technologies using electrochemical systems (CIDAUT, AICIA, Energylab, Leitat, ITE)
- Renewable hydrogen purification (Leitat)
- Renewable hydrogen storage (CIDAUT, ITE)
- Integration of digital tools in the hydrogen value chain (ITE, CIDAUT)

Syllabus with Application to:

The syllabus of the H2ENRY network can be aimed at a wide range of professionals and students interested in the hydrogen and sustainable energy sector. The potential recipients include:

- Researchers in renewable energy, hydrogen, and related technologies.
- Technical professionals in the energy sector looking to specialize in hydrogen production, storage, and use.
- University students in engineering, chemistry, environmental sciences, or related fields who wish to acquire skills in this emerging field.
- Policymakers and regulators who need to understand developments in hydrogen technologies for energy policy formulation.



www.h2enry.es

info@h2enry.es

Coordinator:

Issue date: November, 2024