

HIGH VALUE HYDROGEN: Technologies and Solutions for the Whole Hydrogen Value Chain

SUMMARY

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The National Hydrogen and Fuel Cell Technology Testing Centre and TECNALIA join forces to give a **specialized and comprehensive technological response** to the demand of the industry involved in the whole hydrogen value chain, addressing the challenges of Hydrogen in the coming years.

For this purpose, we provide **technological solutions**, **R&D services** and **transferable assets** to help the industry meet the ambitious goal of making 24% of global energy demand hydrogen by 2050, with annual sales in the range of 630 billion euros.

As a national research centre at the service of the entire scientific, technology and industrial community, the [National Hydrogen and Fuel Cell Technology Testing Centre \(CNH2\)](#) is aimed at driving forward the scientific and technological research into hydrogen and fuel cell technologies.

With its main headquarters located in Puertollano (Ciudad Real), it was created in 2007 as a Public Consortium between the Ministry of Education and Science, currently the Ministry of Science, Innovation and University Education, and Castilla-La Mancha Regional Government, with each entity holding a 50% interest.

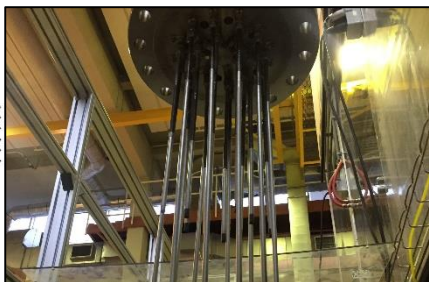
[TECNALIA](#) is a leading Research and Technological Development Centre in Europe, whose mission is to transform technology into GDP to improve people's quality of life, by creating business opportunities for companies, being member of BRTA (Basque Research and Technology Alliance).

We work with an increasingly strategic business relationship model based on trust, collaboration, and a shared technological approach.

We are the first private Spanish organisation in contracting, participation, and leadership in the European Commission's Horizon 2020 programme and we are ranked second in European patent applications.

OUR VALUE PROPOSAL

HYDROGEN PRODUCTION



- Electrolyzers
- PEM
- Solid Oxide
- Reforming / pyrolysis
- Biotechnologies for H₂ production

H₂ DISTRIBUTION TRANSPORT & STORAGE



- H₂ Purification
- Power to Gas
- Hydrogen injection for distribution
- Materials in contact with Hydrogen
- Hydrogen Storage

HYDROGEN USE



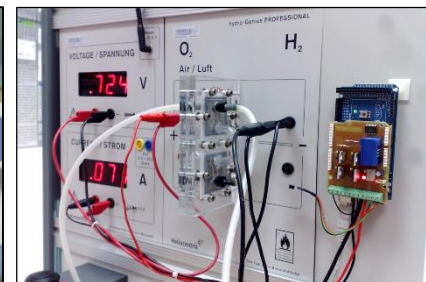
- Fuel Cells
- H₂ integration on Smart Grids
- H₂ use in transport systems
- H₂ use in the industry
- H₂ use in buildings

MATERIALS FOR H₂ DEPLOYMENT



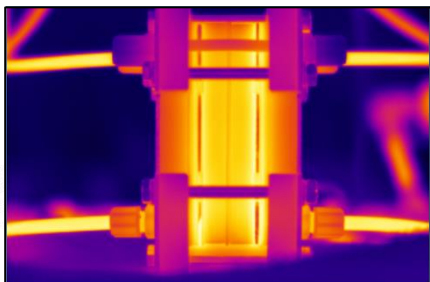
- Degradation related to Hydrogen
- Materials characterisation
- Surface engineering

PROCESS ENGINEERING FOR H₂ DEPLOYMENT



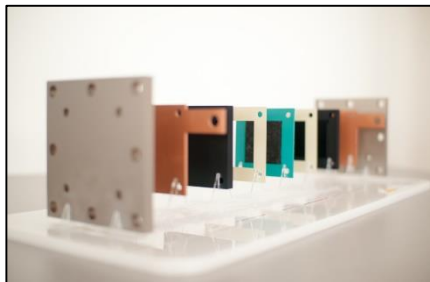
- Power electronics
- Support to digitalization
- Simulation
- Prototyping
- Support to manufacturing

Our Value Proposal in HYDROGEN PRODUCTION



ELECTROLIZERS

Development of alkaline electrolysis components (electrodes, membranes...) and cells. Development of stacks and systems. Electronic control and optimization for the Balance of Plants (BoP). Electrolyzer integration on energy systems.



PEM

Design, manufacture and scale up of MEAs and components of electrolyzers and fuel cells. Testing of components. Electrochemical characterization. Accelerated stress and durability tests. Measurement procedures.



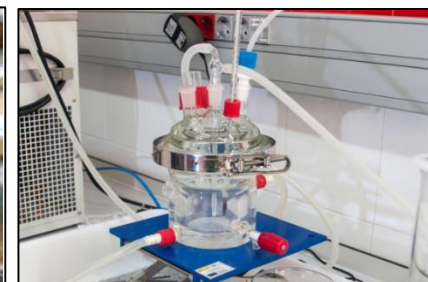
SOLID OXIDE

Electrochemical characterization and testing of SOFC and electrolyzers (up to 500W). Materials processing. Integration of material synthesis, sample fabrication and thin film deposition. Thermal treatments. Physicochemical characterization.



REFORMING / PYROLIS

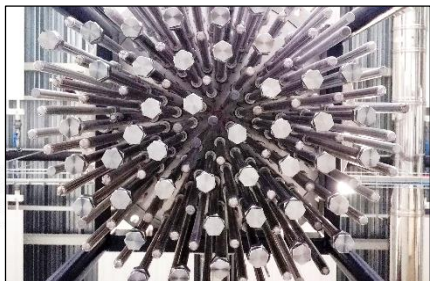
Development of smaller, cleaner and more efficient units: reducing the number of process operations; involving multifunctional equipment (process intensification). Novel membrane-based reactors. Hydrogen production from natural gas, biogas, methanol, ethanol, ammonia, and other sources.



BIOTECHNOLOGIES FOR H₂ PRODUCTION

Bio-H₂ production using microbial processes. Electricity production by different microbial fuel cells technologies. Microbial fuel cell-constructed wetland for wastewater treatment and power generation.

Our Value Proposal in HYDROGEN PURIFICATION, TRANSPORT & STORAGE



HYDROGEN PURIFICATION

Development of membranes for hydrogen purification from gas mixtures coming from several industrial processes. Membranes and membrane-reactors prototyping and construction. Selection of suitable membranes for specific applications.



POWER TO H₂

Conversion of green H₂ into synthetic natural gas (SNG) and other energy carriers. Synthetic natural gas production from green H₂ and captured CO₂.



H₂ INJECTION FOR DISTRIBUTION

Injection of synthetic natural gas coming from green H₂ and distribution by existing natural gas network. Distribution of natural gas and hydrogen mixtures using existing and updated networks. Materials, components and process for hydrogen injection in natural gas networks.



MATERIALS IN CONTACT WITH H₂

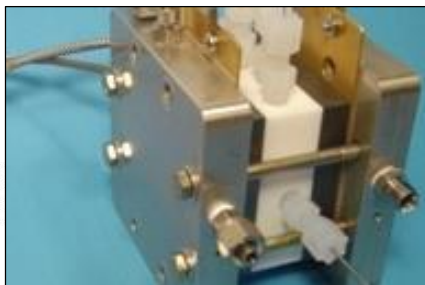
Selection and development of materials to be used in processes involving hydrogen to avoid fragilization and embrittlement problems.



HYDROGEN STORAGE

Presurized H₂ - working with pressures above the common standards for hydrogen storage technologies. Hydrogen storage as liquid H₂. Hydrogen storage in chemical systems: metal hydrides.

Our Value Proposal in HYDROGEN USE



FUEL CELLS

new developments at stack, module and/or fuel cell system level. Development and optimization of fuel cell balance of plant. New materials and components for Fuel Cells. Control and power electronics. Integration and application



H₂ INTEGRATION ON SMART GRIDS

Integration of the hydrogen as energy carrier with other energy storage solutions such as batteries and ultracapacitors. Techno-economic and environmental analysis.



H₂ USE IN TRANSPORT

Power plant configurations. Optimization of power converters and motor drivers. Characterization of vehicles under real operating conditions. Vehicle Refuelling / Charging. Powertrain and eDrive control development. Integration of complex hybrid systems



H₂ USE IN THE INDUSTRY

Development of new processes and modification of existing processes for the use of hydrogen instead of fossil fuels in energy intensive sectors.



H₂ USE IN BUILDINGS

Demonstration of the use of hydrogen technologies in the residential sector. Development and validation of hydrogen devices in homes (hydrogen based micro-cogeneration systems for instance).

Our Value Proposal in MATERIALS FOR H₂ DEPLOYMENT



DEGRADATION RELATED TO HYDROGEN

We support the selection of materials and development of protection techniques to improve performance in service conditions. We implement monitoring techniques to ensure the safety of industrial infrastructures, under a wide range of aggressive industrial conditions.



MATERIALS CHARACTERISATION

Chemical, structural and morphological characterization of materials and components, studying its evolution and degradation.

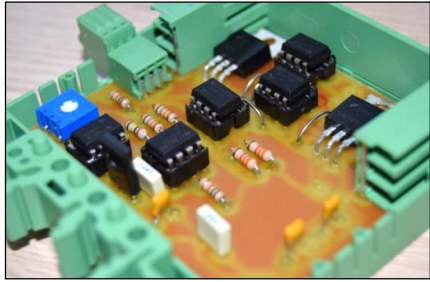
Analysis, characterization and quality control of materials and components before and after the material useful life.



SURFACE ENGINEERING

We solve industrial problems, such as wear, erosion, ageing, corrosion or bio-fouling. We provide support to improve the functional properties of materials and components, including: resistance to wear, rusting, optical or electrical properties. We also incorporate self-cleaning, anti-frost, anti-microbial, anti-fouling properties, etc.

Our Value Proposal in PROCESS ENGINEERING FOR H₂ DEPLOYMENT



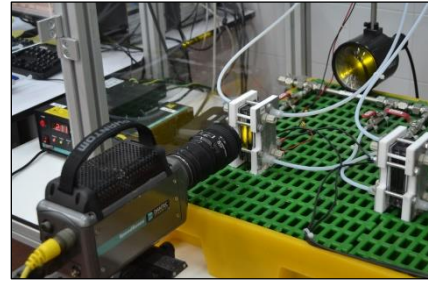
POWER ELECTRONICS

Development of control systems, communications and monitoring facilities. Development of equipment customized for hydrogen systems and fuel cells. Development of embedded and ad-hoc instrumentation and control equipment.



SUPPORT TO DIGITALIZATION

We develop long-term digital innovative solutions that put business at the top of the digital transformation. through the identification and the selection of technologies for the integration of the hydrogen in the new energy system.



SIMULATION

Thermo-fluid dynamic analysis: Thermal and fluid management of electrolyzers, fuel cells and auxiliary equipment, using CFD. Hydrogen leaks in open and confined spaces. Study of the matter and energy transport phenomena and their influence on parameters such as process efficiency or energy consumption.



PROTOTYPING

Development and manufacture of components and elements of hydrogen and fuel cell systems, membranes, membrane reactors....as well as assembly of test benches and support structures of systems.

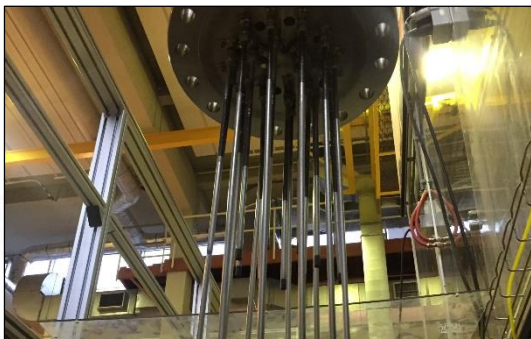


SUPPORT TO MANUFACTURING

Full fabrication of low power polymeric technology fuel cells and electrolyzers and the development of their BoPs and control systems. The digital equipment and the methods used can reproduce the fabrication processes developed at others Fab-Labs

HIGH VALUE HYDROGEN · TECHNOLOGIES AND SOLUTIONS FOR THE WHOLE HYDROGEN VALUE CHAIN | SOME RELEVANT ACHIEVEMENTS

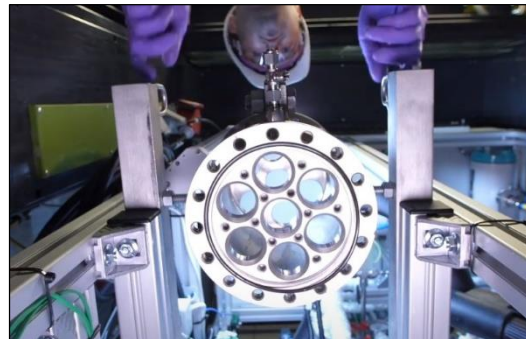
H2SITE - ADVANCED MEMBRANE REACTOR DEVELOPED FOR PURE HYDROGEN PRODUCTION AT SMALL TO MEDIUM SCALE



BIOGAS MEMBRANE REFORMER FOR DECENTRALIZED HYDROGEN PRODUCTION (BIONICO)



MEMBRANES AND CATALYSTS BEYOND ECONOMIC AND TECHNOLOGICAL HURDLES (MACBETH)



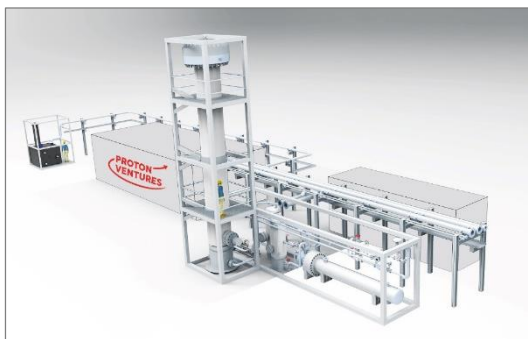
FLEXIBLE HYBRID SEPARATION SYSTEM FOR H₂ RECOVERY FROM NATURAL GAS GRIDS (HYGRID)



PROCESS FOR THE GENERATION OF RENEWABLE NATURAL GAS (RENOVAGAS)



ADVANCED MATERIALS AND REACTORS FOR ENERGY STORAGE THROUGH AMMONIA (ARENHA)



HYDROGEN IN GAS GRIDS: A SYSTEMATIC VALIDATION APPROACH AT VARIOUS ADMIXTURE LEVELS INTO HIGH PRESSURE GRIDS (HIGGS)



DEVELOPMENT OF ADVANCED SOLUTIONS FOR THE HYDROGEN TRANSPORT AND USE (SINATRAH)



HIGH VALUE HYDROGEN · TECHNOLOGIES AND SOLUTIONS FOR THE WHOLE HYDROGEN VALUE CHAIN | SOME RELEVANT ACHIEVEMENTS

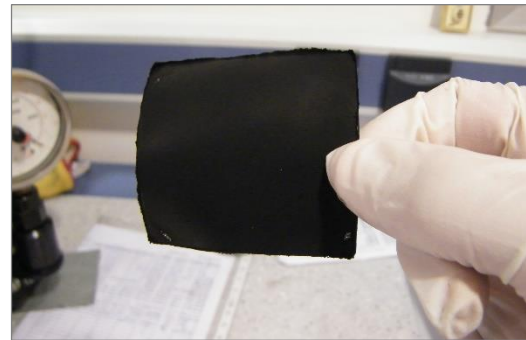
HYDROGEN-AEOLIC ENERGY WITH OPTIMISED ELECTROLYSERS UPSTREAM OF SUBSTATION (HAEOLUS)



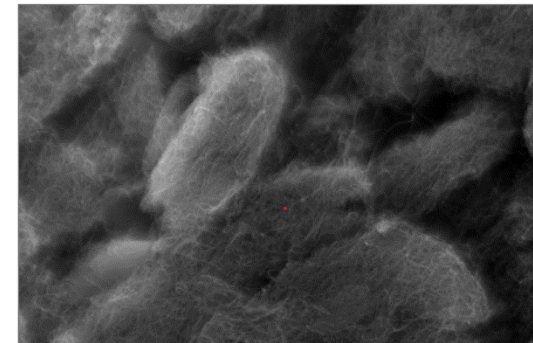
HIGH-CAPACITY HYDROGEN-BASED GREEN-ENERGY STORAGE SOLUTIONS FOR GRID BALANCING (INGRID)



INNOVATIVE FABRICATION ROUTES AND MATERIALS FOR METAL AND ANODE SUPPORTED PROTON CONDUCTING FUEL CELLS (METPROCELL)



DEVELOPMENT OF ADVANCED CATALYSTS FOR PEMFC AUTOMOTIVE APPLICATIONS (NANO-CAT)



ADVANCED CONTROL SOLUTIONS IN HOUSE DEVELOPED TOOLS DYNACAR®



HYBRID TRUCK POWERTRAIN



H2CAR - FUEL CELL VEHICLE PROTOTYPE



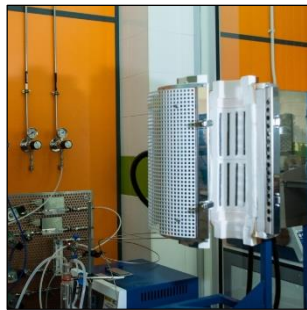
A FLEXIBLE NATURAL GAS MEMBRANE REFORMER FOR M-CHP APPLICATIONS (FERRET).

A wide range of high level infra-structures for technological development and testing purposes for the whole Hydrogen Value Chain

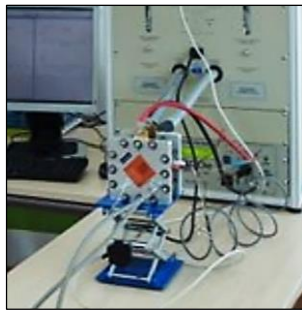
ALKALINE ELECTROLYSIS LABORATORY



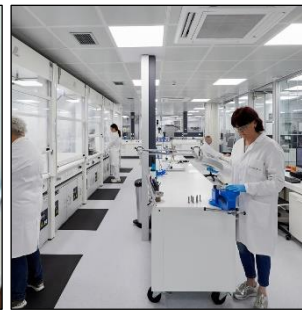
SOLID OXIDE TECHNOLOGIES LAB



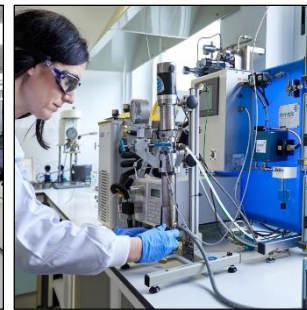
PEM TECHNOLOGY RESEARCH & SCALE-UP LAB



MEMBRANE TECHNOLOGY AND PROCESS INTENSIFICATION



SUSTAINABLE CHEMISTRY LAB



MATERIALS FOR EXTREME CONDITIONS LAB



SURFACES ENGINEERING LAB



HYDROGEN STORAGE LAB



PEM TECHNOLOGY TESTING LAB



MATERIALS FOR EMERGING APPLICATIONS LAB



SMART GRID AND DISTRIBUTED GENERATION LAB



MICROGRID LAB



POWER ELECTRONICS LABORATORY - THOR

HIGH VALUE HYDROGEN · TECHNOLOGIES AND SOLUTIONS FOR THE WHOLE HYDROGEN VALUE CHAIN | INFRASTRUCTURES & EQUIPMENT

VEHICLE
LAB

HYDROGEN
REFUELLING
STATION +
CHARGING POINT
FOR EV

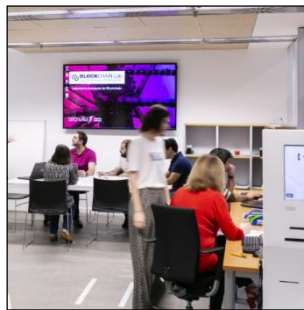
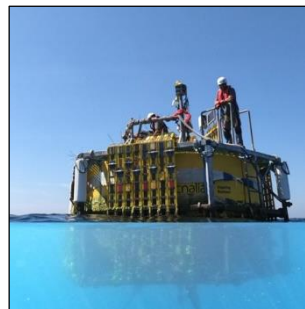
THERMAL
SYSTEMS AND
ENERGY
EFFICIENCY LAB

DOMESTIC
SYSTEMS
INTEGRATION
LAB

KUBIK
EXPERIMENTAL
BUILDING

HARSHLAB -
FLOATING
LABORATORY IN
REAL OFFSHORE
ENVIRONMENT

MATERIALS
CHARACTERISAT.
LAB



POWER
ELECTRONICS
LAB –
PUERTOLLANO

POWER
ELECTRONICS
LAB - BIZKAIA

CIBERSECURITY
IN SMART GRIDS
LAB

BLOCKCHAIN
LAB

SIMULATION
LAB

PROTOTYPING
LAB

FABRICATION
LAB

Strategic agreement with

Active participation in the following associations and platforms



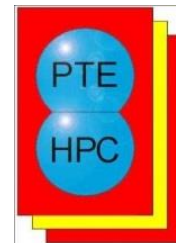
in the framework of membrane
reactors: process design &
optimization, membrane and
reactor development and scale
up, prototype development and
validation and techno-economic
analysis



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING



Ekain Fernández is the “coordinator of the Hydrogen
Distribution Technical Committee”, which forms part of the
Executive Committee of Hydrogen Europe.



TECNALIA and CNH2 have and active participation in the BASQUE HYDROGEN CORRIDOR (BH₂C)

BH₂C, is a project born by Petronor-Repsol to advance the decarbonization of sectors such as energy, mobility, industry or services.

- 78 organizations: 8 institutions, 12 knowledge centers and business associations and 58 companies.
- 34 projects from across the whole H₂ value chain. **We participate in a huge number of BH₂C projects and has a leading role in the Technological Development Roadmap.**
- 1.3 billion euros of investment by 2026,
- 650 million in green hydrogen production, 250 million for technological and industrial development, 50 million in the research of hydrogen applications in mobility, residential sector and industry.
- 1,340 direct and 6,700 indirect jobs.
- Annual production of 20,000 tons of hydrogen
- Reduction of more than 1.5 million tons of CO₂ per year.



SOLUTIONS FOR THE INTEGRATION OF THE HYDROGEN
INTO THE ENERGY SYSTEM OF THE FUTURE



For more information please
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