

*Hydrogen as Energy Carrier:
a Regional Venture*

**FOUNDATION FOR THE
DEVELOPMENT OF NEW
HYDROGEN TECHNOLOGIES
IN ARAGON**



Some strengths of Aragón

1. Energy development
2. Solid industrial sector
3. Strategic location
4. **Human resources:** the best value of society



Enterprising

Research

The Foundation: origin, stakeholders, mission, location

What we do: activity areas

Engineering and Consultancy, R&D, Educational Training, projects.

Publications

Partnership

Facilities & I7HER Project

Future



Foundation Origin

The Foundation was born as a **key player** for promoting strategic projects in hydrogen

Technical Workshop
Hydrogen and Fuel Cells
(31st of March 2003)



23rd December 2003:
signature of the
constitution by 28
stakeholders (**private non-
for-profit organization**)

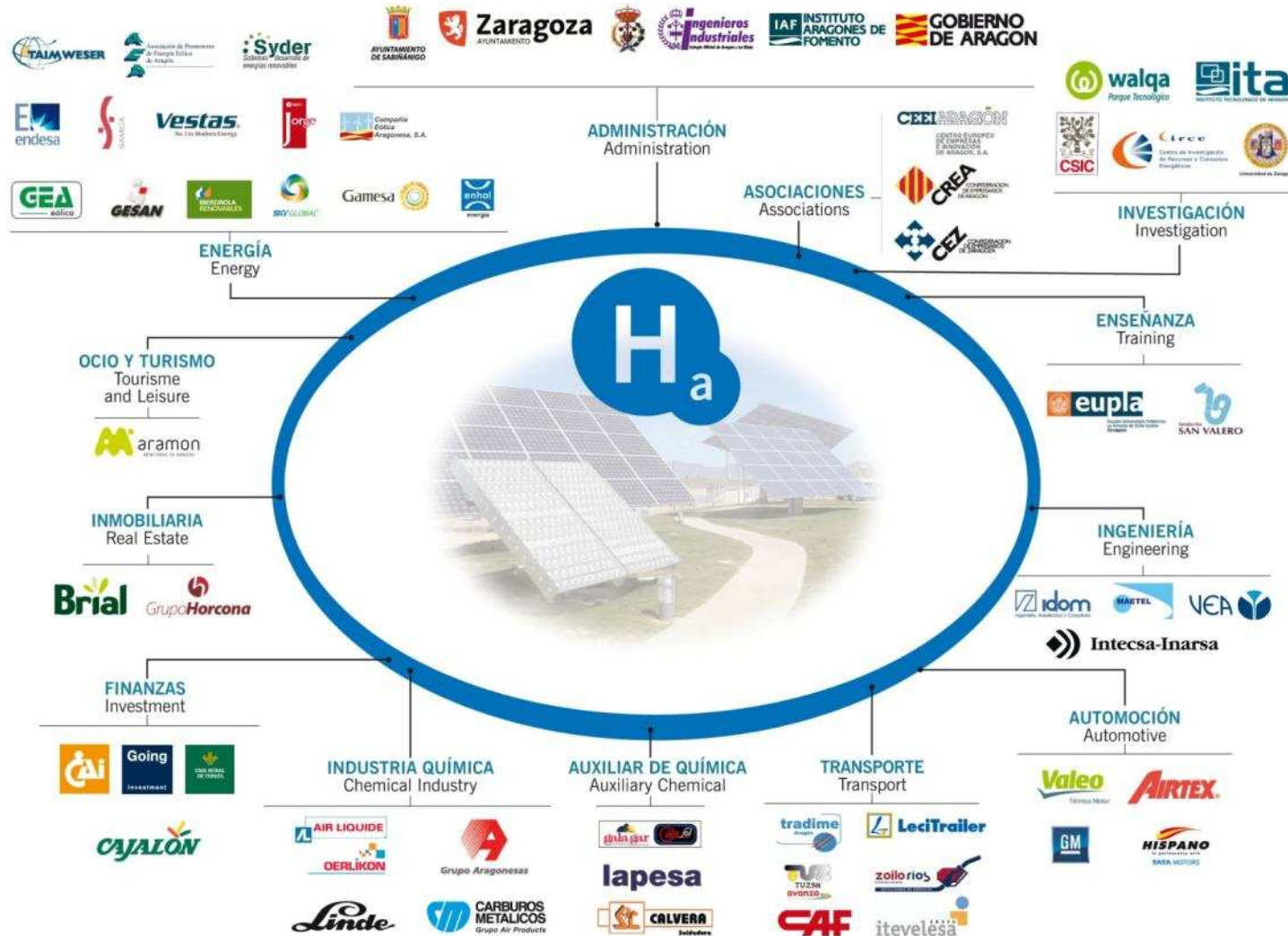
21st May 2004: official
registration of the Foundation

25th May 2004: First meeting
of the Council



Stakeholders

58 Stakeholders belonging to all relevant sectors.



Mission

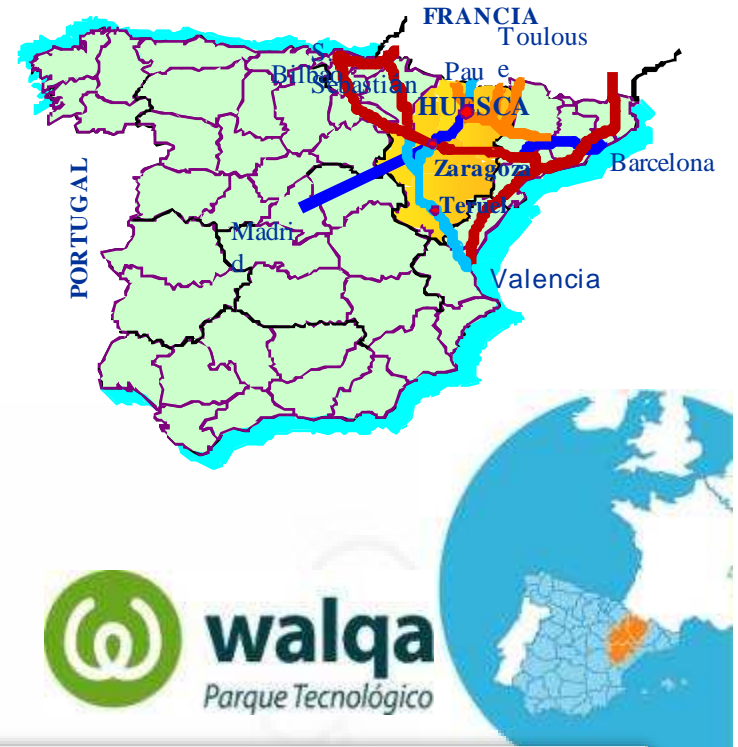
- Support the development of **strategic projects** which create employment, welfare, diversification and competitiveness of the industrial tissue.
- Develop a **strategic agenda** with a long time frame.
- Create a **network of industrial companies** which cooperate and generate future business opportunities based on hydrogen technologies

SMEs are key
for
employment

Renewable
Energies are
key for
sustainability



Location



What we do: work areas

➤ **ENGINEERING AND CONSULTANCY**

- Organization of regional, national and public finance.
- Technological surveillance
- Technology transfer
- Technical and economical feasibility analysis
- Development of hydrogen installations

➤ **R&D**

- Hydrogen production using electrolysis through wind and photovoltaic energy.
- Integration of fuel cells in applications, both automotive and portable and stationery applications.
- Hydrogen storage and management systems, carrying out validation tests on this technology.

➤ **EDUCATIONAL TRAINING**



What we do: work areas

➤ ENGINEERING AND CONSULTANCY

✓ **EDHa and ViTHa projects** strategic lines for the regional industry

20 SMEs assisted, different projects in H₂&FC and fundraising.

Regional funding: Ministry of Industry and Aragon Government

✓ **HY-TETRA:** Technological Transfer. Sixth Framework Programme

5 partners

- Spain
- Italy
- German
- Sweden
- UK



✓ Assistance for **EXPOAGUA 2008** H₂ projects

A compressed hydrogen gas **filling station** and FC vehicles



- Suppliers selection
- Writing specifications
- Monitoring projects and security studies
- Obtaining permits



➤ R&D

✓ R&D services for companies (SPHERA project):

- A cluster of five regional companies and three R&D centers participates in a 4 year long project to develop solutions for production, storage and distribution of hydrogen.

▪ 4M€



✓ Own lines:

- Hydrogen production by electrolysis
- Storage and Distribution systems
- PEM Fuel Cell integration
- FC applications

FORMULA ZERO. 1st go Kart in Spain with H₂ & FC

In collaboration with Eupla and Team Elias.



- ✓ **Collaboration with R&D centers** (Zaragoza University, CSIC, Spanish National Research Council) Software HOGA. Development by Zaragoza University. Allows to optimize hybrid systems with H₂)

➤ EDUCATIONAL TRAINING

✓ Innovative training **H₂- training Project**

First European Curriculum for technicians in H₂.
Leonardo Agency (10 partners from Austria, Italy, Spain, Germany, UK).
Results: **Curricula design and pilot experience**

✓ Master & Courses

Postgraduate programme in H₂ and FC specialization

In collaboration with Zaragoza University
Support thought 6 scholarships

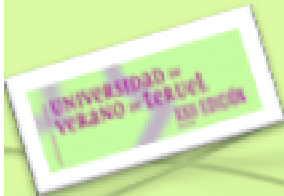
3rd edition, 32 students

Summer course in H₂

UNED-Barbastro, Summer University of Teruel (3rd edition)

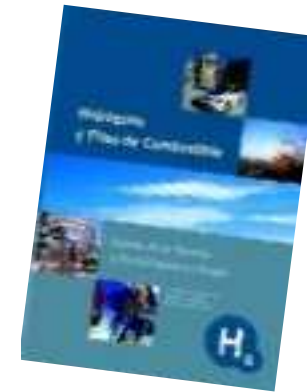
✓ Training on demand:

Development of training material for an online course, **SEAS**
Specific courses



100 students!!

✓ **Hydrogen and Fuel Cells
Technical state and Possibilities in Aragón (2005)**



✓ **Hydrogen Master Plan in Aragón (2007)**

- Technical state
- Strategic lines and opportunities, SWOT analysis.
- Support actions for regional SMEs



✓ **Who is who in hydrogen in Aragón? (2008)**

✓ Member of the Spanish Hydrogen Association, AEH2 and the Spanish Association of Fuel Cells, APPICE, collaboration organizing
The 2nd European Hydrogen Conference

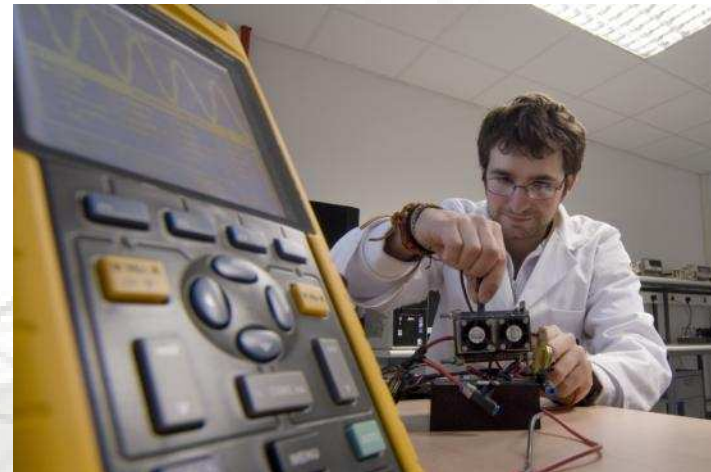


National Conference on Fuel Cells, CONAPPICE 2008.



- ✓ Spanish Platform of Hydrogen and Fuel Cells
- ✓ Participation in the standardization committee 181 of AENOR
- ✓ International Energy Agency, leading two groups:
 - Wind Energy and Hydrogen (Task 24) -23 members of 9 countries-
 - Integration System Evaluation (Task 18) -31 members of 19 countries-
- ✓ Aragon is member of the HyRaMP (European Regions and Municipalities Partnership on Hydrogen and Fuel Cells)
- ✓ Member of E.ENERGY, the Research Grouping of the JTI (Joint Technology Initiative).
- ✓ Certified in Technology Watch by AENOR, Norm 166006-EX.

- ✓ 1.200 m² building
- ✓ Labs (196 m²)
- ✓ Workshop equipped with all safety measures to handle hydrogen and to maintain vehicles (276 m²)
- ✓ Offices (240 m²)
- ✓ Library and showroom (160 m²)



Technological Infrastructure of Hydrogen and Renewable Energies

✓ **Real-scale test bench**, combining all available technologies for **PV and wind electricity generation, electrolysis, storage, and fuel cells**, connected to the electrical grid as well as stand-alone (unique features in the world).

✓ **2 M€ investment**, financed by the Ministry of Education and Science (ref. PCT-A22266217-2005), Regional Government and own resources.

✓ **Photovoltaics: 60 kW on the roof of the parking**

✓ **Plus 1,7 kW at roof's building**



Technological Infrastructure of Hydrogen and Renewable Energies

- ✓ Photovoltaics: 41 kW
- ✓ Displaying all state-of-the-art technologies.
- ✓ Fully operational from September 2007.



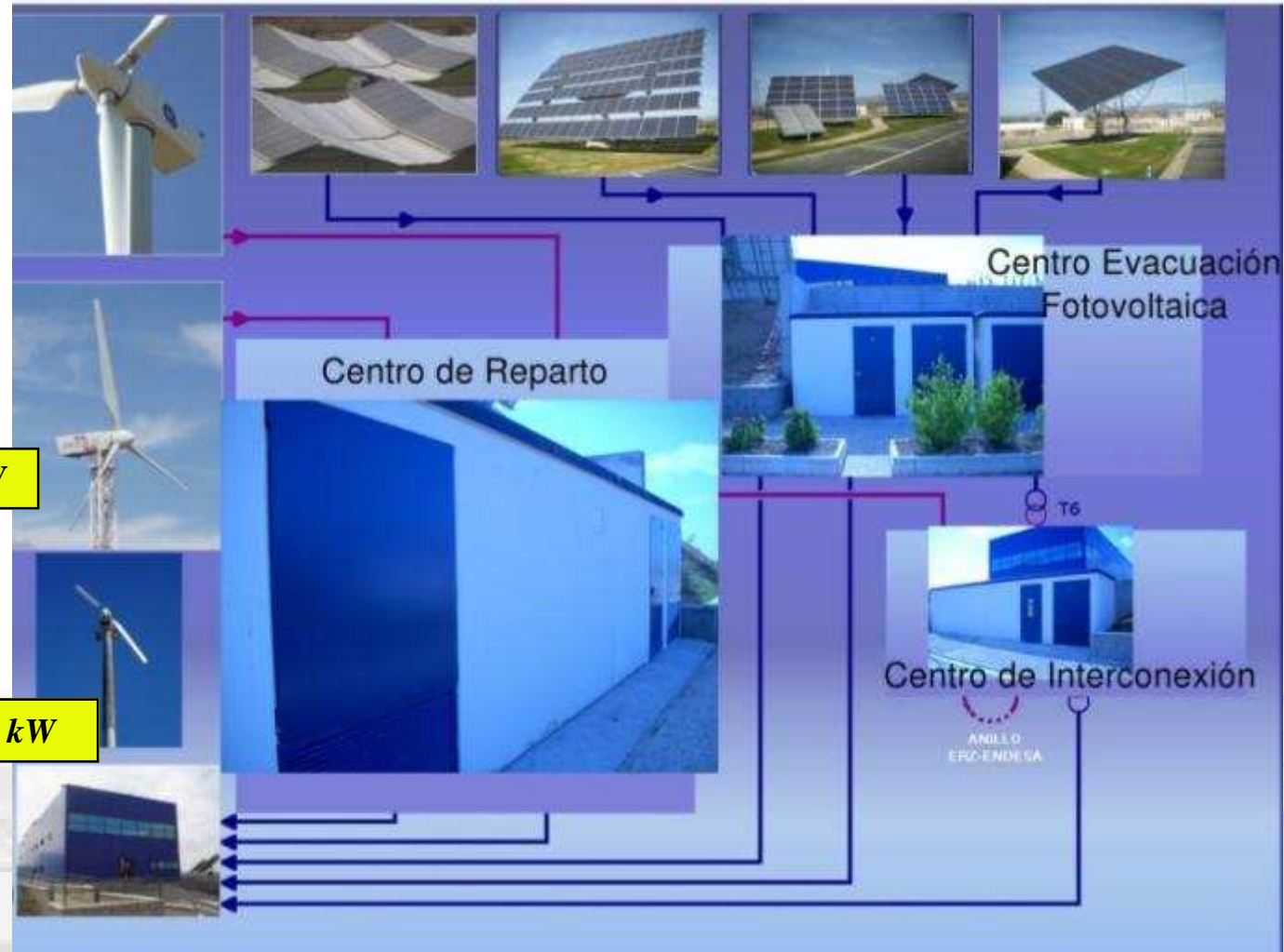
ITHER Project

- ✓ Wind energy: 635 kW in three different turbines.
- ✓ In operation from mid November 2007.

VESTAS V29-225 kW

ENERCON-E33/330 kW

LAGERWAY-LW18/80 kW



Lab for hydrogen generation from RES:

- ✓ Electrolyser, fuel cells, metal hydride and compressed gas storage.
- ✓ In operation since December 2006.



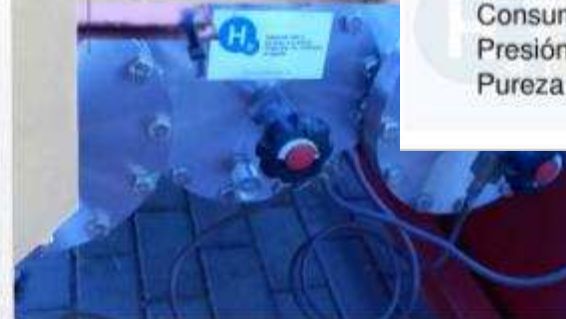
Pila de combustible
Producción: 5kW
Temperaturas de op.: -40°C a 46°C
Consumo: 64 NI/min a 5 kW
Presión de alimentación: 5.5 bar
Pureza req.: 99.99% vol.



Electrolizador Alcalino
Producción: 10 Nm³ H₂/h
Pureza: 99.8 a 99.9% vol.
Consumos:
Energía 4.3 a 4.6 kWh/Nm³
Agua 0.85 l/Nm³ H₂
Refrigerante (H₂O) 40 l/Nm³ H₂



Electrolizador Polimérico
Producción: 0.53 Nm³ H₂/h
Pureza: 99.9995% vol.
Consumos:
Energía 6.7 kWh/Nm³
Agua 0.94 l/h



Hidruros metálicos
Capacidad: 5 Nm³ H₂/cilindro
Peso: 76 kg (34kg MH)
Presión de carga: 15 bar
Tiempo de carga: 45-60 min.
Tiempo de descarga: 10 min. a 2 bar

ITHER Project

Technological Infrastructure of Hydrogen and Renewable Energies

National Engineering Award 2007

In the “Industrial Project” category, awarded by the General Council of Official Colleges of Industrial Engineers.

Reception by His Highness Prince Felipe de Borbón



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