





Sustainable Mountain Huts in Europe. Is it possible to use H2 technologies in mountain huts?

LIFE SUSTAINHUTS

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LIFE15 CCA/ES/000058





European Air Quality Index







WHO WE ARE?



The Foundation for the Development of New Hydrogen Technologies in Aragon (FHA) is a private, not-for-profit entity, <u>created to promote the use of hydrogen as an energy vector</u>.

Research and Technological Development Center, key instrument for <u>the promotion of strategic</u> <u>projects</u> around the hydrogen, renewable energy, electric vehicles, energy efficiency. With the purpose of generating, storing and transporting hydrogen, for its use in fuel cells, in transport applications or for the generation of distributed energy.

FHA aims to foment research, technological development, cogeneration and industrial adaptation, contributing to **industrial modernization and improved competitiveness**.



Created: December 23rd 2003

First meeting of Board: May 25th, 2004



Facilities and Infrastructures



- Location: Walqa Technology Park, in Huesca
- Building: Part of the Technological infrastructure Hydrogen and Renewable Energies project (ITHER)*
- Facilities: Unique in Spain to work with large scale hydrogen equipment/systems (8.5 m in height, safety measures (ATEX, gas detection equipment and ventilation)



• Infraestructure: TEST BENCH at the services of companies for developing new projects and technologies.

* Awards: International Energy Agency (IEA) (2010) and Spanish National Engineering (2007)



COMPETENCES

- 1. Private R&D&i Partnerships
- 2. Public R&D&i Partnerships
- 3. Public-Private R&D&i Partnerships
- 4. Collaboration Agreements
- 5. Training
- 6. Technology Transfer Agreements





Departamento de Innovación, Investigación y Universidad

Grupo Investigación reconocido H2+I: Hidrógeno para la Investigación

> PLAN ESTATAL DE INVESTIGACIÓN CIENTÍFICA Y TÉCNICA Y DE INNOVACIÓN 2013-2016





Objectives of LIFE SUSTAINHUTS







To improve the sustainability of mountain huts through renewable energy integration, energy efficiency and insulation.



10 European huts involved in 4 different countries (hydrogen storage system in one hut).



Replication in other isolated systems in Europe

This project is financied with European Union LIFE programme, under the agreement nº LIFE15 CCA/ES/000058



European Commission









Set of mountain huts

SustainHuts











Technologies identified







PV







Mini-wind





Automatization





Thermo-chimney

Pellet stove

Hydrogen

Hydrogen



Electrification

Solar thermal



Novel insulation



Hydrogen in Bachimaña











Hydrogen in Bachimaña









Basic info of the hut







- Hot water, bar service, nursing, heating, lockers, radio, telephone, webcams, heliport and weather data collection.
- ✓ Goods and fuel supplied by helicopter.

- Opened in 2012, 80 accommodations
- ✓ 2200 m of altitude
- ✓ Off-grid





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Configuration proposed







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Restrictions / boundaries

- ▶ Budget (90,000€)
- Main elements should be prototypes (specifically for project, not available as serial prodcut, ...)
- High altitude (2,200 m)
- ► No roads (helicopter)
- Many months to produce H2

Solution

- ▷ No compressor (for simplicity)
- Small production (0.25 Nm3/h = 0.5 kg/d) @ high pressure (50 bar)
- PEM technology (off-grid, easy maintenance)
- \triangleright High efficient FC at any altitude
- The maximum storage allowed by budget



Electrolyser





Supplier: Hidrógena (Spain)

Specifications:

- PEM Technology
- Production 250NI/h, purity 99.995%
- Pressure regulation from 0 to 50 bar.
- Local console for process control and monitoring of status
- Ethernet connection for data acquisition and remote operation
- Pressure and temperature sensors
- Water tank
- Automatic warning and alarm system





Fuel Cell





Supplier: Spectronik (Singapur)

Prototype includes an <u>altitude dependent oxidant blower control</u>: to combat less oxygen supply in higher altitude, an altitude sensor is installed in the fuel cell to adjust the oxidant blower accordingly to push more air into the fuel cell

Туре	PEM, closed cathode, air-cooled
No. of cells	40
Voltage range	24-36 VDC
Rated power	1608W (67A @ 24V)
Operating ambient temperature	[-15,57]°C
Operating altitude	5000m (with power derating)
Delivery pressure	0.5-0.7 barg (7-10 psig)
Fuel consumption	20L/min @1600W
Gas tubing	OD 6mm PU
Start-up time	<10s
Electronic controller	Welter V1.5
Power output connector	XT-90
Wireless communication	3G/4G/LTE modem
Data acquisition software	HyperTerminal/ Graphic User Interface
System protection	Low voltage, high temperature, low fuel supply
Remote control	Periodic maintenance, fan speed, hard restart, manual purge,
	blower speed
Overall system weight	4600g







Storage alternatives





Limitations: weight carried by helicopter (800 kg), low footprint (public mountain), tough climate conditions



Type IV tank 2 x 850 L @60 bar

Supplier: MAHYTEC, FR

Carbon fiber rack of bottles 18 x 50 L @200 bar

Supplier: Calvera (Carbotainer), ES

1800 L @40 bar Supplier: Lapesa, ES

Steel tank

Selected:

- cheap, low weight, customizable (horizontal), no modifications required if compressor is eventually installed
- 4 kg of H2 will be stored, enough for demo purposes



Other examples of H2 in huts (not in Sustain Sustain States of H2 in huts (not in Sustain States of States



Col du Palet (2600 m)

- Electrolyser: 0,5 Nm3/h (2,5 kW)
- ▷ Photovoltaic energy source
- Storage: 5 kg @ 30 bar (MAHYTEC)
- Pem Fuel Cell: 2,5 kW. Use for pumping drinking water
- \triangleright In operation since 2015
- \triangleright Developed by POWIDIAN
- ▷ Budget: 200,000 € (80% FEDER)









- Permit requested to Panticosa municipality in April 2019, accepted on June 2019 (affected by local elections). Official project not required, just a supporting report of the H2 installation.
- ☑ The main elements are **in fabrication** (electrolyser, storage, fuel cell)
- ✓ Installation was scheduled for November 2019, but delays in fabrication and snow prevent to do it this year (hut is opened but helicopter is not allowed to fly)
- ☑ Components and installation are within the budget
- Electrolyser and Fuel Cell to be installed in the basement (well ventilated), storage outside the building
- ☑ First year it will be operated manually, aiming at remote control & monitoring later







- ✓ LIFE SUSTAINHUTS is a project aiming at **improving sustainability** of mountain huts: air quality, climate change mitigation
- **25 technologies** are being installed in 10 huts in 4 European countries
- ☑ A seasonal storage of energy based on Hydrogen is in progress in Bachimaña (Spain) tapping excess of renewable energy (hydro) during summer and winter to be used in spring
- Electrolyser (0.5 kg/day @50 bar, prototype), storage (carbon fiber, 4 kg) and Fuel Cell (1600 W, prototype) are in fabrication. During 2020 the system will be in operation.
- ☑ Project ends in June 2021.







