Hiperbaric
HIGH PRESSURE TECHNOLOGIES

2023 KOREA EUREKA Day

Meet with **SPAIN**

Daniel Ballorca-Juez

Hydrogen Project Manager, HIPERBARIC

GOBIERNO DE ESPAÑA · MINISTERIO DE CIENCIA E INNOVACIÓN · CDTI INNOVACIÓN

Ministry of Trade, Industry and Energy · Eureka TURKIYE · beyond leading technology KIAT Korea Institute for Advancement of Technology · Keit Korea Evaluation Institute of Industrial Technology · KETEP Korea Institute of Energy Technology Evaluation and Planning

Hiperbaric
HIGH PRESSURE TECHNOLOGIES

HIPERBARIC

High Pressure Hydrogen Compression Technology

Daniel Ballorca-Juez
October, 223

Hiperbaric
HIGH PRESSURE TECHNOLOGIES

ABOUT HIPERBARIC

Hiperbaric, Technology for **Climate Neutrality**

Corporate Consistency

H_2 Compression Technology as a key business line of Hiperbaric

Technological Innovation

Pioneer Company, in Spain and Europe, in the development of proprietary & differential technology, key in the H_2 Value Chain Considered a strategic company by the CDTI (Ministry of Science and Innovation)

Concerned Stakeholders

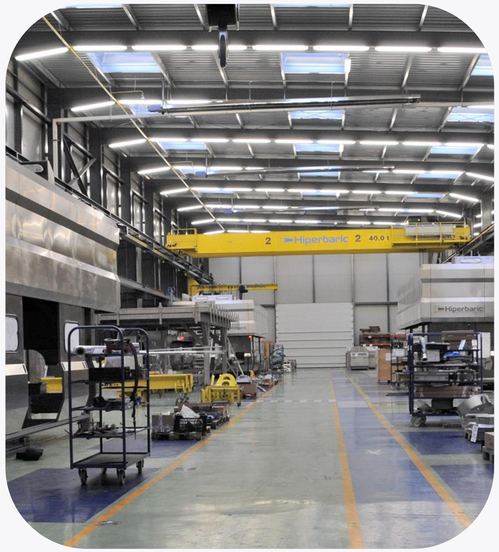
Great impact of our people, customers, partners, suppliers and society on our culture of sustainability

Technology for the World

Our Compression Technology, installed in Spain and Europe, is deploying worldwide

GLOBAL LEADER IN HIGH PRESSURE TECHNOLOGIES

Hiperbaric



Founded in 1999, Hiperbaric designs develops, produces, and markets its high pressure industrial equipment all over the world.

24+
Years

140+
Employees

62M €
Revenue in 2022

22M €
R&D Projects

1.000+
Water compressors

50+
Countries

HIPERBARIC WORLDWIDE

Hiperbaric offices

Hiperbaric, S.A.

C/ Condado de Trevino, 6

09001 Burgos, Spain

Hiperbaric Asia

16 Raffles Quay #33-03

Singapore, 048581

Hiperbaric USA

2250 NW 84th Ave. Unit #101

Miami, FL 33122

Hiperbaric Mexico

San Luis Potosi

Hiperbaric Oceania

Australia

New Zealand

INTRODUCTION

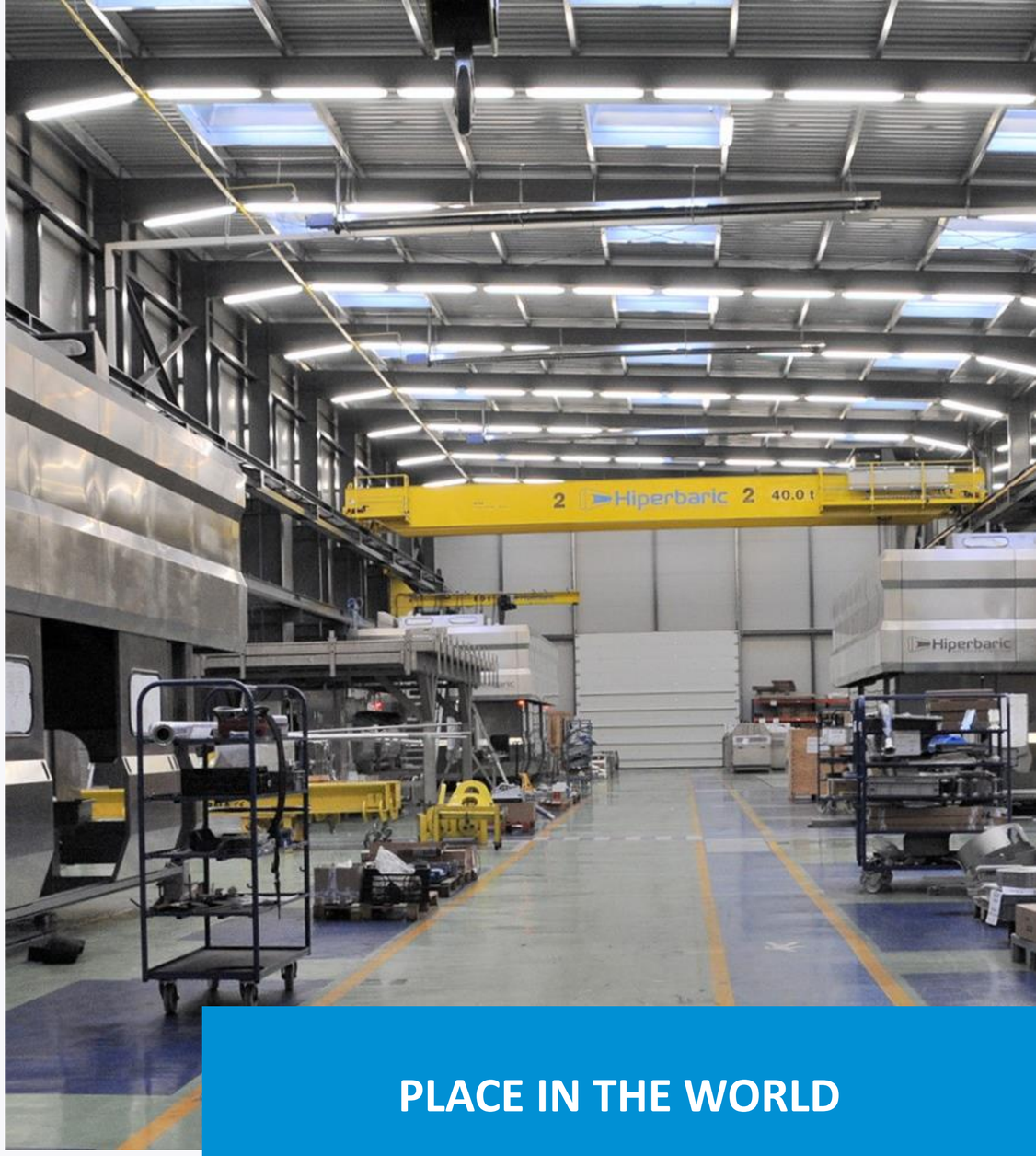
About Hiperbaric

Since 1999, we have been an international leader in the design, manufacture and marketing of **High-Pressure Technologies**

Hiperbaric
HIGH PRESSURE PROCESSING

Hiperbaric
HYDROGEN GAS COMPRESSION

Hiperbaric
HOT ISOSTATIC PRESSING



PLACE IN THE WORLD

Our company DNA is comprised of Innovation, Quality and Reliability.

Quality Standards & Certfications

The Integrated Management System for design and production of high pressure equipment of Hiperbaric is certified by AENOR in accordance with requirements ISO 9001, ISO 14001 and ISO 45001. It guarantees the quality assurance of our products and services.

ISO 9001

ISO 14001

ISO 45001

Experts in **High Pressure Technologies**

HPP

High Pressure Technologies

- *Food & Beverage*

Hydrostatic compression technology: water at 6,000 bar

+1,000 intensifiers installed in the world in 24 years

H_2

Hydrogen Compression

- *Sustainable mobility & industrial storage*

Complete H_2 Compression Solution up to 1,000 bar

H_2 refueling stations, storage and transportation

HIP

Hot Isostatic Pressing

- *3D Metal & Ceramics Components*

First Spanish HIP equipment: argon at 2,000 and 1,400°C

Quality for high-performance components

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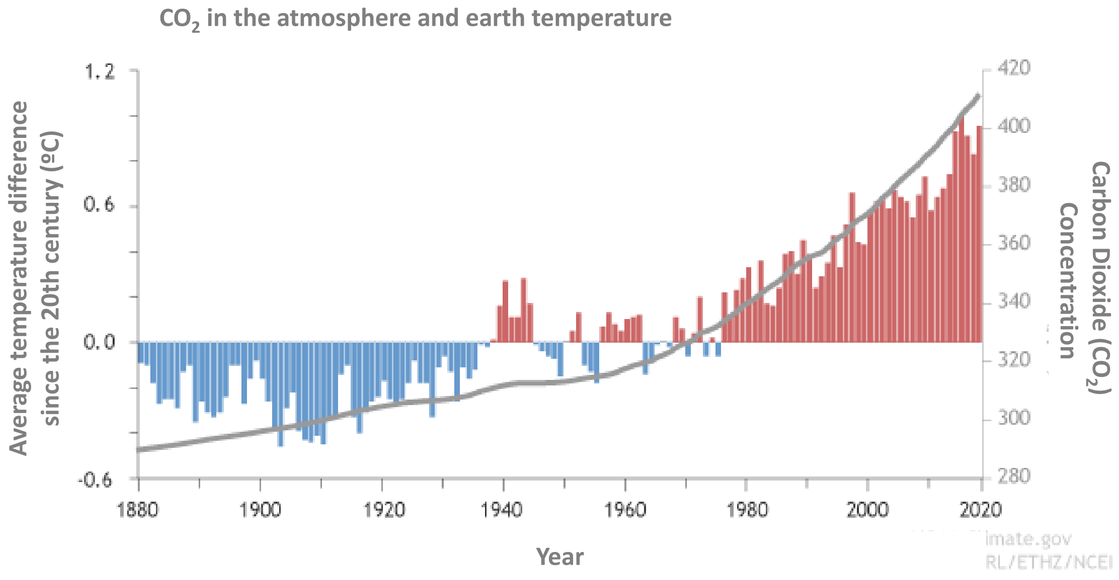
HIGH PRESSURE TECHNOLOGIES

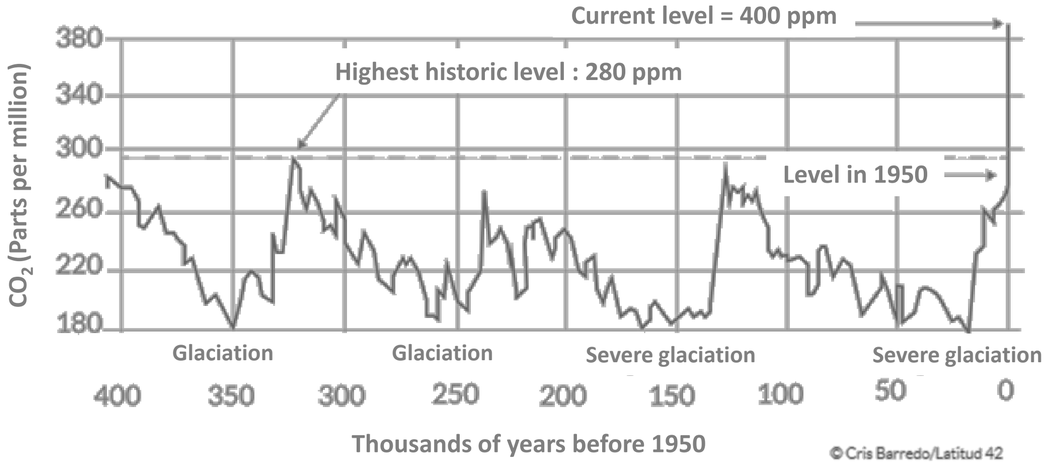
WHY IS IT NECESSARY TO **DECARBONIZE THE PLANET?**

WHY IS IT NECESSARY TO DECARBONIZETHE PLANET?

Exponential increase of CO_2 emissions

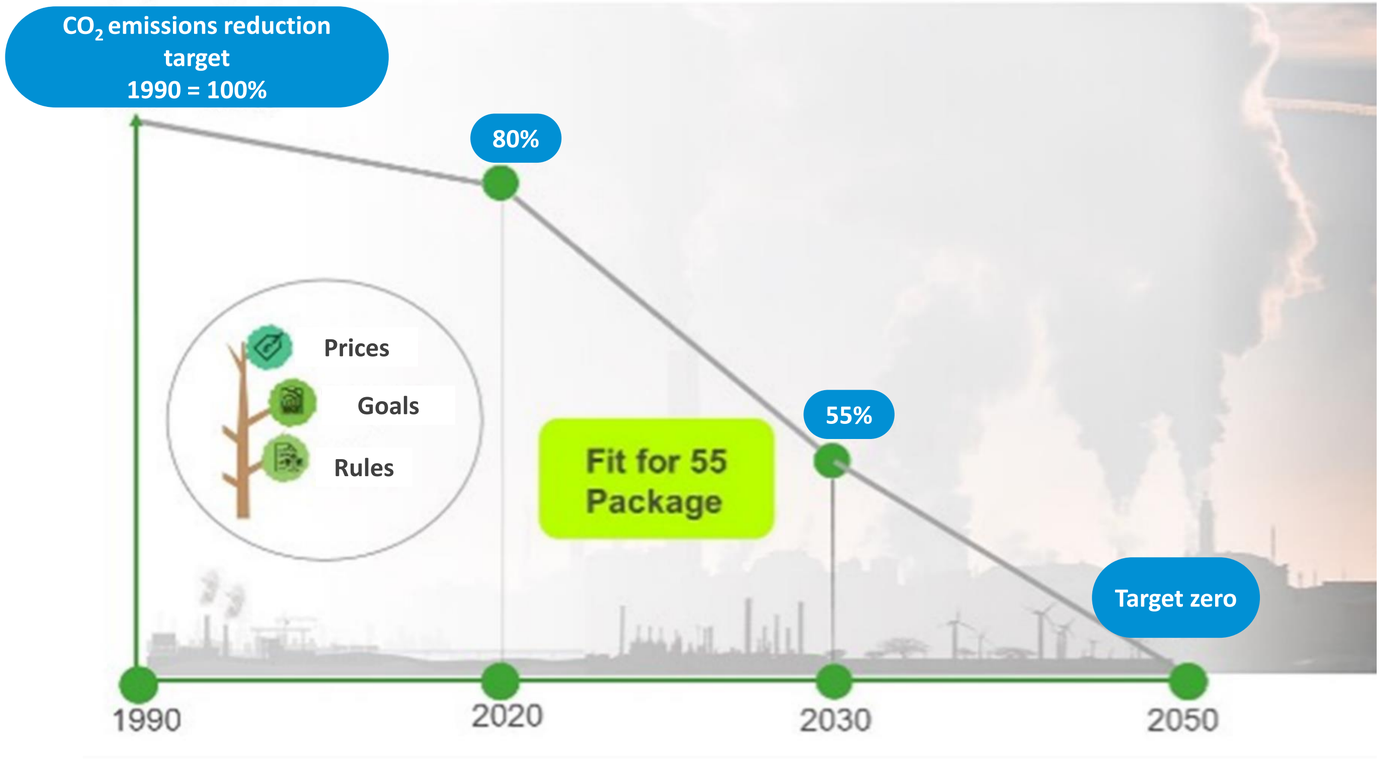
Excessive CO_2 leads to **greenhouse effect** and causes **global warming**





*More than **50%** of CO2 emissions emissions occurred **in the last 30 years***

European objective: **to reduce CO_2 emissions**



Fit for 55

The intermediate target involves reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

European Green Deal

Achieving climate neutrality in a fair, cost-effective and competitive manner by 2050

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HIGH PRESSURE TECHNOLOGIES

SOLUTION: DEVELOP THE ECONOMY OF **RENEWABLE H_2**

SOLUTION: DEVELOP THE ECONOMY OF RENEWABLE HYDROGEN

Green or renewable **hydrogen**

Hydrogen is not an energy source, but an **energy vector.** Until now, most of it has come from fossil fuels. It can also be obtained from **different renewable natural resources such as solar or wind energy.**

During the electrolysis, the water molecule is broken down by electricity into hydrogen and oxygen.

Aplicaciones del Hidrógeno verde

- **Sustainable** mobility
- **Industry**
- **Residential**
- Renewable **raw material**

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HIGH PRESSURE TECHNOLOGIES

Our SOLUTION

HIPERBARIC'S SOLUTION

High Pressure Hydrogen Compression

In-depth knowledge in **high pressure technology**

+

Concern about the weather emergency situation

H2

Hydrogen Compression

Complete solution to

Compress H_2 up to 1,000 bar

What is **Hydrogen Compression**

Hiperbaric
HYDROGEN GAS COMPRESSION

Challenge**: Decarbonization**

Hydrogen is causing a revolution as a result of it being a clean energy source. A dramatic increase in the number of refueling stations, or hydrogen stations, will soon become a reality.

H_2 presents some storage challenges due to its low density at ambient temperature and pressure

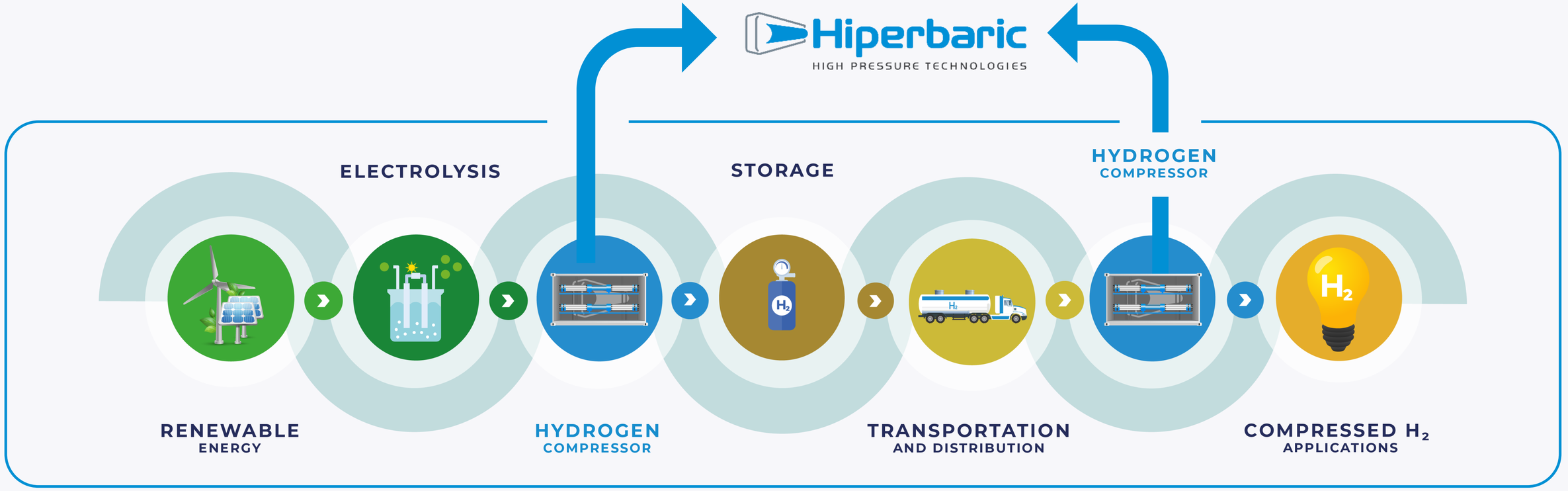
Solution: **Hydrogen compression**

One solution to densify hydrogen, and the most economical, is to compress it to very high pressures of up to 1,000 bar.

This way the volume is considerably reduced and make it possible to be transported to the final location where the hydrogen will be used.

Our mission in the H_2 Value Chain

Hiperbaric develops **high-pressure hydrogen compression technology** as an energy vector for the transition towards **sustainable economy and decarbonized mobility**



Main Applications of Hydrogen Compression

High Pressure Storage

Storing hydrogen is a challenge: low density and flammable gas. Compressing hydrogen at high pressures as a solution.

Tube Trailer Filling

Depending on each project, compressed hydrogen needs to be transported to the place where it will be finally used.

Hydrogen Refuelling Stations

HRS have the potentialto process the hydrogen on-site or have it transported to the station ready-processed.

HIPERBARIC'S SOLUTION

Use of compressed H_2 **for mobility**

Hydrogen has a high calorific value per unit mass

1 kg of hydrogen is equivalent to about 3 kg of gasoline.

At atmospheric pressure and 25°C, the calorific value of H_2 per unit volume is very low.

H_2 is about 13 times less dense than air

In order to achieve efficient transport, storage and mobility application, it is necessary to increase the density of H_2

The most efficient method is compression

Pressure: **700 bar**
Temperature: **25ºC**

- 150 l tank
- Refueling in 5 minutes
- Autonomy: 800 Km

1 Kg of H_2 = 100 km

With compressed H_2 at 7-8 €/ kg, the cost will be similar to that of diesel or gasoline

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HIGH PRESSURE TECHNOLOGIES

HYDROGEN COMPRESSION TECHNOLOGY

HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric **Compressor Groups**

- **Plug-and-play solution**, adaptable to any level of production and demand of up to**500 or 1000 bar**

“Oil-Free” concept guarantees high purity of hydrogen

Efficient cooling thanks to the innovative design of the intensifier cylinder

Modular and scalable design One or two intensifiers depending on the desired flow rate.

Complete plug-and-play solution just needs electricity and power

HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric **Compressor Groups**

- **Plug-and-play solution**, adaptable to any level of production and demand of up to**500 or 1000 bar**

Noise level: average 69dB noise pressure level (*in a 1m perimeter*)

Complete turndown of the unit: 0-100% flow adjustment

Safe and reliable, thanks to the vent system that monitors, evacuates and stops the compressor from gas detection.

HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric H_2 Compressor Groups

Compressor Group **Components**

- **Intensifier Cylinder**
- **Hydraulic System**
- **Refrigeration System**

- **Vent Circuit**
- **Instrumentation & Control Panel**
- **Pneumatic Circuit**

Two-Stage Intensifier Cylinder

The most important component is the **reciprocating hydraulic driven piston technology**, which has different sections to carry out the compression.

Two-stage compression cycle
With cooling between them

High efficiency cooling system as the
Heat is extracted close to the source

Maximum purity of H_2 due to the
Absence of oil in the pistons

HYDROGEN COMPRESSION TECHNOLOGY

Compressor **Range**

Range of compressor groups **adaptable to any level of production and demand**, and to **different suction and discharge pressures**: from 20 bar to 500 or 950 bar

	Hiperbaric 1 KS 50	Hiperbaric 1 KS 95
Inlet hydrogen pressure	20 - 40 bar	20 – 200 bar
Outlet hydrogen pressure	Up to 500 bar	Up to 950 bar
Approximate **flow rate**	26 kg/h	15 kg/h

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HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric KS 50: up to 500 bar

Our compressor solutions up to 500 bar for heavy-duty HRS, storage and tube trailer filling

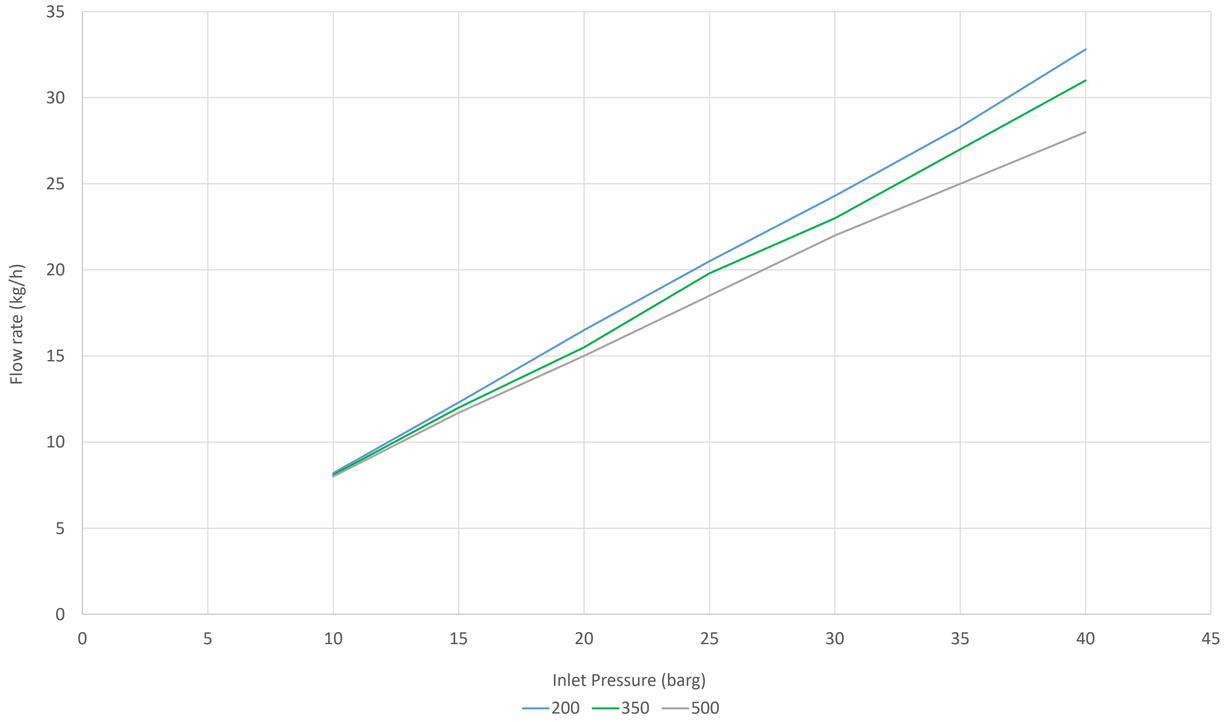
Model	Outlet max pressure (barg)	Hydrogen flow (kg/h)*	Hydrogen flow (kg/day)*	Energy consumption (kWh/ kg of H_2)*	Total Installed Power (kW)
1KS50	500	24	565	1.3	75
1KS50 Pro	500	32	772	1.3	105
2KS50	500	47	1130	1.4	120
2KS50 Pro	500	64	1544	1.4	180

*inlet pressure: 30 barg - Outlet pressure: 500 barg

HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric KS 50: up to 500 bar

Our compressor solutions up to 500 bar for heavy-duty HRS, storage and tube trailer filling



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HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric KS 95: up to 950 bar

Our compressor solutions up to 950 barfor light vehicles HRS

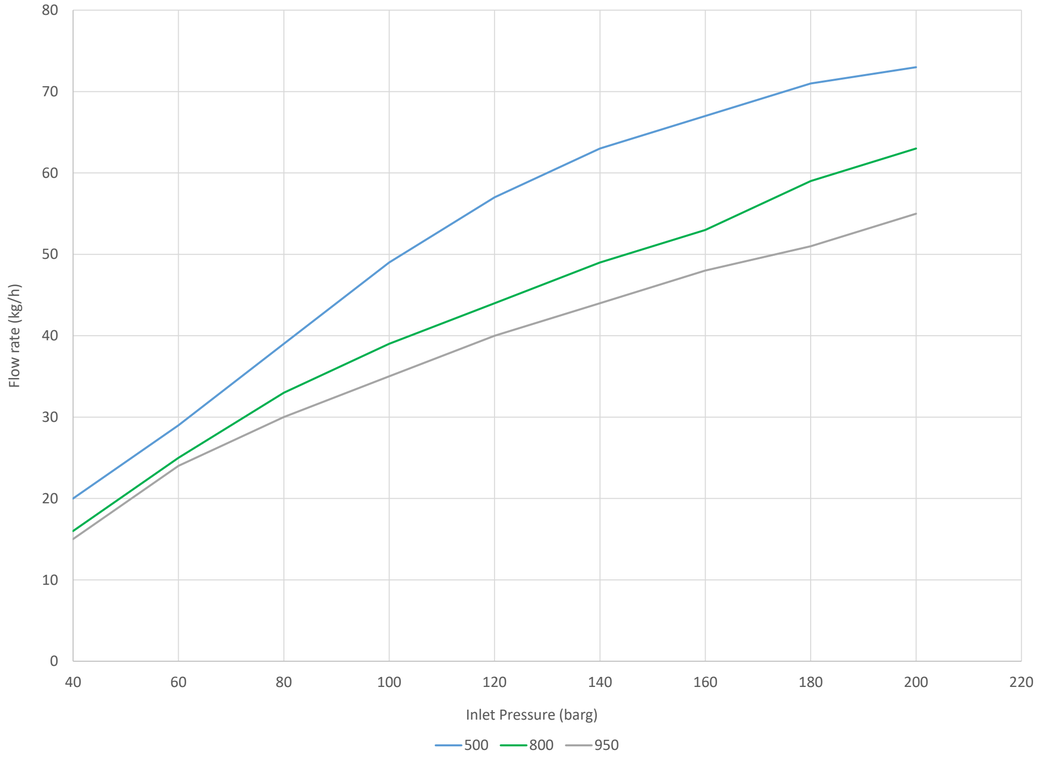
Model	Outlet max pressure (barg)	Hydrogen flow (kg/h)*	Hydrogen flow (kg/day)*	Energy consumption (kWh/ kg of H_2)*	Total Installed Power (kW)
1KS95	950	10	236	4.6	75
2KS95	950	20	471	4.6	120
1KS95 Pro – 1KS95	950	32	756	2.4	110

*inlet pressure: 30 barg - Outlet pressure: 950 barg

HYDROGEN COMPRESSION TECHNOLOGY

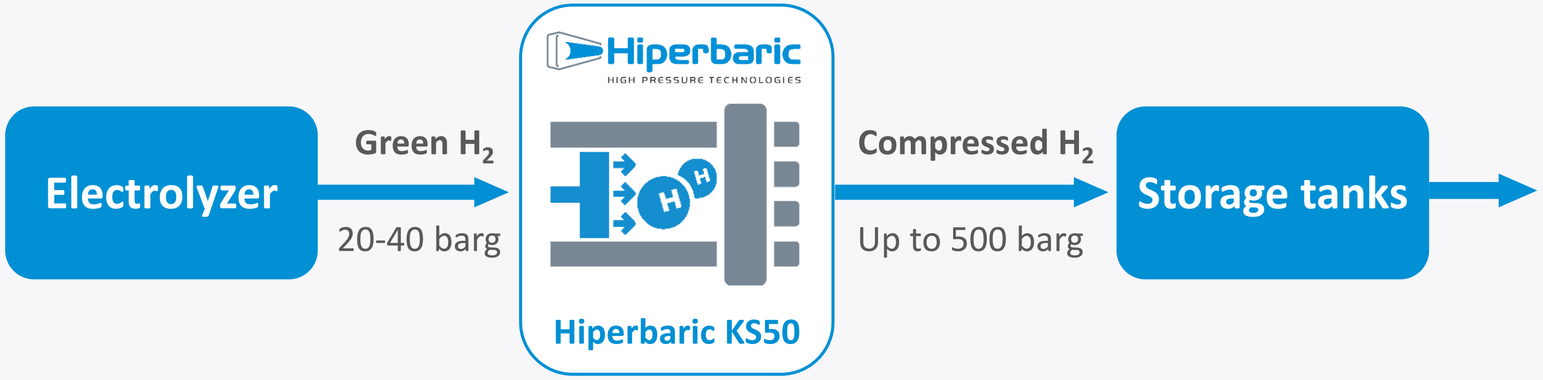
Hiperbaric KS 95: up to 950 bar

Our compressor solutions up to 950 barfor light vehicles HRS



HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric **KS50** Compressor **for Onsite H_2 Production**



Tube Trailer filling

- At 200-350-500 barg

HRS

- Heavy duty
- Material handling
- Trains
- Marine vessels

Industrial Uses

- Chemistry
- Heat intensive applications

Residential

HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric **KS50** Compressor **for Offsite H_2 Production**

H_2 Tube trailer

Green H_2

20-40 barg

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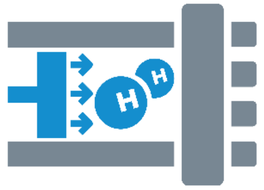


Hiperbaric KS50

Compressed H_2

Up to 500 barg

Storage tanks

HRS

- Heavy duty
- Material handling
- Trains
- Marine vessels

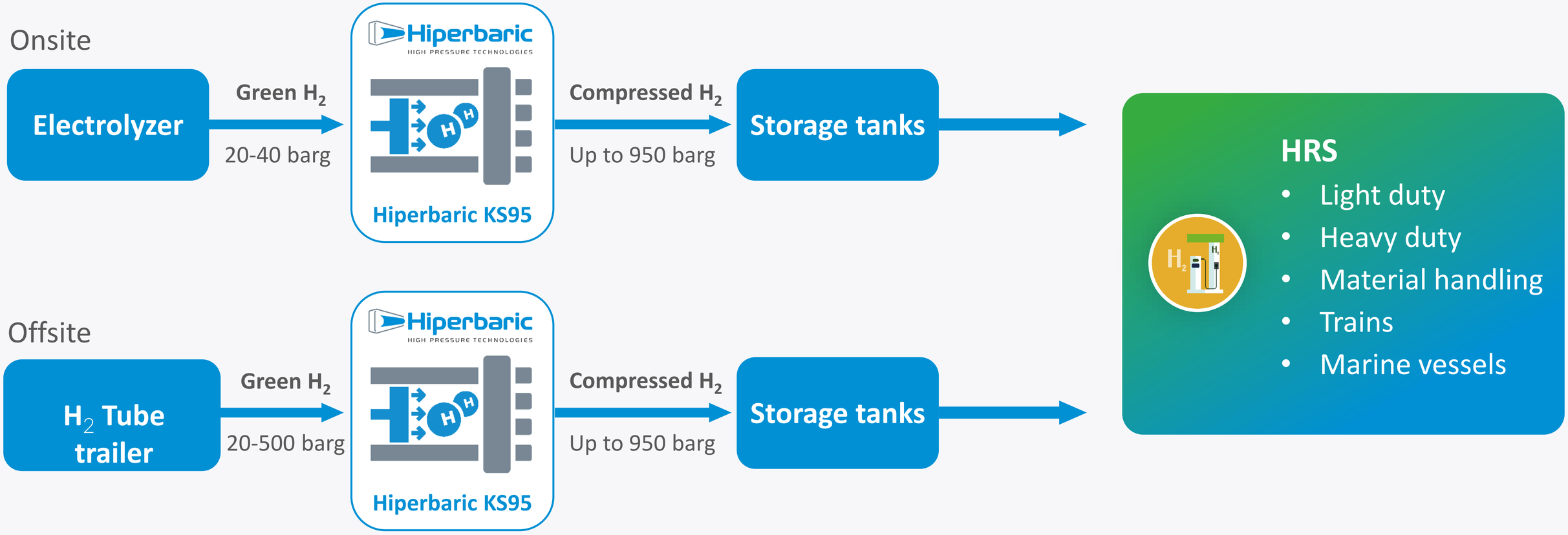
Industrial Uses

- Chemistry
- Heat intensive applications

Residential

HYDROGEN COMPRESSION TECHNOLOGY

Hiperbaric **KS95** Compressor **for Onsite/Offsite H_2 Production**



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HIGH PRESSURE TECHNOLOGIES

CUSTOMERS & **PROJECTS**

CUSTOMERS & PROJECTS

H_2 Customers **Map**

Installed

Projecte in *2023/24*

HRS for Train
in Zaragoza (Spain)

Hiperbaric KS95 off site

Centro Nacional del Hidrógeno

CUSTOMERS & PROJECTS

HRS for Buses
in Bielefeld (Germany)

Hiperbaric KS50 off site

framatome

CUSTOMERS & PROJECTS

Tube trailer Filling in Mallorca (Spain)

Hiperbaric KS50 on site

GREEN HYSLAND

POWER TO GREEN HYDROGEN MALLORCA

enagas acciona CEMEX IDAE Redexis

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CUSTOMERS & PROJECTS

HRS for Buses
in Barcelona (Spain)

Hiperbaric 2 KS50 Pro

Iberdrola

TMB Transports Metropolitans de Barcelona

CUSTOMERS & PROJECTS

High Pressure Storage in Castellón (Spain)

Hiperbaric 2 KS50 Pro

Iberdrola

Hiperbaric
HIGH PRESSURE TECHNOLOGIES

R&D HYDROGEN PROJECTS

R&D HYDROGEN PROJECTS

H_2Press: R&D project for development of **propietary H_2 compression technology**

First hydrogen compressor prototype developed to **test and validate the technology in Hiperbaric facilities**.

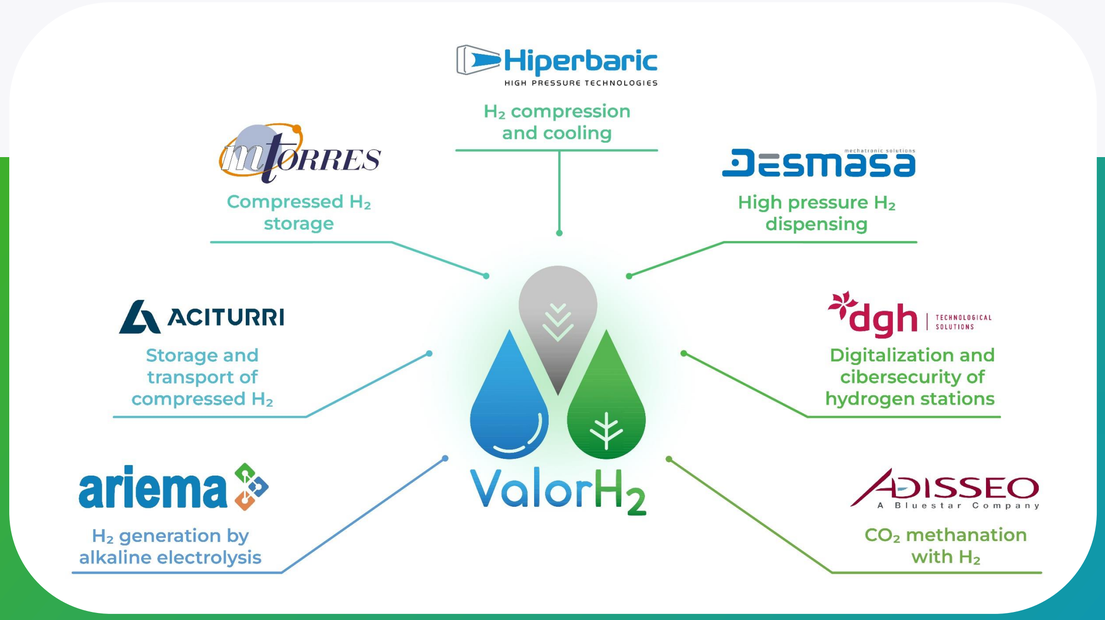
Reliable piston hydrogen compression technology, choosed by relevant players such as Enagás, Iberdrola or Lhyfe.

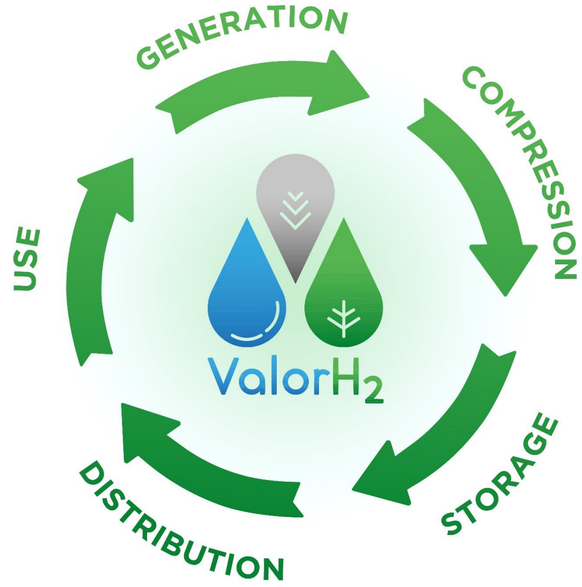
UNIÓN EUROPEA
Junta de Castilla y León
Consejería de Economía y Hacienda
Europa impulsa nuestro crecimiento
competitividad empresarial
ice
Fondo Europeo de Desarrollo Regional (FEDER)
Una manera de hacer Europa

R&D HYDROGEN PROJECTS

ValorH$_2$: Spanish collaborative R&D H$_2$ Project

ValorH$_2$ aims to research the processes of generation, compression, storage, transport and use of green hydrogen **to increase its efficiency, reduce the economic cost and minimize the carbon footprint**.





GOBIERNO DE ESPAÑA MINISTERIO DE CIENCIA E INNOVACIÓN
Financiado por la Unión Europea NextGenerationEU
Plan de Recuperación, Transformación y Resiliencia
CDTI INNOVACIÓN

The project consortium, led by the company **Hiperbaric** from Burgos, is also composed of the industrial companies **Aciturri, Adisseo, Ariema, Desmasa, DGH Technological Solutions and MTorres**, leaders in their respective sectors

R&D HYDROGEN PROJECTS

H_2CYL: Cofounding of a Regional H_2 Association

H2CYL
ASOCIACIÓN CASTELLANO Y LEONESA DEL HIDRÓGENO

Making **Castilla y León** the leading Region in the production and consumption of Renewable Hydrogen

Promote the development of the entire Hydrogen value chain, as a tool for the technical, economic and social growth of Castilla y León, aligned with the energy transition and the decarbonisation of the economy.

Founding members

CAJADEBURGOS FUNDACIÓN

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Desmasa

ACITURRI

R&D HYDROGEN PROJECTS

H_2CYL: **Partners**

H2CYL
ASOCIACIÓN CASTELLANO Y LEONESA DEL **HIDRÓGENO**

Almost 50 partners (universities, technological centers, companies and other entities) **in Spain and Europe**

R&D HYDROGEN PROJECTS

Hydrogen Valley **Burgos**

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H_2 for **Industry & Mobility**

R&D HYDROGEN PROJECTS

Castille and Leon

The highest renewable installed capacity
(Solar: 1.4 GW / Wind: 6.6 GW)

- **23,000 GWh of renewable energies**
  22.5% of national wind energy
- **Consumption of 15,500 GWh**
  58% of production
- **Scope 2030**
  - Installed capacity: 22 GW
  - Production: 46,500 GWh

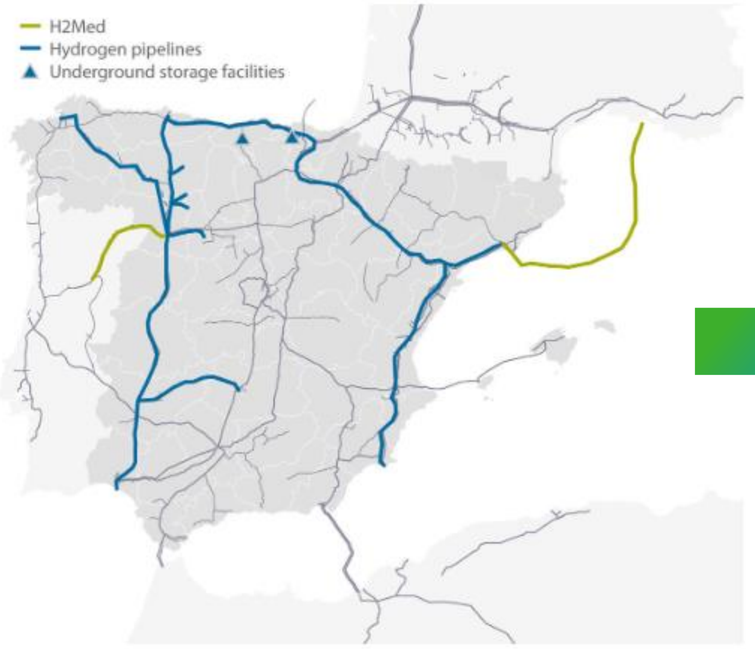
The highest potential of development

- **35 projects**
  14 under development
- **14 GW of renewable energies**
  8.9GW electrolysis
- **€ 8,832 million investment**
- **1,246,000 T H_2/year production capacity**

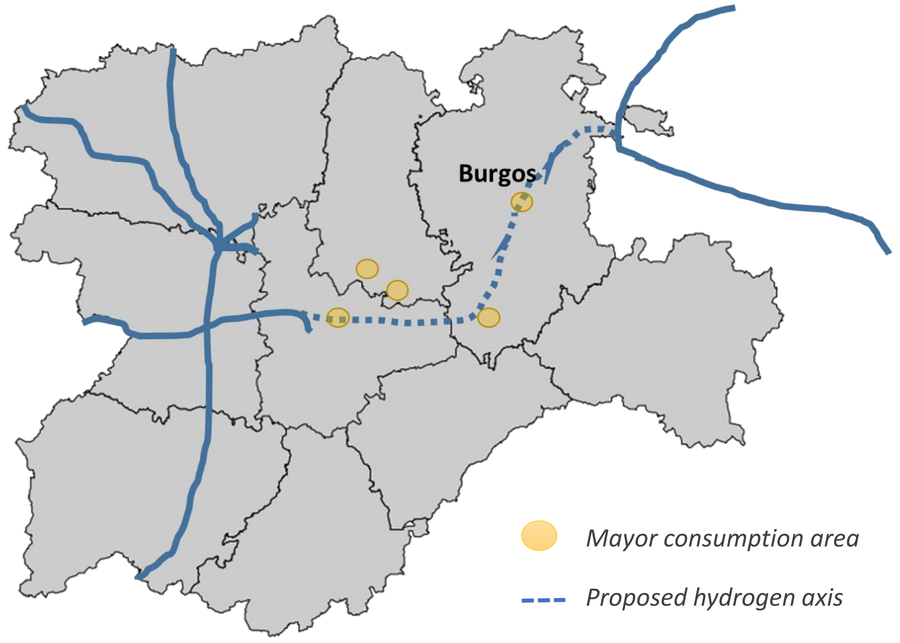
R&D HYDROGEN PROJECTS

Spanish H_2 Network **Should cross Burgos**

Hiperbaric, through H_2CyL, proposes an axis that crosses Burgos and Castilla y León, where there is a high large production capacity of renewable energy and high hydrogen consumption potential



Basic hydrogen infrastructure proposed by Enagás for Spain in 2030.



Enagás proposes to create two renewable hydrogen transmission axes in Spain

- The first encompasses the Cantabrian Coast Axis, the Ebro Valley Axis and the Levante Axis;
- The second, the Vía de la Plata Axis connected to the Puertollano Hydrogen Valley.

Contact Us

Hiperbaric
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Daniel Ballorca-Juez

Hydrogen Project Manager

SECTION

Thanks for attending

Follow us!

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Meet with SPAIN

2023 KOREA EUREKA Day

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Thank you!

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Ministry of Trade, Industry and Energy | Eureka TURKIYE | beyond leading technology KIAT Korea Institute for Advancement of Technology | Keit Korea Evaluation Institute of Industrial Technology | KETEP Korea Institute of Energy Technology Evaluation and Planning