In collaboration with Observatorio Tecnológico del Hidrógeno

ENAGÁS HYDROGEN TECHNICAL DAY

CONCLUSIONS

Technological advances are driving the deployment of hydrogen

The third edition of the Enagás H2 Technical Day showed that mature technologies, ongoing projects, and an industry ready to integrate hydrogen into real-world applications are already in place.

- **Cost reduction, demand stimulation, and infrastructure development** are critical to scaling the hydrogen market.
- **Industry is already adapting production processes** to incorporate renewable hydrogen.
- **Heavy-duty and maritime mobility** are advancing through solutions based on **liquid hydrogen, fuel cells, and a safe, scalable refueling infrastructure.**

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Opening

Available technology, with challenges in cost, demand, and infrastructure

The message was clear: hydrogen technology is maturing. Its competitiveness depends on the coordinated development of investment, regulation, demand, and infrastructure.

During **2025, ten hydrogen technologies advanced by one level on the TRL scale** (Technology Readiness Level), according to the Global Hydrogen Review 2025, published by the International Energy Agency, an unprecedented milestone. Enagás CEO, Arturo Gonzalo, highlighted this achievement while also pointing out some of the **challenges the hydrogen economy must overcome** to become more competitive:

- The **cost of green hydrogen (LCOH)** must continue to fall, ultimately reaching below €4/kg.
- Stimulating **demand** is a priority. To achieve this, the transposition of the RED III Directive is essential, with binding targets to drive end-use applications in industry and transport.
- **Infrastructure** is critical to connecting supply and demand and, ultimately, to making the European hydrogen market a reality.

In addition, Arturo Gonzalo highlighted Hydrogen Council data showing that investment in green hydrogen has increased tenfold over the past five years. More than 500 projects are already underway worldwide, with committed investments totaling USD 110 billion.

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Key speech

Key findings from the IEA reports: "Energy Technology Perspectives" and "Energy and AI"

The market for clean energy technologies continues to grow steadily. Energy innovation is increasingly driven by supply security and competitiveness considerations, while investment in low-emissions hydrogen is gaining traction.

Amalia Pizarro, Energy Technology Analyst at the **International Energy Agency (IEA)**, presented the key findings from several of the agency's recent reports. Among the main takeaways were:

- **Investment in low-emissions hydrogen doubled in 2025 compared with the previous year**, considering both production and end-use applications, according to the Global Hydrogen Review 2026, published on 18 June. Based on projects currently under construction, **a further 50% increase is projected for the following year**.
- From 2025 onwards, **investment in green hydrogen has surpassed investment in hydrogen produced with CO_2 capture**.
- In 2025, **AI-related transactions accounted for one-third of the total value of venture capital deals**, according to the report "Energy and AI".
- **Energy security and competitiveness** are the main drivers of **energy innovation**, according to the report "The State of Energy Innovation 2026".

CONCLUSIONS

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Key speech

Science and innovation driving the hydrogen economy: CSIC's contribution

"The challenge is not only to generate scientific knowledge, but also to transform it into hydrogen-related technologies capable of delivering real impact".

From the **Spanish National Research Council (CSIC)**, Antonio Chica, coordinator of the Global Matter Area, highlighted:

- CSIC's work spans the entire hydrogen value chain. Among its initiatives, Antonio Chica highlighted **TransEner, the Interdisciplinary Thematic Platform (PTI)**, which aims to **drive technological development**, increase the **maturity level** of the solutions it generates, and facilitate their **transfer to industry**.

- It is necessary to **build an energy system** capable of simultaneously ensuring **security, competitiveness, and climate neutrality** in a context of increasing electrification, growing energy demand, and geopolitical uncertainty.

- Materials play a critical role in this transition: the **use of critical raw materials must be reduced**, while **efficiency must be increased** and system durability ensured. CSIC is working on the **development of materials** for Anion Exchange Membrane **(AEM) fuel cells** and Solid Oxide Electrolysis Cells **(SOECs)**.

- One of CSIC's flagship demonstration projects, a 60 kg/day experimental hydrogen refueling station, will enable the validation of hydrogen production, storage, mobility applications, and smart energy management under real-world operating conditions.

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Roundtable Discussion

Green hydrogen in industry: technologies driving its deployment

Industrial decarbonization through hydrogen is no longer a technological concept, with **pilot projects, investments, and roadmaps** already in place, although **large-scale deployment will depend on infrastructure, cost competitiveness, and coordination** across the value chain.

Stegra (Gotzon Gómez, Spain and Portugal director)

Stegra's **green steel plant** in Boden is expected to **begin production in 2027, with an annual capacity of 2.5 million tonnes**. The facility will require 100,000 tonnes of hydrogen per year, produced on-site by a 740 MW electrolyser plant comprising 37 stacks.

ANFFECC / H2FRIT (Manuel Breva, secretary-general)

Tests carried out in ceramic frit furnaces demonstrated **that operation with 100% hydrogen is feasible**, while maintaining product quality and addressing the necessary adaptations in burners, combustion systems, process control, and safety measures.

Moeve (Olivia Infantes, director of regulation and public funding for hydrogen, derivatives and clean energy)

The **hydrogen ring** of the Andalusian Green Hydrogen Valley is a pioneering engineering infrastructure designed to ensure the supply of renewable hydrogen for a wide range of end uses through hydrogen production **using electrolysers and steam reformers**.

Siemens Energy (María Jazmín Nieto, head of gas turbine sales, international projects)

H2Ready turbines enable a gradual transition from natural gas or available fuel blends to higher hydrogen shares, with network infrastructure being a critical factor for scaling up; large turbines such as the SGT5-9000HL require hydrogen consumption exceeding 41 tonnes per hour.

*The discussion was moderated by **Susana de Pablo**, **Enagás'** general manager of engineering, technology and digitalization.*

CONCLUSIONS

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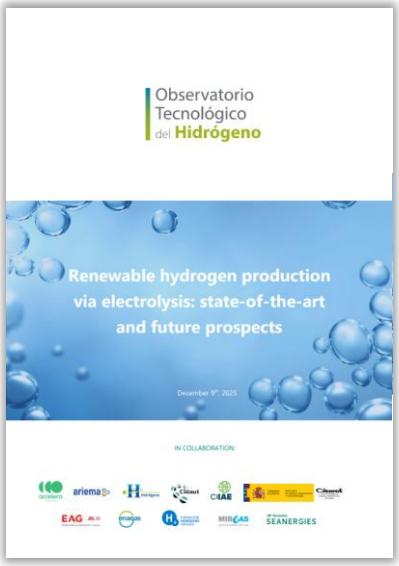
In collaboration with
Observatorio Tecnológico del Hidrógeno

The Hydrogen Technology Observatory is strengthening its role as a benchmark platform for connecting knowledge, industry, and technology.

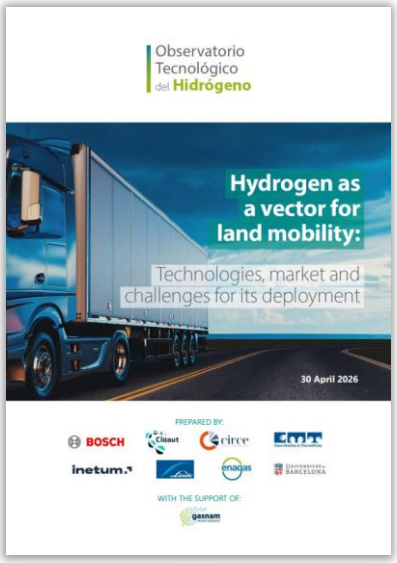
The Observatory's coordinator, Igor Pagazaurtundua, highlighted the latest milestones and developments:

The Observatory already brings together **110 partners in just two years**: leading companies, institutions, technology centers and research organizations, consolidating an increasingly broad technical community.

- In addition to **technology monitoring**, the Observatory continues to promote knowledge generation through technical **events and workshops**, such as the session on hydrogen applications for power generation (14 July, 2026).
- The Observatory's latest reports focus on improving the efficiency of the overall **electrolysis** system and on the evolution of **hydrogen-powered land mobility**.



FULL REPORT EXECUTIVE SUMMARY



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CONCLUSIONS

ENAGÁS HYDROGEN TECHNICAL DAY

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Roundtable Discussion

Hydrogen-Powered mobility: key advances in maritime and land transport

Heavy-duty long-distance transport and maritime applications were at the centre of the discussion, focusing on **range, refuelling, safety, and system robustness**.

Daimler Truck (Jens Fleckenstein, regulatory strategy)

Liquid hydrogen is emerging as a solution for long-haul transport, offering **ranges of more than 1,000 km**, while **around 2,000 hydrogen refuelling stations would be sufficient** to support heavy-duty transport across European routes, compared with the 35,000 charging points that an equivalent electric infrastructure would require.

Clean Energy Partnership / Hyundai (Ignacio García-Lorenzana, board member / senior engineer)

The **standardisation of refuelling and safety protocols** is key to ensuring **reliable and scalable stations with refuelling times** comparable to diesel, with designs capable of scaling up to 4–6 tonnes per day.

PowerCell (Victor Åkerlund, SVP analytics & sustainability)

In maritime applications, **fuel cells** must combine **robustness, high power density, redundancy, and system integration**, ensuring that if one module fails, the system can continue operating thanks to its modular architecture and the support of batteries, which absorb rapid load changes and help extend stack lifetime.

Messer (Mauro Guercia, corporate business development manager)

Hydrogen Refuelling Stations (HRS) require the **integration of equipment, risk management, ATEX zone definition, and noise control**. The business model is fully integrated, with a single provider bundling the vehicle, hydrogen supply, and infrastructure, while the customer pays a fixed price per kilometre travelled.

*The panel was moderated by **Gonzalo Gutiérrez**, director of **Scale Green Energy**, an **Enagás** subsidiary.*

CONCLUSIONS

ENAGÁS HYDROGEN TECHNICAL DAY

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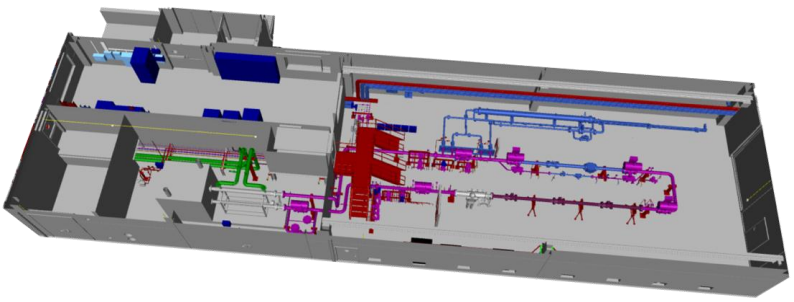
Hyloop+: a new reference laboratory for hydrogen calibration

HyLoop+ is **Europe's first industrial hydrogen meter calibration laboratory with a primary standard**, built on Enagás' experience in natural gas and **adapted to the specific characteristics of hydrogen** and the requirements of the **future hydrogen transmission network**. Claudio Rodríguez, Director of Technical Services and Technology, and Jaime Renedo, Instrumentation and Measurement Manager, highlighted its key features:

- HyLoop+ will enable the validation of **measurement, quality, operation, and safety technologies** under real-world conditions, helping to address current sector gaps on the path to road to 2030.

- Its roadmap includes capabilities for testing **different flow volumes, pipe diameters, and equipment** (including instruments, flow computers, quality measurement devices, and impurity analyzers), facilitating technology testing, development, and certification.

- The project is currently in the **installation phase for piping and equipment**, with commissioning scheduled for 2026, ahead of an internal calibration period that will run until February 2027, when intercomparison operations with other reference standards are set to begin.



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From innovation to market: R&D projects and start-ups

These three examples demonstrate how applied innovation can accelerate the adoption of hydrogen in mobility and industrial applications.

H2MAC (María García Camprubí, head of the fluid dynamics for energy and climate group at the Aragon Institute of Technology - ITA)

The project demonstrates a **complete fuel cell propulsion system for mobile machinery**, applied to a **120-kW excavator** and a **240-kW crusher**. This combination makes it possible to meet a range of powertrain requirements and generate guidelines for heavy-duty machinery. H2MAC is currently 50% complete and plans to carry out 1,000 hours of real-world testing in 2027.

EVARM (Xavier Ribas, founder and CEO)

The start-up presented its **first fuel cell vehicle developed entirely in Spain**, along with retrofitting solutions for trucks and vans featuring **350-bar hydrogen tanks and upgrade options to 700 bar**. EVARM has validated **operating ranges of up to 16 hours** between refuelling for heavy-duty fleet applications.

HigH2-Furnaces (Raquel Sevilla, innovation manager at Kalfrisa)

Kalfrisa's **industrial furnaces** have achieved **100% hydrogen combustion at a thermal output of 500 kW**. The project demonstrates that hydrogen can be integrated into industrial thermal processes, if **combustion conditions, safety requirements, and equipment adaptations** are properly managed.

*The session was presented by **Emilio Martínez**, entrepreneurship and open innovation manager at **Enagás**.*

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"The history of energy has shown that **transformation** happens when three elements are aligned: **vision, investment, and collaboration**. We have the **technology**, **projects are already underway**, and we are **firmly committed**. The next challenge is **scalability**,"

concluded Natalia Latorre, energy transition general manager at **Enagás**.

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