June 2024. Technology Snapshot

Hydrogen in Catalonia

ACCIÓ Catalonia Trade & Investment
Generalitat de Catalunya
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Carried out by
Strategy and Competitive Intelligence Unit of ACCIÓ

Barcelona, June 2024

Contents

Executive Summary: Hydrogen Value Chain and Key Data

Clean hydrogen will contribute to the decarbonization of the economy, either in its energy vector applications such as heavy-duty mobility or electric generation, or as a feedstock in industries such as chemicals.

Value Chain

PRODUCTION → TRANSFORMATION → TRANSPORT AND STORAGE → END USE

Demand Sectors

- Industry
- Mobility
- Energy
- Heat

World Market

The hydrogen market is predicted to be worth nearly $1.4 trillion per year by 2050.

The cost of producing green hydrogen is expected to fall from $6/kg today to $1.5-2.5/kg in 2030.

Europe leads the world in hydrogen projects, with 35% of the world total and an associated investment of $117 billion.

More than 40 countries have a clean hydrogen strategy, half of them in Europe.

The EU supports hydrogen with initiatives such as the European Strategy for Hydrogen, the RepowerEU, the NZIA and the European Hydrogen Bank.

Executive Summary: Hydrogen in Catalonia

Catalonia has all the elements of the value chain to position itself as a benchmark hydrogen valley in Southern Europe.

198 companies along the value chain

41% more companies than in 2022.

Turnover of **€700 million** (**64%**) across **2,313** jobs (**+74%**).

70.4% of them are part of the auxiliary and engineering industries.

Ecosystem of agents present in all segments of the value chain

14 technology and research centers

14 universities and training centers

21 associations and clusters

18 institutions and public administration

Benchmarking Initiatives

Catalonia's Hydrogen Valley

Ebro Hydrogen Corridor

Center for the Decarbonization of the Chemical Industry

H2CAT Network

Dedicated Hydrogen Research Center

Hydrogen boost for America's Cup

High-Capacity Ports and Airports

1st Petrochemical Hub in Southern Europe

Geo-strategic position for the use of hydrogen in heavy-duty mobility, the European pipeline network and import-export channels

H2MED (Barcelona-Marseille) to transport hydrogen to the rest of Europe

Ebro Hydrogen Corridor with the North of the Iberian Peninsula

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1. Hydrogen Definition

Hydrogen as a Matter

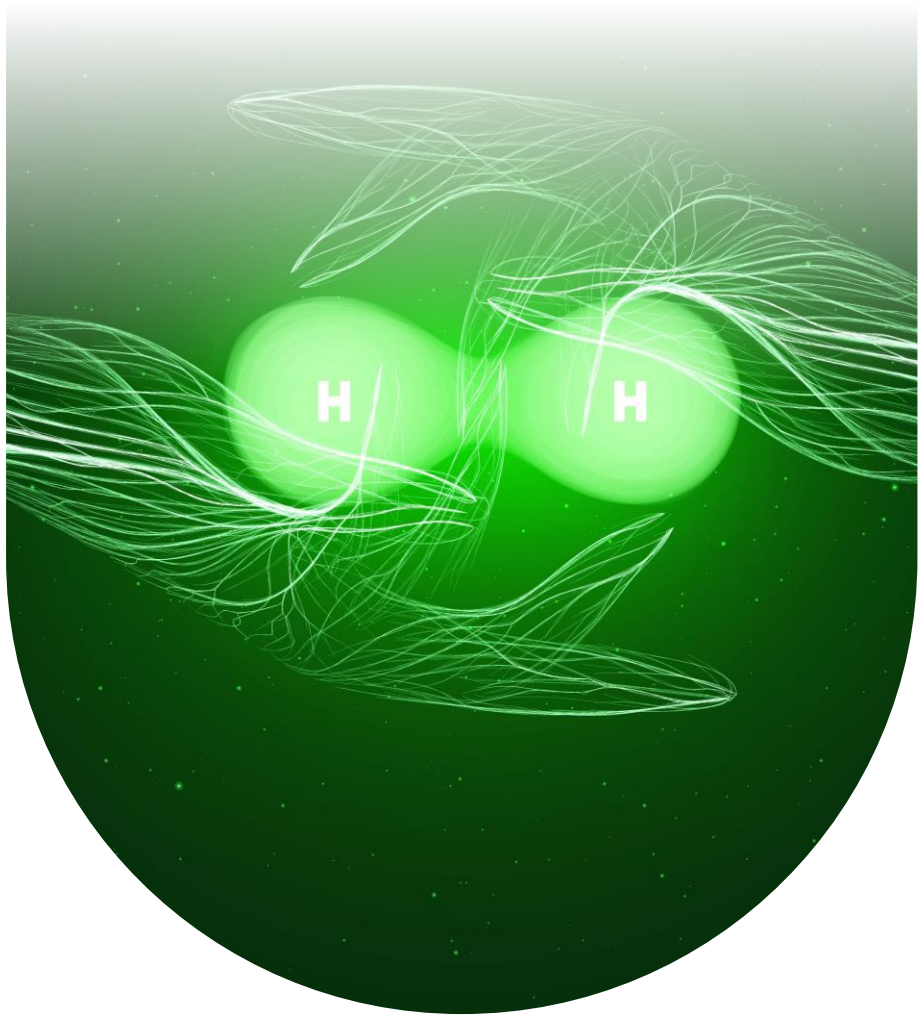
Hydrogen makes up about 75% of the matter in the universe and has three times the energy content of natural gas.

Hydrogen is the first element in the periodic table and is the lightest chemical element in the universe: the atom consists of one proton and one electron and is stable as a diatomic molecule (H_2). Under normal conditions, hydrogen is in a gaseous state and is tasteless, colorless and odorless.

It makes up about 75% of the matter in the universe, but combines with other elements such as oxygen to form water molecules or carbon to form organic compounds.

It has the highest energy content by weight of any conventional fuel, around three times that of diesel, natural gas or bioethanol. However, it is a very light gas, with a density of only 0.09 kg/m^3.

It is an almost permanent gas and only liquefies at very low temperatures (below -253°C). It is usually stored under pressure because of its very low density. Liquefaction increases its density by a factor of 800. Its characteristic property is its excellent flammability.



Hydrogen as an Energy Vector

Hydrogen can be produced from a variety of abundant precursors, including natural gas, coal, water, and renewable energy sources.

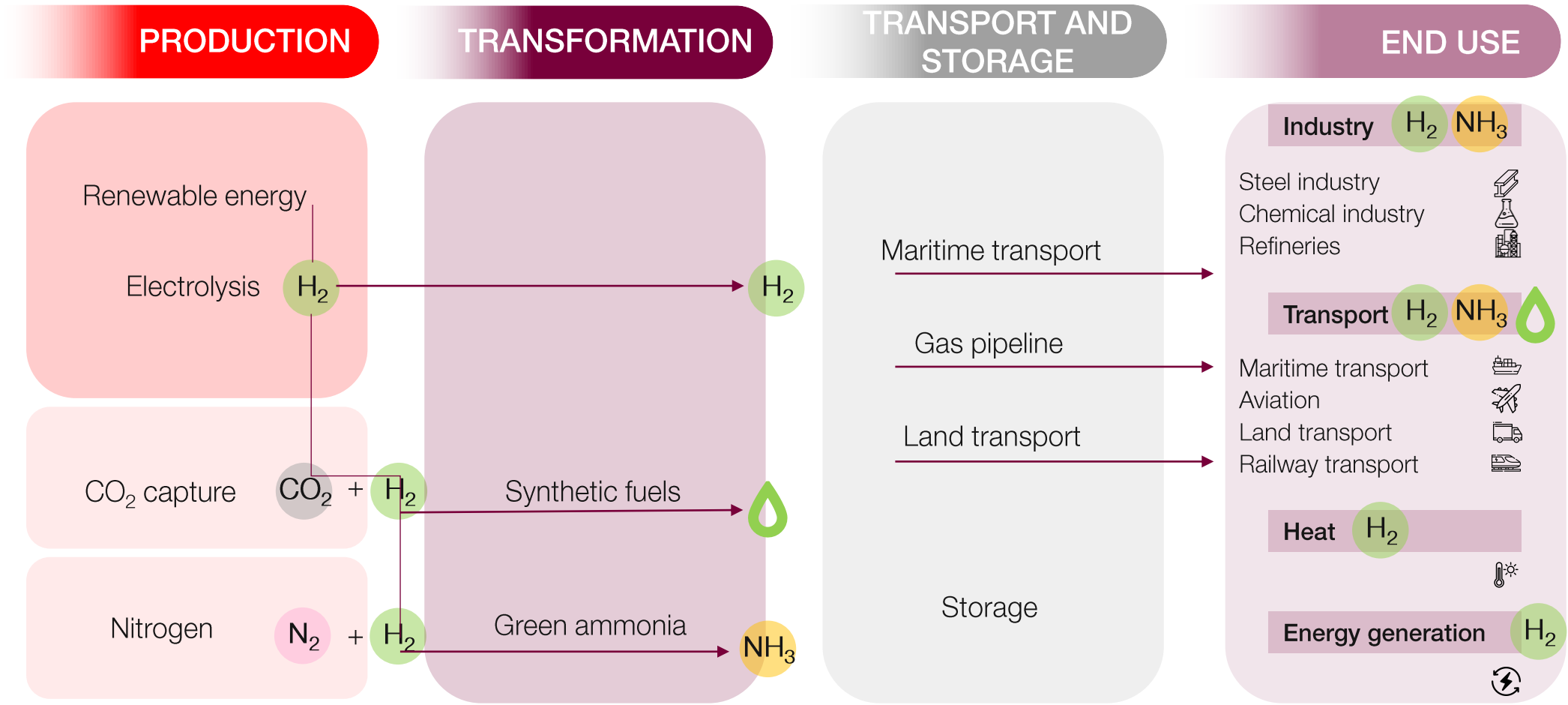
Hydrogen has three times the energy content of diesel and natural gas.

Hydrogen is not an energy source but an energy vector, a substance or device that stores energy for later use.

Hydrogen is a good energy vector because it can be produced from a variety of abundant precursors, including natural gas, coal, water, and renewable energy sources.

The use of hydrogen will make it possible to diversify the energy supply with greater use of national resources, thereby reducing dependence on oil and gas imports.

Clean Hydrogen Value Chain



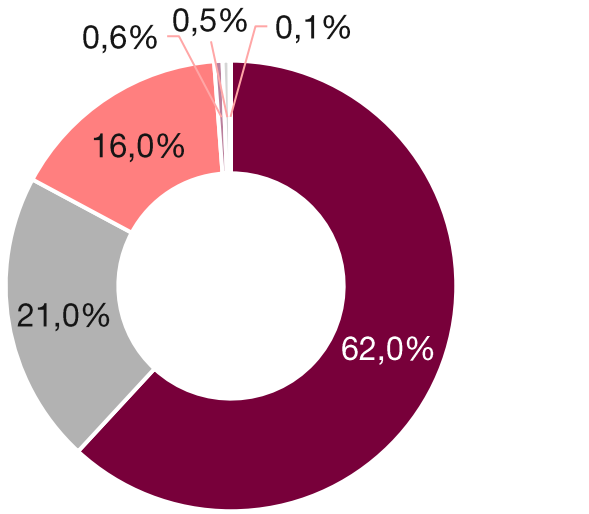
Source: IRENA (2023): Geopolitics of the Energy Transformation

Hydrogen Production

Global hydrogen production is still dominated by the use of fossil fuels.

- World hydrogen production reached about **95 million tons** in 2022, 3% more than in 2021.
- Production was dominated by the **use of fossil fuels**:
  - **Natural gas** without Carbon Capture, Utilization and Storage (CCUS) accounted for **62%** of world production.
  - In the case of **coal**, China was responsible for **21%** of world production.
  - The **hydrogen produced as a by-product** in refineries and the petrochemical industry accounted for **16%** of world production.
- The production of **low emission hydrogen**, which includes carbon capture and electrolysis processes, from both renewable and grid sources, was less than 1 million tons (**0.7%** of world production).
- The production and use of hydrogen resulted in more than **900 million tons of CO_2 emissions** in 2022.

Hydrogen Production By technology (2022)



Source: IEA (2023) Global Hydrogen Review 2023

Renewable, Circular and Clean Hydrogen

From colors to emissions.

Hydrogen is a key element in decarbonizing, diversifying Europe's energy sources and reducing its dependence on external sources

The need for critical materials for the manufacture of electrodes and hydrogen batteries hampers manufacturing and economic viability and can lead to a supply chain crisis.

There is not enough green hydrogen being produced to meet the needs of the industry.

Color sorting emphasizes known production methods, often mixing processes with raw materials or emissions.

Low carbon, renewable, clean or circular hydrogen: Switch from the color palette to a more realistic system based on the intensity of carbon emissions, both from a production and a life cycle perspective.

To be considered **low-carbon**, hydrogen production must be below the EU's proposed emission limit of **3.38 kg CO2 equivalent per kg* of hydrogen**, which is 70% lower than fossil fuels, including transportation and other non-production emissions.

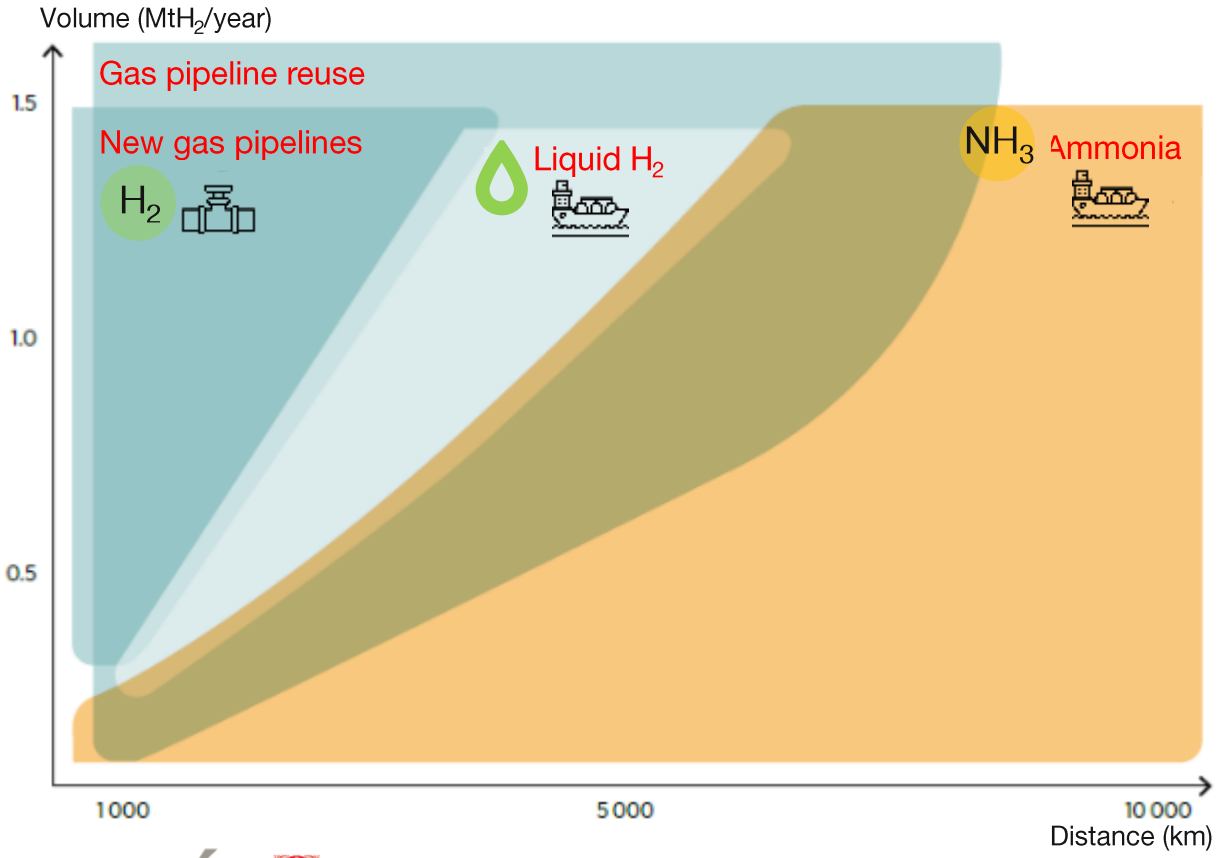
**In the United States, to qualify for the tax benefits of hydrogen production under the IRA, the limit is 4.0 kg of CO_2 equivalent per kg of hydrogen.*

Sources: Hydrogen Science Coalition , IEA, Department of Energy US Government, World Economic Forum, Hydrogen Europe, European Commission, Commission sets out rules for renewable hydrogen, February 2023; Capgemini

Hydrogen Transport

Gas pipelines and ships are the two main methods of transporting hydrogen; distance and volume determine the most efficient method.

Hydrogen Transportation Options Considering Volume and Distance



Methods for transporting hydrogen by ship

Liquid hydrogen

Hydrogen molecules must be cooled to -253°C at port terminals before being loaded into highly insulated tankers, an energy-intensive process. An alternative is to use organic compounds (LOHC) that can absorb and release hydrogen without the need for refrigeration.

Ammonia

Hydrogen is converted to ammonia by reaction with nitrogen. There is a well-established international trade in ammonia; it is currently used as a raw material to make fertilizers, but could also be used as a fuel for decarbonization. The disadvantage is that it is toxic in case of leakage.

Source: IRENA (2023): Geopolitics of the Energy Transformation

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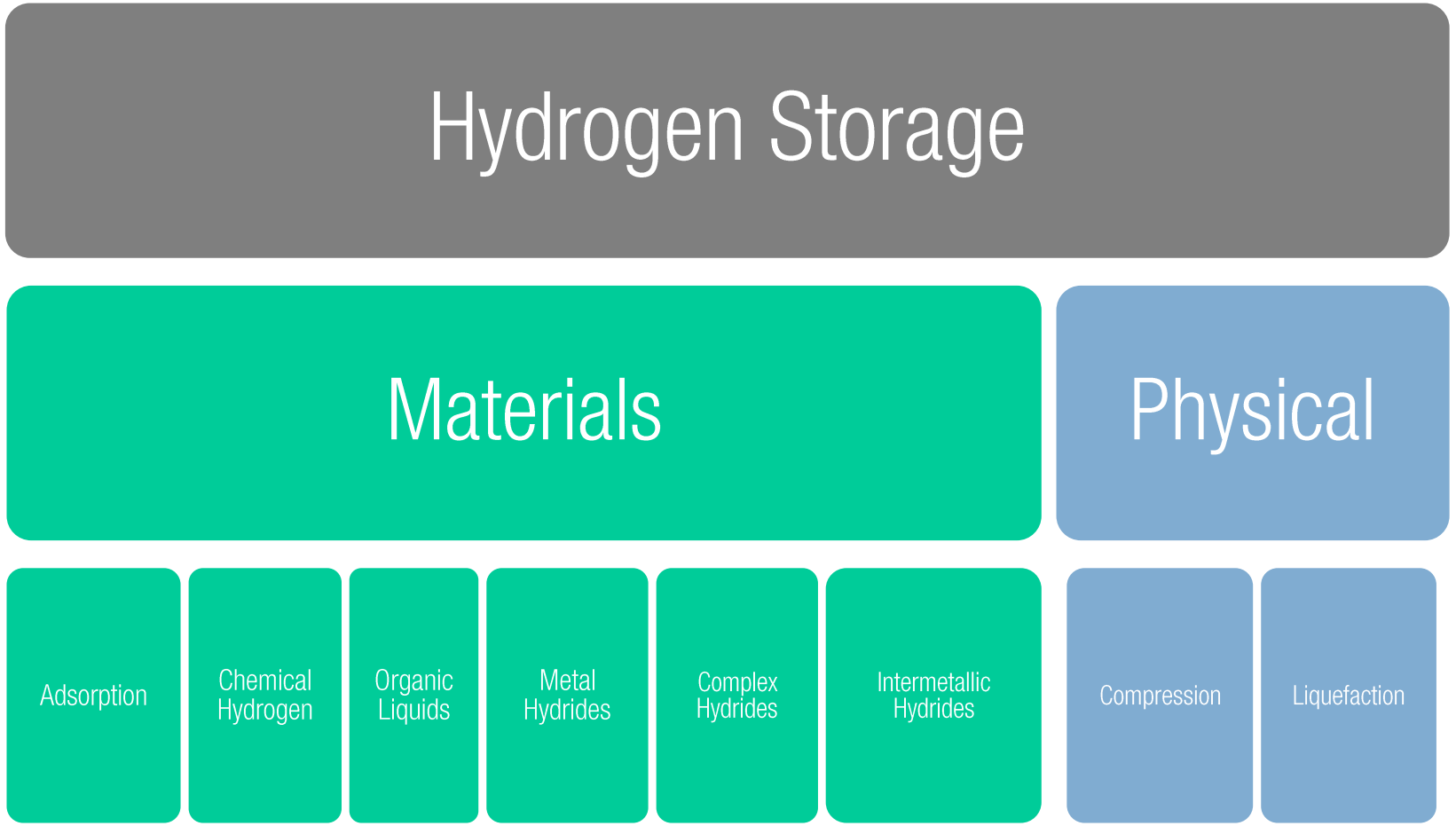
Hydrogen Storage

The transition to a carbon neutral economy and the need for energy storage are the main factors driving the development of hydrogen storage.

- Most storage methods require compression, refrigeration, or the use of hydrogen-bonding material.
- Hydrogen is typically stored in gaseous form in pressure vessels, in liquid form in cryogenic tanks, or chemically by adsorption or absorption.
- In terms of materials, ammonia, metal hydrides, and hydrogenation of carbon dioxide are the major and emerging hydrogen storage technologies.



Sources: Hydrogen Europe; Frost&Sullivan, Shell, Naturgy

Hydrogen Applications

Industry

- Ammonia. Fertilizers
- Ammonia. Refrigerants
- Food. Vegetable fat saturation
- Welding
- Metallurgy
- Flat glass production
- Electronic components, semiconductors, LEDs, etc. production
- Hydrogen peroxide
- Other chemical products

Mobility

- Space exploration
- Aviation
- Industrial vehicle fleets
- Public transport
- Private transport
- Ships
- Trains

Energy

- Hydrogen fuel cells
- Backup power for hospitals, data centers, or remote locations
- Synthetic fuel production

Heat

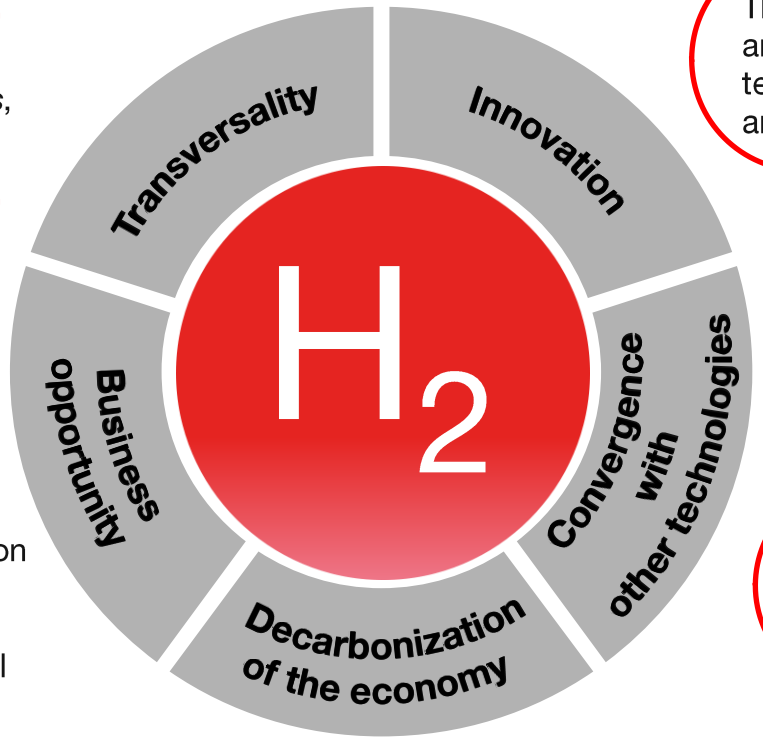
- Integration with existing natural gas networks
- Industrial heat
- Heatings
- Stationary fuel cells

Note: Hydrogen combustion can be useful to produce heat reaching high temperatures > 300ºC without emitting particles or CO_2, but it is necessary to strictly control NOx emissions to ensure that the combustion is sustainable and meets the requirements of greenhouse gas emissions such as NOx.

Importance of Hydrogen for Industry

The use of hydrogen can have an impact in many areas, from infrastructure to *smart cities*, going through the production processes.

The large-scale use of hydrogen presents challenges and opportunities for the development of technologies that can be applied in different sectors and along the entire value chain.



In an environment that is increasingly aware of climate change and the desire to achieve carbon neutrality, the use of hydrogen can create new business models derived from its possible applications in different fields such as industrial and domestic heating, mobility, etc.

The development of hydrogen technologies includes other areas such as the design of materials, the search for transportation and storage systems and methods, the adaptation of products and processes, and safety elements.

Clean hydrogen will contribute to the decarbonization of the economy, either in its energy vector applications or as a feedstock in industries such as chemicals.

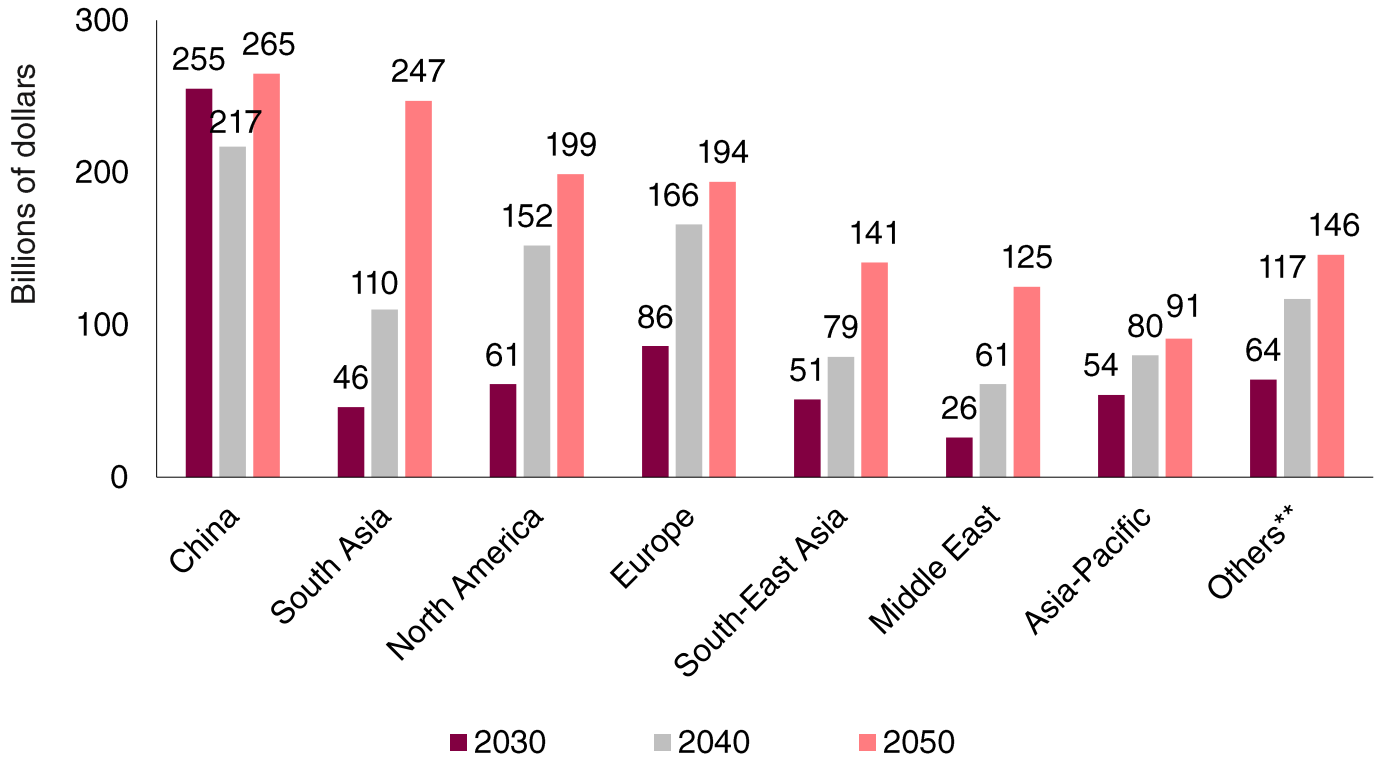
2. The World Hydrogen Market

Hydrogen on a Global Scale

The clean hydrogen market is expected to exceed the value of the global LNG trade* by 2030 and continue to grow to **$1.4 trillion annually by 2050.**

- **More than $9 trillion of cumulative investment will be needed** in the global clean hydrogen supply chain to meet the 2050 zero emissions goals.
- Clean hydrogen can serve as a catalyst to **support 2 million jobs globally each year** between 2030 and 2050.
- **Interregional trade is key** to unlocking the full potential of the clean hydrogen market, supported by a **diversified transportation infrastructure.**
- **The forecast for 2050 is that China and South Asia** will end up being the main trading poles for this technology, with a market value of **$265 billion and $247 billion** respectively, followed by **North America in third place with $199 billion**.
- The global hydrogen trade will generate more than **$280 billion in annual export revenues by 2050.**

Hydrogen Market Development by World Region (billions of dollars)



*LNG: Liquefied Natural Gas.
**Others: Included in order of highest business volume: Eurasia, Latin America and Africa.

Source: Deloitte's 2023 global green hydrogen outlook

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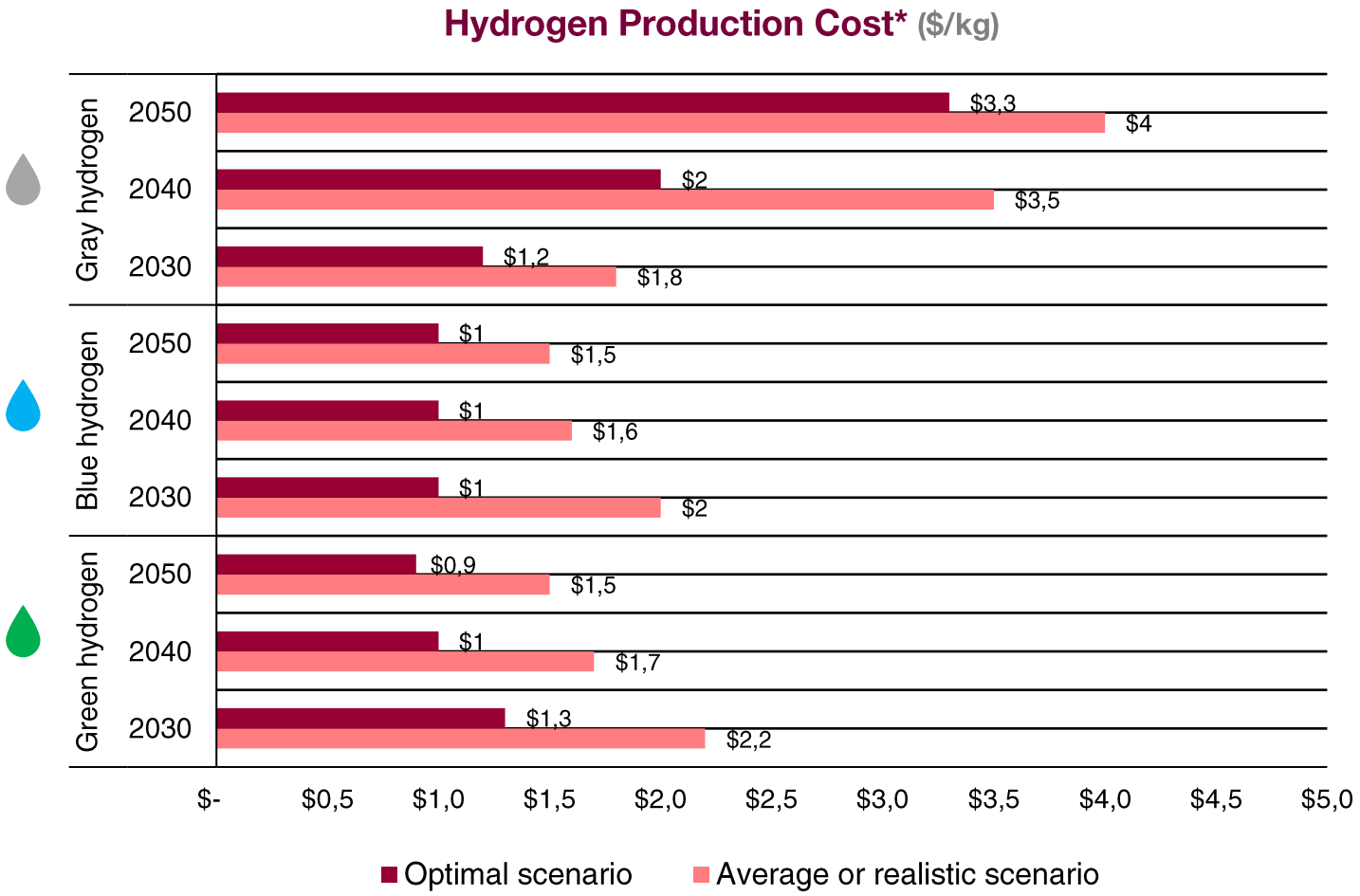
Evolution of Clean Hydrogen Prices



*Note: **Green hydrogen**: produced by electrolysis and renewable energy (0 CO_2 emissions); **Blue hydrogen**: produced from natural gas, CO_2 is generated and captured during production; **Gray hydrogen**: produced from fossil fuels, CO_2 is generated that is not sequestered and released.*

- Estimates point to a **gradual decrease in the cost of clean hydrogen** and a **gradual increase in the cost and CO_2 emission rates**, which may exceed $300/t **$CO_2e$** on average by 2050 (for produced hydrogen that generates CO_2 or gray hydrogen).
- For green hydrogen, **production costs are estimated to fall** to $1.5-2.5/kg by 2030, $1-1.7-2/kg by 2040, and **$1-1.5/kg by 2050**. **Currently**, the production cost of **green hydrogen** is higher (**about $6/kg**) than gray hydrogen, making it less competitive.
- As for the production cost of blue hydrogen, it will decrease and will be between **$1-1.5/kg by 2030** and is expected to **stabilize around these prices** by 2050.
- Estimated demand for clean hydrogen is expected to grow to approximately 660 million metric tons per year by 2050, and clean hydrogen will reach a **competitive cost that will be applied in many sectors**.

Source: McKinsey Hydrogen Insights in Carbon Pricing 2023 (World Bank Group)

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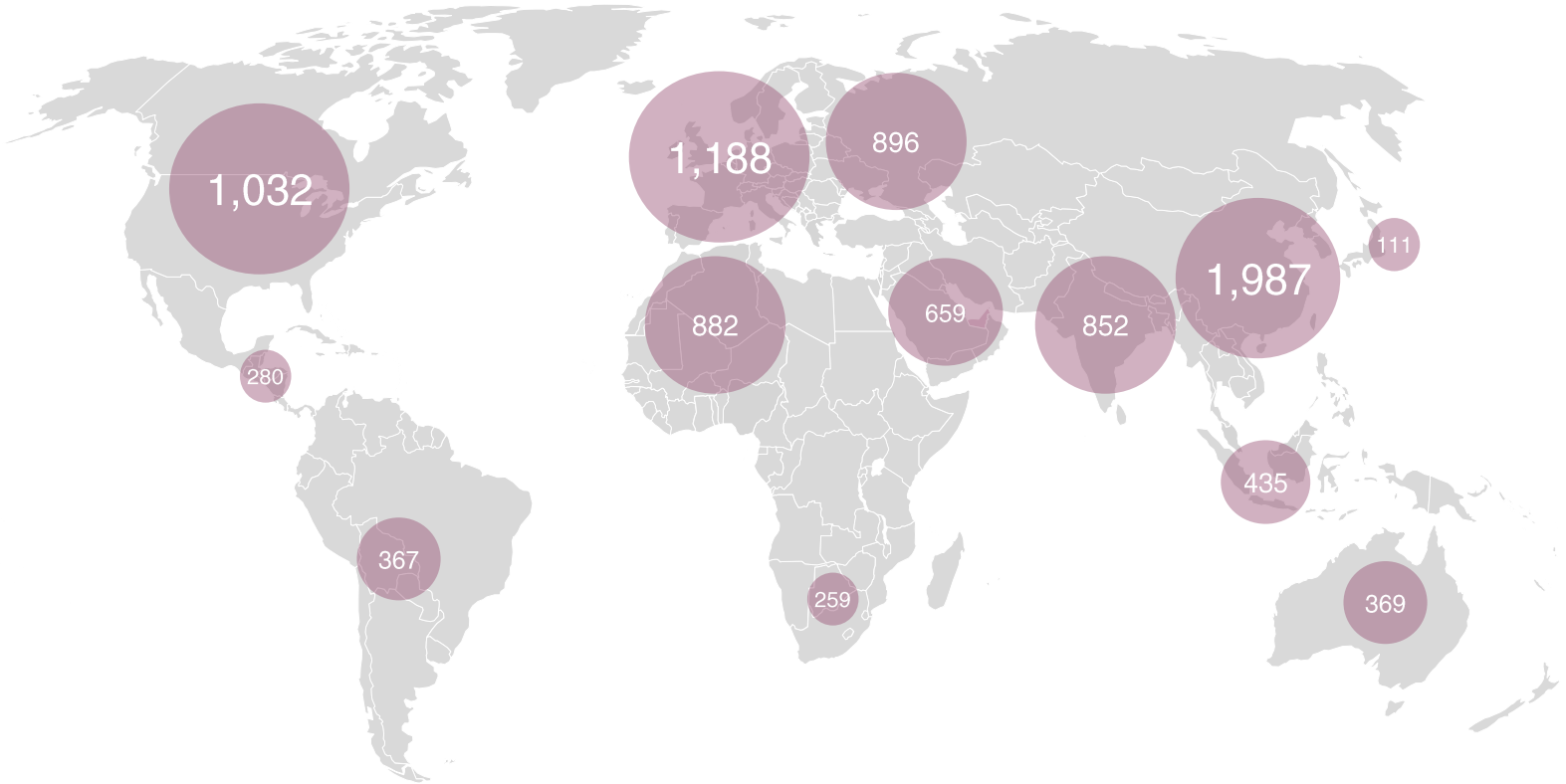
Regional Clean Hydrogen Investments

Cumulative Investment in Clean Hydrogen Supply Chain in 2050

(billions of dollars)



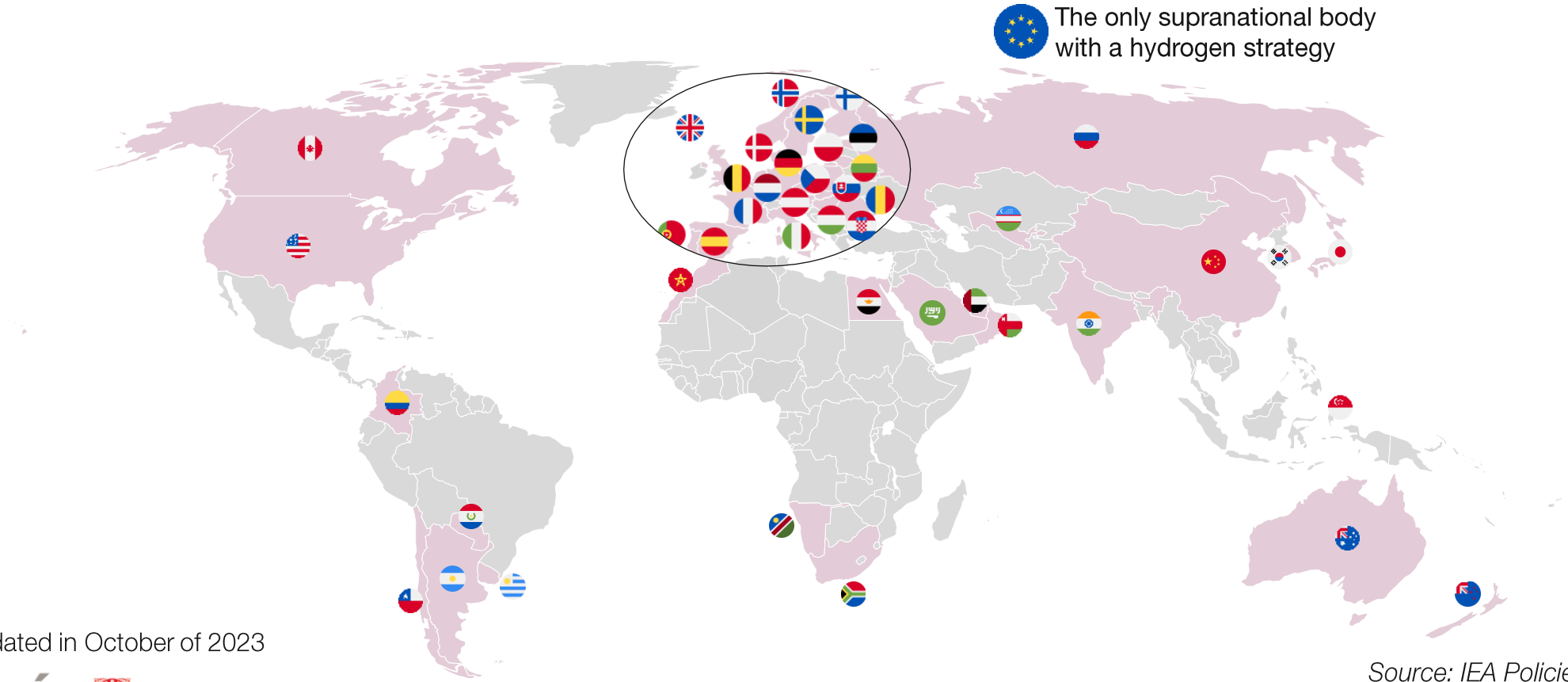
- The forecast of cumulative investment in the clean hydrogen supply chain through 2050 places **China and Southeast Asia, Europe, and North America as the major global players** in clean hydrogen.
- **Investment** in **China and Southeast Asia** is expected to exceed **$1.98 trillion**; in **Europe**, **$1.18 trillion**; and in **North America**, **$1.03 trillion**.
- Other regions of the world will also develop their clean hydrogen infrastructure with significant investments in their supply chain, positioning themselves as **suppliers or international transport hubs**, such as the **Maghreb, South Asia or Eastern Europe**.

Source: Deloitte HyPE model-based analysis

National Hydrogen Strategies Worldwide

More than **40 countries have a national strategy** or agreement to promote hydrogen and related technologies, **half of them in Europe.**

Countries with Strategies Related to Hydrogen



Note: Updated in October of 2023

Source: IEA Policies Database

The EU Hydrogen Strategy

European Strategy for Hydrogen

The strategy, adopted in 2020, promotes the production of clean hydrogen in the EU and makes it a priority for economic growth.

2020 - 2024

Install **6 GW of electrolyzers in the EU** to produce **1 million tons of hydrogen**.

2025 - 2030

Generate **40 GW and produce 10 million tons of hydrogen**.

2030 - ...

Large-scale deployment of clean hydrogen.

Other hydrogen promotion tools

REPowerEU

Plan to deal with energy market disruptions caused by the war in Ukraine:

- **€200 million** intended for green hydrogen research.
- **10 Mt** of green hydrogen imports by 2030.
- Promote the **regulatory framework** for green hydrogen.

Net-Zero Industry Act

Promote 8 technologies to achieve carbon neutrality:

- Envisages that 40% of them will be manufactured in the EU **electrolyzers and batteries of combustible** in 2040.
- Simplify the **regulatory framework** for manufacturing these technologies.

European Hydrogen Bank

Financial instrument to unlock investment in the hydrogen value chain:

- It has organized **auctions to narrow the gap between the production costs of clean and fossil hydrogen**. A new auction is planned from April 2024.

Source: European Commission

Spanish State Initiatives

Hydrogen Roadmap

Key Figures in 2030

- **€8.9 billion** in investments
- **4 GW** of installed electrolyzer capacity
- **25%** of the industry's energy consumption
- **100 - 150** of public access hydrogen stations

PERTE

PERTE of Renewable Energy, Hydrogen and Storage (ERHA)

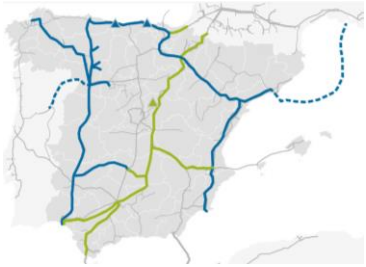
- **€16.3 billion** in investments mobilized
- **€1.55 billion** in clean hydrogen projects

PERTE of Industrial Decarbonization

- **€3.1 billion** in investments mobilized
- **€450 million** in clean hydrogen projects

Hydrogen Network

- **Cantabrian cornice axis, Ebro valley axis and Llevant axis, with connection Barcelona-Marseille (H2MED)**
- **Via de la Plata axis (connected to Puertollano Hydrogen Valley)**



H2 Pioneers Program

1st call

€150 million
19 funded projects

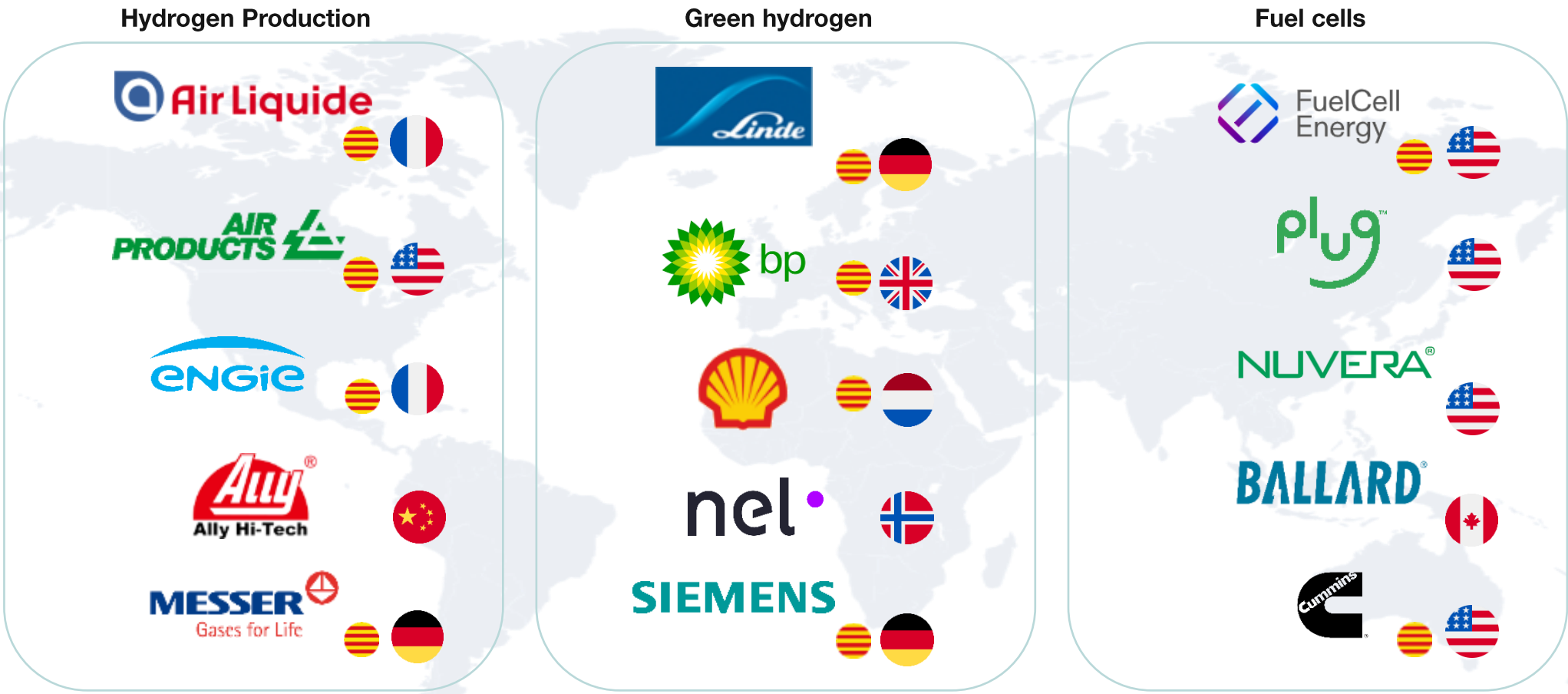
2nd call

€150 million
14 funded projects

Sources: Ministry of Industry, Trade and Tourism, and Enagás

Major Companies in the Hydrogen Market Worldwide

By sector, the gas companies stand out, and by nationality, the North American companies.



Sources: Markets and Markets, 2023, Defense ETFs, Blackridge Consulting, Businesswire and GlobalData

3. Hydrogen Opportunities and Challenges

Hydrogen Opportunities

- **Clean hydrogen is a key vector for achieving decarbonization goals**, especially in energy-intensive industrial sectors or heavy-duty mobility.
- **Developing electrolyzers** with flexible systems that increase multi-range efficiency and half-life, reduce cost and dependence on critical materials, and improve productivity. **Catalyst development.**
- **New storage media development.** Design of tank materials to avoid hydrogen leakage and fragility issues.
- **New business models and opportunities** for the auxiliary industry in the adaptation of materials and equipment, as well as nozzles, turbines, valves, coatings, welding and the creation of networks of hydrogen plants or specific distribution of hydrogen.
- **Development of specific technologies** for different applications and with better efficiency. The availability of H_2 opens up new avenues for hydrogenation of CO_2 and other carbon-based molecules, enabling the production of chemical products and synthetic fuels in gaseous or liquid form, the latter for aviation, shipping or heavy machinery. Special emphasis on maritime and rail transportation.
- The hydrogen value chain will require n**ew technologies and new sectors** such as catalysts, solvents, carbon capture, membranes, pipes, etc., and skilled personnel such as technicians, engineers, manufacturers, installers, etc.

Hydrogen Challenges

- The production of clean hydrogen, especially from renewable sources, will require significant cost reductions. **The cost of renewable electricity is 75% of the cost of hydrogen.**
- Although hydrogen has a very high gravimetric density, it has a very low volumetric energy density, which means that it **must be compressed and processed at high pressures and very low temperatures** for storage and transportation.
- Hydrogen is a **very reactive gas and can cause embrittlement in various materials** such as steel. It also has a high burning rate. The infrastructure to deliver hydrogen to the point of use must be reformed and adapted.
- **Hydrogen is an energy carrier** that can combust (react with oxygen) under certain conditions and therefore must be handled with strict safety measures. However, the goal is to use it electrochemically or in chemical processes. There is a lack of a harmonized regulatory framework to facilitate the introduction of hydrogen on a large scale.
- **The cost and adaptability of fuel cells to different environments** are still unresolved, and some technologies, such as SOECs, are at a pre-commercial stage.
- Electrolyzers depend on **critical raw materials such as rare earths**, which are dominated by China. Without control of the entire value chain, EU sourcing and manufacturing objectives cannot be met.

4. Hydrogen in Catalonia

Mapping the Hydrogen Ecosystem in Catalonia

198 companies +41.4%

€699.3 million +64.2%

2,313 jobs +73.6%

57.9% of companies are SMEs

19.4% are less than 10 years old

79.6% have a turnover of more than one million euros and **57.7%** more than 10 million euros.

4.6% are startups

52.6% are exporters

Per segments*

25.5% of the companies are in the hydrogen production phases

59.7% are part of the transformation, transport and storage process and fuel cells

70.4% are part of the auxiliary and engineering industries

*Companies may belong to more than one segment of the hydrogen value chain.

Source: ACCIÓ (2022, latest data available)

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Hydrogen Ecosystem in Catalonia

Production

Transformation

Transport, Storage and Infrastructures

Fuel cells

End users*

Auxiliary Industries and Engineering

*Representative sample. Companies are not quantified for business mapping purposes.

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Source: ACCIÓ

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Agents of the Hydrogen Ecosystem in Catalonia

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Source: ACCIÓ

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Initiatives to Promote Hydrogen in Catalonia

184 companies
43 public entities
22 clusters and associations
13 research centers

Catalonia's Hydrogen Valley

XARXA H2CAT

Production | Storage and Distribution

Use as an energy source | Use as raw material

H2CAT Network

Green hydrogen boost

For the first time, the America's Cup support boats will be powered by hydrogen

CER H2

UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

Hydrogen Laboratory | Fuel Cell Laboratory

Specific Center for Hydrogen Research (CER-H2)

Center for the Decarbonization of the Chemical Industry

Budget of €5 million for the development of the center in Camp de Tarragona

Ebro Hydrogen Corridor

To be the benchmark for the development of clean hydrogen and to lead the deployment of its value chain in Southern Europe.

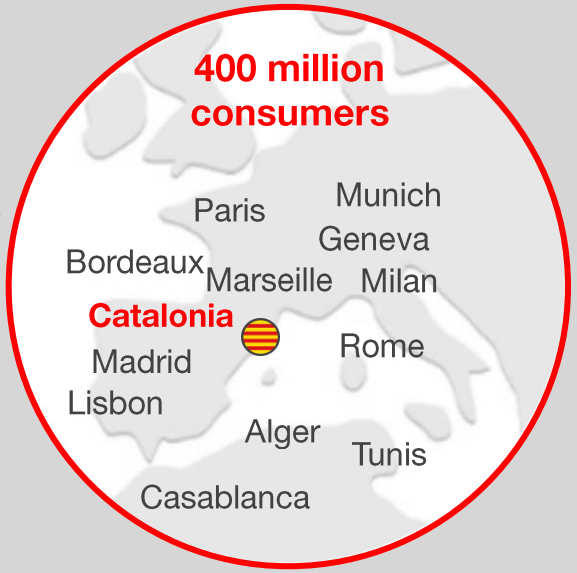
Strategic distribution capacity: a hub of international connections ready for hydrogen

Catalonia's excellent geo-strategic location allows for **efficient intercontinental connections** with Asia and America, as well as **quick and easy distribution** in Southern Europe and North Africa. This strategic location will serve to become a reference point capable of supplying hydrogen to the rest of Europe.

Unmatched distribution capacity

Its **strategic location** and **extensive network of infrastructures** make Catalonia the gateway to Southern Europe and the leading distribution center in the Mediterranean.

The logistics network can reach 400 million consumers in Europe and the Mediterranean/Africa in less than 48 hours*.



** By all means of transportation: air, rail, truck and ship.*

H2MED will support the development of hydrogen in Europe

The H2MED* foresees the **maritime connection between Barcelona and Marseille** to send 2 million tons of green hydrogen per year to the rest of Europe.

This will allow Catalonia to be a **hub for both hydrogen reception and production and export** to serve a very demanding hydrogen market in the coming years.

** Expected to be implemented in 2030.*

Sources: ACCIÓ (2023) Logistics in Catalonia and H2MED

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Integrated logistics hub: two of the most important Mediterranean ports

Catalan ports:
Port of Barcelona
Port of Tarragona

Both ports have services and infrastructure specialized in the handling and shipment of certain types of products, which favors their import and export.

Port of Barcelona

Port de Barcelona

- Specialized in general cargo and high value-added goods, the Port of Barcelona is connected to 178 ports around the world by 88 regular lines.
- It has one of the highest productivity levels in Europe and is a benchmark port in the Euro-Mediterranean region.
- It is the state leader in the value of goods and the most important transportation and services infrastructure in Catalonia.
- It houses a hydrogen plant to support the celebration of the 37th America's Cup.

Port of Tarragona

Port Tarragona

- With world-class infrastructure and designs, it is positioned as a hub in the Mediterranean for the storage and distribution of energy products.
- The investment in Moll de la Química has made it possible to double the area of the port dedicated to the storage of all types of bulk liquids, whether hydrocarbons, chemical products or other derivatives of the energy transition, such as ammonia for the capture and storage of hydrogen.
- The current storage capacity is over 800,000 m^3 and the intention is to increase the capacity year by year until it reaches 1.2 million m^3.

Sources: Port of Barcelona and Port of Tarragona

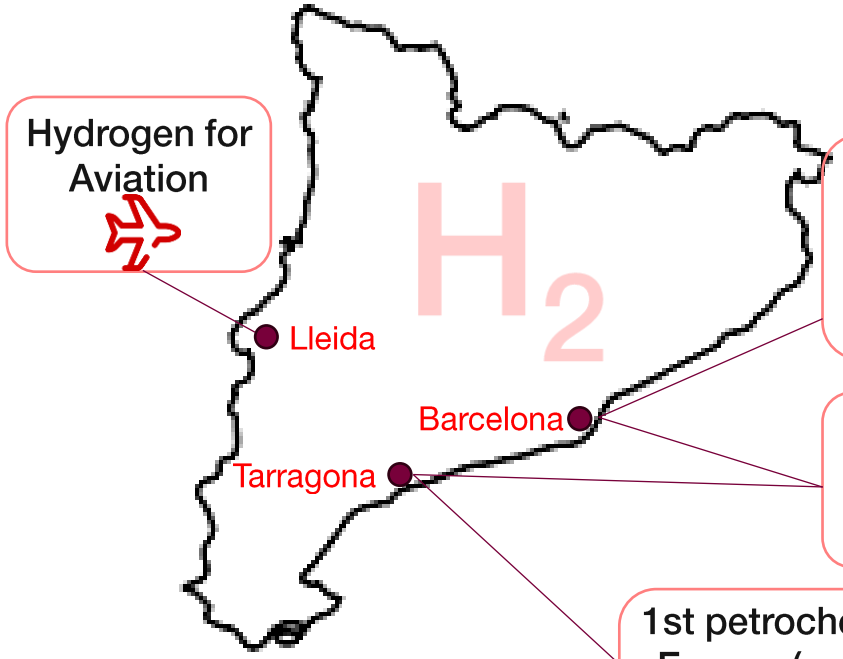
Catalonia's Hydrogen Capacities

Rich knowledge and talent ecosystem

Strong and diversified industry

First order logistics node

Hydrogen for Aviation



More than 3 million inhabitants in the AMB (mobility and industry)

High capacity ports and airports

1st petrochemical hub in Southern Europe (need for clean hydrogen for decarbonization)

Geo-strategic position for the use of hydrogen in heavy-duty mobility, the European pipeline network and import-export channels

H2MED (Barcelona-Marseille) to transport hydrogen to the rest of Europe

Ebro Hydrogen Corridor with the North of the Iberian Peninsula

Source: Adapted from Catalonia's Hydrogen Valley

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Talent in Catalonia

Interuniversity Master in Hydrogen Technologies: to train professionals in the various technologies of the hydrogen value chain in generation, storage, transport, distribution, conversion and applications. The 3rd edition was launched in 2023.

Mondragon Unibertsitatea · Universidad del País Vasco Euskal Herriko Unibertsitatea · Universitat Rovira i Virgili · Universitat Politècnica de Catalunya BarcelonaTech · Universidad Zaragoza

Degrees

- Degree in Energy Engineering and Sustainability (Universitat de Lleida)
- Degree in Energy Engineering (UPC BarcelonaTech)

Masters and Postgraduate

- Master in Renewable Energy and Energy Sustainability (Universitat de Barcelona)
- Master in Power Electronics
- Master's Degree in Automotive Engineering
- Master's Degree in Energy Engineering
- Master's Degree in Interdisciplinary & Innovative Engineering

(UPC BarcelonaTech)

- Hydrogen as an Energy Vector: Technologies and Application (Enginyers Industrials de Catalunya)

Professional Training

- Course on Green Hydrogen Production by Electrolysis (HELEC) (Comte de Rius Institut · Institut Escola del Treball)

Training for a Hydrogen Economy based Renewable Energy Society in the Anthropocene

THERESA Doctoral Network

First European PhD program for legal specialists in the field of hydrogen.

Universitat Rovira i Virgili · University of Groningen · University of Eastern Finland

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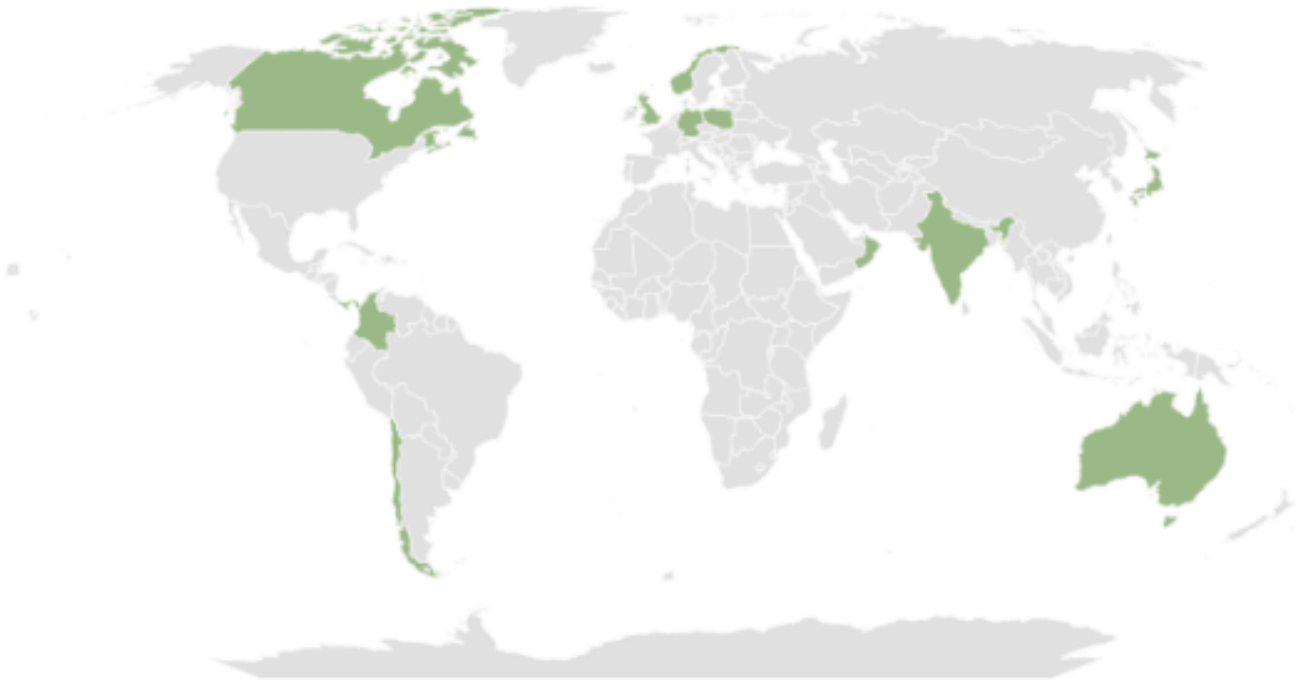
International Opportunities for Hydrogen



United Kingdom
Net Zero 2050: Government Commitment

Australia
Hydrogen and Renewable, the Government's Big Bets for 2023-2024

Poland
Hydrogen as the Axis of Decarbonization in Poland

Norway
Norway, Where the Energy Future Exists

Belgium
Belgian Commitment to Green Energy and European Strategic Pillar

Germany
Technological Challenges for the German Renewable Energy Sector

Netherlands
A 100% Sustainable Industry by 2050

Japan
Japan, an Automotive Powerhouse on the Way to the Vehicle of the Future

Singapore
Singapore Seeks to Diversify its Energy Sources

Oman
Infrastructures that Will Boost Tourism, Trade and the Economy

India
Green Energy Alternatives for Mobility

Panama
Equipment, Technology and Engineering Services for Green Hydrogen Projects

Canada
Canadian Energy Market: Clean Technologies and Sustainability

Chile
Chile 2050 Energy Plan

Colombia
At the Forefront of Energy Diversification

Source: Global Map of International Business Opportunities 2023

ACCIÓ Catalonia Trade & Investment

Generalitat de Catalunya
Government of Catalonia

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Hydrogen SWOT in Catalonia

Strengths

- Large presence of intensive industry in the use of hydrogen, especially chemicals
- Participation in the Ebro Corridor and other European initiatives
- Presence of research centers and universities
- TMB - AMB is a pioneer in Spain in the application of the H_2 in vehicle fleets

Weaknesses

- Few specialized companies
- Low penetration of renewable energy
- Lack of investment in industrial research and development
- Political, regulatory and standards uncertainty

Opportunities

- A firm commitment to climate neutrality and decarbonization in the EU: clean hydrogen will be key
- Need to connect the H2MED to the Port of Tarragona
- Next Generation EU grants
- Creation and development of applied technologies along the value chain

Threats

- Cost of renewable hydrogen remains high compared to fossil fuels
- Some technologies are immature
- Significant energy is lost in the production and conversion of hydrogen
- Lack of regulation and certification

Source: ACCIÓ

5. Success Stories in Catalonia

Success Stories in Catalonia

Lleida-Alguaire Airport will install an electrolyzer to produce hydrogen with its photovoltaic park and a hydrogen generator.

Vueling is committed to sustainable fuels, in line with the objectives of the European strategy ReFuelEU Aviation.

The **Port of Tarragona** is adapting its infrastructure to export and import hydrogen from around the world, becoming a logistics hub.

The **Port of Barcelona** will host the 2024 America's Cup, where support boats will run on hydrogen supplied by **Carburos Metálicos**.

Evarm has developed the first prototype hydrogen car and the hydrogen powered truck that participated in the last Dakar.

Applus IDIADA collaborates with various partners in the development of fuel cell and hydrogen vehicles.

Hydrogenizing BCN is an initiative that aims to create an ecosystem for SMEs and startups that allows them to participate in the hydrogen economy.

TMB has made a commitment to the use of hydrogen in public transport. 36 more will be added to the 8 hydrogen buses already circulating in Barcelona.

QEV Technologies will have electric and hydrogen platforms for buses and heavy trucks at the D-Hub in the Free Zone.

Hydrogen-Refueling-Solutions has chosen Barcelona for its first office outside of France to accelerate the hydrogen supply network.

Repsol is leading a consortium to install a 150 MW electrolyzer to supply renewable hydrogen to the Tarragona petrochemical complex.

Celsa is testing the production of green hydrogen with new technologies applicable to the steel industry for the valorization of by-products.

Jolt has patented the technology, which consists of a new surface coating process to produce more efficient industrial electrodes.

Indox has developed a green hydrogen plant for industrial self-consumption.

MMM specializes in the clean, efficient and decentralized production of hydrogen and biogas.

AMES is leading a project to develop high-temperature electrolysis technology for efficient renewable hydrogen production.

NanoChromia, a **URV** spin-off that has developed nanosensors to detect specific gases such as hydrogen.

The PRIMA platform, developed by **IREC** in Gurb since 2022, is a platform for the integration of renewable energy and storage.

Institutional Interviews

We would like to thank all the institutions that contributed to this study for their time and knowledge.

Check out the report here:

More information about the sector, news and opportunities:

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