Renewable hydrogen, a key energy carrier for Spain and Europe

Arturo Gonzalo, Chief Executive Officer of Enagás

DÍA DEL HIDRÓGENO DE ENAGÁS

enagas

Table of Contents

1. **Europe paves the way in H_2**
2. **Enagás, catalyst for an H_2 market**
   - Enagás Hydrogen Infrastructures: HNO
   - Enagás Renovable
   - Enagás GTS
3. **Spain, first hub in Europe**
   - Production potential
   - Consumption potential
   - H_2 Backbone Network
   - Benefits
4. **Schedule**
5. **Investments and financing**
6. **Conclusions**

Europe paves the way in H_2

Europe paves the way in H_2

Green Deal

Roadmap to a **climate-neutral EU by 2050**.

Fit for 55

Package of measures to **reduce emissions by at least 55%** by 2030.

Europe continues to move forward on H_2 regulatory frameworks

Decarbonisation goals in the EU

Carbon neutrality by 2050

REPowerEU

European plan to **reduce dependence on Russia** and accelerate the energy transition.

The focus of H_2 demand is on sectors that are difficult to decarbonise, such as industry and heavy transport

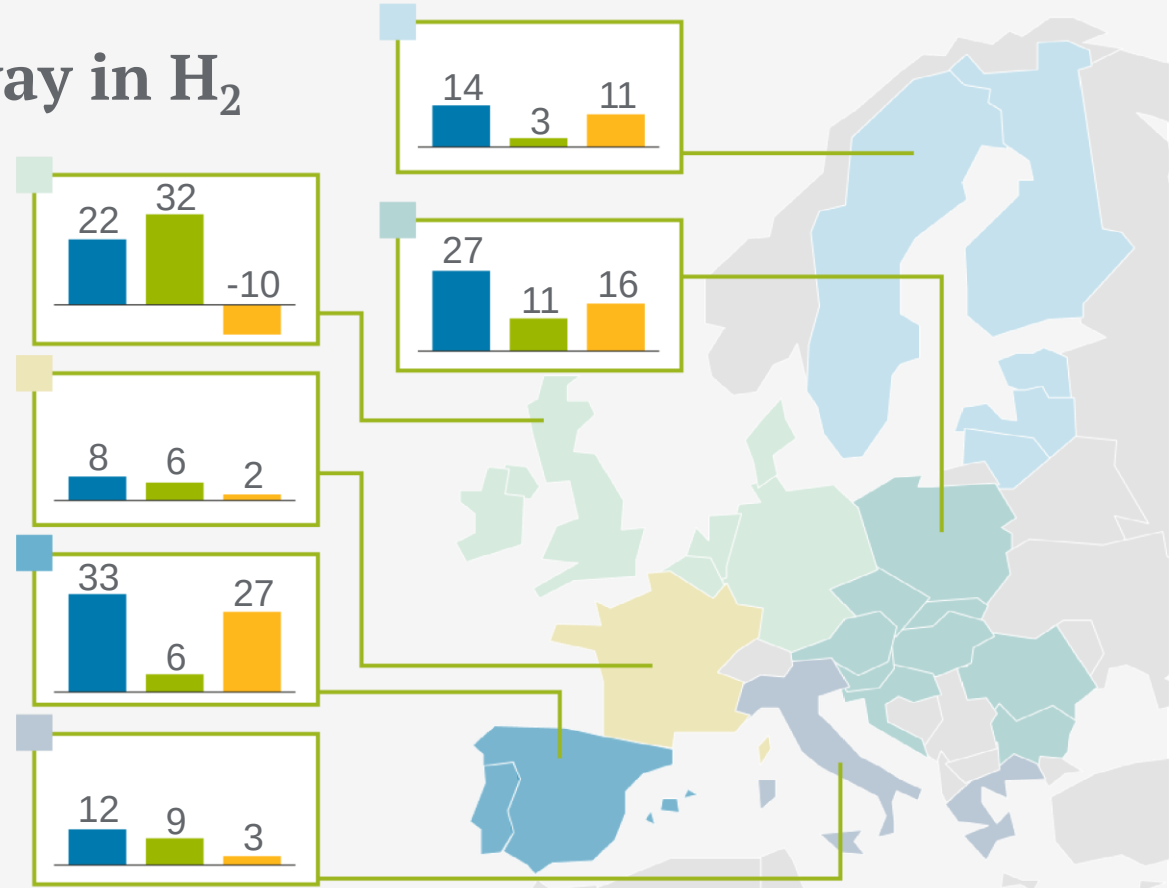
Hydrogen as an energy carrier

2030 target: 20Mt of hydrogen consumption in Europe

Europe paves the way in H_2

Potential H_2 production-demand by region (Mt) 2050

2050



- Renewable H_2 production potential
- H_2 demand
- Regional deficit-surplus

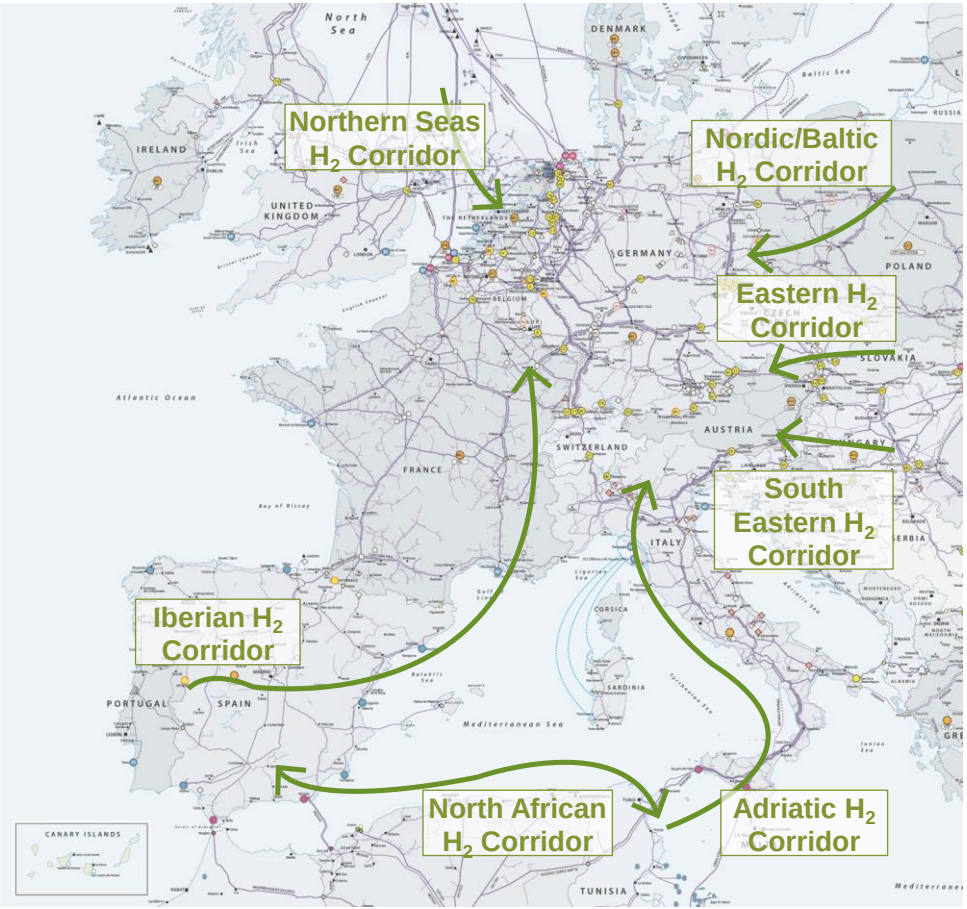
Source: EHB

Source: REPowerEU

Europe paves the way in H_2

REPowerEU Corridors

- Lever for the integration of European markets, to **conynect producer countries with centres of demand**.
- Keys to European **energy independence** and **security of supply**.
- The cost of **H_2 transmission by pipeline over long distances is 2 to 4 times lower** than transmitting electricity over high-voltage lines to produce hydrogen at destination, according to a study by European Hydrogen Backbone.
- The transmission of hydrogen by pipeline **reduces energy losses and avoids over-sizing the electricity infrastructure** to get the same amount of hydrogen to the destination.



Enagás, catalyst for an H_2 market

Enagás, catalyst for an H_2 market

Enagás

- **Pioneers and leaders in the development of renewable gases** (biomethane and green hydrogen) as new energy solutions for decarbonisation
- With **technical know-how** and appropriate **societal instruments** for the development of a renewable hydrogen market
- Incorporation of **Enagás Hydrogen Infrastructures**, in line with its purpose as TSO and HNO
- **60% stake in Enagás Renovable*** with the aim of contributing to the creation of the renewable gas market in Europe
- **Role of Enagás GTS** for the implementation of the Guarantees of Origin System

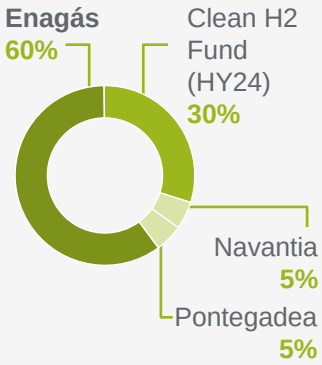
*Enagás' participation is in line with the framework established by the CNMC and will be adapted to EU regulatory developments in this area

Enagás, catalyst for an H_2 market

~25 projects in Spain

~50 partners

~200 €M[1,2] Investment up to 2030

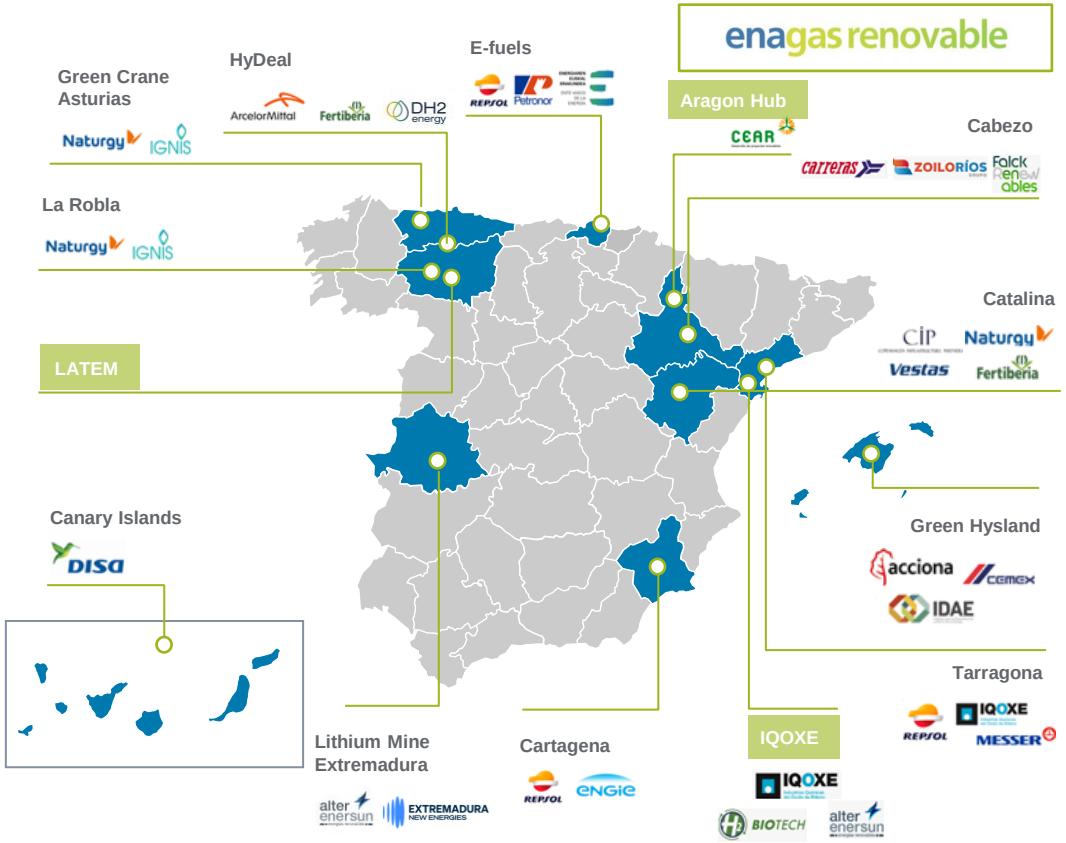


Enagás Renovable is **one of the main players** in the PERTE EHRA award, with **3 pre-selected projects**

The CNMC has defined a **operating framework** for the definition of **Enagás Renovable activities**

1. Includes investments in renewable generation assets.
2. Relating to Enagás, S.A.'s % stake in Enagás Renovable.

H_2's main projects and partners



Projects in green have been pre-awarded under the H2 Pioneros programme of PERTE ERHA

Enagás, catalyst for an H_2 market

Main partners in Spain for the development of hydrogen projects

enagas renovable

acciona · REPSOL · Naturgy · CEPSA · ArcelorMittal · Fertiberia

ENGIE · alter enersun energías renovables · Vestas · IQOXE Industrias Químicas del Óxido de Etileno · IGNIS ENERGÍA · CEMEX

DISA · DH2 energy · CEAR · Falck Renewables PURE POWER TO GROW · Petronor · CIP Copenhagen Infrastructure Partners

ENERGIAREN EUSKAL ERAKUNDEA ENTE VASCO DE LA ENERGÍA · IDAE Instituto para la Diversificación y Ahorro de la Energía · carreras · H2 BIOTECH · MESSER · ZOILORÍOS GRUPO

Enagás, catalyst for an H_2 market

Enagás Hydrogen Infrastructures: HNO

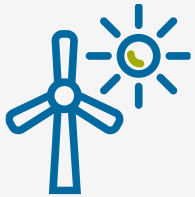
- As a European TSO, Enagás is ready to be **operator of the future hydrogen network**
- More than **50 years' experience** as a developer, owner and operator of the natural gas network
- A **network of infrastructures** that should be the starting point for the development of the future **Spanish H_2 Backbone Network**
- The **proposed European legislation** confirms that TSO status is compatible with HNO status

H2MED, the first axes and the storage facilities of the future Spanish H_2 Backbone Network were submitted by Enagás to the EU call for Projects of Common Interest on 15 December 2022, according to the announcement made by the Spanish Government

Spain, first hub in Europe

Spain, first hub in Europe

Capacities of Spain



Renewable generation potential

Robust infrastructure network

Industrial capabilities

Geographical position

Collaboration with public administrations

H2MED presentation at the Euro-Mediterranean Summit as the first European Green Corridor

Spain, first hub in Europe

Renewable H_2 production potential

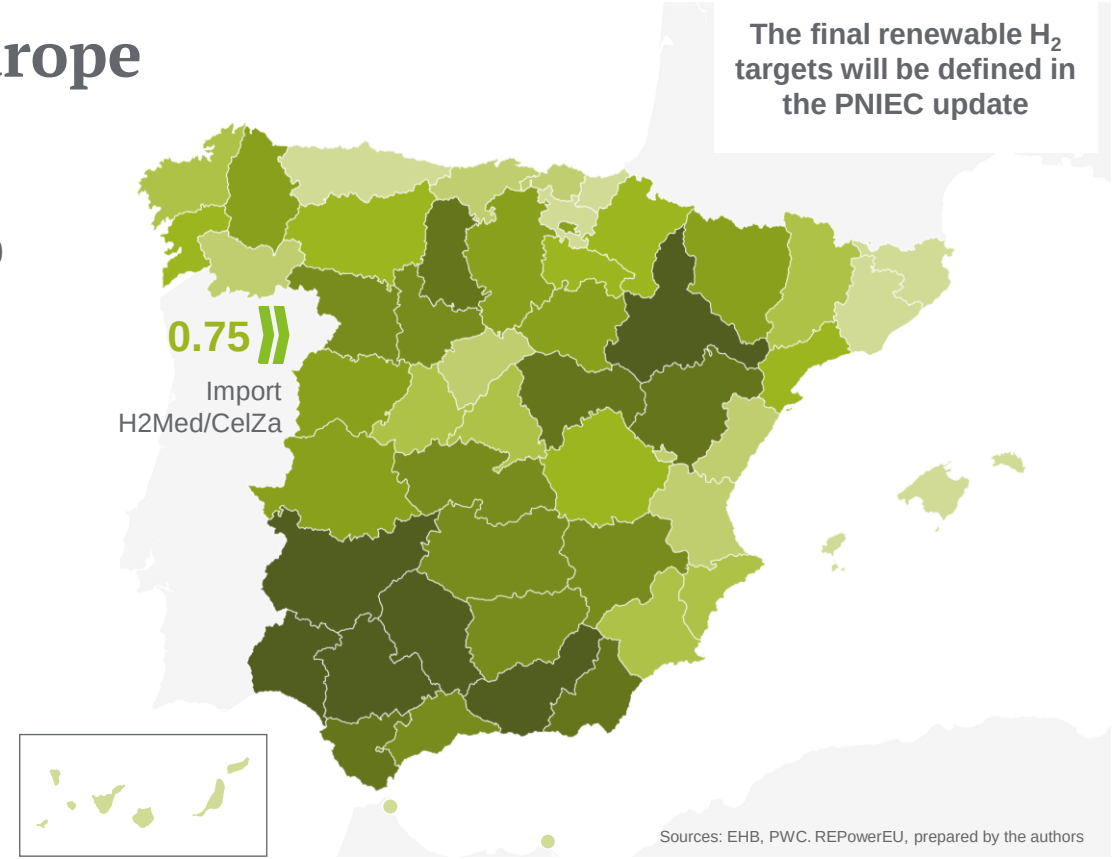
The estimated **renewable H_2 production potential in Spain** in 2030 is **between 2 and 3 Mt** and in 2040, between 3 and 4 Mt

2-3 Mt in 2030

3-4 Mt in 2040

Import from Portugal **0.75 Mt**

The final renewable H_2 targets will be defined in the PNIEC update



Sources: EHB, PWC. REPowerEU, prepared by the authors

Spain, first hub in Europe

Potential renewable H_2 demand in 2030

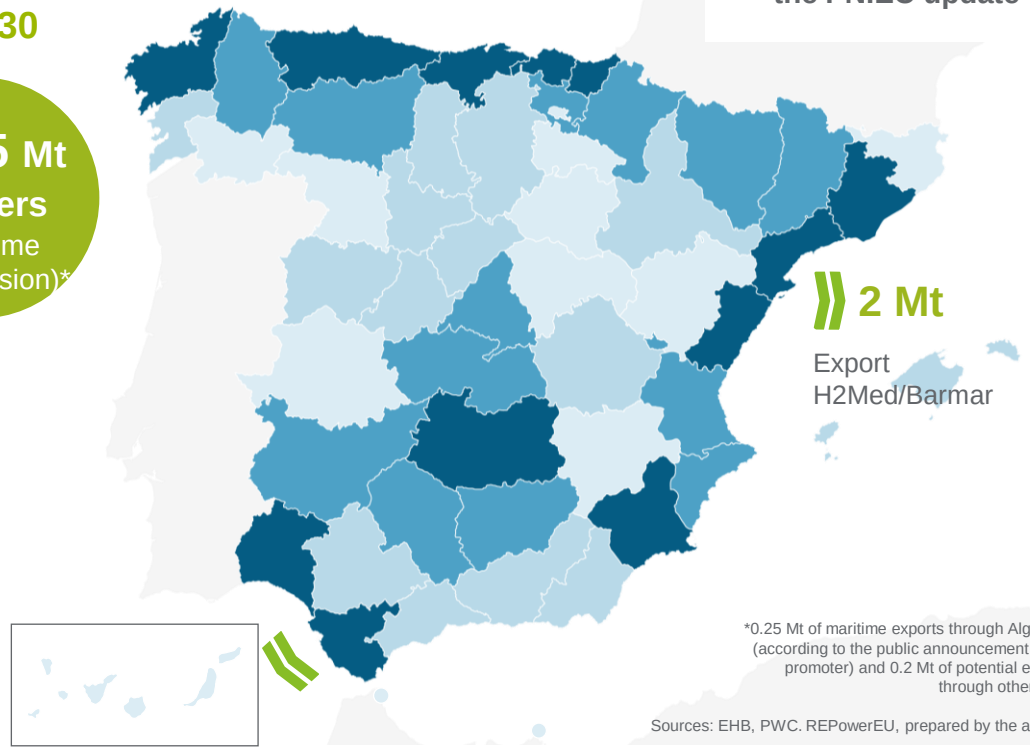
1.3 Mt
National demand

2 Mt
Export
H2Med/ BarMar

~0.45 Mt
Carriers
(Maritime transmission)*

- **Domestic demand** includes industries that are difficult to decarbonise (**refining, chemicals, steel and ceramics**). **Heavy transport**, which could be a potential additional demand, is not included.
- The unequal **distribution between production and demand** in Spain justifies the need for an **H2 transmission network**

The final renewable H_2 targets will be defined in the PNIEC update



*0.25 Mt of maritime exports through Algeciras (according to the public announcement of the promoter) and 0.2 Mt of potential exports through other ports

Sources: EHB, PWC. REPowerEU, prepared by the authors

Spain, first hub in Europe

Spanish H_2 Backbone by 2030*

Transmission and storage projects submitted to PCI call for proposals

High H_2 production potential connection with unmet local demand

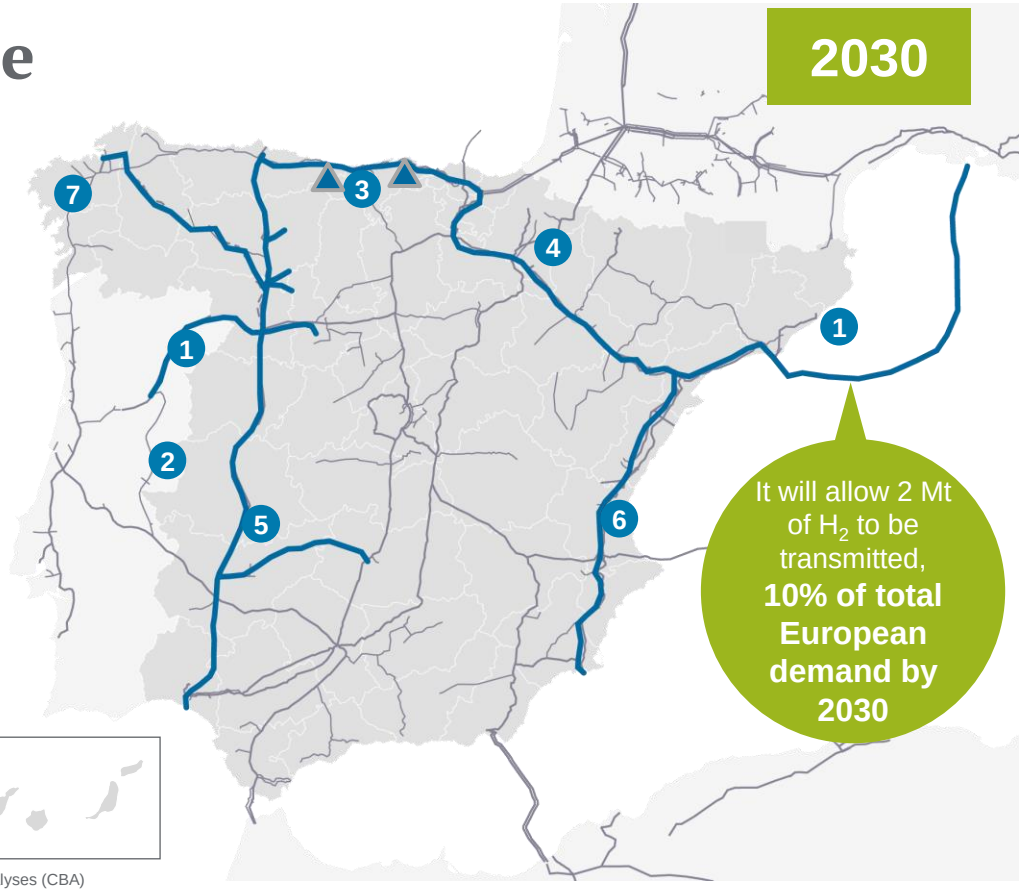
1. H2Med (Barmar-CelZa)
2. Vía de la Plata Axis
3. Cantabrian Coast Axis
4. Valle del Ebro Axis

Connection "H_2 valleys" for supply guarantee

5. Puertollano Connection
6. Levante Axis
7. Coruña - Zamora Connection

   Project submitted by Reganosa to the PCIs

▲ Underground storage facilities

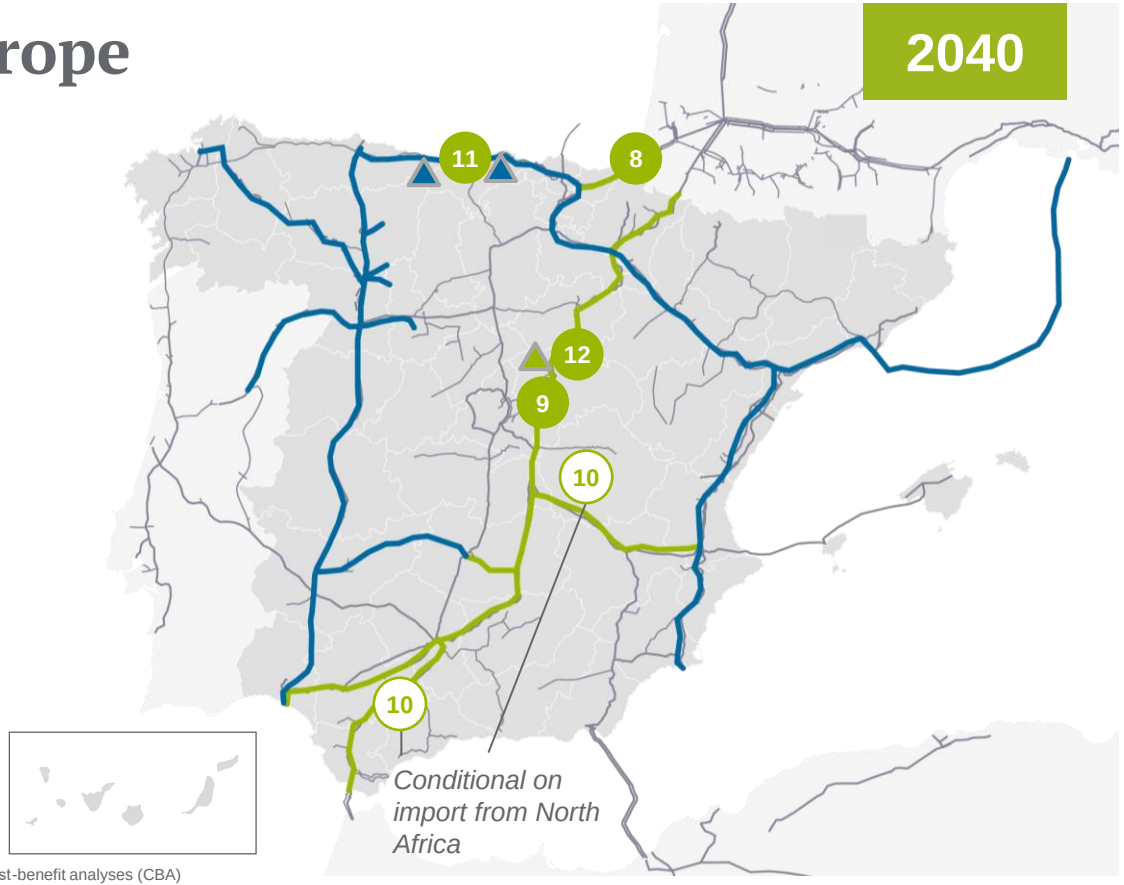


*This network is subject to what is defined in the Government's Binding Planning and prior cost-benefit analyses (CBA)

Spain, first hub in Europe

Spanish H_2 Backbone by 2040*

- **8** **Irún and Larrau exports**: existing interconnections dedicated to H_2 to increase exports to France.
- **9** **Meshing of the Central Zone (Huelva-Córdoba-Madrid-Navarra):** meshing to satisfy demand in the central area, provide security of supply, and guarantee exports and imports North Africa-Europe.
- **10** **North Africa import, Tarifa-Córdoba and Alcázar de San Juan-Montesa**: the following interconnections exist to increase exports to the rest of Europe.
- **11** **H_2 Storage Facilities in Cantabria and Basque Country:** incorporation of storage facilities to guarantee supply to the H2 transmission infrastructure.
- **12** **Yela H_2 storage facility.** (Other potential storage facilities in southern Spain are under study).



*This network is subject to what is defined in the Government's Binding Planning and prior cost-benefit analyses (CBA)

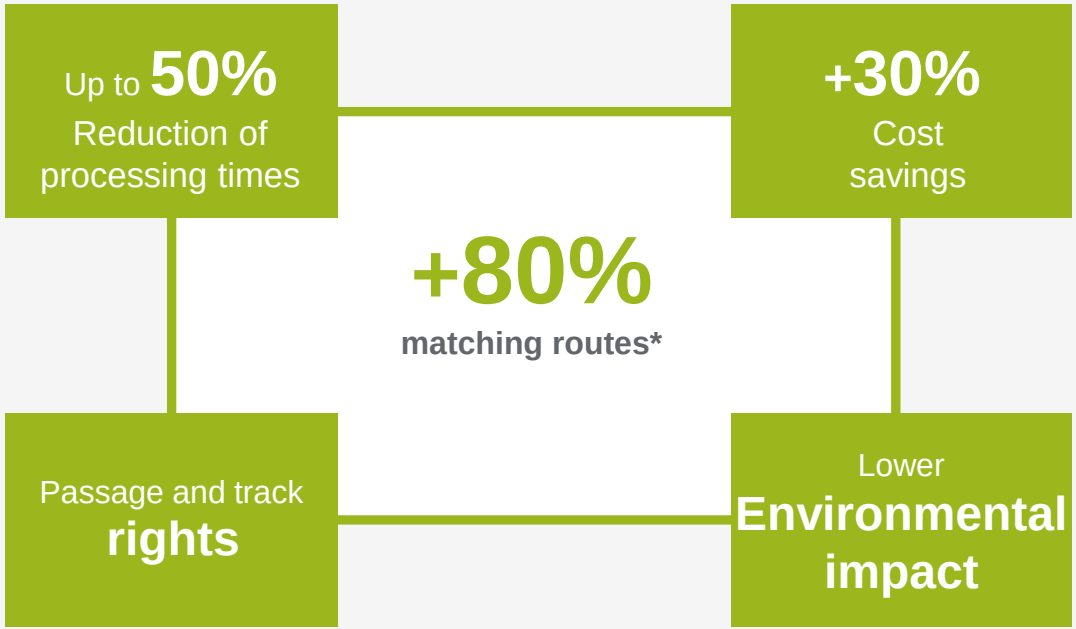
Spain, first hub in Europe

Current infrastructure network

Spanish H_2 Backbone by 2040

Spain, first hub in Europe

Synergies between gas grid and H_2 grid in 2040



*Contemplates backbone, excluding H2MED

- Enagás' **current** pipeline **network technically ready for H_2**
- **Already identified more than 30%** of reusable pipeline sections. **The aim** is to increase this percentage to **60-70%**

Spain, first hub in Europe

Benefits

Energy and environmental

- Emissions reductions
- Air quality improvement
- Renewables promotion
- Contribution to national objectives

Socio-economic

- Industrial development
- Innovation development
- Investment attraction

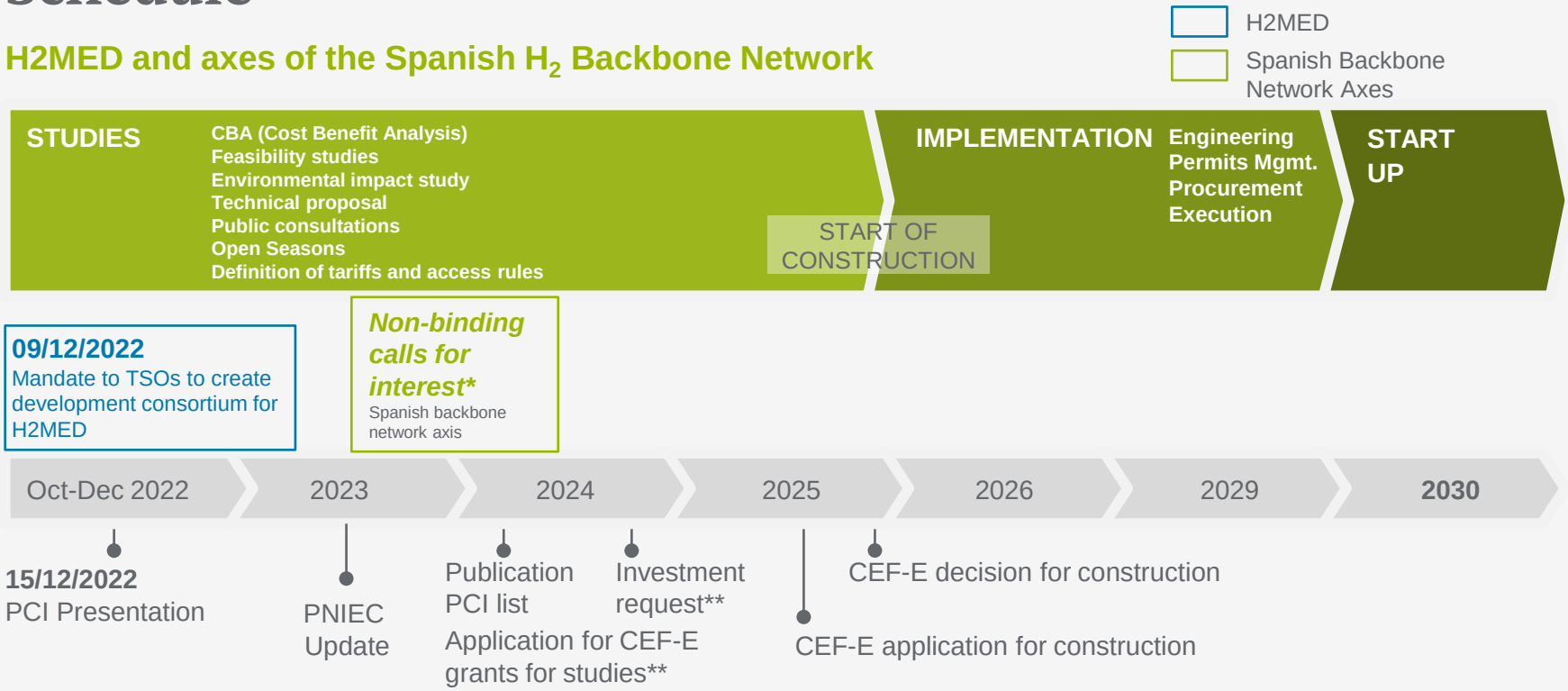
Social

- Just transition
- Employment
- Contribution to local economies
- Sustainable development goals

Schedule

Schedule

H2MED and axes of the Spanish H_2 Backbone Network



*Binding future Planning defined by the Government as part of the energy policy will mark the following steps
**Conditional on schedule for resolution of PCIs

Investments and financing

Estimated maximum investments

Projects submitted by Enagás to the European Union's call for PCIs

	Capacities	Technical specifications	Investment
H2Med-BarMar Total	**Maximum capacity:** **2 Mt**	Length: **455 km** Diameter: **28"** Max. depth: **2,600 m** Operating pressure: **210 bar** BCN compression station: **140 MW**	**≈ €2,135 M***
H2Med-CelZa Total	**Maximum capacity:** **0.75 Mt**	Length: **248 km** Diameter: **28"** Operating pressure: **100 bar** Zamora compression station: **24.6 MW**	**≈ €350 M** ≈ €157 M Spanish side

Total H2MED: ≈ €2,500 M

*Investment for each operator to be decided

Estimated maximum investments

Projects submitted by Enagás to the European Union's call for PCIs

		Segments	Technical specifications	Investment
Spanish Backbone	Axis 1	**Cantabrian Coast Axis** Connection of demand in the northern area with H_2 production points. **Valle del Ebro Axis** Connection of demand in the northern area and Castellón, and H_2 Tarragona valley, to the high H_2 production in Aragón. **Levante Axis** Castellón-Murcia, to connect Murcia H_2 valley and Cartagena e-Terminal.	Approx. length: **1,500 km** **Route:** · Gijón-Torrelavega-Vizcaya-Álava-La Rioja-Zaragoza-Teruel · Teruel-Tarragona · Tarragona-Barcelona · Teruel-Castellón-puerto Sagunto · Puerto Sagunto-Cartagena	≈ €1,650 M
	Axis 2	**Vía de la Plata Axis** H_2 production connection Extremadura and Castilla León demand by 2030 northern area and Musel export potential **Puertollano Connection** To connect Puertollano H_2 valley	Approx. length: **1,250 km** **Route:** · Gijón-Musel · Gijón-Avilés · Gijón-Salamanca · Salamanca-Mérida · Mérida-Huelva · Mérida-Vegas Altas Saceruela-Puertollano	≈ €1,850 M

Estimated maximum investments

Projects submitted by Enagás to the European Union's call for PCIs

	Capacities analysed	Technical specifications	Investment
H_2 storage North 1	Under analysis Potential capacity 2030: **335 GWh**	New salt cavern in Cantabria	**≈ €580 M**
H_2 storage North 2	Under analysis Potential capacity 2030: **240 GWh**	New salt cavern in the Basque Country	**≈ €590 M**

The axes in question act as major collectors of hydrogen production distributed throughout the national territory. This, together with the development of potential underground storage facilities under study, will allow optimisation of infrastructure needs, both in terms of compression and the transmission capacity of the pipelines, with average diameter ranges considered to be 16"-36".

Estimated maximum investments

The investment will take place from 2026

The final amount will be conditioned by:

- Final list of **PCIs**
- Final objectives of the **PNIEC**
- **Government Planning**
- Results of the **calls for interest and Open Season**
- Final percentage of the **current infrastructure network that can be reused**
- **Final technical characteristics** of the projects

H2MED ≈ €2,500 M* TOTAL

BarMar ≈ **€2,135 M**

CelZa ≈ **€350 M** in total

(≈ **€157 M** Spanish side)

Axis and storage facilities of the Spanish H_2 Backbone

≈ **€4,670 M**

Investment figures are gross without considering potential subsidies
In the case of BarMar (H2MED), the investment for each operator is still to be decided

Financing

1. **EU funds.** CEF-E programme for projects and other European funding streams
2. **Open Seasons.** Firm commitments from future off-takers that may give rise to project finance mechanisms
3. **Cross-border cost allocation**. The Infrastructure Regulation provides for mechanisms to allocate the costs of PCIs to the beneficiary countries by mutual agreement
4. **Tolls** associated with the use of infrastructure

Conclusions

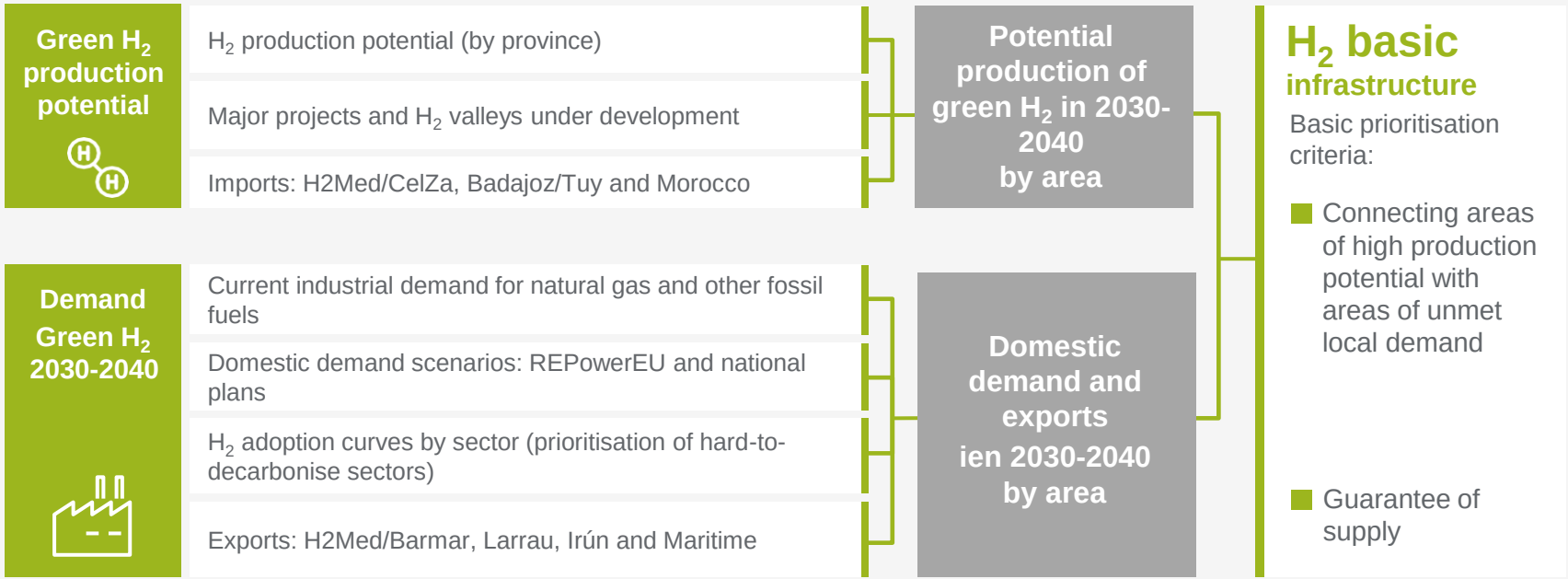
Conclusions

- Enagás, **catalyst of the H_2 market in its triple capacity** as TSO (potential HNO), participates in the promotion of renewable gas projects through Enagás Renovable and as GTS
- As a European TSO, Enagás is ready to be an **operator of the future hydrogen network**
- **Enagás submitted the** H2MED **projects** and the backbone lines of the Spanish H_2 Backbone Network to the EU's Project of Common Interest candidacy in December, as **announced by the Spanish Government**
- The company is **working on the projects in full coordination with the TSOs in Portugal and France**, as commissioned in December and **in line with European plans** and Enagás' **Strategic Plan**
- **Net Zero** infrastructure
- **Enagás is a pioneer** in the development of renewable gases and has the **technical know-how and societal instruments** for the development of a renewable hydrogen market.
- The Iberian Peninsula has a **network of infrastructures** that will be the starting point for the development of a future **H_2 backbone network**
- Enagás will start **non-binding supply and demand matching mechanisms in 2023** to optimise the development of the backbone network
- **Spain** has the conditions to become **Europe's main renewable H_2 hub**

Annexes

Market analysis 2030-2040

Methodology for identification of H_2 transmission infrastructure needs in 2030-2040



Thank you very much

DÍA DEL HIDRÓGENO DE ENAGÁS

enagas