1st Hydrogen and Energy Efficiency Congress,
ANDI and NATURGAS

Latinoamérica en la carrera por el hidrógeno entre Europa y Estados Unidos

FTI CONSULTING™

October 19, 2023

Green Hydrogen will be Part of the Energy Transition Equation

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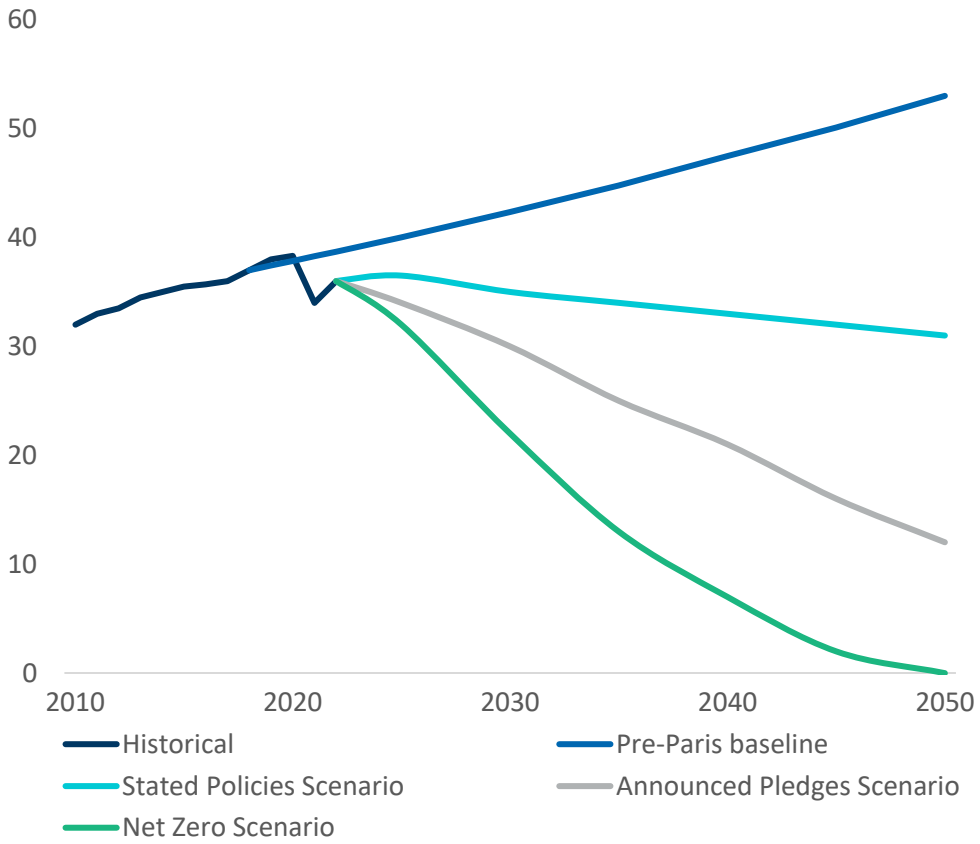
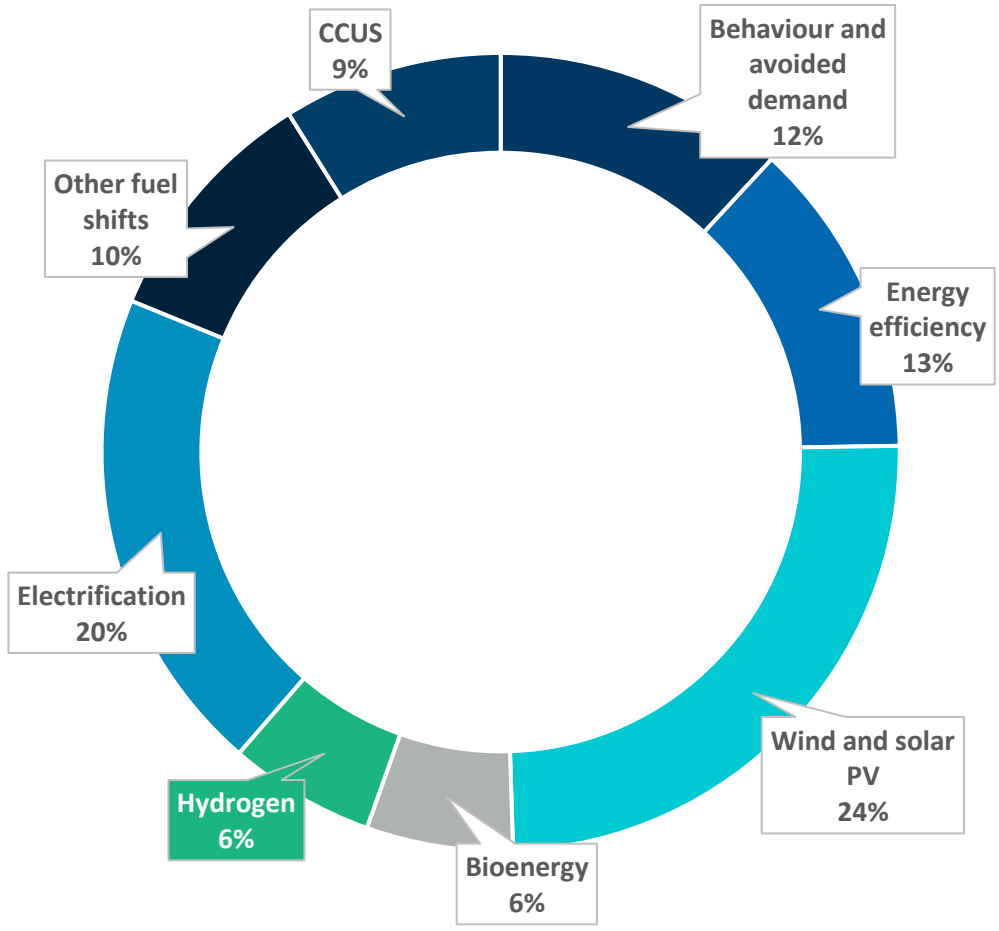
Energy Transition proves to be harder than expected: all the solutions to decarbonize final energy will need to be developed to reach the Net-Zero

According to the Sept. 2023 IEA report, Hydrogen will contribute to 6% of the cumulative emission reductions needed to hit our net zero targets by mid-century

Energy-related and process CO2 emissions, 2010-2050 (Gt CO2)[1)]



Cumulative CO2 emissions reduction by mitigation measure in the NZE Scenario, 2022-2050 (Share, %)[(2)]

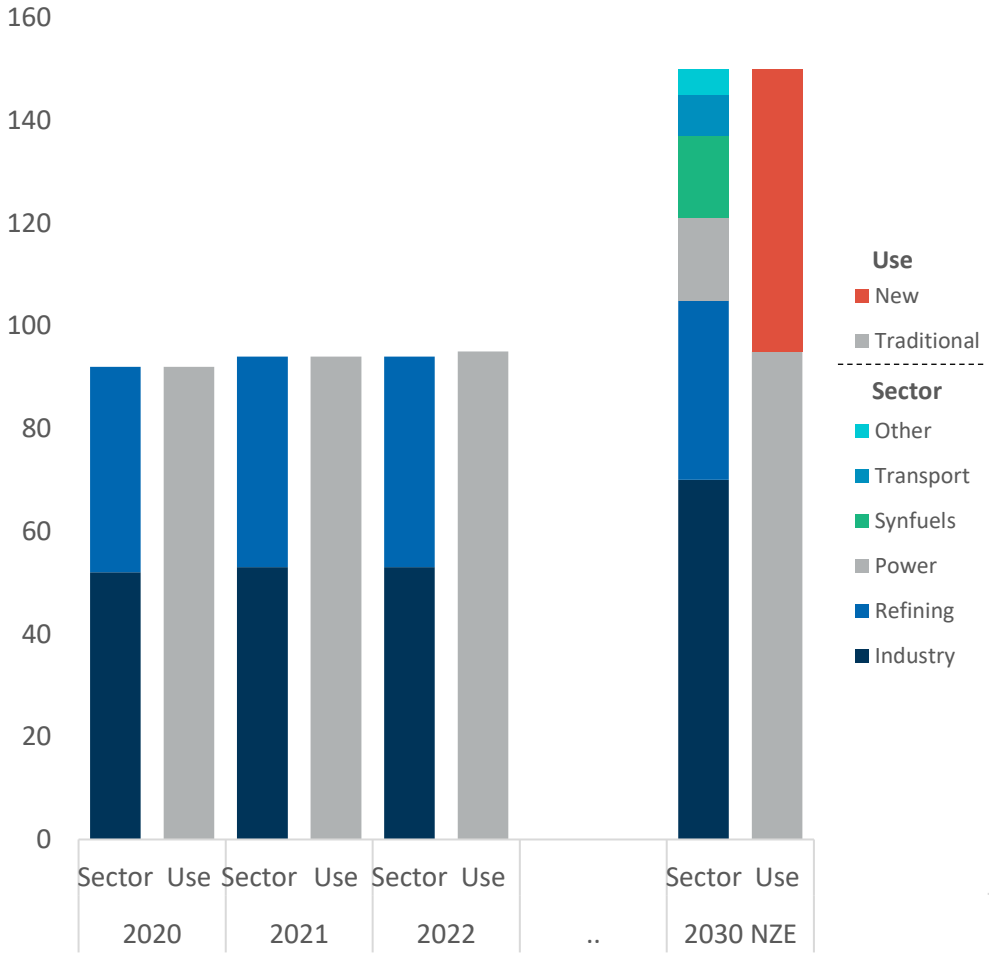


(1) IEA, Energy-related and process CO2 emissions by scenario, 2010-2050 (Link ; (2) IEA, Net Zero Roadmap, Update 2023 (Link).

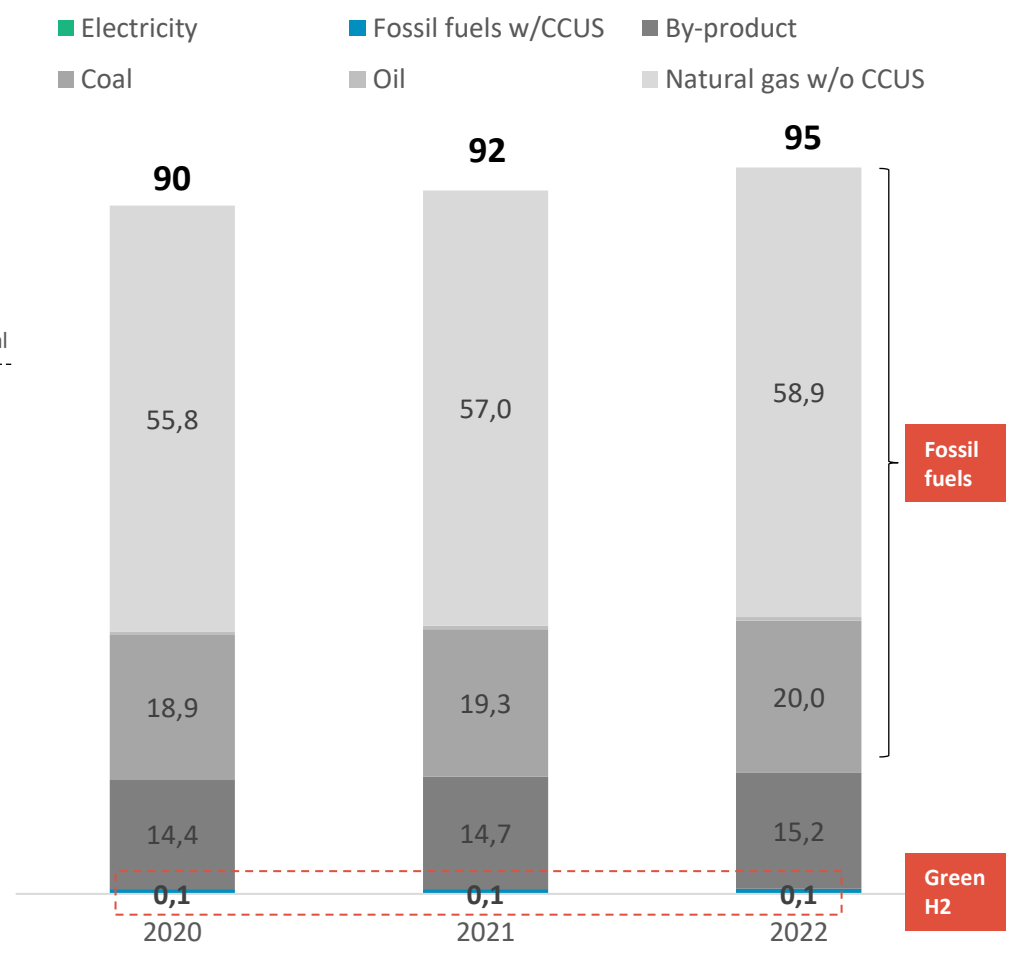
Global H2 demand stood at 95 Mt (2022)—2.5% of final energy—and only less than 1 Mt was supplied through low-emission hydrogen (0.7%)

China is the largest single consumer of hydrogen by far, accounting for nearly 30% of global hydrogen use (less than double of the second largest consumer, the United States, 17%)

Hydrogen demand by sector and type of use, 2019-2030 (Mt)[1]



Hydrogen production by technology, 2020-2022 (Mt)[1]

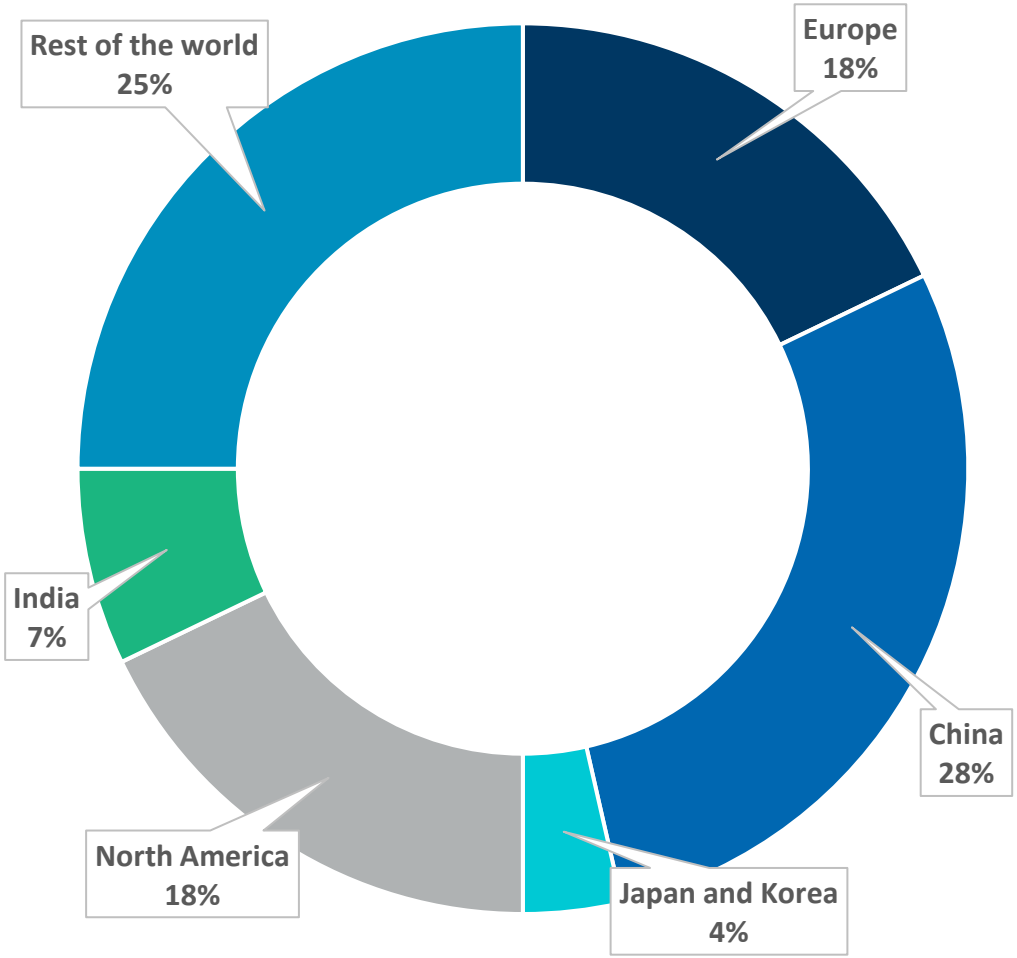


Notes: Traditional applications include refining, feedstock to produce ammonia, methanol and other chemicals; and as a reducing agent to produce direct reduced iron (DRI) using fossil-based synthetic gas. Potential new applications include transport, production of hydrogen-based, biofuels upgrading, high-temperature heating in industry, and electricity storage and generation.
(1) IEA, Global Hydrogen Review 2023 (Link).

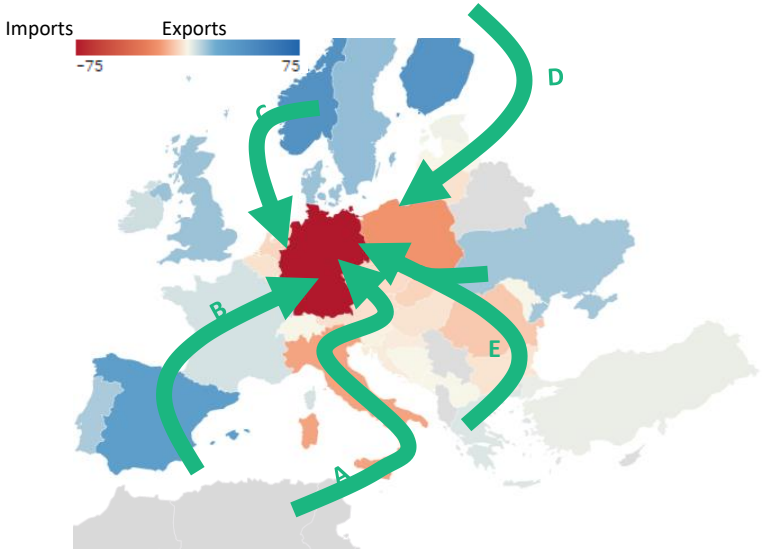
China, India, Japan, SK, Europe, and North America will account for 75% of global hydrogen demand, according to the Hydrogen Council

By 2030, the first piped imports into Europe will occur as domestic hydrogen supply (ie. Germany) is constrained and available renewable capacity is built up to decarbonize power

Hydrogen demand by region, 2030 (Share %)[1]



Hydrogen demand deficit from local supply in Europe, 2030[2]



Regional differences in supply and demand

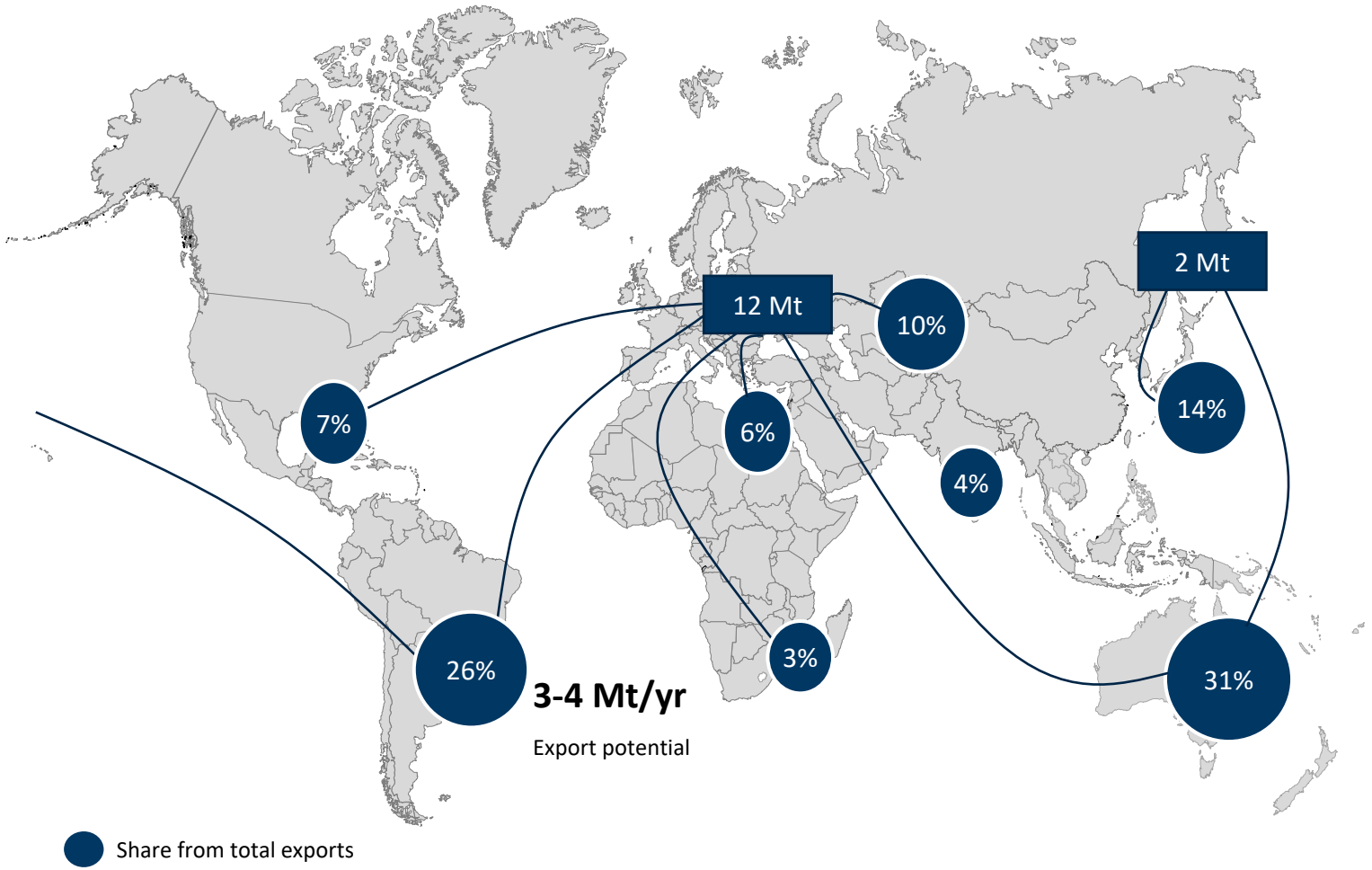
- Across different regions of the world, there are significant differences in the hydrogen supply-demand balance.
- Some regions are characterized by a net supply of low cost, hydrogen resources. These regions benefit from vast renewable energy potential, high capacity factors and substantial land availability (ie. Latin America and Australia).
- Other regions will require hydrogen imports from other regions to meet their hydrogen demand (ie. Europe).

(1) Hydrogen Council, Global Hydrogen Flows: Hydrogen trade as a key enabler for efficient decarbonization (Link); (2) European Hydrogen Backbone (EHB) Initiative, May 2022.

Latin America and Australia will represent more than half of the hydrogen exports by 2030, according to the EIA

Based on announced export-oriented projects, 14 Mt could be exported all around the world by 2030 in direction to deficit regions like Europe and Asia – regions with larger demand

Global hydrogen trade in 2030[1,2]



150 Mt/year
Expected global demand for 2030

9%
Of the international trade of H2 will be demand from Europe (12 Mt) and Asia (2 Mt)

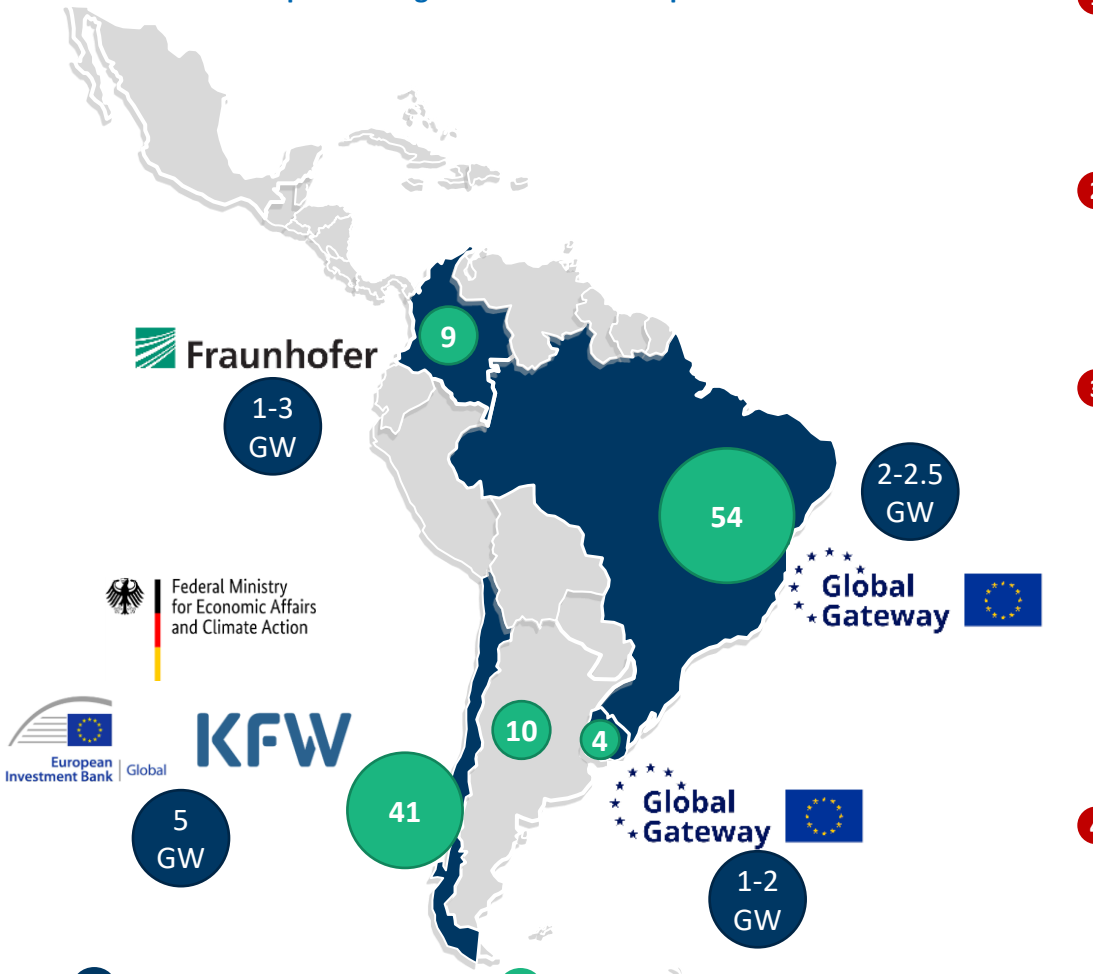
26%
Is the export of the Southern Cone (from total exports)

(1) IEA, Global Hydrogen Review 2023 (Link); (2) IDB, Unlocking Green and Just Hydrogen in Latin America and the Caribbean (June 2023) (Link).

The EU, through its Global Gateway,[1] has committed to boost investments in the Latin America region for developing a renewable hydrogen industry

The EU and the European Investment Bank (EIB) have agreed to cooperate on energy, including hydrogen, with Colombia, Chile, Brazil and Uruguay with an investment of at least EUR$2.25 bn in the region

Latin America Cooperation Agreements with Europe (1,2)



(1) Issued on December 1, 2021. The EU can support countries, including Latin America, in the creation of competitive markets to enable hydrogen produced outside the EU to be traded internationally EU's Global Gateway (Link); (2) Hinicio, H2LAC Index 2023 (Link); (3) Hydrogen Central (Link); (4) UE, Statement by the President with President Lula da Silva (June 2023) (Link); (5) Delegation of the European Union to Chile, June 2023 (Link); (6) EU and Uruguay boost cooperation on renewable energy (Link).

1 Colombia

- Colombia and Germany signed agreements to consolidate their bilateral relations on green H2 production and its derivatives and its potential export towards Germany (June 2023).(3)

2 Brazil

- The EU will invest EUR$2 billion to support Brazil's production of green H2 and to promote energy efficiency in industry.(4)

3 Chile

- Chile and the EU launched two new cooperation initiatives on green H2 worth EUR$225 million.
  - A technical assistance project that will contribute to the development of the green hydrogen sector in Chile led by EU and German Federal Ministry of Economics and Climate Protection (BMWK).
  - The creation of a fund that will directly finance green hydrogen production projects though the European Investment Bank (EIB) and the German Development Bank (KfW).(5)

4 Uruguay

- The EU and Uruguay signed an agreement of energy cooperation to promote the production of H2 to reach climate neutrality by 2050.
- The agreement underlines that investments should comply with the environmental legislation related to marine and land sectors in both the EU and Uruguay.(6)

There are barriers to be overcome before green hydrogen can be produced in a commercial scale and a global market is developed

These vary across regions, depending on government policies, market conditions, and technology readiness[1]

Safety concerns

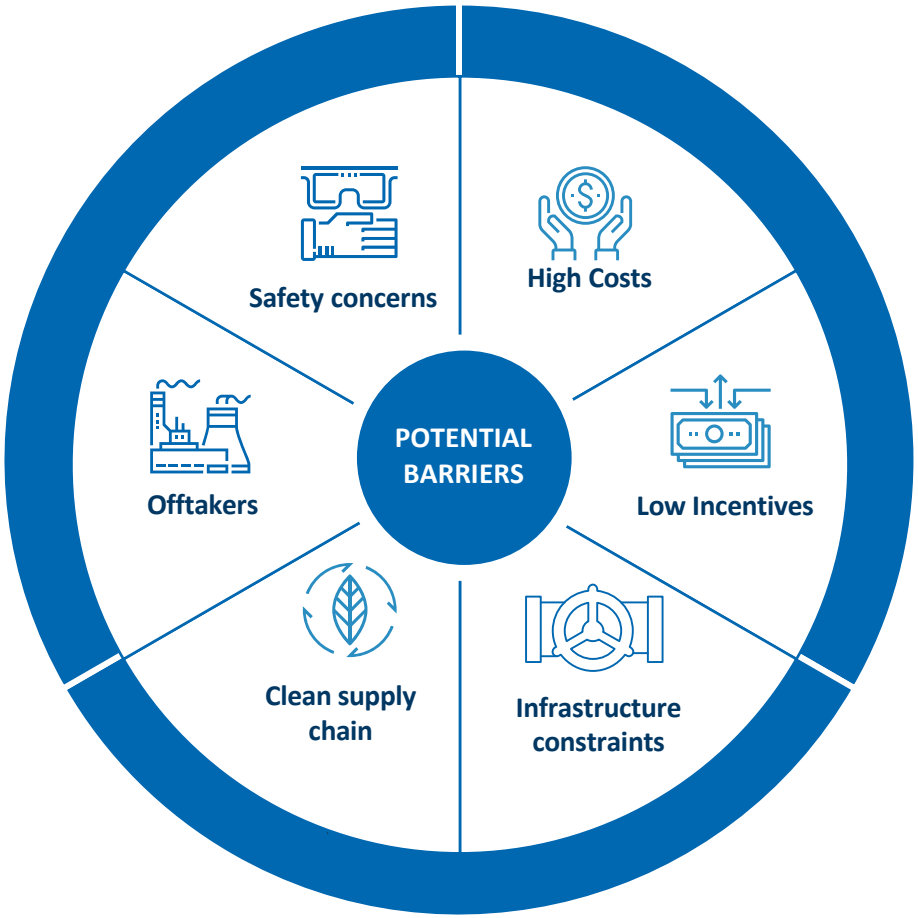
- Safety standards remain unclear, particularly for the transport and storage of hydrogen
- Lack of standards for tracing the environmental impacts of different hydrogen supplies (ie. Water and land resources)

Offtakers/Commerciality

- Green hydrogen is not yet in real demand for practical applications
- Hydrogen is not yet publicly traded
- Commerciality difficulties due to face-value logistical benefits (i.e renewable sites far from essential infrastructure)

Clean supply chain

- Limited renewable energy infrastructure (i.e low reliability)
- Low renewables penetration in own energy system
- Green production uncertainty, making volume commitment arrangements complex



High costs

- The cost of green hydrogen is still quite expensive compared to other fuels (technology at early stage)
- Higher transportation and storage costs
- Lack of production scale leading to high cost per unit metrics

Low financial incentives

- Limited pool of creditworthy investors to offtake green hydrogen
- Inadequate financing mechanisms on a state and local level for renewable projects
- No/few price support policies in green hydrogen production

Infrastructure constraints

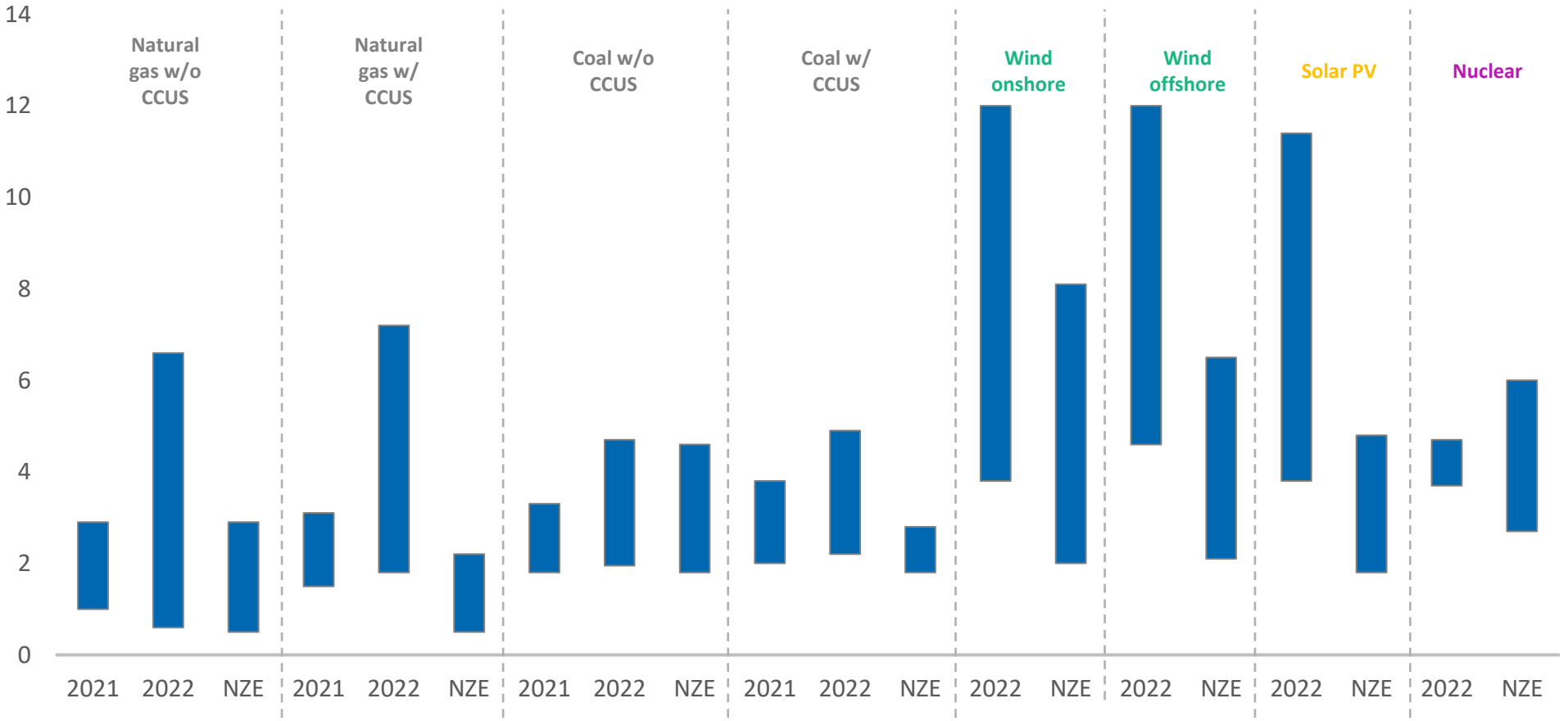
- Lack of investment
- Limited existing infrastructure
- Lack of blending targets (ie. Use of natural gas pipelines or any other existing infrastructure)

(1) IEA, the Future of Hydrogen (Link). FTI Analysis

The levelised cost of hydrogen from unabated fossil-based sources was in the range of USD 1-7/kg H2, while renewable, USD 4-12/kg H2 (2022)

If large-scale deployment takes place, the production costs of green hydrogen using electricity from solar PV could fall to USD 1.6/kg H2 and for wind, USD c.2.0/kg H2 by 2030

Levelised cost of hydrogen production by technology in 2021, 2022 and in the Net Zero Emissions by 2050 Scenario in 2030 (USD/kg H2)(1)

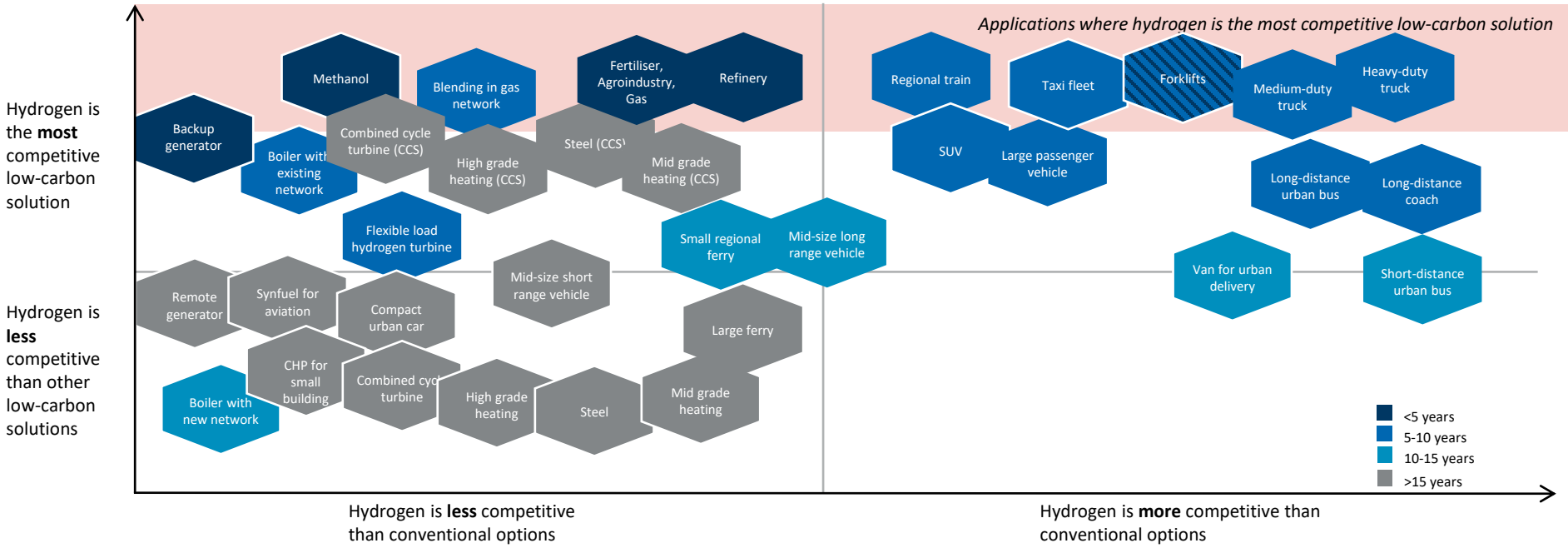


(1) IEA, Global Hydrogen Review 2023 (Link).

Hydrogen is mainly used as a feedstock or an energy source; its potential for decarbonization is guided by the relative economics of green H2

Hydrogen applications currently compete against other low-carbon solutions and conventional options with only some competitive in the short term

Green Hydrogen - Hydrogen Application Viability



Note: (1) Low-carbon/renewable hydrogen is the only alternative competing with grey hydrogen
FTI Analysis; adapted from the Hydrogen Council's "Path to Hydrogen Competitiveness."

Europe: Leading, despite bureaucracy

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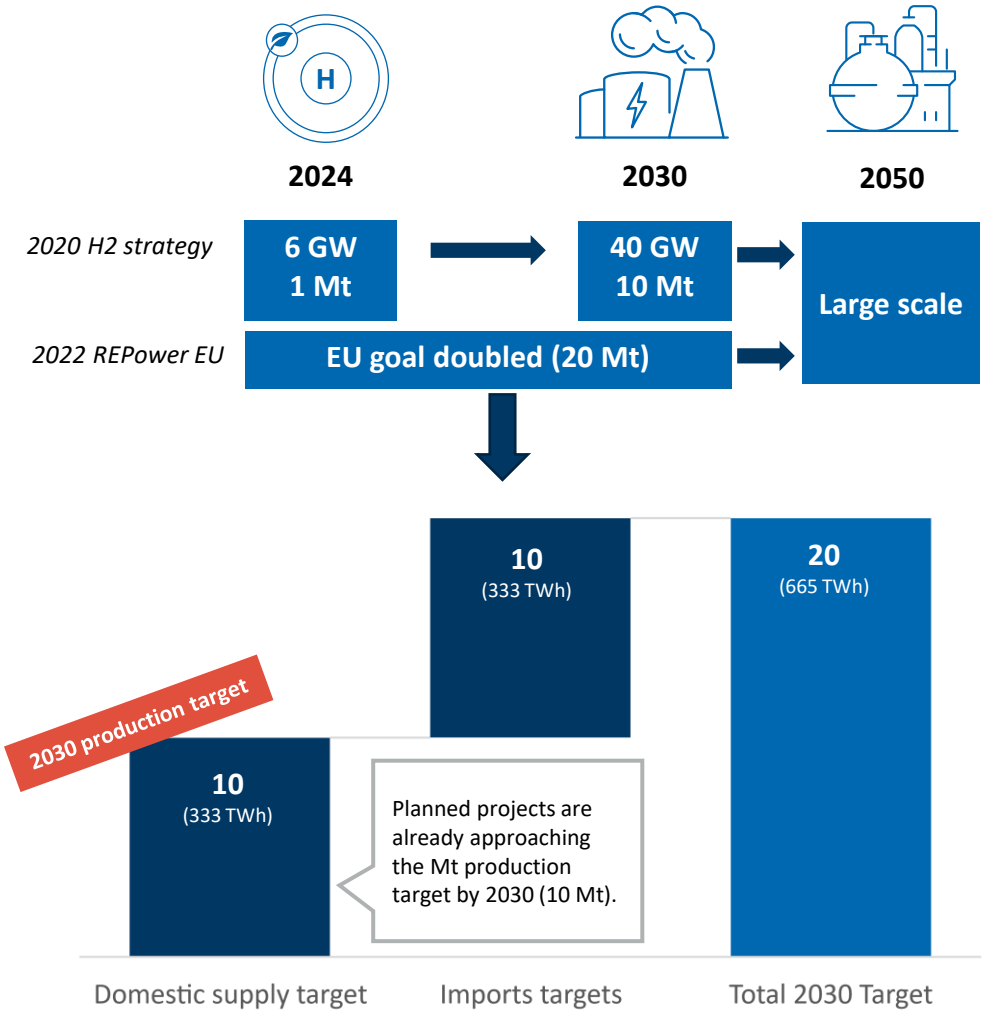
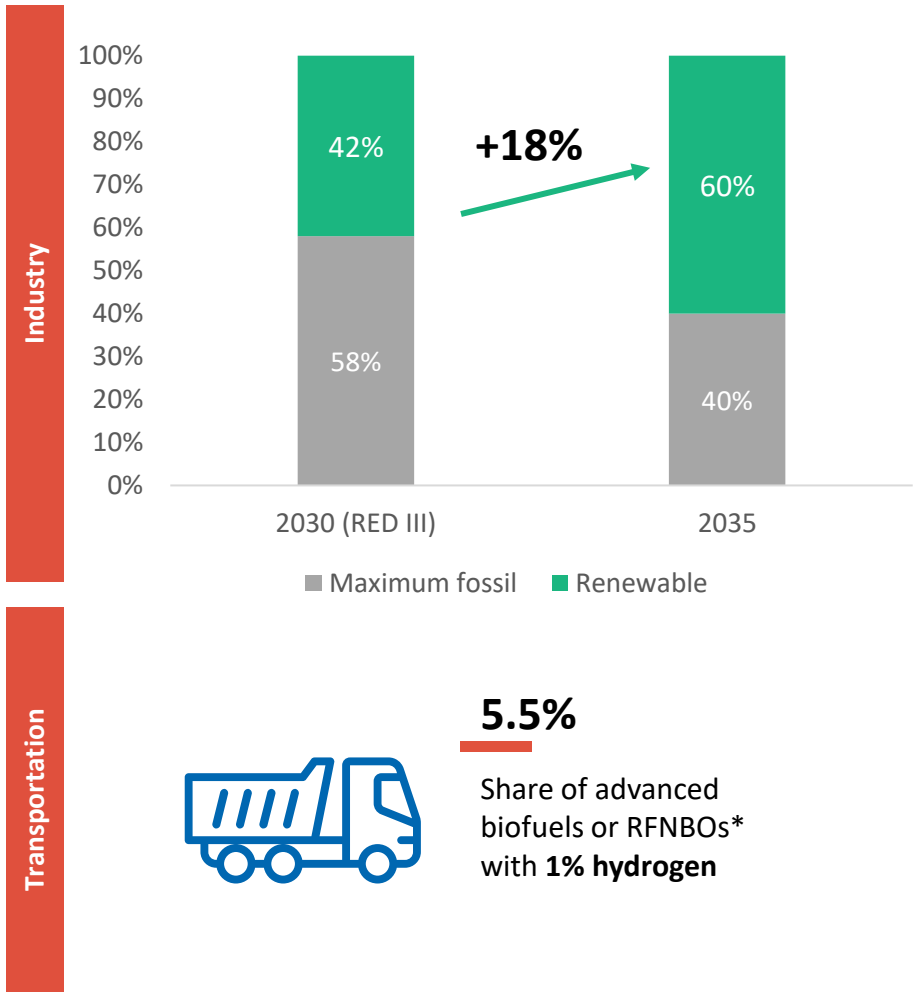
The EU aims at an off-take of green hydrogen of 20 Mt by 2030: 50% would be supplied domestically, while the remaining 50% with imports

RED III further strengthens the target for renewable hydrogen, establishing that 42% of H2 used in the industry sector must come from RFNBOs by 2030 and 60% by 2035 and at least 1% for transportation

Europe's target green H2 production (up to 2050)[1,2]



2030 EU hydrogen targets by sector (RED III)[3]



5.5%

Share of advanced biofuels or RFNBOs* with **1% hydrogen**

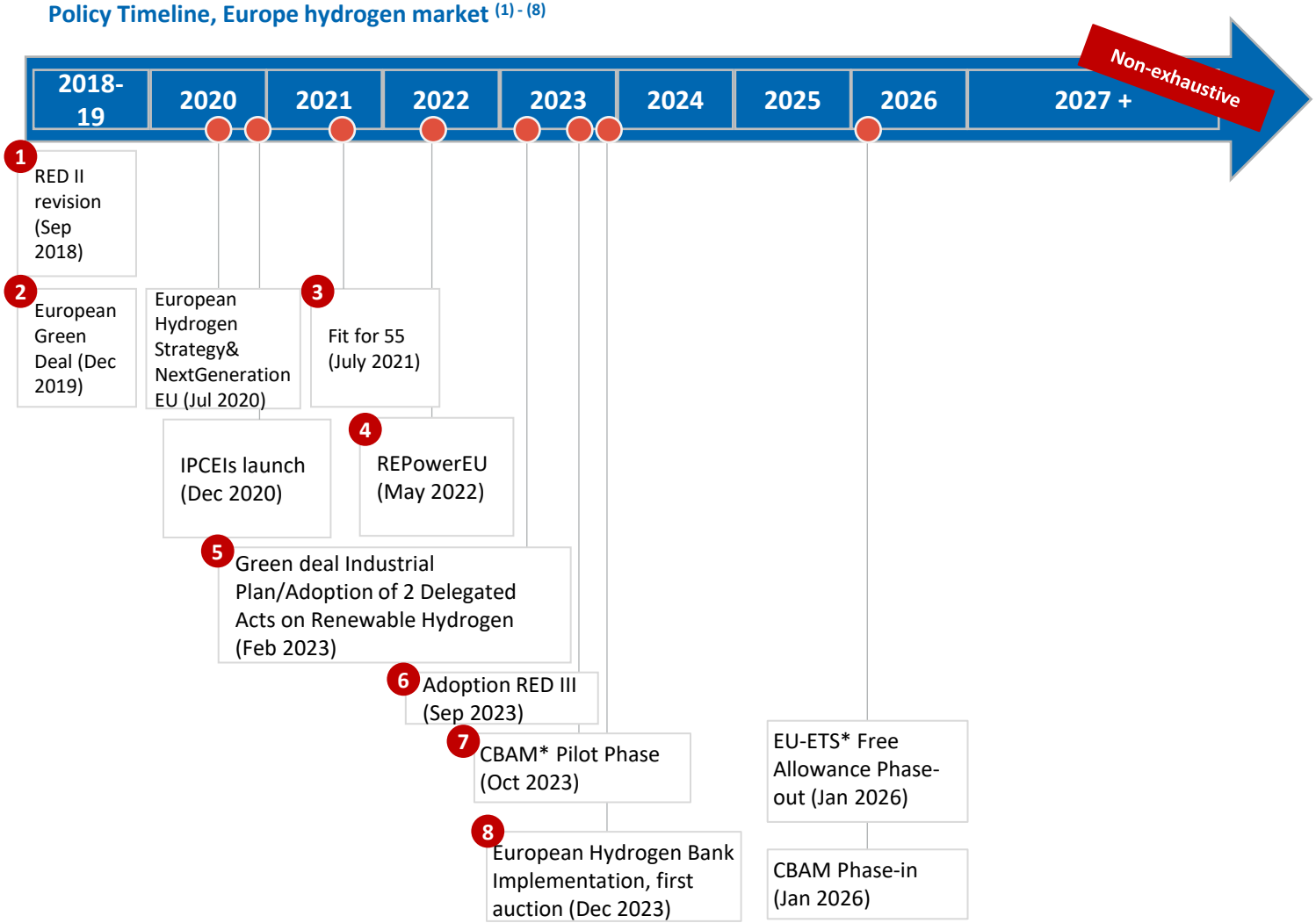
* Notes: RFNBO means renewable liquid and gaseous fuels of non-biological origin.

(1) EU Hydrogen Strategy (Link); (2) EU hydrogen policy (Link); (3) International Energy Agency and European Commission (Link, Link ,Link).

Europe has developed a strong policy framework to achieve Net-Zero in 2050, which supports the development of a large-scale hydrogen market

The EU will continue to implement key policies to incentivize the penetration of green H2 in hard-to-electrify sectors, including industry and transportation

Policy Timeline, Europe hydrogen market (1) - (8)



Policy Targets

1. **RED II**: EU target for RES Energy Sources consumption by 2030: 32%
2. **European Green Deal**: Carbon neutrality by 2050
3. **Fit for 55**: reduce GHG emissions by 55% by 2030
4. **REPowerEU**: Targets of 10 Mt of renewable hydrogen for production and an additional 10 Mt from imports
5. **Green Deal Industrial Plan**: scaling up the EU's manufacturing capacity for Net Zero technologies such as renewable hydrogen
6. **RED III**: 45% of the hydrogen used by industry must be green by 2030 (reaching 60% in 2035), with 1% of all fuel used in transport to be RFNBOs by 2030
7. **CBAM:** prevents carbon leakage associates with the EU-ETS carbon market extension to other heavy industries
8. **European Hydrogen Bank:** streamlines and accelerates investments for hydrogen projects

*Notes: CBAM: Carbon Border Adjustment Mechanism; ETS: Emissions Trading Scheme; RED: Renewable Energy Directive; IPCEIs: Important projects of common European interest.
(1) Fit for 55 refers to the EU's target of reducing net greenhouse gas emissions by at least 55% by 2030 (Link); (2) EU Emissions Trading System (EU ETS) (Link); (3) European Commission, Carbon Border Adjustment Mechanism (Link); (4) REPowerEU (Link); (5) European Hydrogen Bank (Link); (6) RFNBO" means renewable liquid and gaseous fuels of non-biological origin. Council of the EU, Renewable energy: Council adopts new rules (Link); (7) Green Deal Industrial Plan (Link); (8) Hydrogen Europe, Temporary Crisis and Transition State aid Framework (Link).

RFNBOs are a central pillar of the EU hydrogen economy due to the quotas for RFNBO use in the transport and industry sector set in RED III

To qualify as RFNBO, green H2 must meet a set of criteria outlined in two Delegated Acts of RED II (adopted on June 20, 2023)

	Delegated Act (DA) on RFNBOs	Delegated Act on GHG emission saving from RFNBOs & RCFs
Objectives	■ Specifies conditions for renewable status of hydrogen, hydrogen-based fuels, and energy carriers (Renewable Fuel of Non Biological Origin - RFNBO) ■ Ensures that these fuels can only be produced from **additional renewable electricity generated** at the **same time** and in the **same region as their own production**	■ Defines GHG emissions savings calculation for RFNBOs and Recycled Carbon Fuels (RCFs) ■ Establishes a common, comprehensive, lifecycle measurement system for emissions and savings assessment ■ Enforces **a minimum 70% GHG savings requirement for recycled carbon fuels compared to replaced fossil fuels**
Requirements for green H_2 to qualify as Renewable Fuel of Non Biological Origin (RFNBO)	■ **Off-grid electricity / direct line between renewable electricity production and electrolyser**: Renewable production built contemporaneously (<3 year gap) ■ **Grid electricity**: 3 main cases — **Nearly only renewable production on the regional grid** (Share of renewable electricity in the grid > 90%): **Maximum utilization rate is share of electricity produced from renewable sources** in the grid — **Low-carbon renewable and/or nuclear grid** (Emission intensity of the grid <18g CO2/MJ): Power Purchase Agreements (PPAs) with renewable production, complying with ○ Temporal correlation: Match of hourly volumes consumed by electrolyser ○ Geographical correlation: Same bidding zone — **Other grids – General case:** ○ Additionality: New unsubsidized renewable electricity source ○ Temporal correlation: Match of hourly volumes consumed by electrolyser ○ Geographical correlation: Same bidding zone	■ RFNBO and RCF production must achieve a minimum 70% reduction in **GHG emissions savings compared to traditional fuels** ■ The target implies that RFNBOs/RCFs' total emissions should be equal to or lower than **28.2 gCO2eq. / MJ** (3.4 kg CO2eq. per kgH2) compared to total emissions of a fossil fuel comparator (hydrogen produced from natural gas through steam methane reformer) set at **94 gCO2eq. / MJ** (11.3 kg CO2eq. per kgH2)

Notes: "EC" refers to the European Commission.
Source: European Commission (Link).

The Additionality Delegated Act sets out the conditions for the supply of electricity from RES to green hydrogen and qualify as fully renewable

There are 4 compliance cases for using grid electricity which depend on share of RE in the grid, grid emission intensity & imbalance settlement periods

→ Meets the condition
→ Fails to meet the condition

Conditions for Off-grid elec. cons. by RFNBO installation

Conditions for Grid electricity consumption by RFNBO installation

Share of RE in the grid > 90% → *Emission intensity of the grid <18g CO2/MJ* → *Use of electricity during imbalance period*

Compliance Options

Compliance Case 0
- Direct connection between RFNBOs production & renewable electricity (RE) production plants
- Electricity production installation set up less than 36 months after RFNBO production facility
- Proof of disconnection i.e. no electricity feeding from the grid, through smart metering or absence of grid connection

Compliance Case 1
- Grid electricity consumption is considered renewable if the **number of production hours does not exceed a pre-determined number of production hours**(1) set in proportion to the quantity of renewable electricity available in the bidding zone

Compliance Case 2
- RFNBO producers must have entered into **PPAs with renewable electricity producers** for a quantity equivalent to their consumption
- **Temporal and geographical correlations** must be met

Compliance Case 3
- RFNBO producer use electricity from the grid during an **imbalance settlement period**, if it is proven that:
  - RE installation were **dispatched downwards**
  - Consumed electricity **reduced the need for re-dispatching**

Compliance Case 4
- **Temporal and geographical correlations** must be met
- **Additionality criteria must be met**

Concrete examples

Own off-grid renewable electricity production close-by

Location in a nearly-all renewable electricity production zone

Location in a low-carbon electricity production zone (ex. with nuclear), and PPAs from same bidding zone set to match input electricity quantities during month

Probably only an optimisation route on top of base electricity supply

Renewable PPAs supporting new un-subsidized RE production units providing RE input during same month and bidding zone

Notes: "RE" refers to Renewable Electricity; "RFNBO" refers to Renewable Fuels of Non-Biological Origins; "PPAs" refers to Power Purchase Agreements: "RES" Renewable Energy Source. (1) Calculated by multiplying the total number of hours in a calendar year by the share of renewable electricity applicable to the bidding zone where the RFNBO is produced.
Source: European Commission, FTI Consulting analysis.

Under the 1st DA, RFNBO producers are compliant and able to source off-grid renewable electricity if three conditions are met simultaneously

Delegated Act on RFNBOs – Conditions for off-grid electricity consumption

RFNBO production unit

Conditions for **OFF-GRID electricity** consumption by RFNBO installation

Direct link between RFNBOs production & renewable electricity (RE) production site

- RFNBOs production units and installations generating RE must **be directly connected,** or
- RFNBOs production and electricity **production occur at the same installation**

Electricity production installation contemporaneity

- The installation generating renewable electricity **must not have come into operation more than 36 months** prior to the installation producing RFNBOs
- When **an additional production capacity** is added to an existing RFNBOs installation, aggregation in one unit is possible under two conditions:
  - Production capacity is added **at the same site** as the incumbent installation
  - Production capacity is added **at the latest 36 months** after the initial installation became operational

Proof of disconnect between RE installation and the grid

- The installation generating RE **must be disconnected from the grid**, or
- **A smart metering system**, measuring electricity flows from the grid, **shows that no electricity has been extracted from the grid to produce RFNBOs**

Selection of key definitions

"***Installation generating renewable electricity*** *means individual units, or groups of units, producing electricity in one or several locations from the same or from different renewable sources, namely wind, solar, geothermal energy, ambient energy, tide, wave and other ocean energy, hydropower, and* ***excluding units producing electricity from biomass and storage units"***

[Delegated regulation on Union methodology for RNFBOs & Directive (EU) 2018/2001]

"***Direct line*** *means either an electricity line* ***linking an isolated generation site with an isolated customer*** *or an electricity line linking a* ***producer and an electricity supply undertaking to supply directly their own premises, subsidiaries and customers****"*

[Regulation (EU) 2019/944]

*'****Come into operation****' refers to starting production of RFNBOs or renewable electricity* ***for the first time*** *or* ***following a repowering*** *(1)* ***requiring investments exceeding 30% of the investment that would be needed to build a similar new installation.***

Notes: (1) repowering' refers to renewing power plants producing renewable energy, including the full or partial replacement of installations or operation systems and equipment for the purposes of replacing capacity or increasing the efficiency or capacity of the installation.
Source: European Commission

RFNBO producers can use grid elec. under three cases – if none apply, temporal & geographical correlation & additionality criteria apply

Delegated Act on RFNBOs – Conditions for grid-electricity consumption

Share of RE[1] in the grid > 90% [2] — Yes → *Emission intensity of the grid <18g CO2/MJ* — Yes → *Use of electricity during imbalance period* — Yes

No (Share of RE) → *If Cases 1-2-3 not met then, three criteria must be met*

No (Emission intensity)

Compliance Case 1

- Grid electricity consumption is considered renewable if the **number of production hours does not exceed a pre-determined number of production hours** [3] set in proportion to the quantity of renewable electricity available in the bidding zone

Compliance Case 2

- RFNBO producers must have entered into **PPAs with renewable electricity producers** for a quantity equivalent to their consumption
- **Temporal and geographical correlations** must be met

Compliance Case 3

- RFNBO producer use electricity from the grid during an **imbalance settlement period**, if it is proven that:
  - RE installation were **dispatched downwards**
  - Consumed electricity **reduced the need for re-dispatching**

Compliance Case 4

- **Temporal and geographical correlations** must be met
- **Additionality criteria must be met**

Key definitions

Bidding zone' means the largest geographical area within which market participants are able to exchange energy without capacity allocation

[Regulation (EU) 2019/944]

Map of the future Bidding zone by 2025 as defined by ACER

Source: ENTSOE

Notes: (1) Electricity generated by solar, wind, hydropower energy as opposed to fossil energy. (2) The average share of renewable electricity shall be determined by dividing the gross final consumption of electricity from renewable sources in the bidding zone calculated by analogy to the rules set out in Article 7(2) of Directive (EU) 2018/2001 by the gross electricity production from all energy sources as defined in Annex B to Regulation (EC) 1099/2008, except water previously pumped uphill, plus imports minus exports of electricity to the bidding zone. (3) Calculated by multiplying the total number of hours in a calendar year by the share of renewable electricity applicable to the bidding zone where the RFNBO is produced.
Source: European Commission

Since 2020, EU Member States have started developing national strategies and defining incentives to deploy large scale hydrogen projects

EU countries have defined different deployment targets in green hydrogen capacity production ranging from 4 GW to 10 GW up to 2030

National Hydrogen Strategy, selected countries (as of October 2023)[1]

	Spain	France	Germany	UK	Italy
Published date	Oct - 2020	Sep - 2020	Jun - 2020	Aug - 2021	Nov - 2020
Electrolyser capacity by 2030	4 GW (original) 11 GW (update in discussion)	6.5 GW	5 GW (original) 10 GW (August 2023)[5]	10 GW	5 GW
Specific targets in industry and transportation	• 150-200 FCEV buses by 2030 • 2 hydrogen-powered train lines by 2030 • 74% of hydrogen used in industry to be renewable by 2030 (under discussion) (June 2023)[2]	• Up to 40% of hydrogen used in industry is renewable by 2028[3]	N/A	N/A	• 2% H2 share at final energy demand 2030 (20% in 2050) in transport, industry, refineries and blending
Network regulation and policy	• Expected to come with EU regulations • Enagás launch of Request for Interest on dedicated infrastructure (H2Med)	• Hydrogen injections to gas grid are possible, below threshold of technical restrictions[4]	• First rules and standards for high pressure pipelines are formulated[6] • 2% blending cap	• Initial network regulatory and legal framework not expected before 2025 • Up to 20% (under discussion[7]	• Public consultation process in relation to pilot projects • 2% blending cap

- Obligations scheme.
- Subsidies to investment EU/National

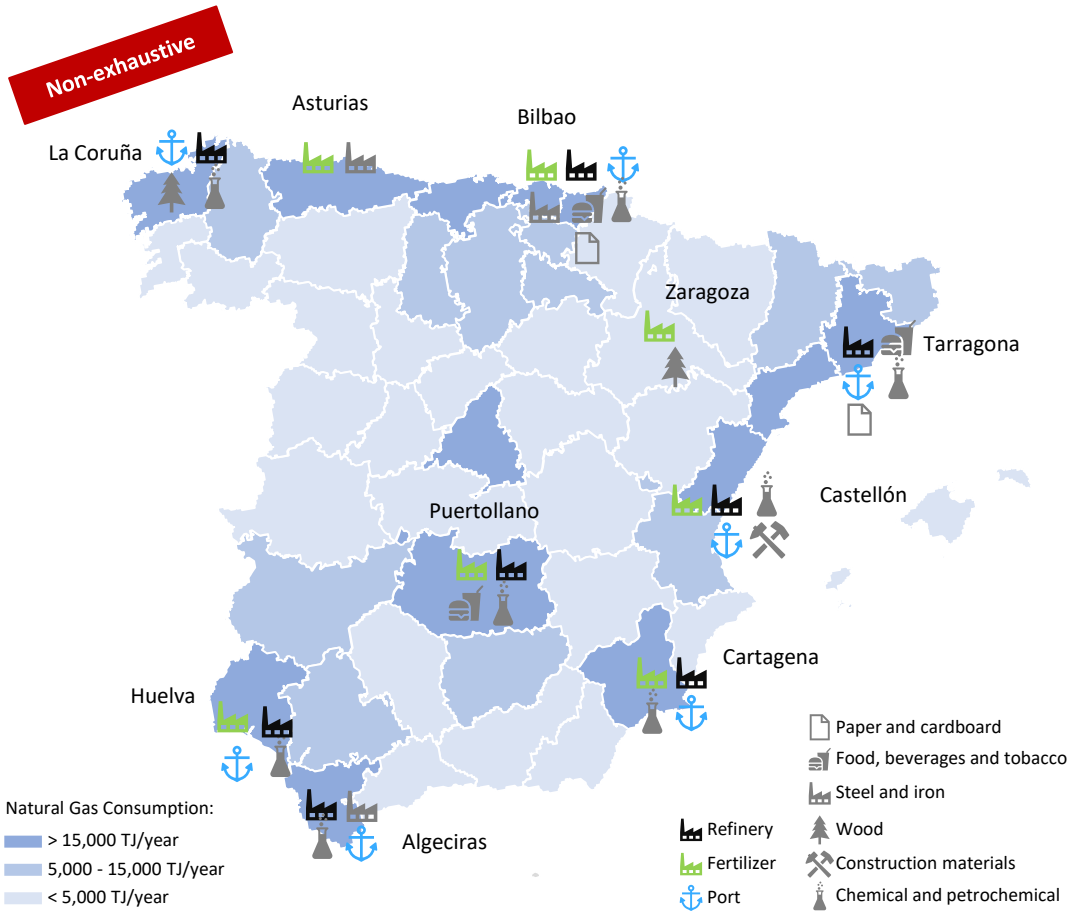
- CCfD / fixed premium per kg of H2 produced for a max. of 10 years

(1) International Energy Agency, Policies database (Link, Link); (2) Spain's climate strategy plan draft (June 2023) (Link); (3) France's Green Hydrogen Plan 2020-2030 (Link); (4) Ordinance No. 2021-167 (Link); (5) Germany National Hydrogen Strategy Update (August 2023) (Link); (6) European Hydrogen Backbone, 2022 (Link); (7) UK Department for Energy Security and Net Zero, 2023 (Link).

We expect one of the largest hydrogen demand to be driven by large industrial clusters, led by refineries and fertilizer

Spain has several regions with high industrialization which could create hydrogen consumption locations, promoting and encouraging the creation of hydrogen "valleys" or "clusters"

Spain hydrogen demand potential locations[1]



Estimated Actual Consumption: 500,000 t/year	
Refineries	**Ammonia/Methanol**
c. 350,000 t/year	**c. 125,000 t/year**

Grey hydrogen consumers (refineries and fertilizers)

- Relevant players (e.g. Iberdrola, Repsol) have already announced hydrogen developments to gain first mover advantage. However, there is still an untapped market that could represent an opportunity for new players.

Natural gas industrial consumers

- Main natural gas intensive industries (e.g., chemical, construction materials, wood, steel and iron, and paper and cardboard) are scattered across different provinces in Spain, most located near coastlines.

Transportation and city services

- Hydrogen applications across freight, city services and train industries are in a nascent stage, with only a few announcements made by local governments – Government's 2030 vision sets high level goals for ground transportation.

(1) Hoja de Ruta del Hidrogeno, Ministerio para la Transición Ecológica y el Reto Demográfico; El Refino en España y Portugal, AOP; Fabricas Españolas de Fertilizantes, Asociación Nacional de Fabricantes de Fertilizantes; Company Websites

More than 15.5 GW of green hydrogen projects are now in development in Spain, largely exceeding the 4 GW original target for 2030

Iberia has already started to capitalize on the opportunity by launching a growing number of hydrogen projects both at a corporate and government level across the different value chain components

Selected examples of projects in the Iberian market[1]

Non-exhaustive

	Renewable Production	Hydrogen Production	Storage	Transport/Distribution	End User
Fertilizer	**Green H2 supply to Fertiberia – Ciudad Real** 2021-2027: 800 MW H2 + BESS Investment: **1,800 M€ (s**ubsidies: Innovation Fund and Next Generation EU				
Refineries		**Pilot Electrolyser at R&D Facility** 800 kg/year of H2 Investment: TBD			**E-Fuel production in Bilbao** 100 MW H2 Investment: 140 M€
Industrial	**Green H2 in Coruña** 50MW H2 Investment: n.a. (subsidies: AACC)	**Sun2Hy - fotoelectrocatálisis** Investment: 192 M€ Subsidies: CDTI[1] and FEDER[2]			
Transport	**Green Hysland - Mallorca** 7.5 MW H2 Investment:5**0 M€ (**Subsidies: €10m EU)				**FCH2RAIL** 2021-2025: Train prototype Investment: 40 M€ **Train Prototype**
Other demand-export/injection grid	**H2 Sines (PT) - Production of green H2 for export** 2021-2030: 1,000 MW H2 Investment: **1,500 M€** (subsidies likely from PT or EU)		**Green Crane-Enagás, Snam** 1,900 MW electrolysers (400 MW in SP) Investment: 2,250 M€ (subsidies: IPCEI) **Cartagena – Injection to regasification plant**		

+50 Projects +€4bn in Investments	▪ +50 projects have been made public ▪ +€4,000m investment expected ▪ Consortiums primarily constituted among national players
~70% Requested Subsidies	▪ +70% of projects analysed explicitly expect public support at a local or European level (sums have not been disclosed) ▪ Repsol is one of the few to have 100% private funded projects
Industry Hub Focused	▪ Several projects will be developed specifically for industry hubs (e.g. refineries, fertilizers, chemicals) ▪ Projects also take advantage of port proximity for potential exports
End-to-End Alliances	▪ Most projects are being developed jointly by forming alliances that leverage stakeholder expertise and minimize risk in an unmatured sector ▪ Government agencies are pushing/promoting coalitions
Top Projects	▪ Green Hysland (most mature) ▪ Iberdrola-Fertiberia (most ambitious) ▪ Reganosa (most complex) ▪ Green Crane (multinational) ▪ H2 Sines (particularity of export oriented)

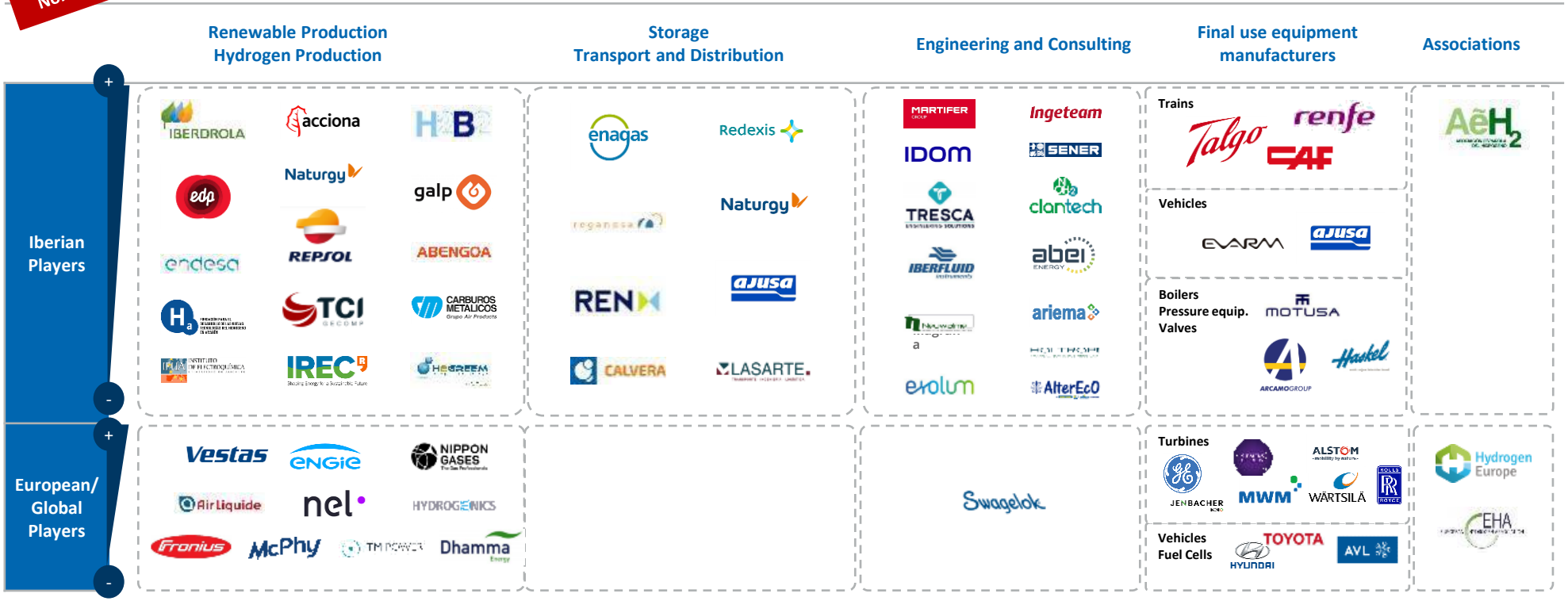
(1) Public sources including media, industry associations, Spanish Hydrogen Association (Link), and FTI interviews with stakeholders.

Dozens of players are involved in the development of the green hydrogen market in Spain, focused in covering different parts of the value chain

A significant number of players in the H2 space are working in the Iberian market –the competitive landscape remains fragmented with local and international players focused on specific activities

Illustrative of players in the Hydrogen space in Iberia[1]

Non-exhaustive

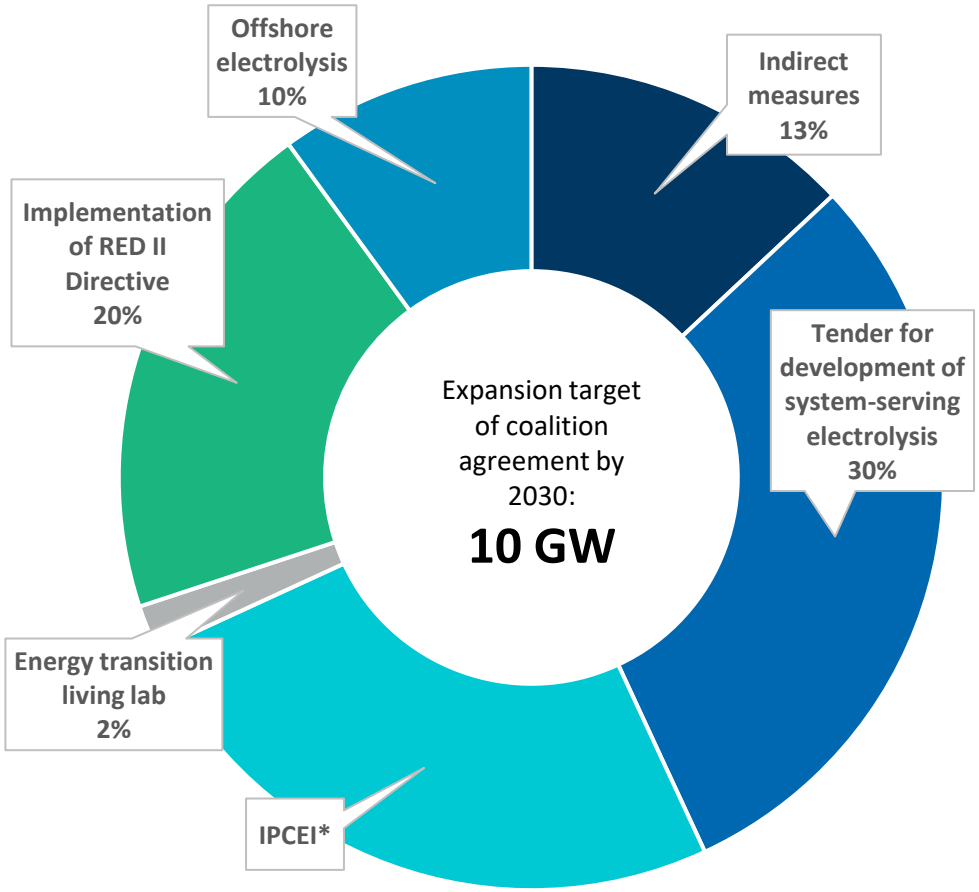


(1) Public sources including media, industry associations and FTI interviews with stakeholders.

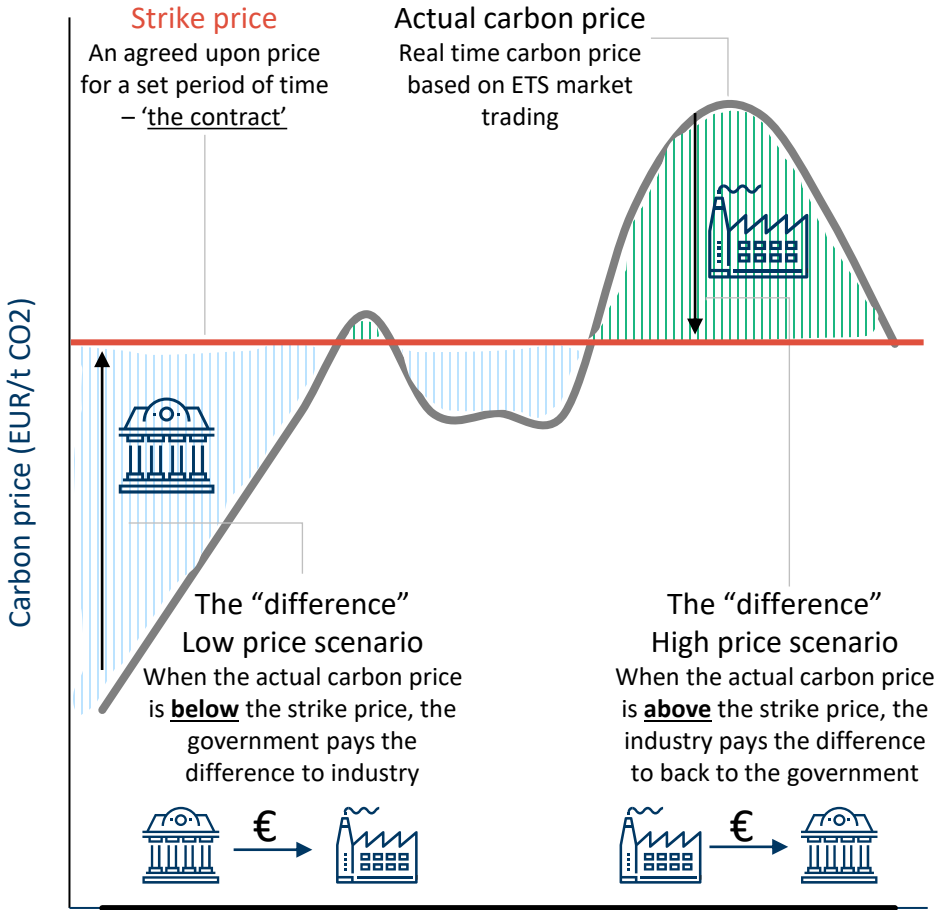
Germany doubled its green hydrogen production target for 2030 in its new update of national strategy (July 2023), from 5 GW to 10 GW

With the Carbon Contract for Difference (CCfD) scheme issued in June 2023, Germany is launching a new funding instrument which is aimed at promoting the transition of energy-intensive industries to hydrogen

Mix of instruments to reach hydrogen target[(1)]



Carbon Contract for Difference (CCfD) mechanism[(1)]

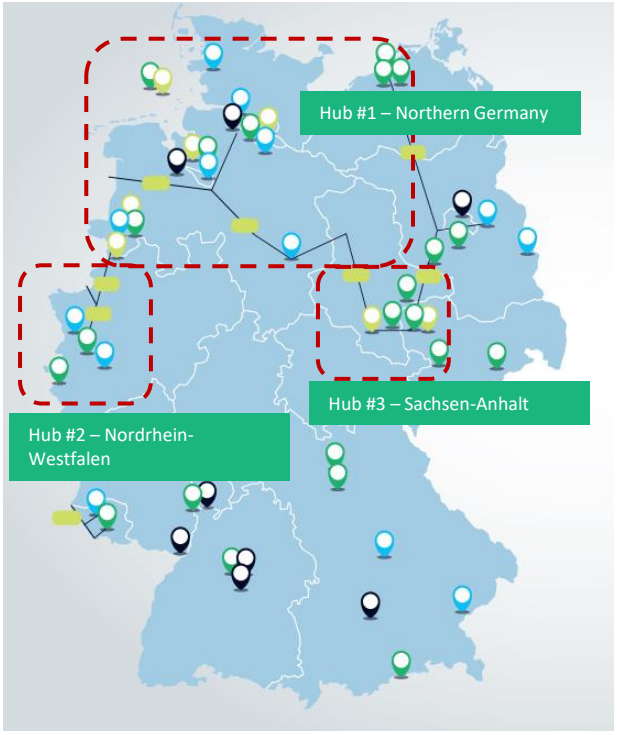


* IPCEI stands for Important Project of Common European Interest and was signed by 23 EU Member States and Norway in order to interlink European hydrogen projects and to benefit from spill-over effects at a European level. (1) Germany's National Hydrogen Strategy Update (July 2023).

Despite Germany's ambitious production targets (10 GW by 2030), still, imports are expected to cover a relevant share of its demand (50%-70%)(1)

Germany plans to connect industrial hubs, located in the south and the east of the country, with hydrogen pipelines to the north in an effort to cut carbon emissions from its manufacturing-heavy economy

Germany IPCEI-Hydrogen Projects(2)



Green Hydrogen Hubs	Key players	Description
Hub #1 – Northern Germany ■ Most active area for hydrogen initiatives with HY-5 alliance coordinating activities across all 5 states (including Hamburg and Bremen)	RWE, Shell, VATTENFALL, GASCADE, ArcelorMittal, uniper	■ Green Hydrogen projects will be developed around the offshore wind power supply. Key hub for offshore wind in Germany (mainly from the North Sea). ■ Integrated mix of multiple initiatives around the North Sea from Germany and imports from other countries.
Hub #2 – Nordrhein-Westfalen ■ Has its own hydrogen roadmap and a cross-border cooperation partnership with the Netherlands ■ Plans for being reliant on H2 imports to supply its steel and automotive plants	Air Liquide, thyssenkrupp, BAYER	■ One of the most industrialised regions in Germany with many energy-intensive industries (e.g. steel, chemicals, cement) and key hub for automobile sector. ■ Hard-to-abate industrial activity (w/o energy sector) with emissions of 51.2 million tonnes of CO2 annually.
Hub #3 – Sachsen-Anhalt ■ Still developing its hydrogen strategy, with some pilot projects underway ■ Hydrogen initiatives centred around the Leuna refinery, and tests for underground H2 storage	Linde, TotalEnergies, BASF We create chemistry	■ Has long-term potential as a hydrogen hub due to its large refining and chemical footprint in the state. ■ Aims to be self sufficient in green hydrogen production by 2040, with a 1 GW electrolyser production capacity.

(1) Hydrogen Insight (Link); (2) Norddeutsche Wasserstoff-Hubs (Link).

United States: a “pragmatic” Approach?

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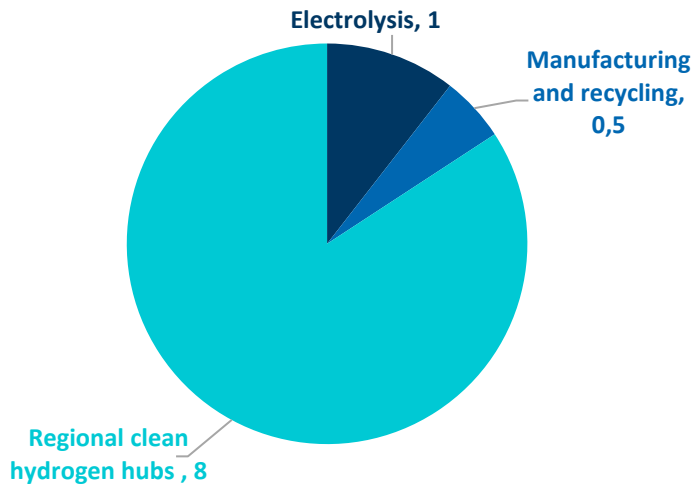
In June 2023, the U.S. issued its National Clean Hydrogen Strategy and Roadmap to set the pathway for clean hydrogen opportunities

The U.S. have adopted a pragmatic approach to boost energy transition, which include incentives of up to US$3/kg – this provides a clear direction to green hydrogen sponsors

U.S. National Clean Hydrogen Strategy and Roadmap[1]

1. **Target strategic**
   Achieve 10 MMt*/year of clean hydrogen by 2030, 20 Mt by 2040 and 50 Mt by 2050
2. **Reduce the cost of clean hydrogen**
   Enable $2/kg H2 by 2026 and $1/kg H2 by 2031 (currently between $5-$7/kg H2)
3. **Focus on regional networks**
   Deploy regional clean hydrogen hubs and ramp up scale

Legislation Highlights, 2021-2022 (Bipartisan Infrastructure Law, in US billions)



U.S. climate goals [1]

- The U.S. National Clean Hydrogen Strategy and Roadmap aligns with the Administration's goals, including:
  - A 50% to 52% reduction in U.S. 2005 GHG emissions by 2030
  - 100% carbon pollution-free electricity by 2035
  - Net zero GHG emissions no later than 2050

Current status of hydrogen in the US: incentives and short term actions

- **Inflation Reduction Act (IRA):** Includes significant tax credits. The highest tax credits, for the lowest carbon hydrogen reach up to US$3/kg.[1]
- **Bipartisan Infrastructure Bill**: In October 2023, the Department of Energy selected 7 hydrogen hub proposals to receive federal funding (up to US$7 billion) to develop regional H2 economies.[2]
- Priority actions for 2023:[1]
  - Standards & Certifications: Accelerate the development of standards for clean hydrogen
  - Demand Creation & Management: Coordinate internationally to drive demand for clean hydrogen
  - Research & Innovation: Expand the number and scope of innovate clean hydrogen projects
  - Landscape coordination: Enhance the coordination and transparency of international collaboration on clean hydrogen

* MMt: Million metric tonnes
(1) U.S. National Clean Hydrogen Strategy and Roadmap (Link); (2) US Department of energy, Biden-Harris Administration Announces $7 Billion For America's First Clean Hydrogen Hubs, Driving Clean Manufacturing and Delivering New Economic Opportunities Nationwide (Link).

Latin America's Turn

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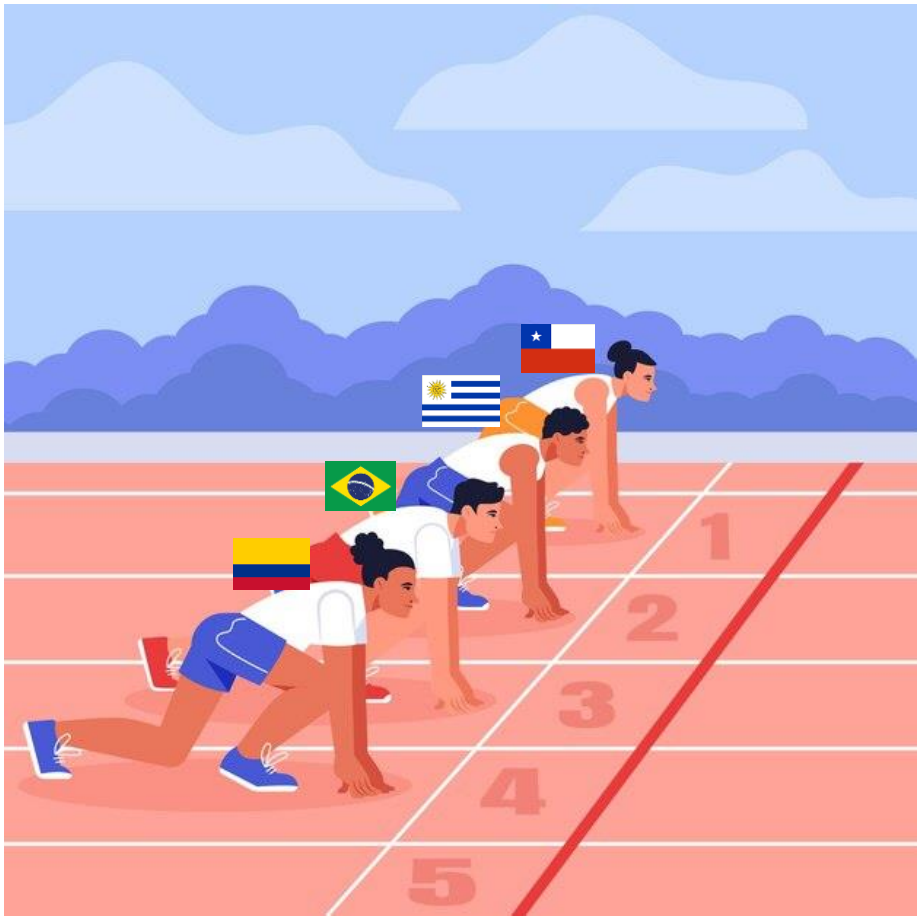
Is Latin America willing to seize the green hydrogen opportunity?



- The global race for green hydrogen is starting “now”
- Latin America is in a privileged position to supply Green Hydrogen to Europe and the U.S.
- Some Latin American Governments are actively engaging in this space, but still need to define their strategy in a pragmatic manner and start materializing it at scale
- Colombia has at its disposal the ideal combination of public and private stakeholders to harness this opportunity effectively
- It’s Latin America’s turn

(1)

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