



# The H<sub>2</sub> Supply Chain Revolution

MTBS

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**Training and Summits**



**Financial & Strategy**

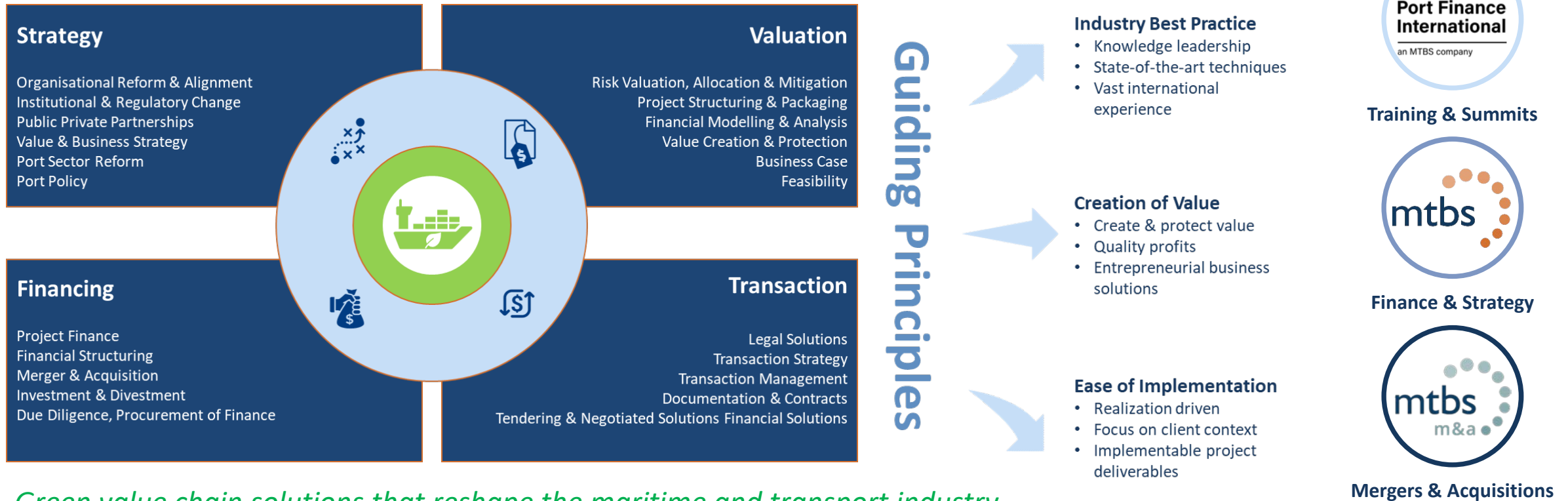


**Mergers & Acquisitions**

# Introduction to MTBS

· *MTBS Group's mission is to unlock value in the maritime and transport industries*

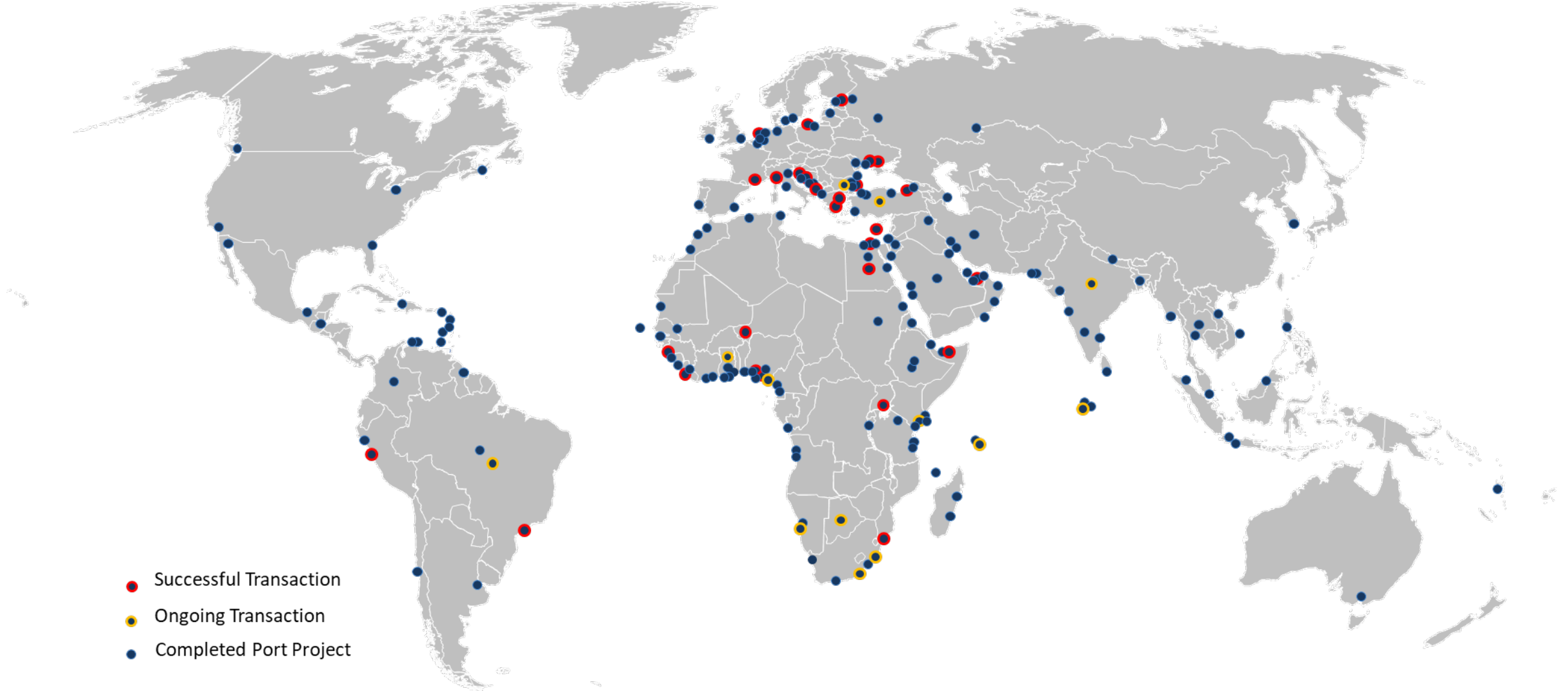
*On the interface of land and water, positioned between public and private interests, ports are the most strategic nodes in the global transport network. Therefore, MTBS Group believes that ports offer a unique value proposition. It is the mission of the MTBS Group to unlock and protect this value by offering its clients sustainable business solutions and creating the quality profits they seek.*



*Green value chain solutions that reshape the maritime and transport industry*

# MTBS Worldwide Client Base

*MTBS advises actors in the maritime industry regarding financing, strategy, transactions, and business cases.*





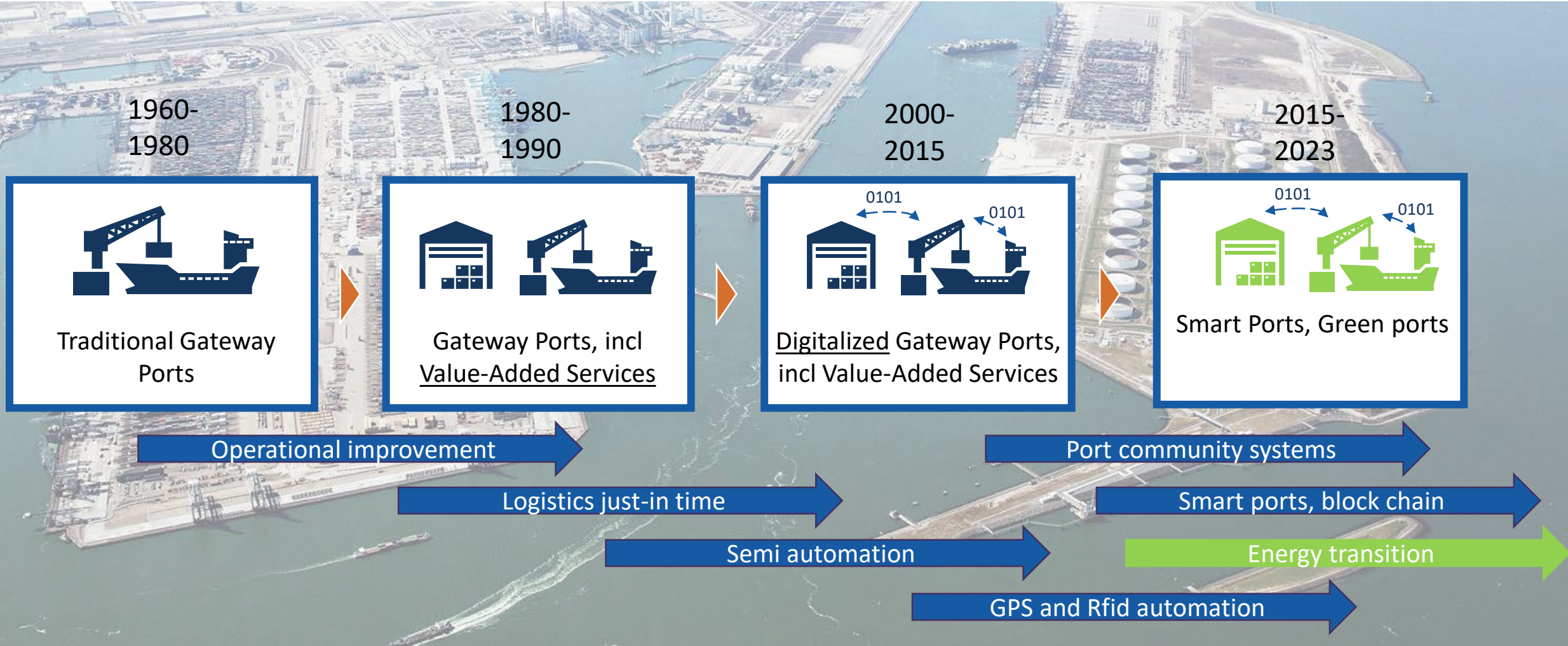
# MTBS Worldwide Client Base

MTBS advises actors in the maritime industry regarding financing, strategy, transactions, and business cases.

| Authorities |  |  | GTOs & Shipping Lines |  | Industrials | Governments | IFIs | Banks & Equity |
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# The Port Sector faces energy transition challenges

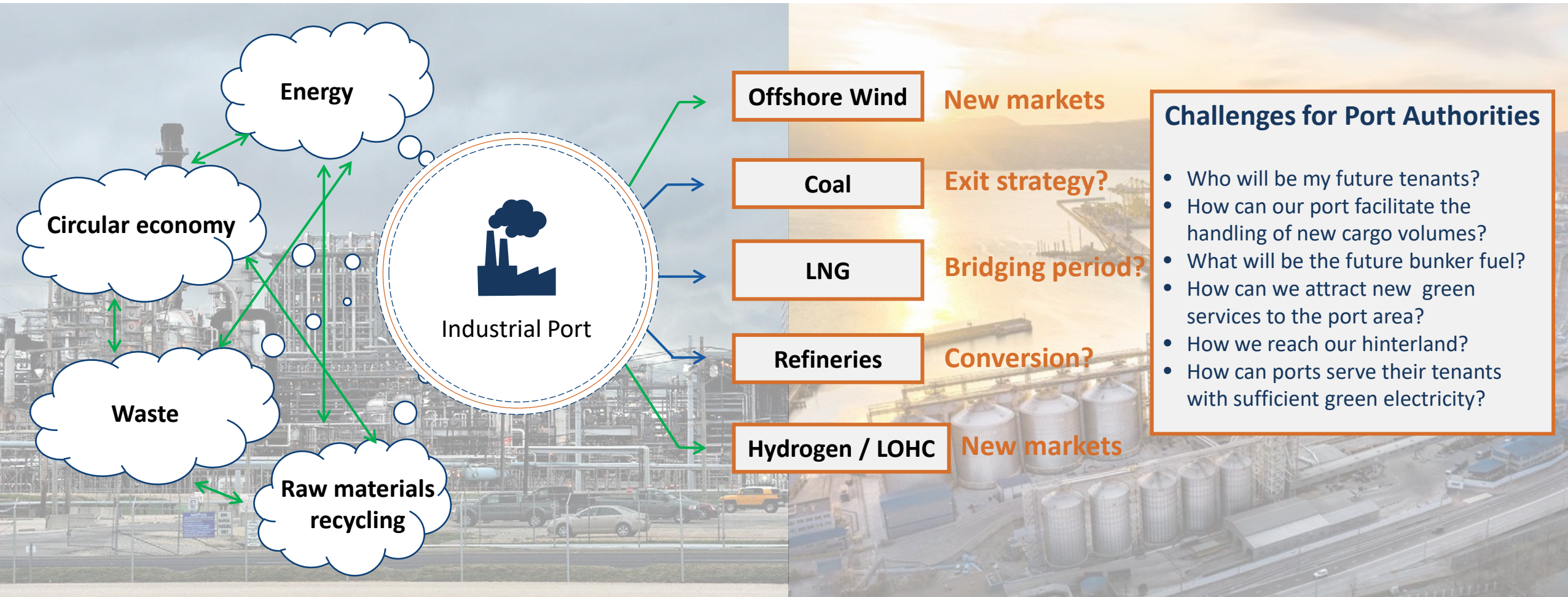
*The port environment has been changing, as the world is in full transition and may still face the digitalization challenges whilst new environmental challenges are already being prioritized*





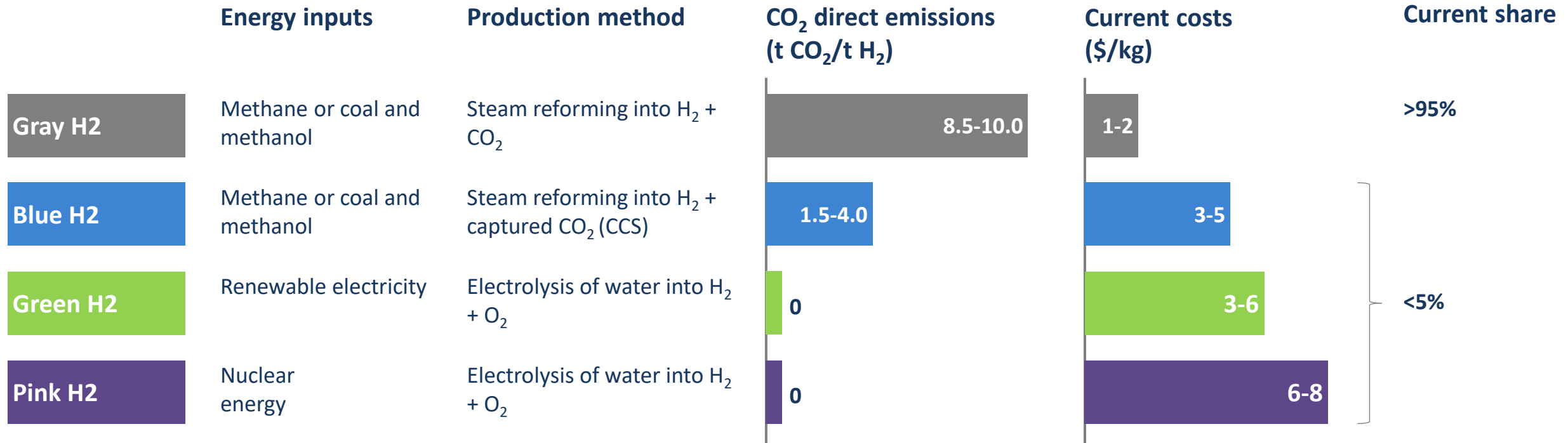
# The Port Sector faces energy transition challenges

*Although there are many different challenges, Industrial Ports can consider these as opportunities and should transform to keep up with changing demands*



# What is Hydrogen?

Green hydrogen is categorized as the cleanest of production methods using electrolysis, a chemical process without CO<sub>2</sub> emissions.



## Benefits

- Hydrogen is already used in industrial processes
- Hydrogen can be used as fuel, an energy carrier or a feedstock.
- Hydrogen will play a key role in decarbonising specific sectors where other alternatives are more expensive or unfeasible (e.g., heavy-duty transport, heavy industry, shipping and aviation).

## Challenges

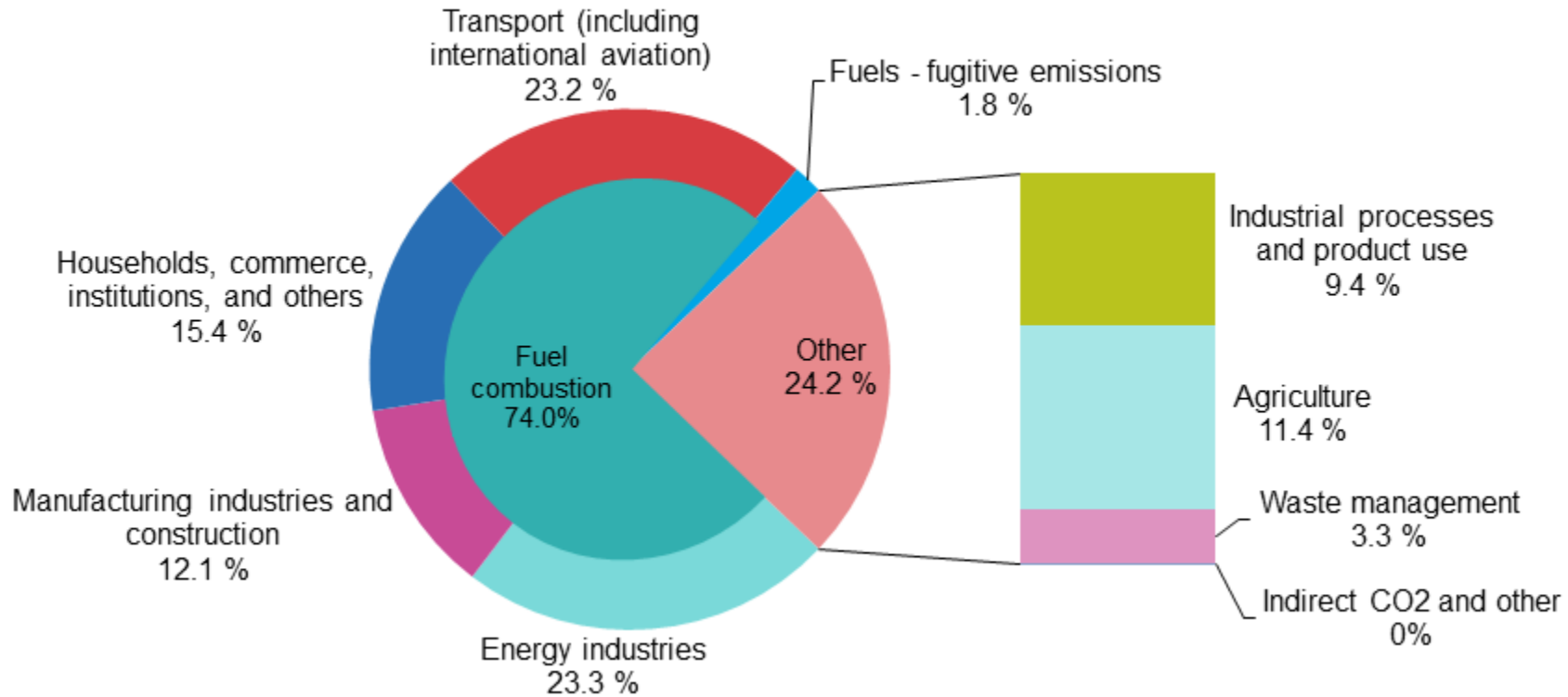
- Issues with low energy value H<sub>2</sub>, transportation issues
- Scaling up electrolysis and electricity consumption
- Adjusting natural gas infrastructure
- Gain practical experience (production/infrastructure/applications)
- Developing (appropriate) legislation and regulations



# Why should we use green hydrogen?

*The transport and energy sectors are responsible for the highest greenhouse gas emissions in the EU, in total 3.1 M kt CO<sub>2</sub> equivalent units were emitted by the 27 EU-member states in 2020*

Greenhouse Gas emissions in the EU by source sector (2020)



Hydrogen and Liquid Organic Hydrogen Carriers (LOHC) will play a role in the energy transition to zero carbon emission

Source: EEA, republished by EUROSTAT (2020)

# The Hydrogen Opportunity

In a decarbonized energy system, green hydrogen should be introduced to meet global emission reduction targets. The industry needs to act in a big way. Think big, act big.



A robust **hydrogen end-market already exists**, with a production of roughly 94 Mt H<sub>2</sub> per year



This represents **2.5% of the global energy consumption**.



**By 2030 115 Mt** of the total hydrogen demand is expected on the basis of existing policies.



About **20 Mt** is expected to be contributed by pledged projects for low carbon hydrogen leading to **130 Mt H<sub>2</sub> in 2030**



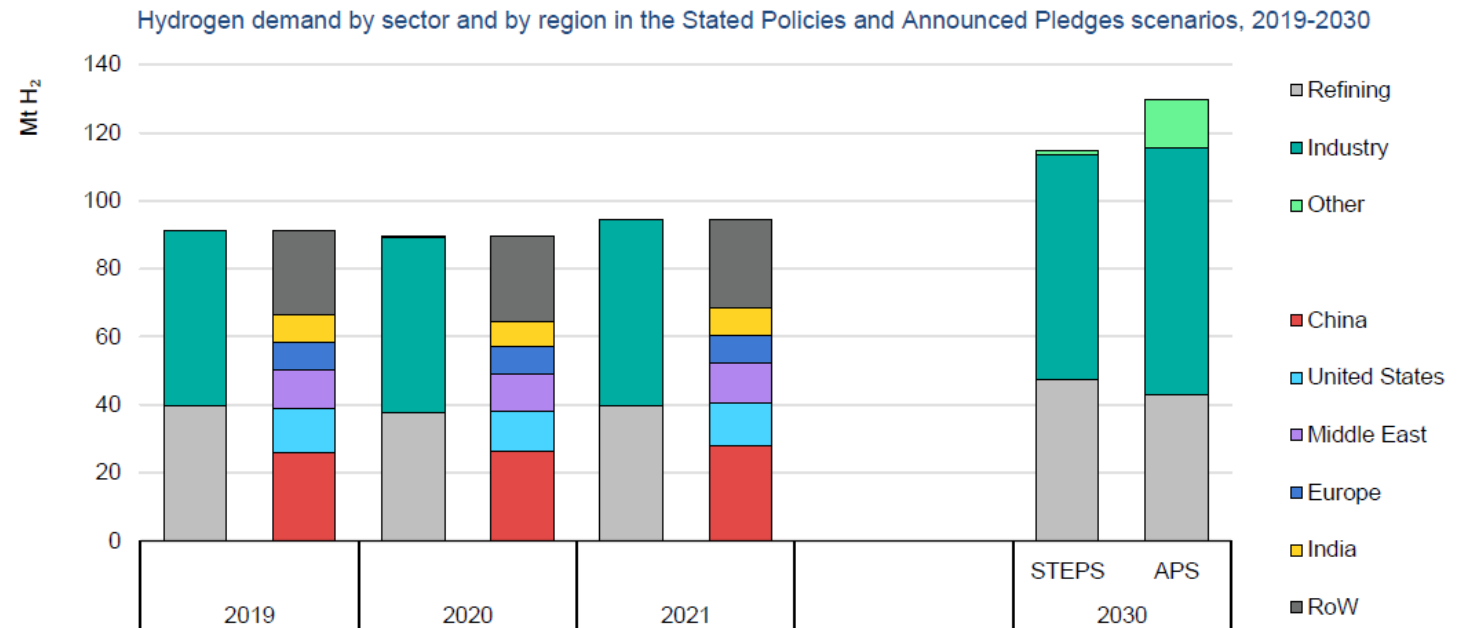
**34 Mt would be required by 2030 according to plans** and for Net Zero path by 2050 globally, it would require around **100 Mt by 2030**.



In the case of electrolysis, the realisation of all the projects in the pipeline could lead to **an installed electrolyser capacity of 134 - 240 GW by 2030**.



43% of hydrogen produced today is **consumed by the refining sector** the **57% by other industries** such as **chemical, fertiliser and steel sector**

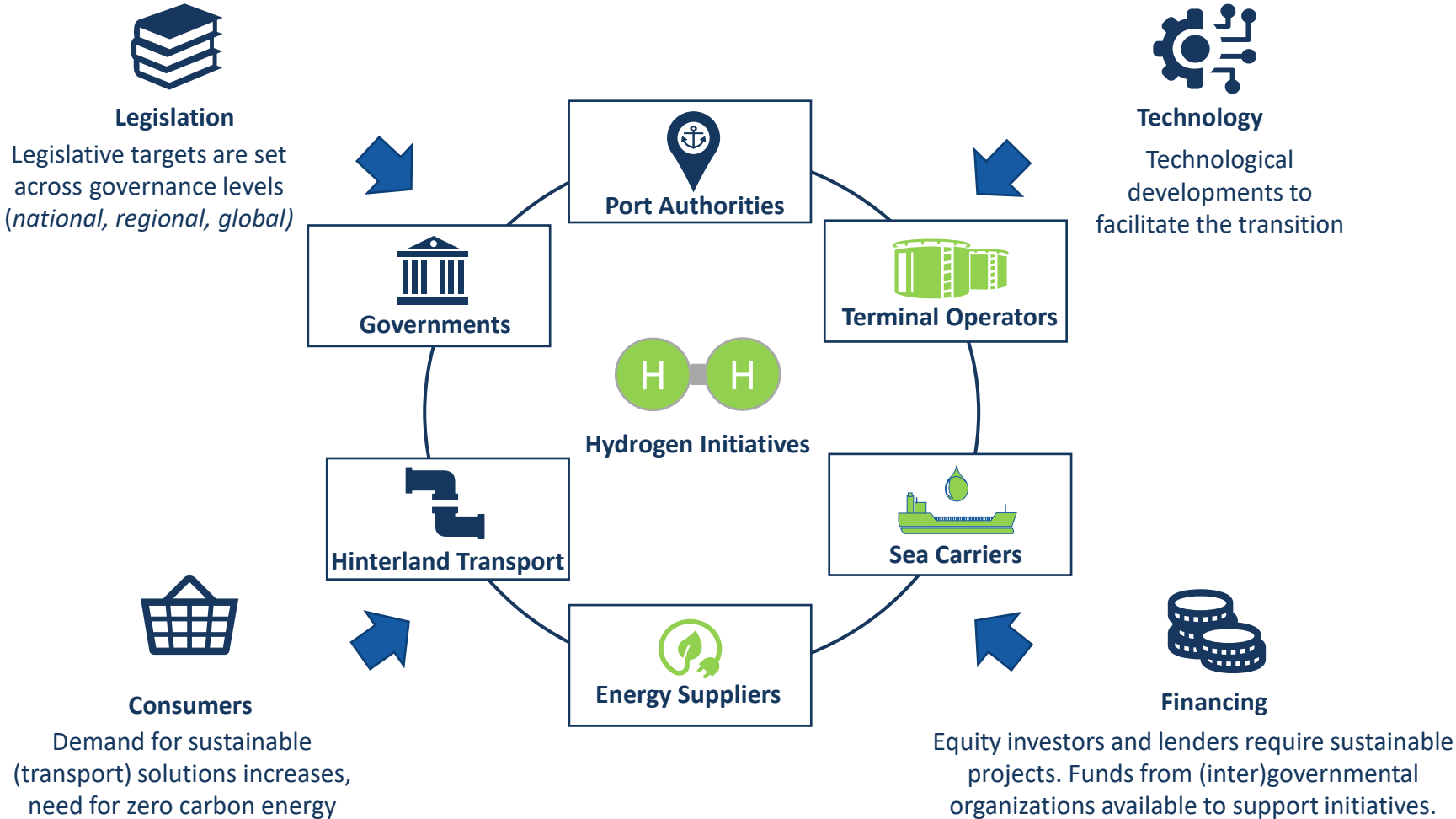


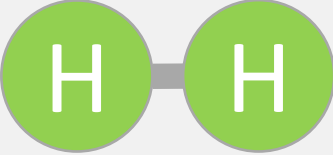
Notes: Mt H<sub>2</sub> = million tonnes of hydrogen; STEPS = Stated Policies Scenario; APS = Announced Pledges Scenario. Other includes transport, buildings, power generation sectors and production of hydrogen-derived fuels and hydrogen blending.

Source: IEA global hydrogen review 2022

# The Maritime Environment

Every stakeholder in the maritime environment has a green responsibility, and all actors are required to facilitate the developments of hydrogen





**Hydrogen Applications**

- Hydrogen supply to industries (refineries, chemical, fertiliser, steel sectors)
- Zero carbon bunker fuels
- Hydrogen imports for heavy transport
- Storage of energy



# Legislative Overview

*The regulatory environments puts pressure on actors to quickly improve their environmental performance (the energy transition development to decarbonize causing transformational effects on economies).*

## Global

- **Paris Agreement:** Global response to the threat of climate change. Keeping global temperature rise well below 2°C above pre-industrial levels. Pursuing efforts to limit temperature increases even further to 1.5°C. Task Force on Climate-related Financial Disclosures (TCFD) Recommendations.
- **United Nations Sustainable Development Goals:** Setting the course for a green future – mitigating externalities.
- **IMO:** MARPOL (Annex VI), the International Convention for the Prevention of Pollution from Ships, concerned with preventing marine pollution from ships.
  - Net zero target of 50% by 2050, proposals to 100% net zero supported by 28 countries
  - From VLSFO and ULSFO to LNG, to Methanol possibly Ammonia

## Regional (EU)

- **EU Green Deal:** growth strategy that aims to make Europe climate-neutral by 2050.
- **EU 'Fit for 55' package:** 55% reduction of emissions by 2030 compared to 1990 levels, including:
  - **Alternative Fuel Infrastructure Directive (AFIR):** ensures adequate recharging and refuelling infrastructure (for EU ports: OPS and LNG refuelling points)
  - **FuelEU Maritime:** sets obligations on the supply of, and demand for, renewable and low-carbon maritime fuels.
  - **Revision Emission Trading System (ETS2):** extension of emission trading to shipping sector
  - **Carbon Border Adjustment Mechanism (CBAM):** puts a carbon price on imports to the European Union of a targeted selection of products to prevent carbon leakage.

# Evolution in Green Shipping

*The shipping industry is decarbonizing, although the fuel mix is yet to be determined. This poses an uncertainty on the port planning, as infrastructure requirements might differ for different fuels.*



## LNG Vessels

Since 2021, CMA CGM operates various **LNG-powered vessels**, among which 23,000 TEU container vessels.

Since 2021, CMA CGM has extended its orderbook by more LNG-powered vessels.



## Methanol Vessels

In **August 2021**, A.P. Moller - Maersk ordered a series of **8 large ocean-going container vessels** capable of being operated on **carbon neutral methanol**.

Maersk has a total of 19 green methanol vessels on order



## Ammonia

DNV, MAN Energy Solutions, Eltronic Fueltech and Technical University of Denmark on the **AEngine project**, which aims at making the first two-stroke ammonia powered engine. The project is now moving towards the testing stages.



## Energy Containers

Exchangeable energy containers (ZES packs, SKOON box) are used as **modular batteries** to propel electric barges for inland shipping. The packs can be exchanged and charged at stations along the waterway.

# Hinterland transport via pipelines

*It is technically feasible and financially viable to repurpose existing natural gas pipelines for hydrogen use*

## The Dutch Hydrogen Network

- Hytransport within the Port of Rotterdam
- Dutch national hydrogen grid.
- Delta corridor, providing connections to industrial clusters and end users in The Netherlands, Belgium and Germany.

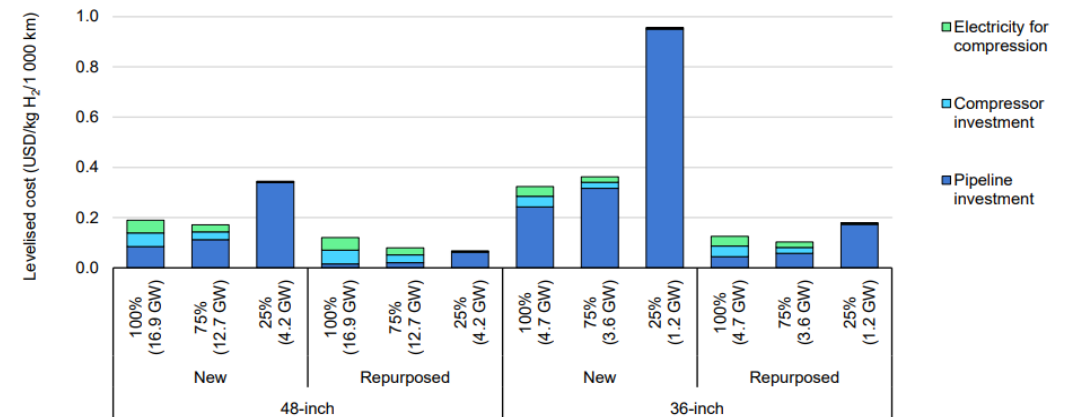


Source: Port of Rotterdam

## Repurposing pipelines vs. new pipelines

- Repurposing existing pipelines for hydrogen use can cut investments costs by 50-80%
- Volumetric flow of hydrogen is up to three times higher than natural gas, new compressors and more powerful turbines are needed
- Offshore natural gas pipelines operate under higher pressure, hydrogen may not be suitable to operate under such pressure
- For onshore transport a right balance between operating capacity and pipeline diameter can result in lower levelized transportation costs

## Levelized cost of hydrogen transmission based on pipeline diameter and throughput capacity

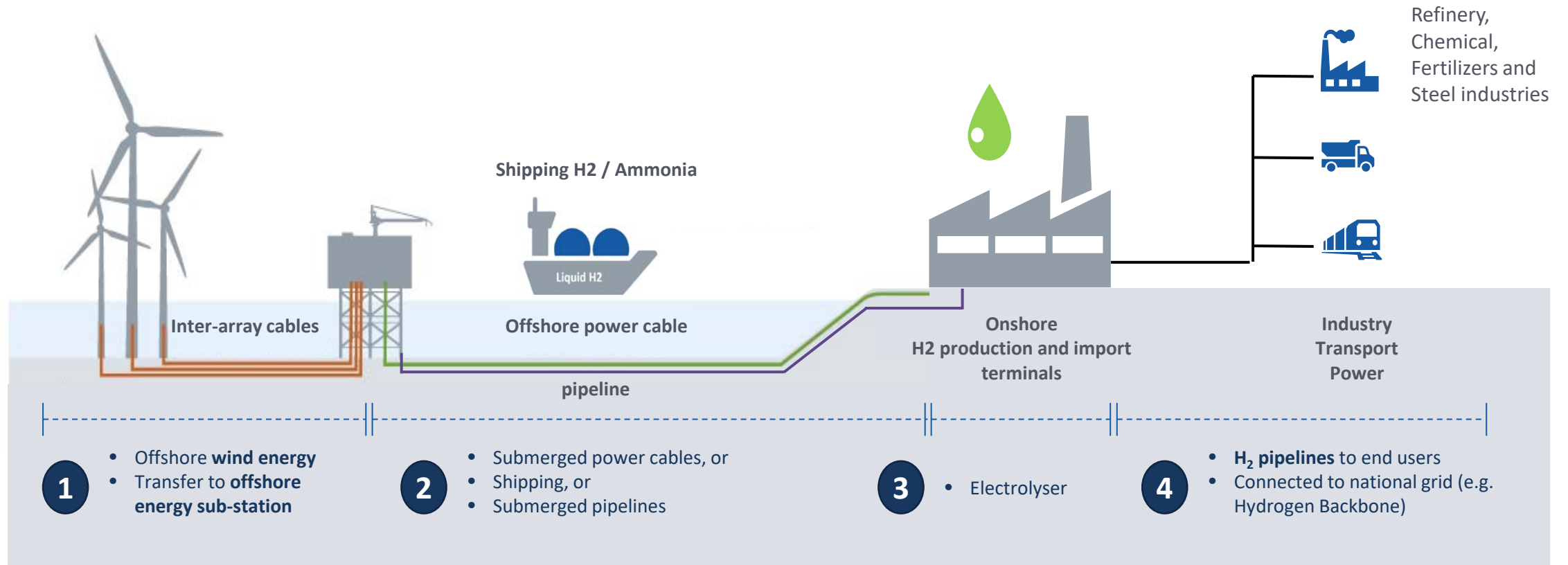


Source: IEA Global Hydrogen Review 2022



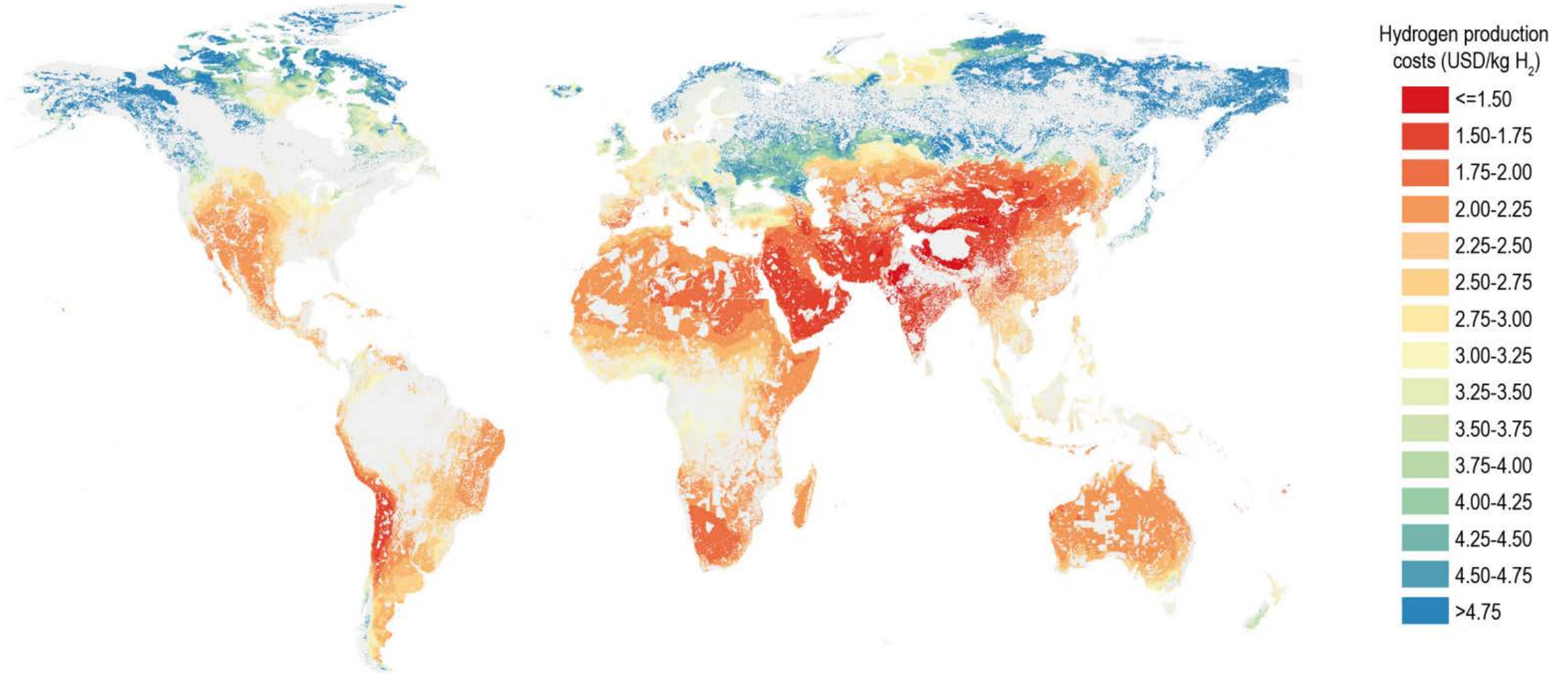
# Green Hydrogen Supply Chains

An sample of future hydrogen supply chains, with: offshore wind energy, onshore electrolysis, and various end users



# What drives the competitiveness of green hydrogen

*Hydrogen production costs will be driven by the energy output of solar- and wind power systems*

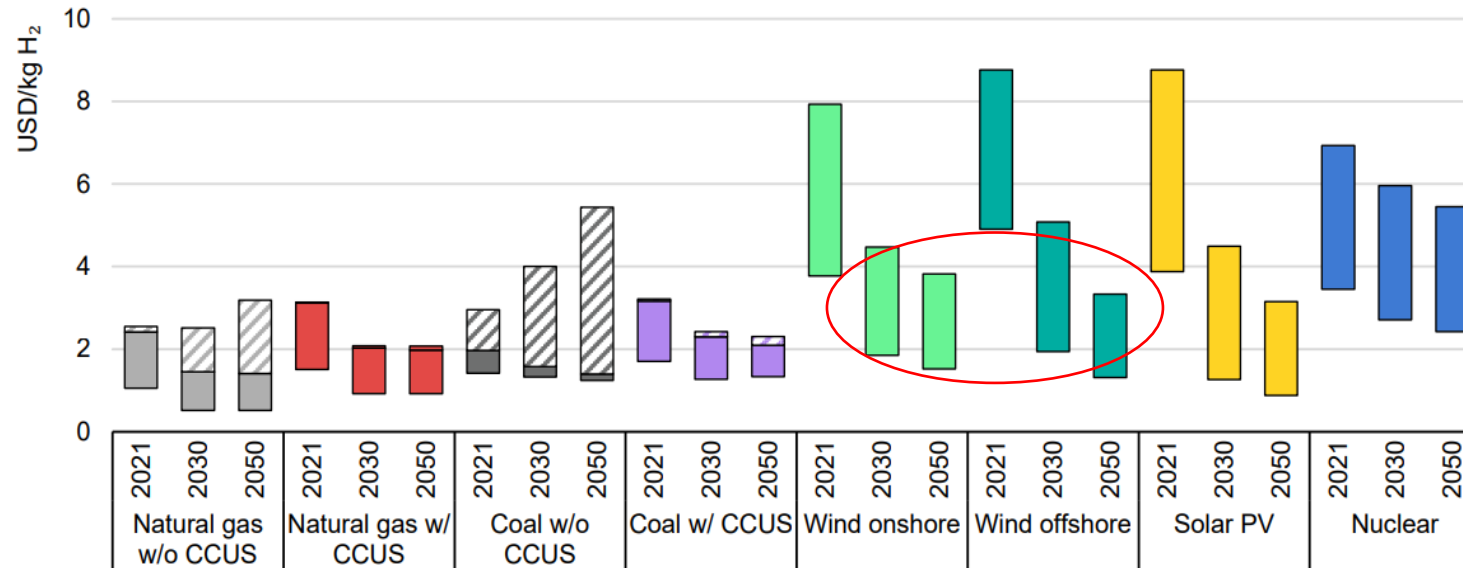


Source: IEA Global Hydrogen Review 2022

# What drives the competitiveness of green hydrogen

*Cheap and constant renewable energy availability offers opportunities for cost reductions in green hydrogen production, the competitiveness compared with grey hydrogen production depends largely on future CO<sub>2</sub> emission rights prices and subsidies.*

Levelized cost of hydrogen transmission based on pipeline diameter and throughput capacity



Source: IEA Global Hydrogen Review 2022

Notes:

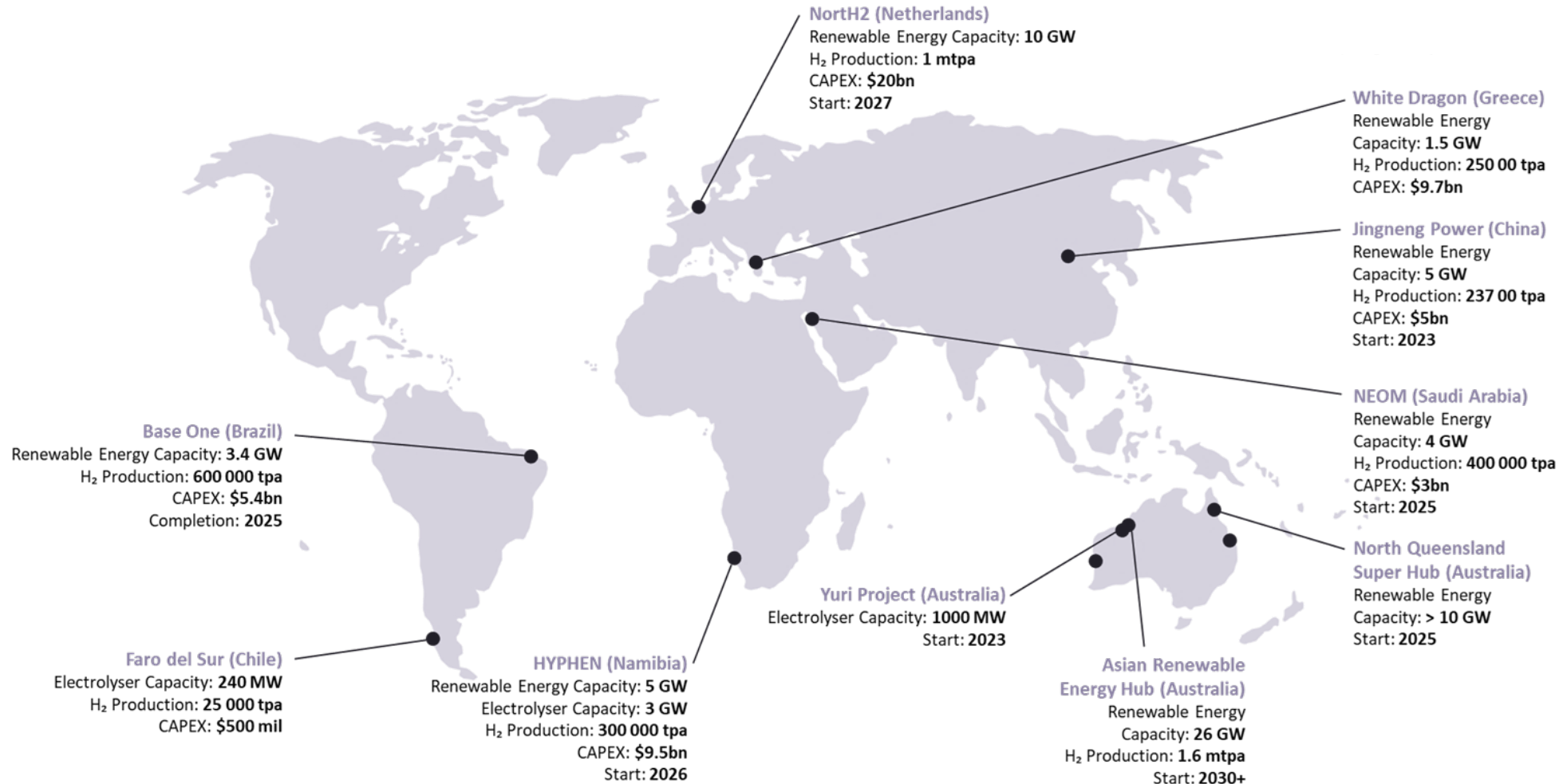
- Ranges of production cost estimates reflect regional variations in costs and renewable resource conditions.
- The dashed areas reflect the CO<sub>2</sub> price impact, based on CO<sub>2</sub> prices ranging from USD 15/tonne CO<sub>2</sub> to USD 140/tonne CO<sub>2</sub> between regions in 2030 and USD 55/ tonne CO<sub>2</sub> to USD 250/ tonne CO<sub>2</sub> in 2050.



# Electrolyser capacity

Estimates indicate hydrogen consumption will grow exponential by the energy transition.

The rise in electrolyser capacity are expected to follow suit as will be the maritime transport volumes as a result.



# Working together

Investments in the energy transition need value chain overlooking consultancy to make them work. Ports play a key role in facilitating the new developments and must adopt to new energy transition strategies.



# Thank you

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