



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

**ConnectingEU
Insights**

**Hydrogen
applications for
ports and logistics**

Lionel BOILLLOT

Project Manager

Brussels, 26 April 2021

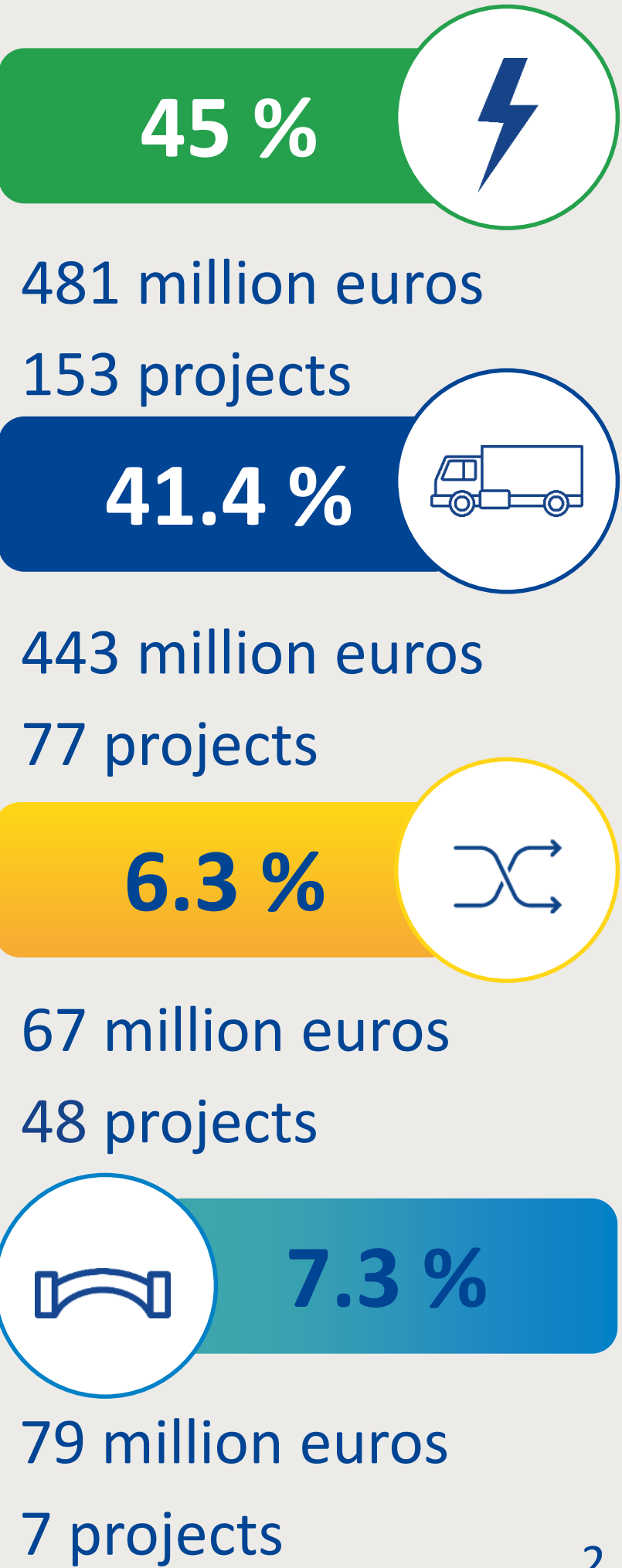
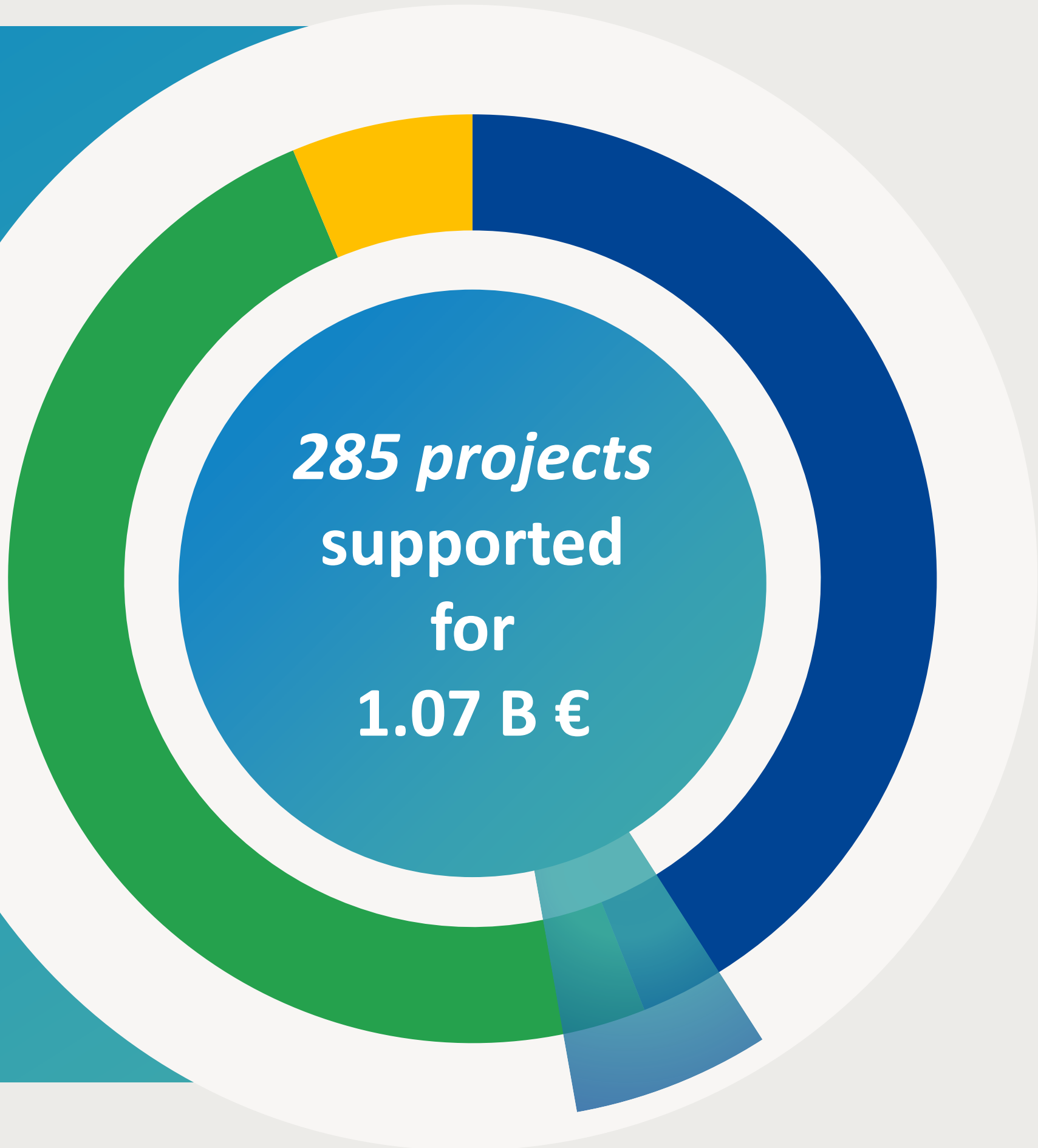


Strong public-private partnership with a focused objective

A combined private-public of more than 2 billion Euro has been invested since 2008



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Similar leverage of other sources of funding: 1.08 B €

Sustainable ports

Worldwide ports are aware of the urge to decarbonize their sector



World Ports Sustainability Program



Ports are **nodal points** in **global supply chains**. At the same time, they are **embedded in** local and regional **communities**. As a result, ports must respond to **worldwide, regional and local challenges**, such as **climate change**, mobility, digitalisation, migration and social integration.

European Sea Ports Organisation

Top 3 environmental priorities of the port sector over the years:

- Air Quality
- Energy consumption
- Climate change

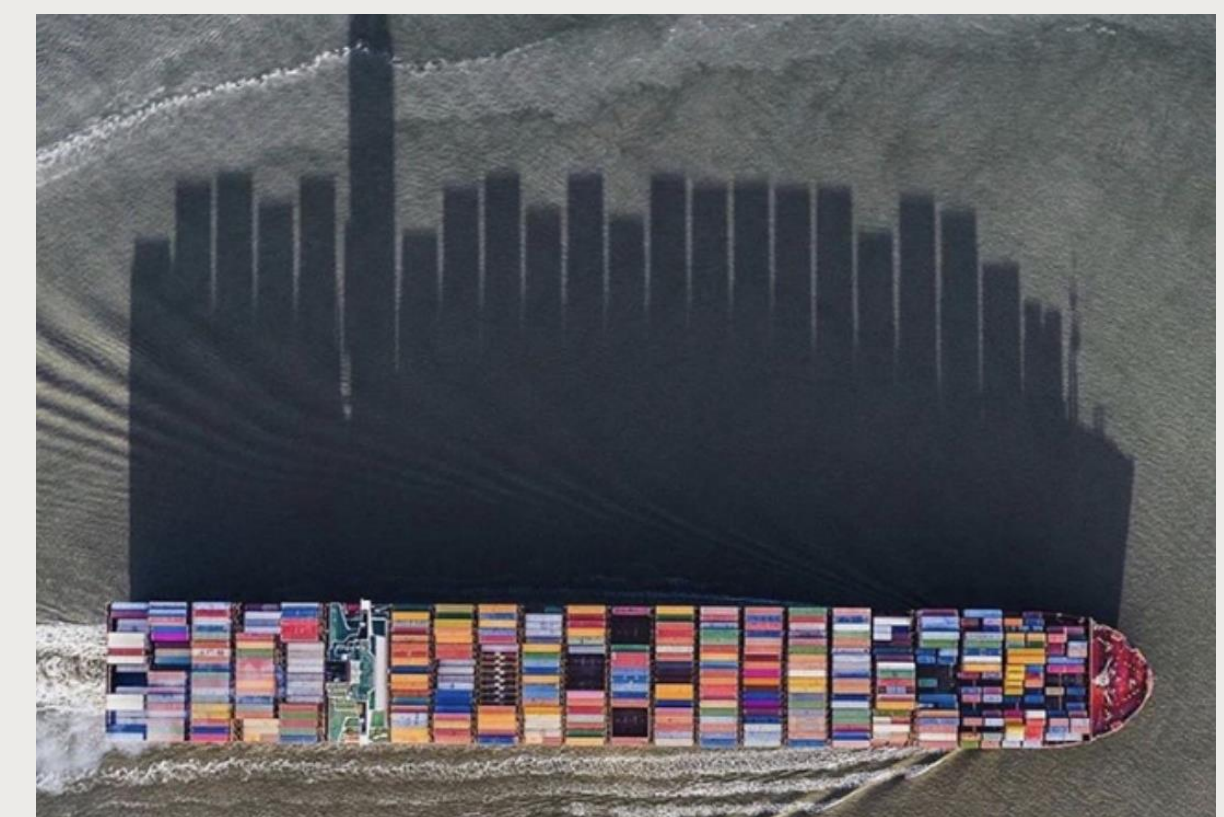


	2004	2009	2013	2016	2017	2018	2019	
1	Garbage/ Port waste	Noise	Air quality	Air quality	Air quality	Air quality	Air quality	
2	Dredging operations	Air quality	Garbage/ Port waste	Energy consumption	Energy consumption	Energy consumption	Energy consumption	
3	Dredging disposal	Garbage/ Port waste	Energy consumption	Noise	Noise	Noise	Climate Change	

Green hydrogen can decarbonise full port ecosystems



1. **Hydrogen for ships**
2. Hydrogen for port operations (container handling)
3. Hydrogen for the industry in port area
4. Ports as coastal hubs for hydrogen production and logistics



FCH2 JU support for FC and H2 in maritime applications



Moving towards larger sizes of vessels, no « size fits all »

Ships

2020 - LH₂
vessel

LH₂
PEM



3 MW

2019 - sea-
going
vessel

NH₃
SOFC



2 MW

2018 - ferry +
barge pusher

CH₂
PEM



1 MW



2017 -
research
vessel

CH₂
PEM



0,16 MW

2013 - APU for
yachts

LPG
HT PEM



0,05 MW

HySHIP

- RoRo vessel, for coastal goods transport
- 3MW fuel cell system using LH₂ (>5t storage)
- Conceptual designs for a 20MW ship
- Develop a standardised bunkering system
- LH₂ distributed to a series of maritime bases in a containerized system

ShipFC

- Platform support vessel in North Sea (Norway)
- Length: 95m, Gross tonnage: 5073MT
- Operation: 2024
- Zero emission ammonia

Regulations, codes and standards for hydrogen ships

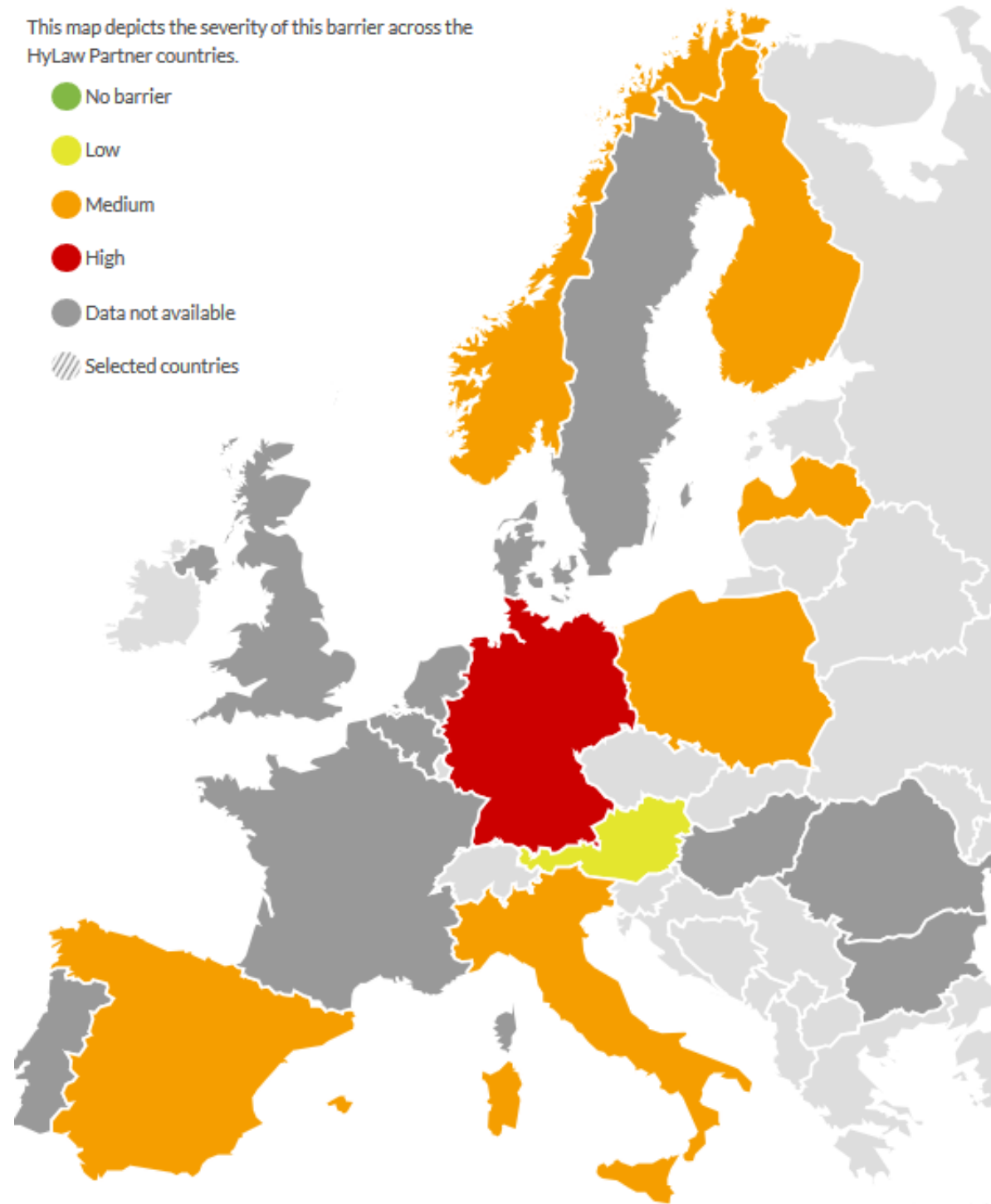
Enable investments, financial institutions, shipbuilders, shipowners and charterers need comprehensive and predictable legal framework



Bunkering

This map depicts the severity of this barrier across the HyLaw Partner countries.

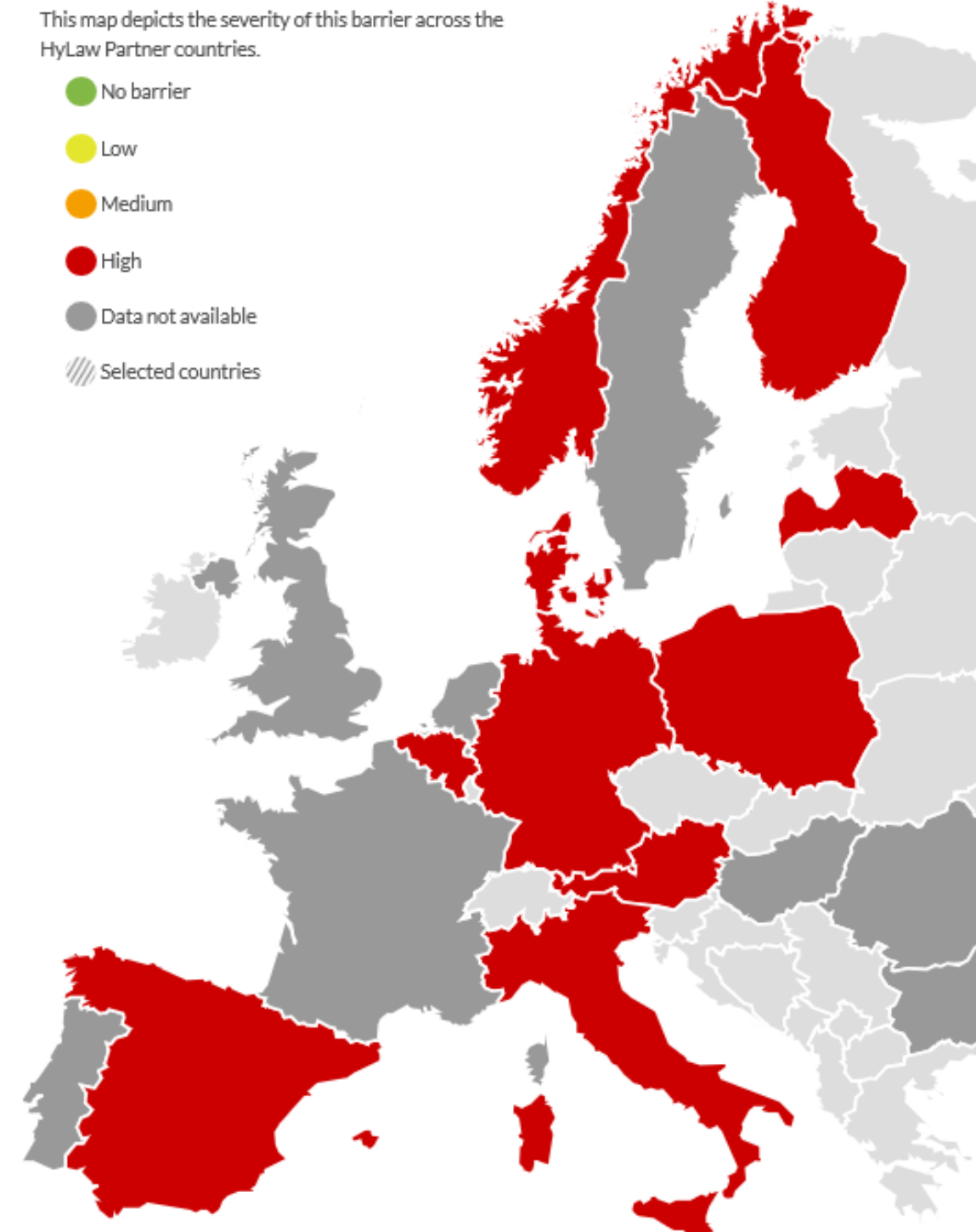
- No barrier
- Low
- Medium
- High
- Data not available
- /// Selected countries



Design / type approval

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HyLaw

www.hylaw.eu

2020 – Pre-Normative Research & Regulations, Codes and Standards

- Experimental data concerning the interaction of hydrogen with maritime (materials, ships, bunkering installations and harbours)
- Guidelines for safe design for the new IGF chapter on hydrogen



Dissemination of knowledge and for the coordination of research activities in the field of hydrogen safety

CEN/CENELEC SFEM WG Hydrogen

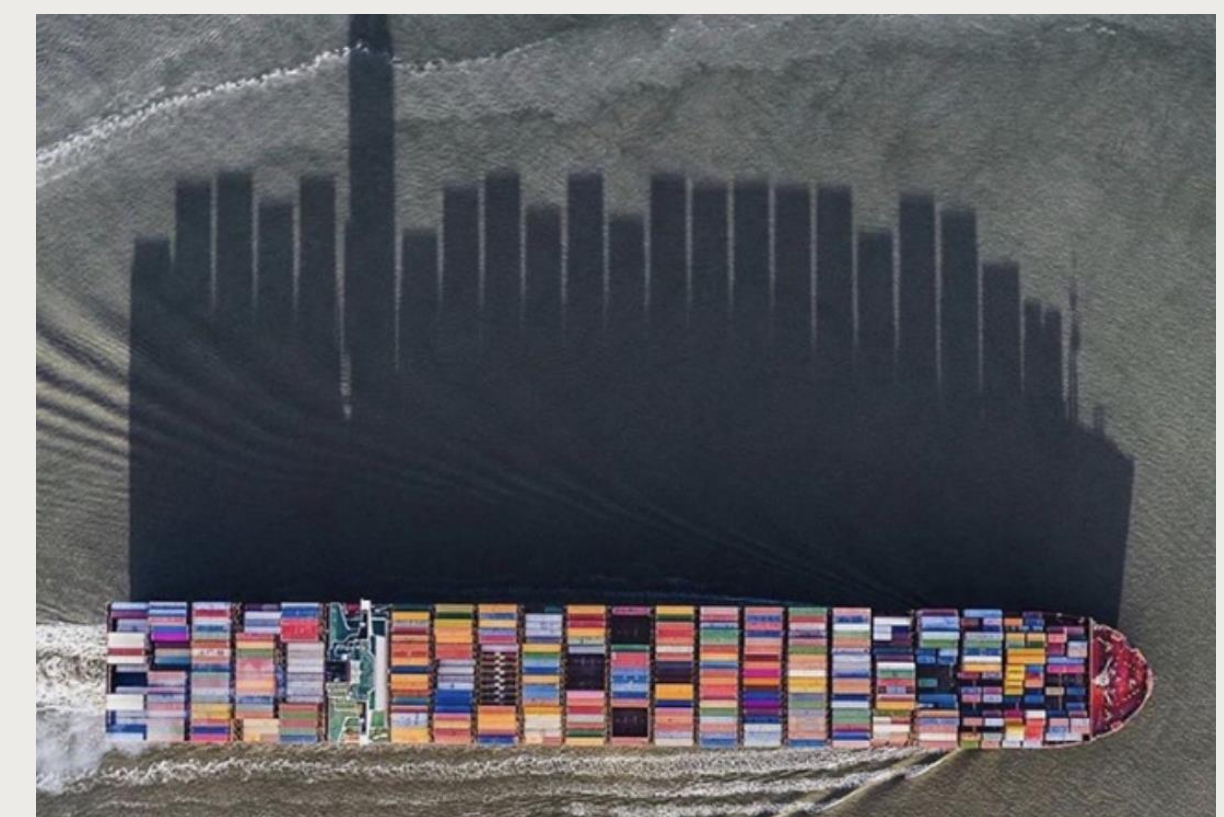
Develop an appropriate PNR/standardisation roadmap/action plan to address PNR gaps in the maritime sector



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Clean Ports operation

Machinery for container operation, tug boats and on-shore power are been tested in various ports in Europe



Port container terminal operation

- Larger trucks fleets and container machinery (RTG cranes, straddle carrier)

Port ships and boats fleet

- Tug boats, pilots boats – even H₂ blend with ICE

On-Shore Power / hotel load to ships

- 500kW-2MW for ships at berth (needed)

Port Terminal Equipment kg/day H₂



RTG Crane
45 kg/day



Forklift
5 kg/day



Straddle Carrier
46 kg/day



Container Handler
56[L] 25[E] kg/day



Reach Stacker
33 kg/day



Yard Tractor
21 kg/day



H₂ for port operation – container terminal

H2ports - First application of H₂ technologies in port handling equipment in Europe – Valencia Port

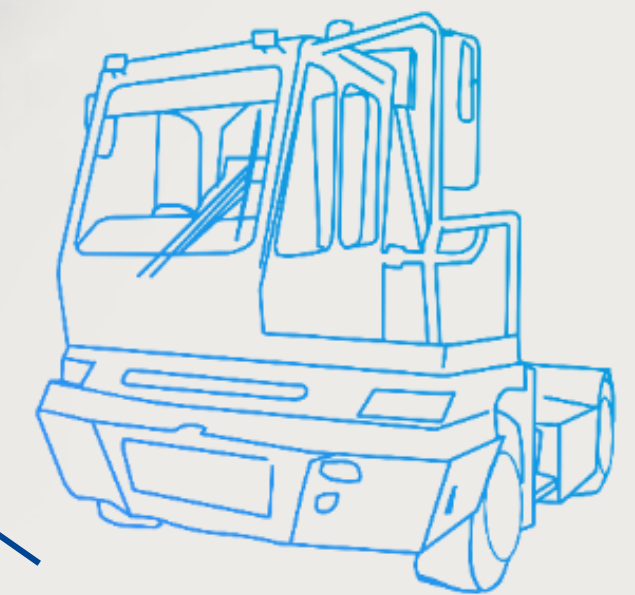
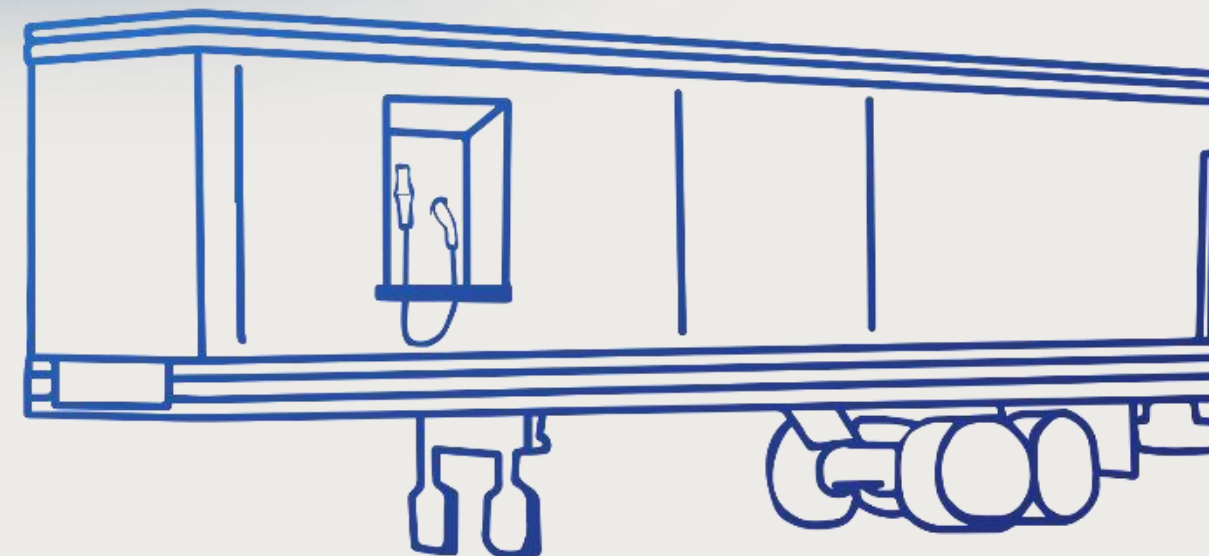


Reach Stacker in MSC Terminal

- FC: 90-120 kW
- 2 years / 5000 h of operation

Mobile HRS

- Hydrogen supply logistics at ports
 - Port regulatory framework
 - Safety procedures



Yard Tractor in Valencia Terminal Europa

- FC: 85 kW
- 2 years / 5000 h of operation



H2 for port operation – container terminal in USA

California: Port of Los Angeles and Long Beach



Long-haul trucks waiting in line at exit of LA port



- Peterbilt + Transpower - 1 truck
- Daimler/Freightline + Ballard - 1 truck
- Toyota + Kenworth Truck (Paccar company) T680s - 10 trucks
- US Hybrid - 1 truck
- Hydrogenics - 1 truck



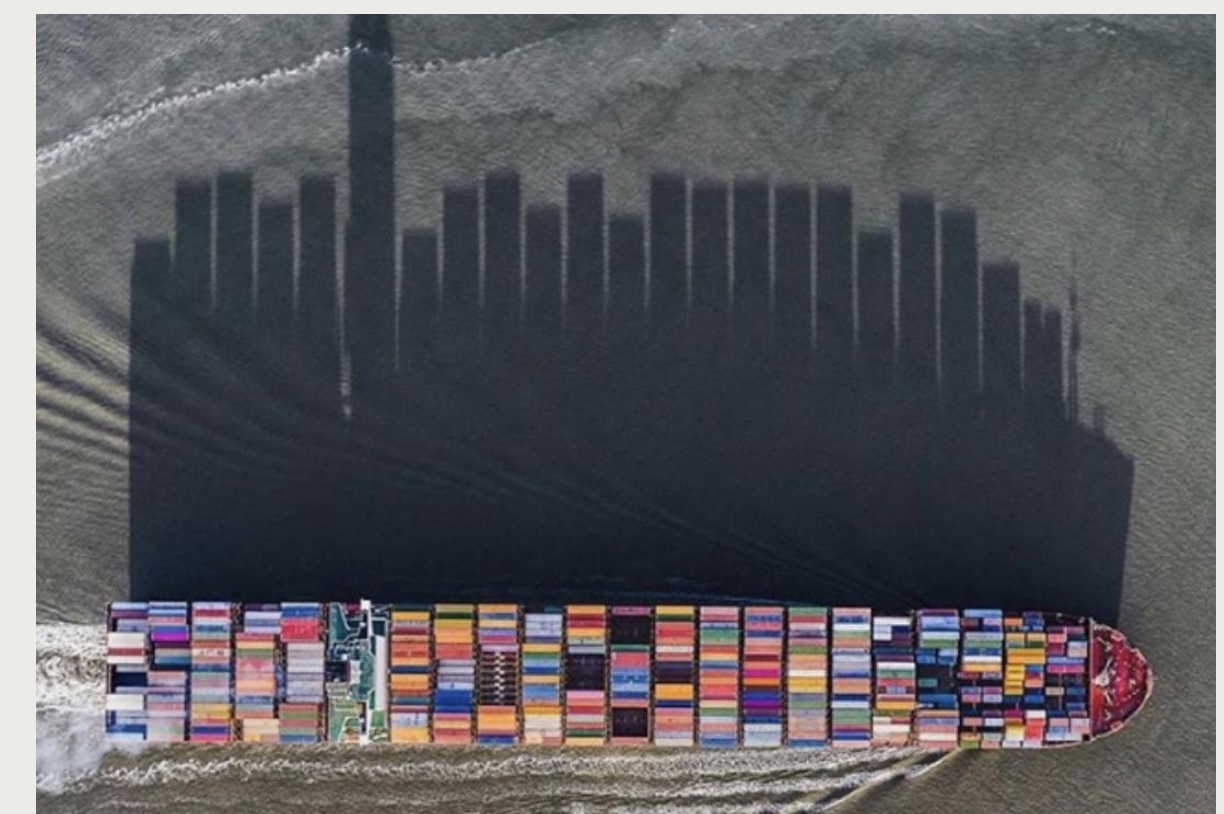
hybrid electric/hydrogen CNG/hydrogen



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Energy intensive industry is often located next to ports

Hydrogen can help these industries to decarbonise their operation

- 80% of world' hydrogen production is for refining, steelmaking, ammonia and methanol production
- Most of this hydrogen is handled through ports

Fig. 4.2: Hydrogen production sites [Fra15]

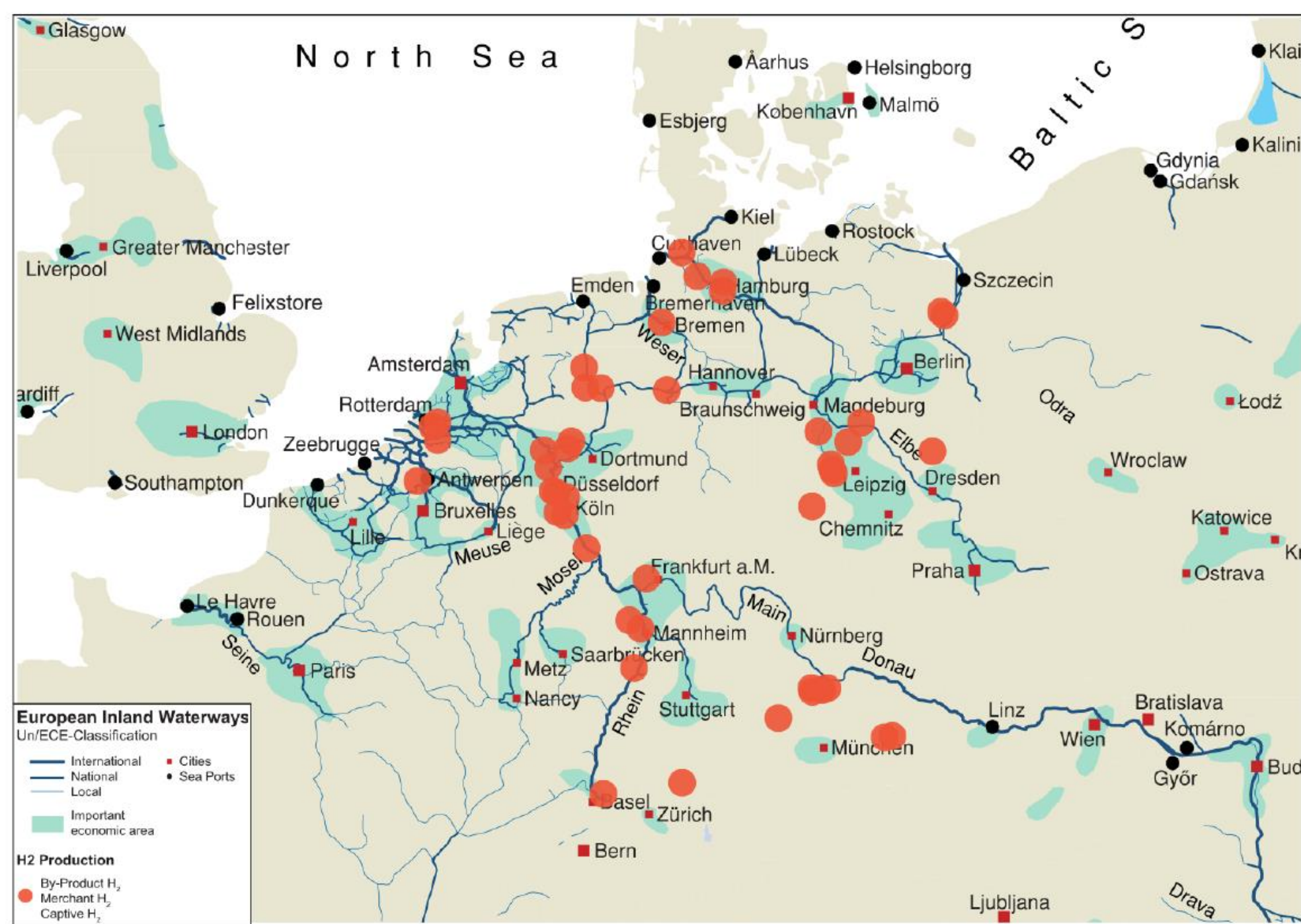
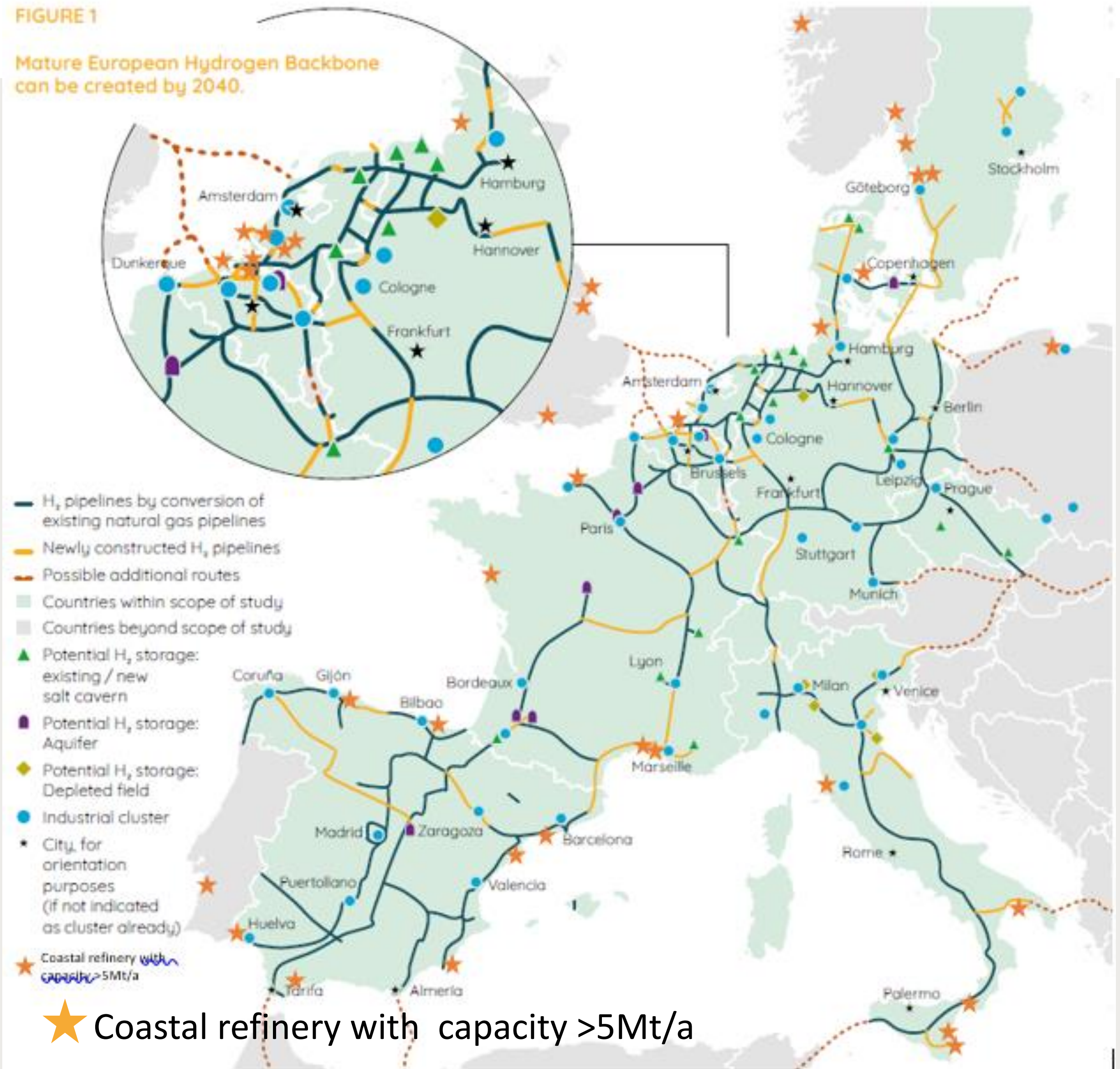


FIGURE 1

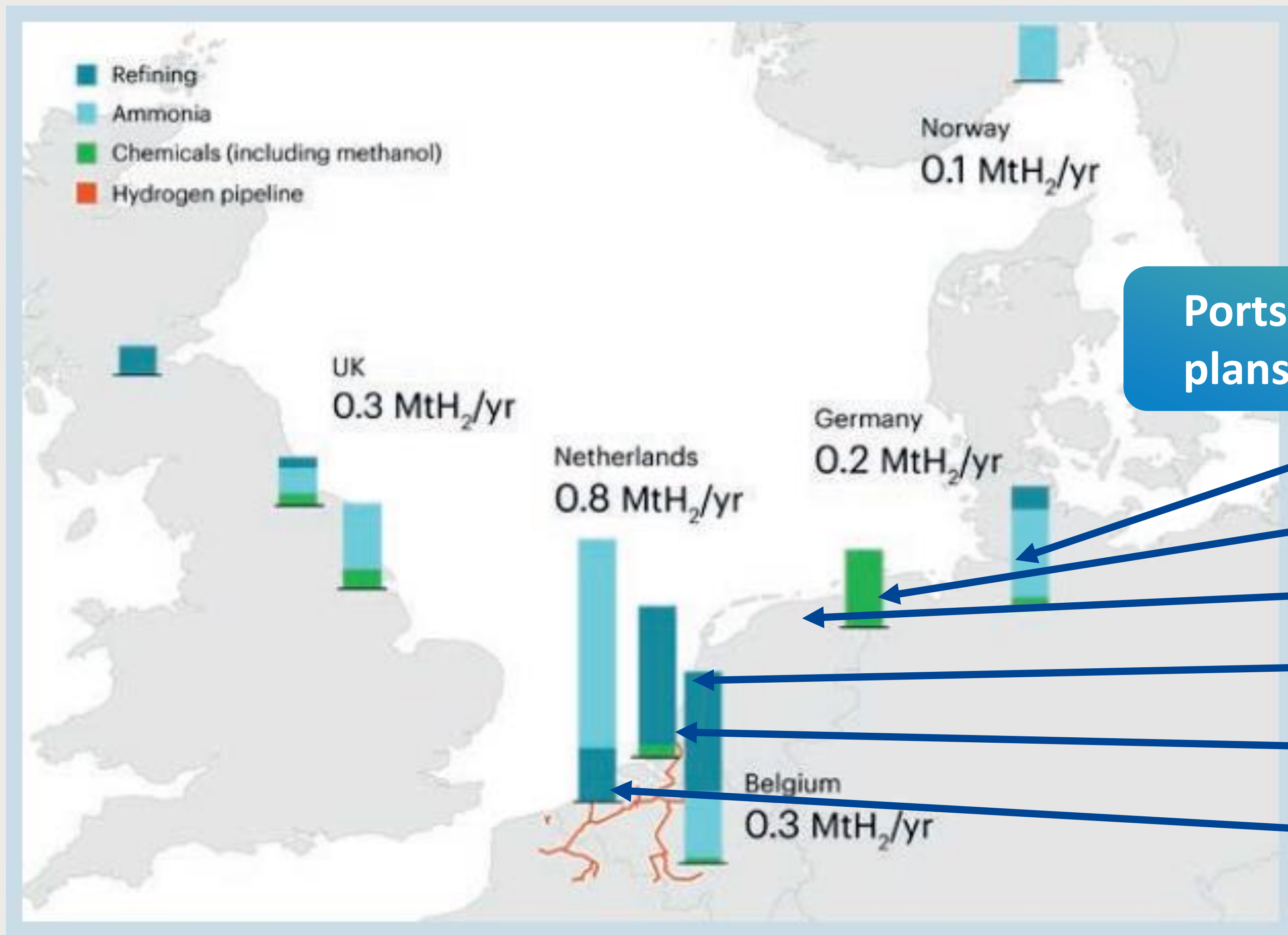
Mature European Hydrogen Backbone can be created by 2040.



Ports as hydrogen hub to supply the hydrogen demand for industry



The potential for low carbon or green hydrogen is immense – the North Sea case (July – December 2019)



Ports with plans for H₂

- The nine industrial hubs around the North Sea currently consume a total of 1.7 Mth₂ annually, nearly half of which is for ammonia (0.8 Mt), and most of the rest for refining (0.6 Mt) and chemicals (0.2 Mt).

- Production of this H₂ is responsible for 15 MtCO₂, equivalent to one-third of Germany's CO₂ emissions from the manufacturing and industrial sectors.

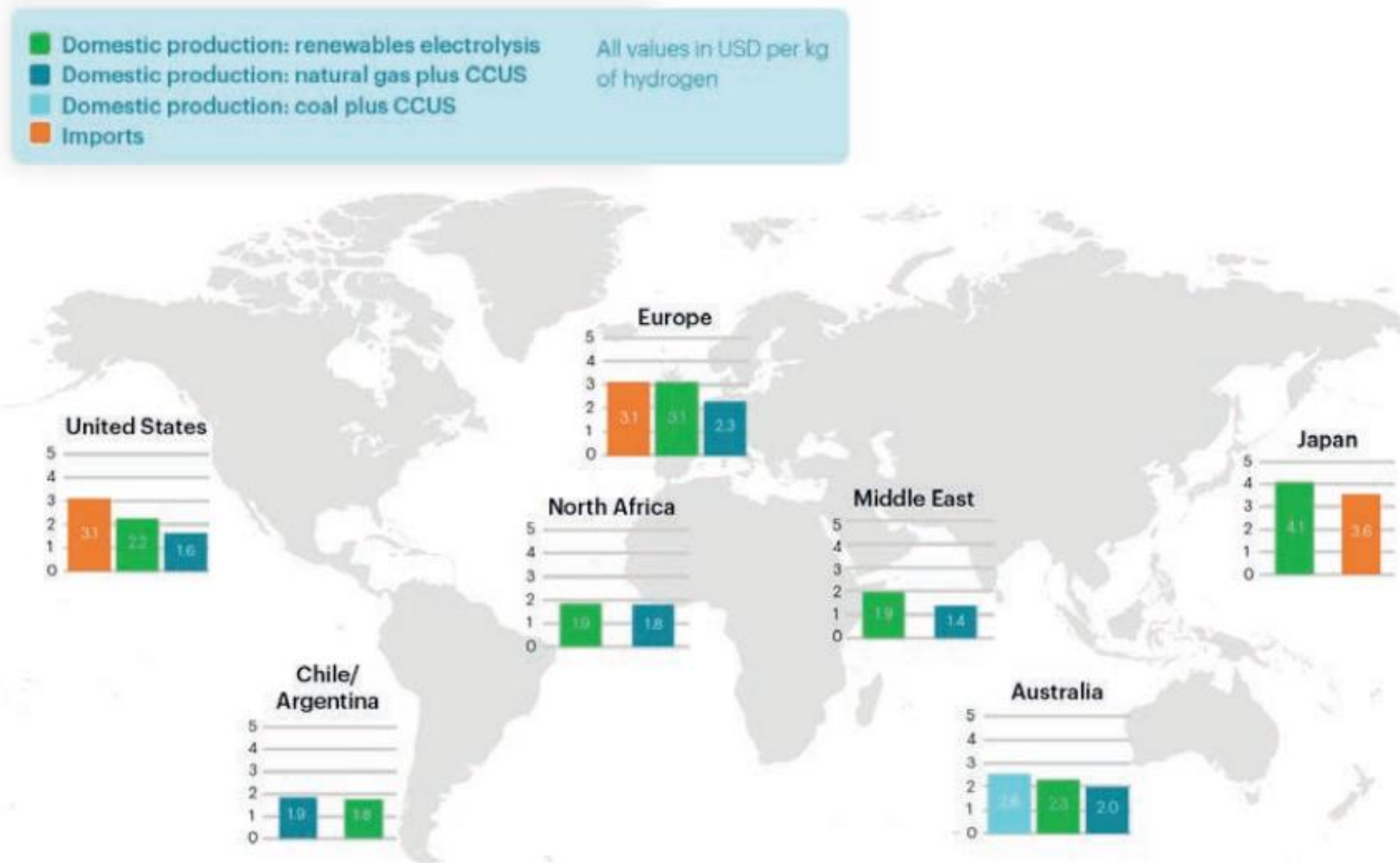
Hambourg
Emden
Groningen
Amsterdam
Rotterdam
Oostende + Antwerp

Ports as hydrogen hub: worldwide logistics of hydrogen

Internal Energy Agency – report July 2019



Figure 68. Routes for hydrogen trading with long-term costs compared to domestic production.



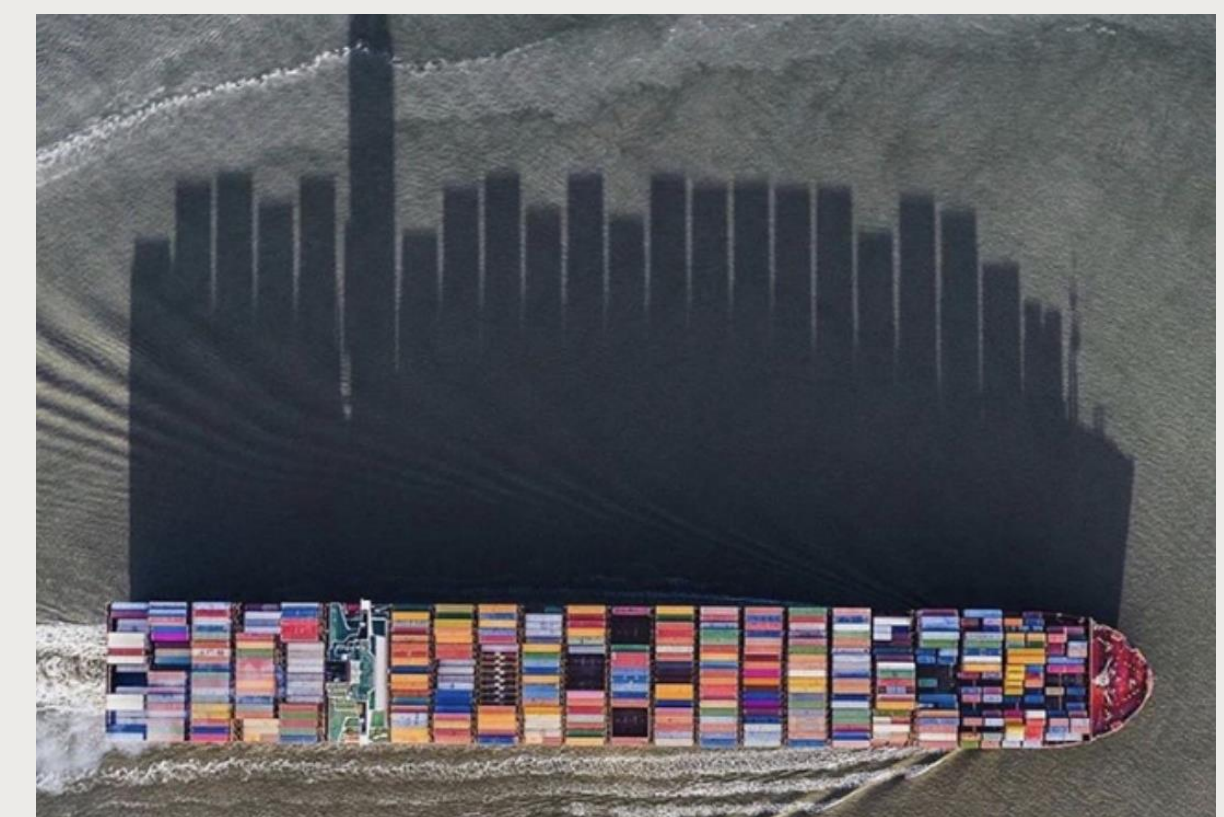
Launch the hydrogen trade's first international shipping routes

- Lessons from the successful growth of the global LNG market can be leveraged.
- International hydrogen trade needs to start soon if it is to make an impact on the global energy system.
- *Coastal* industrial hubs are of particular interest for hydrogen value chains

Green hydrogen can decarbonise full port ecosystems



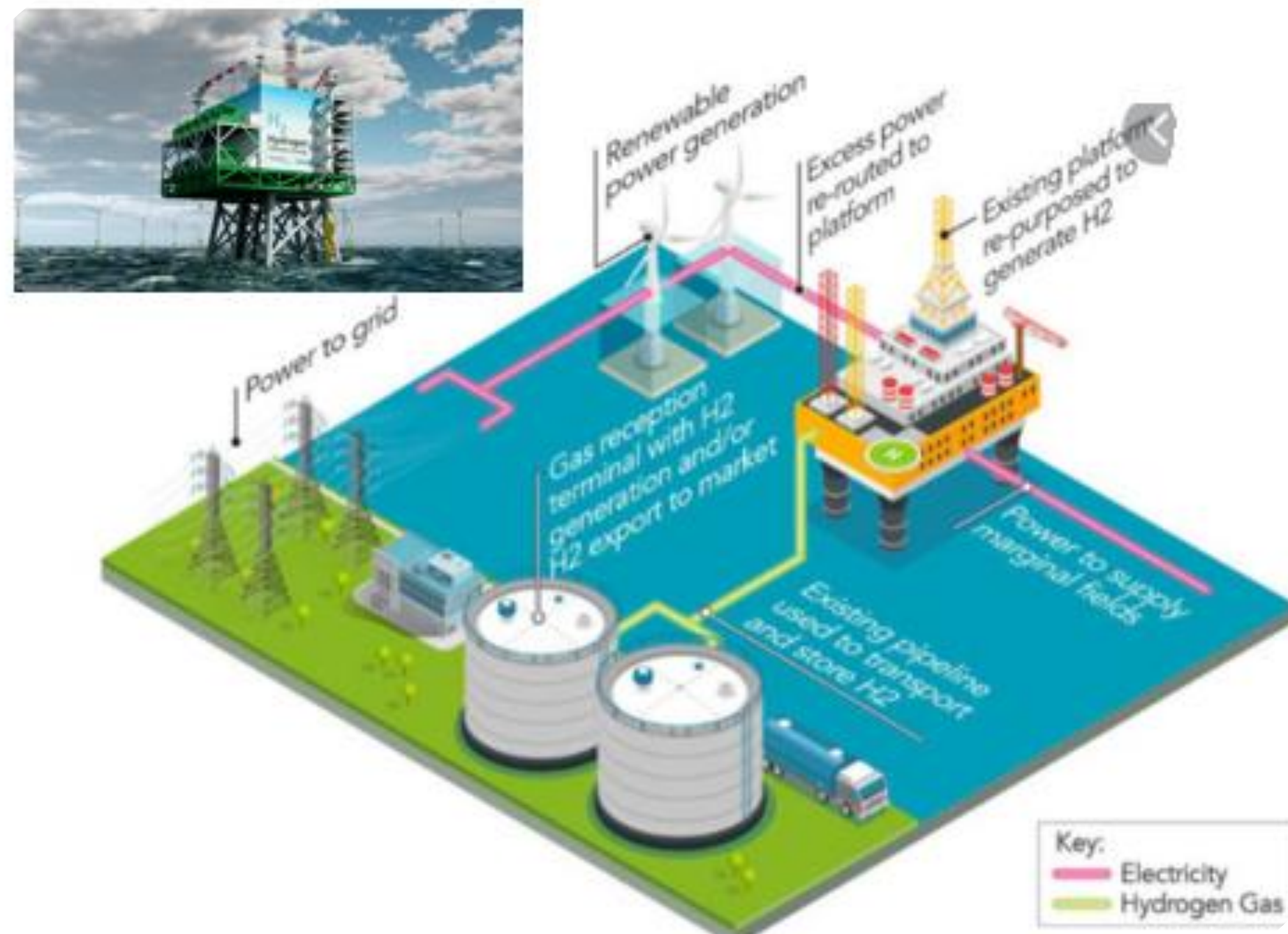
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Integration of renewable energy to produce green hydrogen

Off shore wind and repurposed platform can be a solution to curtailed renewable energy

Again ports are the nearest locations to deliver the hydrogen to users



BIG-HIT Project - “Hydrogen Territory”

Building Innovative Green Hydrogen Systems in Isolated Territories



Orkney Islands



Use of renewable energy curtailment

In 2016 renewable electricity generation **produced 120% of the islands annual electricity demand**

Hydrogen from wind and wave

- Integration with wind and tidal turbines
- 2 PEM electrolyzers (**1MW & 0.5MW capacity**) producing **~50T/year of H₂**.



Port ecosystem

- 75kW PEM for cold ironing (3 ferries) and CHP at harbours offices and marina
- CHP for 2 schools, a HRS for 10FCEVs



Hydrogen Ro-Ro ferries

- HyDIME - 40-60% H₂ in ICE
- HySeas III – H2020 - 600 kW PEM FC Power



Summary : hydrogen can decarbonise the entire port ecosystem

Making H₂ a new fuel for ports activities through innovation



Clean port operations

Port container terminal operation

- Large trucks fleets and container machinery (reach stackers, yard tractors, RTG cranes, etc.)

Port ships and boats fleet

- Tug boats, pilots boats – even H₂ blend with ICE

On-Shore Power / hotel load to ships

- 500kW-2MW for ships at berth



Ports as H₂ coastal hubs

- Creating / **Serving H₂ demand** locally for energy intensive **industry** (steel, chemicals, refineries, etc.)
- Integration of **renewable electricity from offshore** wind
- International **trading routes for H₂**
- **Transport node / ecosystem** with trains, trucks and inland navigation





Thanks for your attention



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