Need for closer cooperation between policy, industry and safety experts on ammonia and other hydrogen fuels

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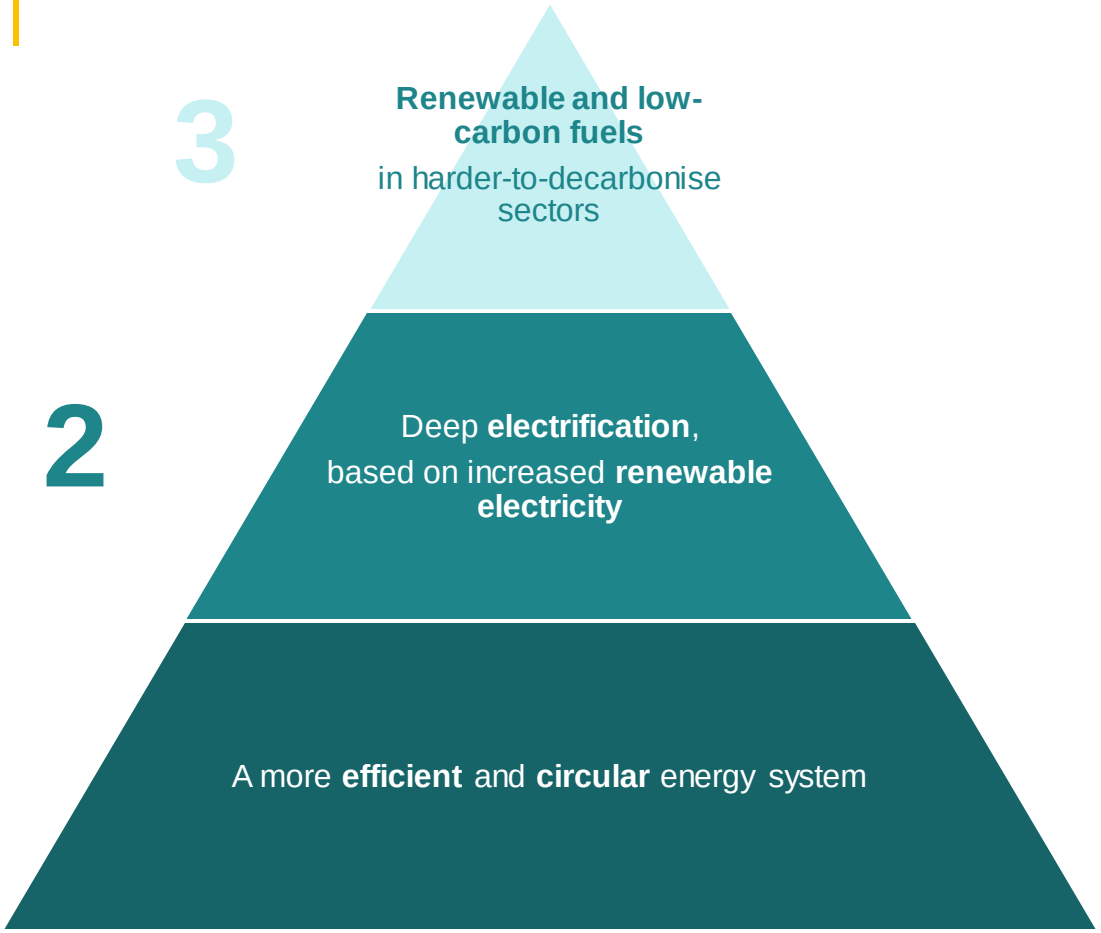
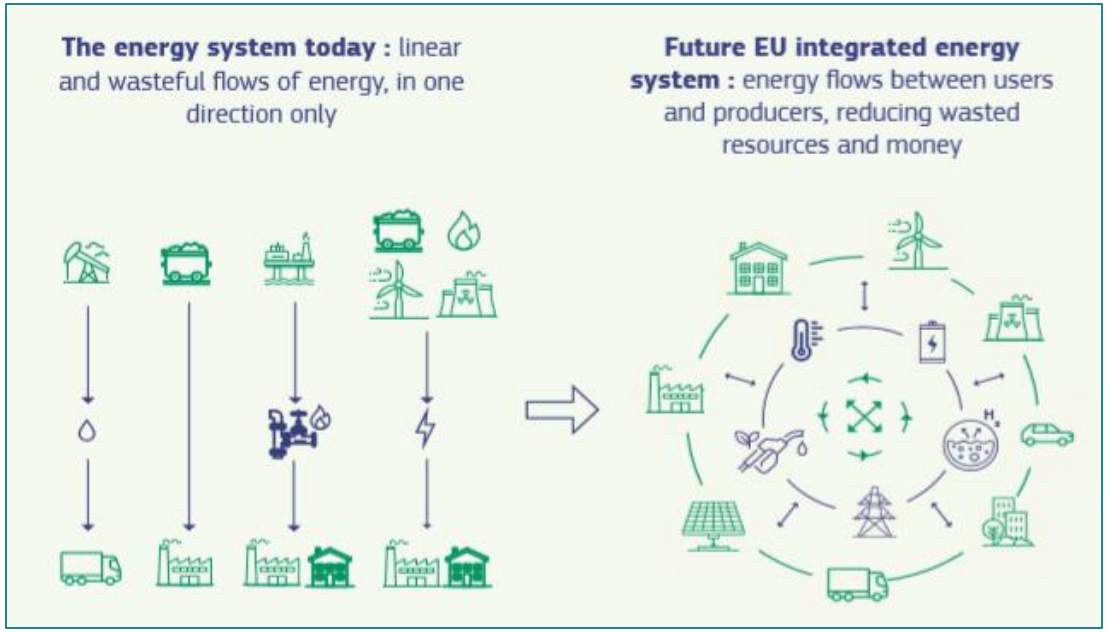
Transforming EU energy system





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Comprehensive hydrogen policy put in place since 2020

- Criteria for hydrogen certification
  - RFNBO DAs
  - Draft Low-carbon DA

- Permitting for manufacturing (NZIA)

- Market rules and infrastructure planning (Hydrogen market package and TEN-E)
- Targets for hydrogen refuel stations (AFIR)

- Targets for renewable hydrogen in industry & transport (RED)
- Renewable and low-carbon hydrogen in maritime & aviation sector (ReFuel)

Hydrogen production

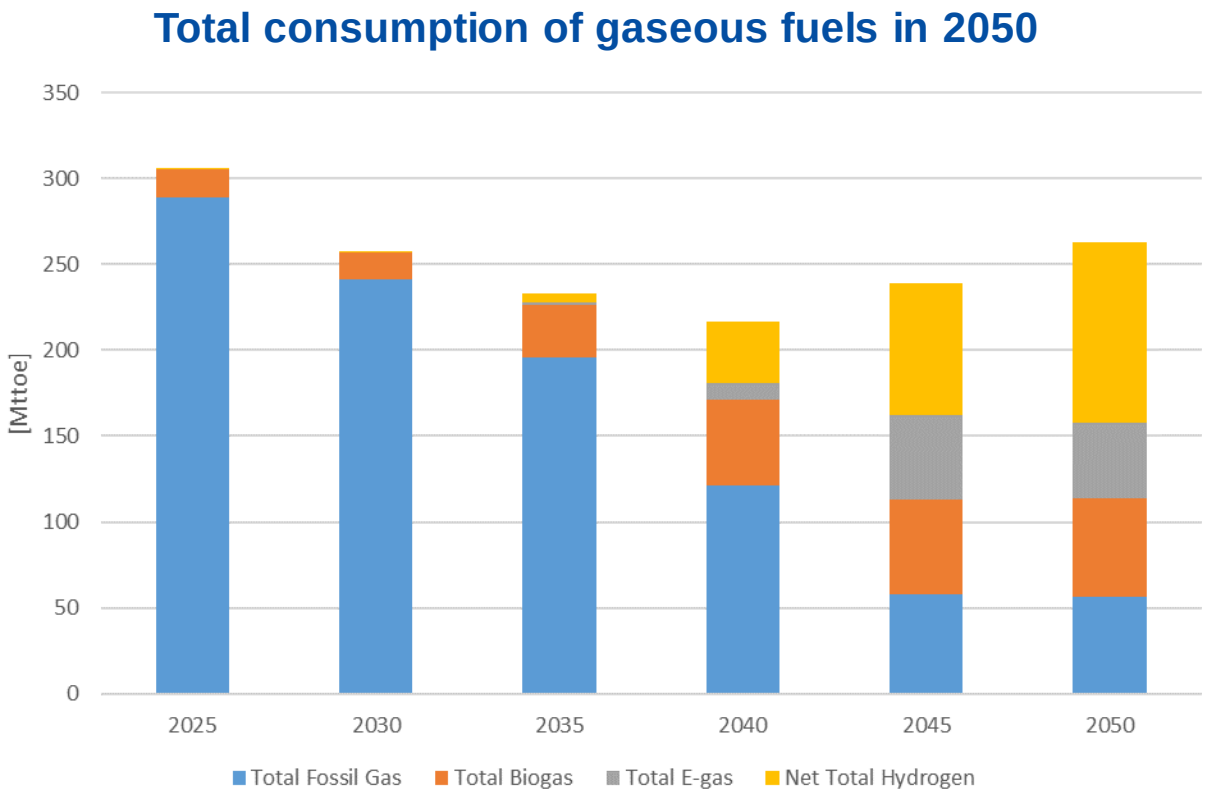
Hydrogen infrastructure & markets

Hydrogen consumption

Hydrogen financing

- Rules for state aid for renewable and low-carbon hydrogen
- Cross-border hydrogen infrastructure (CEF) & hydrogen refuelling stations (CEF)
- Regional development programmes and recovery fund
- European Hydrogen Bank
- InvestEU / international EU development aid

Gaseous fuels in the EU towards 2050



- Gaseous fuels will represent approximately 20% of final energy consumption in 2050
- Shift from unabated fossil gas towards renewable and low-carbon gases
- Gaseous fuels in 2050 to include mainly biogas, bio-methane, renewable and low-carbon hydrogen as well as synthetic methane

Source: EC PRIMES MODEL, MIX H2 scenario. This scenario takes strategic targets European hydrogen strategy into account and considers options of promoting RFNBOs in industry and transport.

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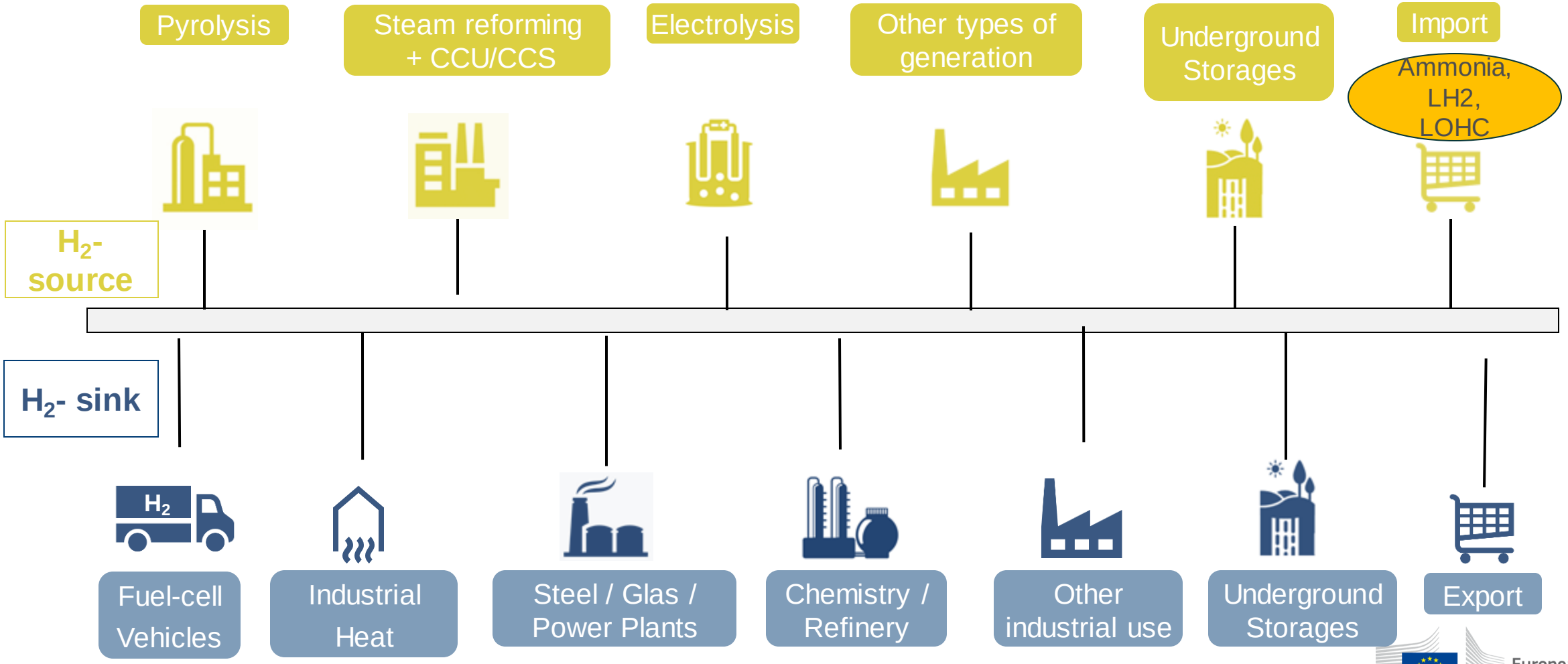
Existing and new technology solutions/ combinations for production, supply and use of hydrogen



EU Renewable Energy Directive: targets for renewable fuels of non-biological origin (RFNBOs) in industry and transport

42% target for the use of **RFNBOs in industry** by 2030 and **60% by 2035**

At least **29 % renewables** in transport
or
14,5% reduction of emission intensity of fuels
+
At least **5,5% advanced biofuels and RFNBOs** (combined target with at least 1% RFNBOs)
+
Incentives for advanced biofuels and RFNBOs (double counting) + incentives for their use in aviation (1,2x or 1,5x multiplier)

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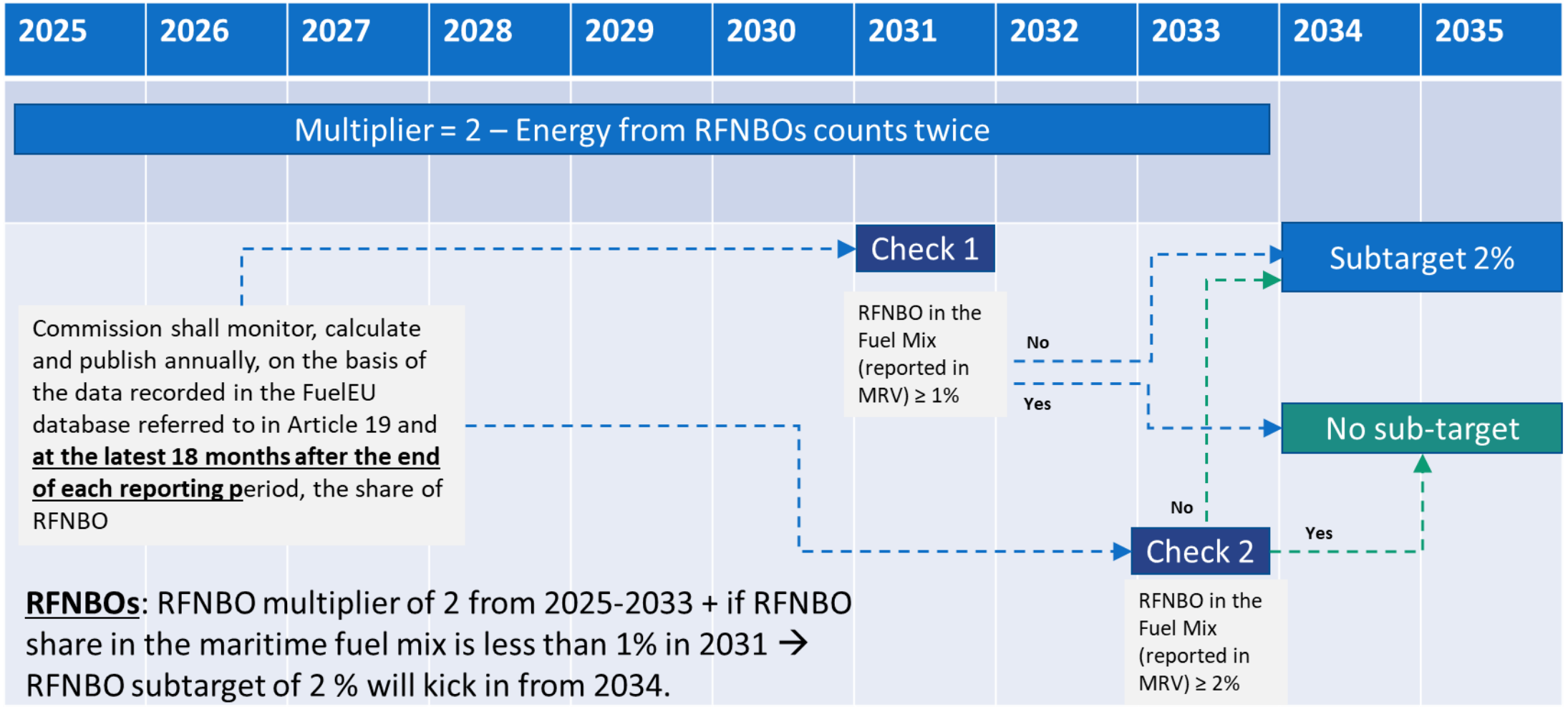
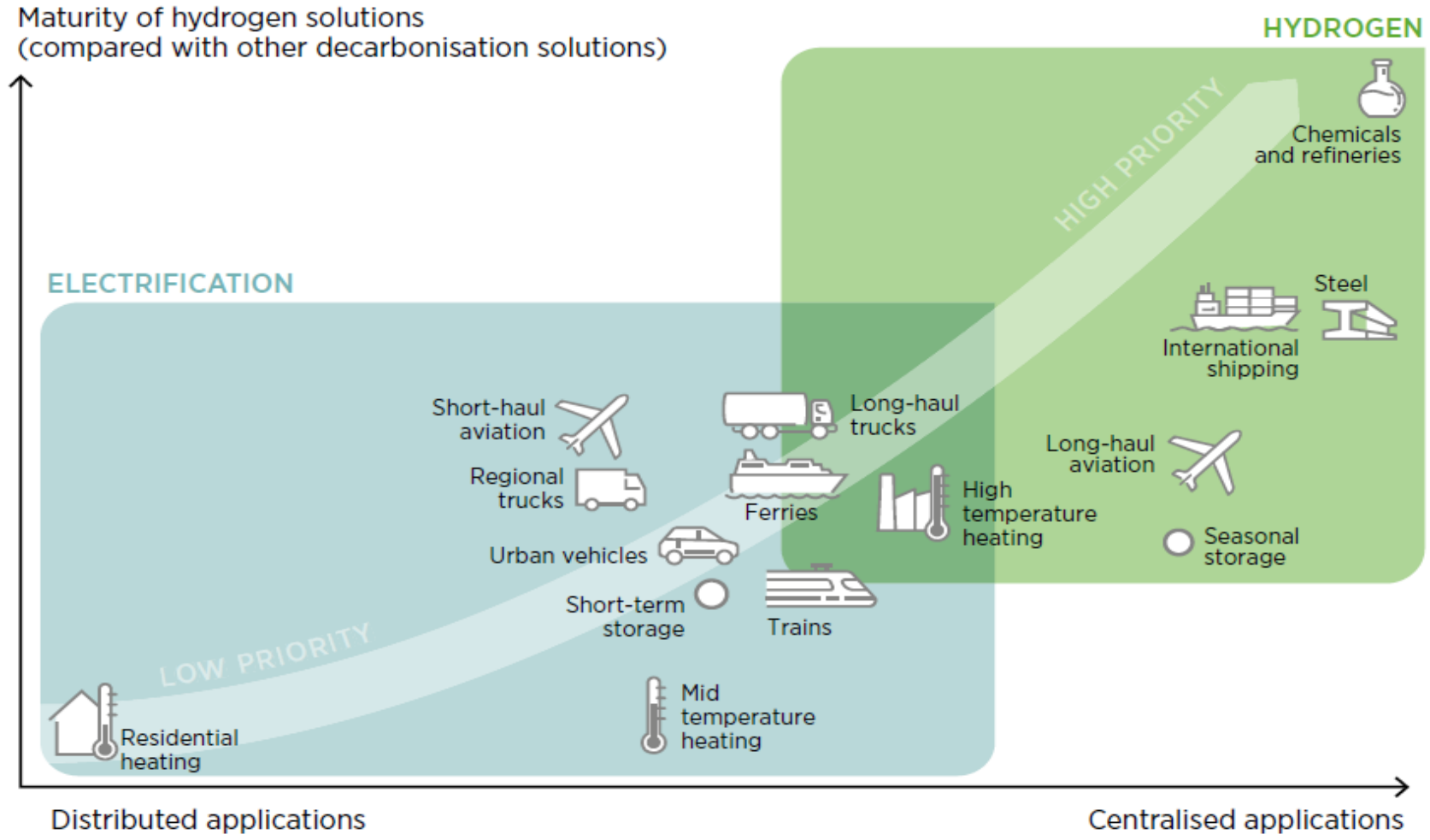
FuelEU Maritime – incentives for RFNBOs



Ammonia as a hydrogen fuel



Source: IRENA, 2022

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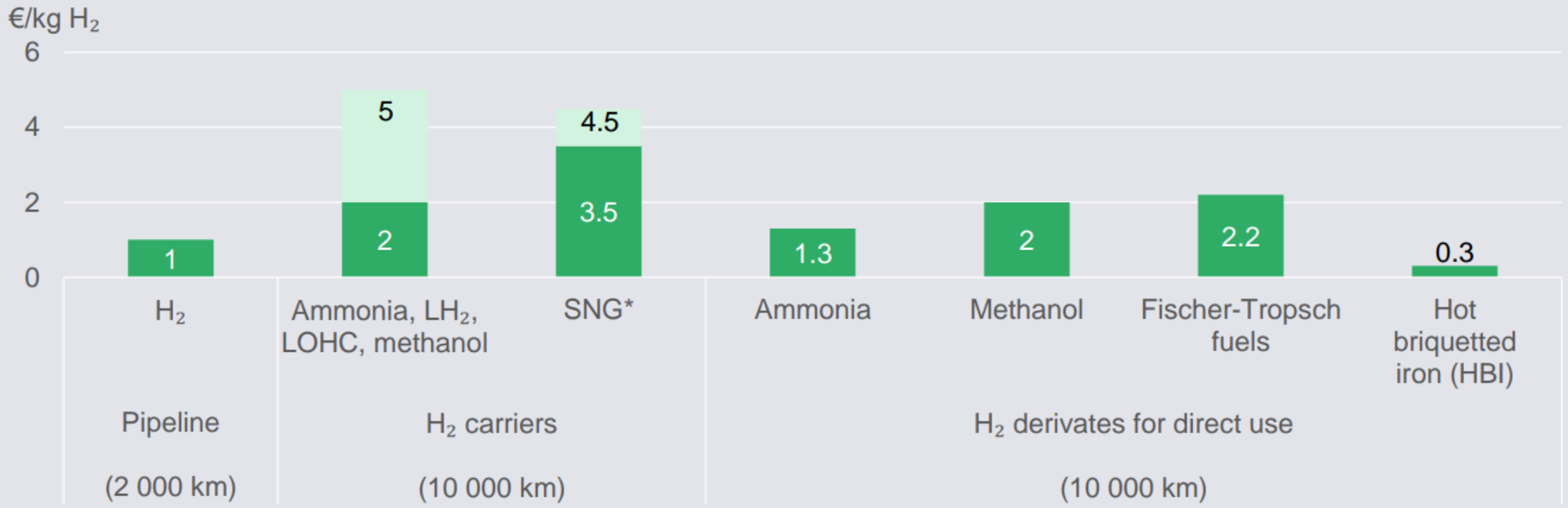
Ammonia as a hydrogen carrier

Hydrogen transport cost to Germany 2030 in €/kg, including conversion losses, but excluding hydrogen production cost (LCOH)



Agora Industry (2023) based on TUHH (2023), Acatech (2022), Agora Industry & Wuppertal Institute (2023); Different shades of green represent minimum and maximum values, respectively; * SNG with a nearly closed carbon cycle; HBI without CAPEX of DRI installations and ships that would be needed anyway in an alternative scenario;

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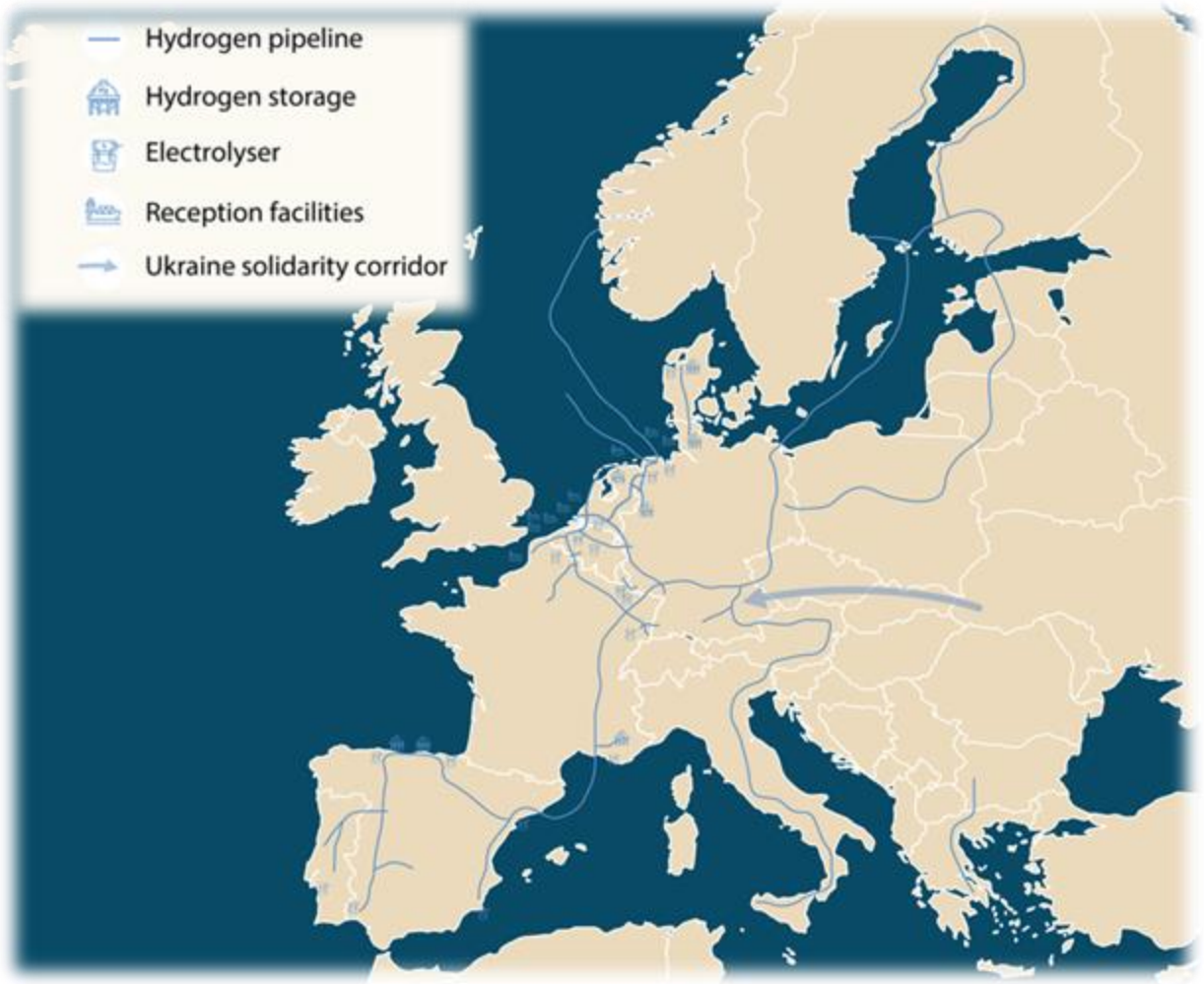
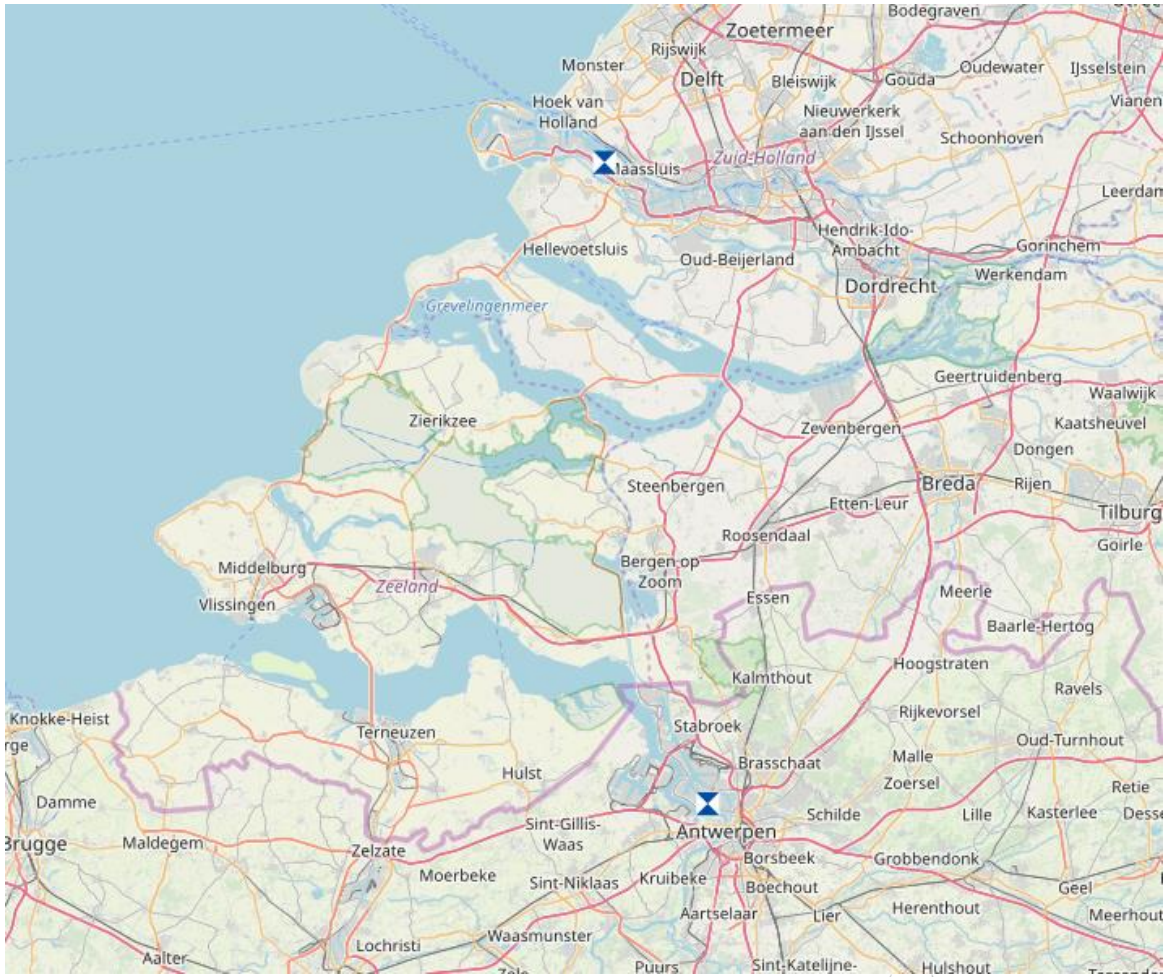
Infrastructure - 2 ammonia receiving facilities on the 1st Union PCI/PMI list under the EU TEN-E Regulation





Interactive map of [166 cross-border energy projects for EU support](#) (*PCI/ PMI Transparency platform*): *https://ec.europa.eu/energy/infrastructure/transparency_platform/map-viewer/main.html*

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Annual Union work programme for European standardisation - 15 February 2024

- **Action 16: Hydrogen technologies and components**

  Develop European standards on quality, technology and safety for the production and use of hydrogen

- **Action 17: Transport and storage of hydrogen**

  Revise existing standards and develop new European standards for hydrogen quality and safety – relevant for injection into the dedicated hydrogen network (?odorisation?), and end uses, including hydrogen-based fuels

- **Action 18: Containers for hydrogen (liquid and gaseous) in inland waterway transport**

  Development of European standards to enhance safety of hydrogen-fueled water transport by aligning standards for vessels carrying hydrogen containers and refueling points, including swappable containers

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European Clean Hydrogen Alliance: 2023 Roadmap on Hydrogen Standardisation

issue / topic horizontal aspects	standardisation gap details / description	100% H2	H2NG	standards	status of standardi-sation
energy / hydrogen carrier	Methanol and ammonia norms for utilization as transport fuel.	x		to be identified	to be identified
energy / hydrogen carrier - maritime -	standards for using ammonia (or other hydrogen carriers such as methanol) as fuels for shipping, heavy road transport or aviation are missing.	x		to be identified	to be identified
gas/hydrogen infrastructure - hydrogen terminal - injection in grid	standards needed for the handling of hydrogen and derivatives when using hydrogen terminals and injecting into the hydrogen grid to avoid issues at interconnection points. here: hydrogen terminal for the transformation of liquid hydrogen or liquid ammonia or LOHC into gaseous hydrogen . Here to add also LIHC and solid state forms	x		to be identified	to be identified
maritime - energy / hydrogen carrier - safety aspects	safety standards and classification for hydrogen, ammonia, and methanol powered ships.	x		to be identified	to be identified