

Global Hydrogen Review and Northwest Europe Hydrogen Monitor Webinar

April 25, 2023

Webinar & Speaker Introductions

Moderated by Jal Desai, National Renewable Energy Laboratory

April 25th, 2023

Agenda

- Overview of the Clean Energy Solutions Center
- Overview of the Hydrogen Initiative
- Global Hydrogen Review
- Northwest Europe Hydrogen Monitor
- Q&A

Webinar Speakers



Carla Robledo

Senior Policy Advisor,
**Government of Netherlands
Ministry of Economic
Affairs and Climate Policy**

Co-Lead, **CEM Hydrogen
Initiative**



Jal Desai

Researcher, **National
Renewable Energy
Laboratory**



Jose M Bermudez

Energy Technology Analyst,
International Energy Agency

Coordinator, **CEM Hydrogen
Initiative**



Gergely Molnar

Gas Analyst, **International
Energy Agency**

Overview of the Clean Energy Solutions Center

Presented by Jal Desai, National Renewable Energy Laboratory

April 25th, 2023

The Clean Energy Solutions Center

OBJECTIVE

To accelerate the transition of clean energy markets and technologies.

RATIONALE

Many developing governments lack capacity to design and adopt policies and programs that support the deployment of clean energy technologies.

AMBITION/TARGET

Support governments in developing nations of the world in strengthening clean energy policies and finance measures

ACTORS

Leads:



Operating Agent:



Partners:

More than 40 partners, including UN-Energy, IRENA, IEA, IPEEC, REEEP, REN21, SE4All, IADB, ADB, AfDB, and other workstreams etc.

ACTIONS

- **Deliver** dynamic services that enable *expert assistance, learning, and peer-to-peer sharing of experiences. Services are offered at no-cost to users.*
- **Foster** dialogue on emerging policy issues and innovation across the globe.
- **Serve** as a first-stop clearinghouse of clean energy policy resources, including policy best practices, data, and analysis tools.

UPDATES

Website:

www.cleanenergyministerial.org/initiatives-campaigns/clean-energy-solutions-center

Factsheet:

www.nrel.gov/docs/fy22osti/83658.pdf

Requests: Now accepting Ask an Expert requests!

The Clean Energy Solutions Center



Ask an Expert Service

- Ask an Expert is designed to help policymakers in developing countries and emerging economies identify and implement **clean energy policy** and finance solutions.
- The Ask an Expert service features a network of more than **50** experts from over **15** countries.
- Responded to **300+** requests submitted by **90+** governments and regional organizations from developing nations since inception



Training and Capacity Building

- Delivered over **300** webinars training more than **20,000** public & private sector stakeholders.



Resource Library

- Over **1,500** curated reports, policy briefs, journal articles, etc.



For additional information and questions, reach out to Jal Desai, NREL, jal.desai@nrel.gov



CEM's Hydrogen Initiative

Carla Robledo, PhD

Policy Advisor Hydrogen - Ministry of Economic Affairs and
Climate Policy of The Netherlands

CEM's HYDROGEN INITIATIVE (H2I)

OBJECTIVE

To raise international ambition and advance commercial scale low-carbon hydrogen deployment in the long-term globally, across all sectors .

RATIONALE

There is a need for long term plans, vision and goals in giving direction to hydrogen uptake and to enable effective planning and development of consistent policies.

AMBITION/TARGET

To build strategic partnerships to develop and facilitate global actions on clean hydrogen and fuel cell deployment across regional, national, and municipal economies.

ACTORS

Co-Leads:



Participants:

- More than 20 governments are part of the network.
- Hydrogen Council and individual companies part of the discussion
- Around 60 port association and authorities
- Coordination with other international H2 initiatives a priority.

ACTIONS

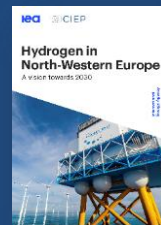
- Global aspirational goals
- Global Ports Hydrogen Coalition
- H2 Twin cities programme
- International hydrogen trade and supply-chains
- North-Western Europe hydrogen market coordination
- IEA Global Hydrogen Review tracking policies and markets



Roundtable on the North-West European Region



- **Objective:** sharing knowledge and monitoring the policy and market developments
- **Activities:**
 - Analysis on the regional developments



- Dissemination
- Facilitating matchmaking between importers/exporters



Global Hydrogen Review

Presented by Jose M Bermudez, IEA

April 25th, 2023



Global Hydrogen Review 2022

Jose M Bermudez, Energy Technology Analyst

Clean Energy Solutions Centre webinar, 25 April 2023

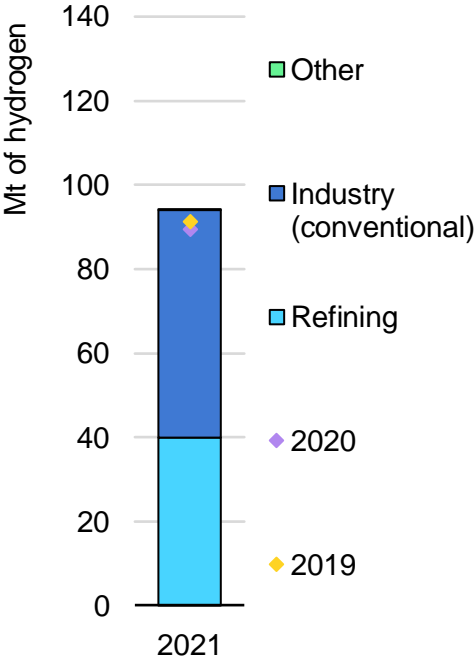


- Hydrogen is widely recognised as an important option in supporting climate ambitions; it can also help enhance energy security
- Net-zero pledges are boosting hydrogen interest, further bolstered by the global energy crisis:
 - Nine new national strategies were adopted last year
 - Large projects are starting to reach FID and major players are signing off-take agreements
 - Growing international cooperation to develop hydrogen trade
- Adoption of low-emission hydrogen as energy vector is at an early stage and needs regular and effective tracking

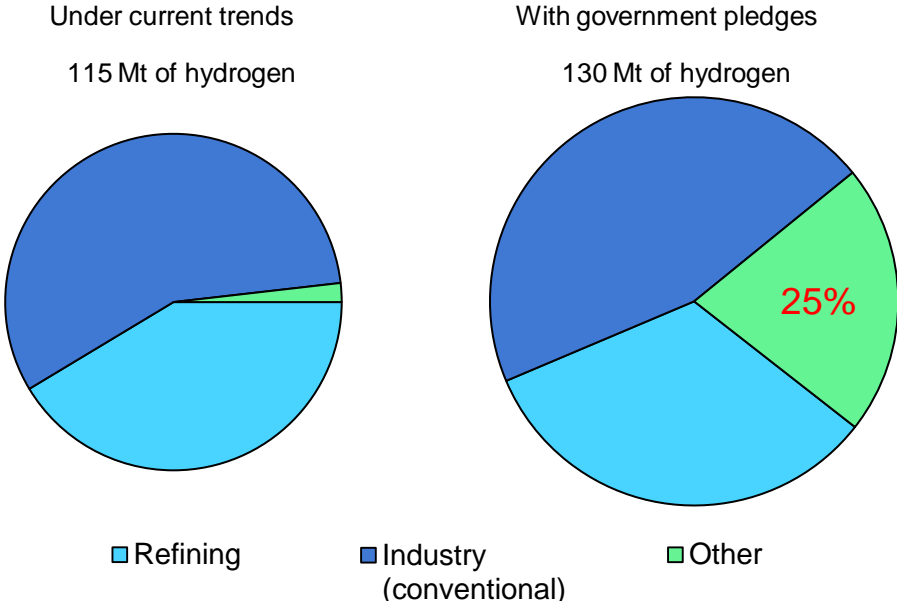
Demand is growing, with positive signals in key applications



Hydrogen demand, 2019-2021

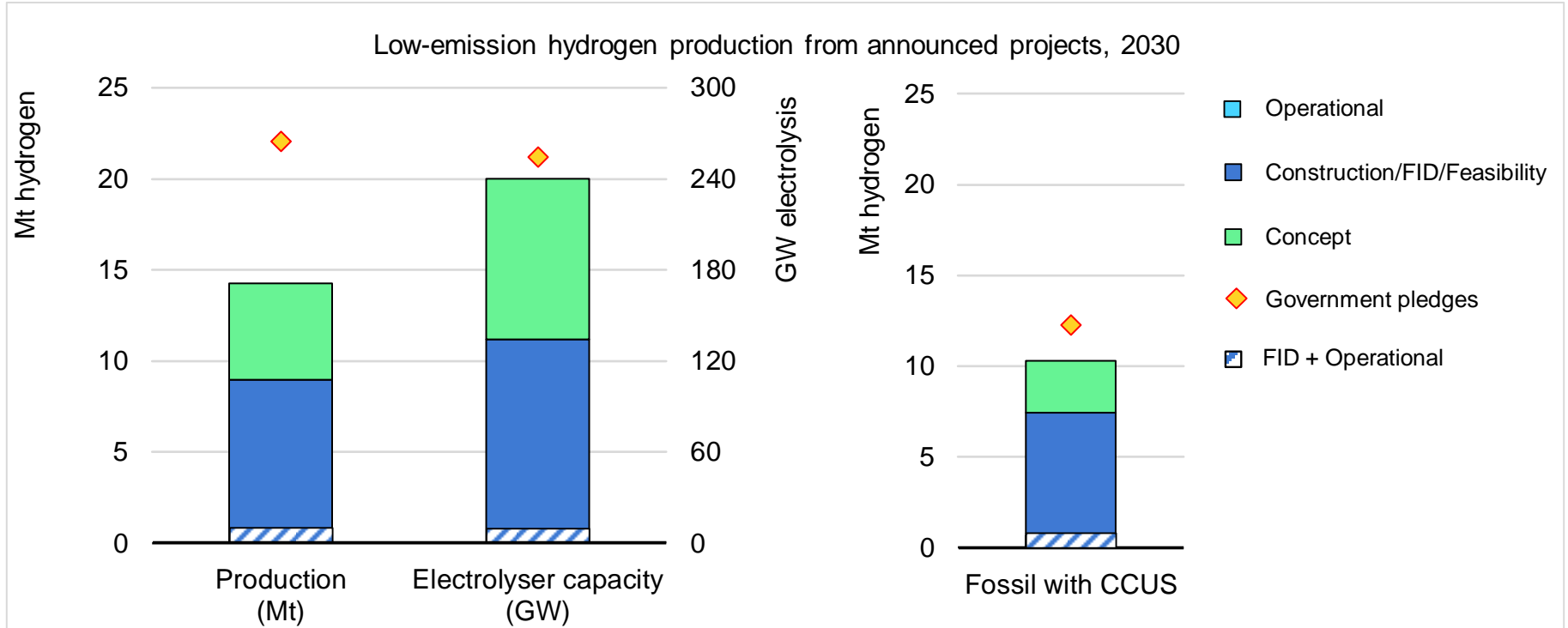


Hydrogen demand, 2030



There are plans to increase hydrogen use in heavy industry, transport and power generation, but ambitious policies are needed for hydrogen to play its role in meet government climate pledges

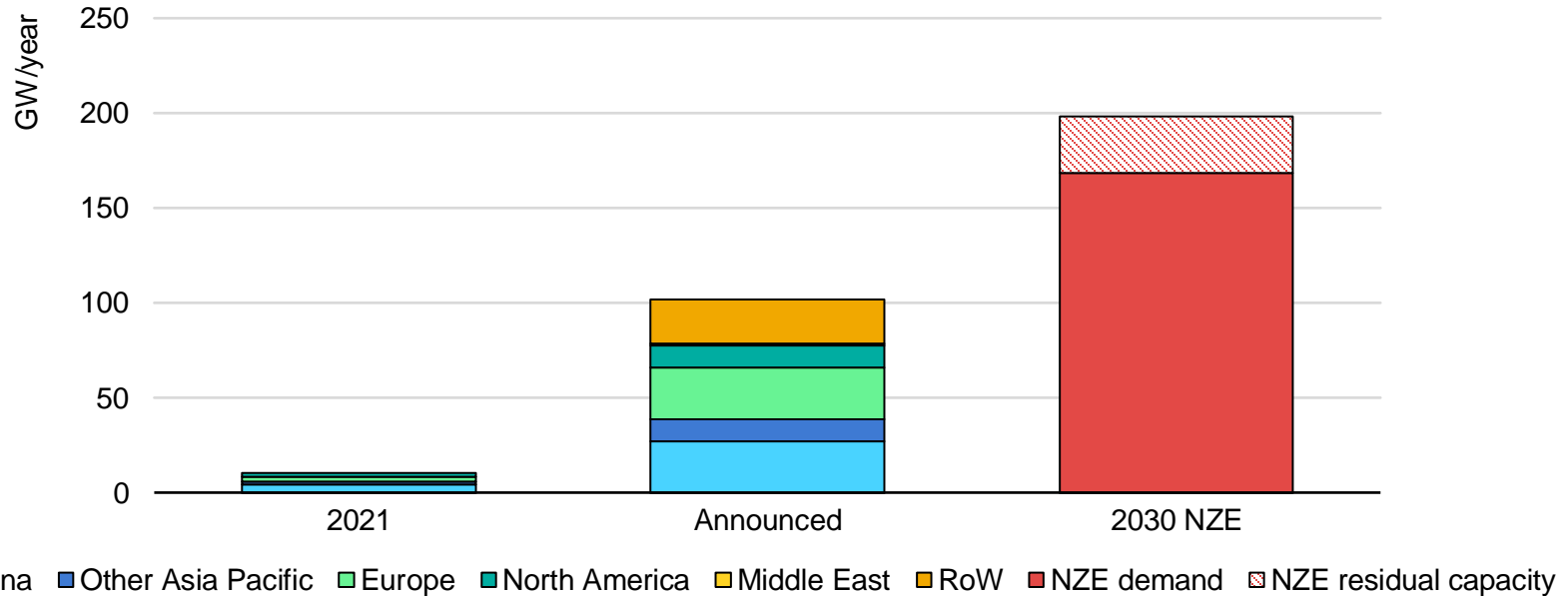
An increasing project pipeline for low-emission hydrogen production



Low-emission hydrogen could reach 16-24 Mt per year by 2030. However, just a few projects are under construction or have reached FID due to uncertainties about demand, regulation and infrastructure

A new energy economy: the case of electrolyser manufacturing

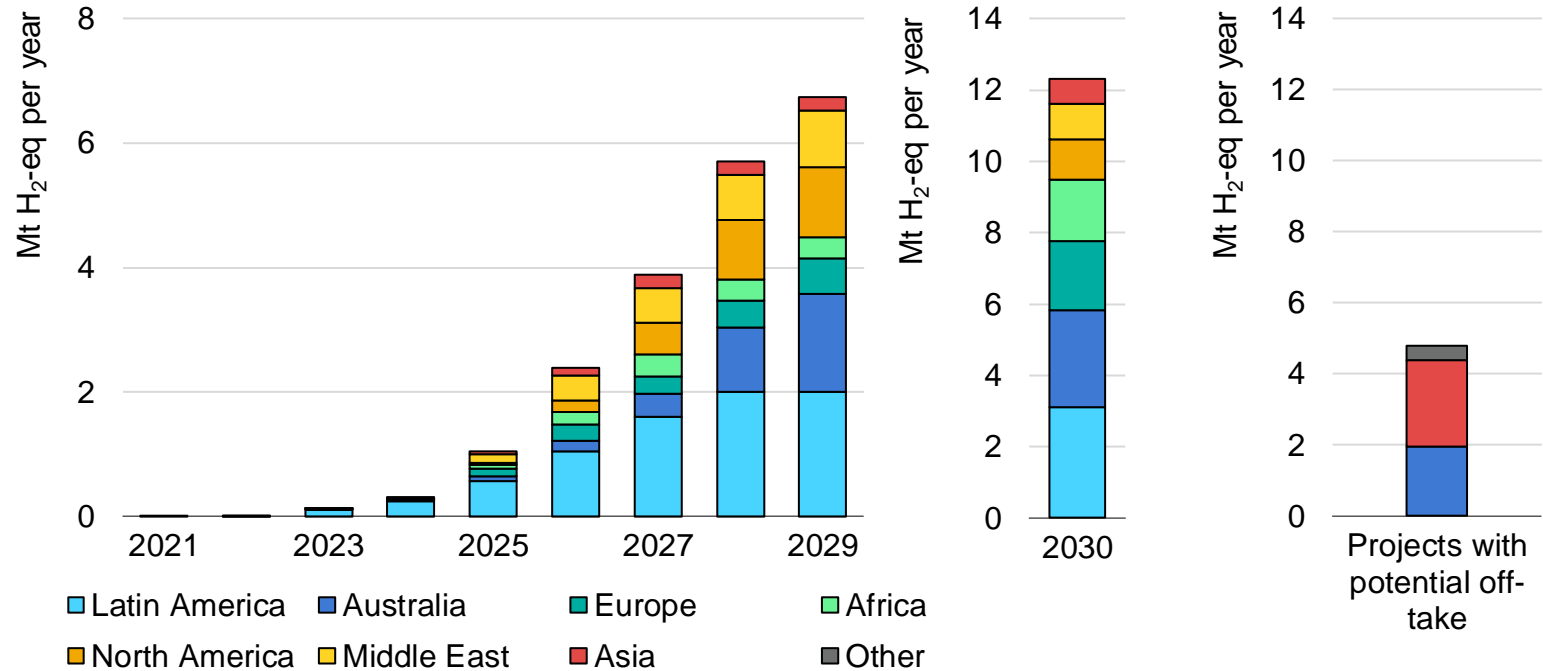
Electrolyser manufacturing capacity by region, 2021-2030



Electrolyser manufacturing capacity could exceed 100 GW per year by 2030. This would be more than enough to support planned electrolyser projects and government targets.

Hydrogen trade can kick start soon, but barriers remain

Planned hydrogen exports by year and exporting region, 2020-2030



Annual exports could reach 12 Mt of hydrogen by 2030, but off-take agreements are lagging behind. Key challenges remain in regulation, infrastructure, demand creation, value for exporters and trade rules

Repurposing gas infrastructure: opportunities and challenges

Selected options to repurpose natural gas infrastructure for hydrogen and ammonia

Infrastructure	Option	Advantages	Disadvantages
Gas pipelines	Full repurposing to hydrogen	Lower costs than new pipelines	Technical feasibility depends on pipeline material
	Build new hydrogen pipeline	Optimal material choice and design for hydrogen	Higher costs than repurposing
LNG import terminals	Repurpose for LH₂	Use of existing site and civil works	Complete replacement or significant modification of key equipment, e.g. storage tank, pipes
	Design new LH₂ terminal for initial LNG use	Key equipment (storage tank, pipes) can be used for LNG	No experience with LH ₂ storage tanks at the size of LNG ones
	Repurpose for ammonia	Storage tank and piping can be used	Heavier weight of ammonia limits maximum capacity of storage tank
	Design new LNG terminal to be ammonia-ready	Lower repurposing costs compared to standard LNG terminal design	Heavier weight of ammonia requires stronger foundation for tank and pipe support

1. Move from announcements to policy implementation
2. Raise ambitions for demand creation in key applications
3. Identify opportunities for hydrogen infrastructure & ensure that short-term actions align with long-term plans
4. Intensify international cooperation for hydrogen trade
5. Remove regulatory barriers

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Northwest Europe Hydrogen Monitor

Presented by Gergely Molnar, IEA

April 25th, 2023

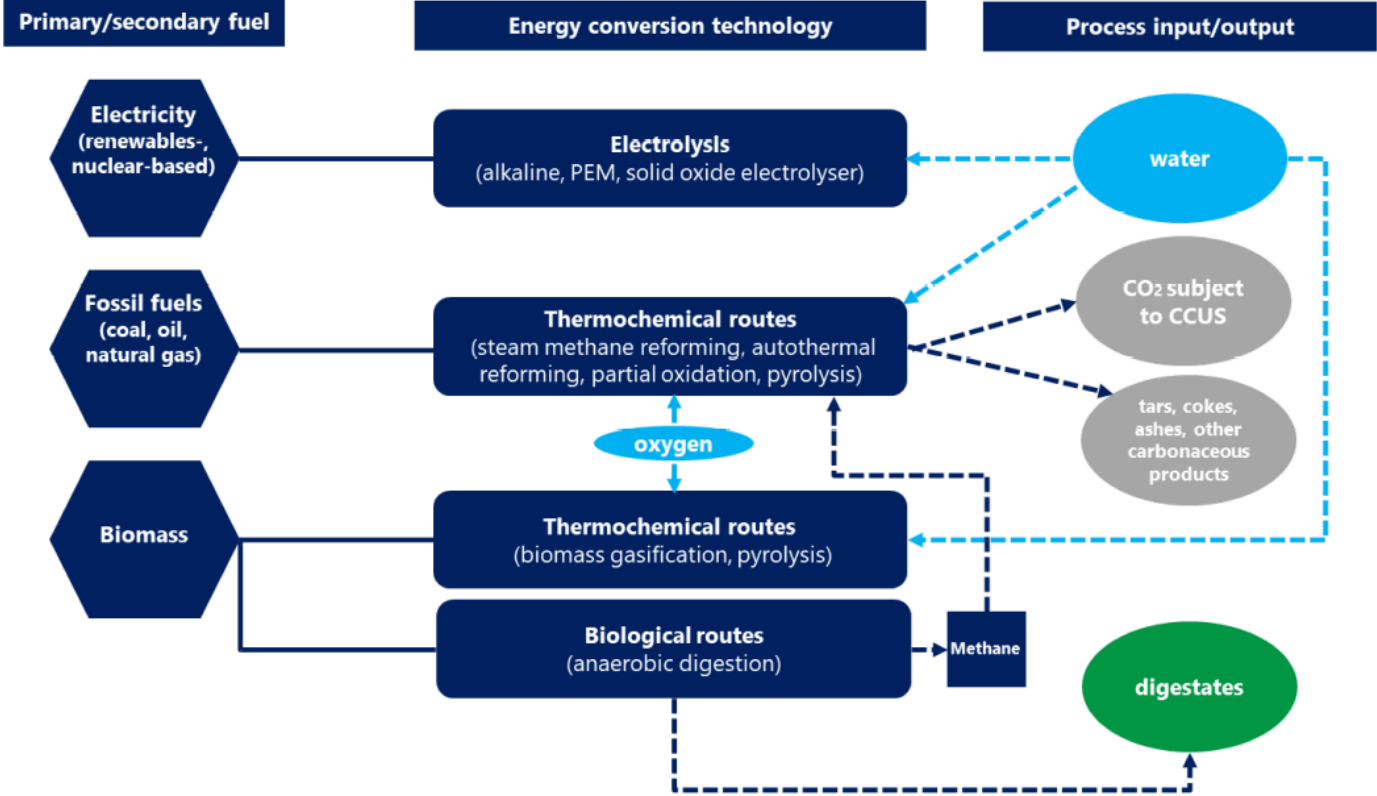


Northwest European Hydrogen Monitor

Gergely MOLNAR, Gas Analyst

Clean Energy Solutions Centre webinar, 25 April 2023

Low-emission hydrogen: defining production routes

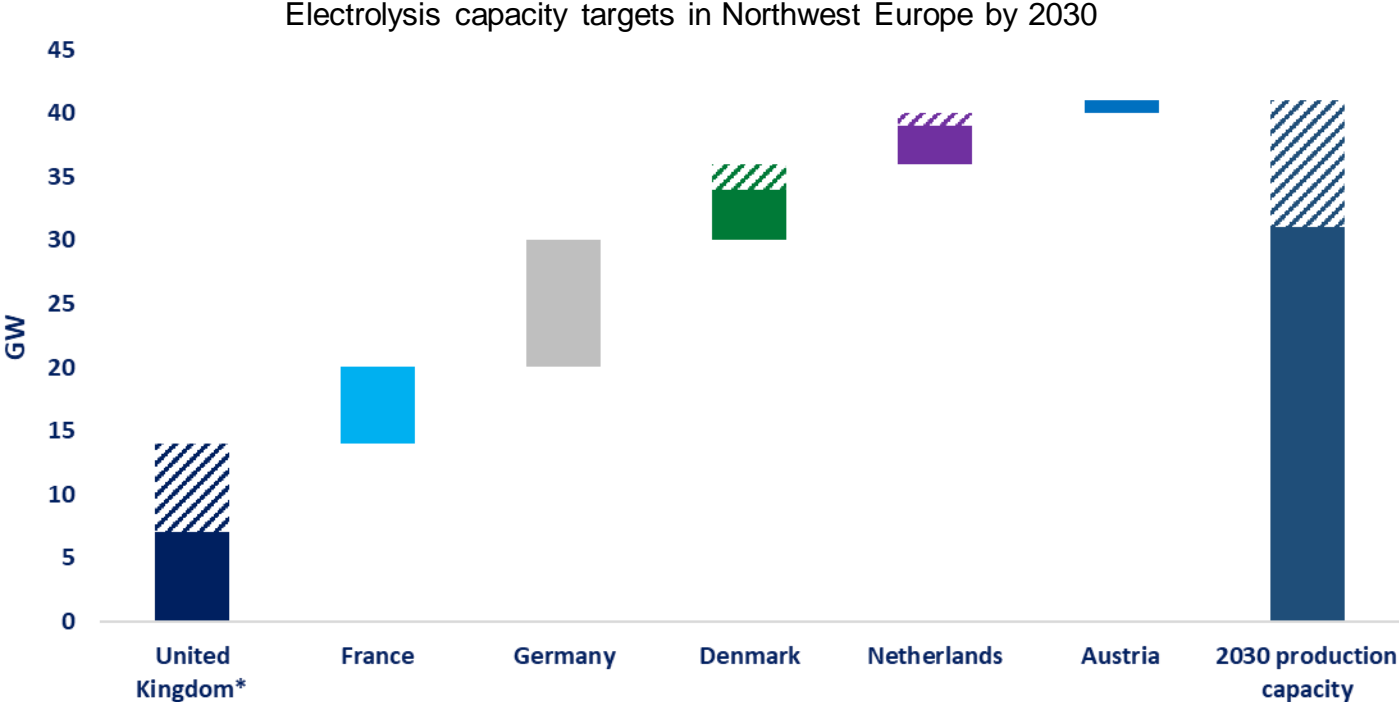


Most of Northwest European countries adopted hydrogen strategies

Hydrogen strategies and roadmaps adopted in Northwest Europe
(2020 – 2023)



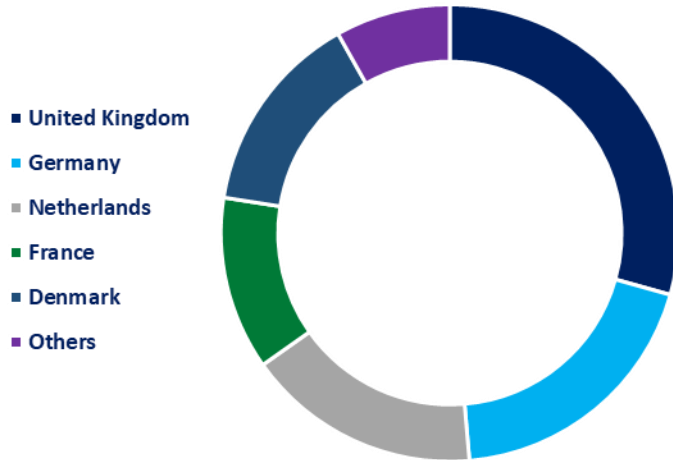
Northwest Europe targets 30-40 GW of installed electrolysis capacity



The majority of the countries adopted production targets for electrolytic hydrogen, while Norway opted for a technology neutral approach.

The pipeline of projects translates into 14 MT/y capacity by 2030

Planned low-emission hydrogen capacity by country (2030)



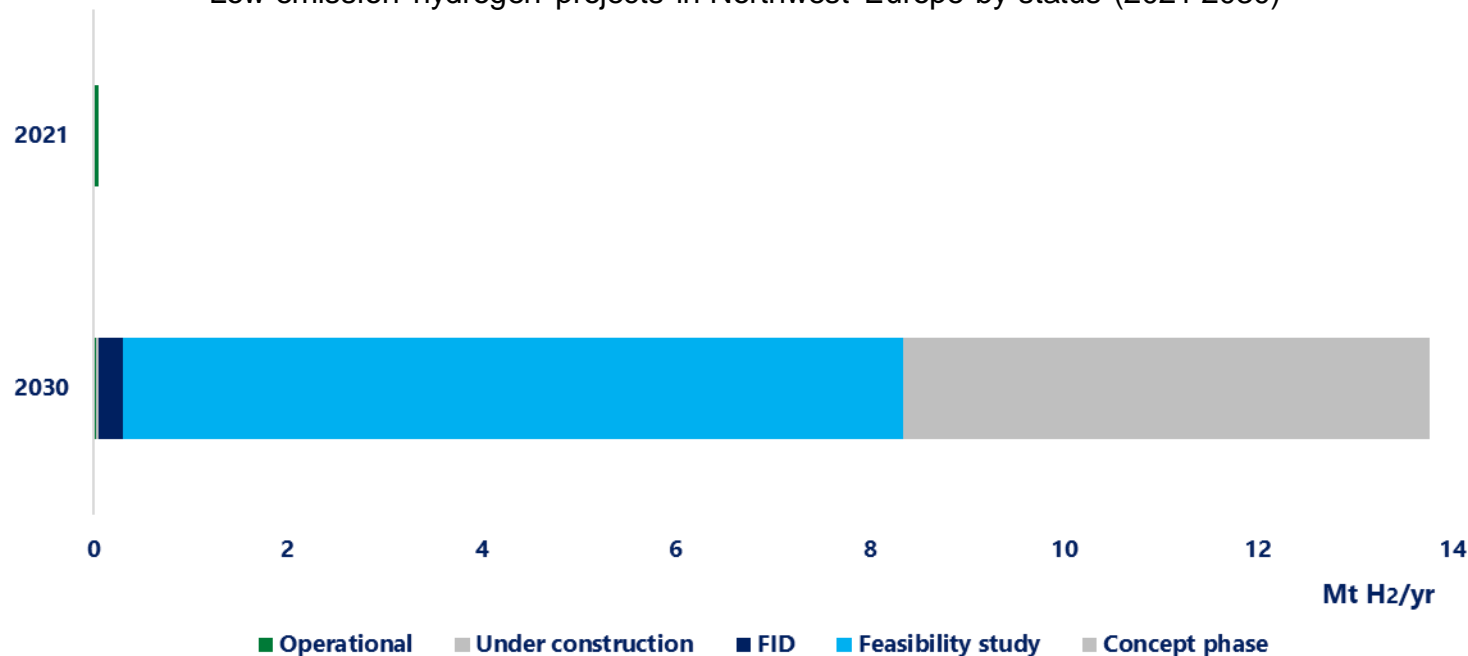
Planned low-emission hydrogen capacity by country (2030)



The United Kingdom, Germany and the Netherlands could account for almost 70% of total low-emission hydrogen production capacity, with electrolytic hydrogen taking the lead.

The majority of low-emission hydrogen projects remain tentative

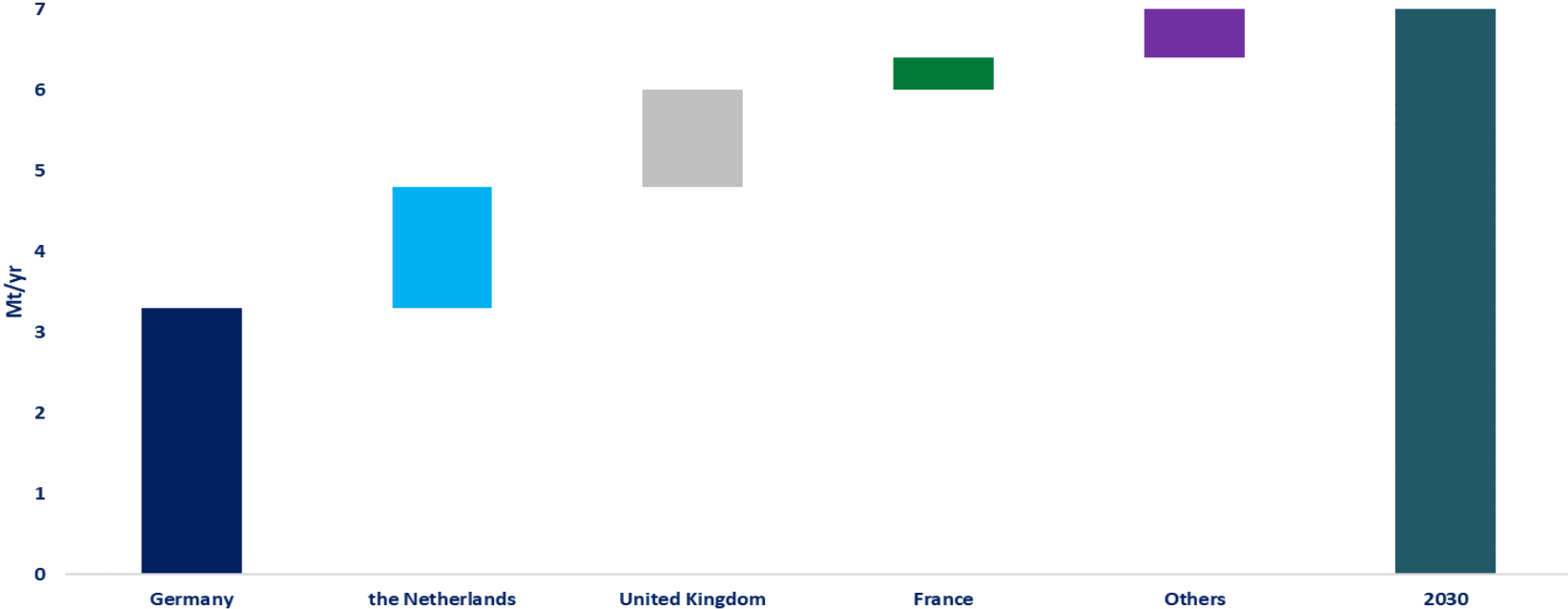
Low-emission hydrogen projects in Northwest Europe by status (2021-2030)



Over 95% of low-emission hydrogen projects are tentative, highlighting the importance of subsidy schemes and support mechanisms.

Demand creation will be crucial to enable market development

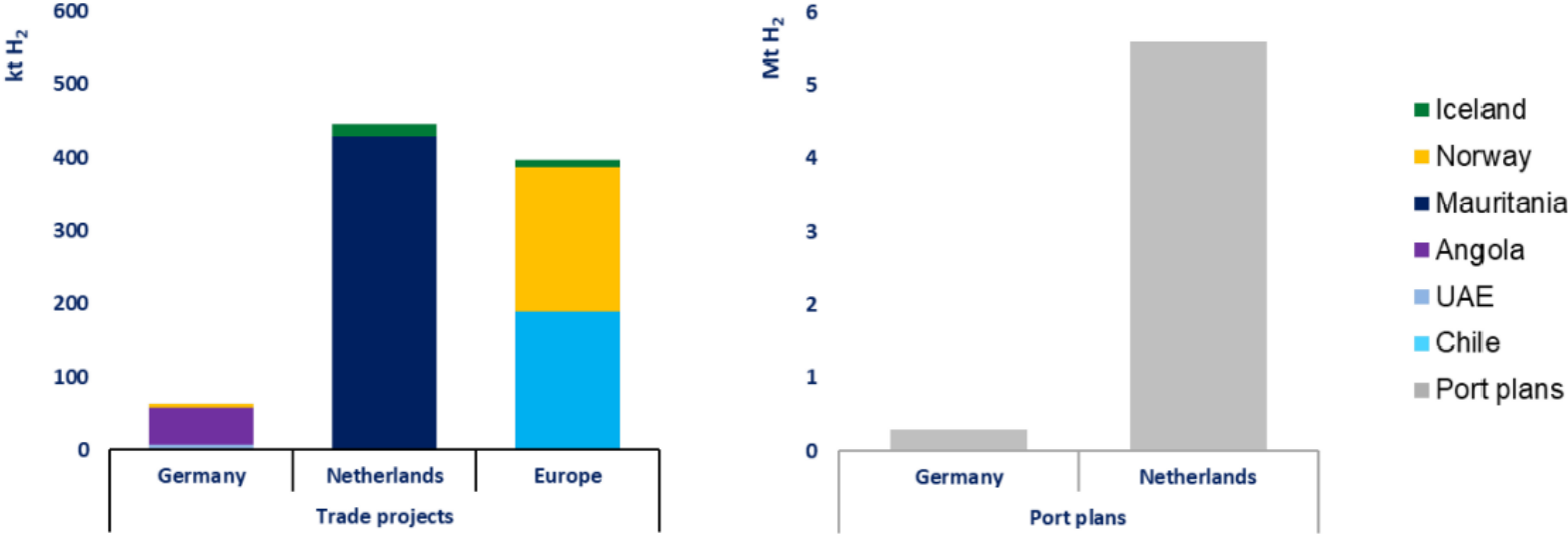
Expected low-emission hydrogen consumption by Northwest European country to 2030



Based on announced targets, Northwest Europe’s low-emission hydrogen consumption could reach close to 7 Mt H₂/y by 2030.

Northwest Europe can play a fundamental role in hydrogen trade

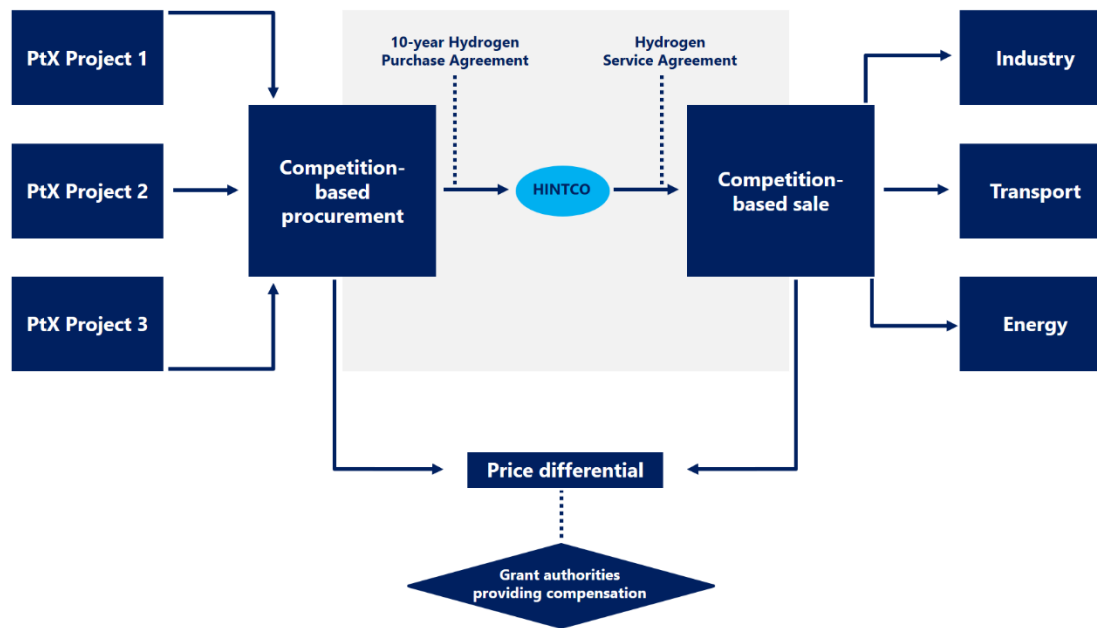
Trade projects and ports plans for hydrogen import to the Northwest European region, by 2030



The Netherlands and Germany lead the import projects development. Major ports in the Netherlands have plans for importing a combined amount of more than 5 Mt H₂ by 2030.

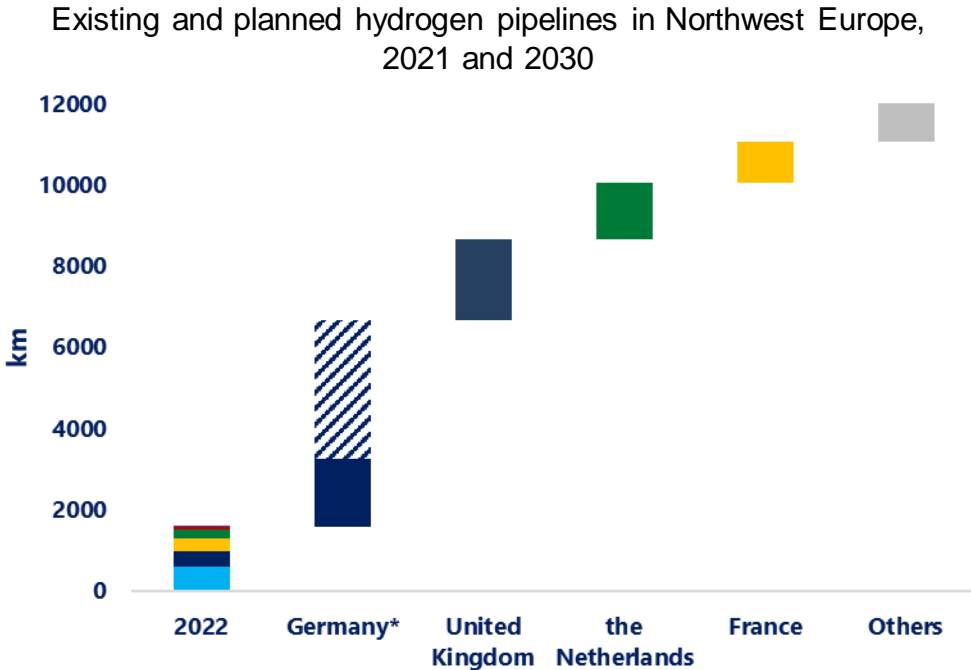
H2Global aims to derisk hydrogen investment via long-term contracts

Simplified scheme of the H2Global instrument

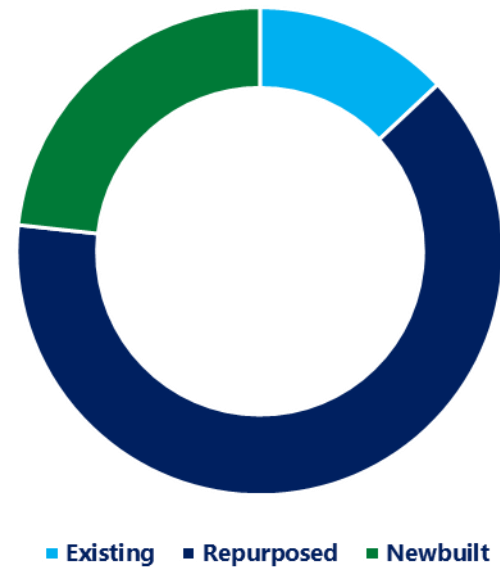


H2Global auction-based mechanism will facilitate the conclusion of long-term import contracts for low-emission hydrogen and hydrogen derivatives.

Hydrogen networks could reach over 12 000 km by 2030



Hydrogen pipelines in Northwest Europe in 2030, by origins

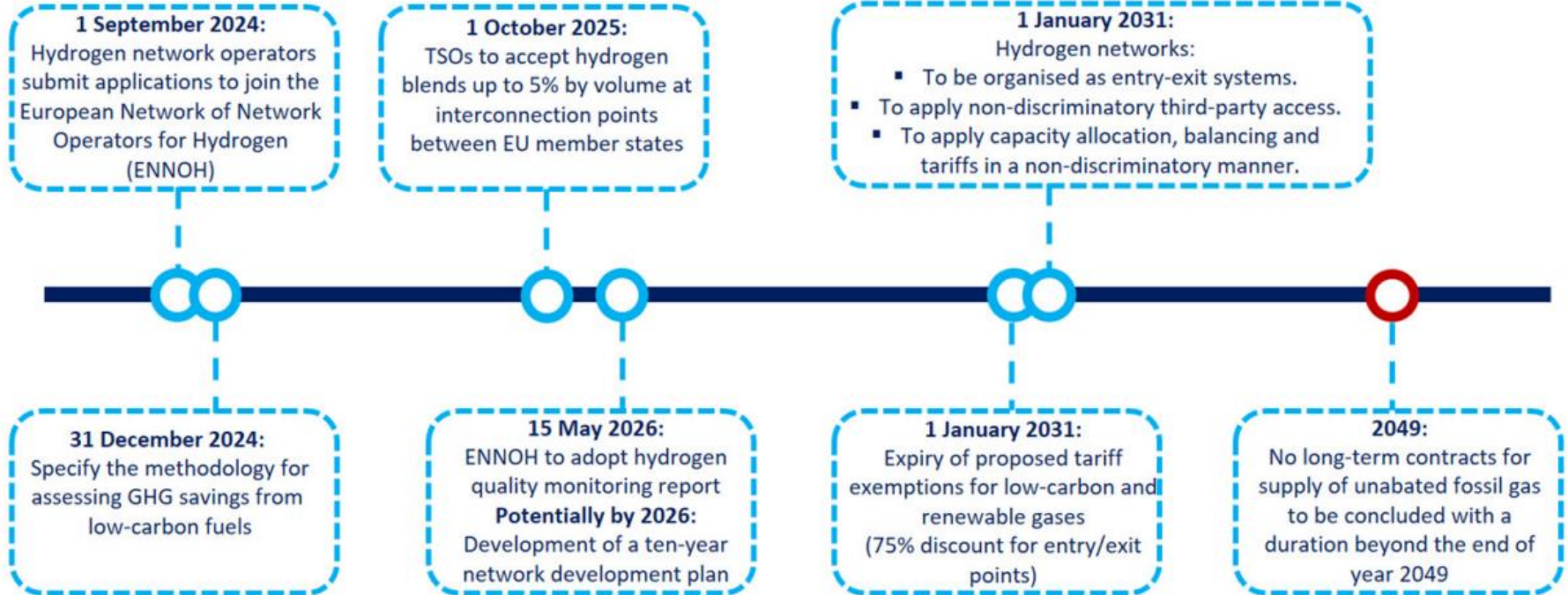


*3 400 km were included as tentative projects based on scenarios developed by TSOs.

Based on the current targets set by northwest European countries, the region’s hydrogen network could increase by almost eightfold to over 12 000 km by 2030.

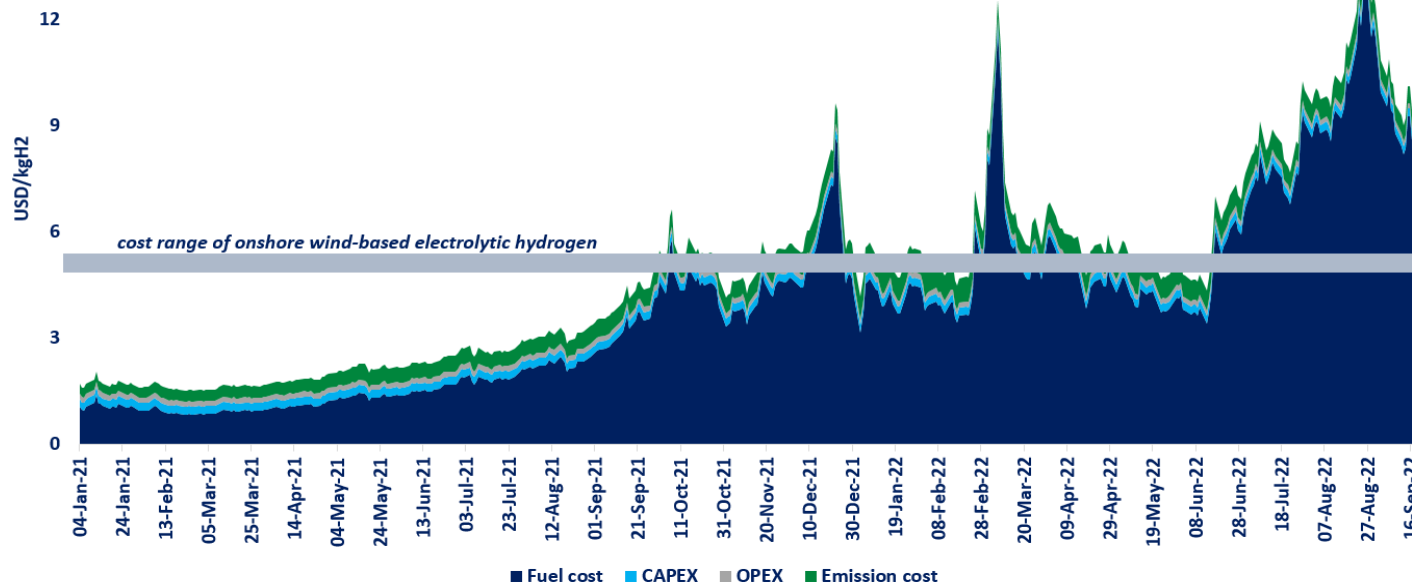
The regulatory framework for hydrogen is still nascent

The European Commission's proposed Hydrogen and Decarbonised Gas Markets Package



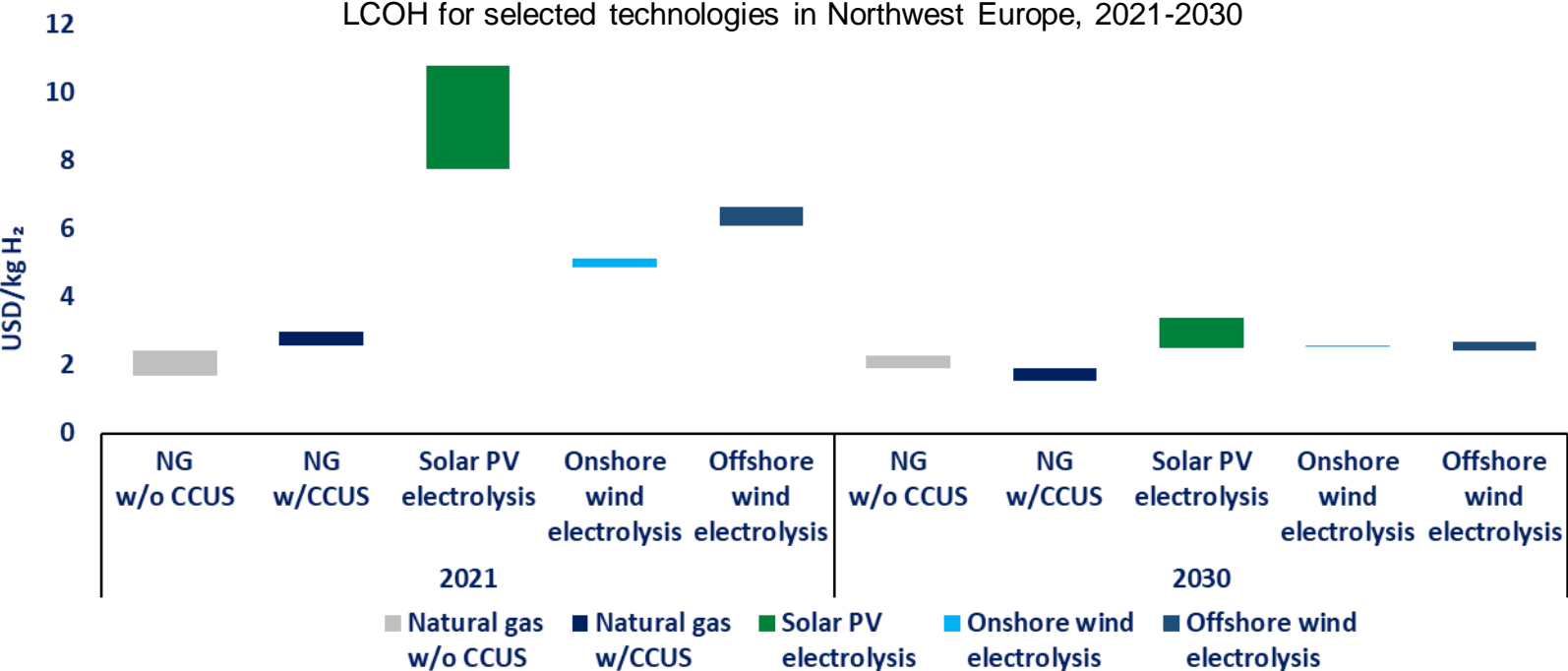
Record high gas prices eroded the cost-competitiveness of gas-based hydrogen in Northwest Europe in 2022

15 Estimated production costs of gas-based hydrogen produced via SMR without CCUS vs wind-based electrolytic hydrogen (2021-22)



The cost of unabated gas-based hydrogen rose above the estimated cost of wind-based electrolytic hydrogen in 2022 amidst the surge in gas prices to record levels.

Low-emissions hydrogen is set to become cost competitive by 2030



Our projections indicate, that renewable electrolytic hydrogen will be competitive with gas-based hydrogen by 2030, even assuming natural gas prices returning to their historic average levels.

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Thank You!