

From Grey to Green




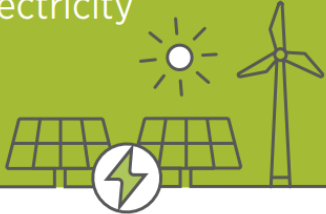
Current challenges in the green hydrogen industry

Jan-Henrik W. Kuhlefeldt, GM HydrogenPro (Tianjin) Co. Ltd.

Disclaimer

This presentation contains forward-looking statements and information, including assumptions, opinions and views of the Company or third-party sources, and are solely opinions and forecasts which are subject to risks, uncertainties and other factors that may cause actual results and events to be materially different from those expected or implied by the forwardlooking statements or information. The Company does not provide any assurance that the assumptions underlying such statements or information are free from errors nor accept any responsibility for the future accuracy of opinions expressed herein or as part of the Information, or the actual occurrence of forecasted developments.

Colors of hydrogen

Color	GREY HYDROGEN	BLUE HYDROGEN	TURQUOISE HYDROGEN*	GREEN HYDROGEN
Process	SMR or gasification	SMR or gasification with carbon capture (85-95%)	Pyrolysis	Electrolysis
Source	Methane or coal 	Methane or coal 	Methane 	Renewable electricity 

Note: SMR = steam methane reforming.
** Turquoise hydrogen is an emerging decarbonisation option.*

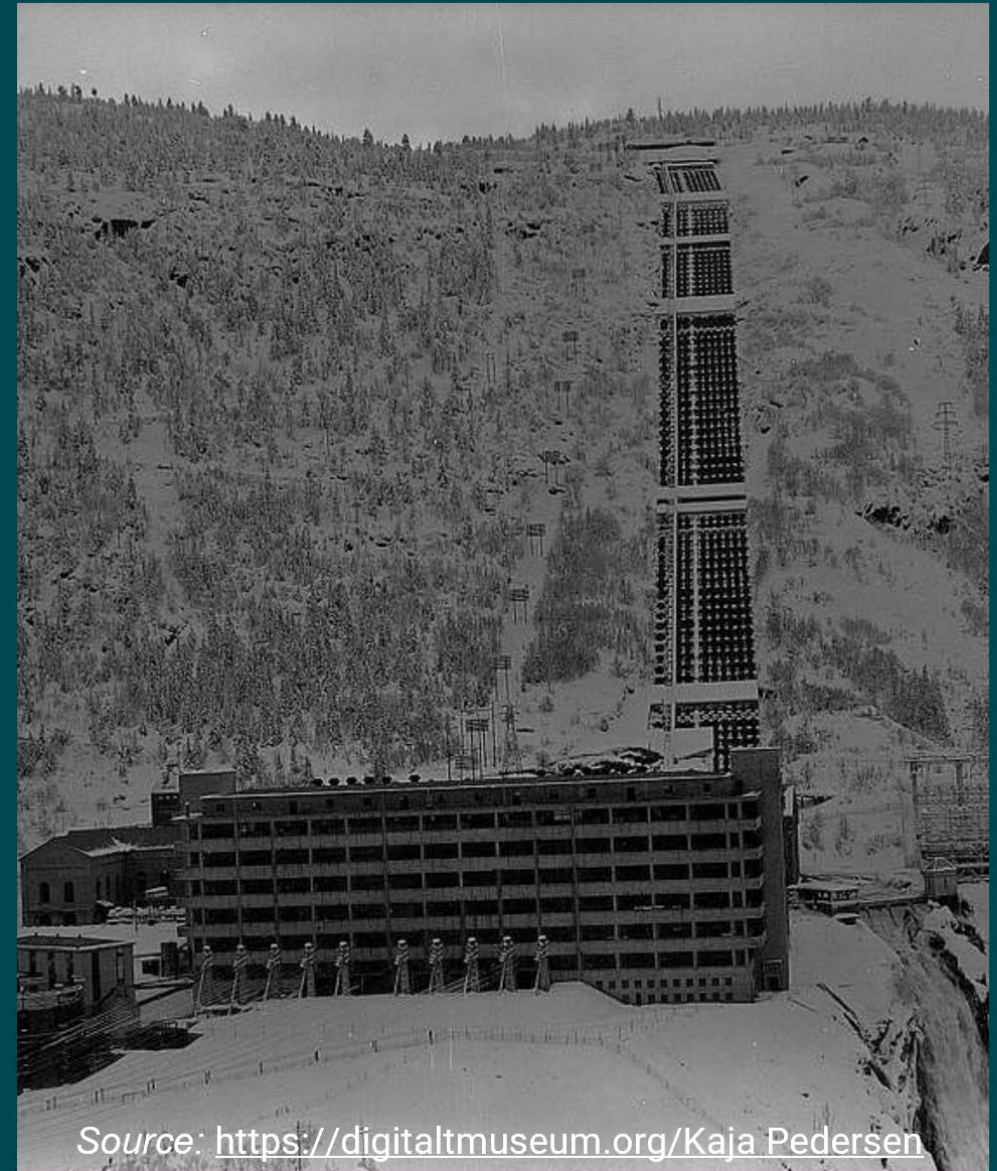
Norwegian DNA


Norsk Hydro : worlds first green hydrogen

1929: 167 MW, 37 000 Nm³/h



Source: Norsk Industriarbeider museum





HydrogenPro is a global provider of market-leading, large-scale green hydrogen technology & systems

1


THE WORLD'S LARGEST ELECTROLYSER

- › 5.5 MW single stack suitable for renewable energy input
- › A modular system that can be scaled to any size for large-scale industrial applications
- › Pressurized hydrogen ready for industrial use

2

GAME-CHANGING ELECTRODE TECHNOLOGY

- › Significant lower energy need for same H2 output
- › Reduced cooling water need
- › Reduced OPEX from H2 production



Market-leading
levelized cost
of hydrogen

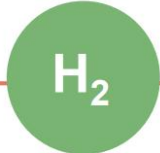
Serving industrial applications and hard-to-abate sectors



Renewables



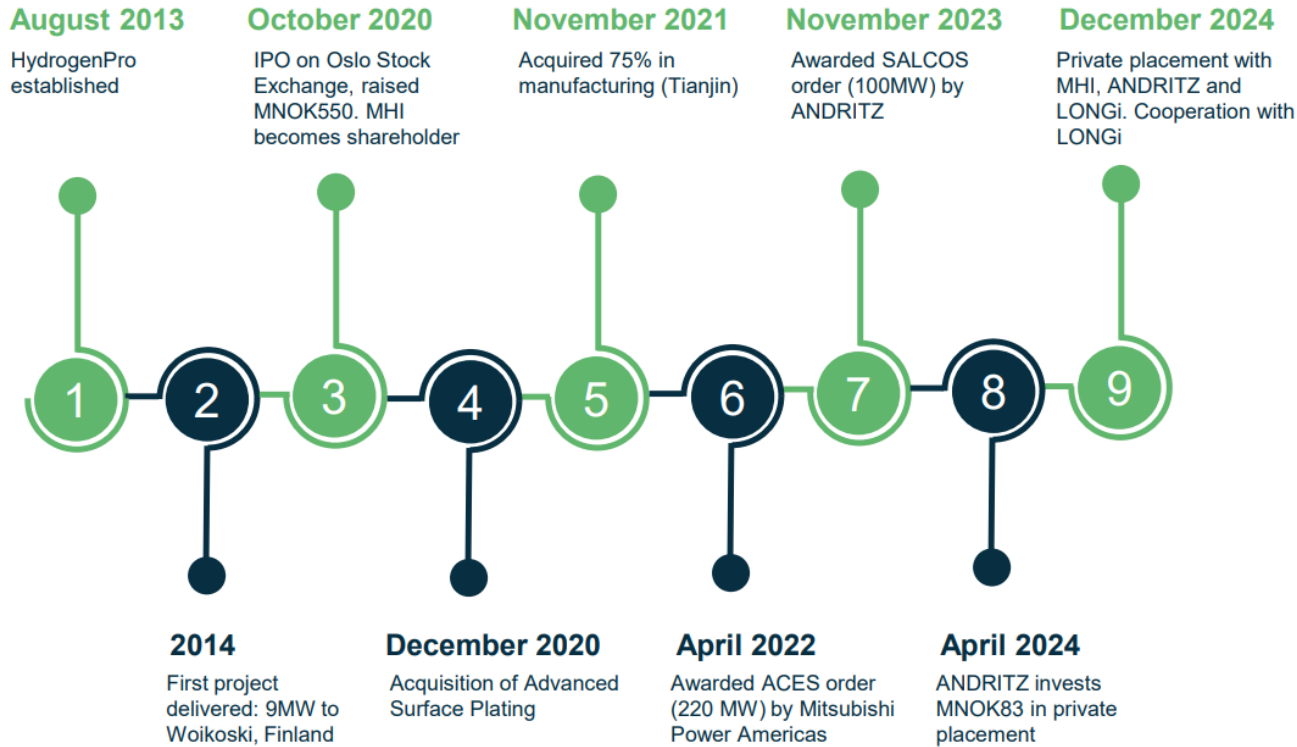
Water



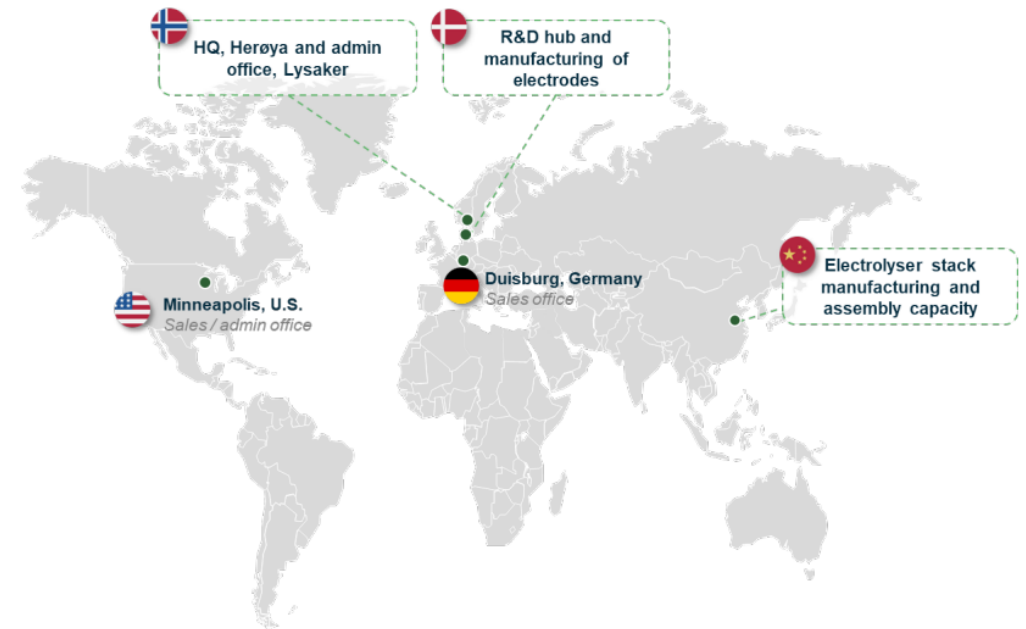
- Power-To-Gas**
- Refinery/Decarbonization**
- Synthetic fuel**
- Balancing the grid**
- Fertilizer/ammonia**
- Steel Production**

HydrogenPro has transformed into a leading OEM, delivering large projects globally

Historical milestones

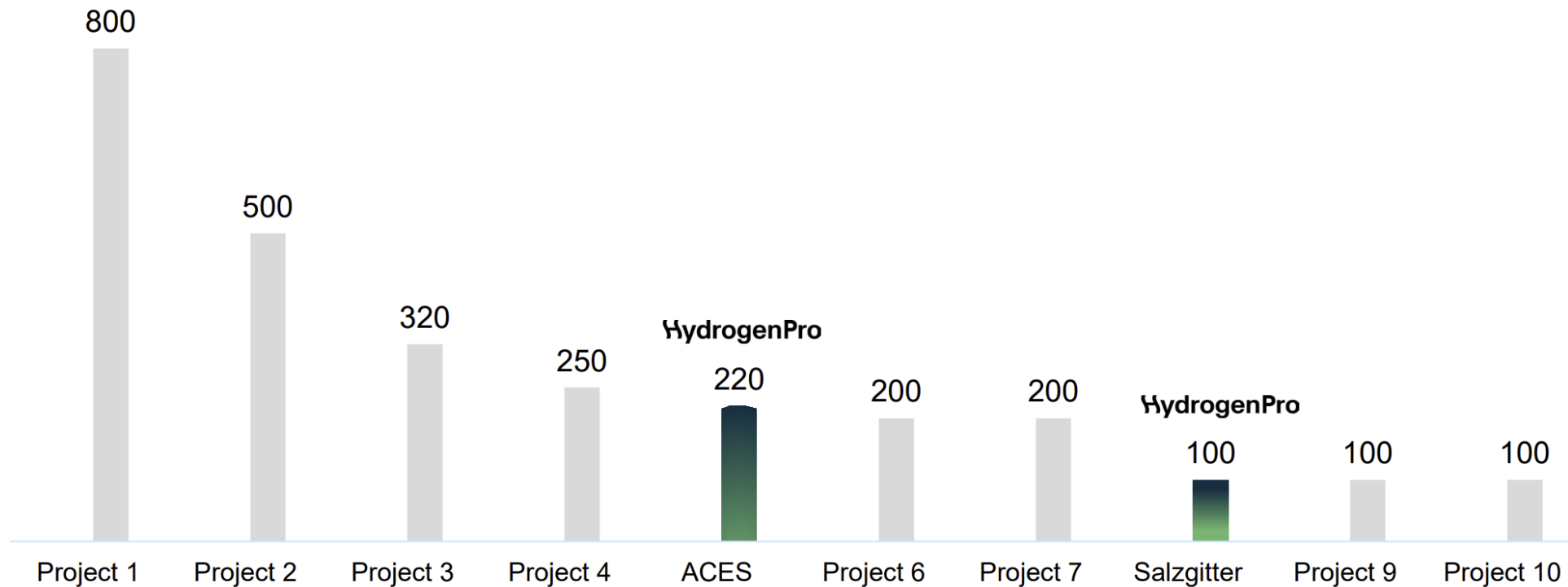


Global presence



HydrogenPro delivers 2 of the 10 largest projects (excl. China) estimated to come online in 2025

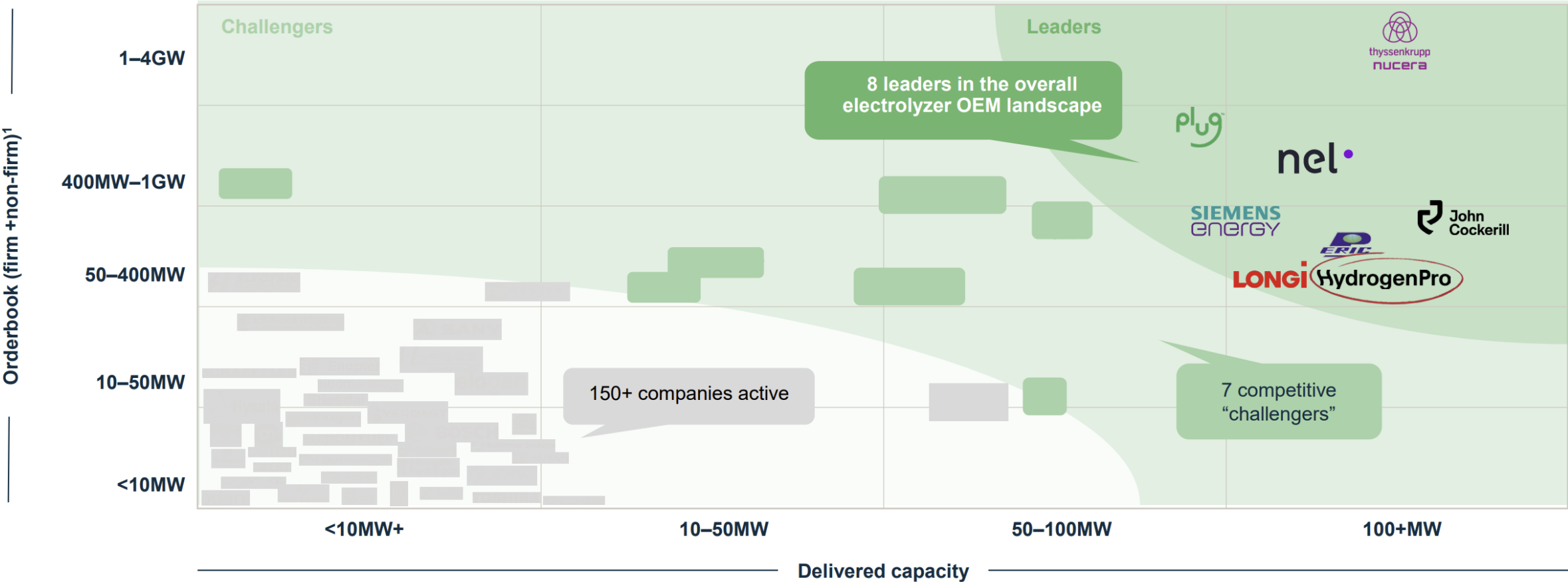
(Electrolyser capacity MW p.a.)



Source: IEA "Hydrogen production projects" database

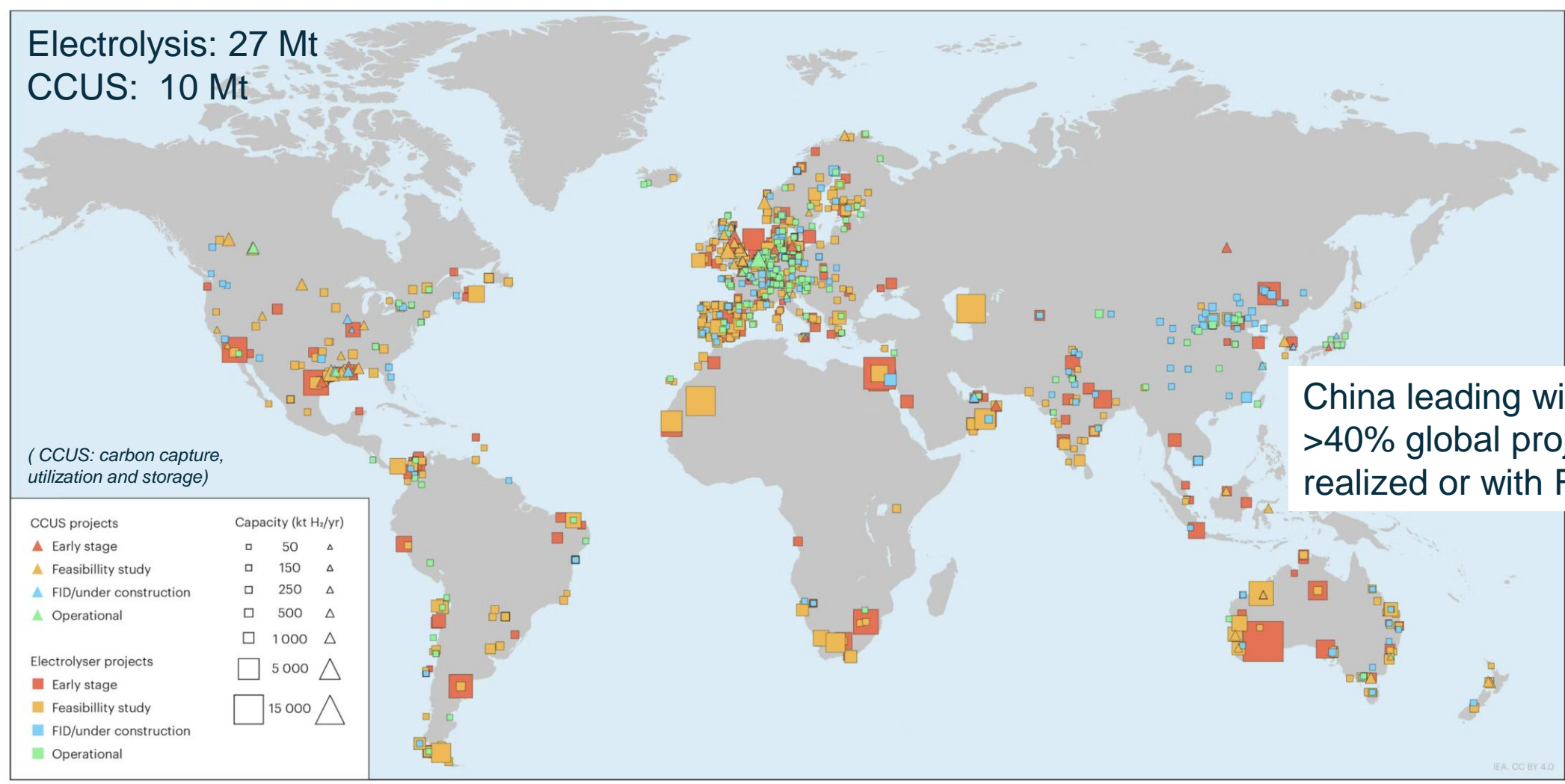
HydrogenPro – among top industry leaders

ELECTROLYZER OEM MAPPING BASED ON DELIVERED CAPACITY AND ORDERBOOK

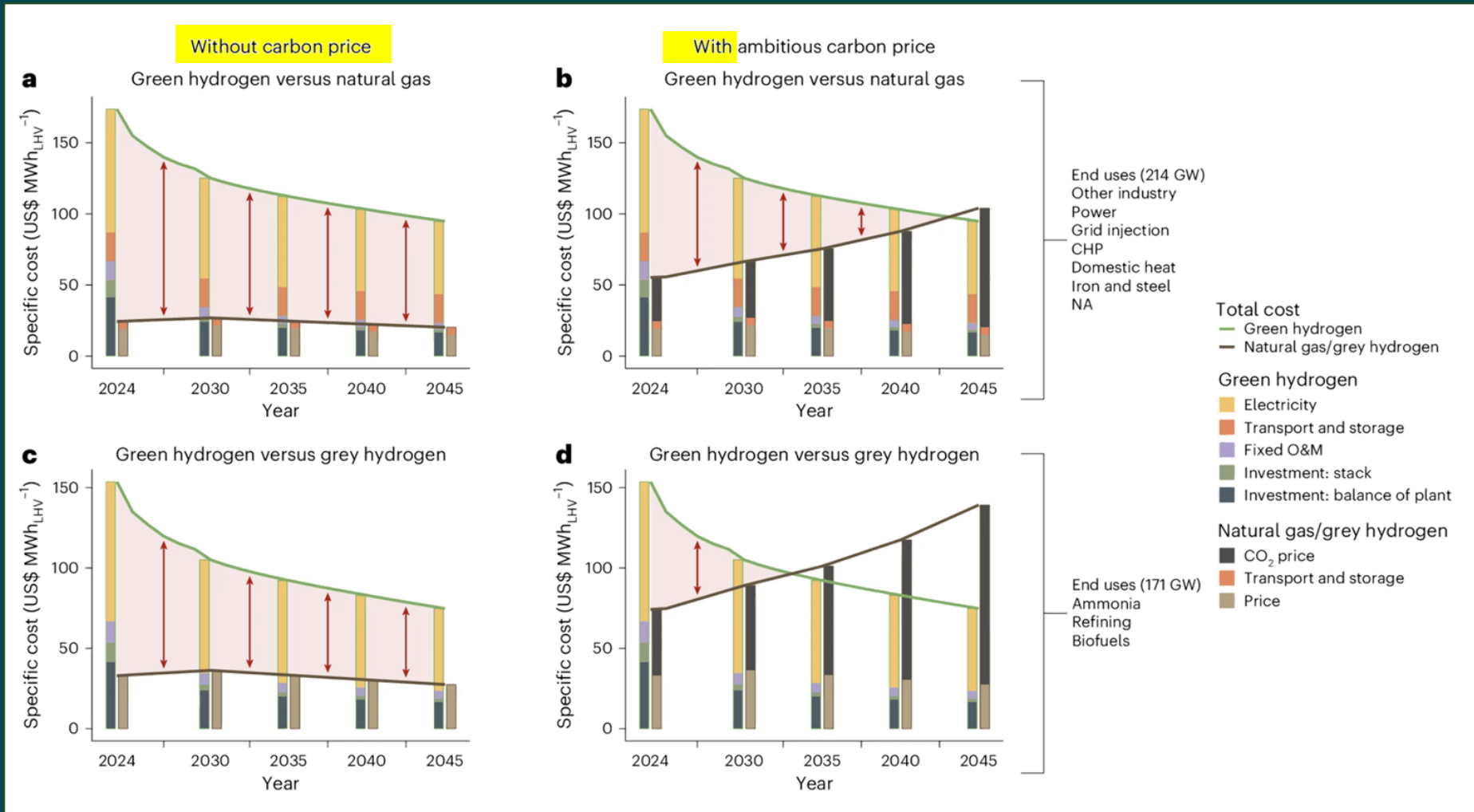


Source: VNZ Insights, Company websites, reports and press releases.
 1. Firm orderbook includes projects which have reached FID or where purchase order has been given while Non-firm orderbook includes pipeline in advanced FEED stages or where project has received funding increasing probability of realisation. Orderbook does not includes Framework Agreements & MoU; Credit to the players for the logos.

Low-emission hydrogen projects as per 2023



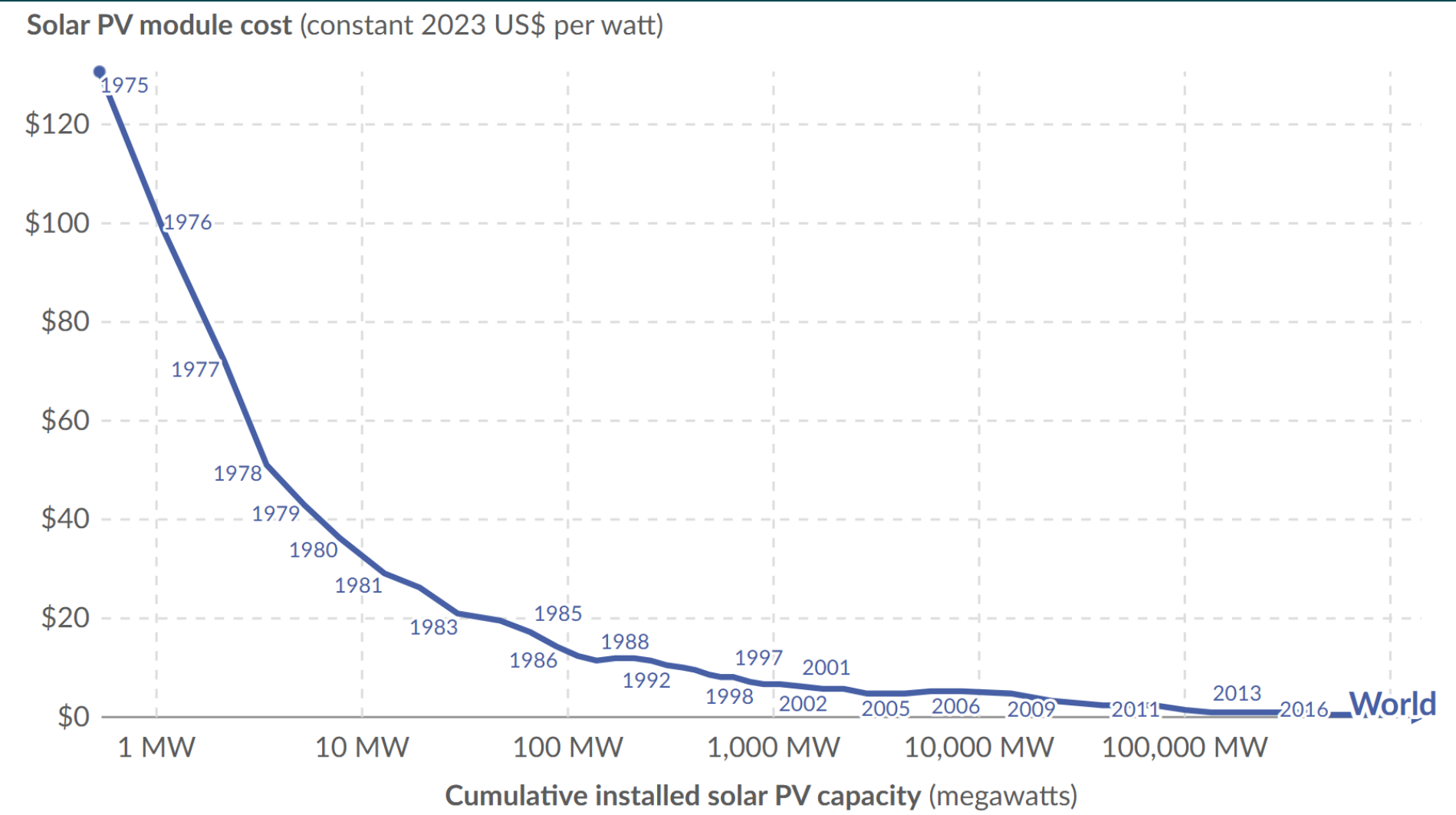
Cracking the difference



Strongly depending on govt. policies and manuf. cost development

Odenweller, A., Ueckerdt, F. The green hydrogen ambition and implementation gap. *Nat Energy* **10**, 110–123 (2025). <https://doi.org/10.1038/s41560-024-01684-7>

Cost PV



Data source: IRENA (2024); Nemet (2009); Farmer and Lafond (2016)

Outlook green hydrogen (example - one of many views)

*“ There is a widespread consensus among scientists, industry and increasingly also policymakers that **green hydrogen, produced from renewable electricity via electrolysis, is critical for reducing emissions in end-use applications that defy straightforward electrification.***

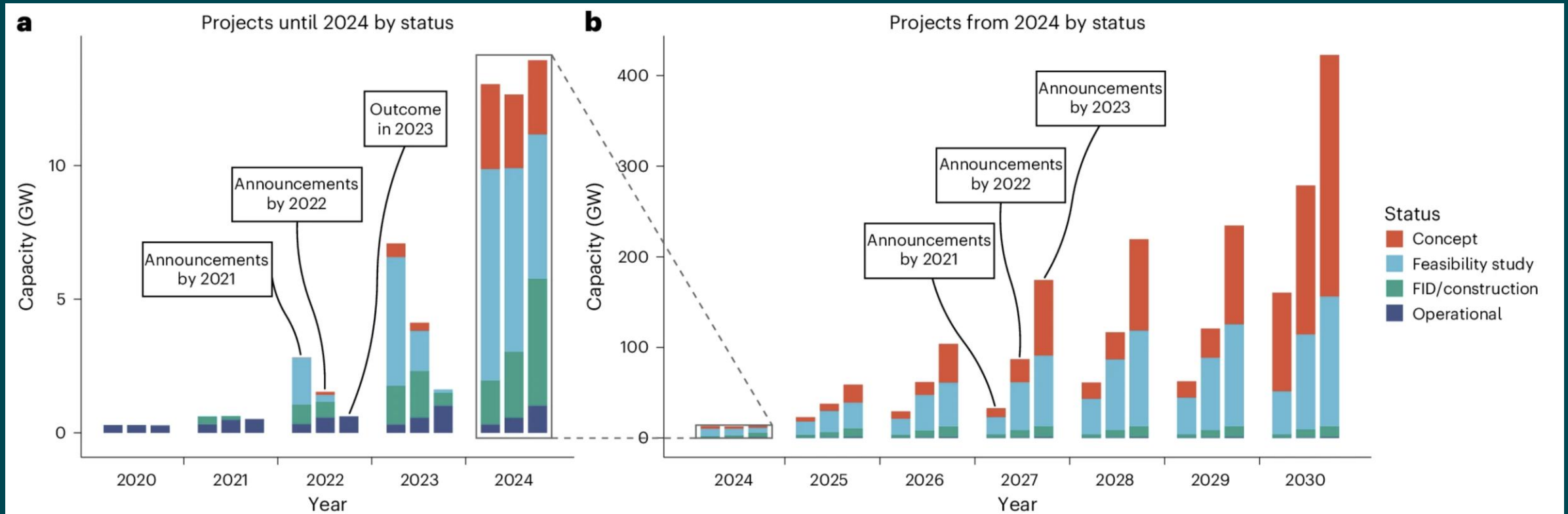
*Additionally, hydrogen is a promising candidate for **long-duration energy storage** of renewables and the **precursor to all electrofuels**, which are highly versatile yet costly.*

*Consequently, policy measures to stimulate the ramp-up of the hydrogen market are gaining momentum as more than **40 governments have already adopted hydrogen strategies.***

Prominent examples are the supply-side subsidies implemented through the the US Inflation Reduction Act and the EU Hydrogen Bank:

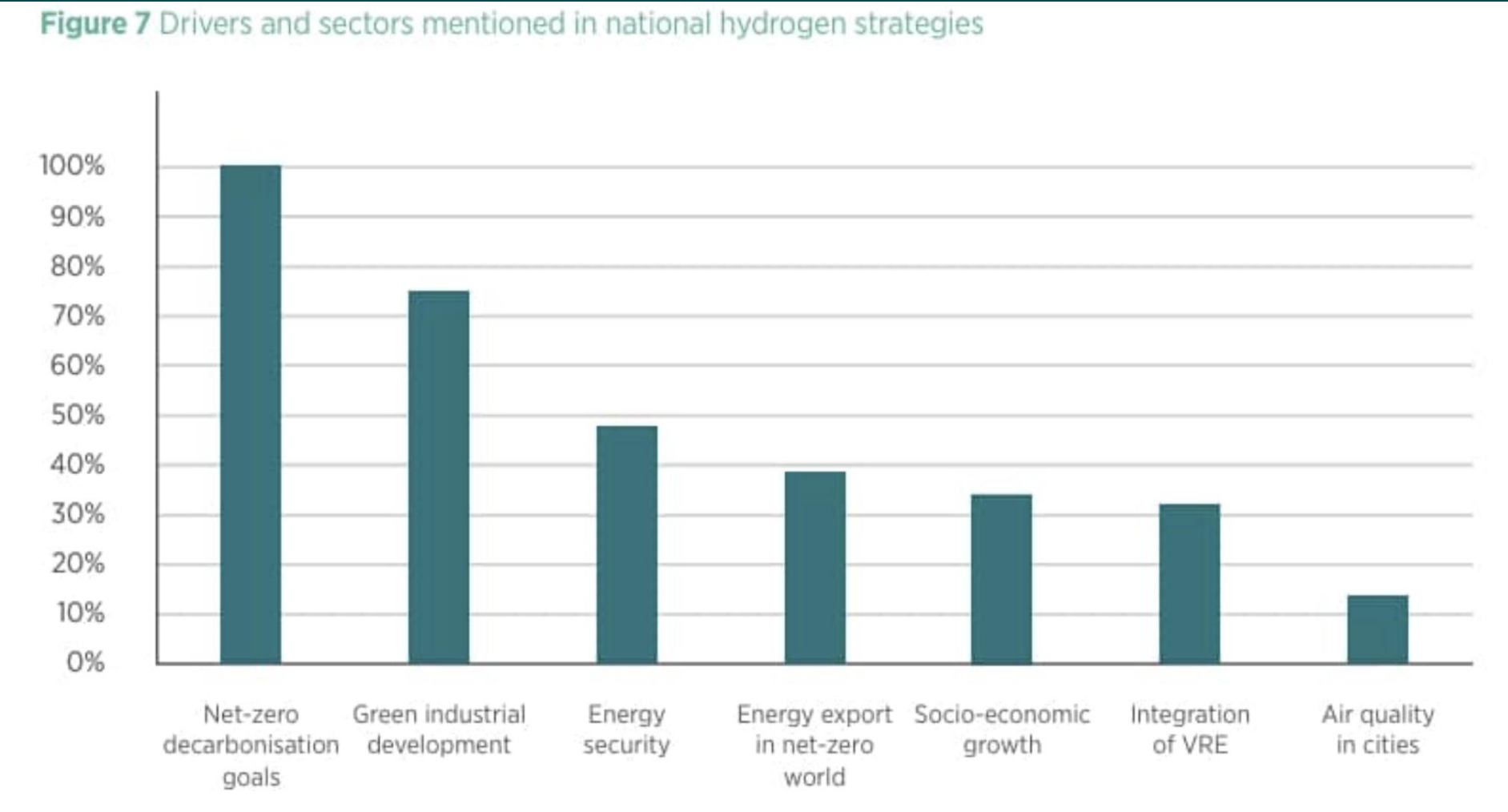
*Such policy support is urgently required: to meet the median ambition in **1.5 °C scenarios**, namely, 350 GW by 2030, **green hydrogen production needs to grow 380-fold**, more than doubling each year. However, **implementation is not going according to plan.**”*

Outlook



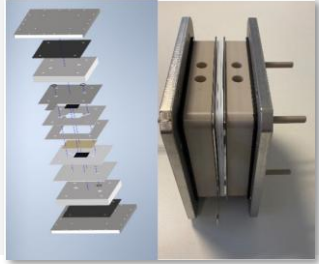
Odenweller, A., Ueckerdt, F. The green hydrogen ambition and implementation gap. *Nat Energy* **10**, 110–123 (2025). <https://doi.org/10.1038/s41560-024-01684-7>

Drivers national hydrogen strategies



Development cost and cycle

BENCH SCALE



- 10-50 Watt
- 3*3 cm electrodes
- Atmospheric
- **Days**

SMALL & SINGLE STACK PILOTS



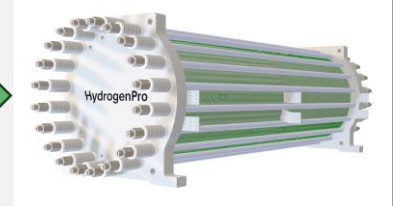
- 1 kW
- 25 cm electrodes
- Pressurised
- **Weeks**

MEDIUM-SIZED STACKS PILOT



- 10 kW
- 50-60 cm electrodes
- Pressurised
- **Months/years**

FULL SIZE & STACK PILOT/COMMERCIAL



- >5000 kW
- 188 cm electrodes
- Pressurised
- **Months/years**



(next slide)

Joint full-scale validation program with ANDRITZ

Purpose

- › Validate stack performance and operating conditions for the SALCOS project including new design improvements to reduce shunt currents and 3rd gen technology

Location

- › Herøya, Norway

Equipment

- › One stack w/ 50% 3rd gen technology and gas separator + Coriolis measurement (gas production), continuous cell voltage monitoring, pressure drops, temperatures, pressure sensors etc.

Status and next steps

- › Stack assembled by ANDRITZ in Erfurt
- › Arrived Herøya in December 2024
- › 500 hours test during Q1 2025 at Herøya, Norway



Pictures from Herøya, Norway




Current challenges and countermeasures HydrogenPro

- Market outlook uncertainty but overall, very positive (even if delayed)
- High CAPEX
- Total project execution efficiency
- High OPEX
- ESG

- Realistic view and investment diligence
- Work on projects with high realization rate
- Build EOS
- Standardized solutions
- Verified solutions
- Improved materials and design (R&D)
- Reliability
- Life-cycle view

- **Partnerships** and cooperations
- Global view

HydrogenPro's industry position validated by strong partners

			
2023 revenues¹	NOK 100 bn	NOK 350 bn	NOK 130 bn
# of employees	29,717	77,778	75,066
Ownership²	16.7%	12.3%	13.3%
Projects	SALCOS (100 MW) + one 5.5 MW project	ACES (220 MW) + two 5.5MW projects	N/A
Main focus region(s)	Europe	North America and Asia	Asia

1) CNYNOK=1.50, EURNOK=11.43, JPYNOK= 0.05728

2) After completion of LONGi transaction. Provided no other new share capital is issued

Summary

- Green hydrogen will be **one part** of the energy transition
- Future demand for green hydrogen will **grow substantially**
- Reducing costs requires **scale**
- Scale will be best built thinking **globally**
- Future growth depends on governmental **green policies**

- **China is** currently in a lead position for implementation
- **Norway** is already playing an important role – and **can play** even a bigger role

**POWERING
INNOVATION.
ENERGIZING
TOMORROW.**