Green Hydrogen

A path to net zero?
A technology, industrial, and sovereignty challenge for Europe

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John Cockerill

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Services

Industry

Hydrogen

“Meeting the needs of our time…”

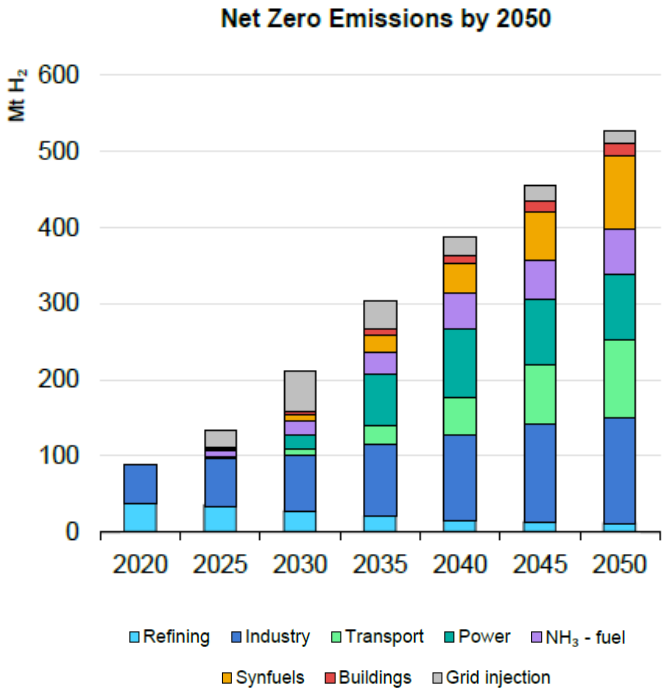
Energy & Environment

Defense

Green H2 needed for net zero but it's a long way…

Electrolyzer manufacturer stock price skyrocketed in 2021 before plumetting

However, market consensus still sees green H2 demand growing to reach net zero in the coming years.



Sources : https://www.hydrogeninsight.com/analysis/analysis-hydrogen-electrolyser-makers-standing-firm-amid-a-quintuple-whammy-of-pressures/2-1-1606626 & IEA GlobalHydrogenReview

Green H2 purpose : decarbonize hard-to-abate industries and vector for green power through 3 channels

Players and governments need to think systemic

Decarbonization of current industry (e.g. Refineries, fertilizers, ammoniac, …)

New processes (e.g. green steel, mobility, e-fuels, …)

Energy carrier (transform renewable energy for storage & transport)

Two different situations should be considered to build the H2 value chain :

1. **Downstream driven**
2. **Upstream driven**

They both come with different challenges & costs

Downstream driven : industry drives the need for green H2 in its processes

Target

Industry decarbonization & green products

Driver

Industry

Application

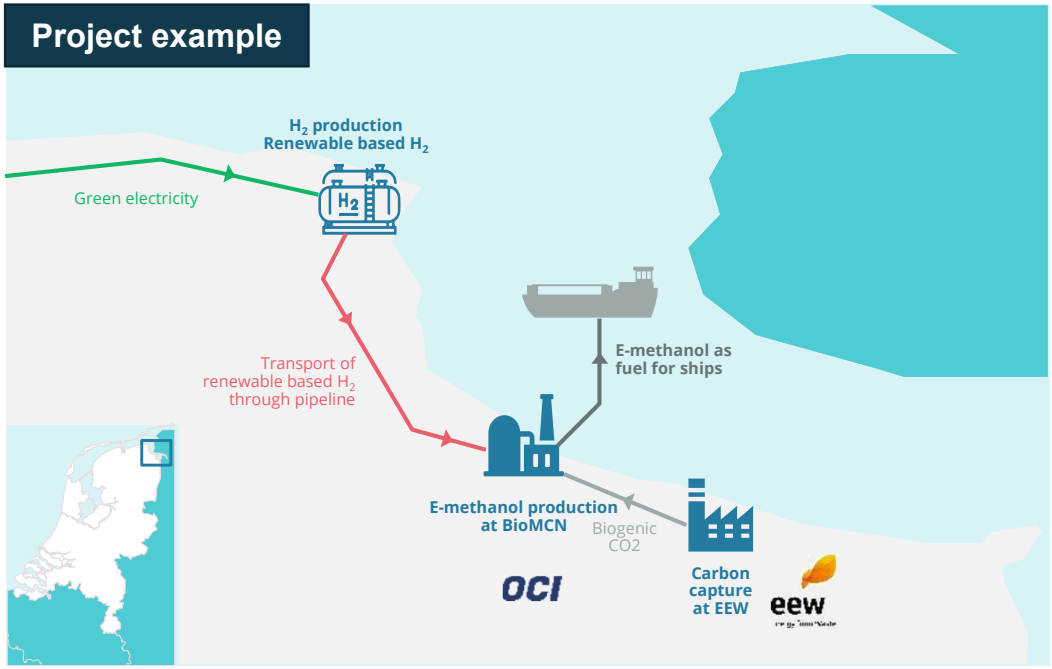
Ammonia, refinery, e-fuels,…

Enabler

Leverage local industrial ecosystems (e.g. green H2 & CO2 input for e-fuels)

Challenges

- Decarbonized electricity in sufficient volumes & low prices
- Process input infrastructures



Upstream driven : capture renewable energy in abundant areas & carry it

Target

Build a worldwide energy system for renewable energy through hydrogen & derivatives as a carrier

Driver

Geographical availability of renewable sources

Application

Industry & utilities
Maritime & transportation

Enabler

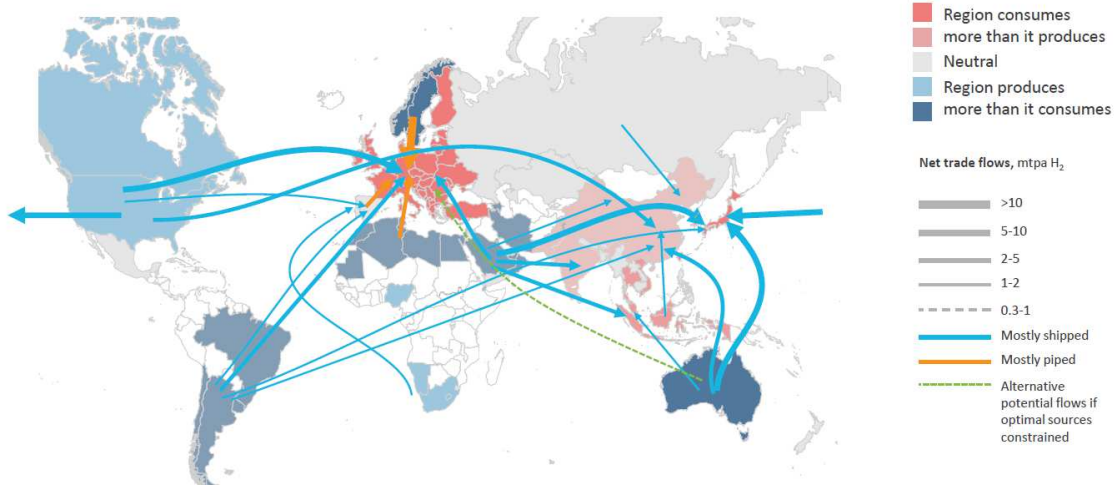
Integration upstream-downstream to enable transcontinental flows

Challenges

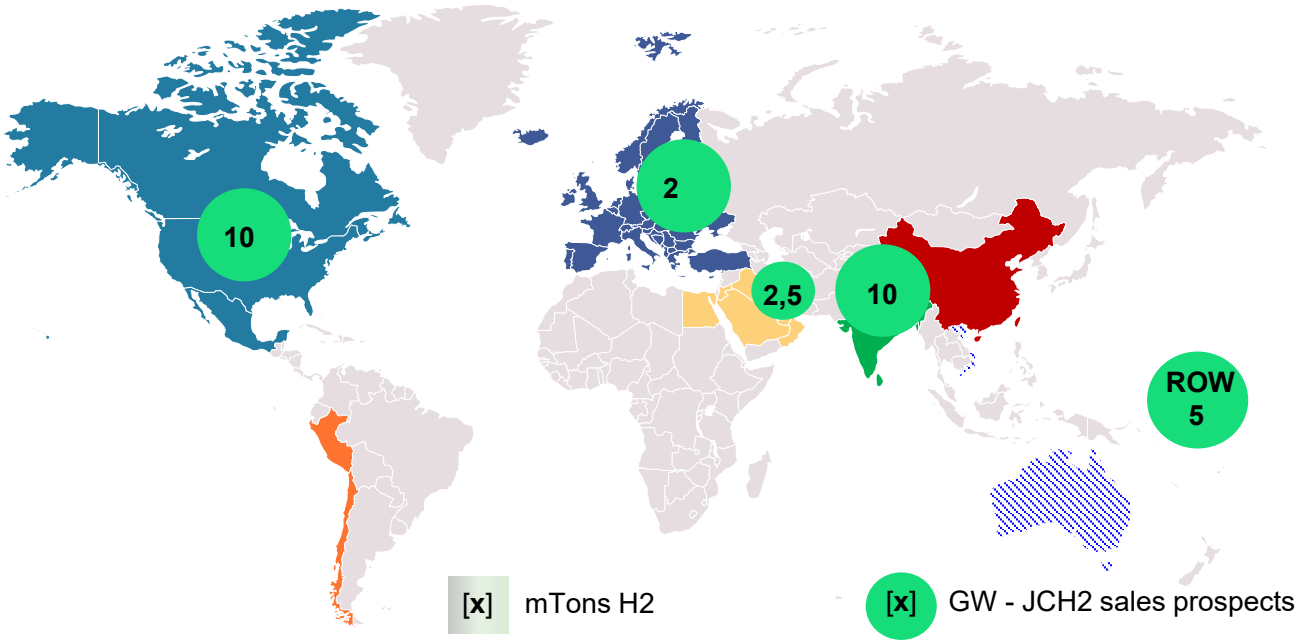
- Transport
- Re-transformation of hydrogen

McKinsey H2 flow map

Major flows of hydrogen and derivatives 2050 – Further Acceleration, mtpa H_2 equivalent



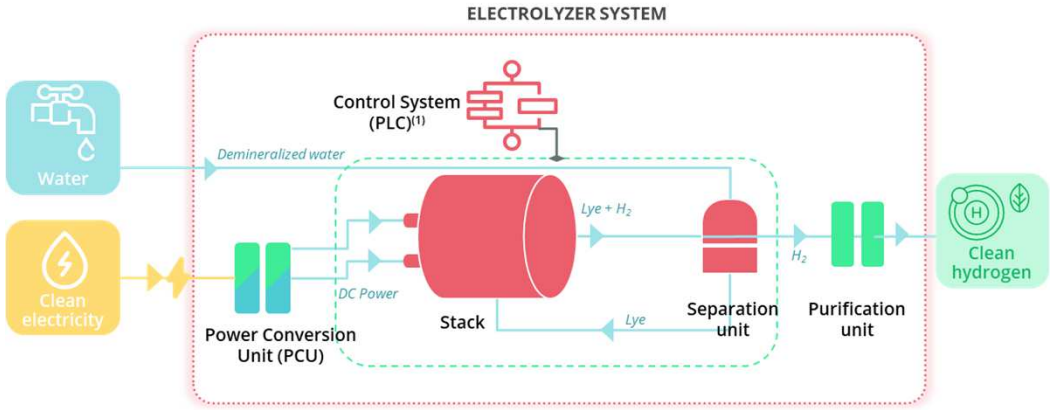
Europe shows a path, but volumes may well be elsewhere…



(1) Europe, North America, Middle-east
(2) Gigawatt scale projects
Sources: *Public Information, Hydrogen Council, McKinsey & Company (October 2022) & John Cockerill*

John Cockerill proposes a broad electrolyzer equipment offering

The challenge: bigger platforms, bigger stacks, lower costs



5+ MW stacks

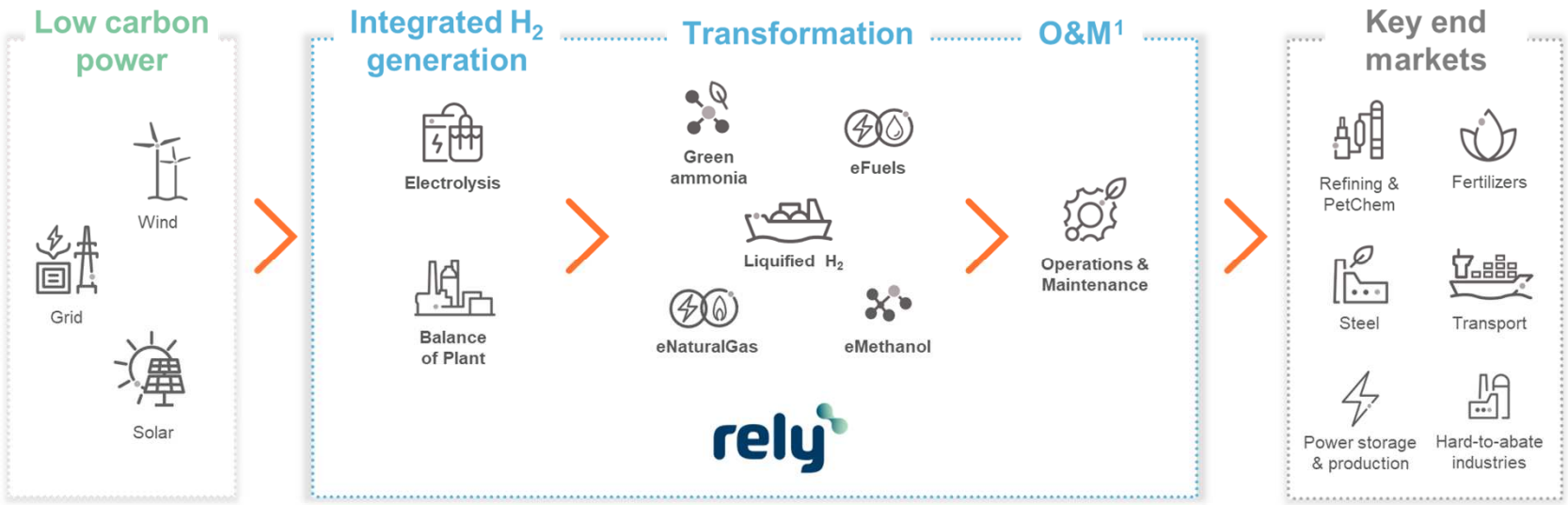
4%/second

Components manufactured internally

3rd party purchased components, specified and integrated by JCH2

Components either manufactured internally, or procured from 3rd parties

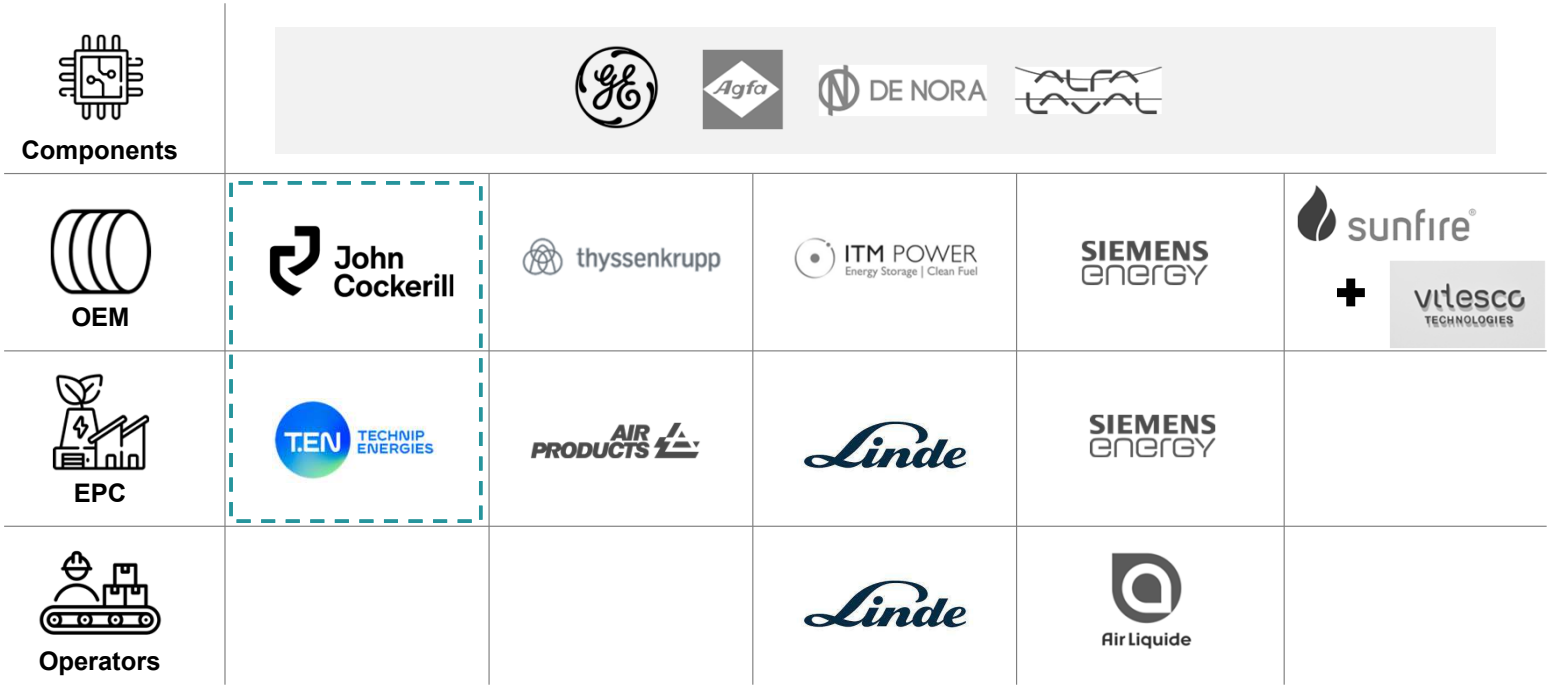
Multi GW projects « from windmill to ammonia » The example of Rely, global EPC for green H2 and Power-to-X projects



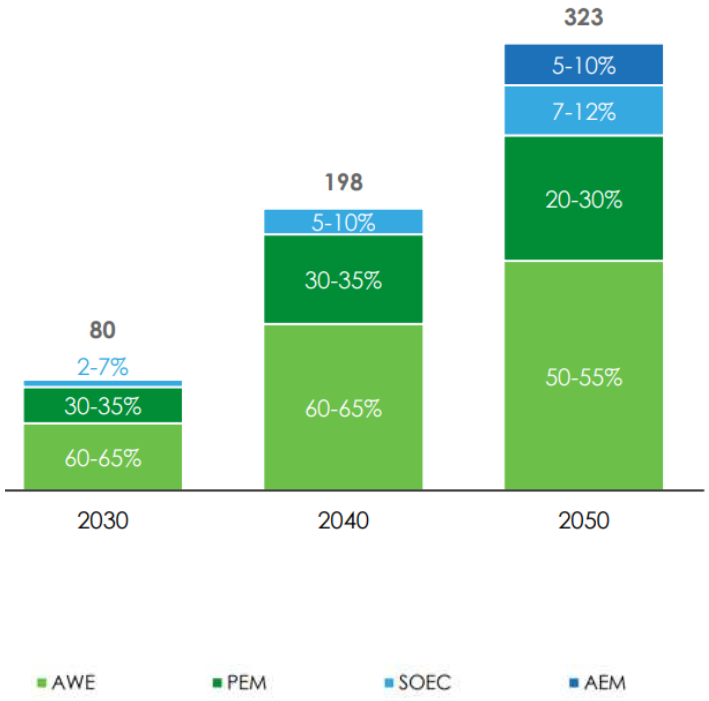
rely = 60% Technip Energies + 40 % John Cockerill

[1] Operations & Maintenance
[2] Balance of Plant

Companies are leveraging partnerships across the value chain



Alkaline electrolyser is the leading technology to produce green H2 and will remain so



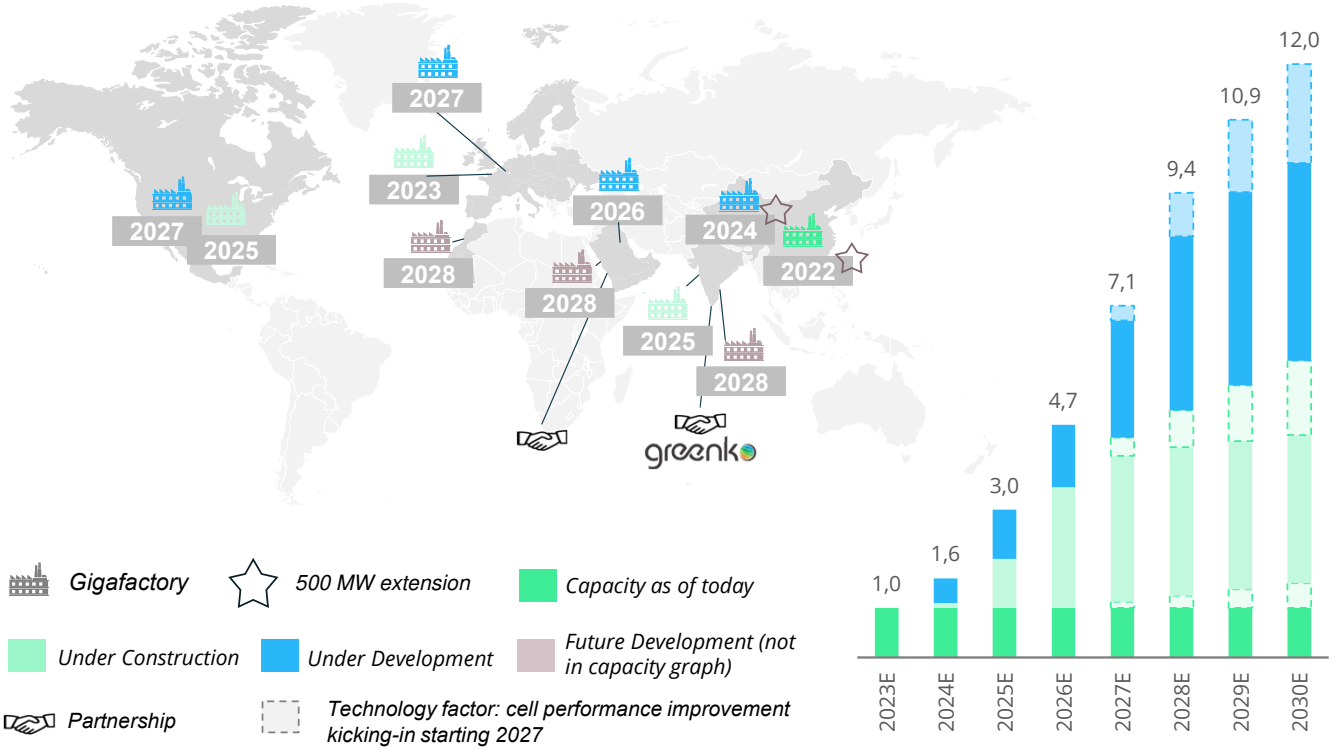
Disclaimer: GW of electrolyzers are based on IEA's net zero emission scenario
Source: Demand split - DeNora Energy transition executive report | CAPEX costs - BNEF

Europe controls all electrolyzer technologies. John Cockerill is the main western player for pressurized alkaline manufacturing

	Technology	Company	Stack capacity (MW)	Stack Pressure (barg)
1	Pressurized ALK	JC	5	15
		PERIC	5	15/30
		Longi	5	?
		Tianjin H2 Equipment (THE)	5	30
		HydrogenPro (1)	5,5	30
		Sunfire	5	30
		McPhy	1	30
	Atmospheric ALK	Thyssen Krupp	5	0
		NEL	2,3	0
2	PEM	Cummins	2,5	30
		Siemens Energy	0,8	0
		Plug	1	40
		NEL	1,3	30
		ITM	2,5	30
	SOEC	Bloom Energy	2	0
3	AEM	Hyve	Under development – production start 2027	
	AEM	Enapter	Production started but unclear volumes	
	AEM	Gen-Hy	Under development – production start 2023 (10MW)	

JC EU UK USA China

JCH2 is rolling out a multilocal manufacturing and servicing strategy



Thank you

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