Global Clean Hydrogen Perspectives: India's Pivotal Role

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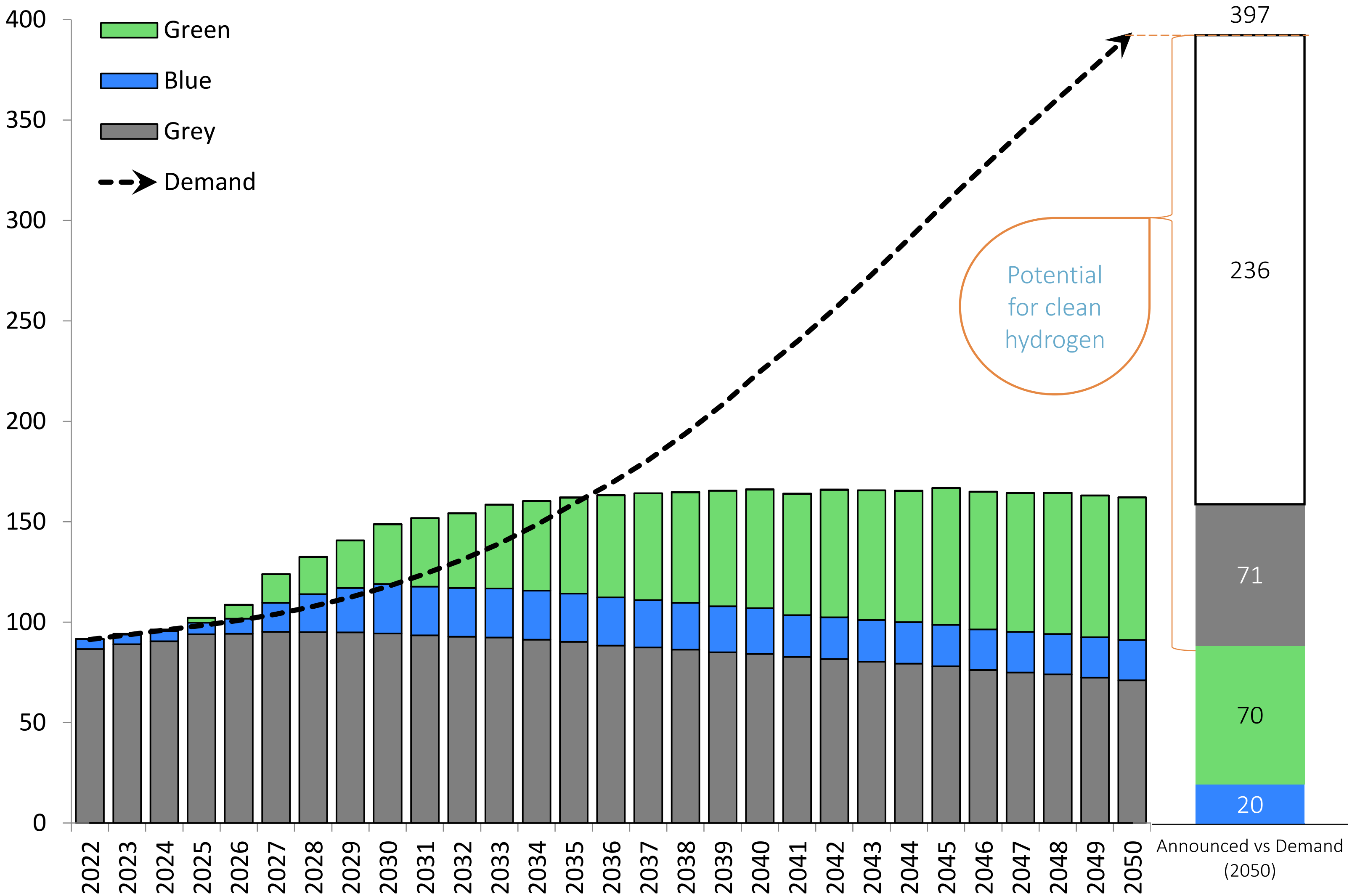
Addressing the significant supply-demand gap: A call for more clean supply announcements

Million tonnes (Mt) of hydrogen – Base case 2050

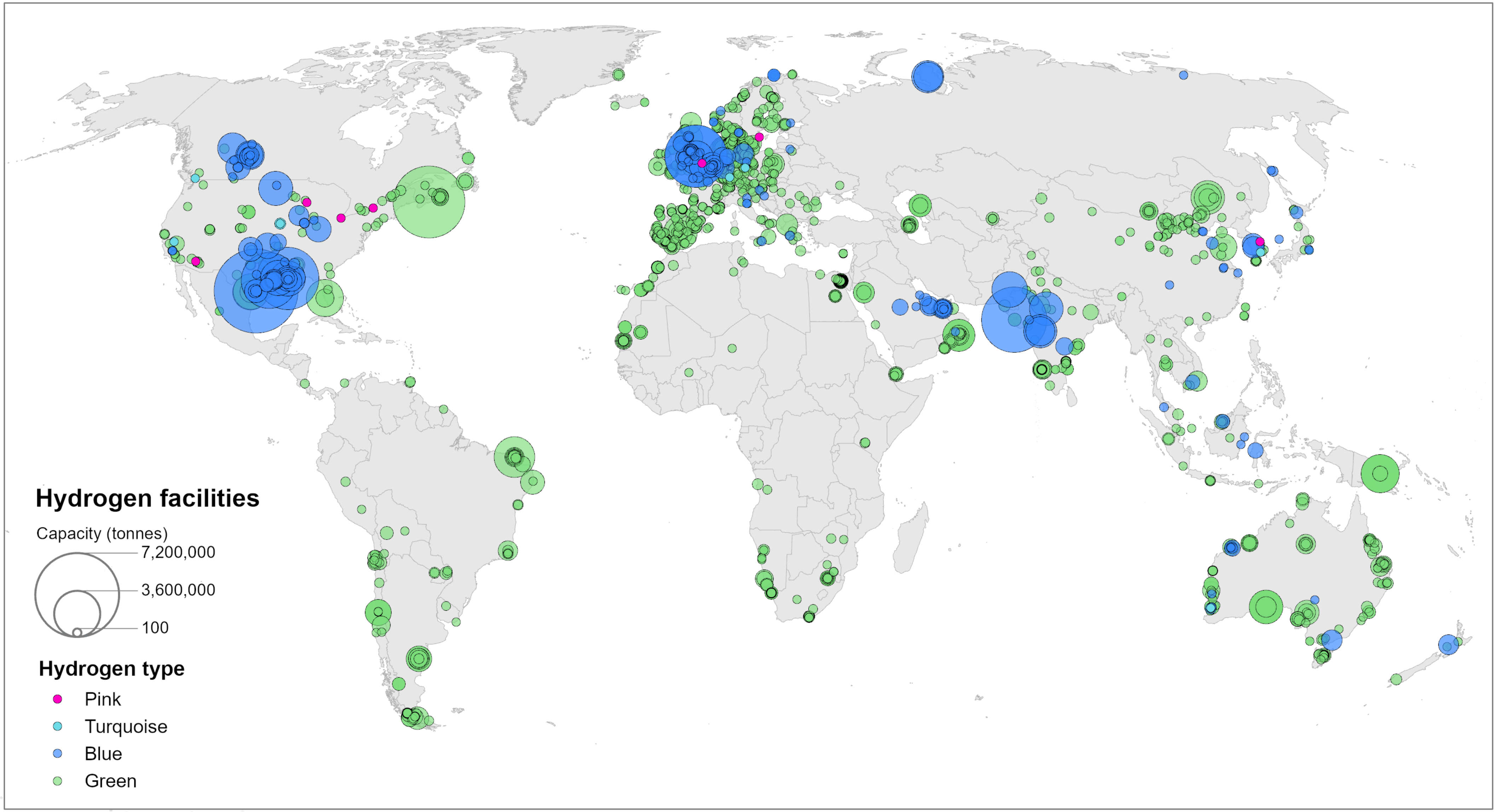


Key Insights

- Hydrogen and its derivatives' demand in conventional applications to expand to power generation, shipping, steel, transport and others.
- Demand of hydrogen set to grow to 400 MMt annually by 2050 if we are to meet 1.8 deg scenario. Unrisked clean hydrogen pipeline has already reached 90 MMt but it needs more investment and expansion to meet this demand.
- Countries with renewable potential emerging into limelight for a new world order of energy.
- Long term of 2050 scenario would favor green hydrogen, but this requires enormous growth in the electrolzyer manufacturing capacity to meet more than 250 MMt of annual production.

Source: Rystad Energy HydrogenCube, Oct 2023

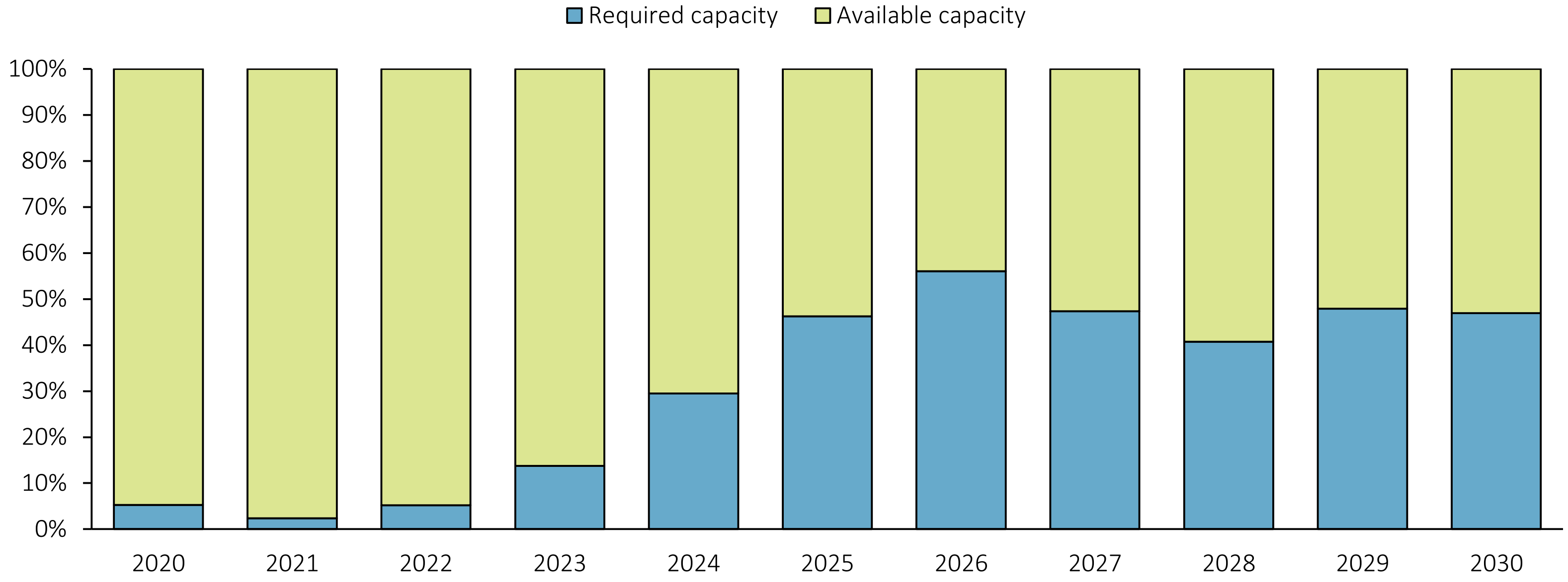
Strong growth in supply announcements across the globe

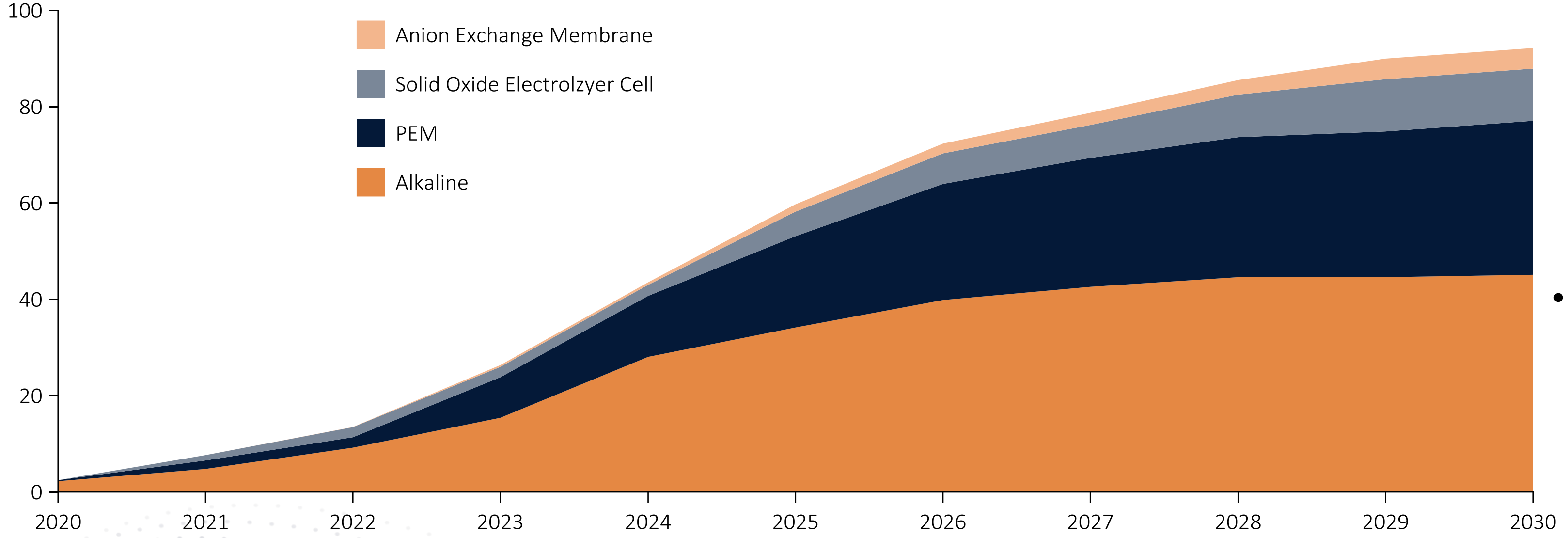


Source: Rystad Energy Hydrogen Solution

Electrolyzer capacity glut widens as suppliers ramp up

Gigawatt (GW) of electrolyzer capacity





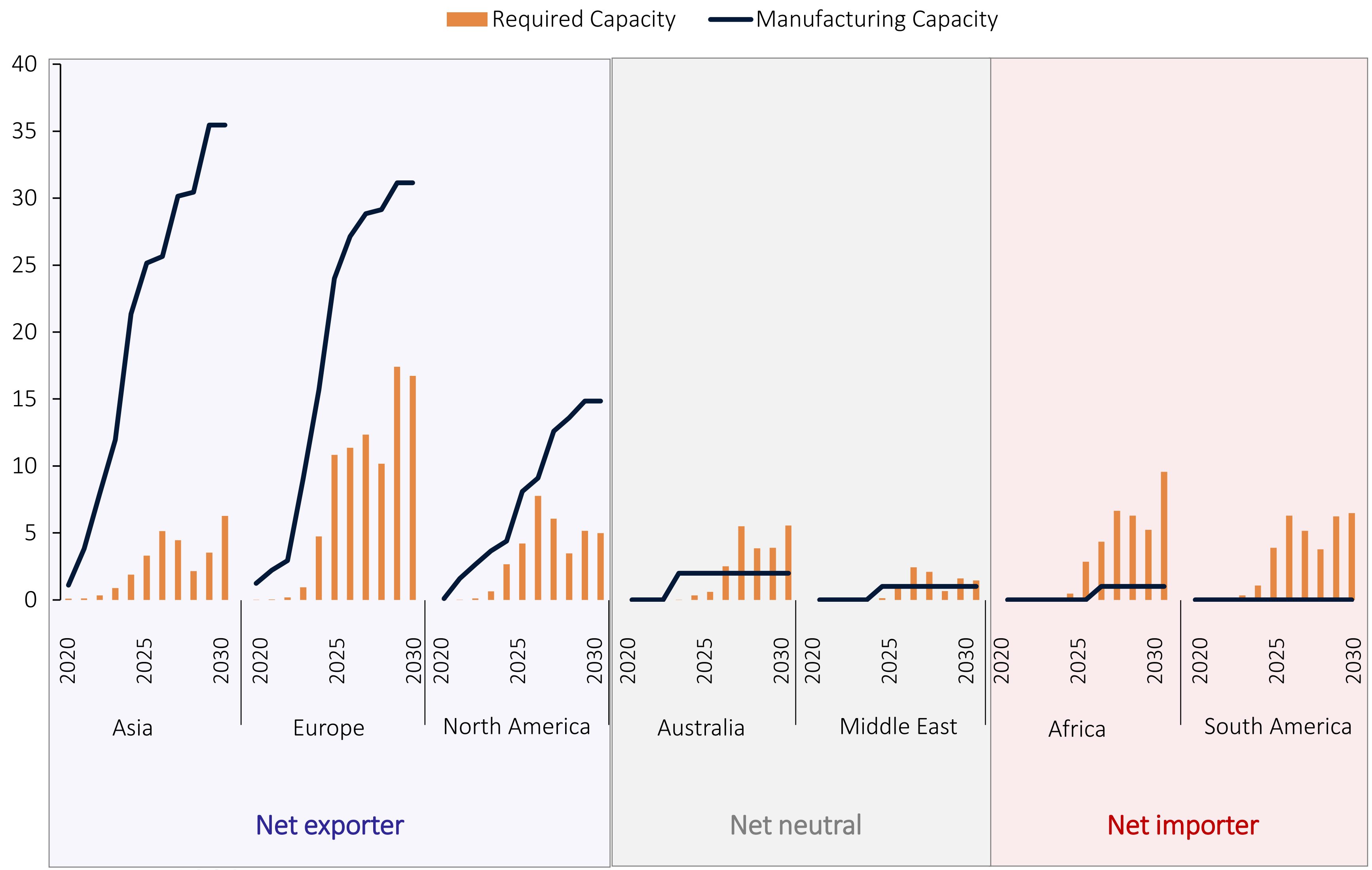
Source: Rystad Energy HydrogenCube, October 2023

Key Insights

- Demand lags today with fewer than 5% of the projects seeing FID. As manufacturers ramp up to enable themselves to bid for large future projects in light of supportive policies, more than 60% of the electrolzyer capacity could be idle this decade.
- Key players recorded record revenue and order back logs last year. Profits kept shrinking in 2022 as it takes time to see return on invested capital, research and development, and skilled personnel while the business is scaling up.
- Trusted conventional technologies of PEM and Alkaline ramping up over the decade while new technologies like Solid oxide and Anion Exchange membrane commercialize. Newer technologies still at lower TRL.

Fierce competition unfolds within electrolzyer manufacturing

Gigawatt (GW) of electrolyzer capacity



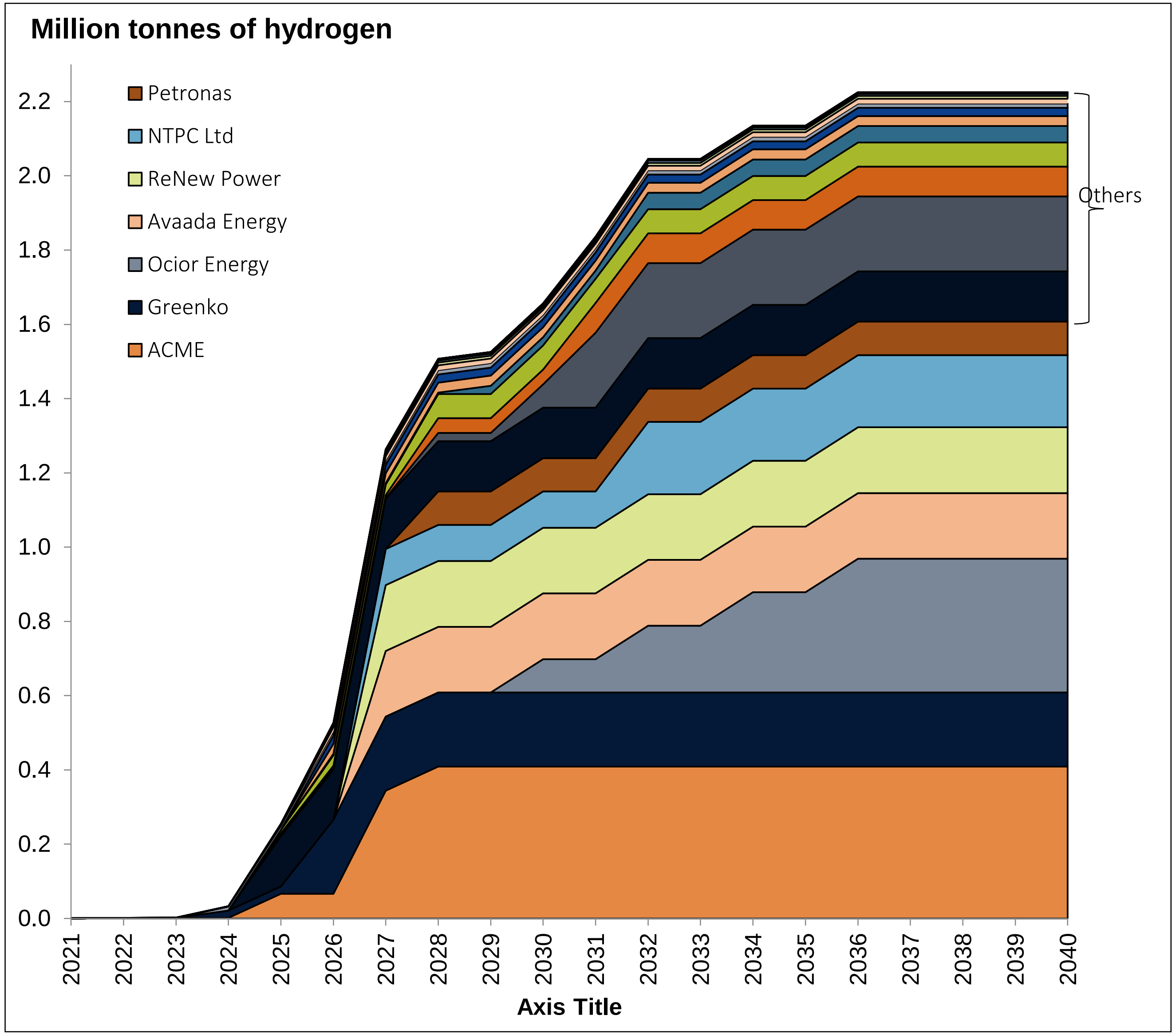
<u>Key Insights</u>

- China dominates with 55% market share but faces competition from west. By the end of 2023, electrolzyer capacity to rise above 26 GW/annum, twice that of 2022 led by Europe, N. America and Asia.
- Favorable policies in US and EU have spiked the manufacturing plans of both regions. But India and China will likely acquire 40% of the global share in 2030.
- Indian manufacturers are presented with the opportunity for low cost electrolyzer export with global oversupply but local shortage. Companies can look to meet the demand in Middle East, Africa and Asia.

Source: Rystad Energy research & analysis

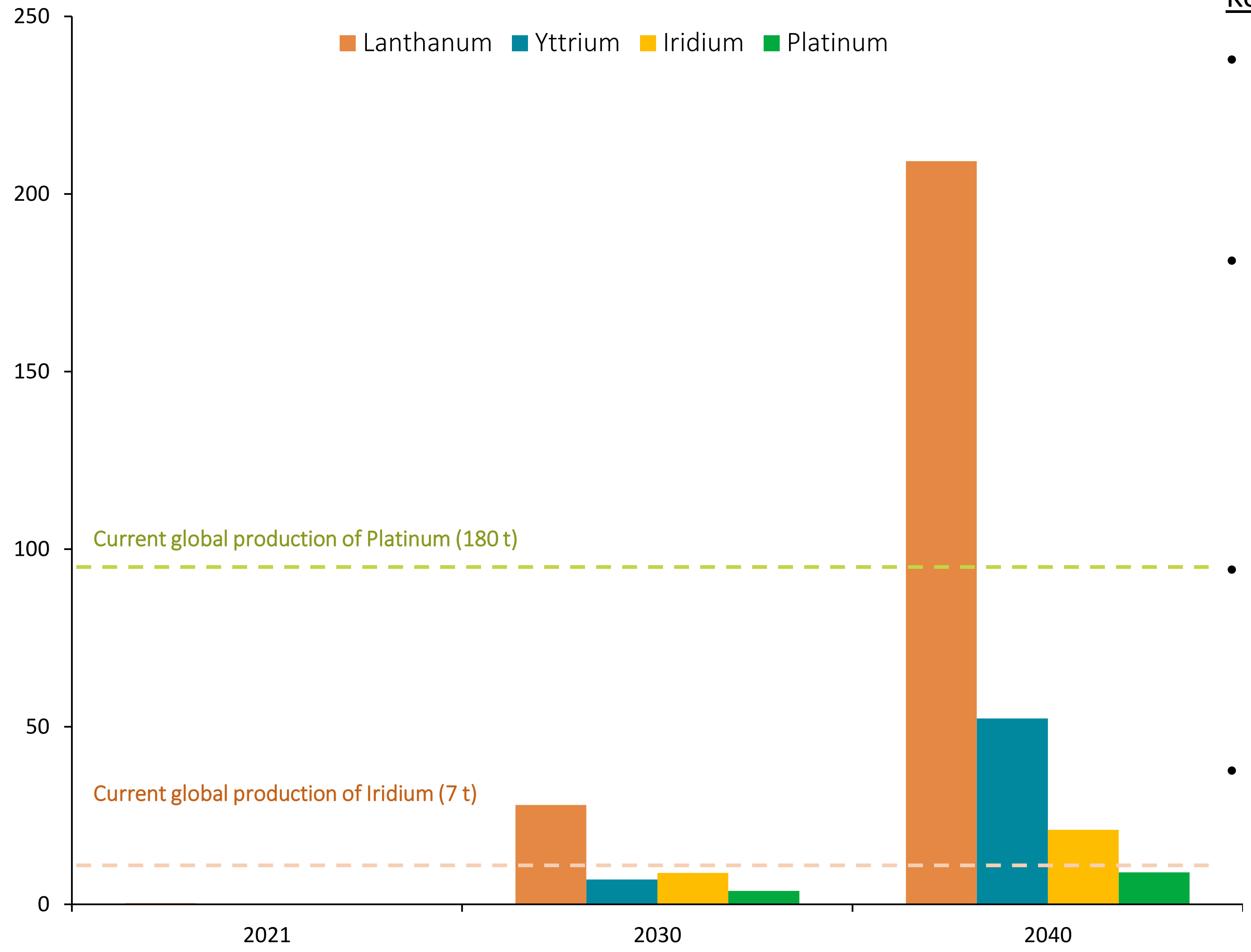
Electrolyzer players partnering with the established foreign makers to scale operations in India

Electrolzyer companies	Partner Companies	Announced Capacity (GW)	Electrolyzer Type
ohmium		2	PEM
h2e		1.2	AEM, SOEC
L&T	McPhy Driving clean energy Forward	1	Alkaline
Greenko	John Cockerill	2	Alkaline
adani	CAVENDISH PROFESSIONALS	5	Alkaline/AEM/PEM
GREENZO ENERGY PVT. LTD.		0.25	AEM
THERMAX	FORTESCUE FUTURE INDUSTRIES	2	Unannounced
H2B2		0.1	
Bharat Petroleum	BARC	Not communicated	Alkaline
GAIL	Unannounced	Not communicated	Unannounced
BHEL	Unannounced	Not communicated	Unannounced
	Stiesdal	Not communicated	Alkaline



Source : Rystad Energy research and analysis

Challenges remain in scaling up present manufacturing capacity
Tonnes of material



Key Insights

- PEM market share at 40% in 2030 with 100 GW announced capacity equating to 35 tonnes. Annual iridium production remains 7 tonnes and limited to certain geographies.
- Iridium's need is going to significantly increase with upcoming market expansion. Targeted Iridium mining is unviable and is tied to Platinum. There is also no current recycling market for pure iridium. Alternative need to be developed, with research into lowering the loading rates to avoid supply chain bottlenecks and Ir recycling.
- Reduce costs through further innovation and automated manufacturing processes (mass manufacturing and reduced labor costs)
- Alternative innovative technologies of Hysata, Supercritical Solutions, sea water electrolysis are still are a lower TRL and would take time to commercialize.

Source: Rystad Energy research & analysis

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