

Hydrogen Market Outlook

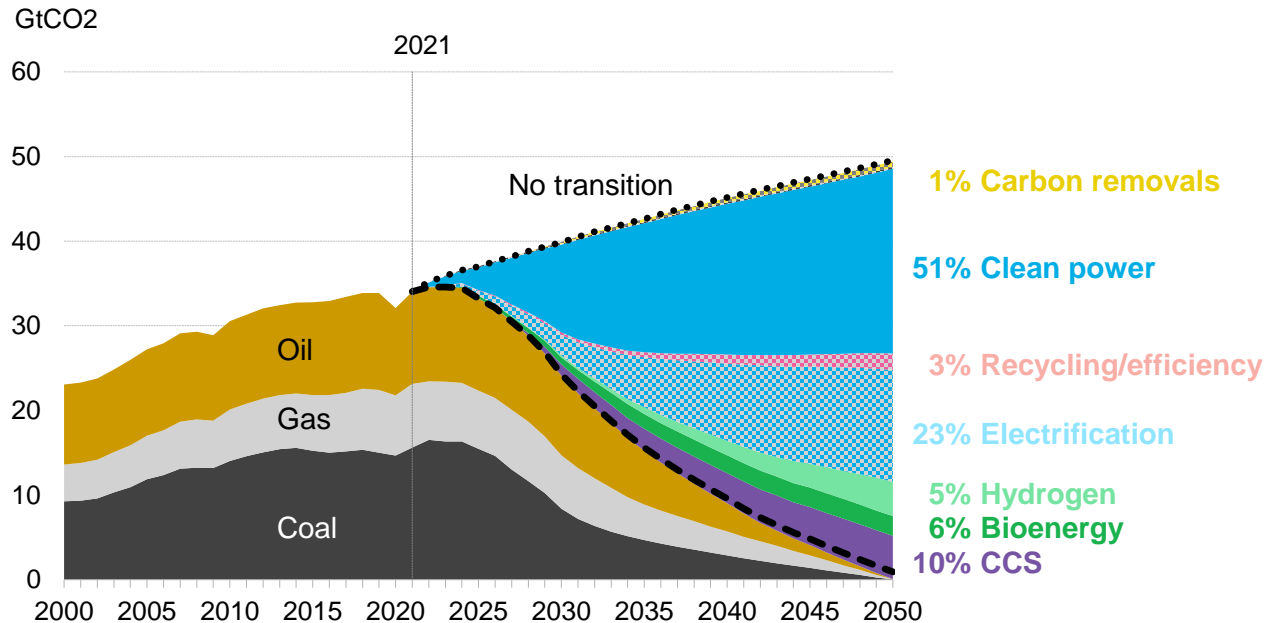
European Hydrogen Week

Adithya Bhashyam

November 20, 2023

Clean hydrogen use accounts for 5% of carbon abatement under a net-zero scenario

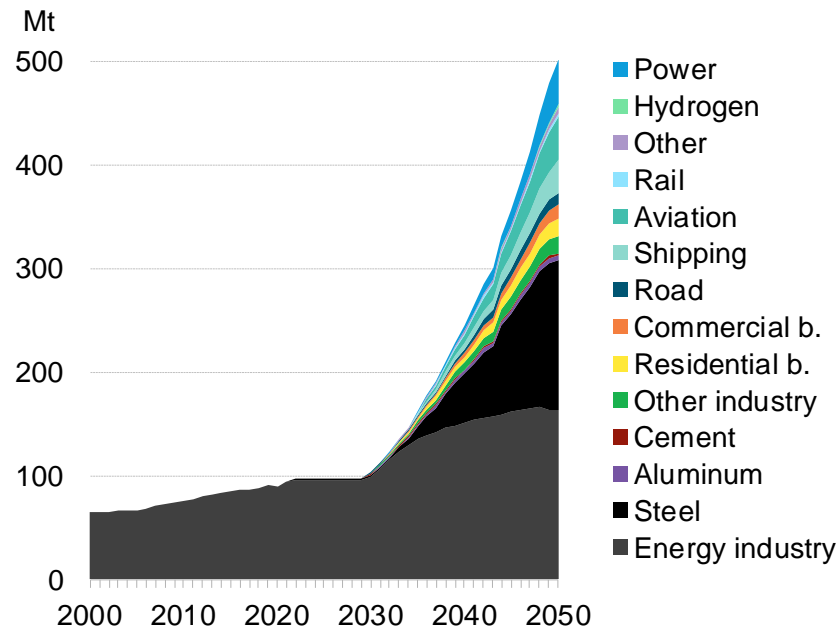
CO2 abatement by technology/type, Net Zero Scenario



Source: BloombergNEF. Note: Abatement also includes fuel switching and other abatement technologies. Values show total abatement in 2023-50.

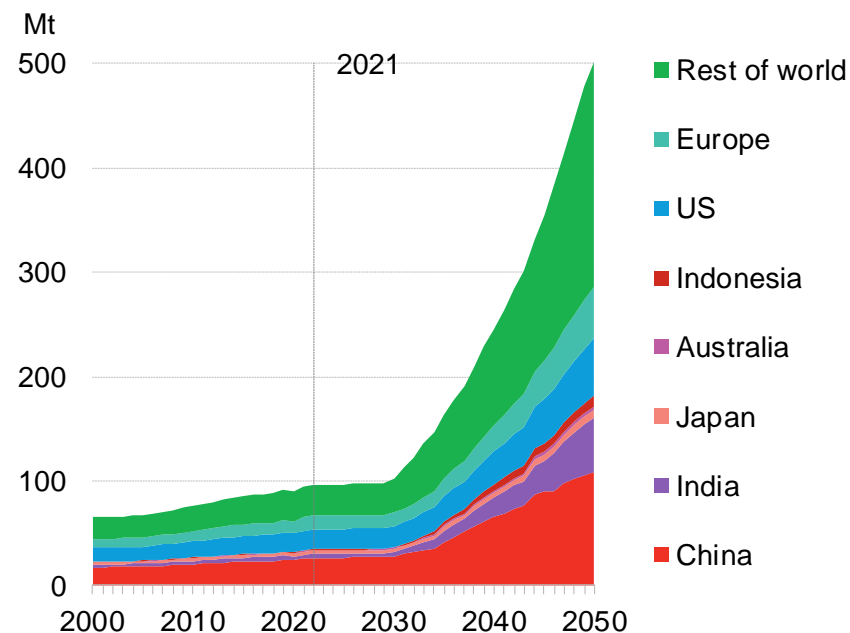
Hydrogen demand grows more than fivefold under BNEF's NEO net-zero scenario (NZS)

By sector



Source: BloombergNEF. Note: "Energy industry" includes legacy uses as well as own-use for energy-producing industries.

By region

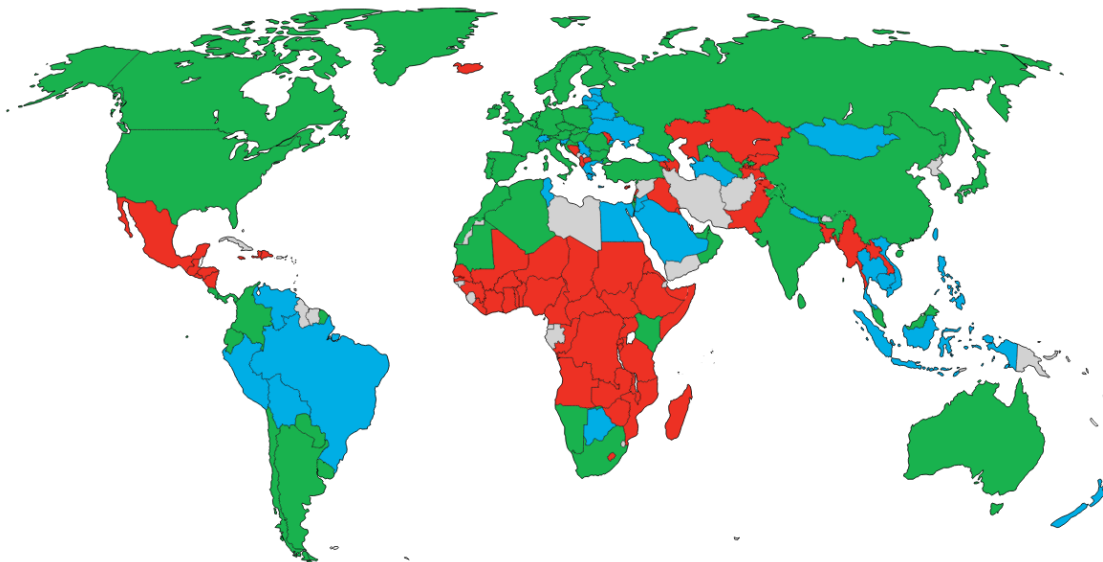


Source: BloombergNEF

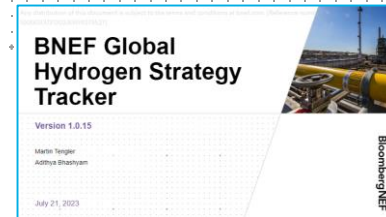
Globally, 53 markets have hydrogen strategies, 20 of which are EU members

Hydrogen strategies as of October 16, 2023

- Published (52)
- In preparation (29)
- No activity (60)
- Not assessed (31)



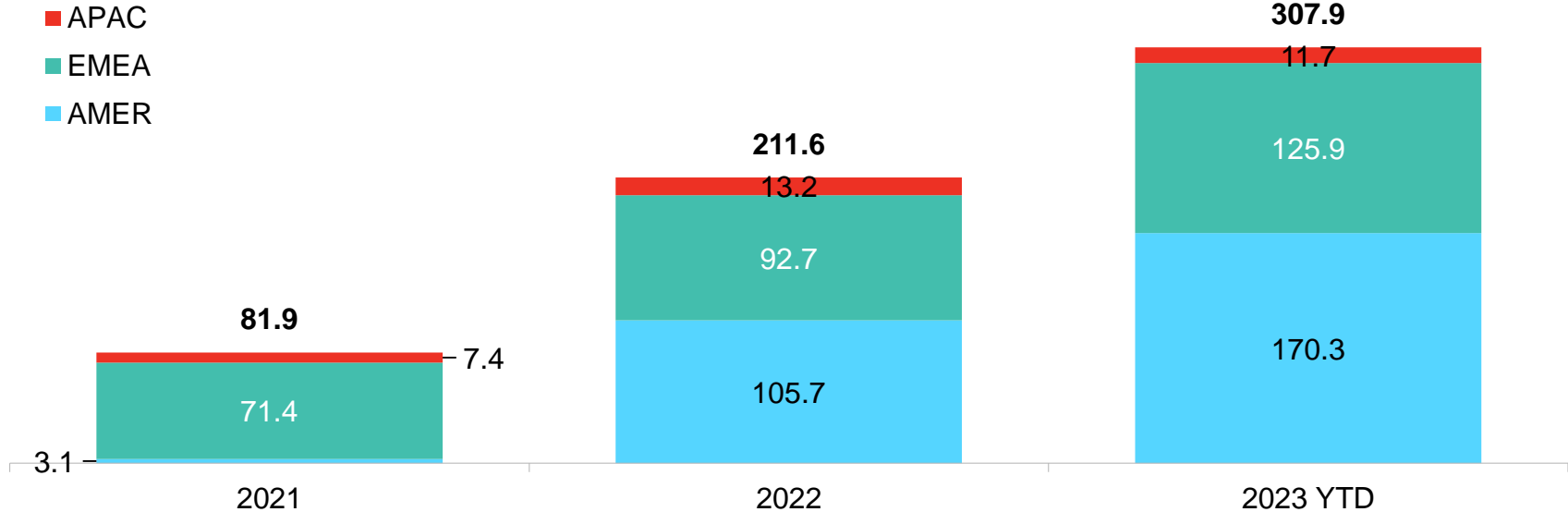
Source: BloombergNEF



Funding for hydrogen is up by 46% since January at \$308 billion

Hydrogen funding by region as of October 16, 2023

\$ billion (2022 real)



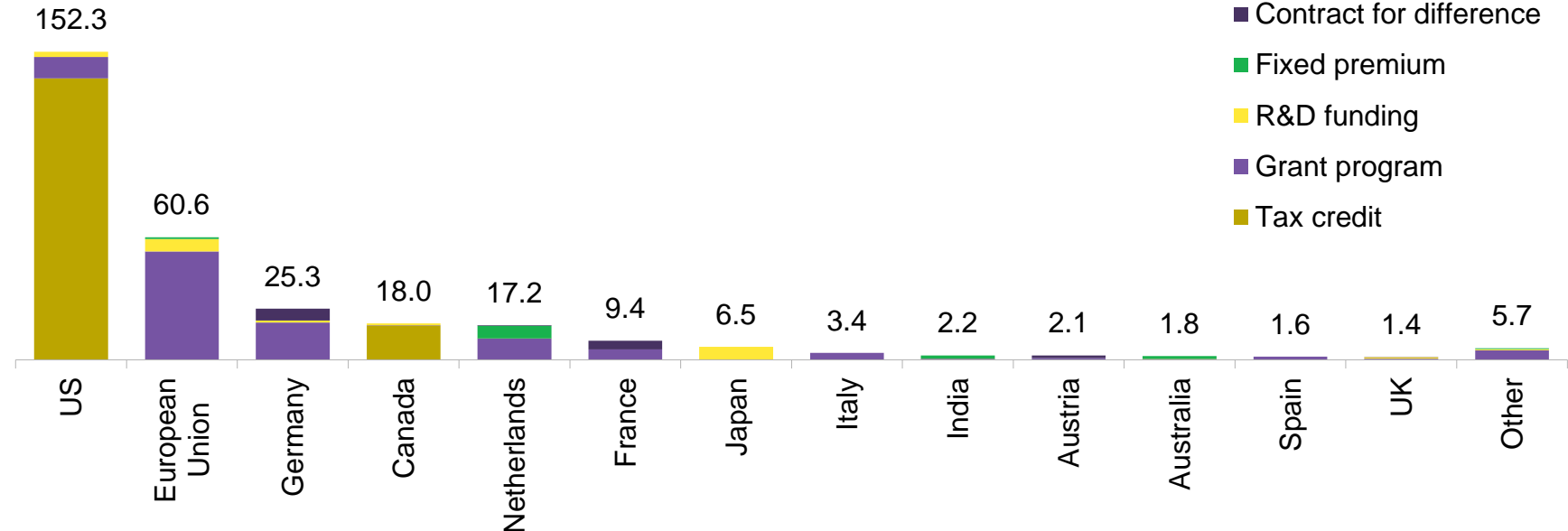
Source: BloombergNEF Hydrogen Subsidies Tracker. Note: 2023 YTD data is as of October 16, 2023.



US, EU and Germany offer the most support. US uses tax credits, Europe grant programs

Hydrogen funding by region as of October 16, 2023

\$ billion (2022 real)



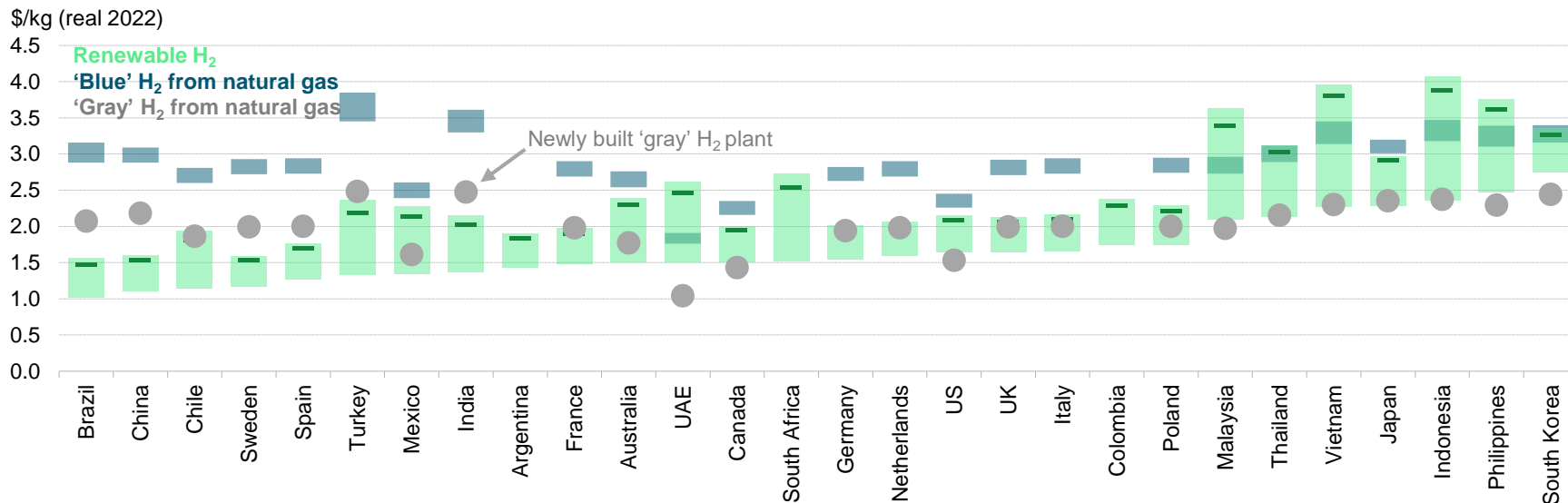
Source: BloombergNEF Hydrogen Subsidies Tracker



Green hydrogen should outcompete blue – and even gray in some markets – by 2030



Levelized cost of hydrogen in 28 markets, 2030

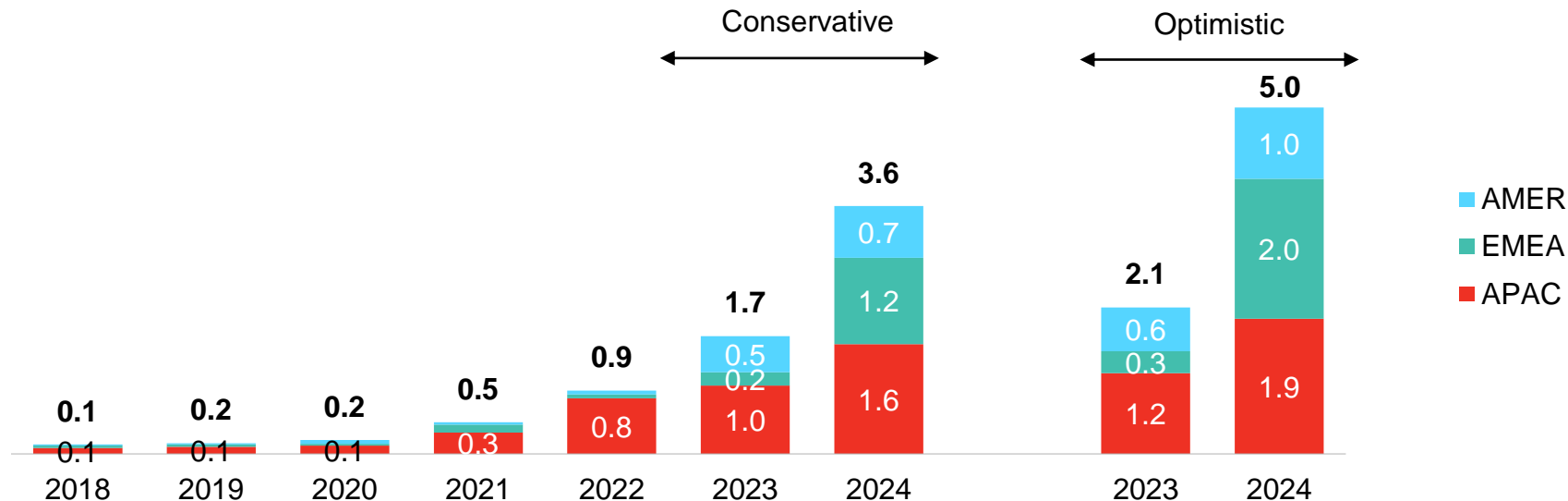


Source: BloombergNEF, National Energy Technology Laboratory (NETL). Note: Based on project financing year. Assumes BNEF's optimistic electrolyzer cost scenario. Renewable LCOH₂ range reflects a diversity of electrolyzer type, Chinese alkaline (low) to proton exchange membrane, or PEM (high). The electrolyzer's electricity is sourced from the cheaper renewable resource. Capital and operational costs for blue hydrogen are sourced from the NETL. Gas prices derived from BNEF's 1H 2023 LCOE Update ([web](#) | [terminal](#)). Grid electricity prices assumed to be \$75/MWh (in real 2022 terms) for all modeled markets.

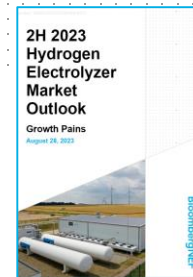
The electrolyzer market is set to double for a third time, and a fourth

Forecast annual electrolyzer shipments

GW



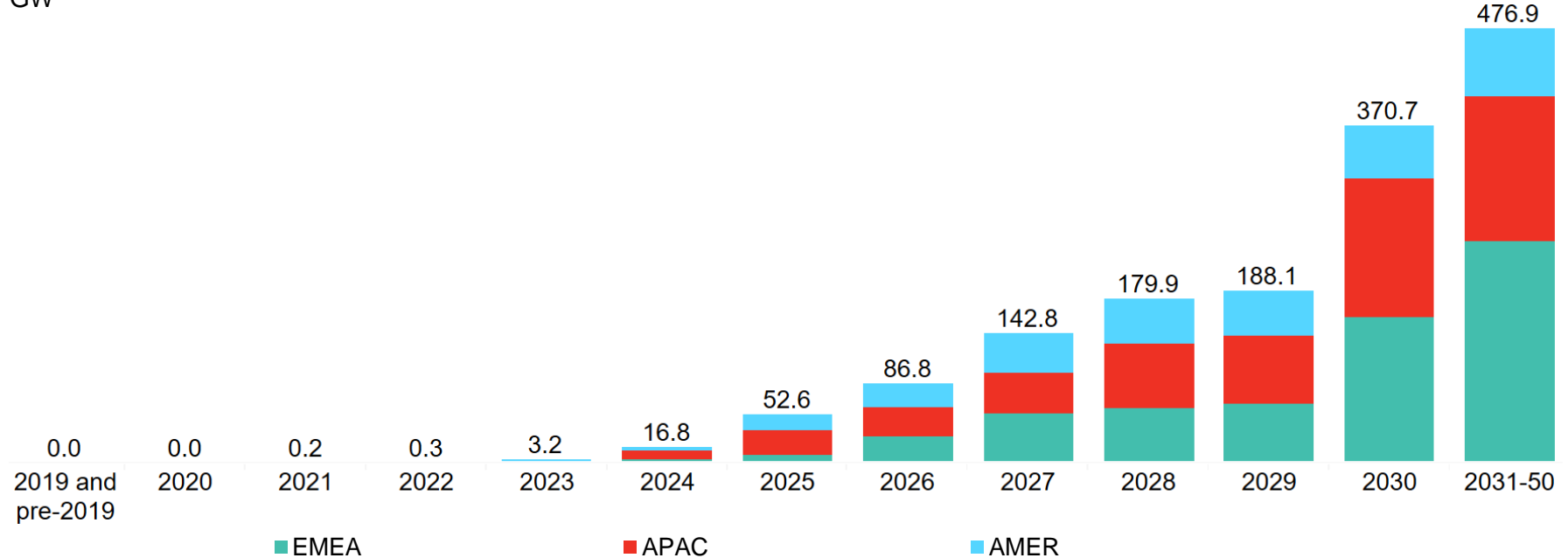
Source: BloombergNEF



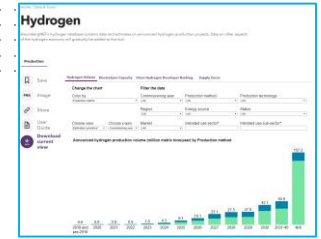
Market could grow more than 100 times by 2030 if all announced projects come online

Announced cumulative pipeline of electrolyzer projects

GW

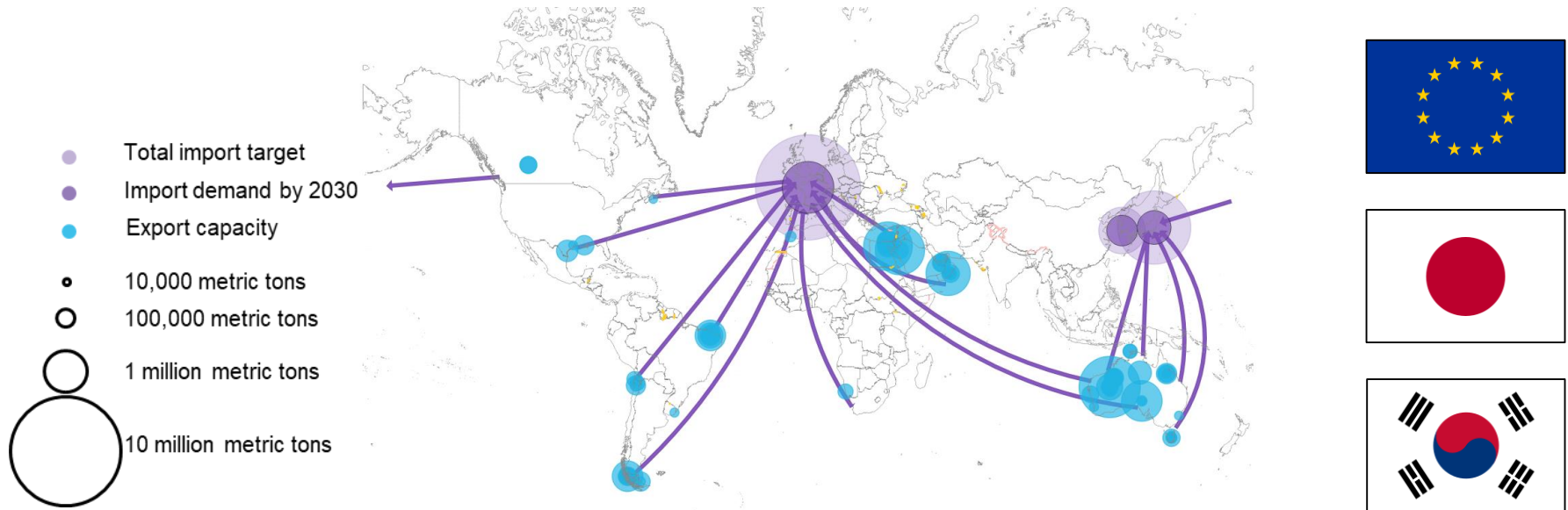


Source: BloombergNEF



Europe, Japan and Korea are looking to import clean hydrogen in the near-term

Planned hydrogen export projects versus import demand

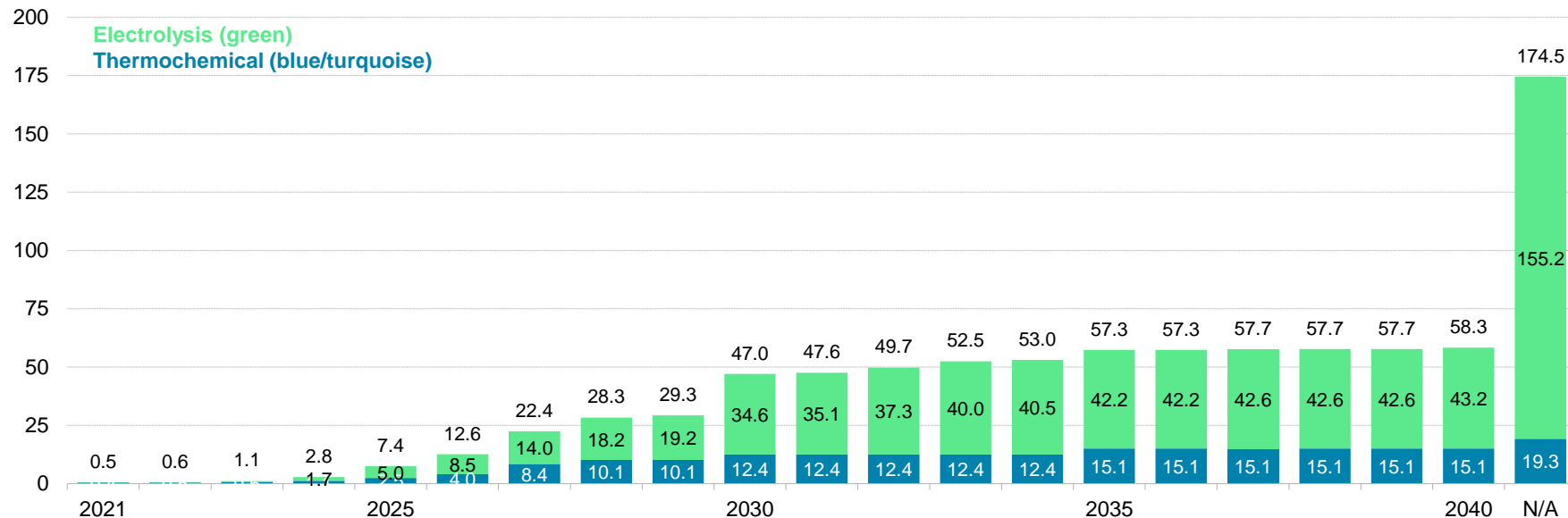


Source: BloombergNEF. Note: Only includes export projects of 9,000 metric tons of capacity estimated using BNEF Hydrogen Supply-Demand Model: Supply. EIA is environmental impact studies. FEAS is feasibility studies. Does not include a 2GW solar – hydrogen project in UAE that didn't disclose hydrogen capacity.

Announced supply could displace more than current demand with green dominating

Cumulative clean hydrogen supply pipeline proposed by developers

Million tons of H₂ per year



Source: BloombergNEF Hydrogen Project Database ([web](#)). Note: this is not a forecast but a pipeline of proposed projects

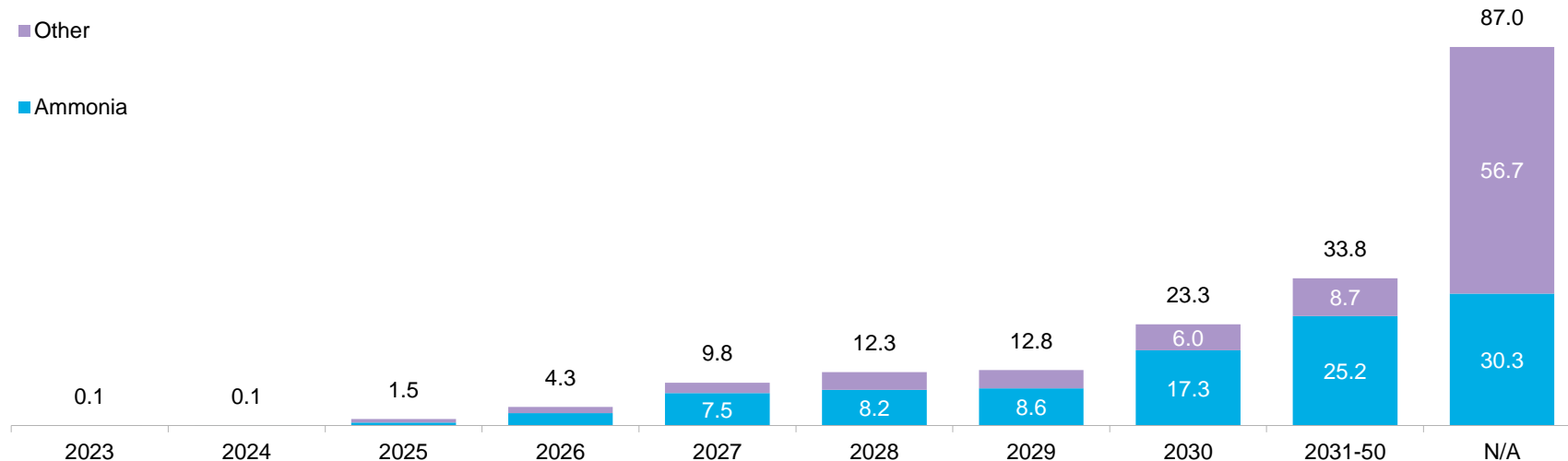
Half of all proposed supply will export, and ammonia is the most popular carrier

Announced supply of H₂ export projects by carrier

Mt-H₂/year

■ Other

■ Ammonia

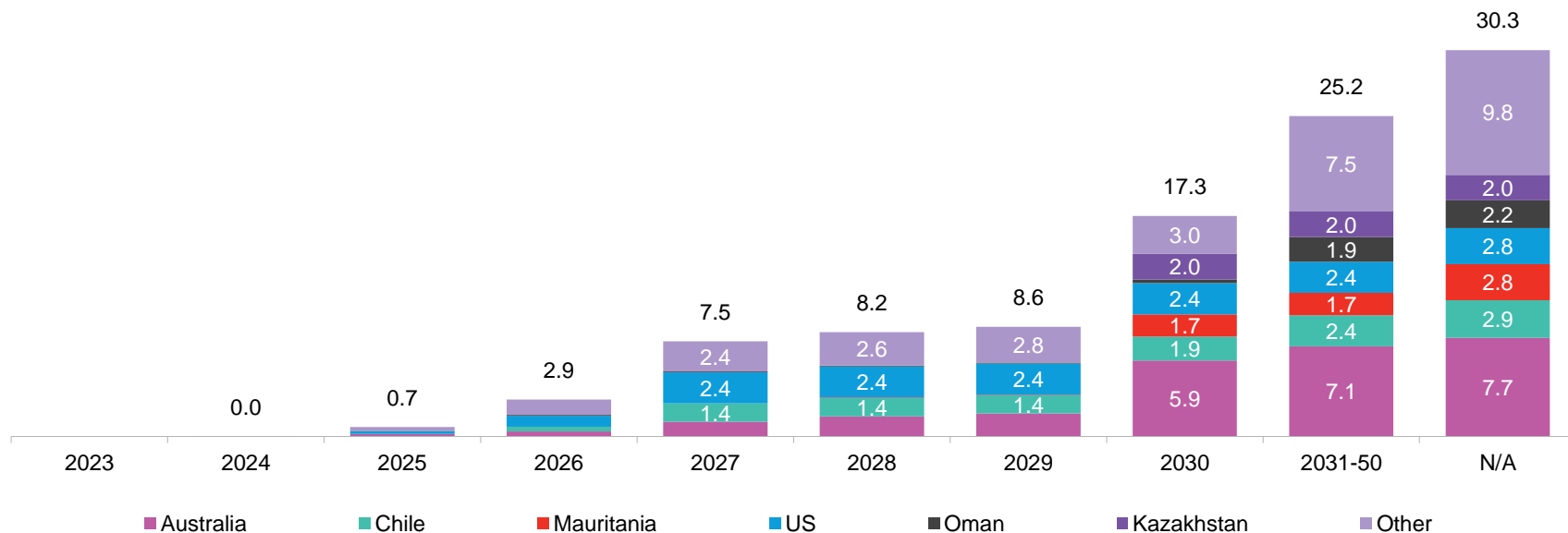


Source: BloombergNEF. Note: as of September 22, 2023. *Many projects without disclosed commissioning date (N/A) also did not disclose transport media. Some of them could use ammonia as the carrier

Australia, Chile and the US dominate supply but Oman could soon follow

Announced supply of H₂ for export as ammonia by origin

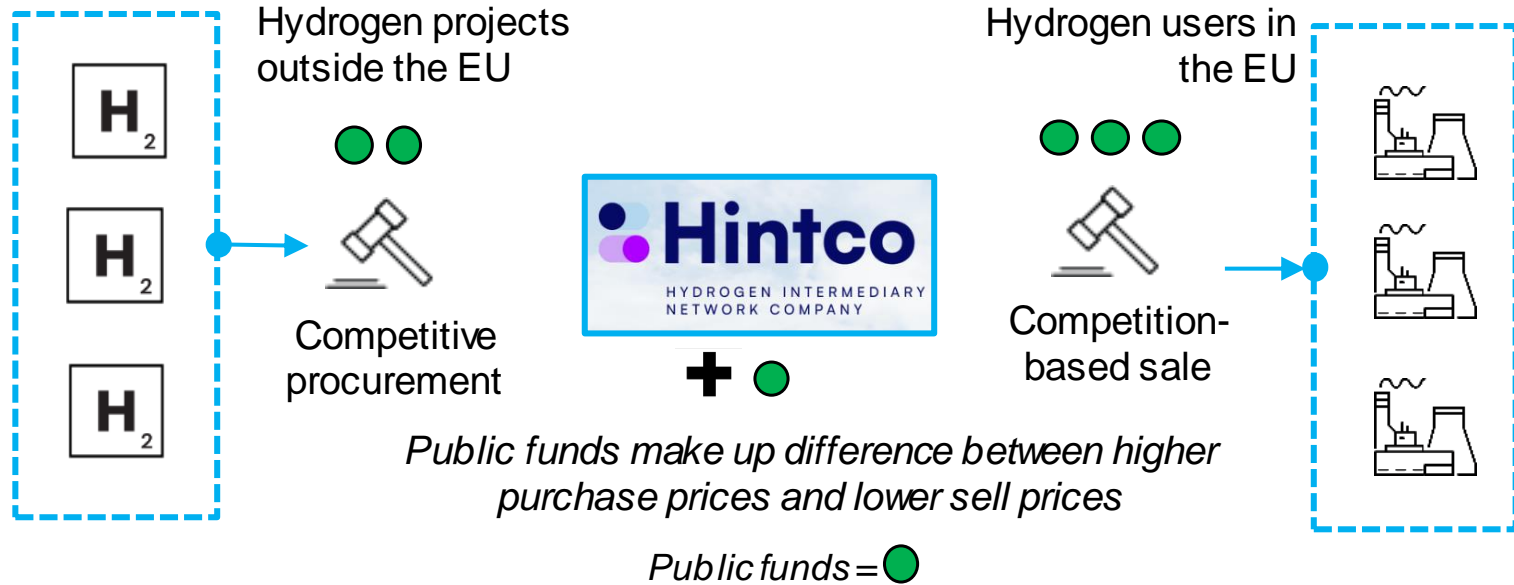
Mt-H₂/year



Source: BloombergNEF. Note: as of September 22, 2023

Imports will need support, schemes like H2Global play an important role

Germany's H2Global green hydrogen import scheme

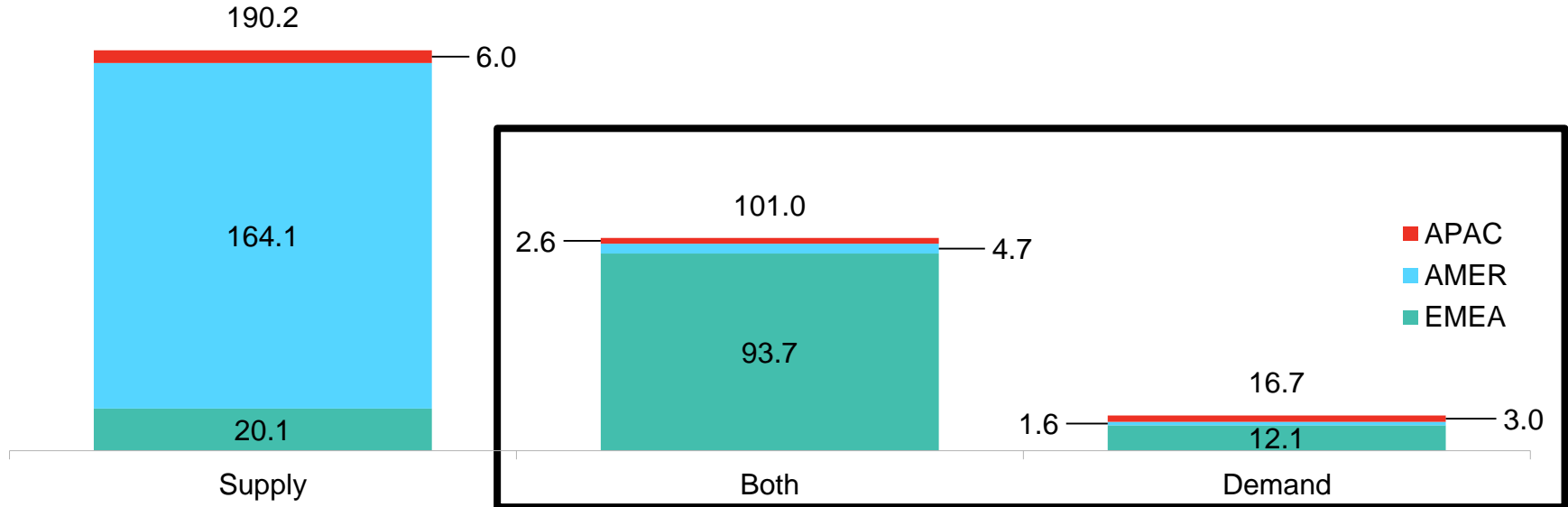


Source: BloombergNEF, H2Global.

Globally, more support for hydrogen uptake will be needed but Europe is clearly leading

Hydrogen funding by category (supply vs demand) as of October 16, 2023

\$ billion (2022 real)



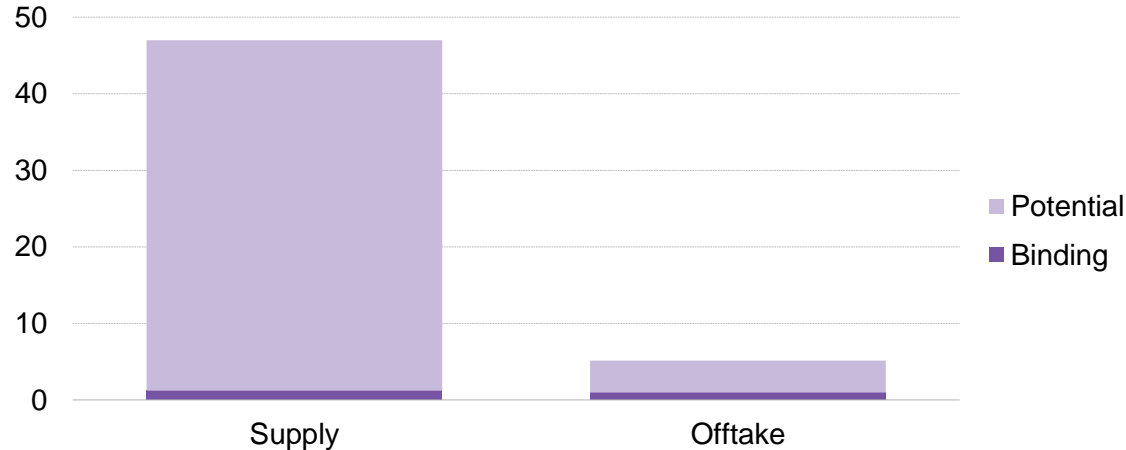
Source: BloombergNEF Hydrogen Subsidies Tracker



Only 1% of clean hydrogen capacity by 2030 is supported by binding offtake agreements

Low-carbon hydrogen supply and offtake by 2030

Million metric tons per year

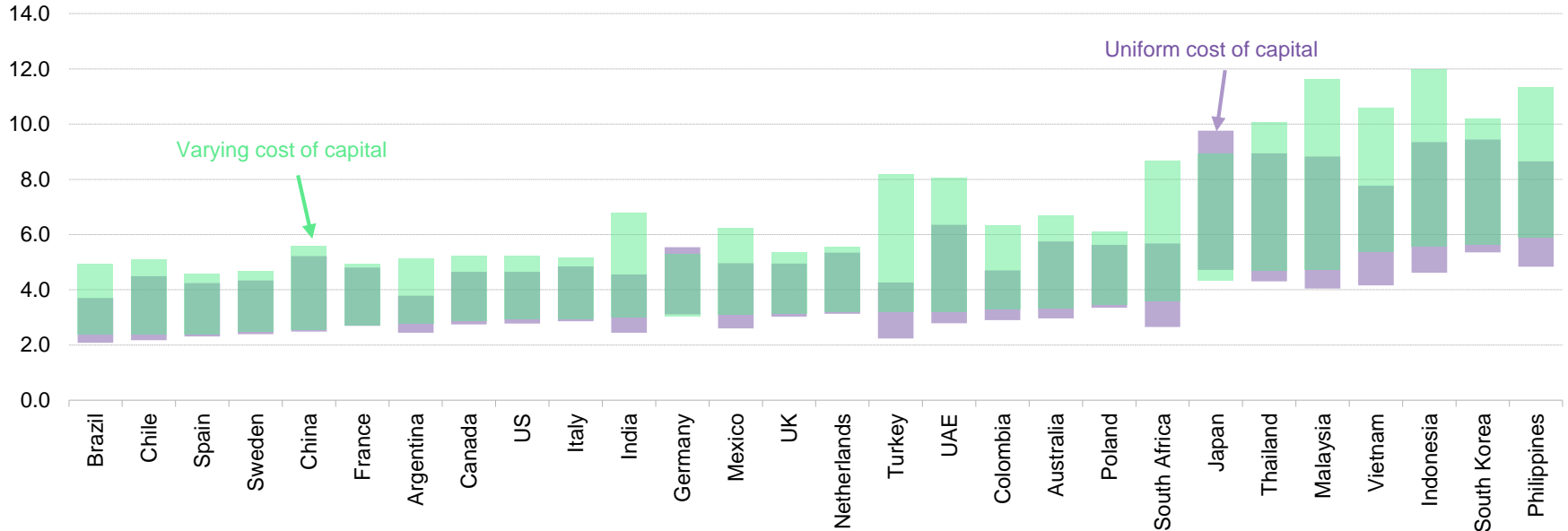


Source: BloombergNEF. Note: Data as of September 29, 2023. The database only includes projects of over 20 megawatts or 2,800 metric tons/year of capacity. Potential offtake includes letters of intent, heads of terms agreements, memoranda of understanding, and unspecified offtake agreements disclosed in news.

High financing costs can raise LCOH by up to \$2-4/kg today, MDBs can help address this

2023 LCOH₂ analysis with varying and uniform cost of capital by market, 2023

\$/kg (real 2022)

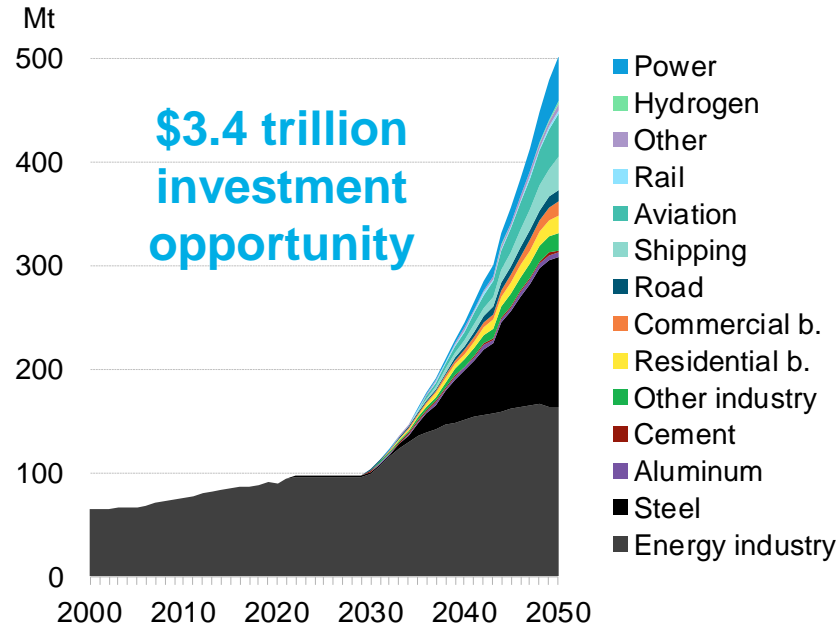


Source: BloombergNEF. Note: CoC refers to cost of capital. Uniform cost of capital scenario assumes a 10% equity IRR and a 5% cost of debt in all markets. Projects financed in 2023 have a 48% debt share. Assumes the renewable electricity source that provides the lowest LCOH₂ for each market.

Clean hydrogen needs \$3.4 trillion in investments until 2050, much of this will come from the private sector

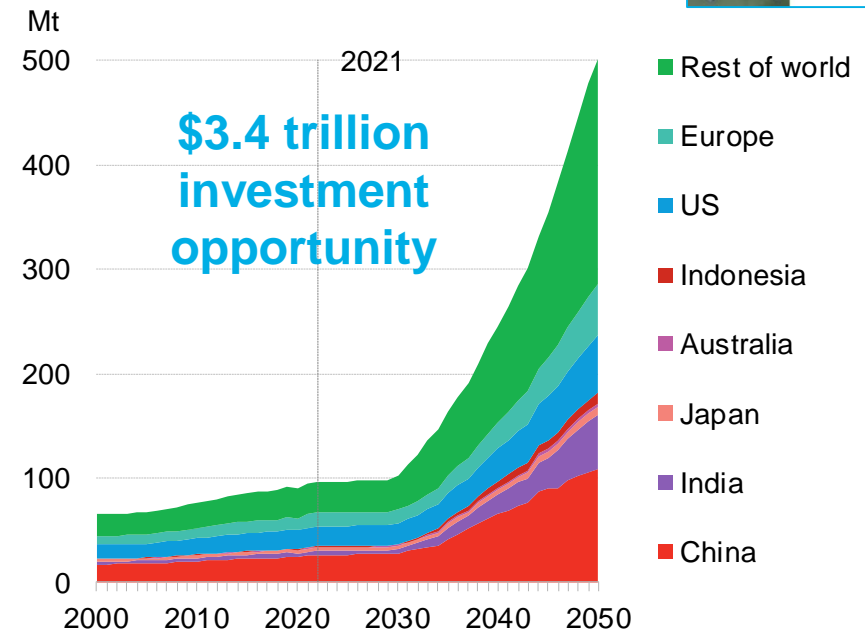


By sector



Source: BloombergNEF. Note: "Energy industry" includes legacy uses as well as own-use for energy-producing industries. Mt is million metric tons.

By region



Source: BloombergNEF. Note: Mt is million metric tons.

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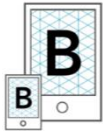
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