Global Hydrogen Review 2025

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International Energy Agency

Where does hydrogen stand today at the global level?

1 Overarching trends

A **China** dominates electrolyser manufacturing capacity, deployment and has the lowest production costs.

B **Low-emissions hydrogen** has increased by 30% since 2020 and expected to quadruple by 2030.

C Deployment, project pipeline and public funding are the largest among **advanced economies.**

2 Physical flows

A **Production** by 2030 could reach 10 Mtpa, out of a pipeline of 37 Mtpa.

B Almost 7 Mtpa of **offtake agreements** have been announced in 2021-2025, but only 1.6 Mtpa is firm.

C Projects targeting **exports** add up to 16.5 Mtpa by 2030, but only 4.2 Mtpa has offtakers.

3 Monetary flows

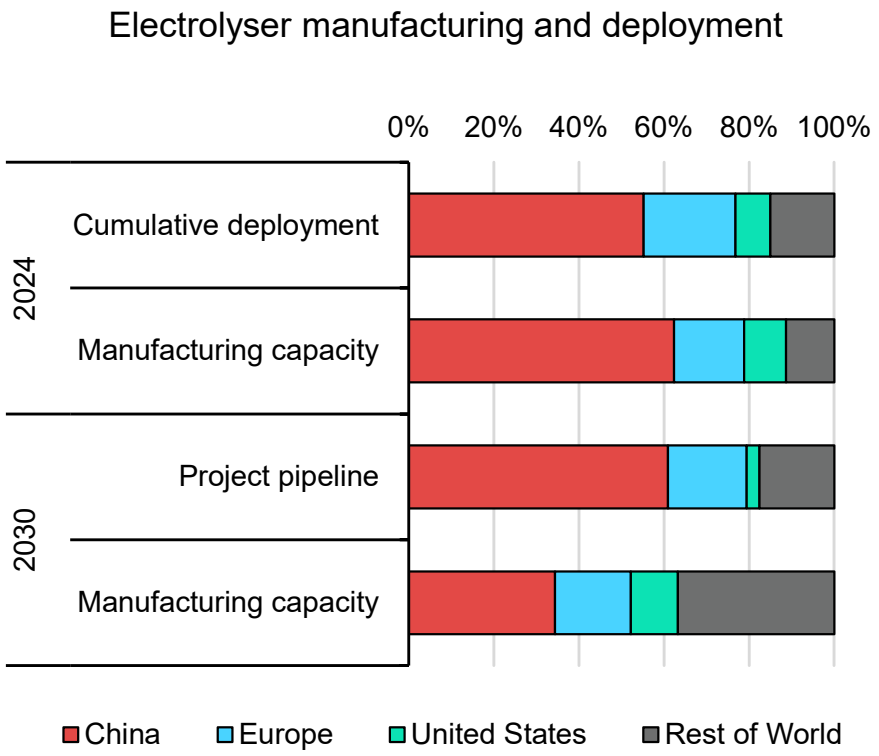
A USD 8 billion of **investment** in hydrogen production in 2025.

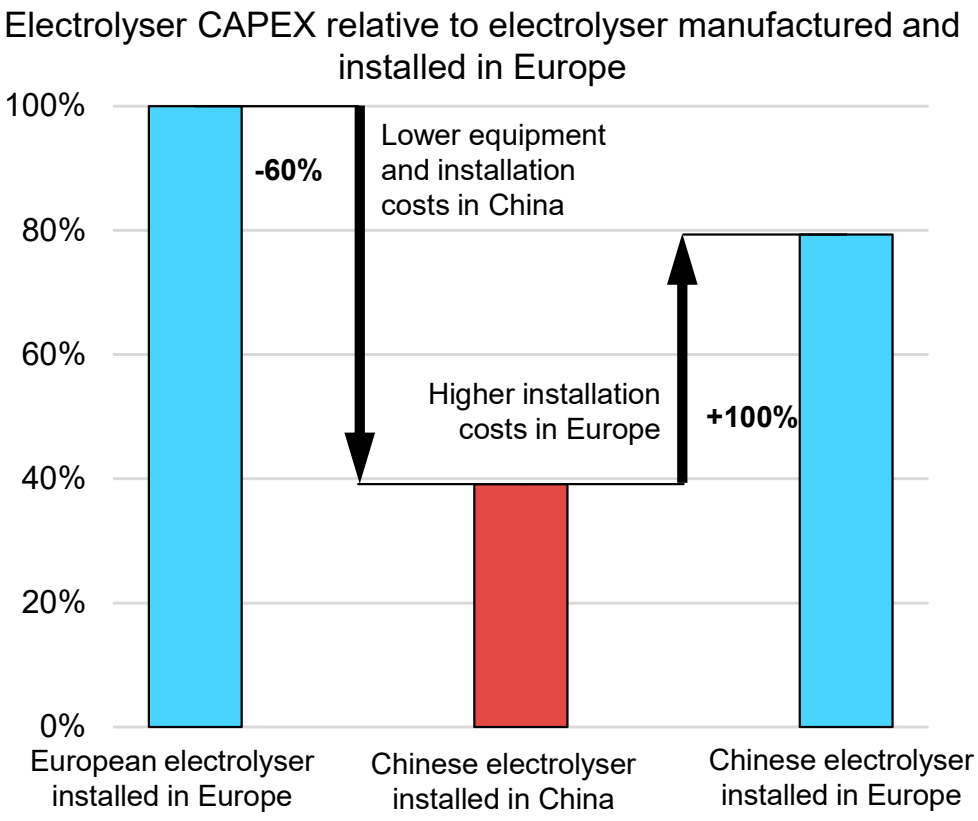
B USD 38 billion of **public funding** in policies that made progress since GHR-25.

C USD 6.6 billion of financing (loans) from **development finance institutions** in 2021-2025.

1A

Impact of lower electrolyser costs in China should not be overstated



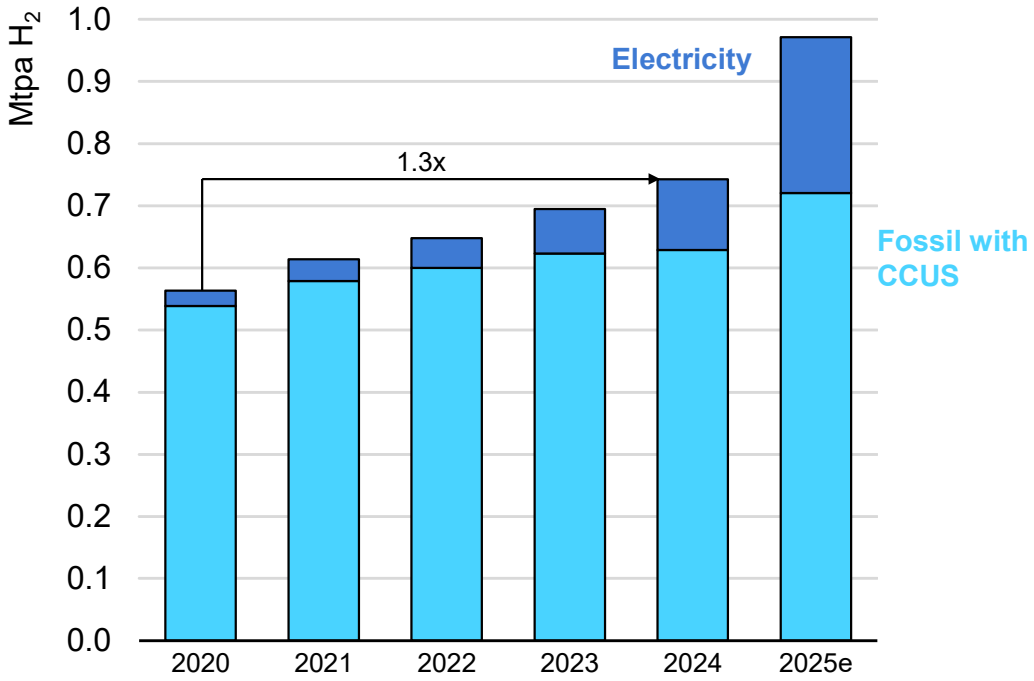


Installing Chinese electrolysers in Europe reduces the total CAPEX by only around 20% due to local costs as installation. Savings in hydrogen production costs are even lower, with electricity being a major cost component.

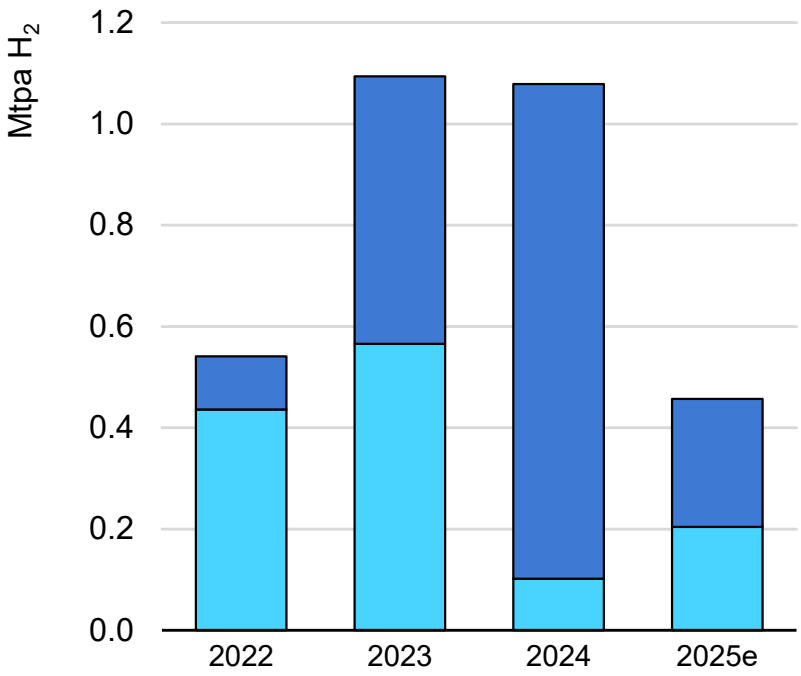
1B

Low-emissions hydrogen has increased by 30% since 2020 and expected to quadruple by 2030

Low-emissions hydrogen deployment



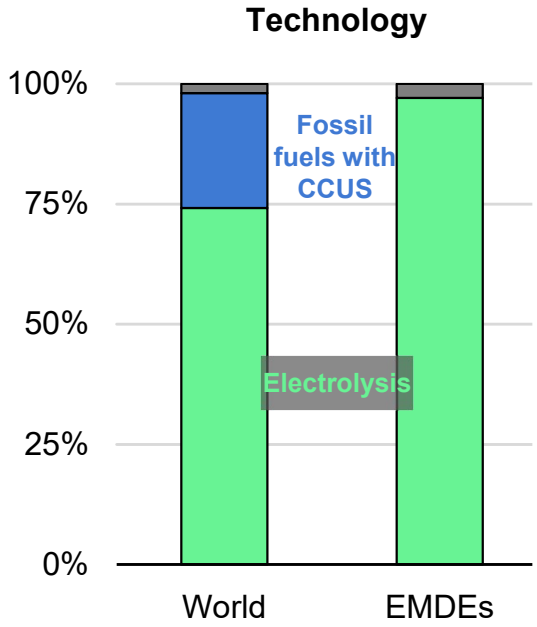
Annual FID for low-emissions hydrogen



1C

How fast can emerging economies turn ambitions into deployment?

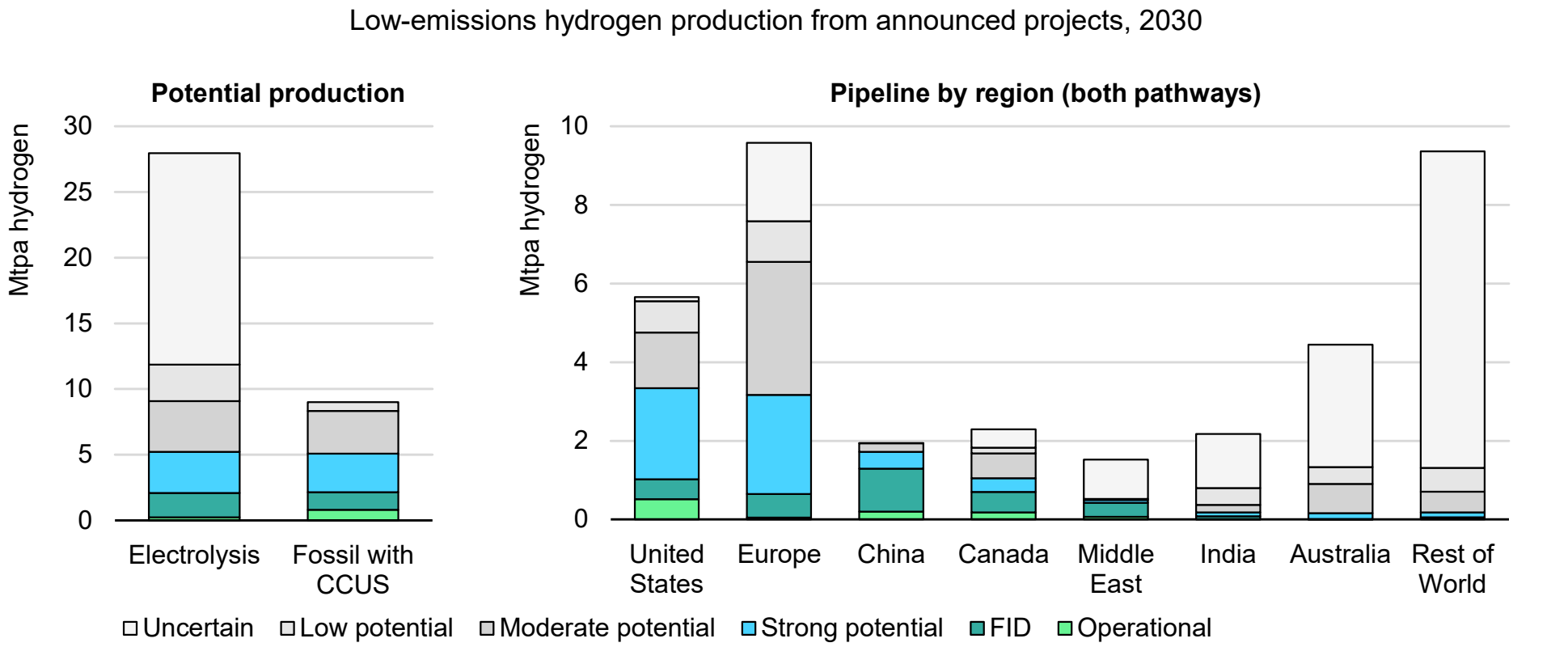
Share of low-emissions hydrogen production from announced projects, 2030



Projects in EMDEs focus almost exclusively on electrolysis, are larger and mainly export-oriented, but remain at earlier stages of development, with limited committed investment

2A

Production by 2030 could reach 10 Mtpa, out of a pipeline of 37 Mtpa

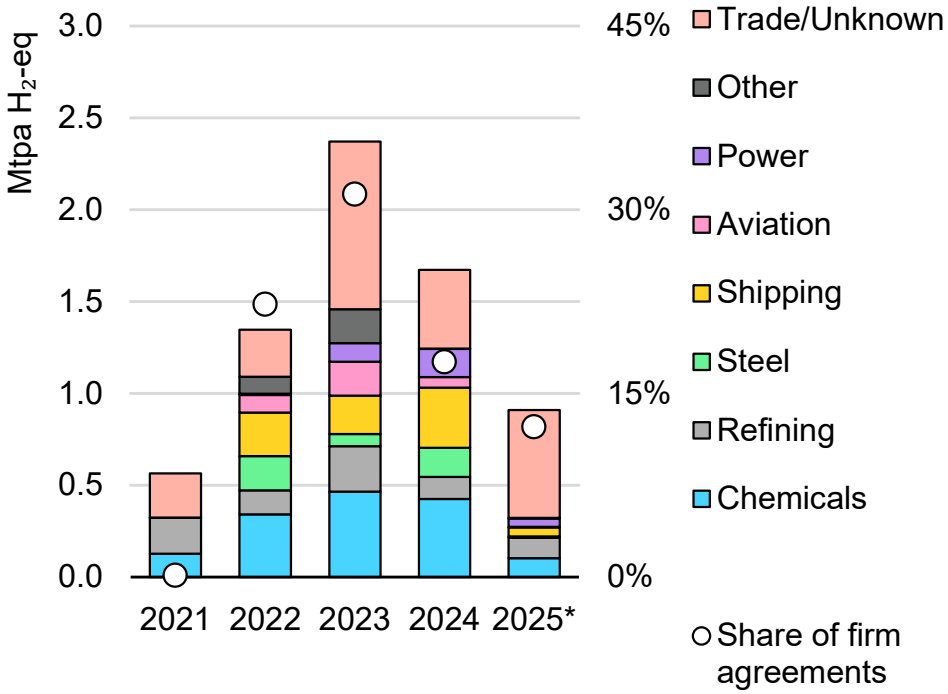


In addition to the 4 Mtpa of projects being in operation or having reached FID, a further 6 Mtpa have a strong potential to become available by 2030, taking into account project size, location and targeted end uses.

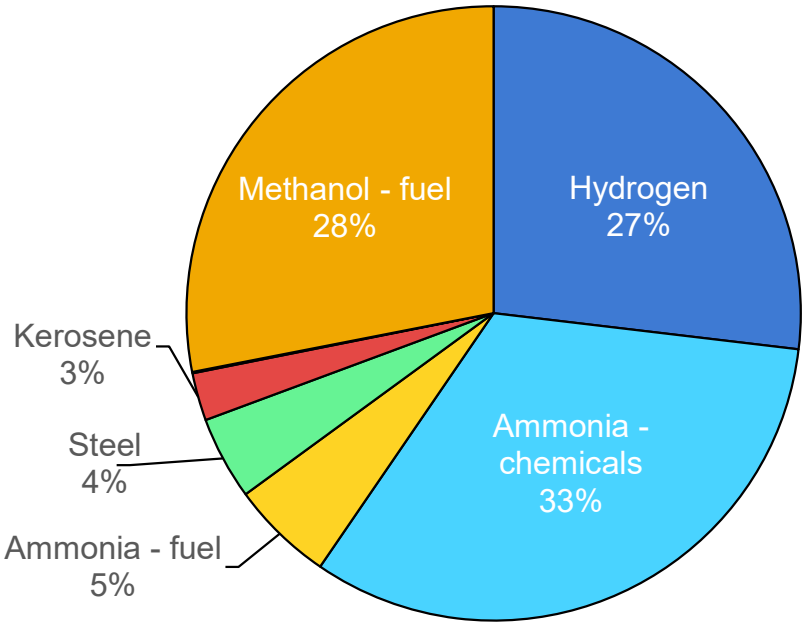
2B

7 Mtpa of offtake agreements have been announced in 2021-2025

Annual agreements by sector



Firm offtakes, 2021-2025 (1.6 Mt)

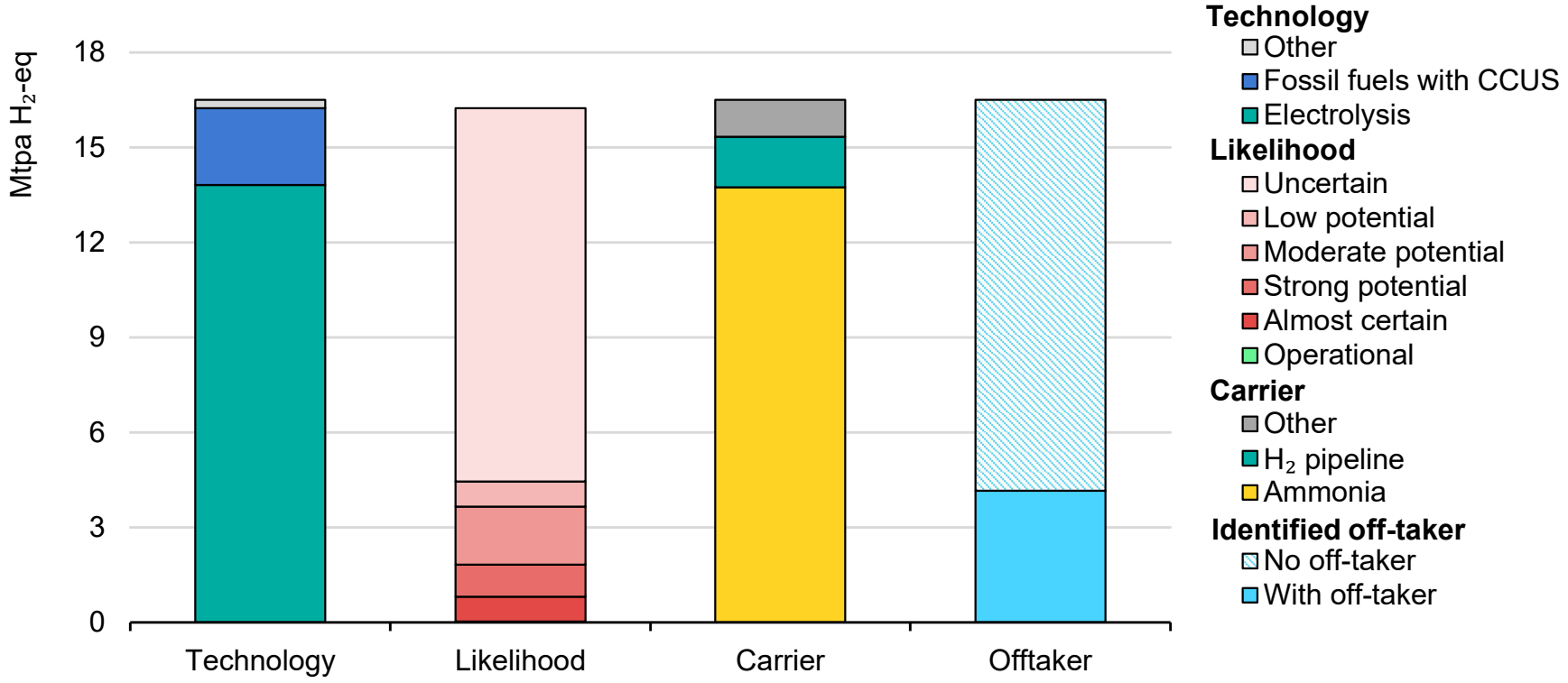


Offtake agreements have slowed down in 2024, mainly due to fewer trade agreements.
But firm offtake in industry, refining and hydrogen-based fuels is helping increase investment in production projects.

2C

Projects targeting exports add up to 16.5 Mtpa by 2030, but only 4.2 Mtpa has offtakers

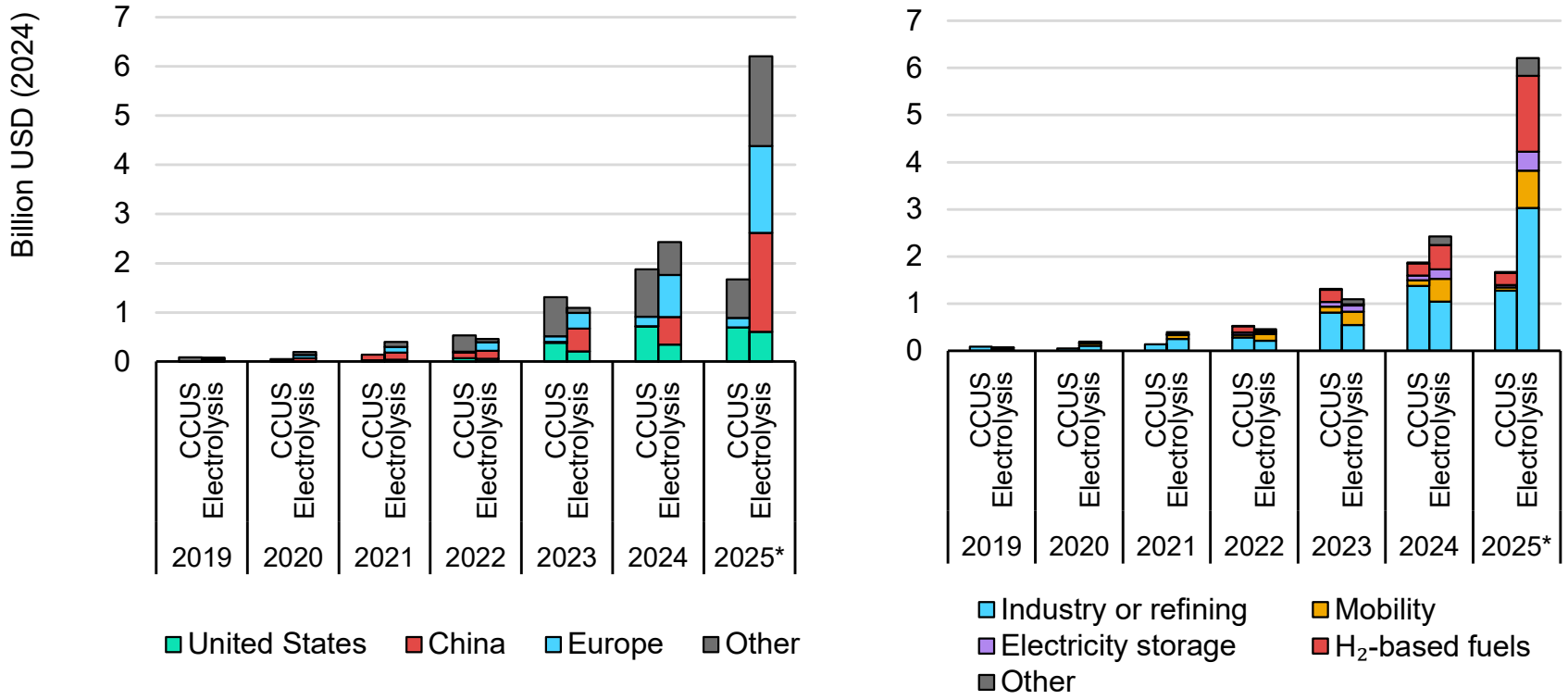
Announced projects for low-emissions hydrogen and hydrogen-based fuels intended for exports, 2030



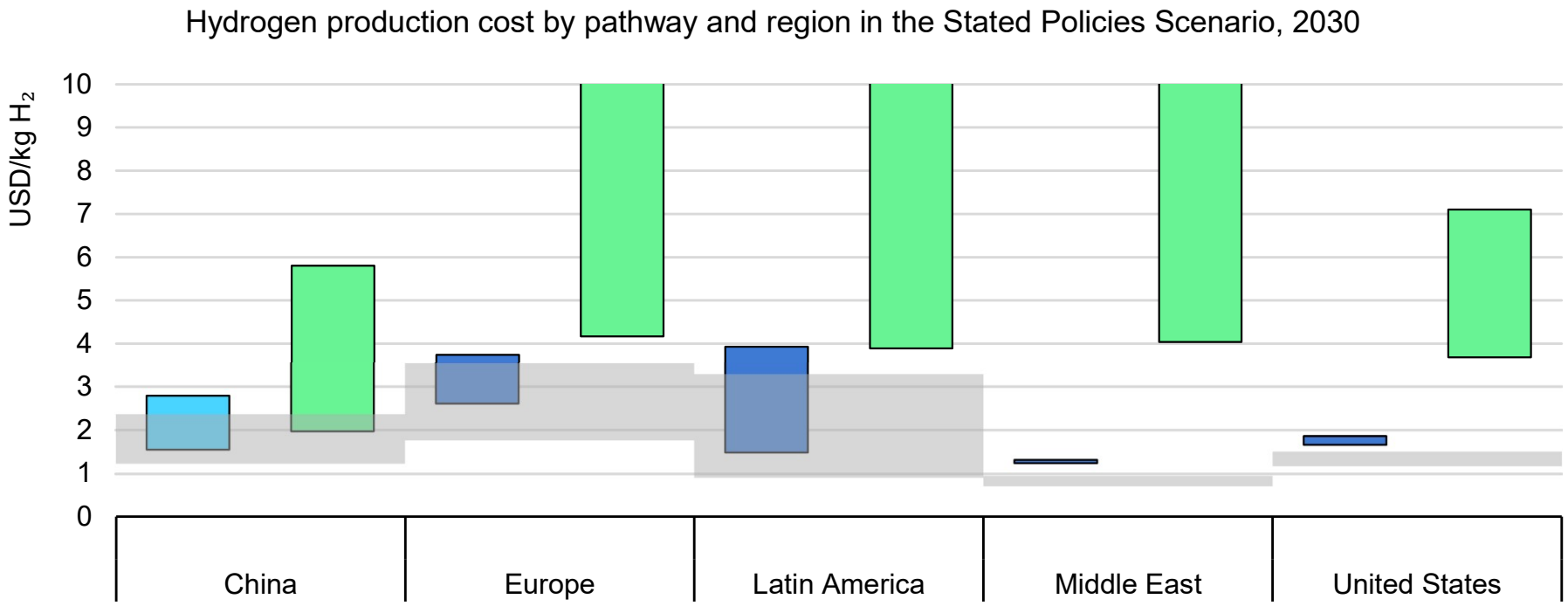
3A

USD 8 billion of investment in hydrogen production in 2025

Investment in low-emissions hydrogen production, 2019-2025



Production cost gap can start closing by 2030



In regions that currently depend on imports and face high natural gas prices, renewable hydrogen production could become competitive by 2030.

Where does hydrogen stand today in Southeast Asia?

4 Mt of demand in 2024

- Indonesia (35%), Malaysia (22%), Viet Nam (15%), Singapore (12%).
- Ammonia (49%), refining (31%), methanol (20%).
- 1% of regional energy-related **CO_2 emissions**.
- 8% of **gas supply**.

5 countries with strategies

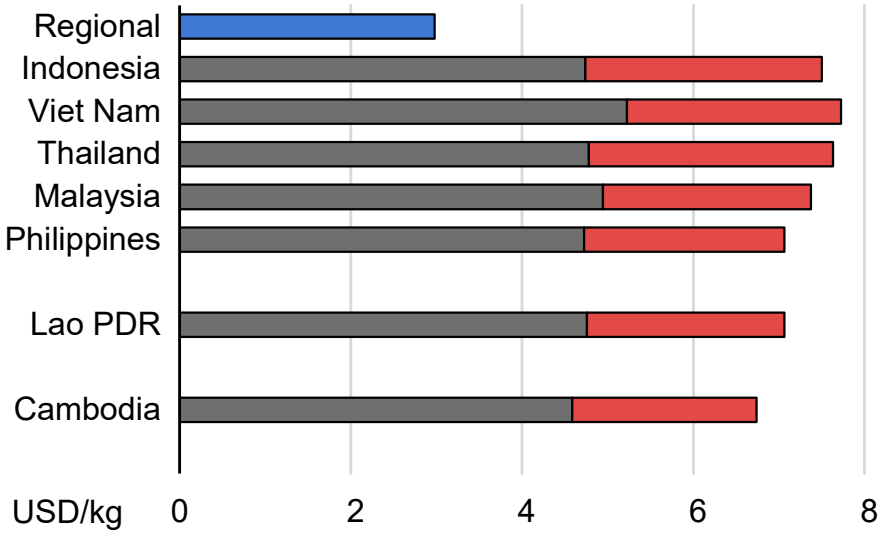
- **Mixed views** on production pathways and trade.
- Preparatory work by Thailand and the Philippines.
- **No certification scheme** is **in place**, but work is ongoing in three countries.

17% of ammonia exports (2023)

- Southeast Asia is a net **ammonia exporter**, but **only Indonesia and Malaysia** export.
- **Malaysia** represents 73% of exports. Most **other countries are importers**.
- Regional **production of crude steel** is 60% of **demand**.

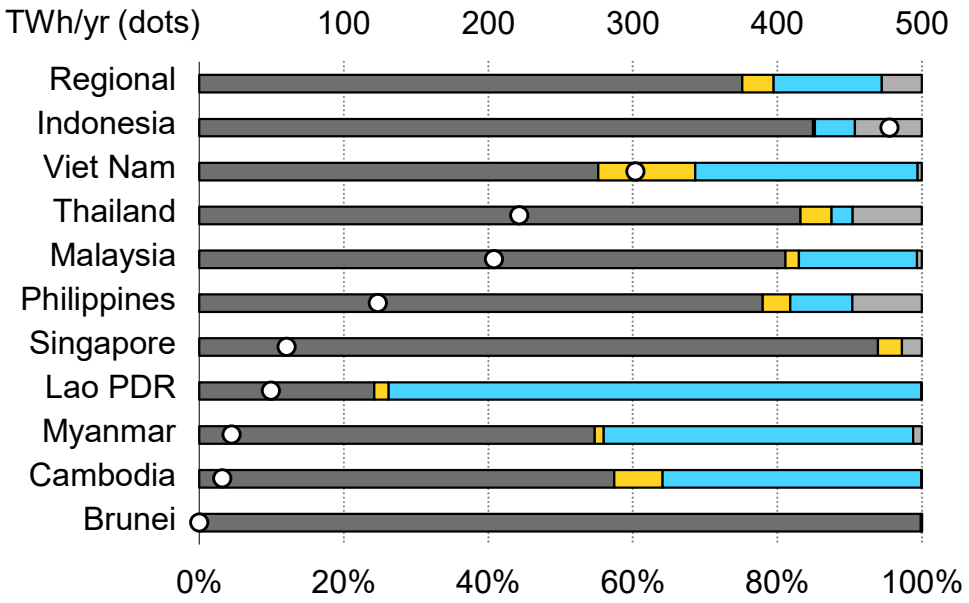
What are the challenges that Southeast Asia is facing today?

Levelised cost of hydrogen production, 2023



CAPEX/OPEX WACC premium Gas with CCUS

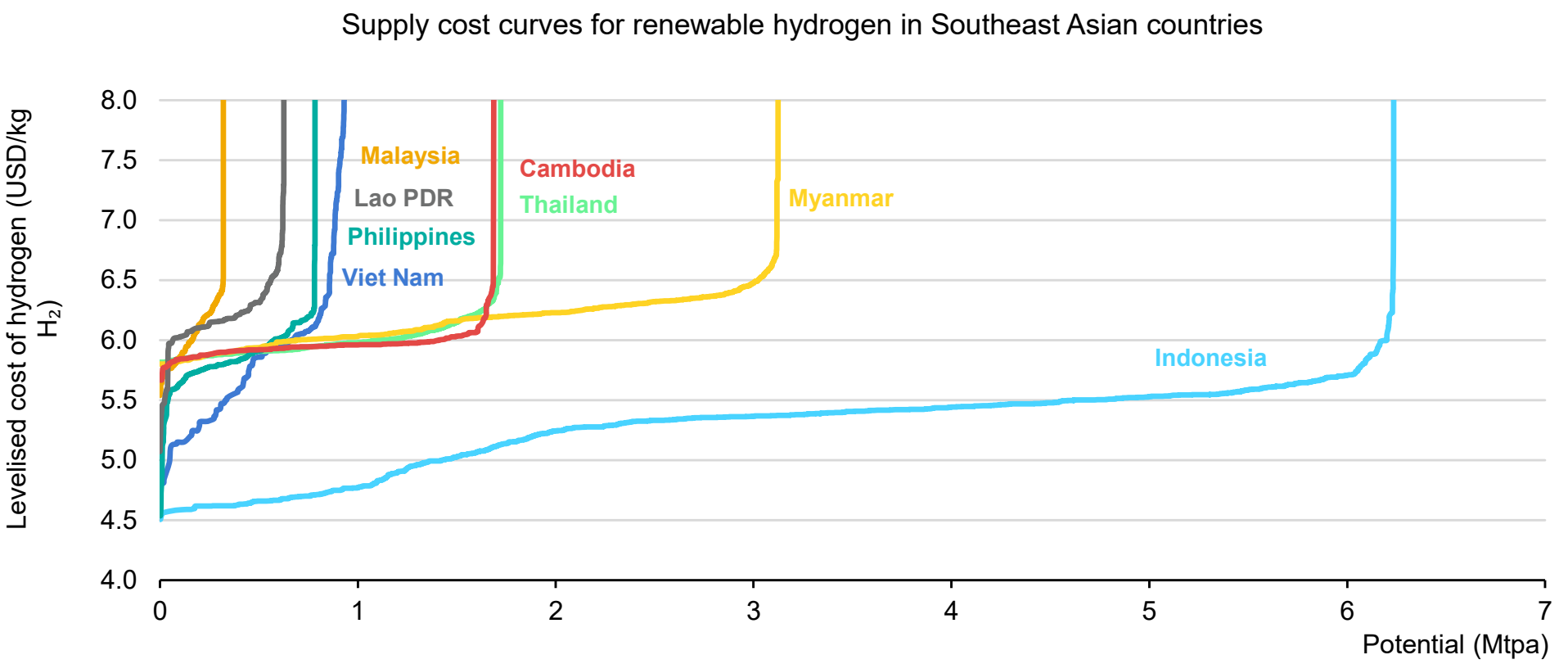
Electricity production mix, 2024



Fossil fuels Hydropower
Solar and onshore wind Others

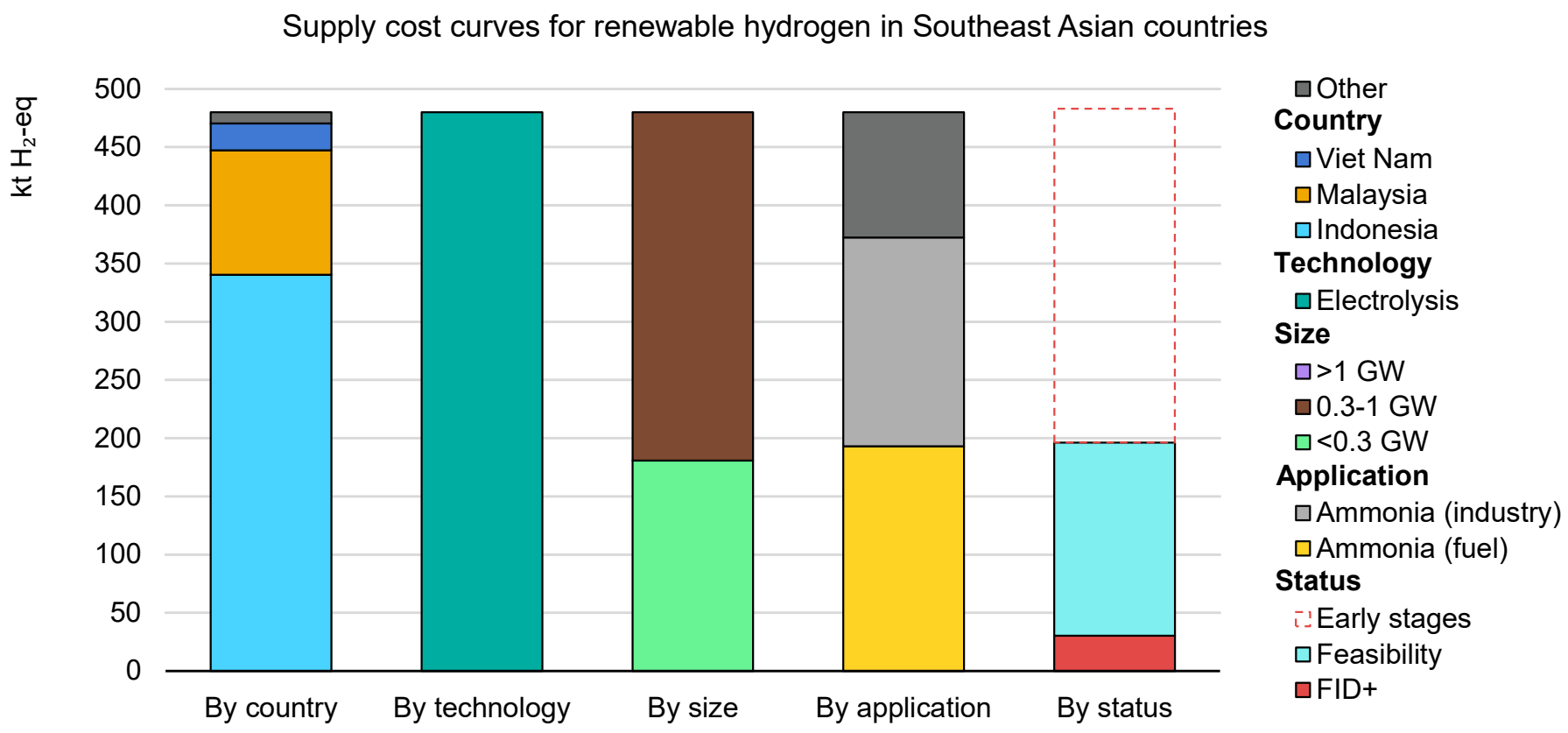
High cost of capital, low renewable penetration in the electricity mix and low incentives for fuel switching in existing industrial applications are the main barriers for low-emissions hydrogen

What are the opportunities in hydrogen production?



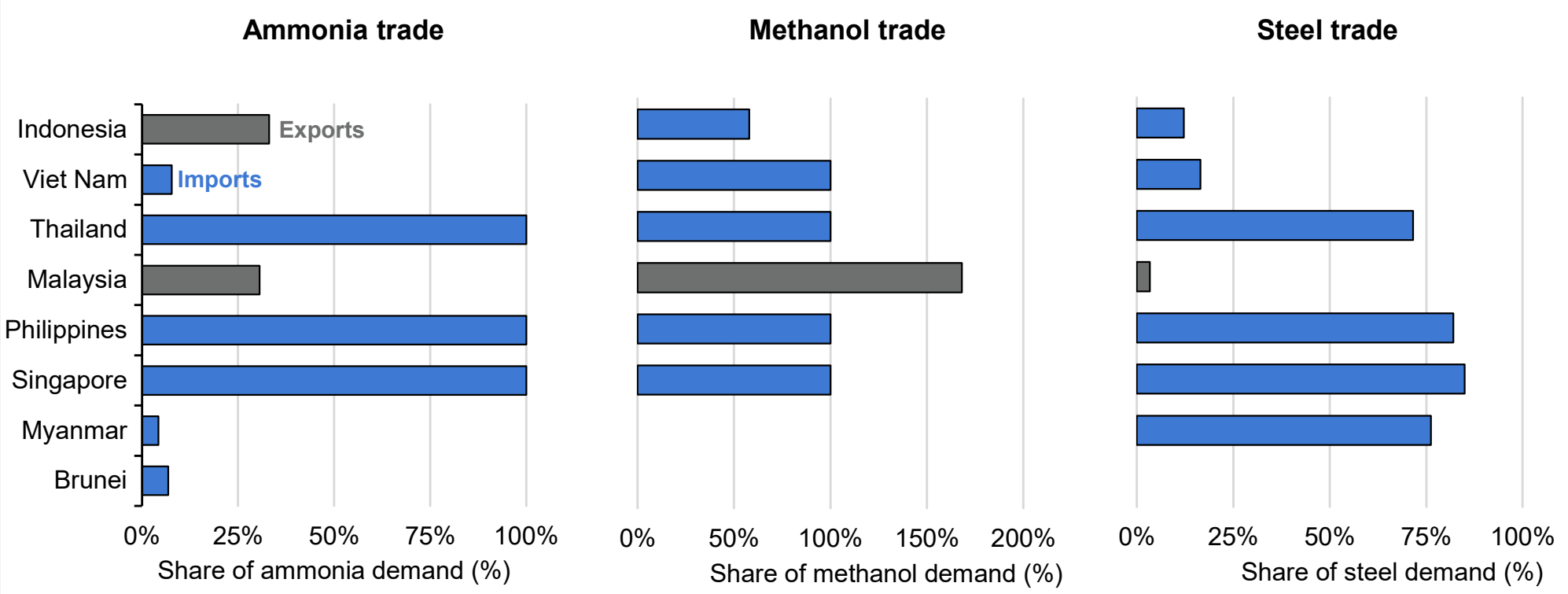
Southeast Asian countries could have nearly 11 Mtpa of hydrogen potential at a production cost below USD 6/kg by 2030 with the bulk of this in Indonesia

Southeast Asia could work on maturing existing project pipeline



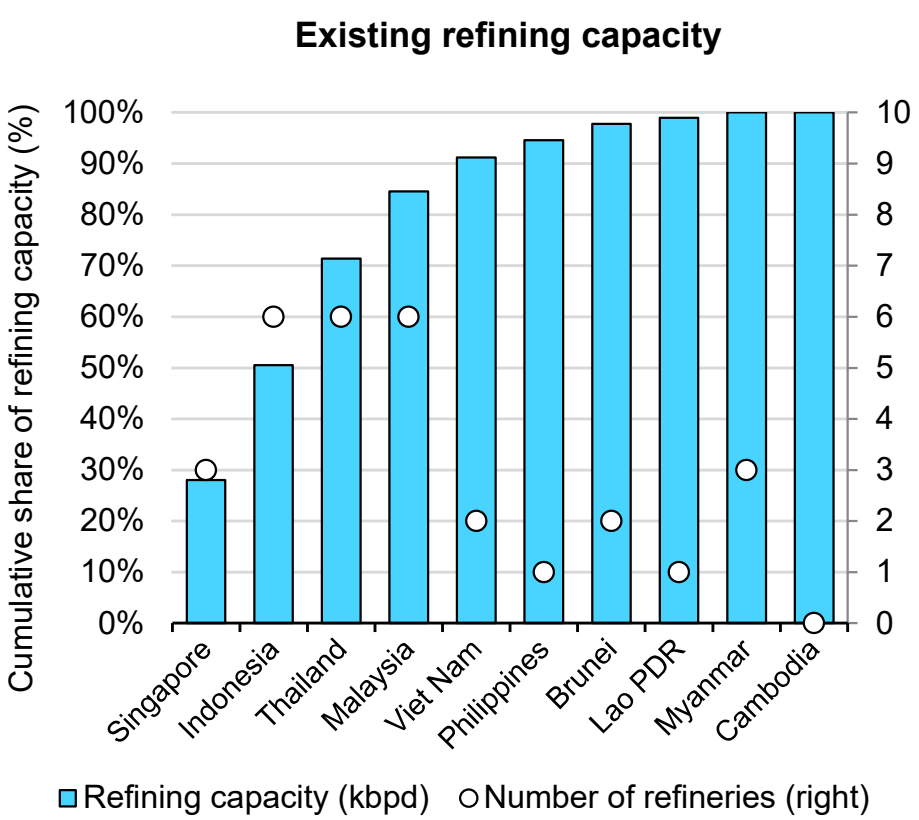
Announced low-emissions hydrogen projects in Southeast Asia total 12% of current regional hydrogen demand, but only 6% of announced capacity has reached FID

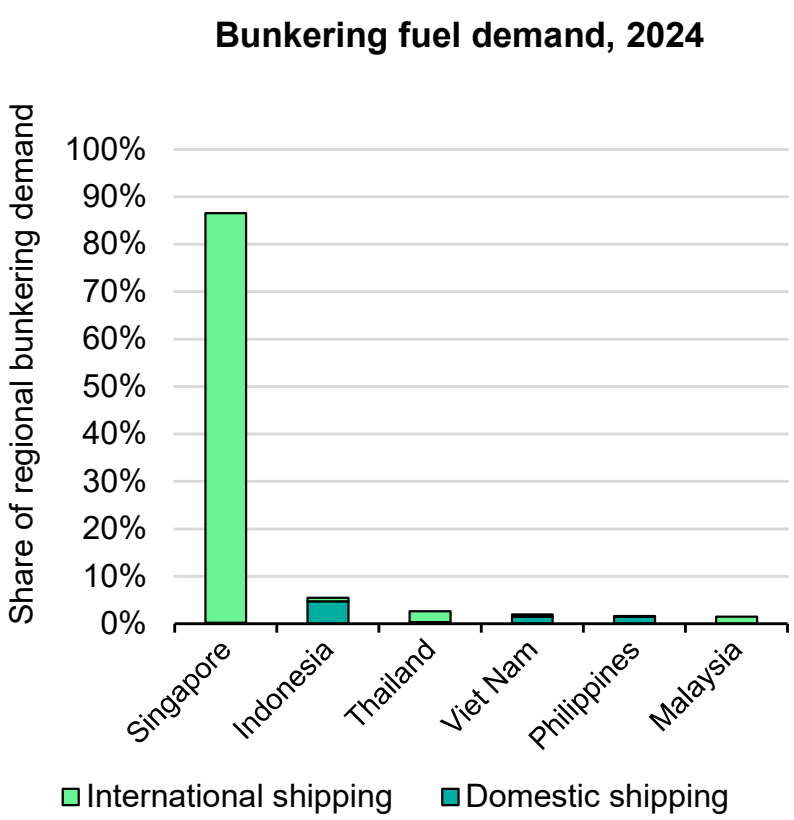
What are the opportunities on the demand side?



Domestic production of hydrogen derivatives has the potential to cut heavy reliance on imports of industrial commodities

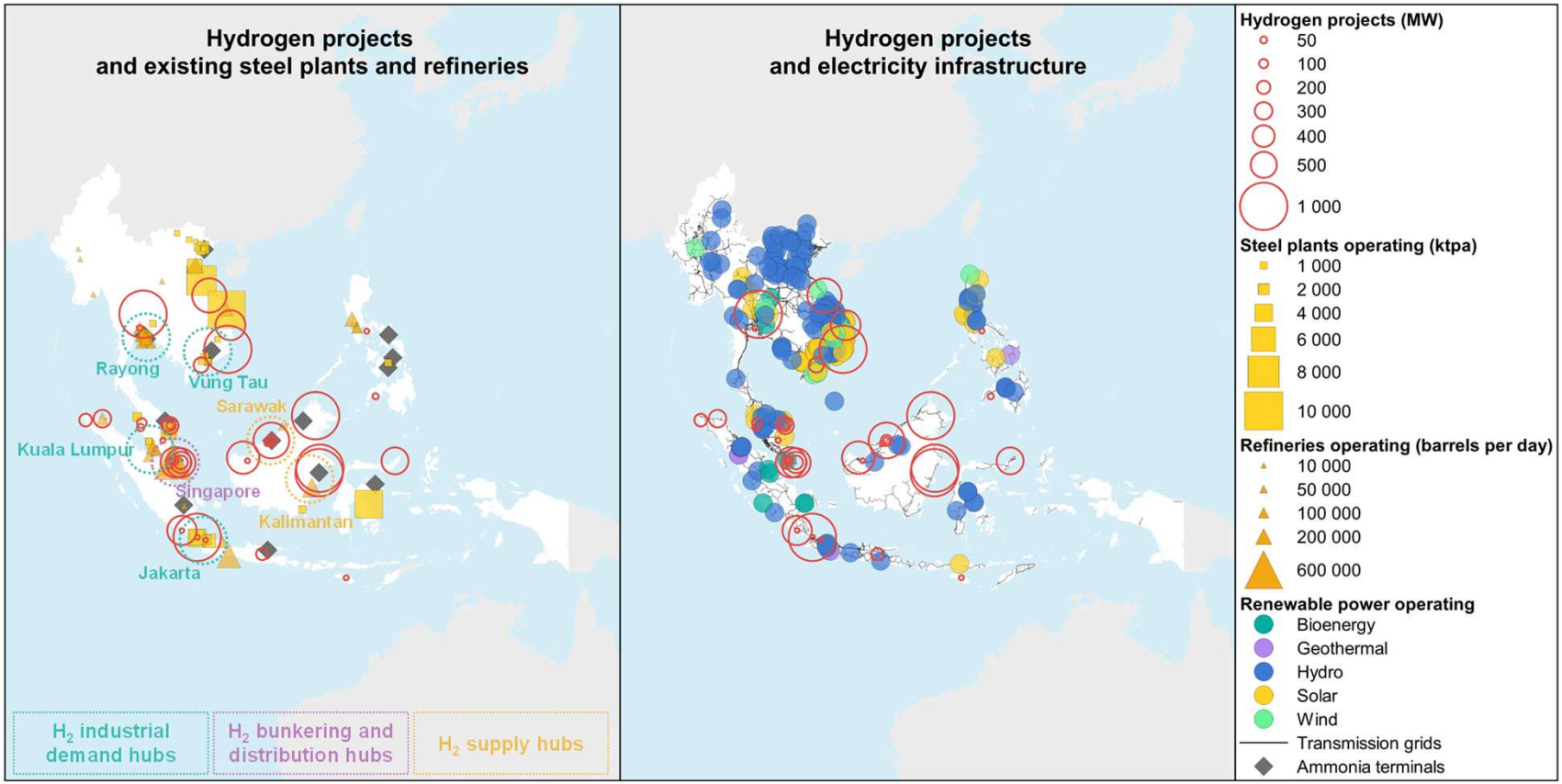
Prospective demand for low-emissions hydrogen is concentrated





Potential demand for low-emissions hydrogen is concentrated in a few sites across countries

Industrial hubs can provide an avenue to trigger hydrogen demand



Existing industrial hubs provide an initial opportunity to trigger demand for low-emissions hydrogen, as does Singapore, as the world's largest bunkering hub

State-owned enterprises provide an opportunity to start developing low-emissions hydrogen

Malaysia

PETRONAS

- **Separate entity** (Gentari) for sustainable energy solutions
- Target: **1.2 Mtpa** by 2030
- Proprietary PEM technology
- Multiple projects in the pipeline

Indonesia

PERTAMINA

- Separate entity (PNRE) for sustainable energy solutions
- Target: **1 Mtpa** by 2030
- **17** projects under development (**1.8 Mtpa**)
- Production from geothermal and natural hydrogen

Thailand

ptt Group

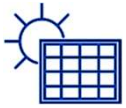
- **Nine** pilot projects submitted to the government
- Plans to develop **1.2 Mtpa** ammonia plant
- **5%** blending for power generation by 2030

Philippines

PNOC

- Operator of current refining capacity (**180 kbpd, 83 ktpa H_2**)
- Exploration of natural hydrogen

Key recommendations for Southeast Asian governments



Prioritize renewable deployment

Create positive spillover effects for hydrogen by building market confidence, standardizing processes, and reducing electricity costs

Deploy pilot projects

Build experience with different configurations, applications, and regions to provide stepping stones for larger projects

Leverage existing applications

Focus on large-scale applications to anchor demand and create economies of scale that other applications can leverage

Develop certification schemes

Start working on certification for hydrogen derivatives to enable policy implementation and global trade

Address high cost of capital

Use policy and financial instruments to reduce WACC through predictable revenue streams, low-cost debt, and guarantees

Collaborate internationally

Learn from best practices in other regions through government, multilateral, and industry partnerships