Global Hydrogen Review 2023

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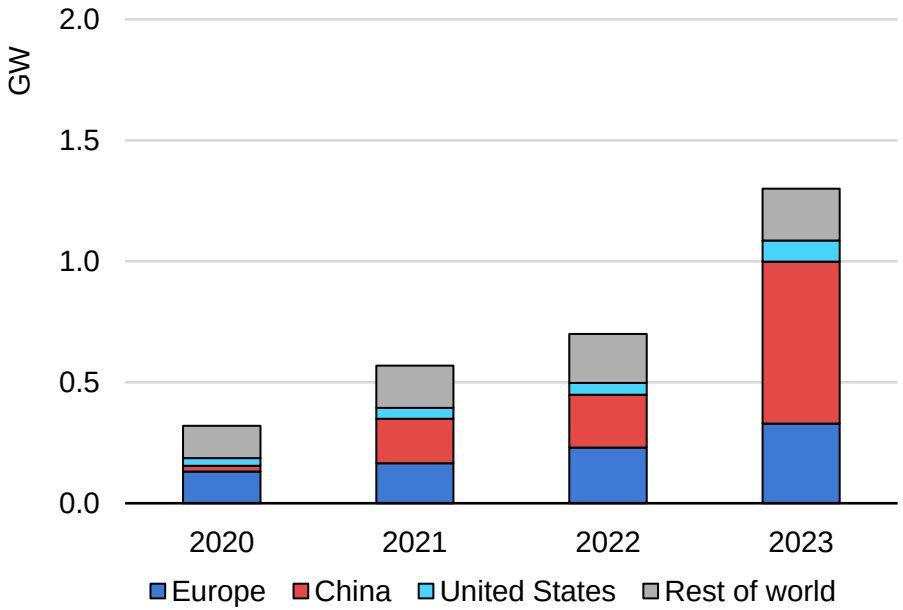
Low-emission hydrogen faces challenging scale-up phase

- Production can increase massively but faces cost challenges
- Efforts to stimulate demand are not sufficient to meet climate ambitions
- The development of hydrogen transmission and storage infrastructure may take longer to develop than the projects it will connect
- Innovation in some hydrogen transport, storage and demand technologies is lagging and some key technologies are not yet commercially available on a large scale
- **How to turn momentum into deployment?**

Growth in electrolyser projects has mushroomed

Historical deployment of water electrolysers and capacity in 2030 based on announced projects



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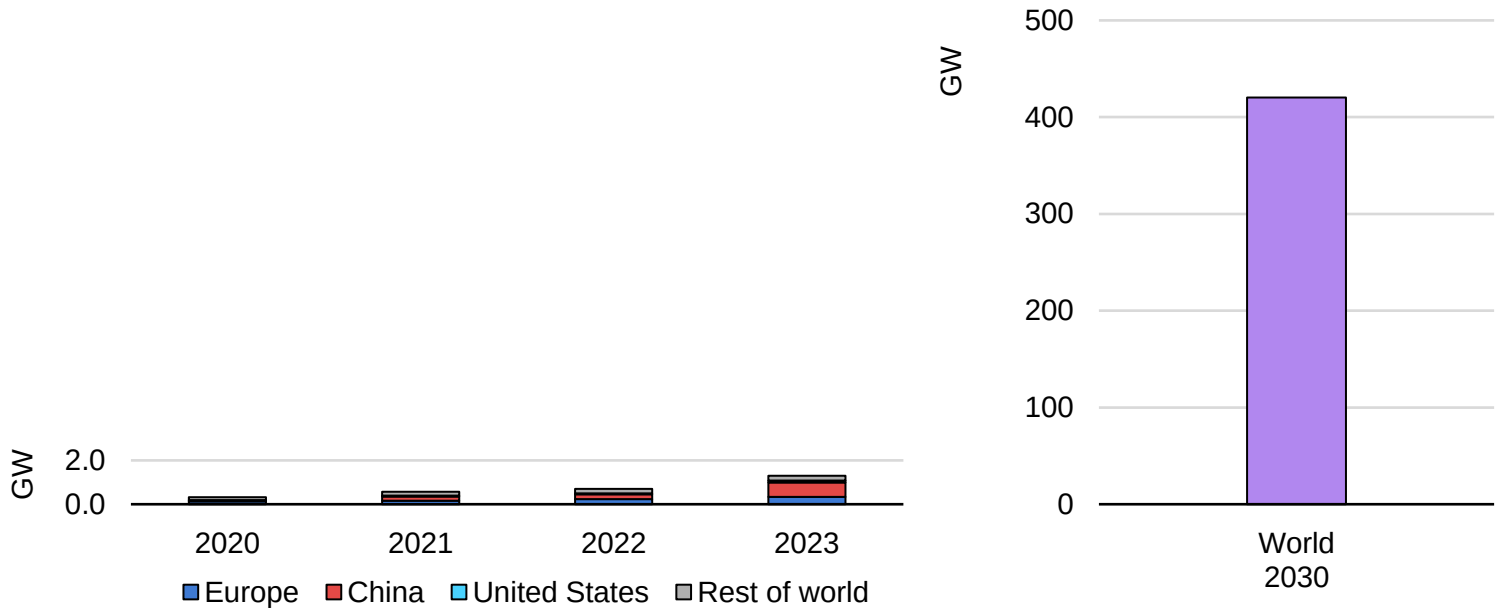

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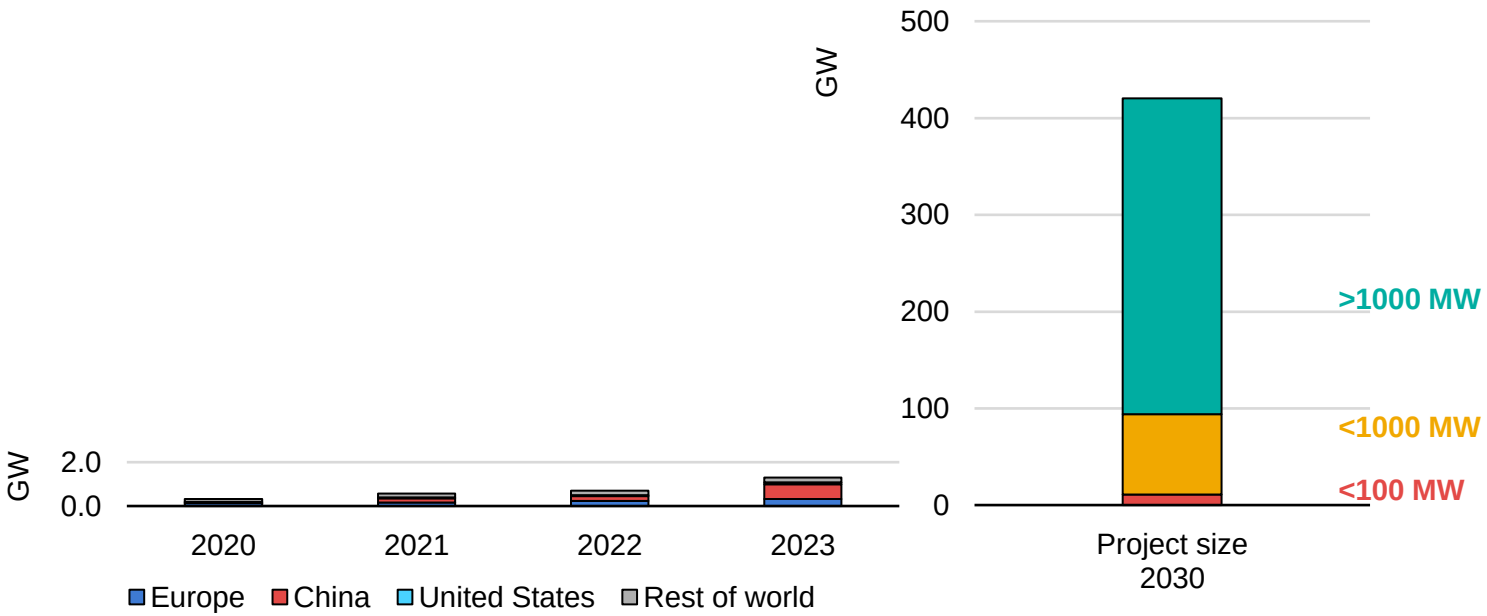

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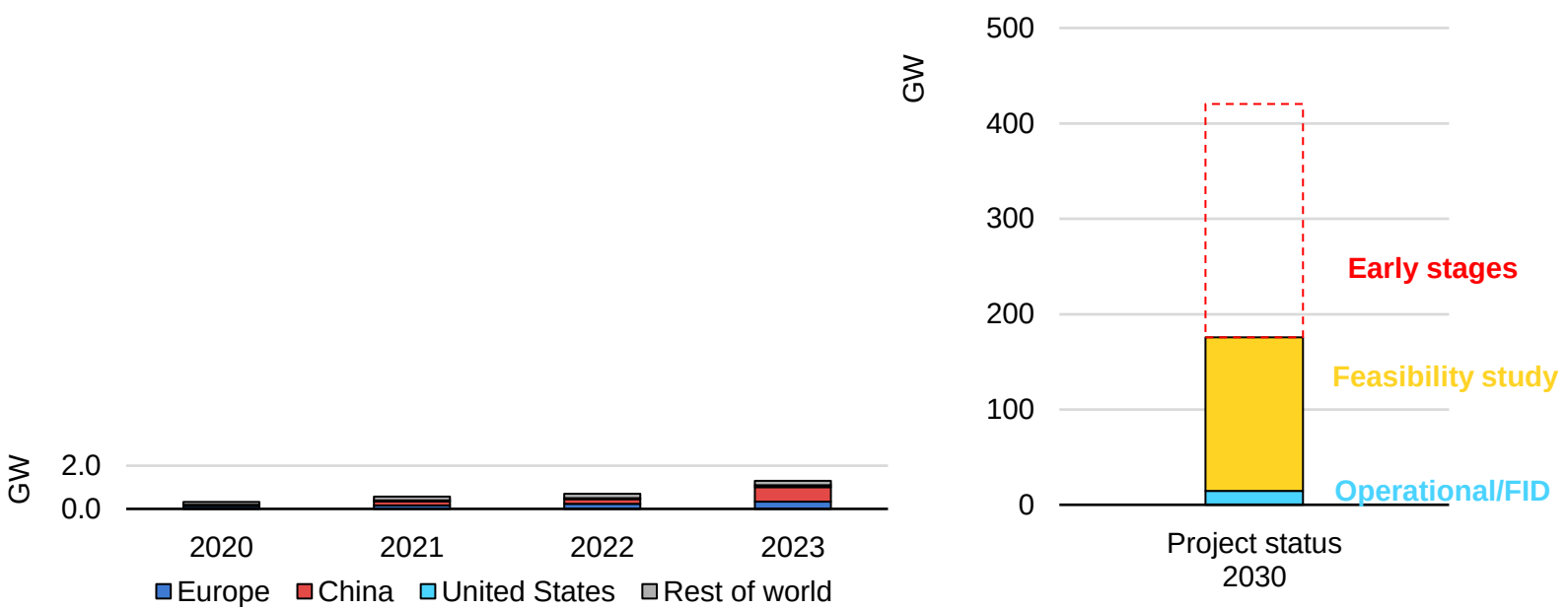

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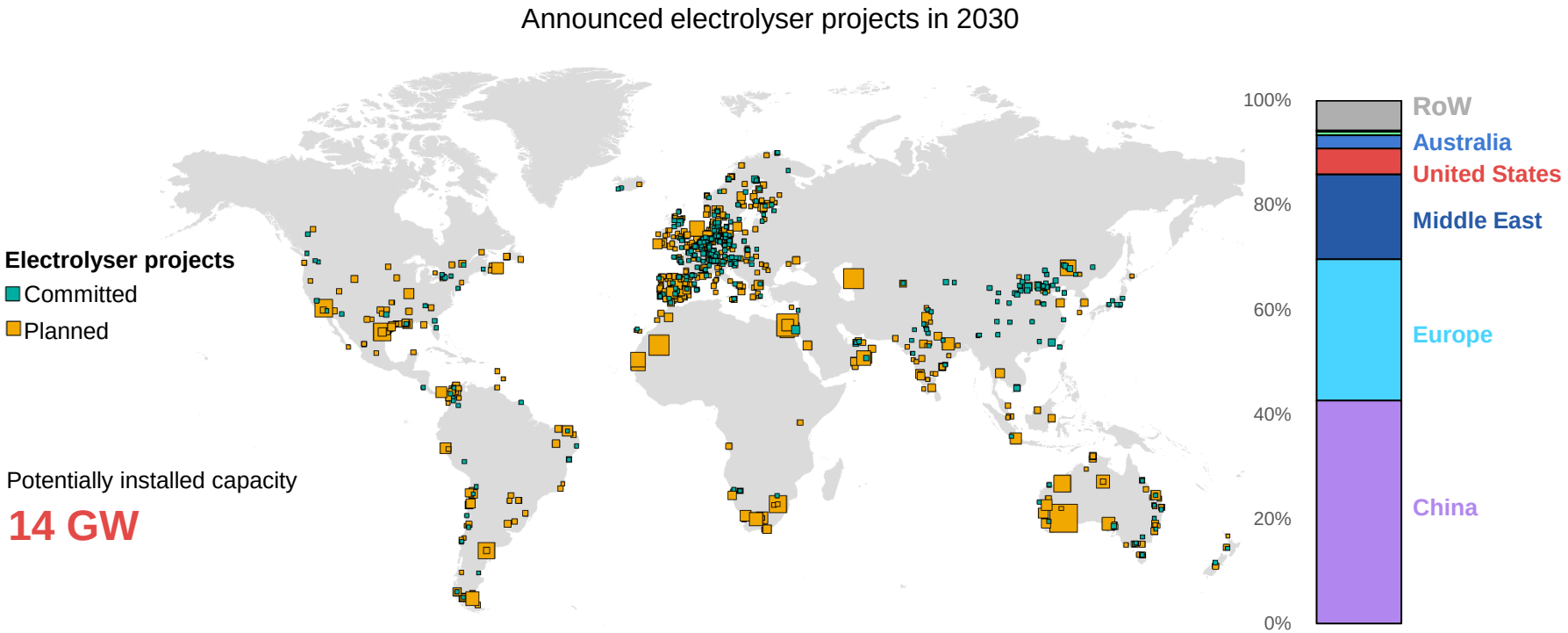
Geographical diversity of electrolyser projects is increasing



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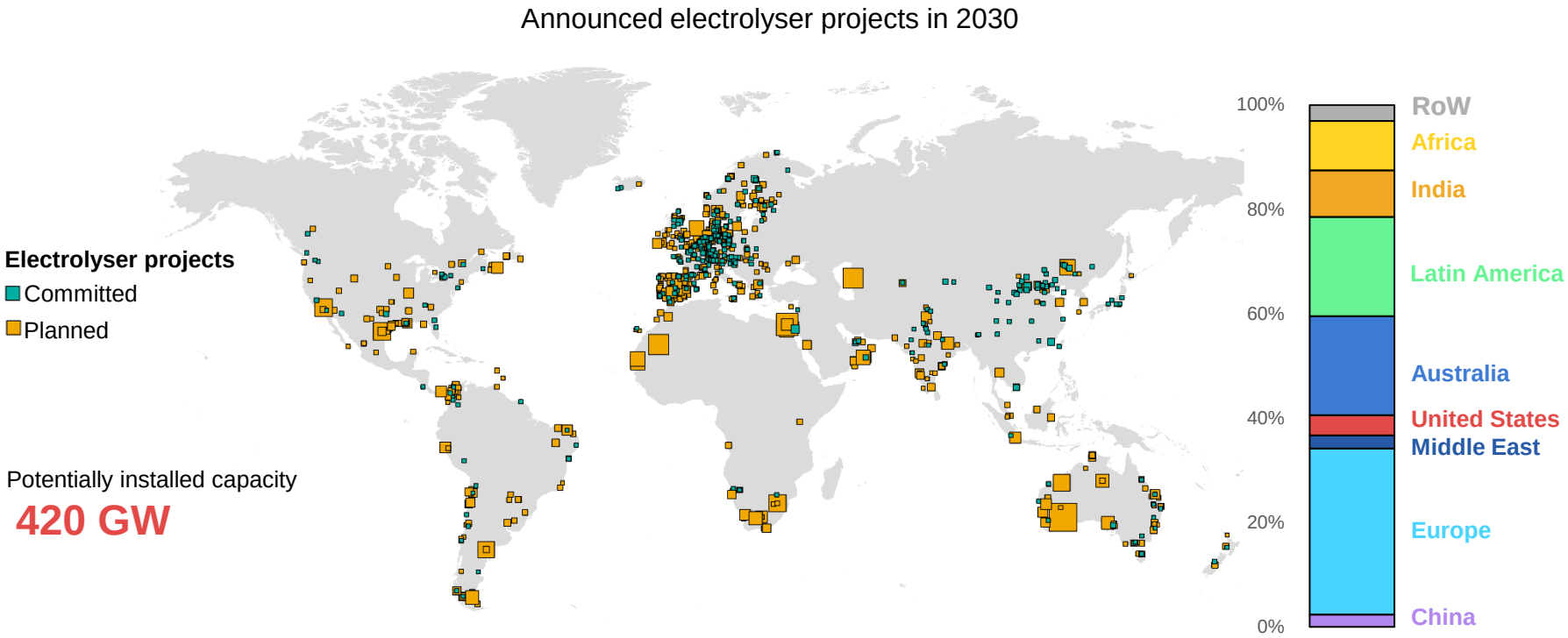

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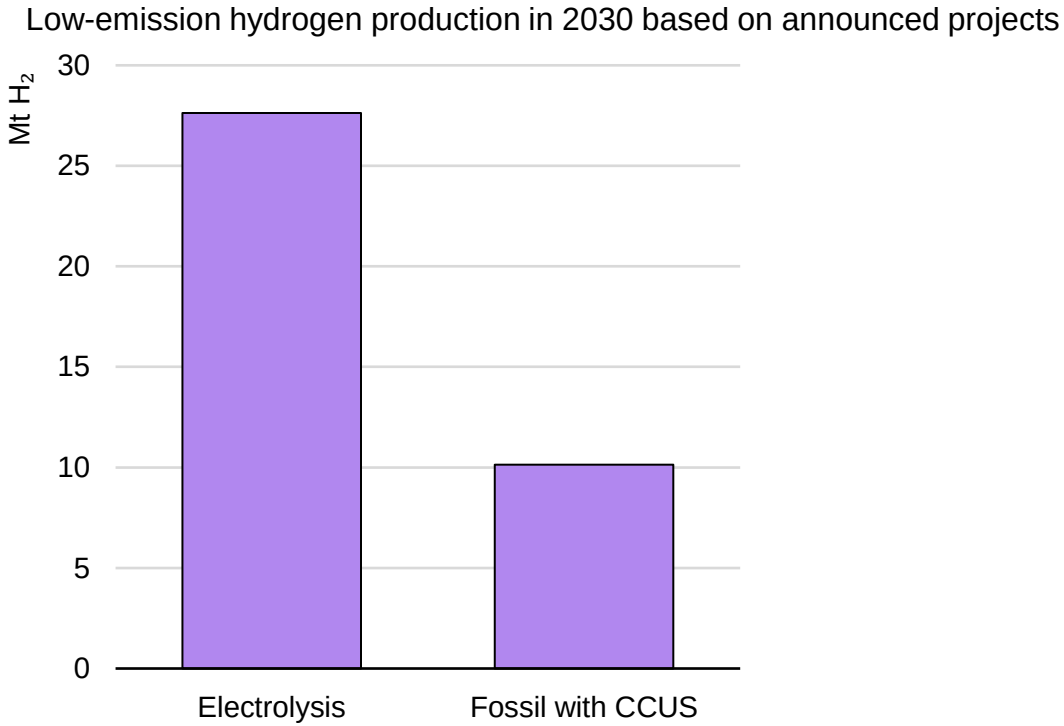
Production routes are evolving differently



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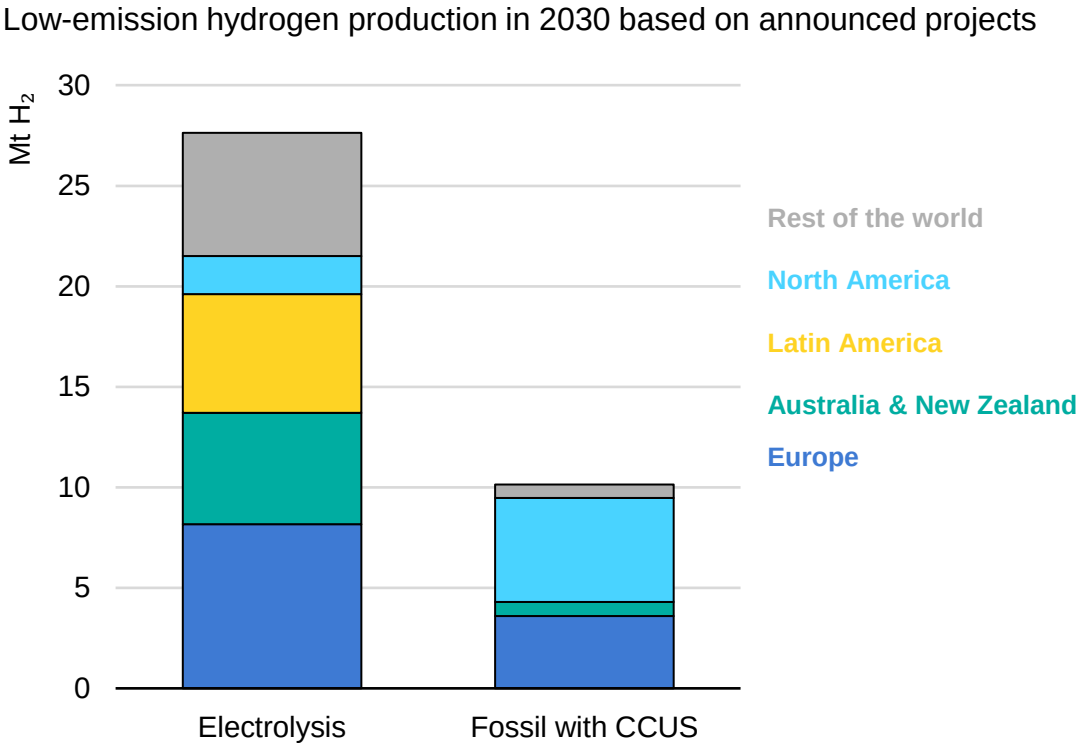

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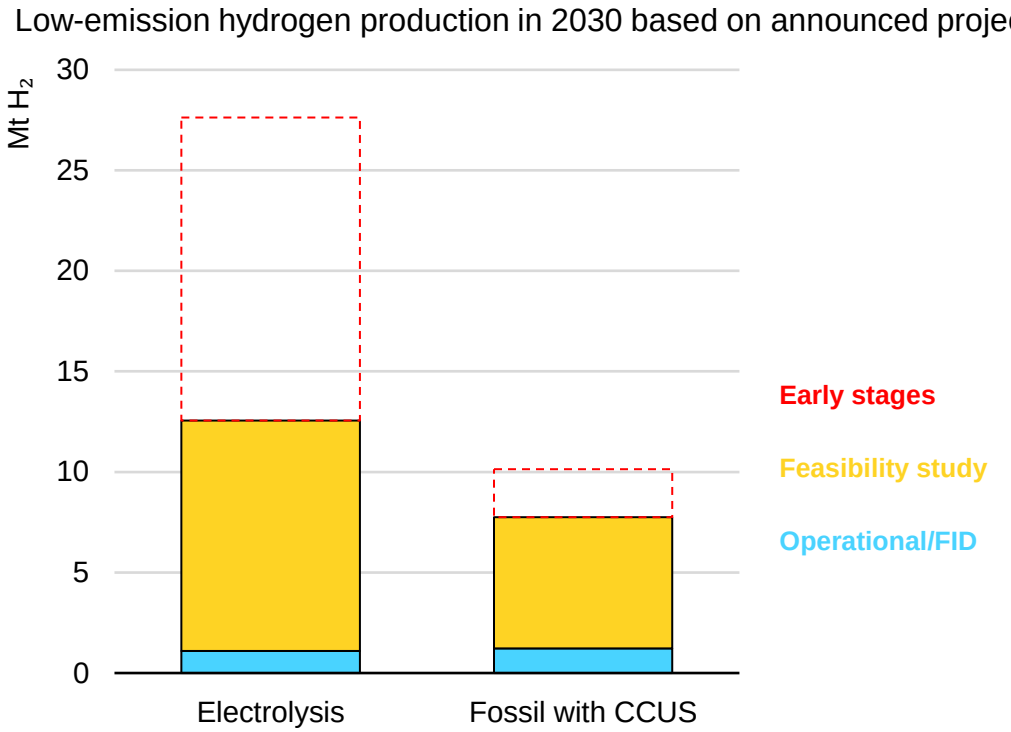

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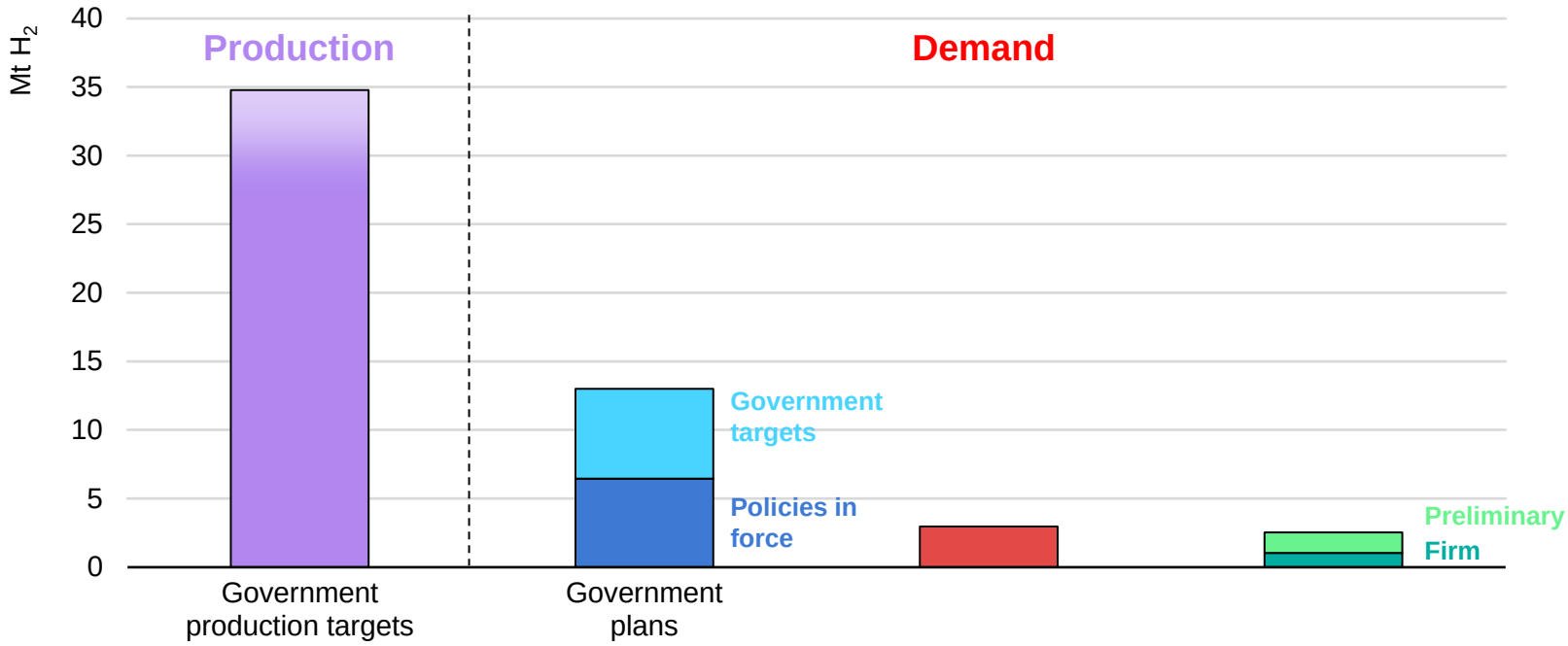
Demand creation is falling behind production ambitions

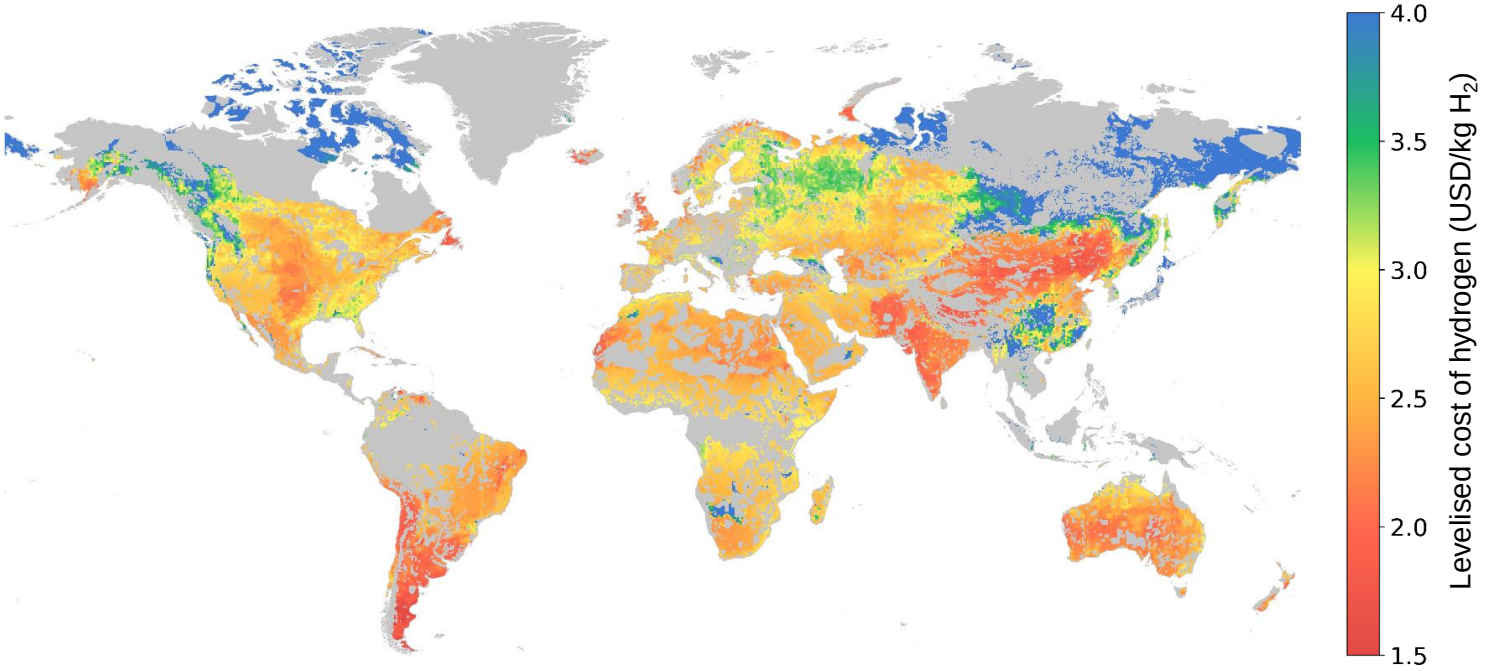
Low-emission hydrogen production targets compared with potential demand, 2030



Actions from governments, international co-operation initiatives and the private sector fall short of production ambitions

Scaling up deployment will bring down costs for renewable hydrogen

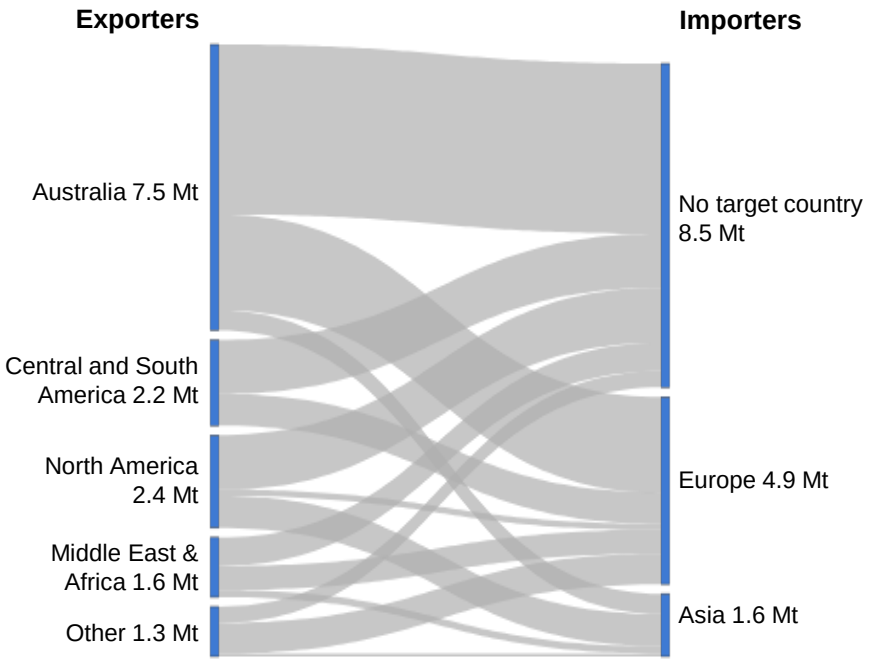
Hydrogen production costs from hybrid solar PV and onshore wind systems in the NZE Scenario in 2030



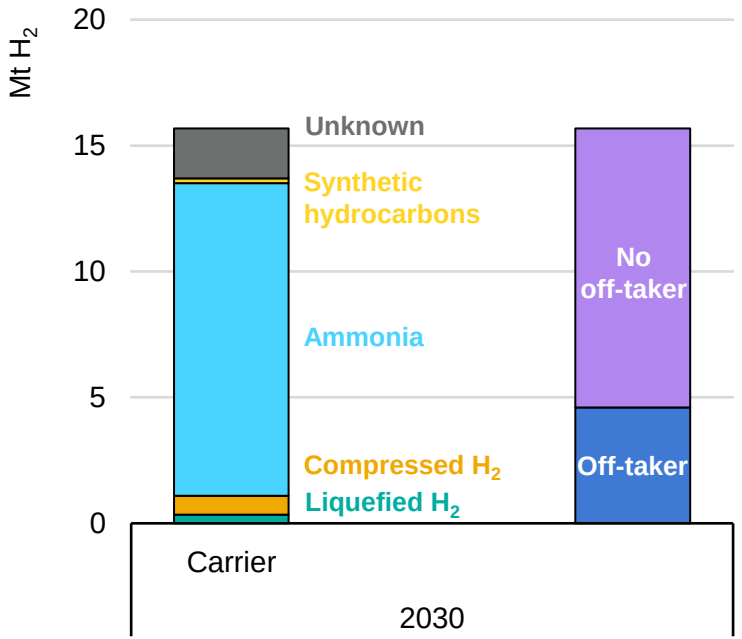
Various regions around the world have excellent renewable resources for low-cost hydrogen production. Costs could approach USD 1.5 kg H_2 by 2030.

Interest in hydrogen trade is growing, but barriers remain

Announced low-emission hydrogen trade flows in 2030

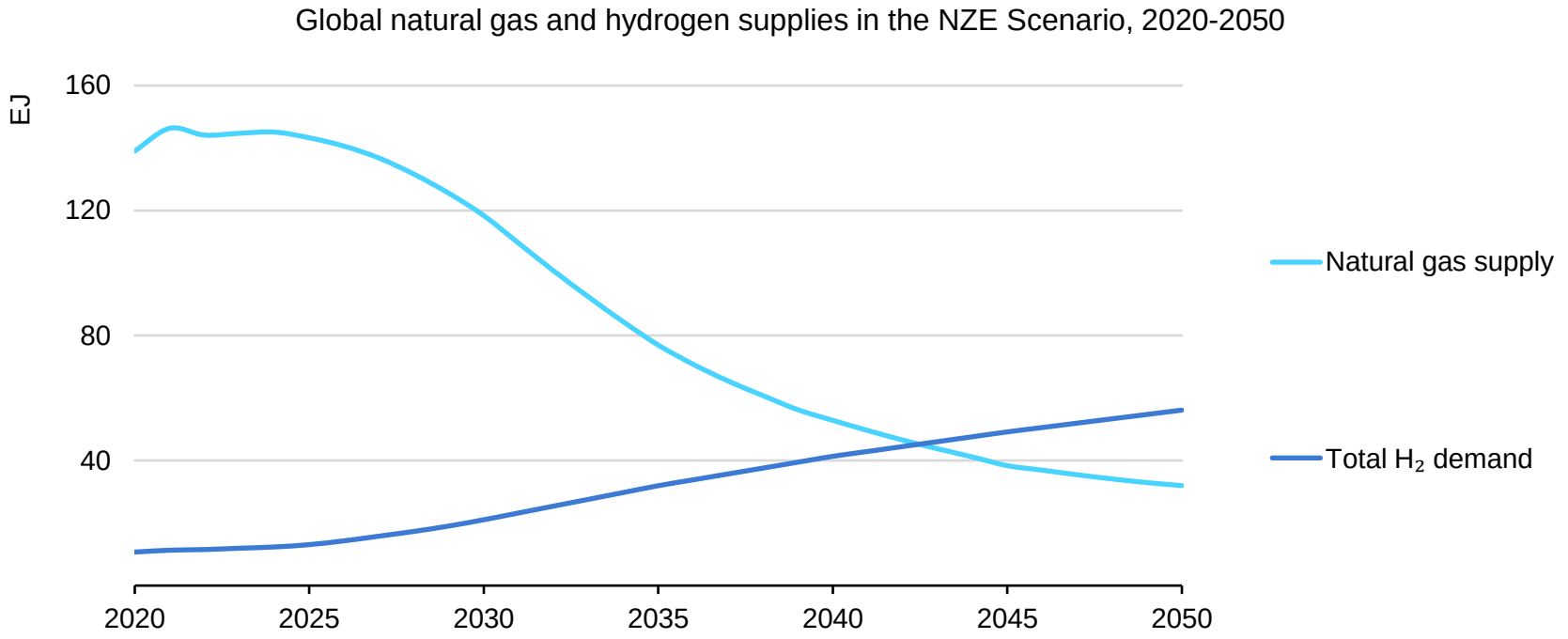


Low-emission hydrogen trade



Planned hydrogen exports could reach 16 Mt by 2030, though almost all projects are at early stages and less than one-third have identified a potential off-taker.

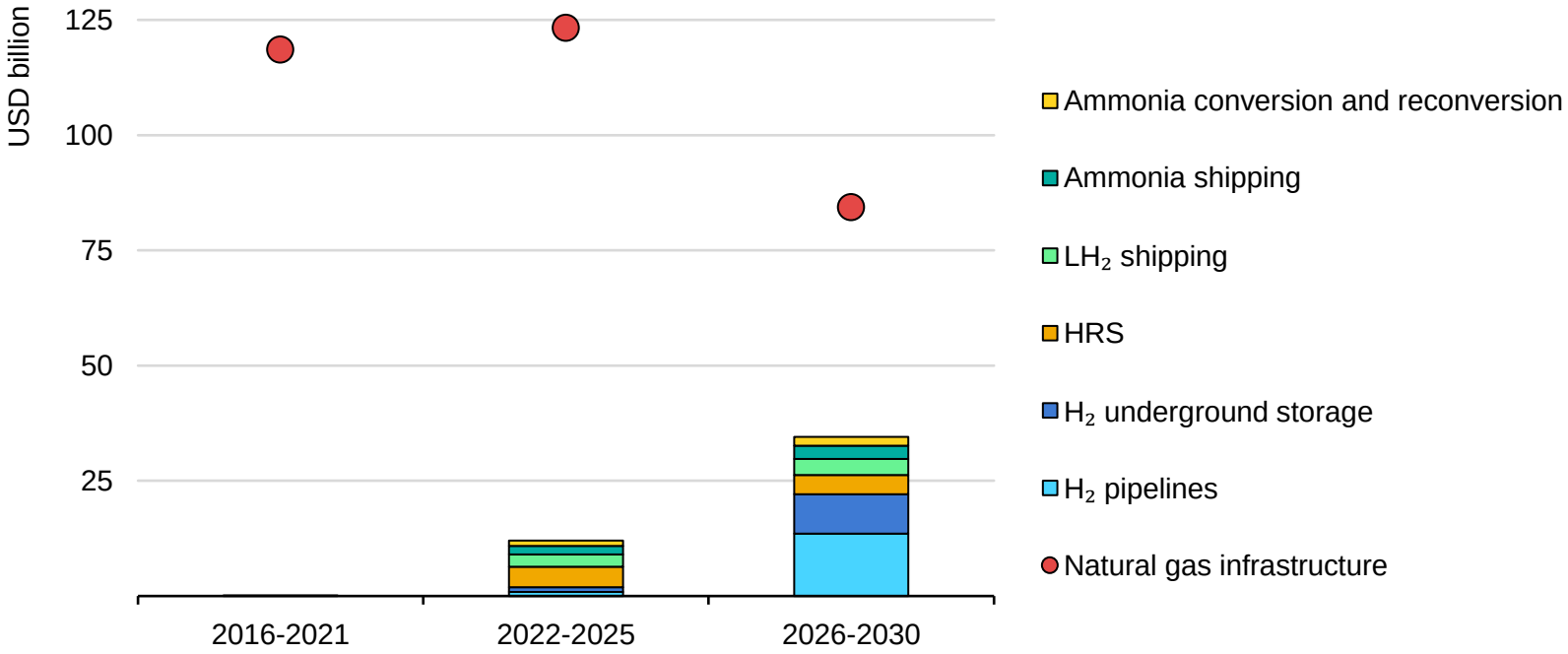
Hydrogen infrastructure needs



Hydrogen supply in the NZE Scenario surpasses that of natural gas by 2045 and by 2050 is equivalent to 40% of the current natural gas supply

Hydrogen infrastructure – an opportunity for investment

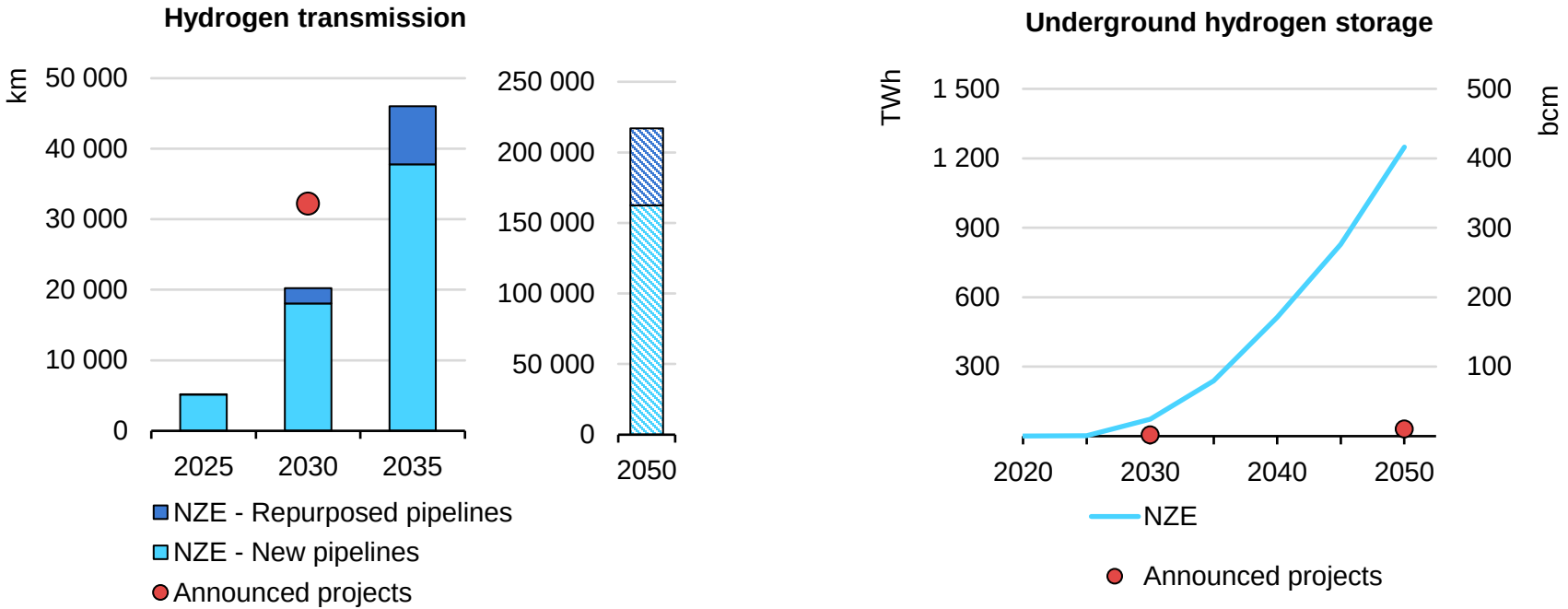
Average anual global investment in hydrogen and natural gas infrastructure in the NZE Scenario, 2016-2050



The NZE Scenario requires major investments in hydrogen infrastructure, mostly for pipelines and storage

The rise of infrastructure for hydrogen transport and storage

Global hydrogen transmission pipeline length and underground storage capacity in the NZE Scenario, 2020-2050



The long lead times associated with infrastructure projects mean that while the announced length of hydrogen pipelines would be in line with NZE needs, underground storage requires urgent and accelerated action

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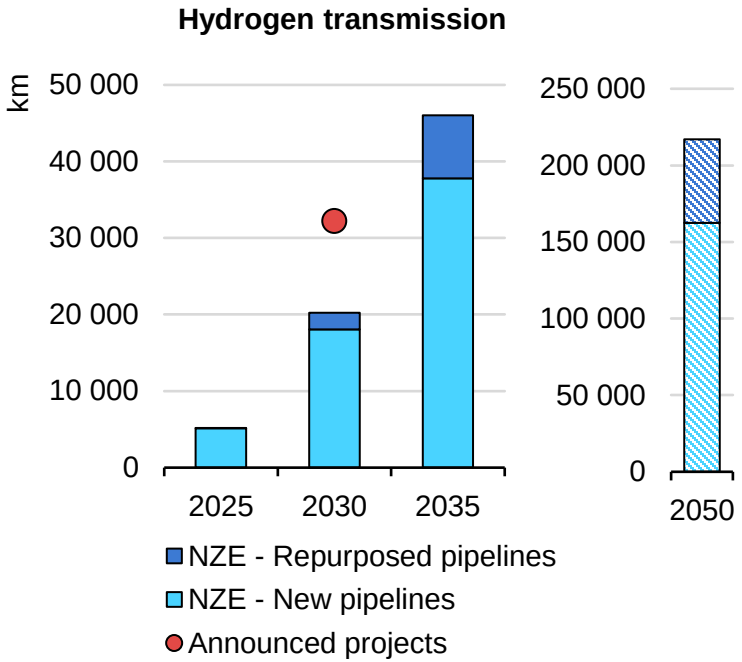

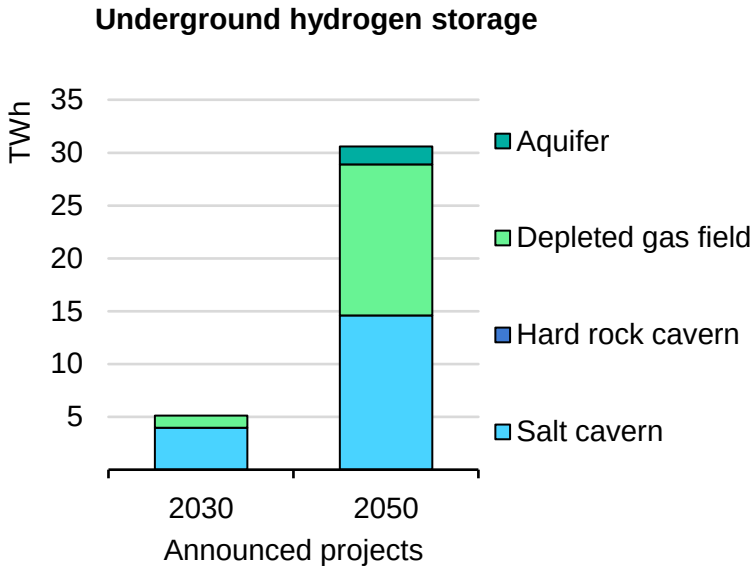

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The rise of the network for the transport and storage of hydrogen

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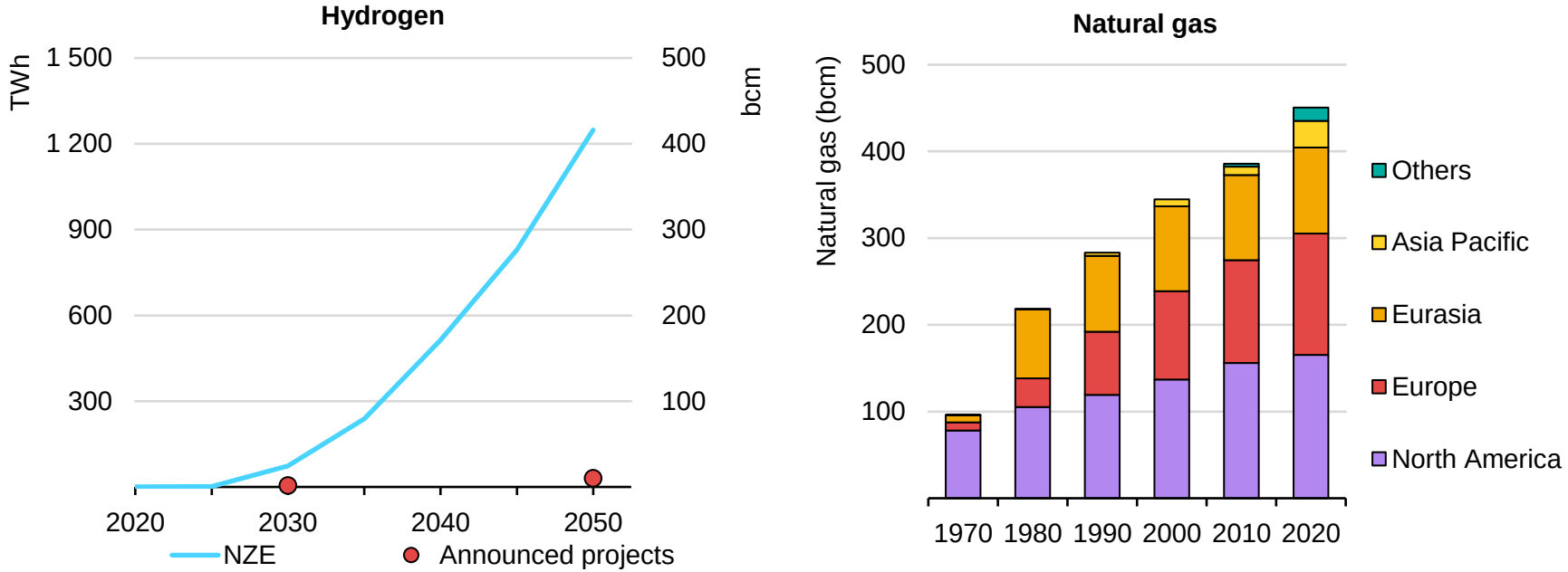
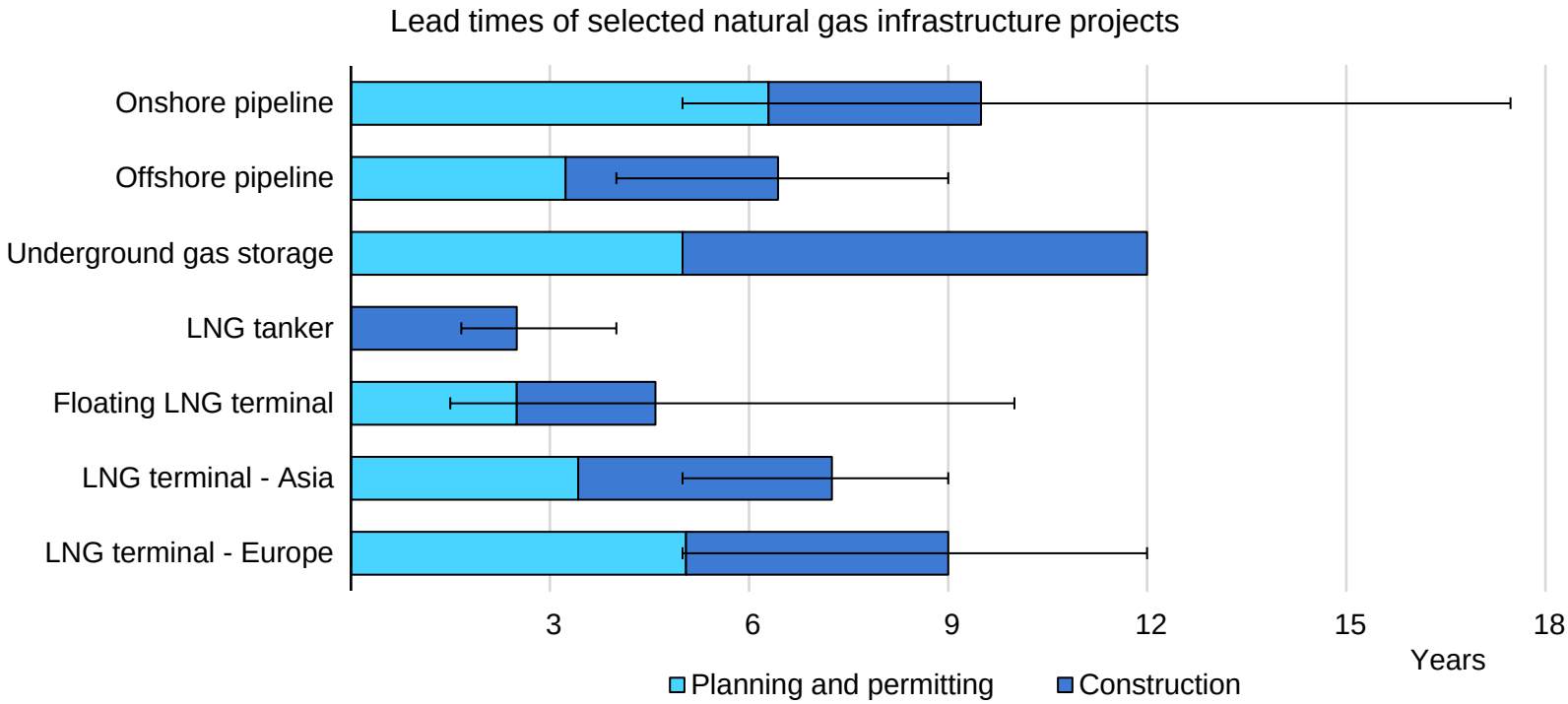


Rapid hydrogen supply growth in the NZE Scenario would require and increase in bulk underground storage, equal to more tan twice that of natural gas over the last 30 years in volumetric terms

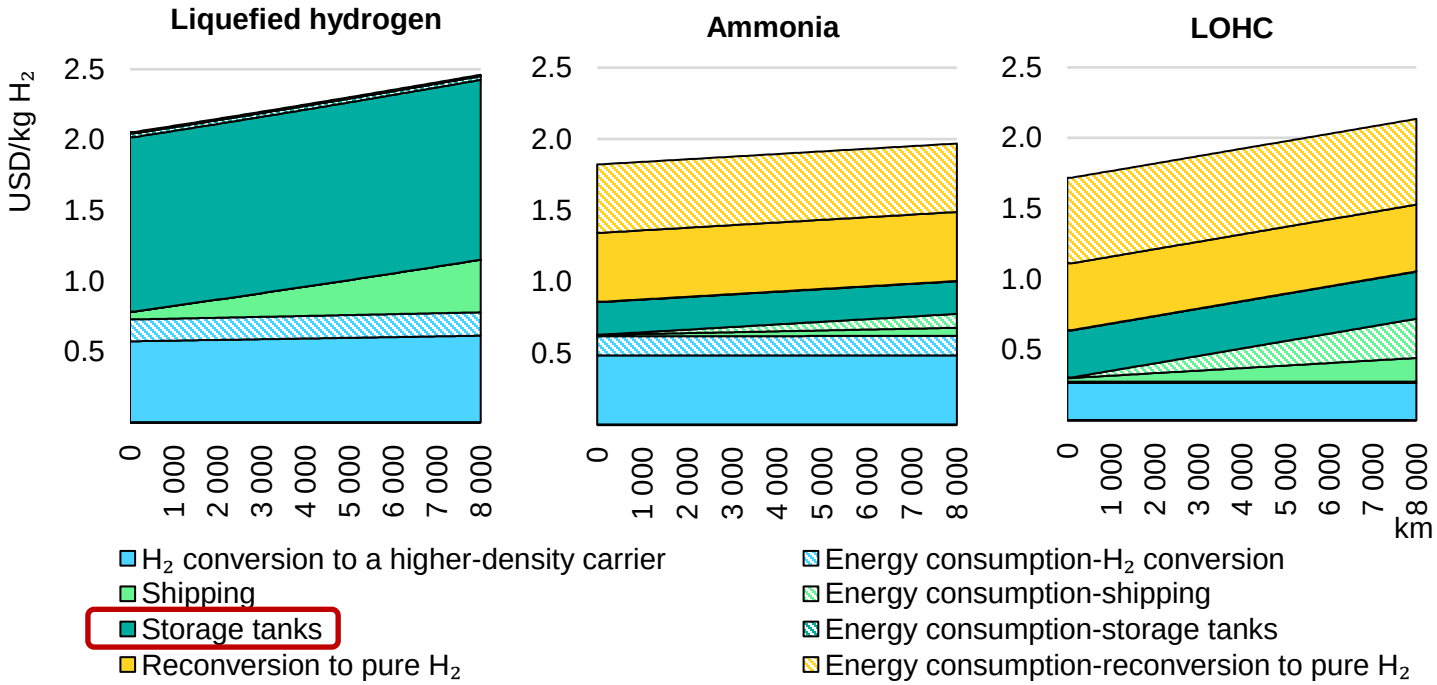
Shortening lead times



Developing new gas infrastructure takes considerable time, so planning must start well in advance and strategies to shorten lead times should be explored

Aboveground hydrogen storage at large scale

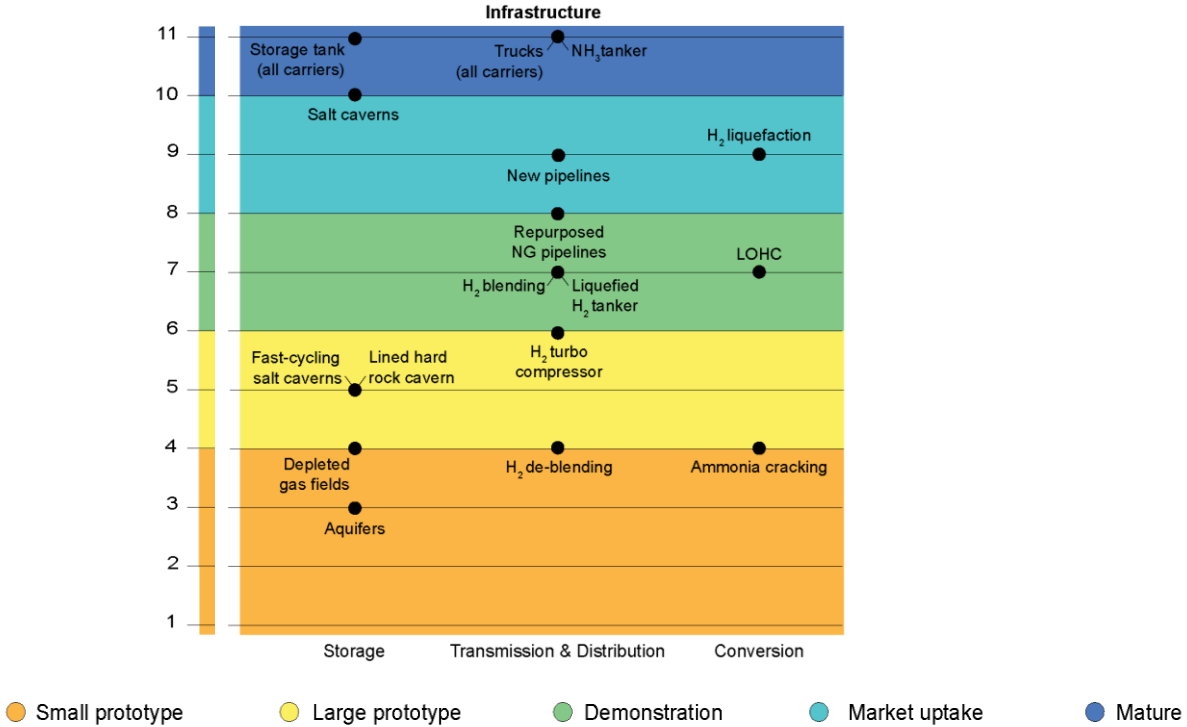
Indicative levelized cost of delivering hydrogen, by shipping-option step and distance in the NZE, 2030



Hydrogen can be stored in above-ground tanks as liquefied hydrogen, as ammonia, or as a carrier, but innovation challenges remain around the cost and losses of LH_2 and reconversion to pure H_2

Innovation will be key to the success of low-emission hydrogen

Technology readiness levels of low-emission hydrogen and synthetic fuels, and infrastructure



Several technologies related to hydrogen infrastructure are not yet commercially available on a large scale

IEA policy recommendations

1. **Implement support schemes** for low-emission hydrogen production and use

2. **Take bolder action to stimulate demand** for low-emission hydrogen, particularly in existing hydrogen uses

3. **Address regulatory barriers**, particularly for project licensing and permitting

4. **Foster innovation** to bring technologies with low TRLs to market and decrease costs

5. **Enhance international co-operation** to enable hydrogen certification and mutual recognition

6. **An increase in concessional financing** to expand the regional outreach to emerging markets.