International Energy Agency

The Future of Hydrogen

Jose M Bermudez, IEA

Webinar Next steps for energy systems integration

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Hydrogen – A common *element* of our energy future?

- Momentum currently behind hydrogen is unprecedented, with more and more policies, projects and plans by governments & companies in all parts of the world

- Hydrogen can help overcome many difficult energy challenges

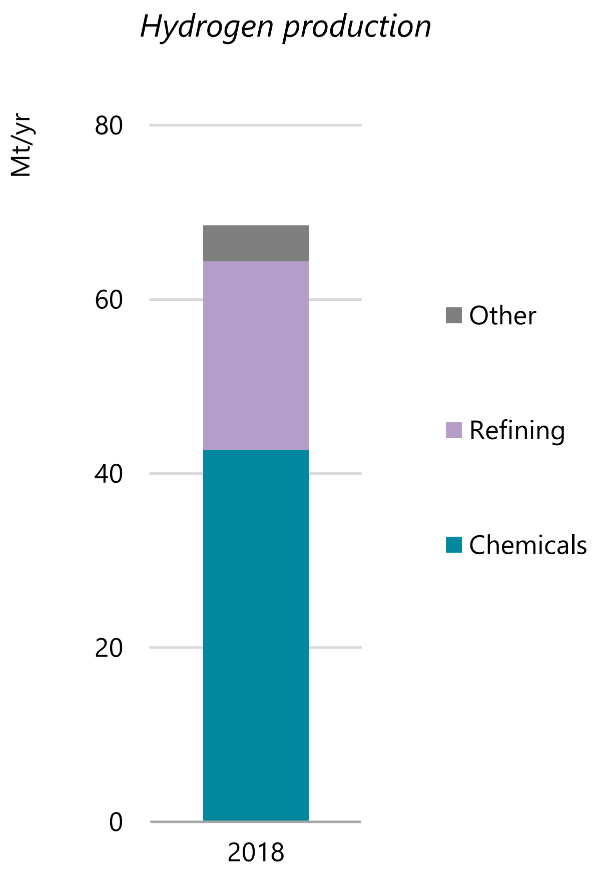
  - ***Integrate more renewables***, including by enhancing storage options & tapping their full potential

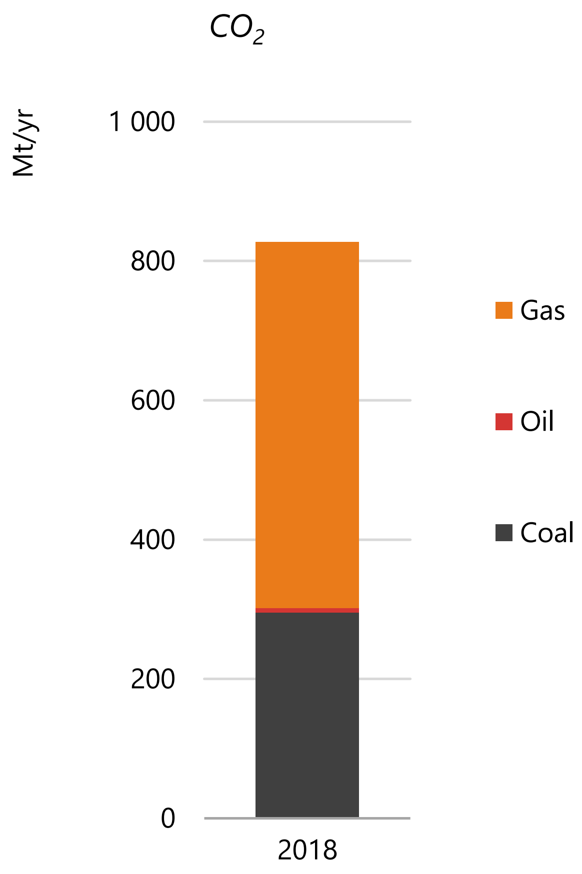
  - ***Decarbonize hard-to-abate sectors*** such as steel, chemicals, trucks, ships & planes

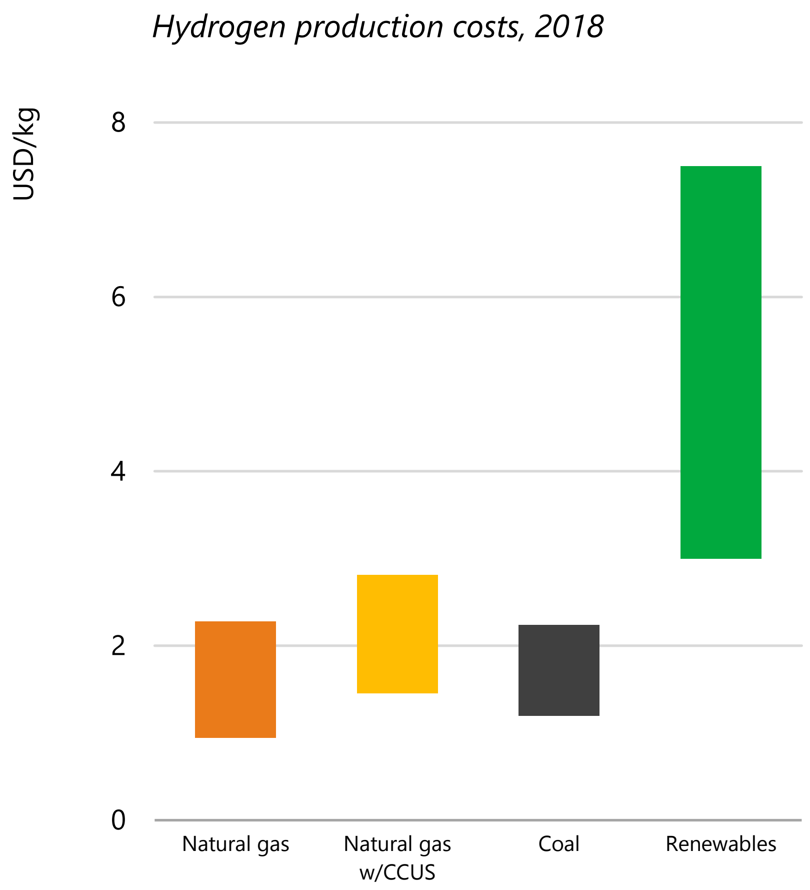
  - ***Enhance energy security*** by diversifying the fuel mix & providing flexibility to balance grids

- But there are challenges: ***costs*** need to fall; ***infrastructure*** needs to be developed; ***cleaner hydrogen*** is needed; and ***regulatory barriers*** persist

Hydrogen is already part of the energy mix

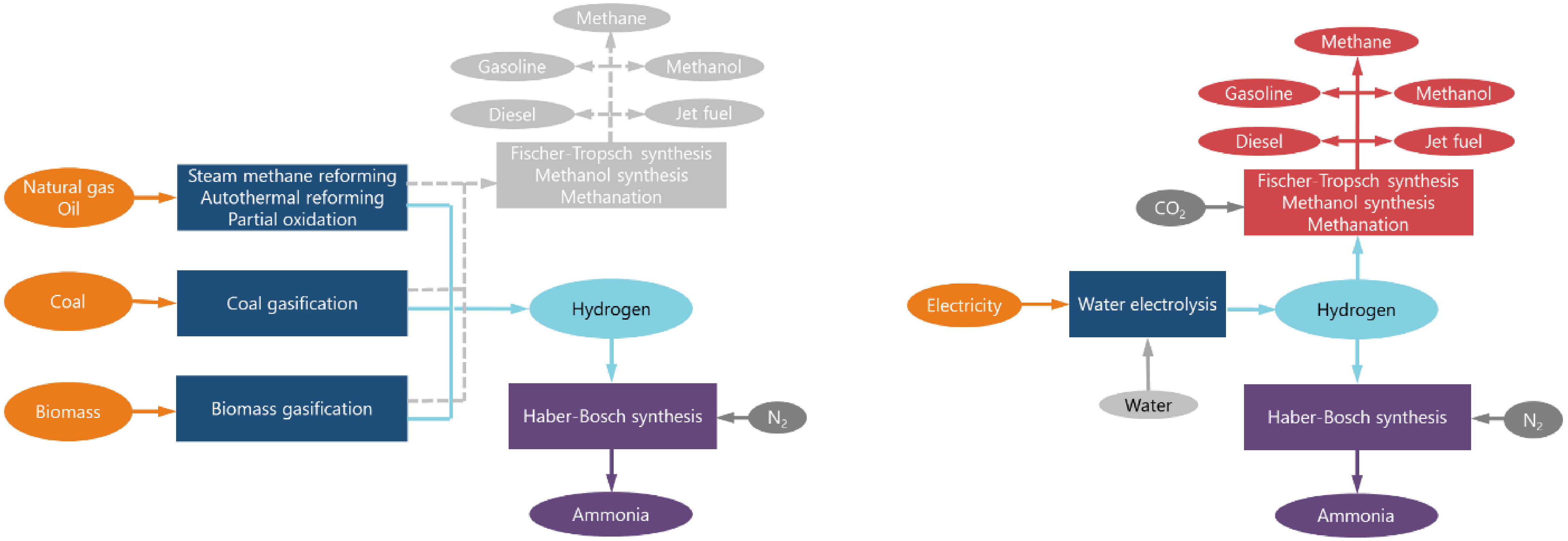






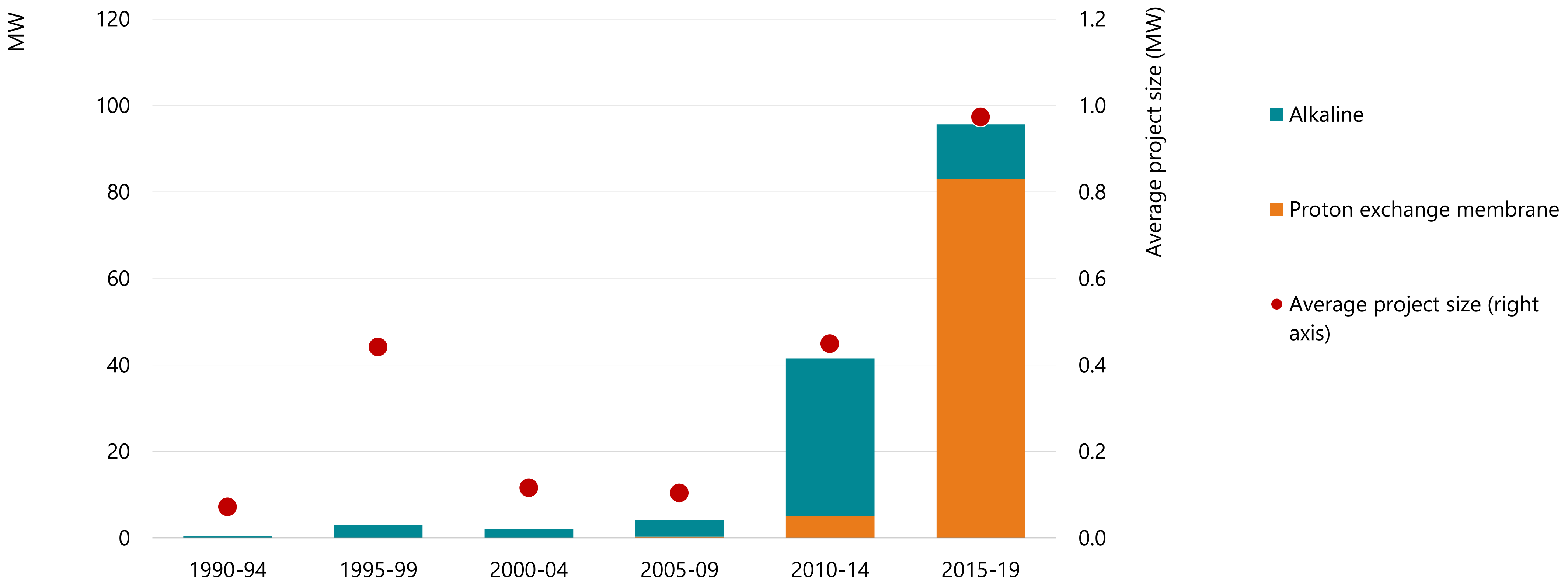
Dedicated hydrogen production is concentrated in very few sectors today, and virtually all of it is produced using fossil fuels, as a result of favourable economics.

Pathways for producing hydrogen and hydrogen-based products



Various options exist to produce hydrogen, with steam methane reforming, coal gasification and water electrolysis being the prevalent ones today

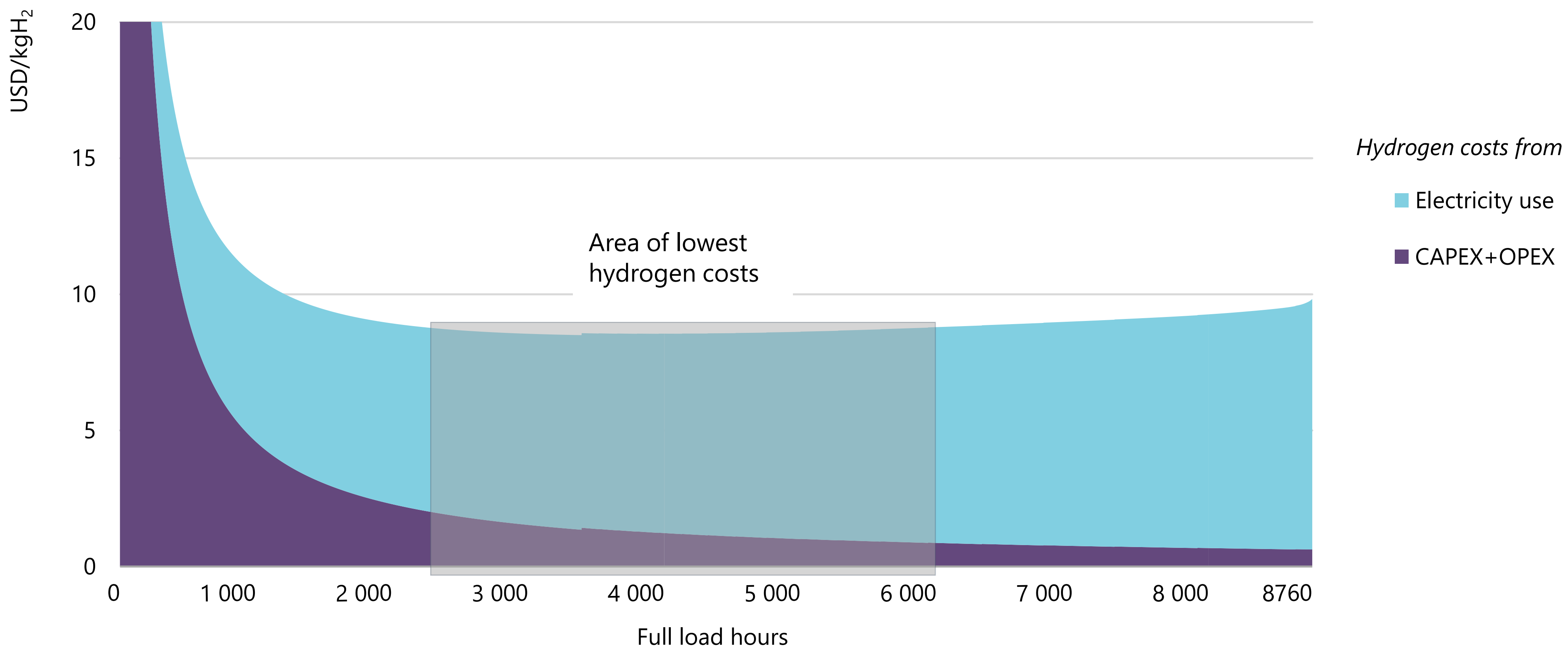
Global electrolyser capacity additions and average unit size



Electrolyser capacity additions and their average sizes have been growing rapidly in recent years, providing cost reductions from economies of scale and learning effects.

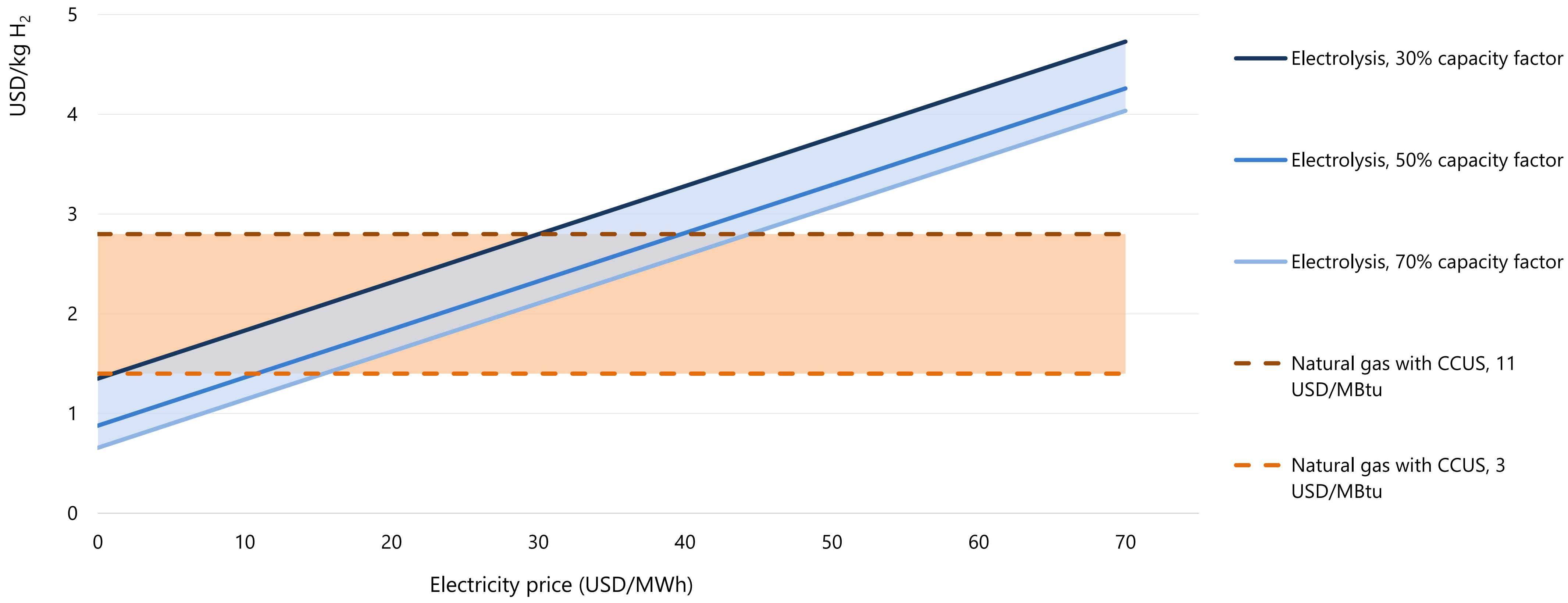
Sweet spot for electrolytic hydrogen production

Electrolytic hydrogen production cost at different full load hours



Mid-load operation of electrolysers achieves the lowest hydrogen costs, balancing CAPEX, OPEX, and electricity costs.

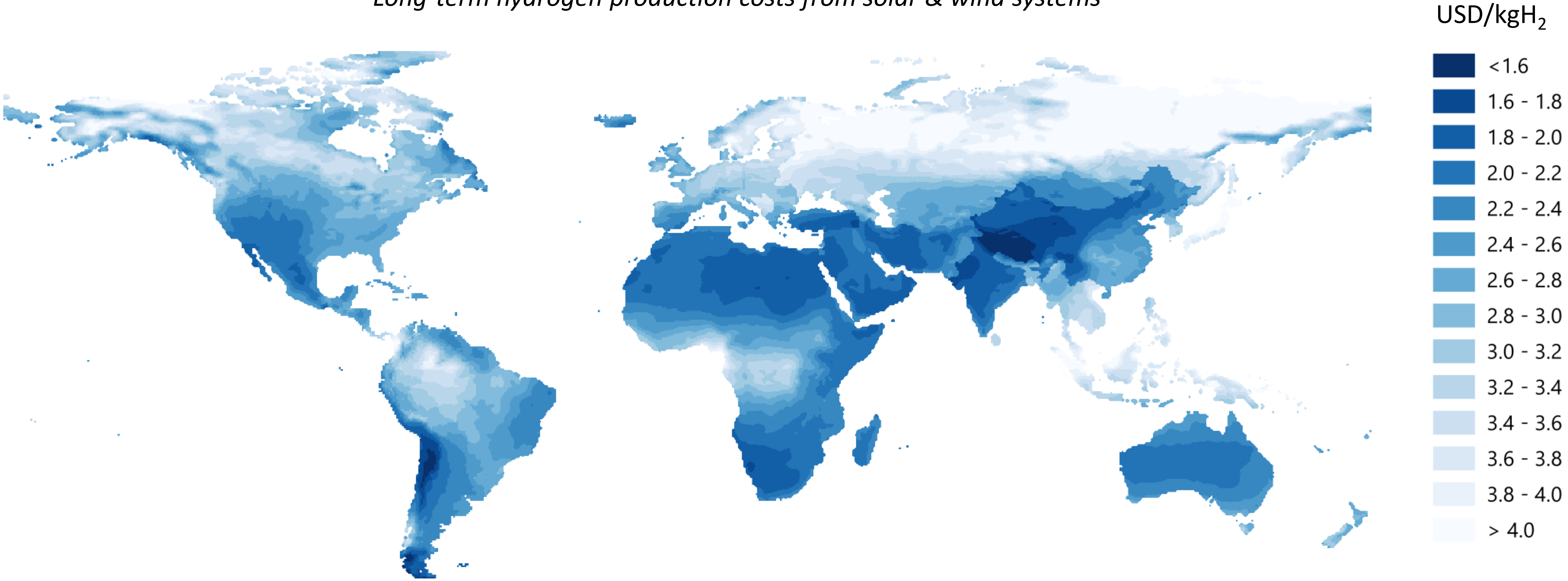
Cost competitiveness depends on electricity and natural gas prices



Depending on local gas prices, electricity at USD 10- 40/MWh and at full load hours of around 4 000h is needed for water electrolysis to become cost competitive with natural gas with CCUS.

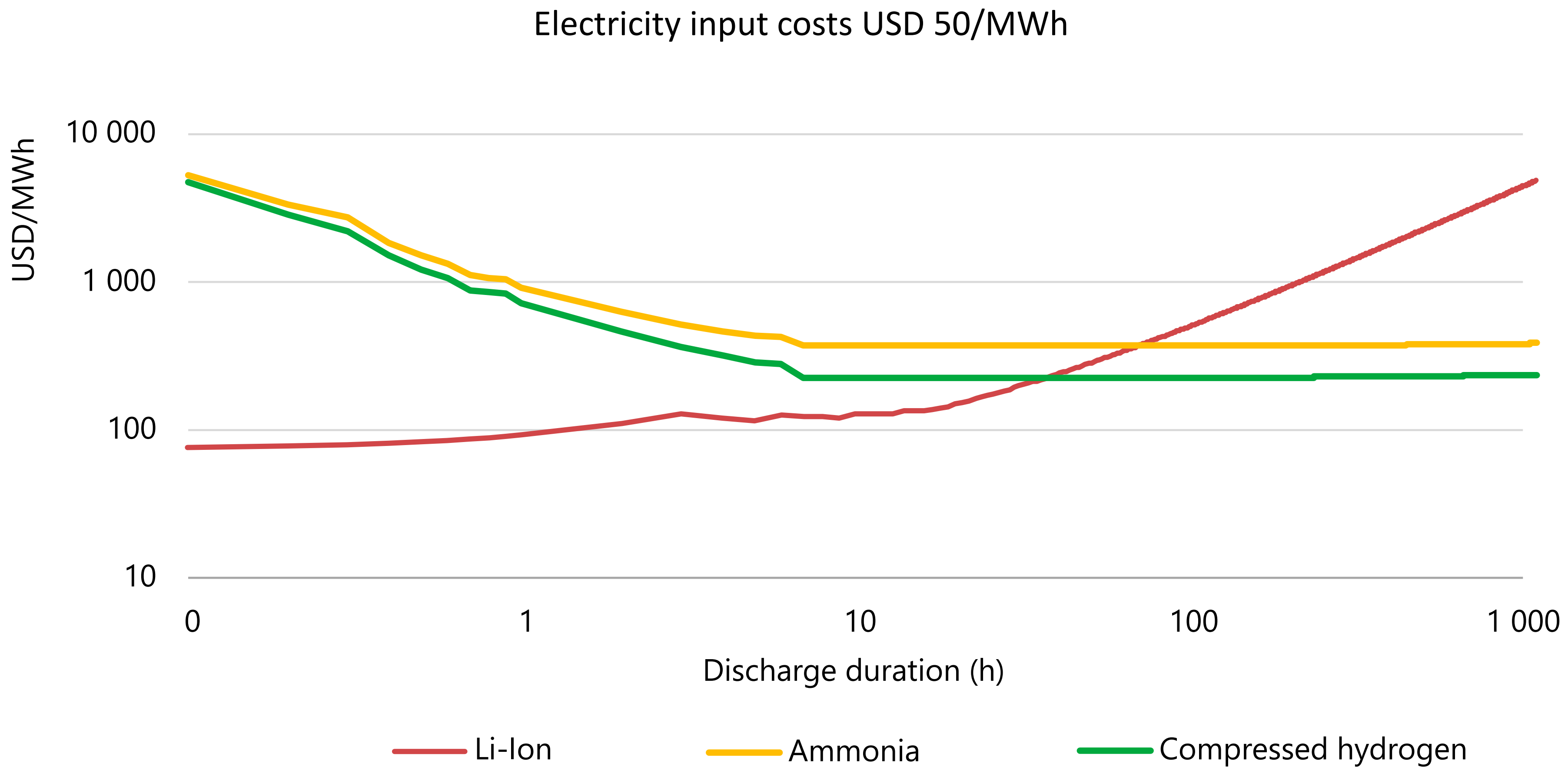
Renewables hydrogen costs are set to decline

Long-term hydrogen production costs from solar & wind systems



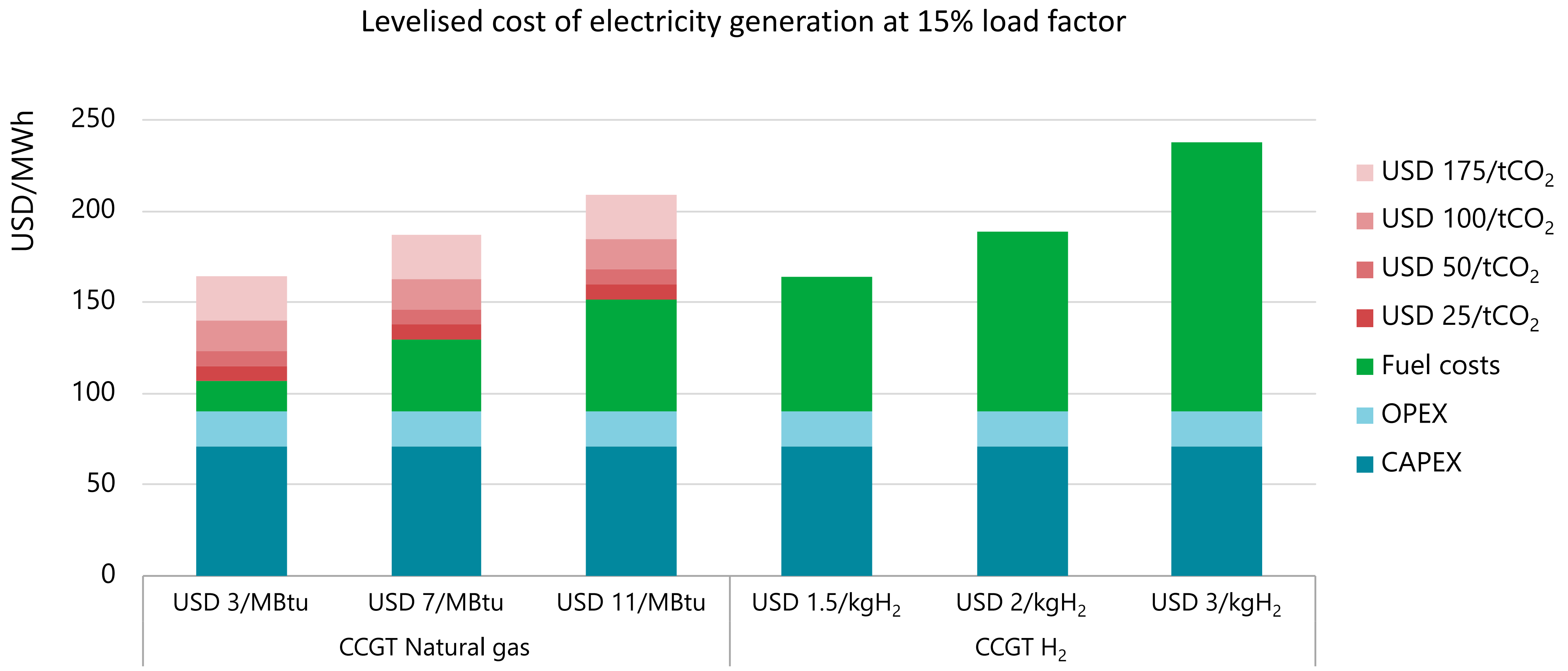
The declining costs of solar PV and wind could make them a low-cost source for hydrogen production in regions with favourable resource conditions.

How costly is hydrogen storage and when does it make sense?



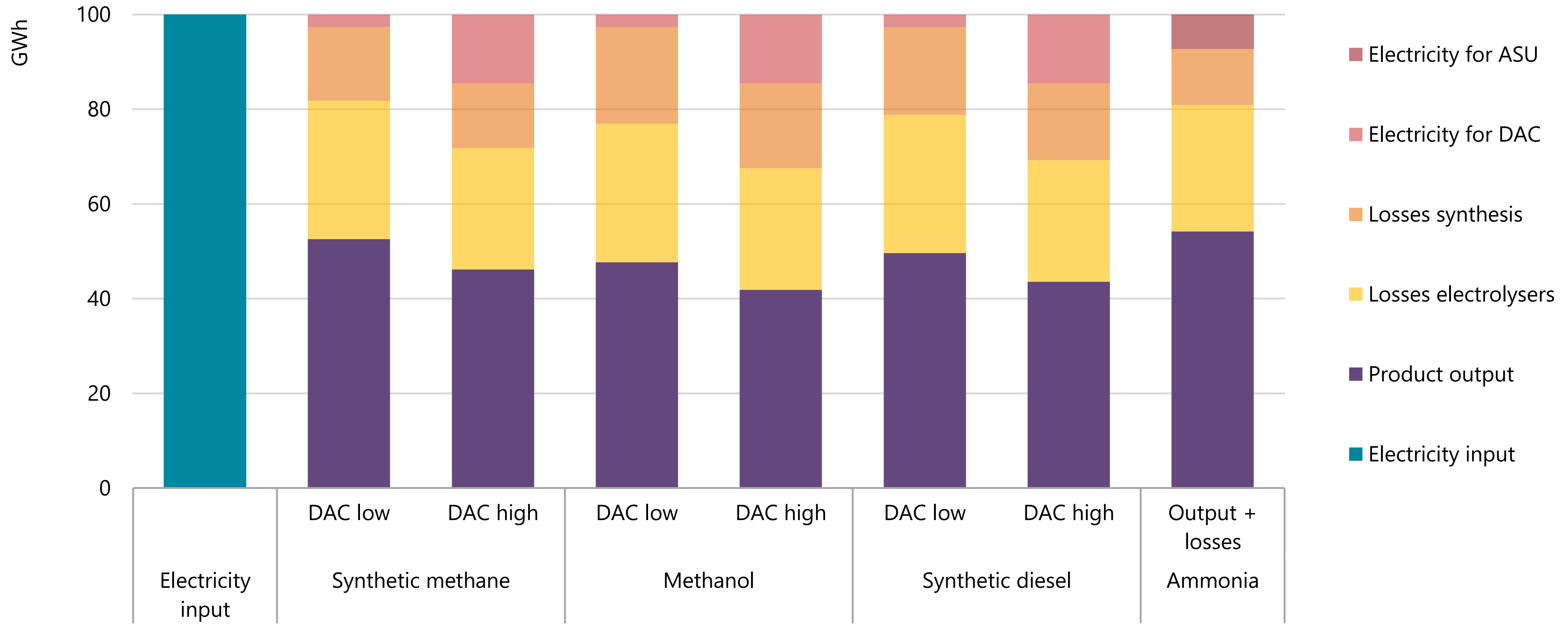
Depending on the costs of the stored electricity, compressed hydrogen storage becomes the most economic storage option at discharge durations longer than 20–45 hours.

Flexible power generation



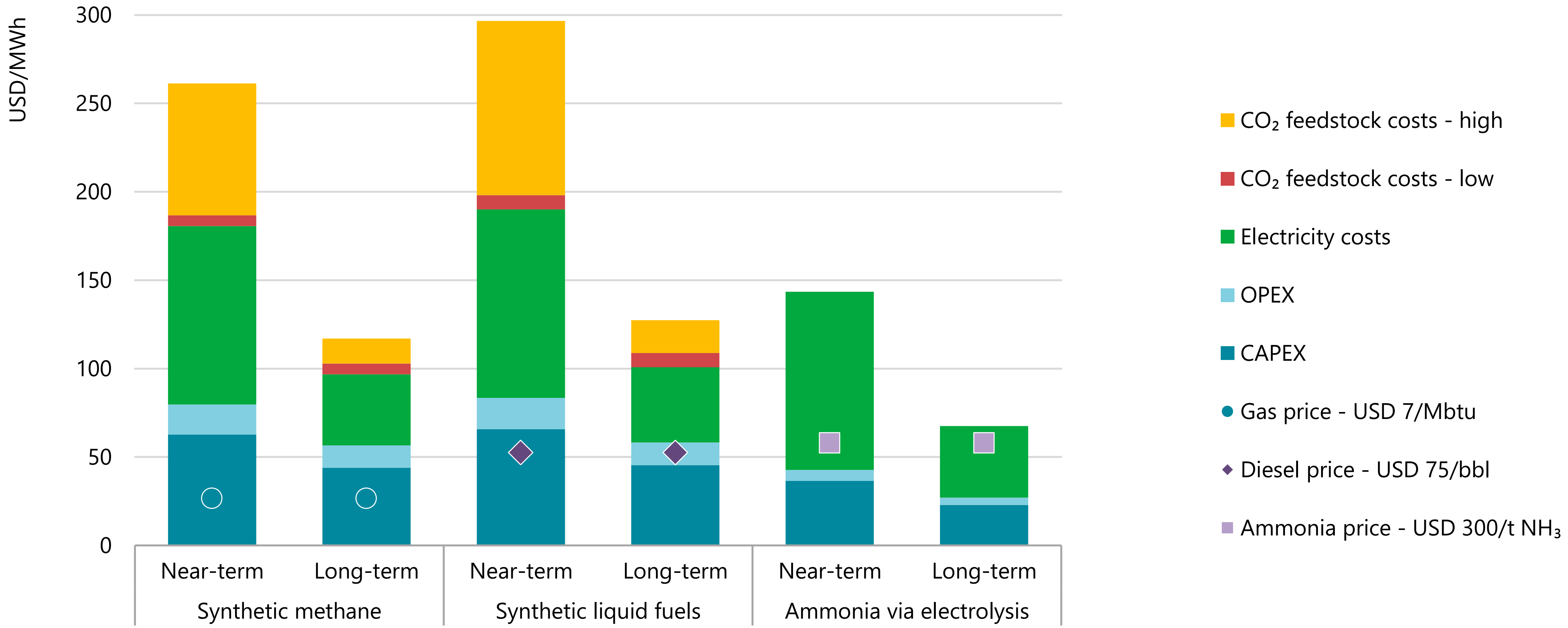
Whether hydrogen-based power generation for load balancing can compete against natural gas depends on regional hydrogen, natural gas and CO_2 prices.

High energy penalty across the value chain



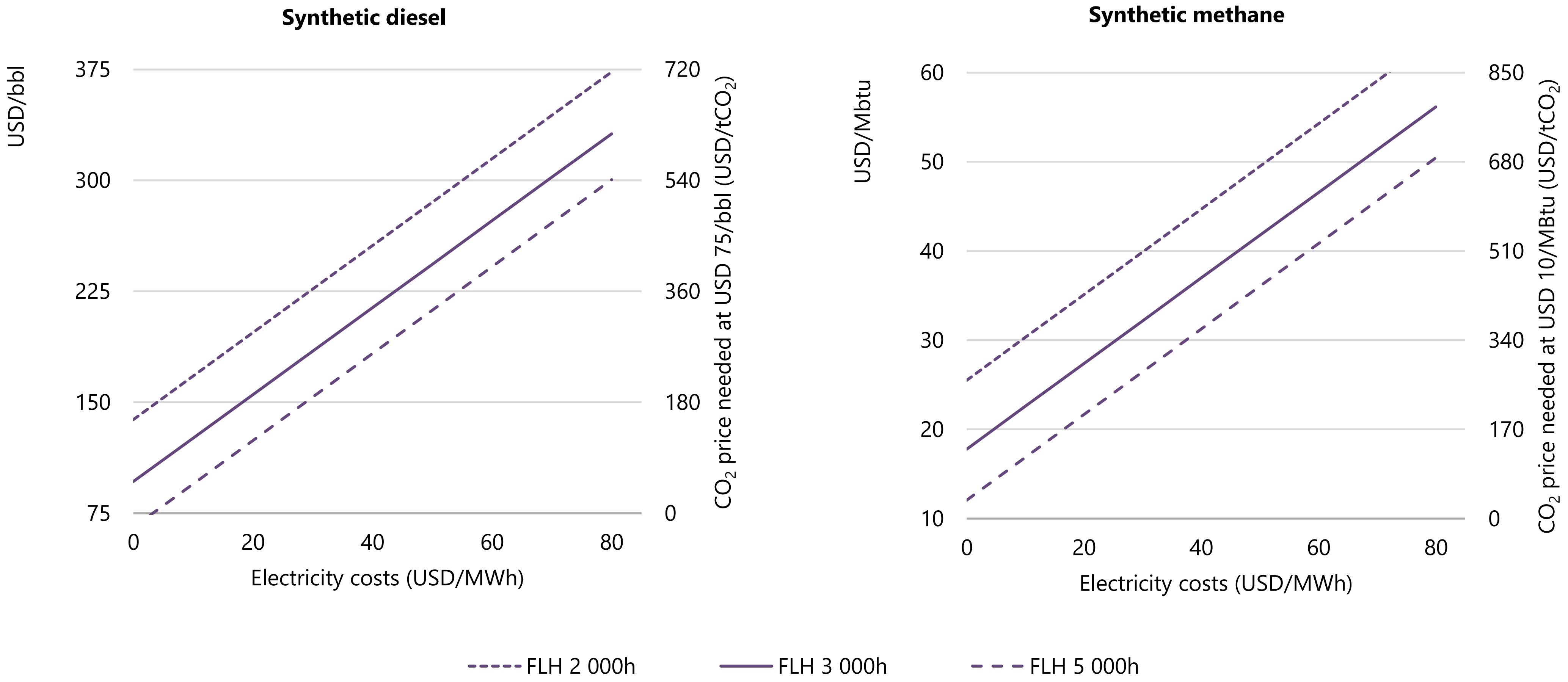
Around 45-60% of the electricity used for the production of synthetic hydrocarbons or ammonia is lost during the process.

Potential cost reduction in the long term



Future cost reductions for hydrogen-based products from electricity will depend on lowering the electricity costs, with cost reductions for CO2 feedstocks also being critical for synthetic hydrocarbons

PtX competitiveness depends on electricity price and CO_2 penalties



A combination of low electricity costs and high CO2 prices is needed to make synthetic diesel and methane competitive with fossil crude oil and natural gas

The IEA's 7 key recommendations to scale up hydrogen

1. Establish a role for hydrogen in long-term energy strategies
2. Stimulate commercial demand for clean hydrogen
3. Address investment risks for first-movers
4. Support R&D to bring down costs
5. Eliminate unnecessary regulatory barriers and harmonise standards
6. Engage internationally and track progress
7. Focus on four key opportunities to further increase momentum over the next decade

Stay tuned for upcoming analysis – the IEA will be launching ETP 2020 in June next year, which will include an assessment of cost effective technology choices to enhance energy security and reach net-zero emissions.

International Energy Agency

Thanks for your attention