



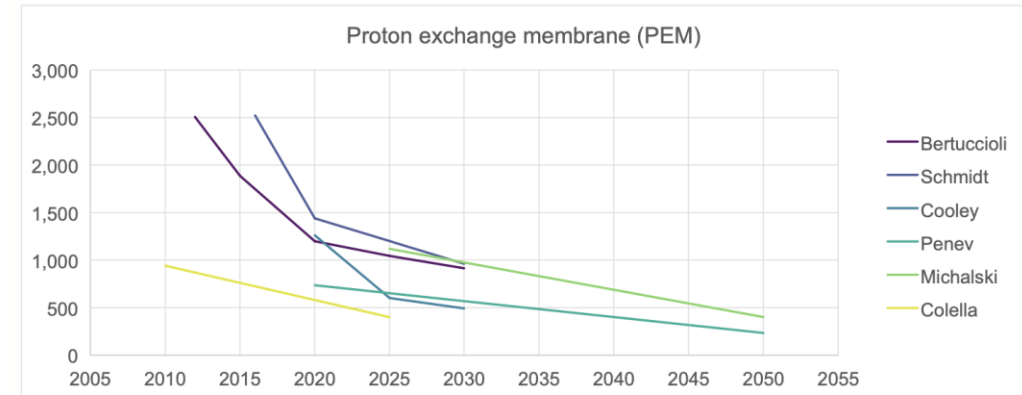
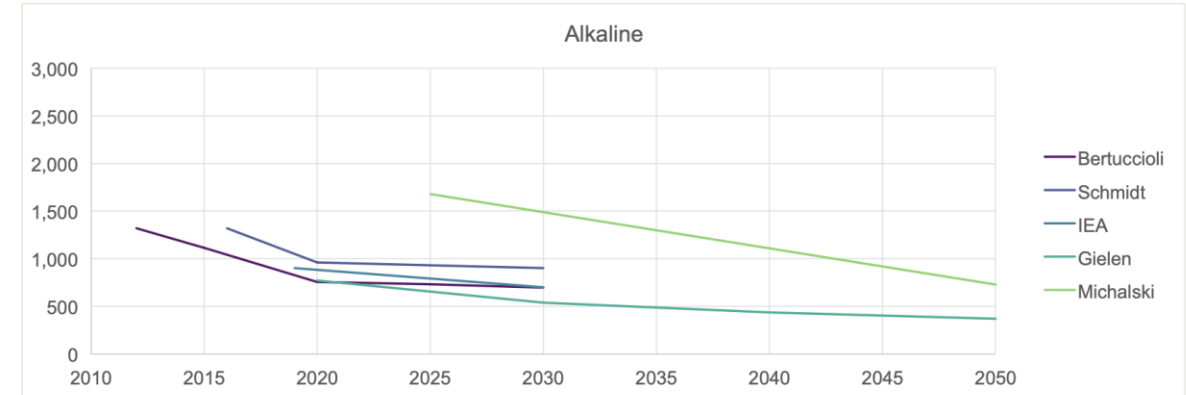
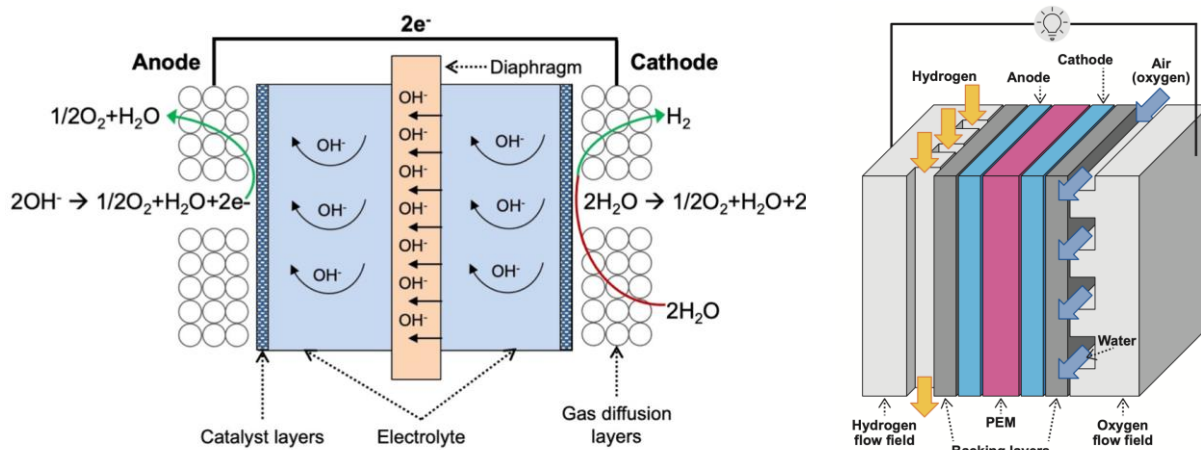
# Hydrogen

---

Emre Gençer

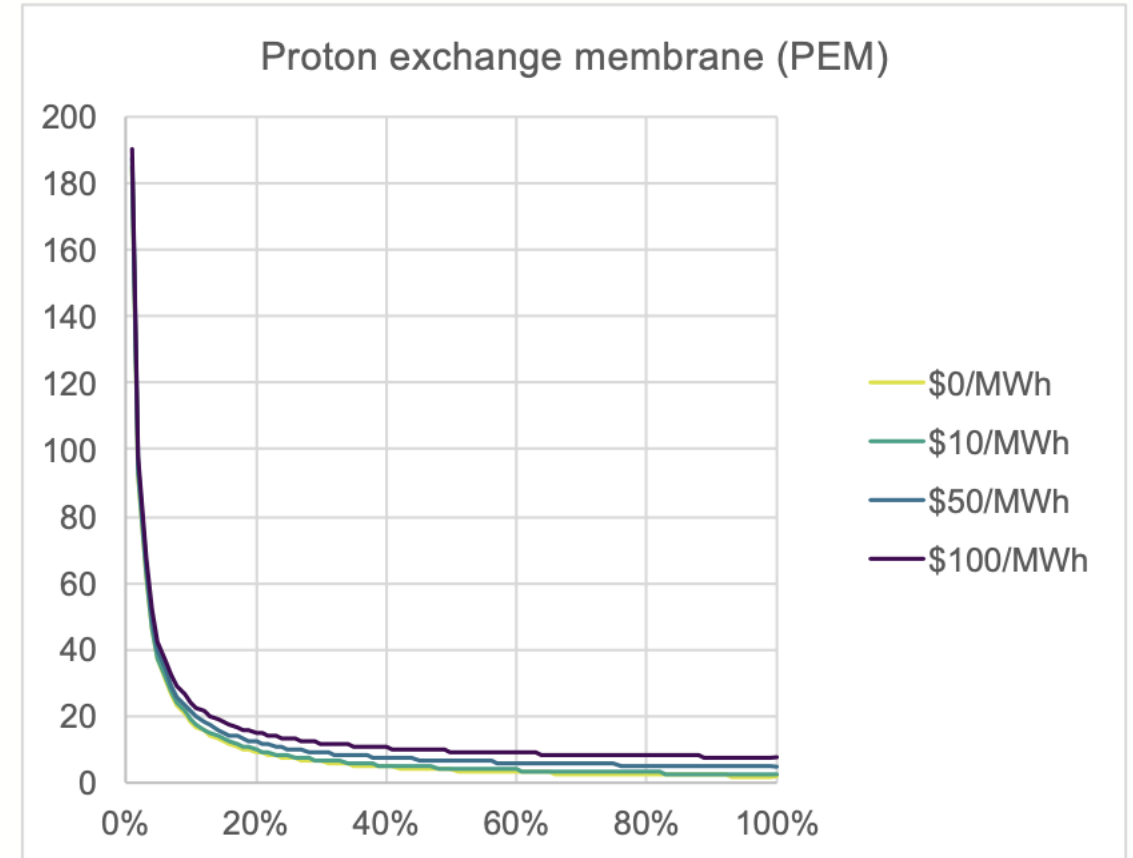
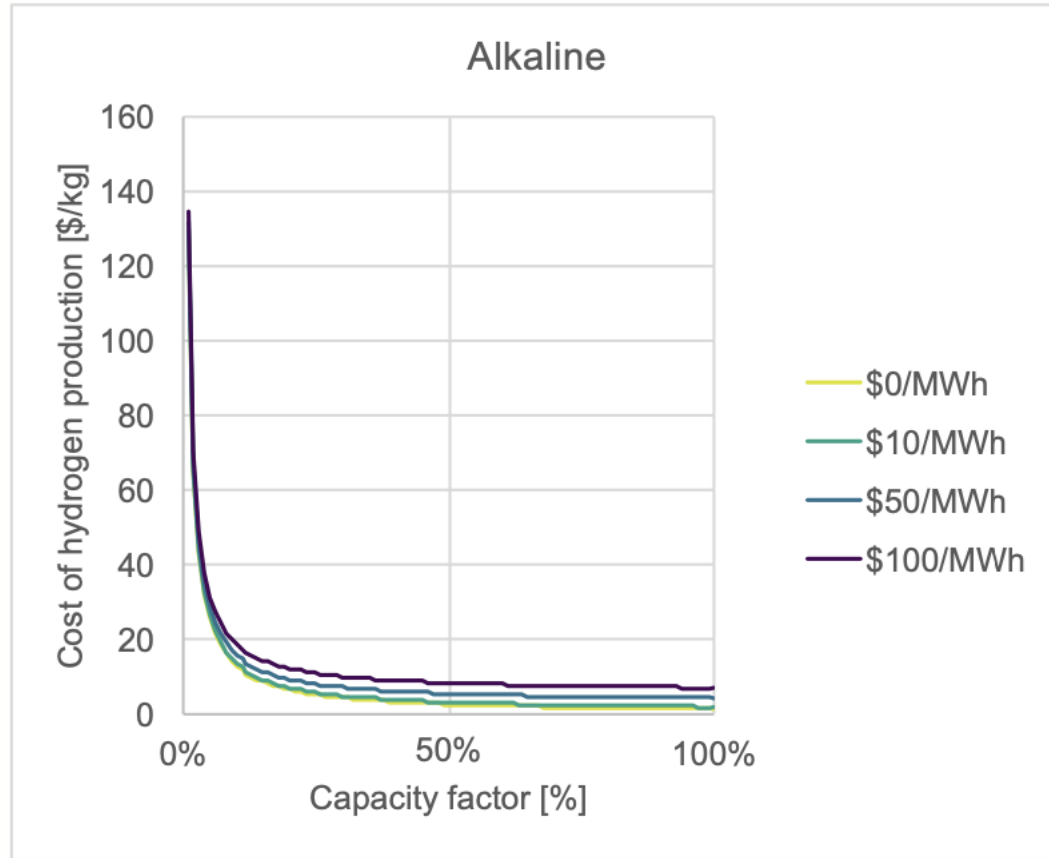
# Chemical energy storage (hydrogen)

- Commercially proven technologies exist for all aspects of the hydrogen value chain except for electricity production via hydrogen.
- Hydrogen is currently produced, transported, and sold to industry as a feedstock for numerous industrial processes. There is no significant consumer market.

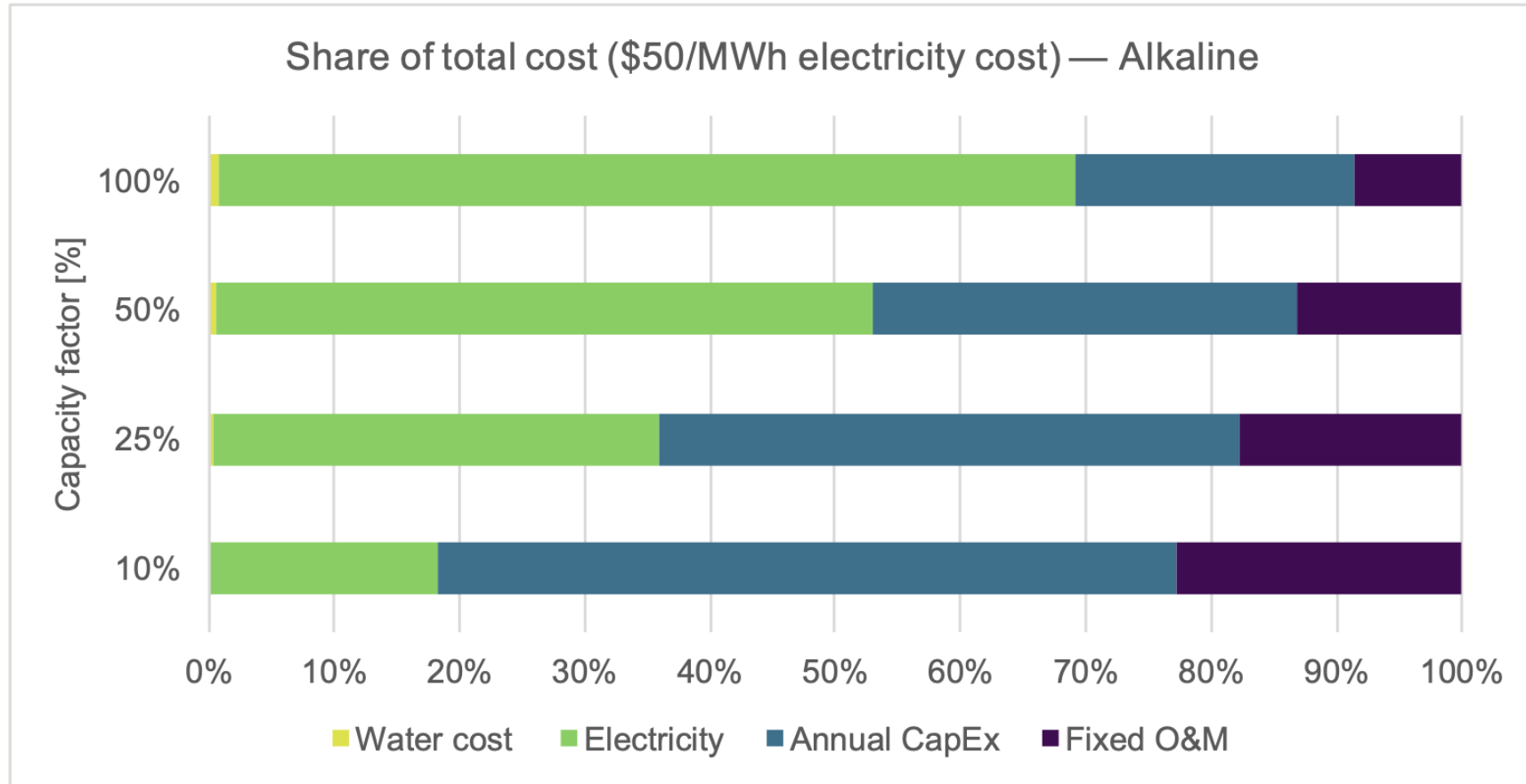


- Forecast capital costs for alkaline and PEM electrolyzers

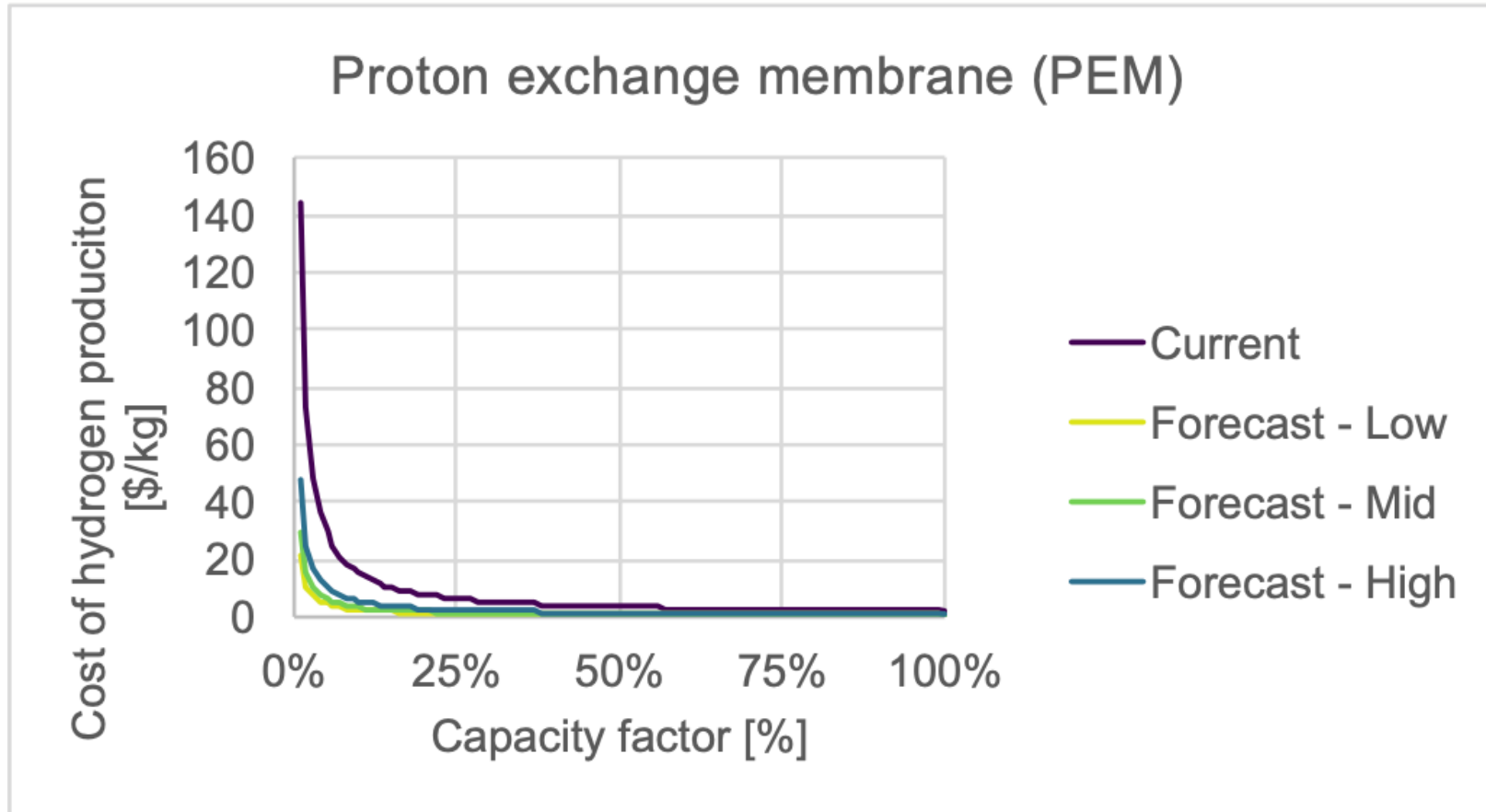
# Cost of hydrogen produced via electrolysis in 2021



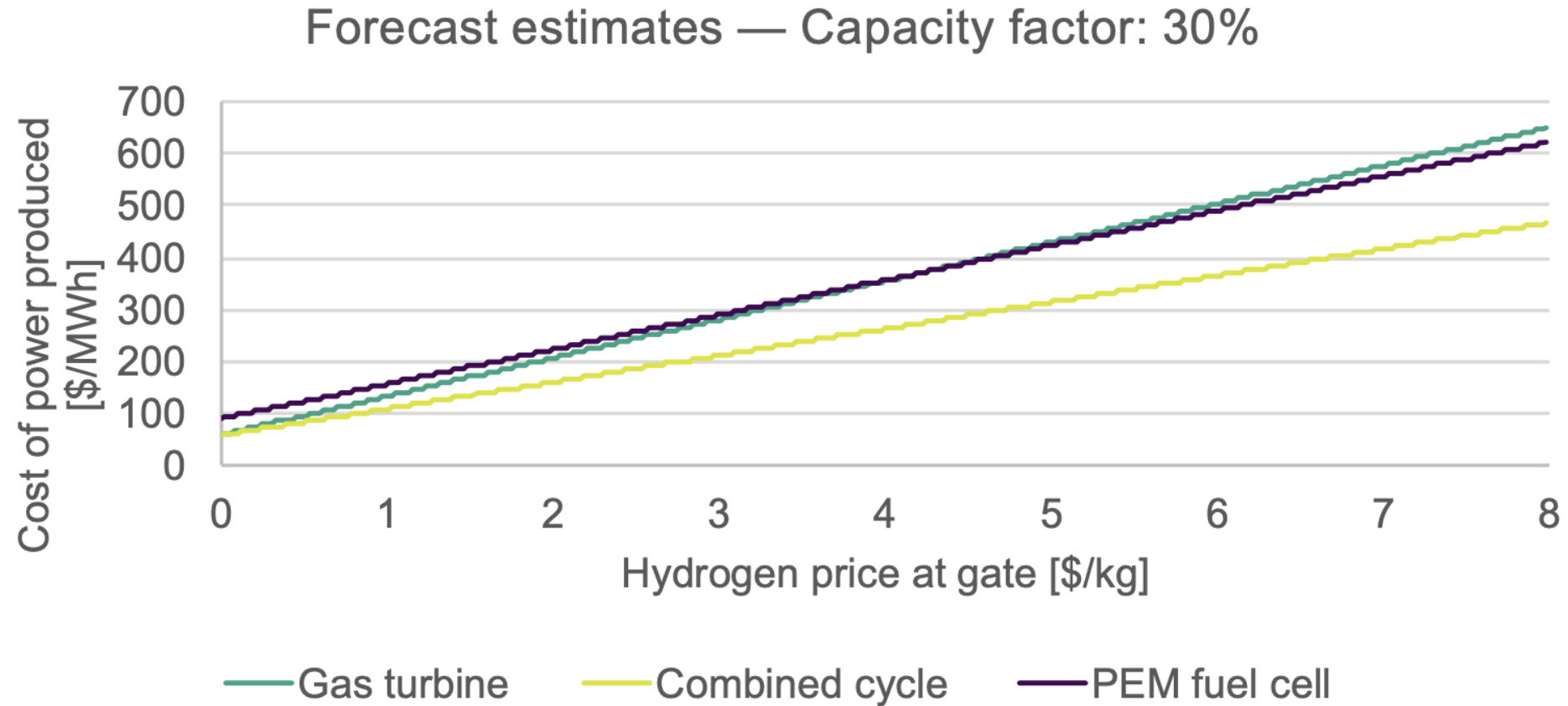
## Cost breakdown by variable



## Cost of hydrogen produced via electrolysis in 2050

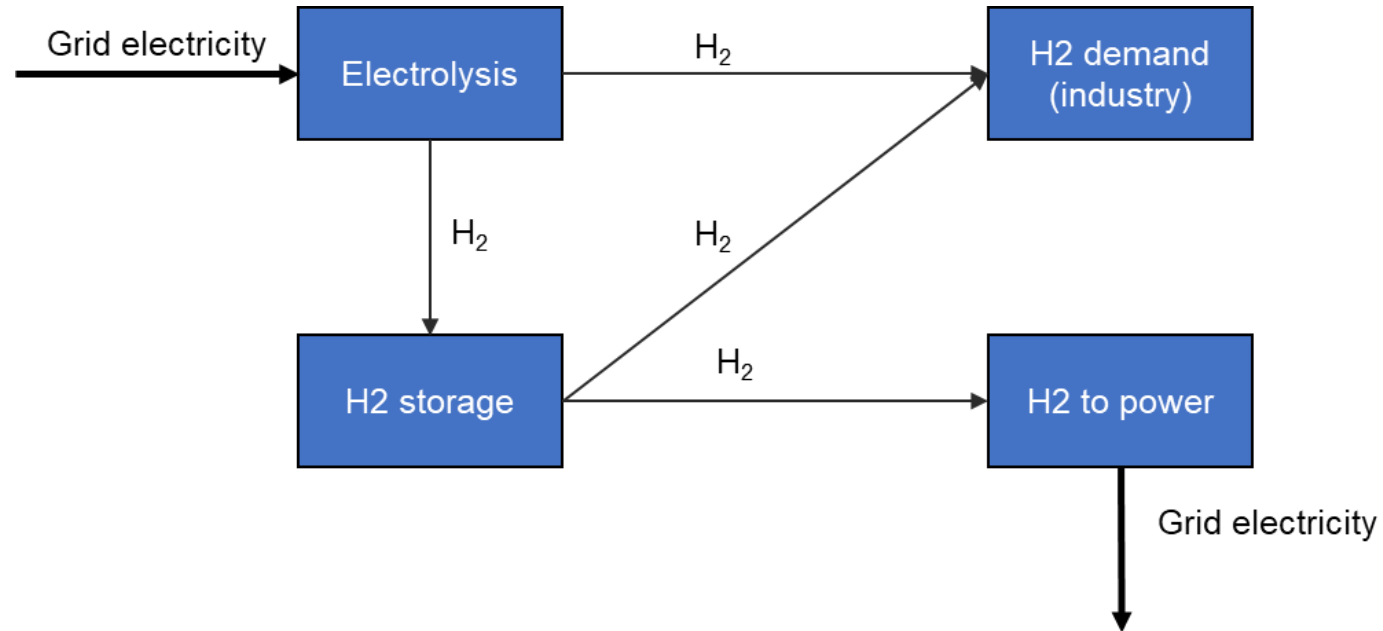


## Cost of electricity



- While low costs to store hydrogen make hydrogen an appealing energy storage medium for long-duration applications, using hydrogen as a fuel to produce power is very expensive relative to similarly positioned thermal power generation assets.

**The role for hydrogen in grid decarbonization is differentiated from many other LDES technologies due to its potential use in economy-wide decarbonization**



Efforts to promote adoption of hydrogen outside the power sector would make its use in the electric power system more attractive by creating a large flexible electric demand

# Takeaways

- **Commercially proven technologies exist for all aspects of the hydrogen value chain except for electricity production via hydrogen.**
- **While low costs to store hydrogen make hydrogen an appealing energy storage medium for long-duration applications, using hydrogen as a fuel to produce power is very expensive relative to similarly positioned thermal power generation assets.**
- **Hydrogen's role as a form of energy storage for the electricity sector will likely depend on the extent to which hydrogen is used in the overall economy, which in turn will be driven by the future costs of hydrogen production, transportation, and storage, and by the pace of innovation in hydrogen end-use applications.**
- **Long-duration energy storage will likely not be the main driver of hydrogen demand in a future decarbonized energy system for the simple reason that hydrogen will be more valuable as a way to indirectly electrify otherwise difficult-to-electrify energy end uses.**