The Value and Development of Green and Low carbon Hydrogen Trade-Challenges

Green and Low-Carbon Hydrogen as an Enabler of the Energy Transition Policy Dialogue
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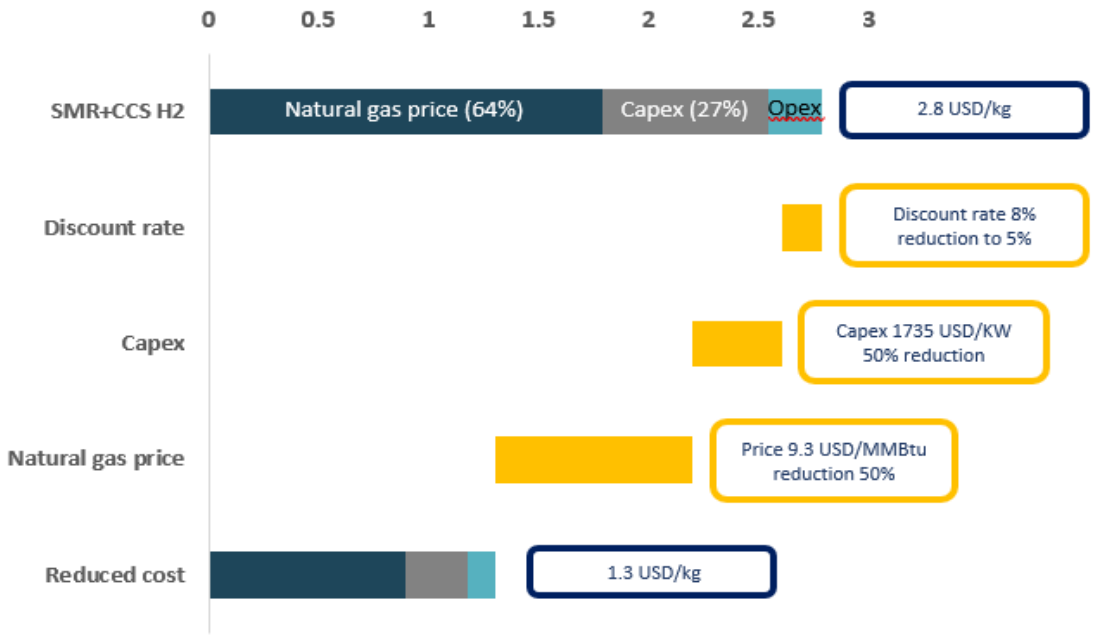
Dr Manuel Heredia
Senior Researcher, Asia Pacific Energy Research Centre (APERC)

Existing challenges to the development of hydrogen trade

- Hydrogen can be an effective tool to decarbonize hard-to-abate sectors.
- However, some challenges remain:
    - High cost of zero- and low-carbon hydrogen
    - Increasing complexity of announced projects
    - Lack of adequate transportation and distribution systems
    - Lack of recognized international standards for zero and low-carbon hydrogen
    - Uncertain future demand

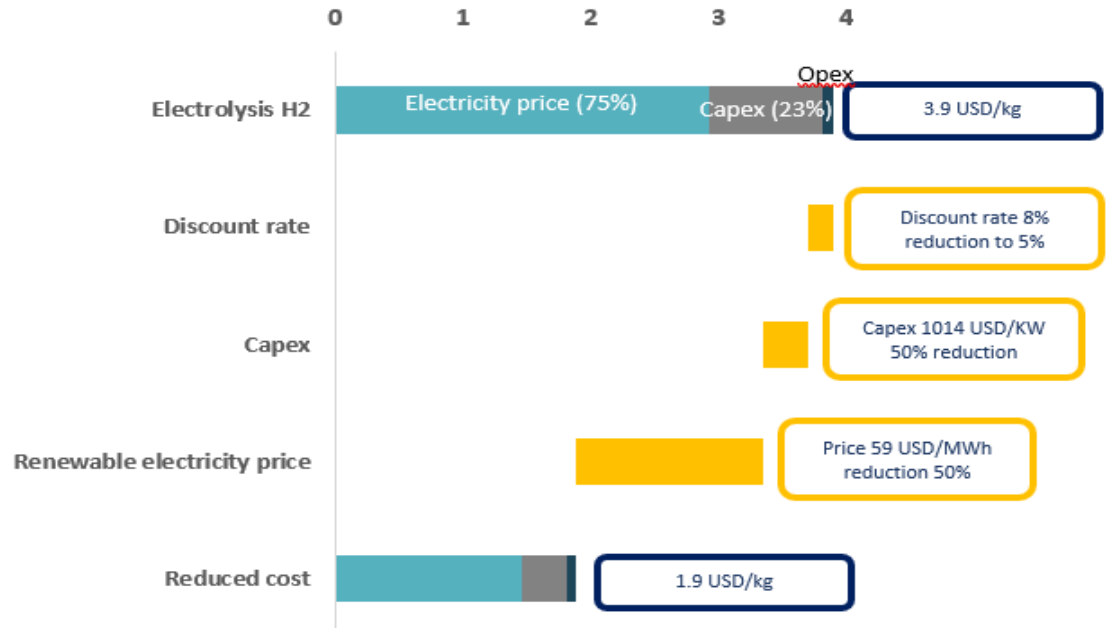
Cost of zero- and low-carbon hydrogen is vulnerable to energy prices hikes

Cost of low-carbon hydrogen (USD/KgH_2)



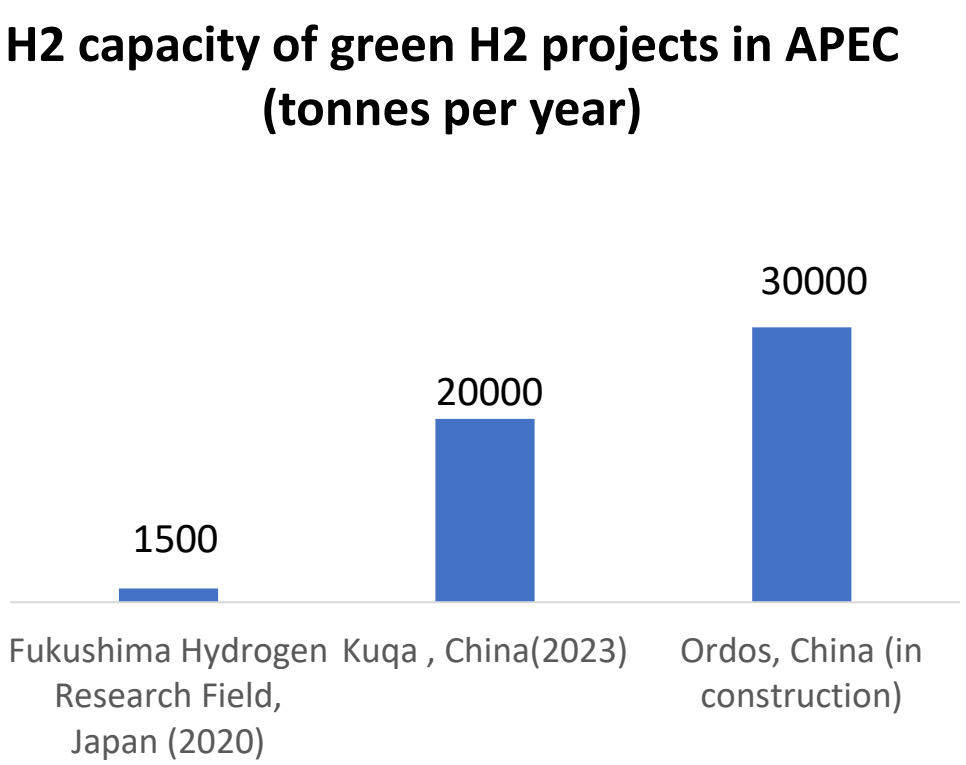
Note. The price of natural gas was estimated using Henry Hub prices in August 2022. Capex cost for US Gulf Hydrogen with CCS (Platts, 2023)

Cost of renewable energy-based hydrogen (USD/KgH_2)



Note: Electricity cost was assumed to be equal to the levelized cost of energy of wind power in US and the capacity factor of electrolyser 50%. Capex cost for Hydrogen Alkaline Electrolysis Capital cost (Platts, 2023)

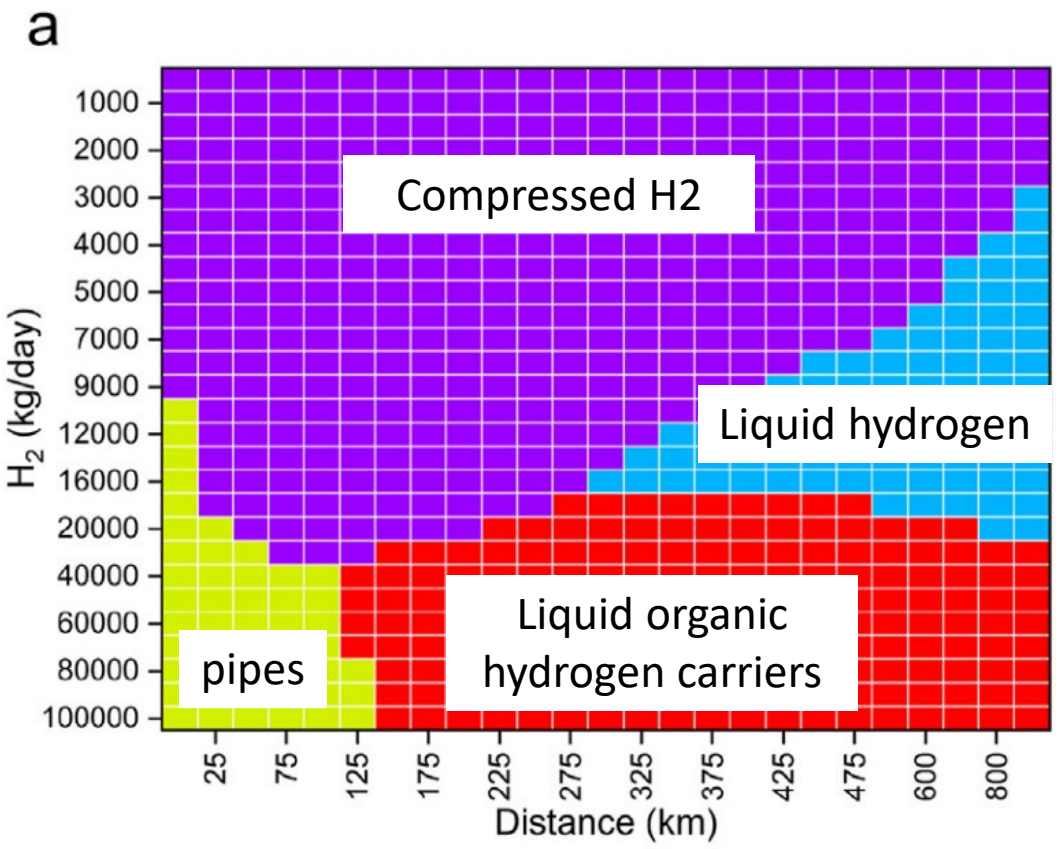
Increasing complexity of hydrogen production projects



- Bigger and more complex projects present new challenges such as the increase of balance of plant costs that may curb the declining cost of electrolysis-based hydrogen. For example, projects that requires several GW of electrolysis capacity require several 10 MW units that can operate safely.
- Alkaline electrolysers, the most matured technology, do not cope well with fluctuating electricity input, being a problem for direct coupling hydrogen production with variable renewable energy projects. Although other alternative technologies exist such as PEM and pressurized alkaline electrolysers, advancements are still required.

Transport and distribution to end-users could be a bottleneck

- A large gap in investment exists in transport and distribution.
- Different conditions require different solutions:
  - Short distance (<350km) and less that 0.4 PJ demand (approx. 10 tonnes of hydrogen/day), transport through trucks is more competitive.
  - Pipelines are expensive in economies that do not have existing natural gas pipelines.
  - Blending hydrogen with natural gas has a limit of 20% (V/V) due to technical constraints. This option reduces the amount of energy per unit of volume (14%) and reduces emission by only 6.7% per unit of energy.

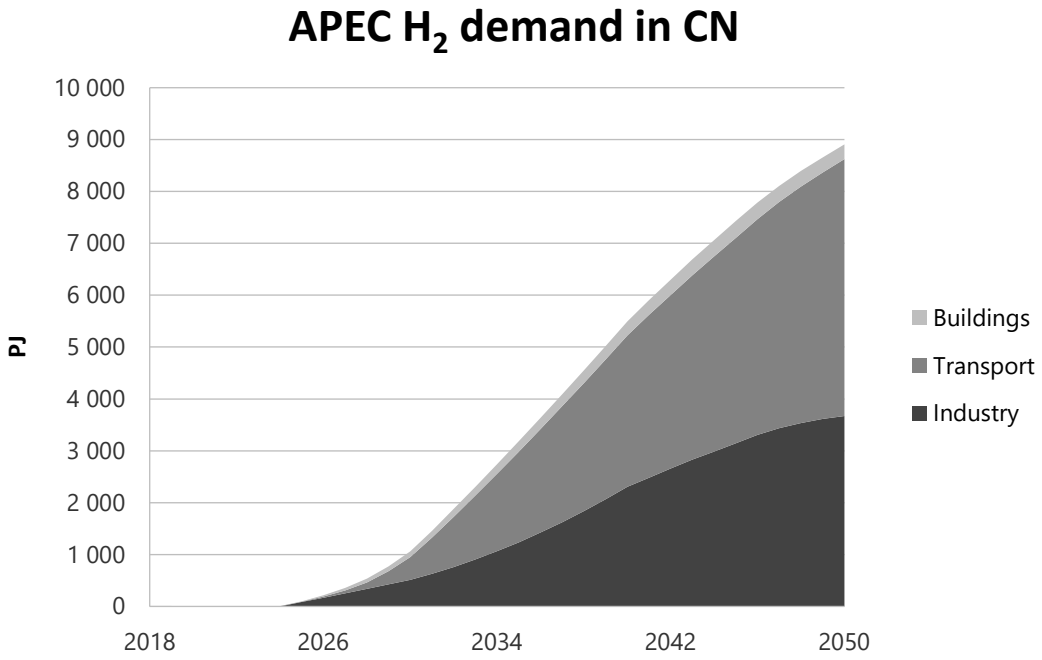


Source: Techno-economic analysis of hydrogen storage and transportation from hydrogen plant to terminal refueling station (Rong et al., 2024)

Regulatory changes and standards are required

- Hydrogen requires special safety regulations due to the big range of explosive limit in air (4-75%). Equipment that will use hydrogen may require adequate protection systems before hydrogen can be widely used.
- Regulatory framework that defines clearly the criteria to classify hydrogen as zero- or low-carbon hydrogen is required. This will help to identify adequately where to allocate resources to support the development of the industry.
- A recognized and agreed international hydrogen standard is required for international trade, because the value of hydrogen resides on its capability to reduce CO_2 emissions.

Hydrogen demand is still uncertain



Source: APEC Energy Demand and Supply Outlook 8th Edition (APERC, 2022)

- The 8th edition of the APEC Energy Demand and Supply Outlook presents projections of hydrogen demand within the APEC region. Under the Carbon Neutrality scenario, CN, the energy outlook foresees a demand of 1064 PJ by 2030 and 8907 PJ by 2050 in APEC. These estimates translate to a demand for 9 million tonnes of hydrogen by 2030 and 74 million tonnes by 2050.

- To achieve this demand, the challenges previously mentioned were successfully overcome. With uncertain demand, achieving final investment decision for remaining announced projects will be delayed.

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