

The Future of a Hydrogen Economy

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Ways for Sustainable Hydrogen Production in Uzbekistan

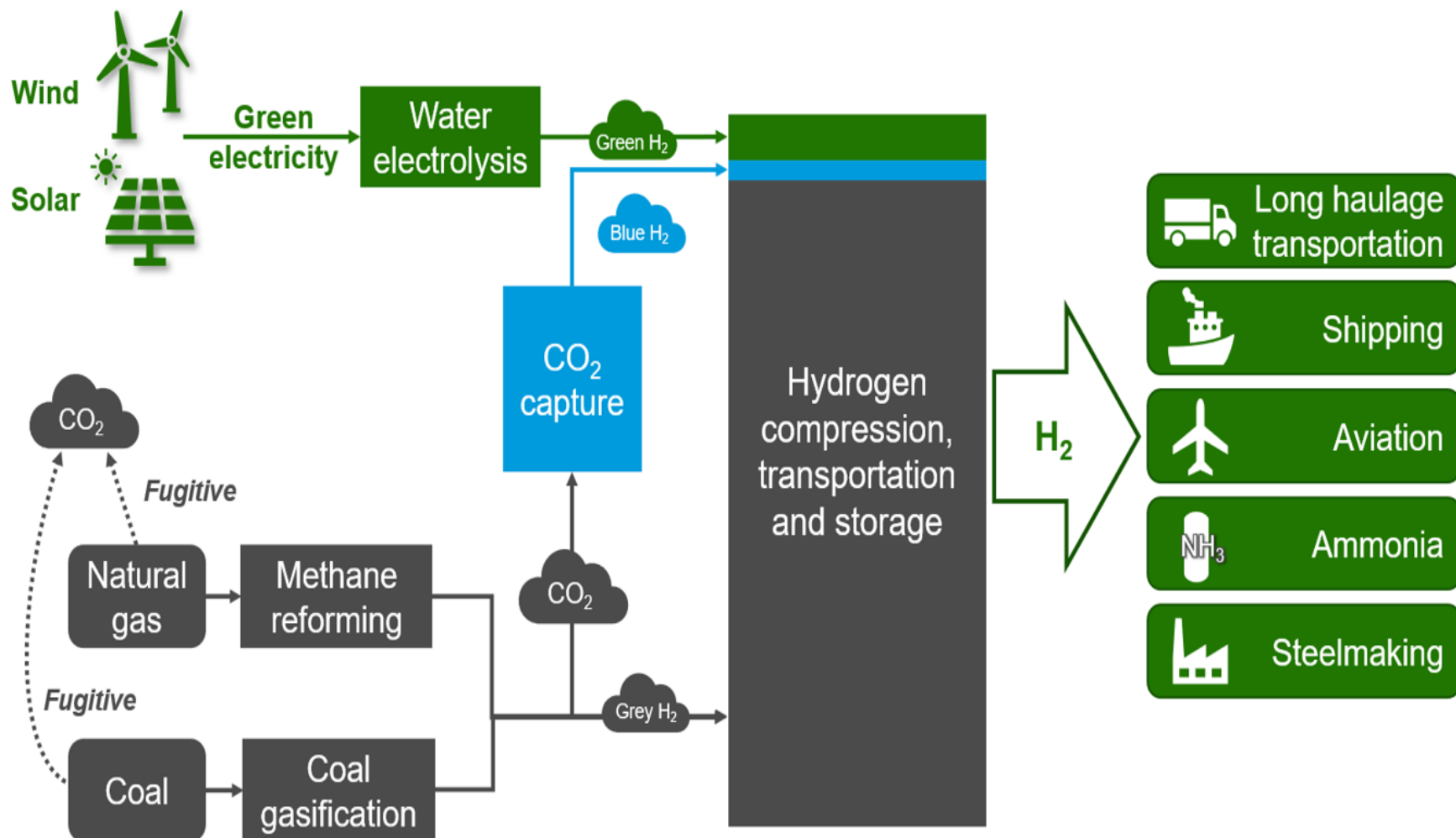
Hydrogen

- Hydrogen can play an important role in increasing energy security and reducing greenhouse gas emissions.
- However, until now, the uptake of hydrogen at scale has been limited due to high costs of production.

Hydrogen

- Hydrogen is a clean fuel that, when consumed produces only water.
- Hydrogen can be produced from a variety of domestic resources, such as natural gas, water, and coal.

Figure 2: Grey hydrogen dominates current hydrogen production



SOURCE: CRU

Energy from green hydrogen will be expensive, even in 2050
Posted 24 February 2023

Coal accounts for 27% of hydrogen demand (IEA 2019).



Transitioning to Hydrogen

“Transitioning to hydrogen as an energy carrier would be a good development for coal. When coupled with carbon capture utilization and sequestration (CCUS), the carbon intensity of coal-derived hydrogen is actually lower than the green hydrogen generated by electrolysis and grid electricity.”¹

¹IEA, Hydrogen From Coal, May 7, 2021

Hydrogen as Energy Storage

- In power generation, hydrogen is one of the leading options for storing **renewable energy**:
 - Hydrogen production can be used in gas turbines to increase power system flexibility.
 - Ammonia could also be used in coal-fired power plants to reduce emissions.

Hydrogen Production

- Hydrogen can be produced from diverse, domestic resources.
 - Most hydrogen is currently produced from fossil fuels
 - Specifically natural gas through SMR.
 - But Gasification has the potential to produce the most economical hydrogen.
 - Electricity from the grid or from renewable sources such as wind, solar, geothermal, or biomass is being used to produce hydrogen.
 - In the longer term, solar energy and biomass could be used more directly to generate hydrogen.

Forecast Increase in Global Hydrogen Demand through 2050 (Hydrogen Council 2017).

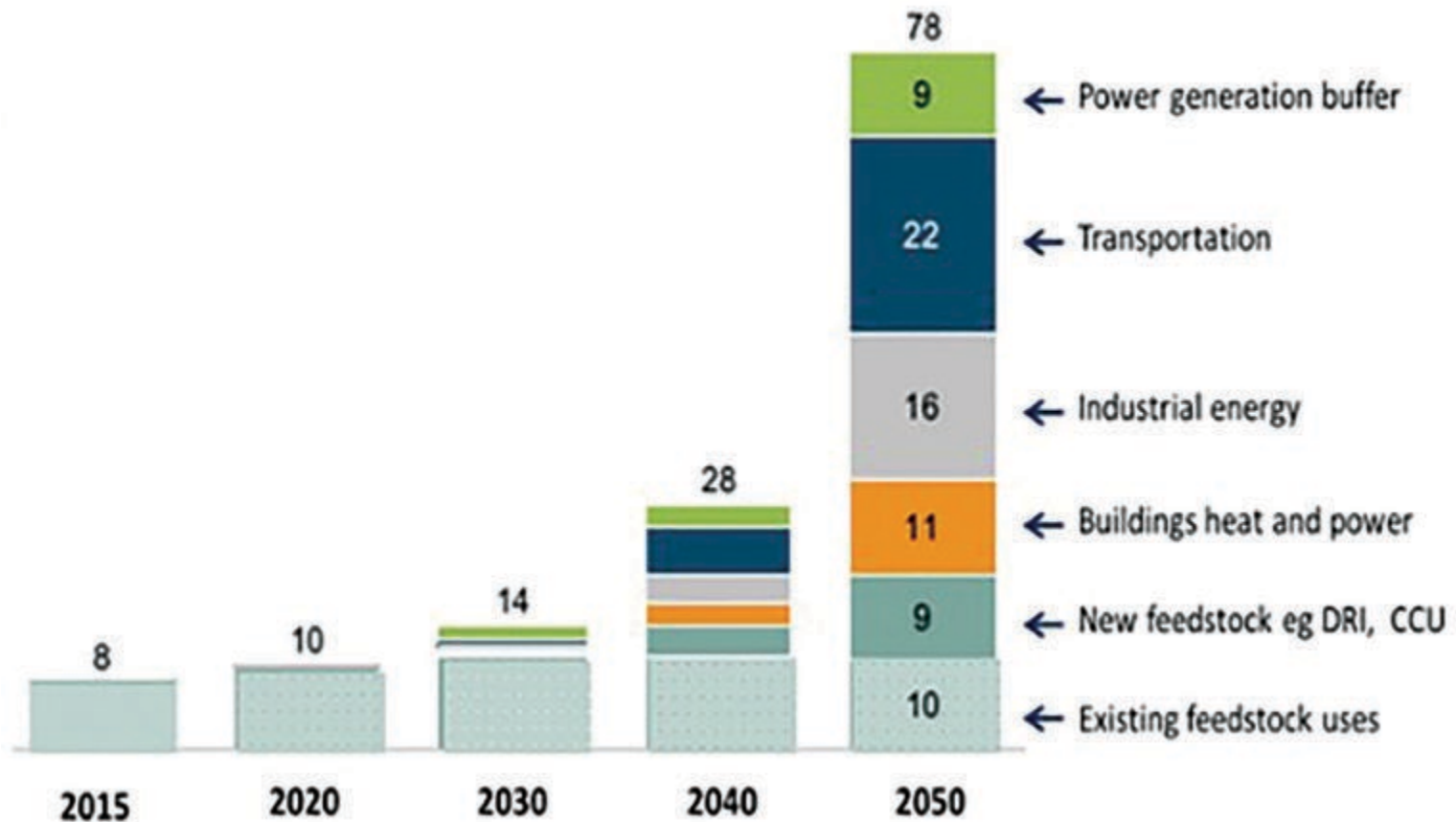


Figure 3.1: Globally, green H₂ costs remain above grey and blue H₂ production costs by 2050...

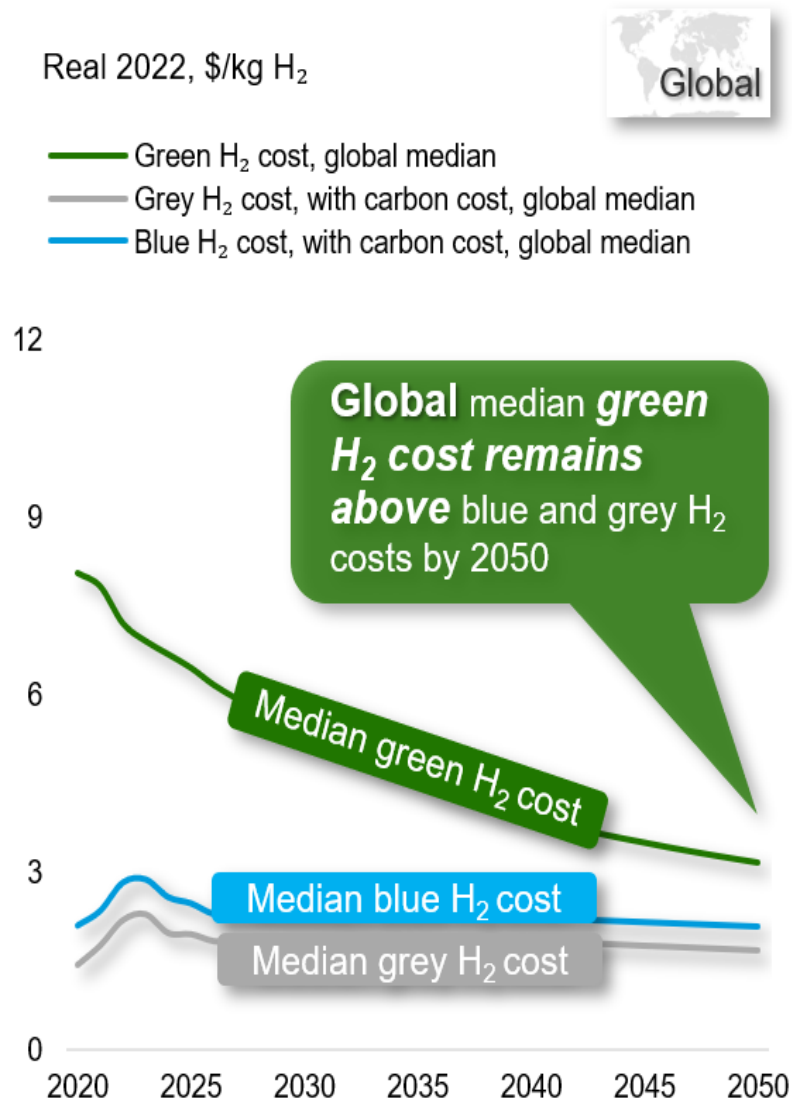
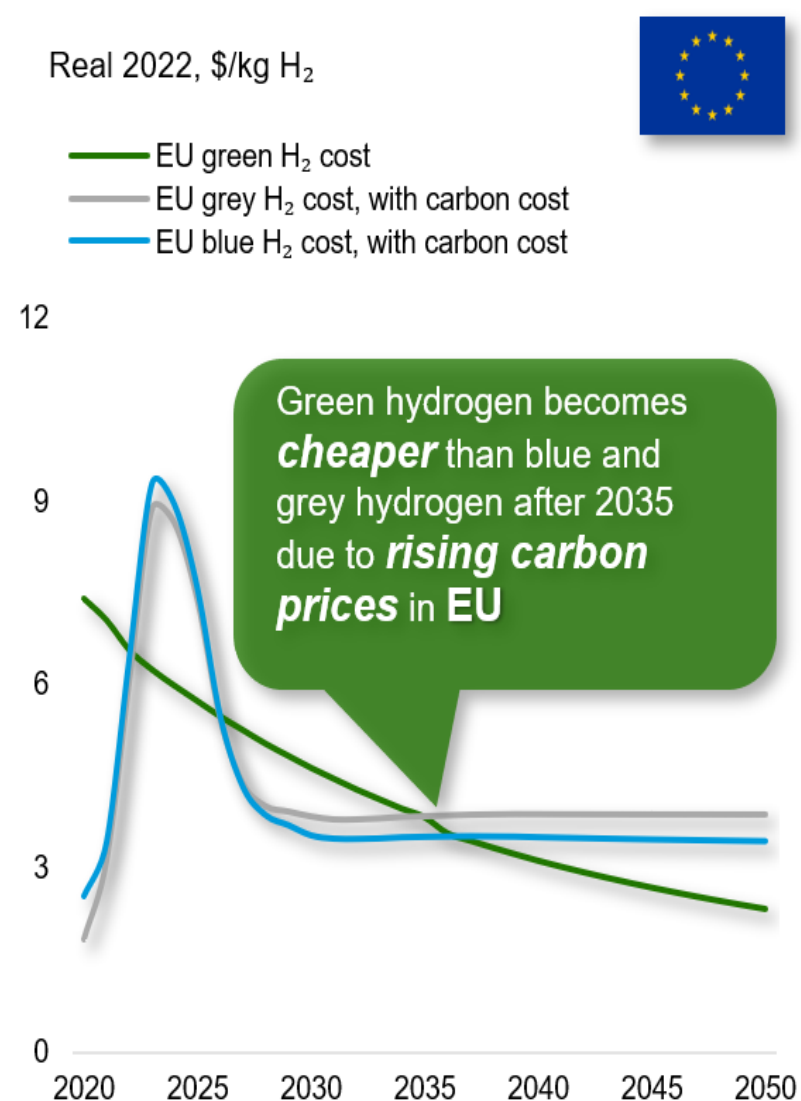


Figure 3.2: ...but green H₂ in the EU will gain cost-competitiveness over blue and grey H₂ in late-2030s



DATA: CRU Hydrogen Cost Model; NOTE: underlying assumptions on fossil fuel and carbon prices from CRU Economics Cost Macro; costs of green power taken from CRU Long-term Renewable Energy Costs Model

Challenges with Hydrogen

- The production of hydrogen is not our current challenge, but, the safe storage of large quantities of hydrogen needs to be addressed.
- Hydrogen storage and transportation is one of the key challenges in order to realize the full potential of hydrogen
- There are several methods for hydrogen storage, each having its own advantages and limitations.
 - Compressed hydrogen gas storage
 - Liquid hydrogen storage
 - Metal hydride storage
 - Carbon nanotube storage
 - Chemical hydrogen storage

Hydrogen Storage

- Hydrogen storage has critical challenges.
 - While progress has been made in developing various hydrogen storage methods, each method has its own advantages and limitations.
 - To overcome the challenges associated with hydrogen storage, we need to invest in the continued research and development required to improve the efficiency, scalability, cost-effectiveness, and **safety** of hydrogen storage.



Conclusions

Hydrogen can be made using various resources including:

- Fossil fuels:
 - Natural gas and coal (preferentially with carbon capture, utilization, and storage);
- Biomass grown from renewable, nonfood crops;
- Nuclear energy and;
- Renewable energy sources, such as;
- Wind, solar, geothermal, and hydroelectric power to split water.

This variety of supply sources is an important reason why hydrogen can be such a promising energy carrier.

Thank You