Global Hydrogen Trends and Opportunities

Emily Beagle, PhD
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Webber Energy Group
THE UNIVERSITY OF TEXAS AT AUSTIN

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Background

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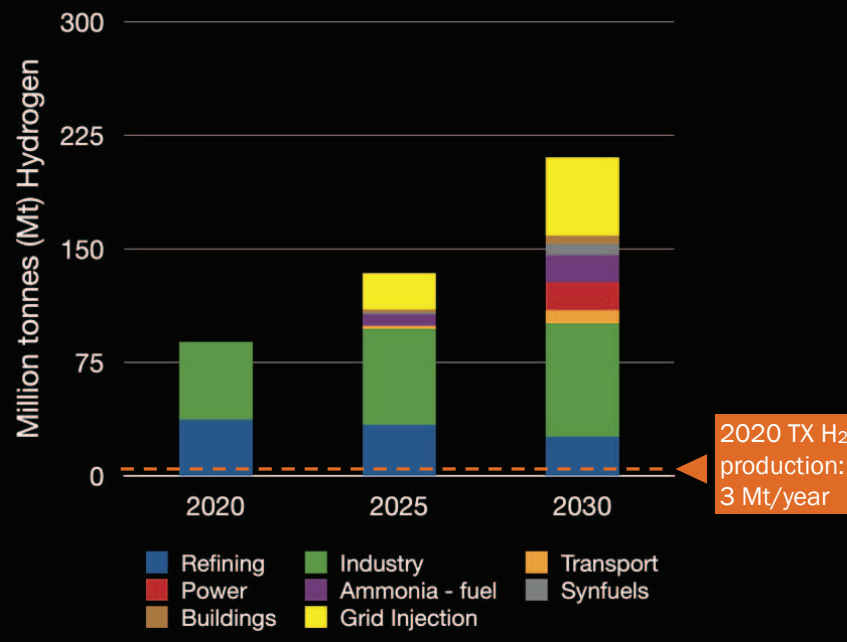
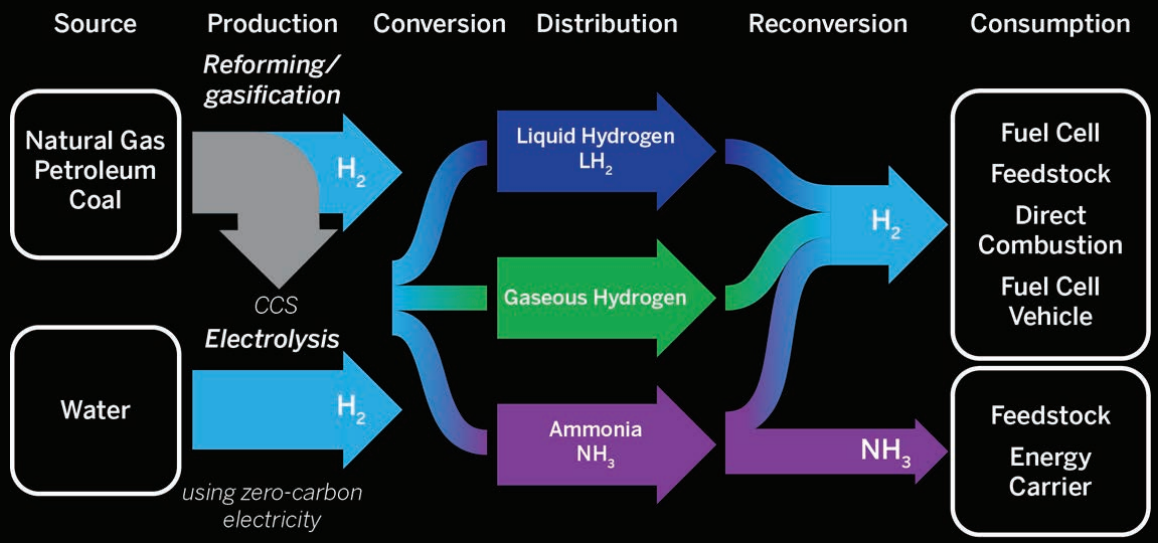
Hydrogen is increasingly being considered a key decarbonization tool

- Hydrogen (H_2) releases no greenhouse gases when used
- Can serve as a fuel, feedstock, or energy carrier
- Potential emission reduction applications across many sectors (industrial, transportation, electricity)

Global hydrogen demand by sector in the IEA Net Zero Scenario

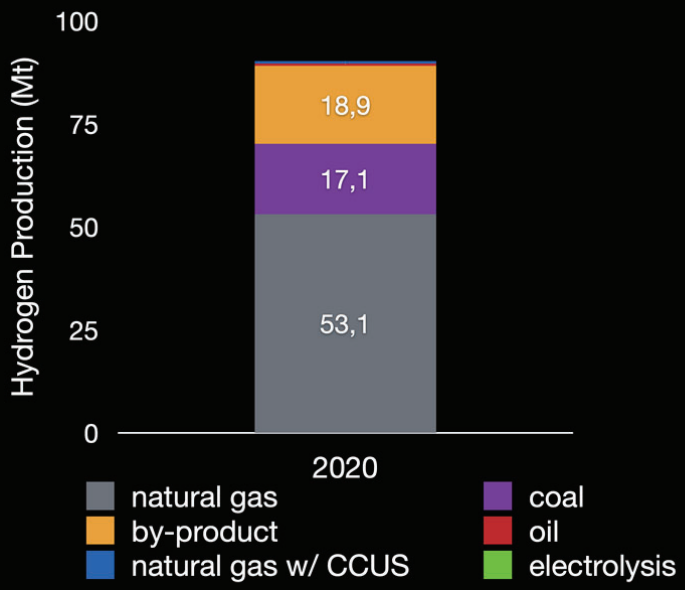


Energy usage and emissions across the hydrogen supply chain are an important consideration for its use



Hydrogen supply chain may look like some version of this - illustrative of different supply chain components

Current hydrogen production methods emit greenhouse gases



- 59% of global hydrogen produced by steam methane reforming (SMR) of natural gas → ~9 kg CO_2/kg H_2
- 19% of global hydrogen produced from gasification of coal → ~19 kg CO_2/kg H_2
- Only 0.7% of global hydrogen production from steam methane reforming of natural gas with carbon capture and storage (CCUS) → ~0.9 - 3.6 kg CO_2/kg H_2
- Negligible production of hydrogen from electrolysis

Hydrogen production coded by 'color' misses some key considerations

Steam Methane Reforming (SMR) of Natural Gas 'Grey Hydrogen'

- Splits methane (CH_4) to produce H_2 with a by-product of CO_2
- ~9 kg CO_2/kg H_2 (at point of production)
- Must also consider upstream emissions
- Continued reliance on fossil fuel feedstocks
- ~95% of US hydrogen production

Steam Methane Reforming (SMR) of Natural Gas with CCUS 'Blue Hydrogen'

- Adds carbon capture and storage (CCUS) to SMR
- ~0.9 - 3.6 kg CO_2/kg H_2 (depending on capture rates)
- Must also consider upstream emissions
- Continued reliance on fossil fuel feedstocks

Electrolysis with Renewable Electricity 'Green Hydrogen'

- Uses electricity to split water (H_2O) into H_2 and O_2
- Lifecycle emissions are dependent on electricity emissions
- Renewable electricity use yields zero-carbon hydrogen
- Negligible amount of global production currently

Title search: Global Hydrogen Trends and Opportunities

Also available as part of the eCourse
2023 Renewable Energy Law eConference

First appeared as part of the conference materials for the
18th Annual Renewable Energy Law Institute session
"Trends and Recent Activity - Hydrogen Energy Projects"