U.S. DEPARTMENT OF ENERGY | Office of Fossil Energy

Hydrogen Strategy
Office of Fossil Energy
Overview

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July 23, 2020 | Hydrogen Workshop | USEA

State of Hydrogen Production Today

Currently 99% of 10 MMT in the U.S. supplied by fossil fuels – least cost

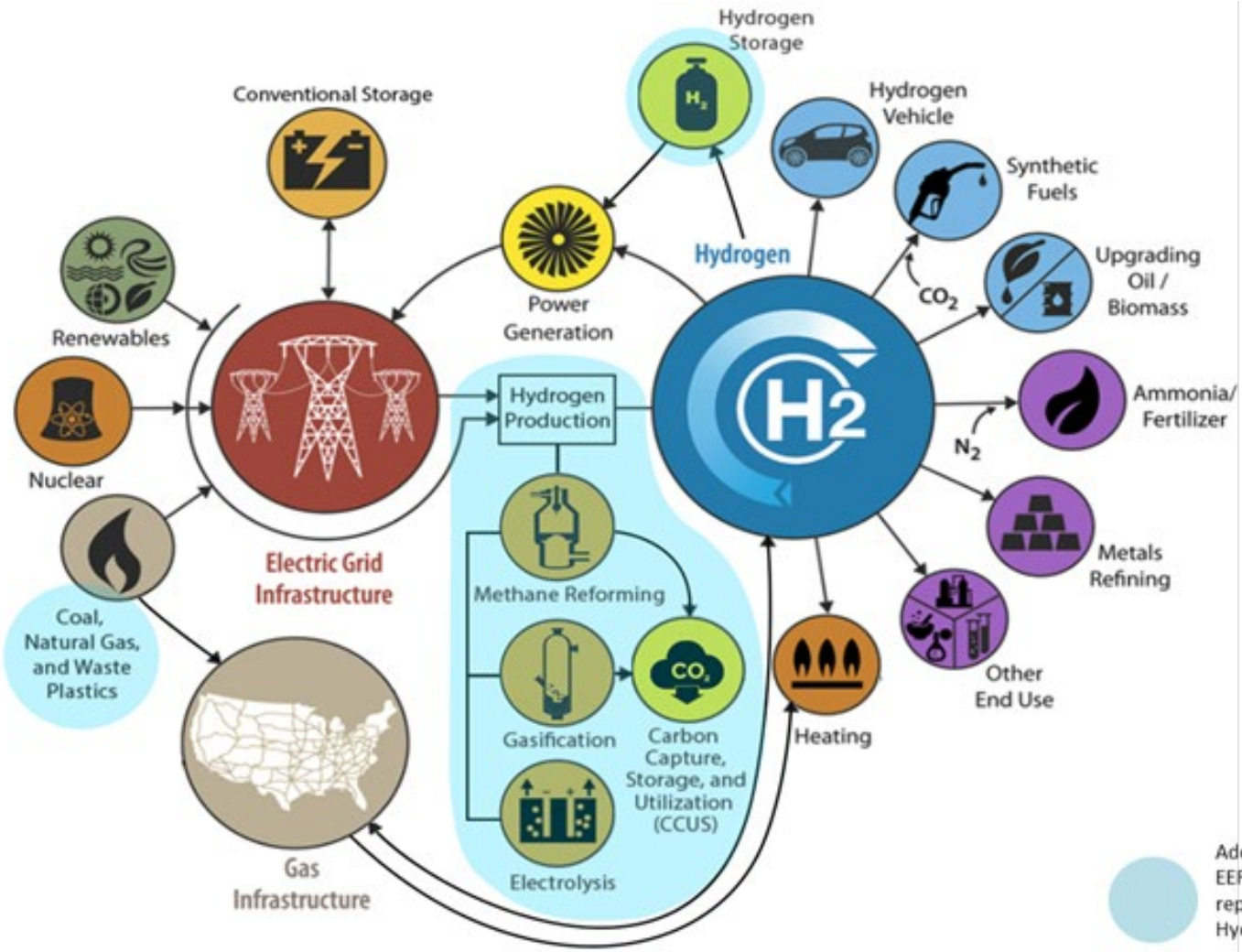
- **96% by SMR**
- **3% by gasification**
- **1% by electrolysis**

70 MMT generated globally

- **76% by SMR**
- **22% by gasification**
- **2% by electrolysis**

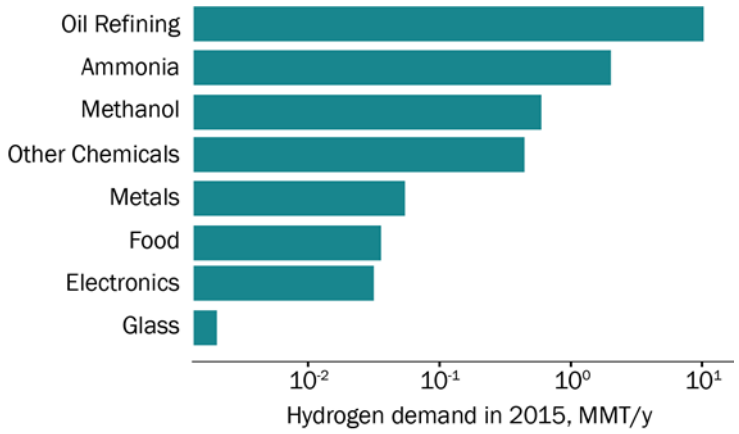
Small fraction includes CCUS

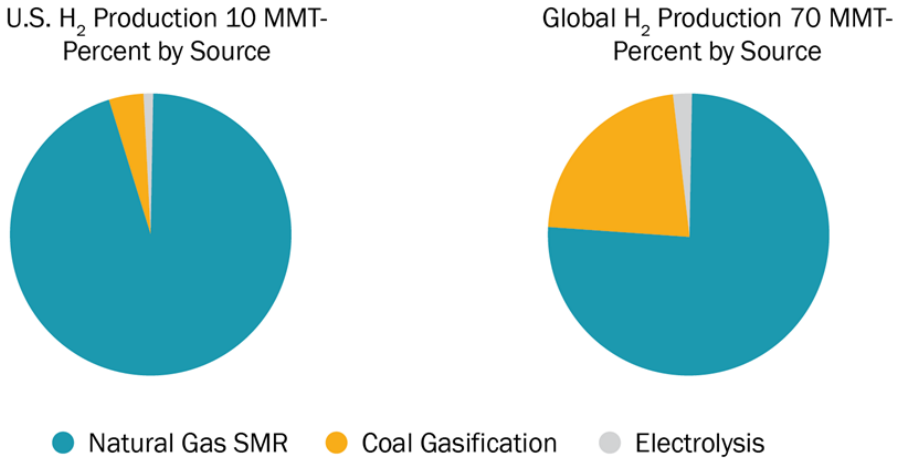
Economics dominates generation mix

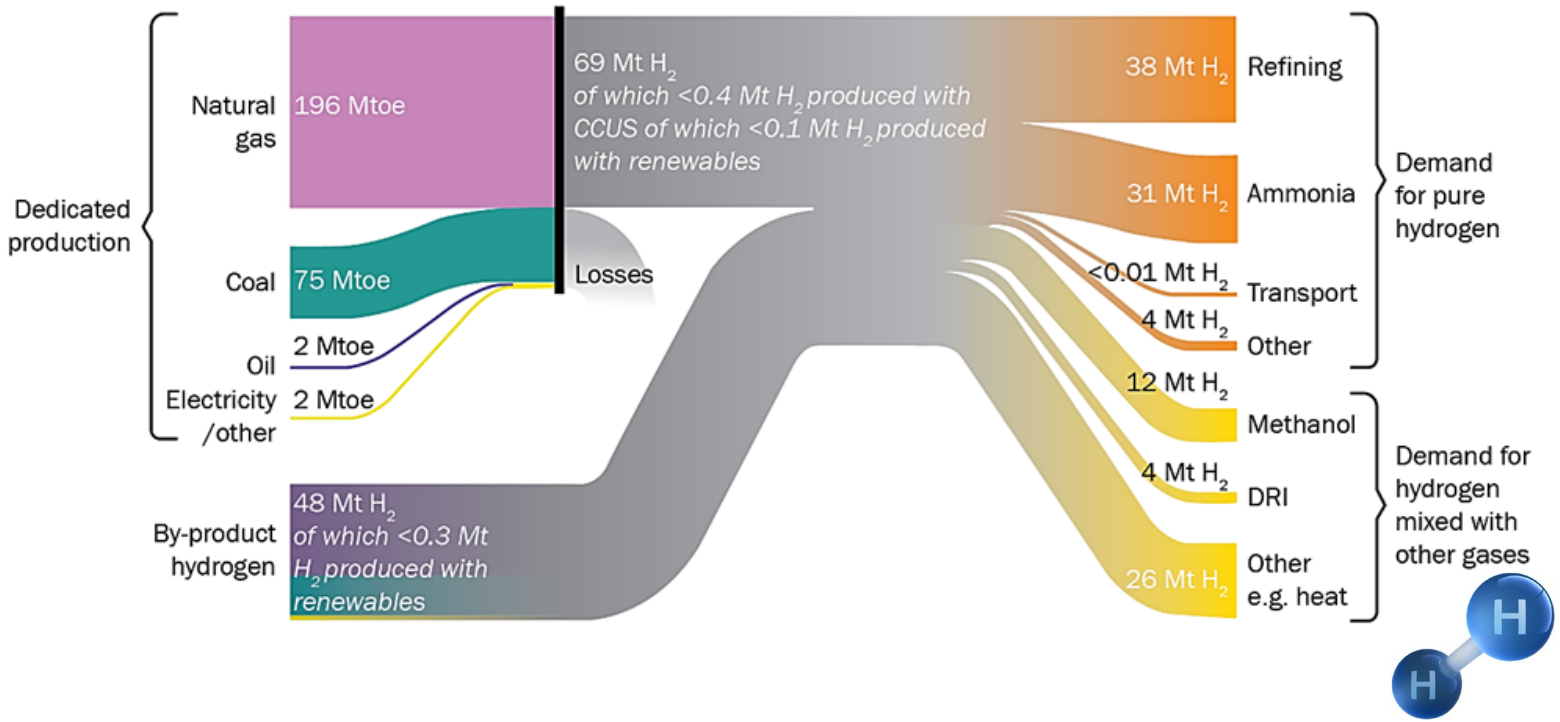


Current Hydrogen Demand

- Current demand is mostly for oil refining and chemical production.
- Metals, electronics and glass production are main industrial sources of demand.
- Food production is main consumer source of demand.
- Transportation, building heating and electricity generation are areas of demand growth for a decarbonized economy.



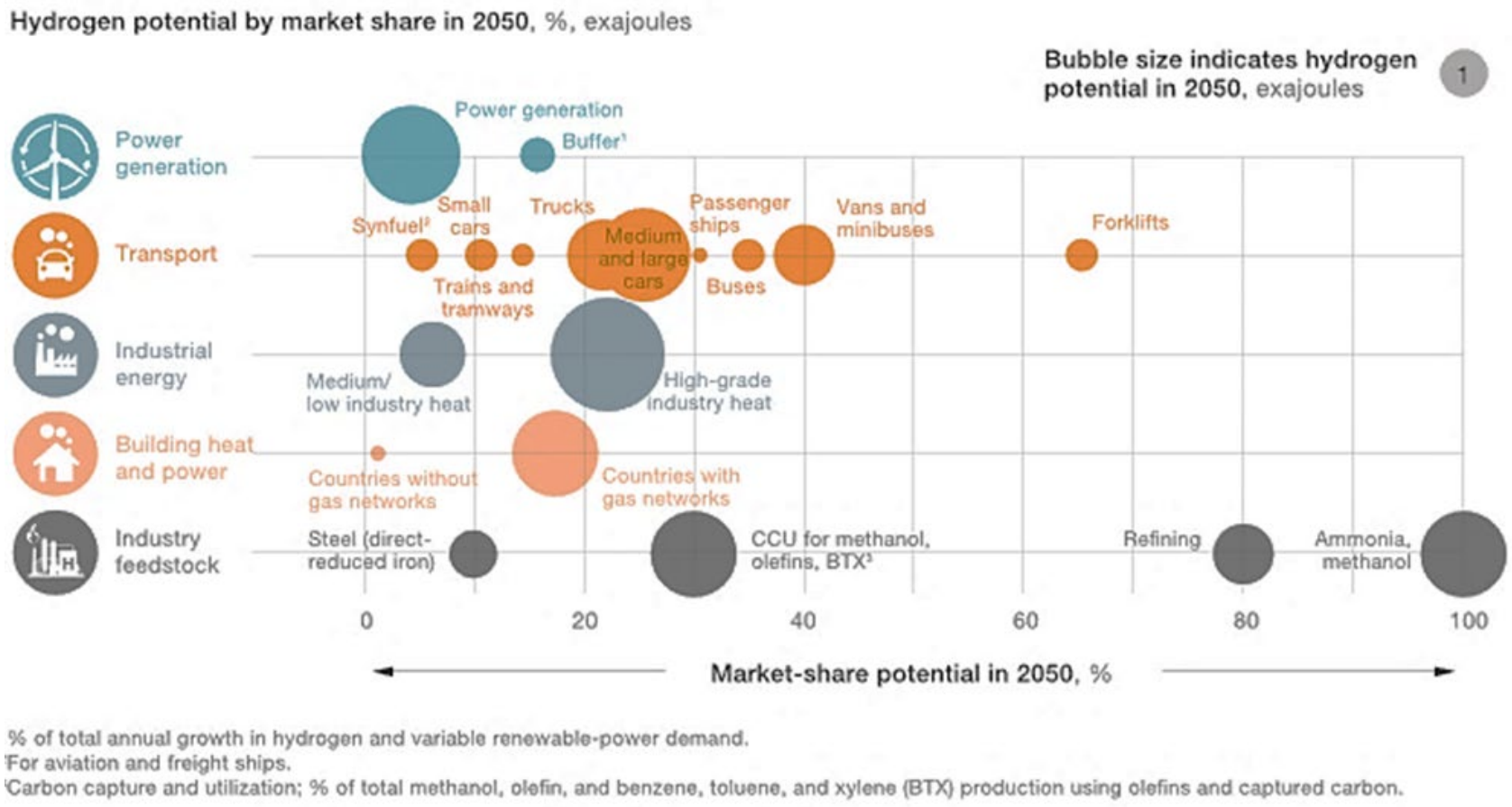




Potential Hydrogen Demand in 2050

- **Transport, buildings, and power sectors all have the potential to use cost-competitive hydrogen.**

- **Fossil fuels with CCUS will support emerging carbon free market opportunities with low-cost hydrogen.**
  - **Utility scale hydrogen based power generation/energy storage**
  - **Steel and advanced alloys manufacturing**
  - **Cement, fertilizer and chemicals production**
  - **Fuel for marine, rail, and heavy-duty vehicle applications**

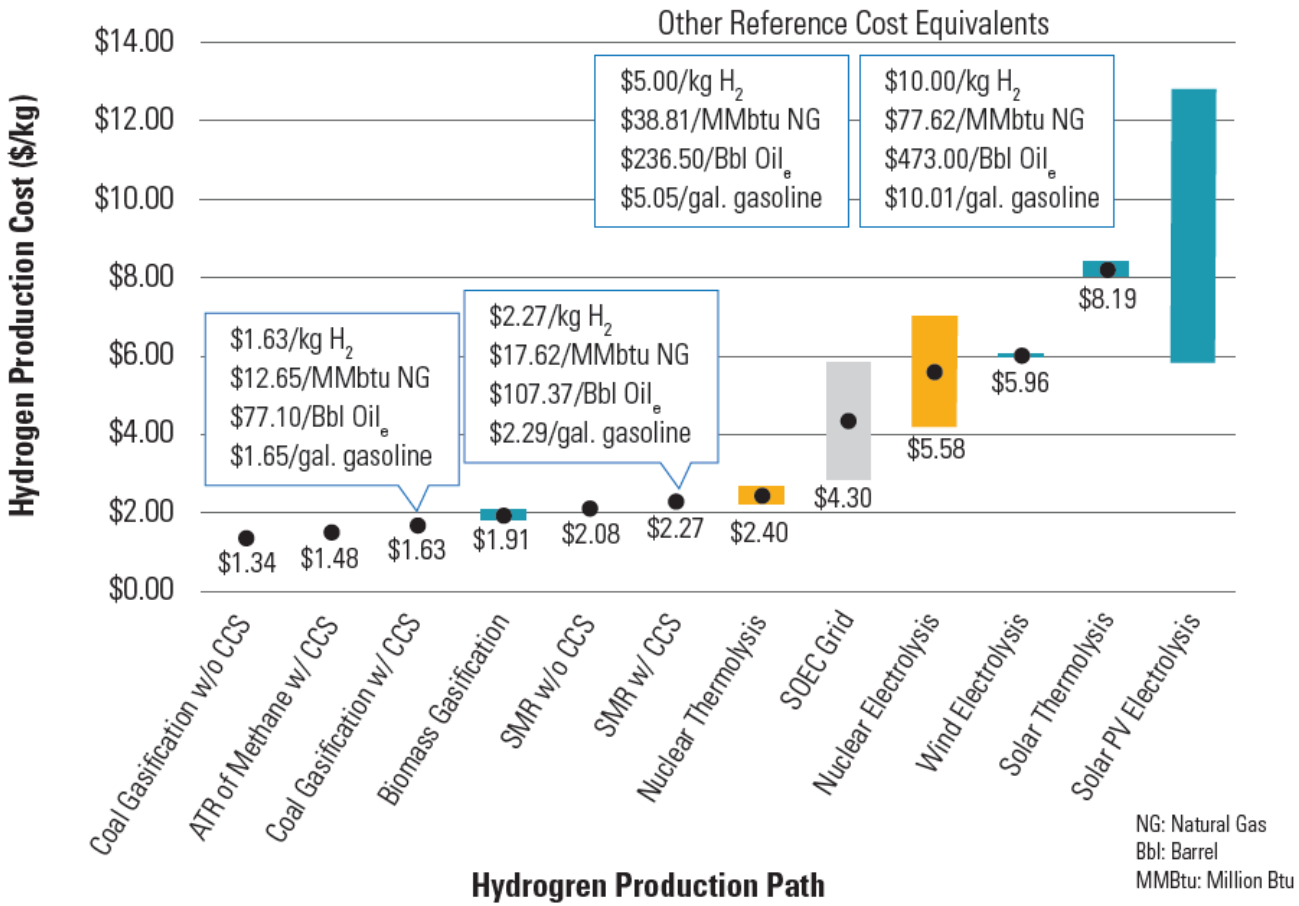


Example of Scale: Hydrogen for the U.S. transport sector would require 200 MMT of hydrogen - 20X current US production.
Transportation fleet expected to increase 2-3X by 2050

Economics of Hydrogen Production

- H_2 production from fossil fuels is the least expensive source, even with CCUS
- Gasification with CCUS could be carbon neutral or even negative when co-firing biomass
- R&D advances could significantly reduce SMR and gasification costs further

Figure 5. Current Hydrogen Production Cost Ranges and Averages by Technology and Equivalent Prices for Fossil Sources with CO_2 Capture and Storage[9,10]

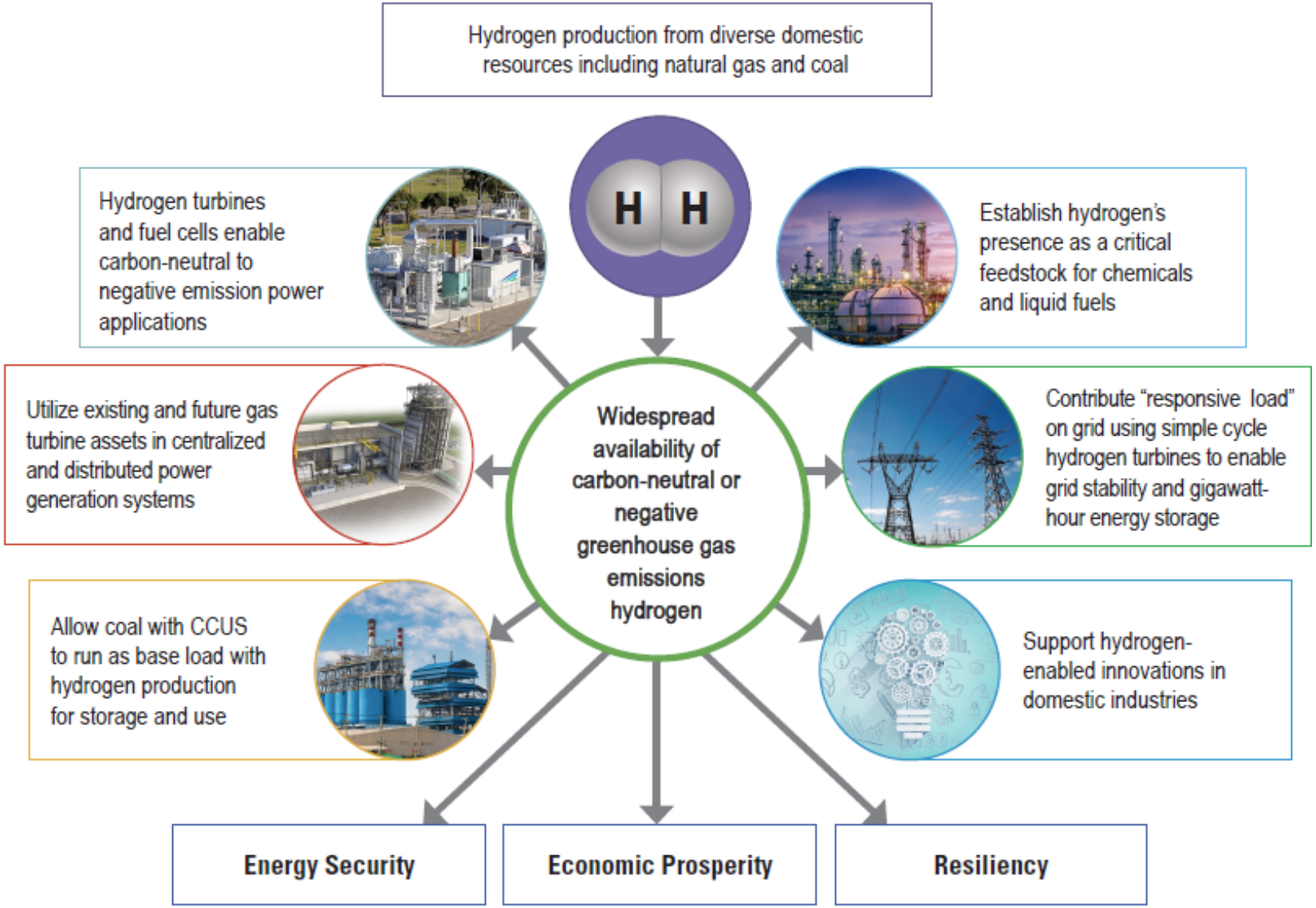


Solar Hydrogen Production: Processes, Systems and Technologies, 1st Edition. Editors: Francesco Calise, Massimo Dentice D'Accadia, Massimo Santarelli, Andrea Lanzini, Domenico Ferrero. Academic Press. August 2019.

PNNL "H2 Hydrogen Tools." Accessed online: https://h2tools.org/hyarc/calculator-tools/energy-equivalency-fuels

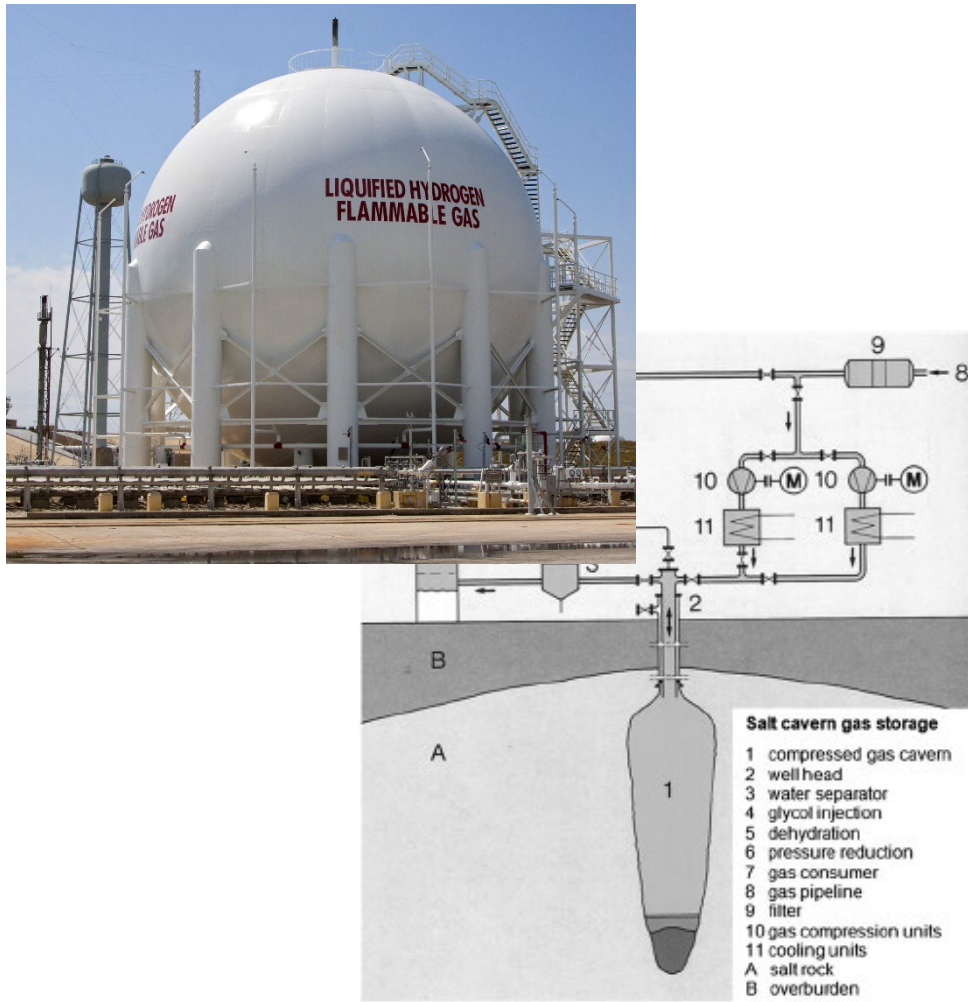
Fossil Energy Hydrogen R&D Program Elements

Relationship of FE Program Elements to Comprehensive Hydrogen Strategy



FE Investments in Hydrogen R&D

- Carbon-Neutral Hydrogen Production Using Gasification and Reforming Technologies
- Large Scale Hydrogen Transportation Infrastructure
- Large Scale On-site and Geological Hydrogen Storage
- Hydrogen Use for Electricity Generation, Fuels, and Manufacturing.



Request for Information—Hydrogen Technologies DE-FOA-0002369

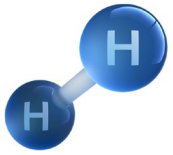
Seeking input from stakeholders about hydrogen technology opportunities and research needs that could lead to technological advances

Topic Areas

1. Natural Gas Hydrogen Production, Transport, and Storage
2. Hydrogen Production from Coal, Biomass, and Waste Plastics Gasification
3. Hydrogen Turbines
4. Hydrogen Storage
5. Hybrid Energy Systems with reversible solid oxide fuel cells to produce hydrogen

Responses Due: August 24th, 2020 to DOE FE National Energy Technology Laboratory

https://netl.doe.gov/business/solicitations



Hydrogen Workshop Agenda – Sessions 2 and 3

Session 2:

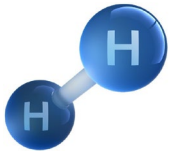
- Hydrogen Production from Solid Feed Stocks, Use, and CCUS technologies to Enable Carbon Free/Negative Products

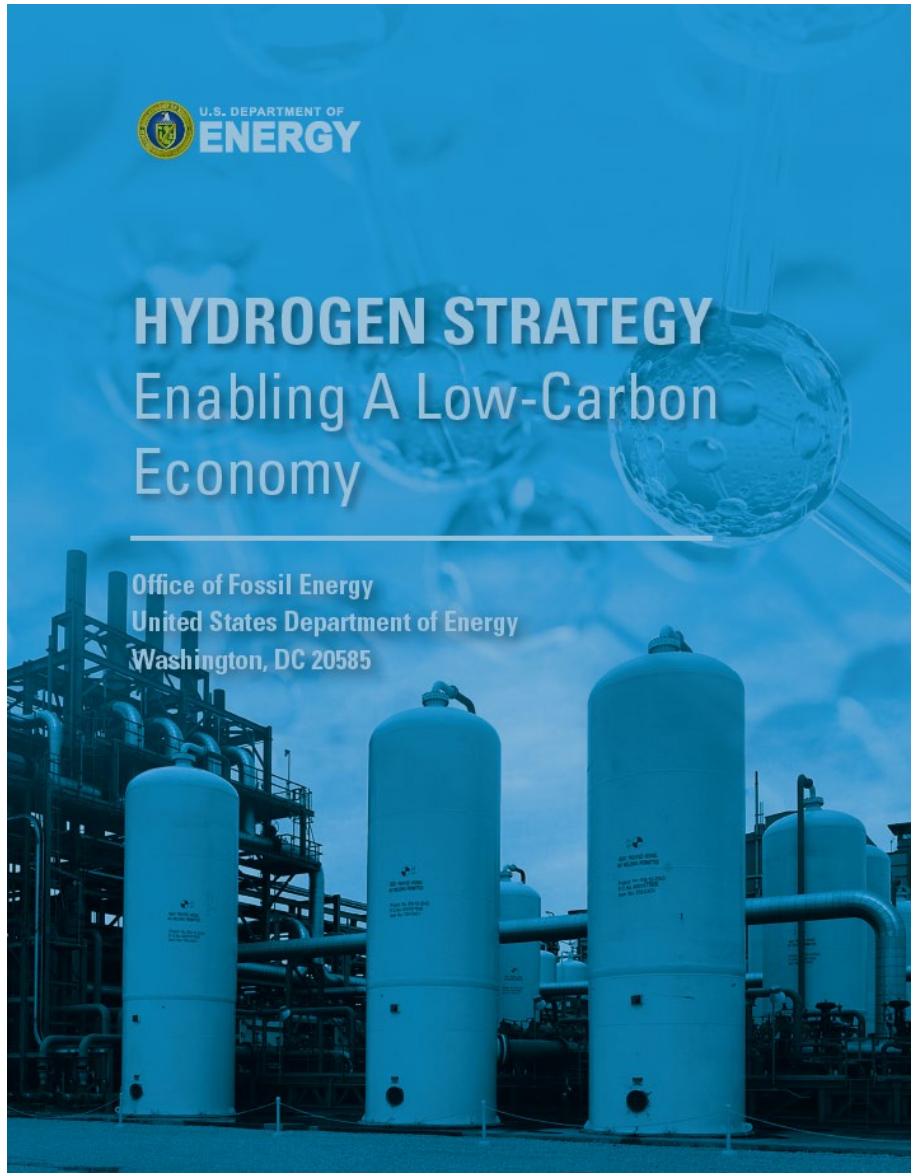
- Oil and Gas Economy wide Production, Transport and Storage of Hydrogen

- DOE LNG Export Activities and Hydrogen Consideration

Session 3:

- Feedback on Fossil Energy Hydrogen Strategy and Future R&D Needs (15-30 Min) – USEA Facilitated





Thank you

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