




U.S. DEPARTMENT OF ENERGY

Office of Fossil Energy

DOE Fossil Energy Hydrogen Program Overview

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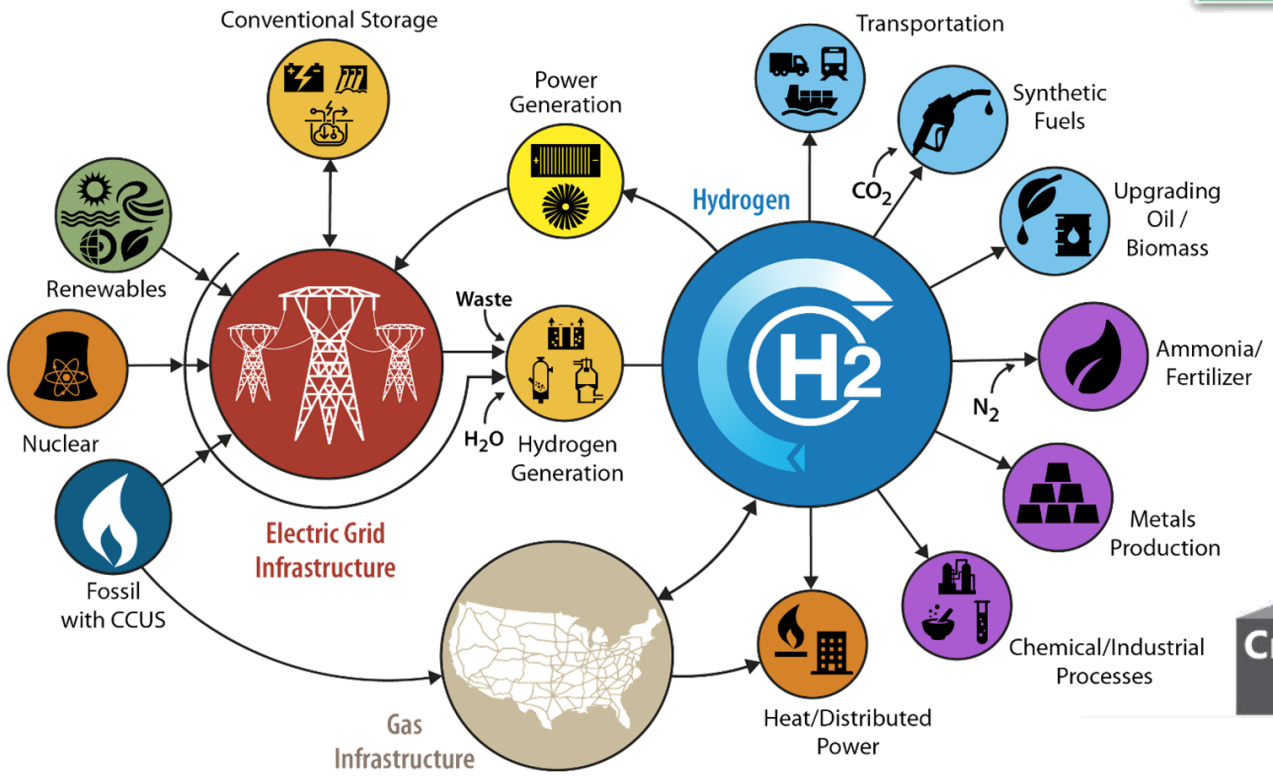
Office of Fossil Energy & Carbon Management

H2@Scale: A Guiding Framework:

DOE's H2@Scale initiative provides an overarching vision for how hydrogen can enable energy pathways across applications and sectors in an increasingly interconnected energy system.



EERE Hydrogen

Feedstocks:
- Renewables and Water

Technologies:
- Electrolysis—Low- and High-Temperature
- Advanced Water Splitting—Solar/High-Temp Thermochemical, Photoelectrochemical
- Biological Approaches

FE Hydrogen

Feedstocks:
- Fossil Fuels—Coal and Natural Gas

Technologies:
- Gasification, Reforming, Pyrolysis
- Advanced Approaches—Co-firing and Modular Systems
- Natural Gas to Solid Carbon plus Hydrogen

Areas of Collaboration

Reversible Fuel Cells, Biomass, Municipal Solid Waste, Plastics

Polygeneration including Co-Gasification with Biomass

High-Temperature Electrolysis, System Integration

Feedstocks:
- Nuclear Fuels and Water

Technologies:
- Electrolysis Systems for Nuclear
- Advanced Nuclear Reactors
- System Integration and Controls - LWRs and Advanced Reactors

NE Hydrogen

Crosscutting R&D Offices: Office of Science (SC) and ARPA-E

Fundamental Science and Advanced Innovative Concepts

FE Investments in Hydrogen R&D

Carbon-neutral Hydrogen Production using Gasification and Reforming Technologies

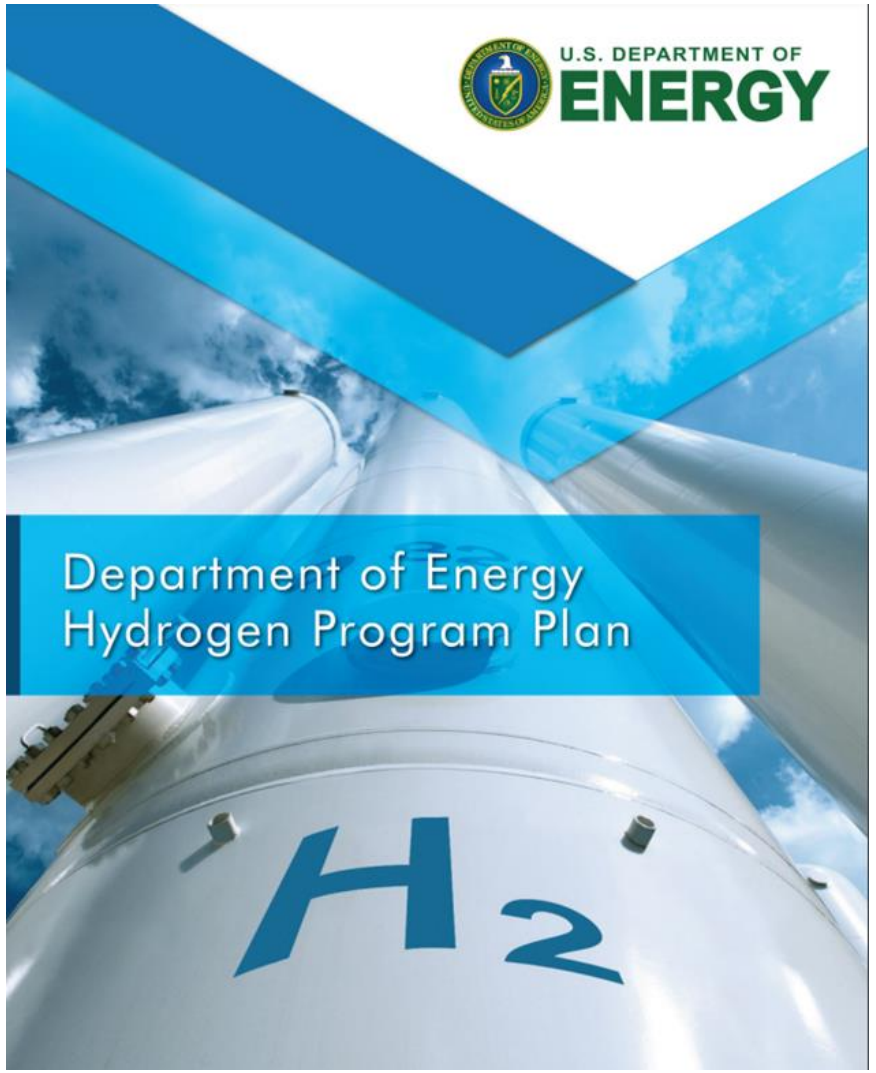
Hydrogen Transport Infrastructure

Hydrogen Storage

Hydrogen use for Electricity Generation, Fuels, and Manufacturing.

GOALS

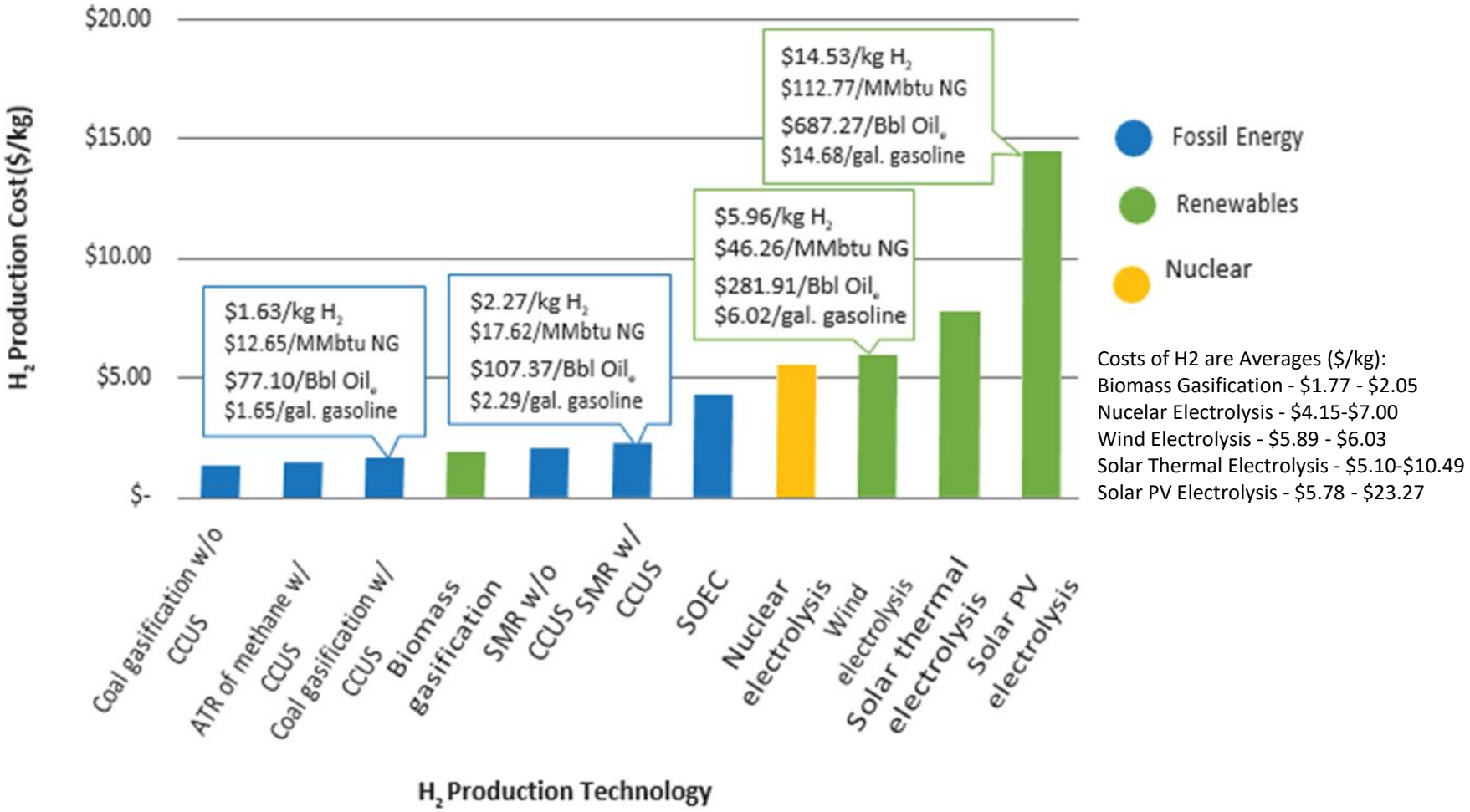
- **Clean hydrogen produced at $1/kg or less**
- **Gas turbines firing zero-carbon fuels**
- **Solid oxide fuel cells and electrolytic cells that can generate hydrogen or produce electricity – reversible architecture**



https://www.hydrogen.energy.gov/pdfs/hydrogen-program-plan-2020.pdf

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



Costs of H2 are Averages ($/kg):
Biomass Gasification - $1.77 - $2.05
Nucelar Electrolysis - $4.15-$7.00
Wind Electrolysis - $5.89 - $6.03
Solar Thermal Electrolysis - $5.10-$10.49
Solar PV Electrolysis - $5.78 - $23.27

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

First Energy Earthshot: Clean H_2 at $1 per kg in One Decade

"…I've asked the Secretary of Energy to speed the development of critical technologies to tackle the climate crisis. No single technology is the answer on its own because every sector requires innovation to meet this moment."

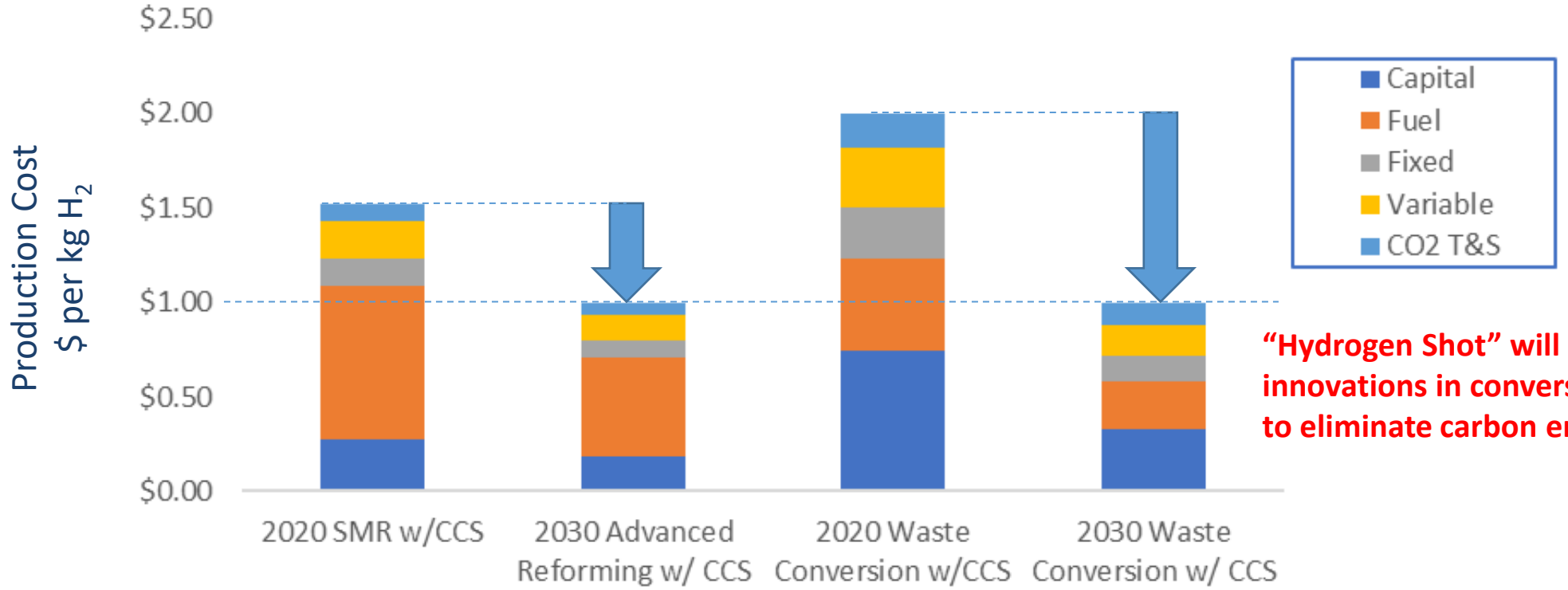
President Joseph R. Biden
April 23, 2021

Launch of Hydrogen Energy Earthshot
First of the Energy Earthshots
June 7, 2021
at DOE Hydrogen Program AMR

Secretary Jennifer Granholm
June 7, 2021

Hydrogen Production Scenarios using Reforming and Thermal Conversion Technology Pathways

Cost reduction pathways for reforming natural gas/biogas and conversion of wastes to hydrogen



"Hydrogen Shot" will catalyze innovations in conversion and CCS to eliminate carbon emissions.

Waste coal, plastics, biomass residuals, MSW, and biogas.

Advanced Technology R&D, Science, and Innovation

- Alternate conversion pathways for reforming and waste conversion are needed for process intensification and optimization.
- Improvements to air separation, catalyst, and carbon capture are key areas to reduce cost and eliminate carbon emissions.



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Thank you – Questions?

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