

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

U.S. DOE Hydrogen and Fuel Cell Perspectives

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IEA-EGRD Hydrogen in the Energy System Decarbonization Webinar, November 24, 2021



U.S. Energy Landscape and Key Goals

U.S. primary energy consumption by energy source, 2019

total = 11.4 guadrillion Btu

total = 100.2 quadrillion British thermal units (Btu)



Note: Sum of components may not equal 100% because of independent rounding. Source: U.S. Energy Information Administration, *Monthly Energy Review*, Table 1.3 and 10.1, eia April 2020, preliminary data Administration Goals include:

- Net zero emissions economy by 2050
- 100% carbon-pollutionfree electric sector by 2035

Priorities: Ensure benefits to all Americans, focus on jobs, EJ40: 40% of benefits in disadvantaged communities

EJ: Environmental Justice

The Challenge: U.S. Energy Related CO₂ Emissions by Sector



Need to address all sectors with portfolio approach

Hydrogen can provide benefits particularly in hard to decarbonize sectors: heavy duty transport, industry, energy storage, etc.

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H2@Scale: Enabler for Deep Decarbonization across Sectors and Jobs



Key Opportunities

- Industry and Chemicals
 Steel, ammonia, cement, syn fuels (e.g., aviation), exports
- Transportation

Trucks, marine, buses, etc.

 Power and Energy Storage Long duration storage, NG blending, turbines, fuel cells

U.S. Snapshot

- 10 MMT of H₂/yr produced today with scenarios for 2-5X growth.
- +10 MMT H₂ would ~ double today's solar or wind deployment
- Potential for 700K jobs, \$140B by 2030

Snapshot of Hydrogen and Fuel Cell Applications in the U.S.



President Biden and Energy Secretary Granholm at Climate Summit



"...l'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 Annual Merit Review

> Secretary Jennifer Granholm June 7, 2021



Hydrogen

Hydrogen Energy Earthshot

"Hydrogen Shot"

"1 1 1" \$1 for 1 kg clean hydrogen in 1 decade

> Launched June 7, 2021 Summit Aug 31-Sept 1, 2021



DOE Hydrogen Shot Summit Stakeholder Feedback

Responses to: Which are the greatest barriers currently preventing public acceptance of wide-spread hydrogen in the US?



earthshot

DEPARTMENT OF ENERGY

Hvdrogen

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All Pathways with Potential for "1 1 1" Included



- Reduce electricity cost, improve efficiency and utilization
- Reduce capital cost >80%; operating & maintenance cost >90%



* Waste coal, plastics, biomass residuals, municipal solid waste (MSW), and biogas

 Reforming, pyrolysis, air separation, catalysts, CCS, upstream emissions



• Photelectrochemical (PEC), thermochemical, biological, etc.

*2020 Baseline: PEM (Polymer Electrolyte Membrane) low volume capital cost ~\$1,500/kW, electricity at \$50/MWh. Pathways to targets include capital cost < \$300/kW by 2025, < \$150/kW by 2030 (at scale). Assumes \$50/MWh in 2020, \$30/MWh in 2025, \$20/MWh in 2030 24 November 2021

Regional Clusters and Geographic Factors for H₂



U.S. Infrastructure Investments, with H₂ Opportunities



DOE Fact Sheet: The Bipartisan Infrastructure Deal Will Deliver For American Workers, Families and Usher in the Clean Energy Future | Department of Energy

Hydrogen

The U.S. DOE Hydrogen Program

The Energy Policy Act (2005) Title VIII and Energy Policy Act of 2020 provide key authorization, coordinated across DOE Offices

Hydrogen is one part of a broad portfolio of activities



www.hydrogen.energy.gov



Priorities

- 1. Low cost, clean hydrogen
- 2. Low cost, efficient, safe hydrogen delivery and storage
- 3. Enable end use applications at scale for impact

Workforce development, safety, codes, standards, and Environmental Justice priorities

Examples of International Collaborations



AN INITIATIVE OF THE CLEAN ENERGY MINISTERIAI

MISSION





CLEAN HYDROGEN MISSION



NNOVATION



The International Partnership for Hydrogen and Fuel Cells in the Economy Enabling the global adoption of hydrogen and fuel cells in the economy

www.iphe.net

Regulations, Codes, Standards, Safety and Education & Outreach Working Groups Task Force to facilitate international trade of H₂

H₂ Production Analysis (H2PA)

RCS&S Compendium



- Reports, workshops, safety sharing
- Assessing gaps
- Education, student engagement, compiling country info

- Developing a common analytical framework to determine emissions footprint for H₂
- Harmonizing approach across countries and pathways



H2 Twin Cities Initiative

Connecting Communities Around the World to Deploy Clean Hydrogen Solutions

Goals

- Global partnerships, collaboration, coordination, and information exchange
- Accelerate hydrogen deployments and user acceptance
- Share lessons learned and best practices
- Awareness of hydrogen and fuel cell technologies worldwide
- Promote Social Equity and Jobs
- Deploy technologies with energy and environmental justice in mind
- Reduce carbon and pollutant emissions



Selection Criteria

- Pair of cities dedicated to hydrogen use at scale
- Existing hydrogen and fuel cell use and commitments to new deployments & metrics
- Public visibility and engagement of the proposed deployments
- Commitments on diversity, equity, and inclusion

Funding

 Nominal funding \$100K-\$200K subject to each country's ministry.



HYDROGEN AND FUEL CELL TECHNOLOGIES OFFICE

Upcoming Opportunities for Engagement



DOE Annual Merit Review and Peer Evaluation Meeting June 6 -9, 2022

Hydrogen and Fuel Cells Day October 8

 Held on hydrogen's very own atomic weight-day





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Thank you

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www.energy.gov/fuelcells www.hydrogen.energy.gov

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