U.S. DEPARTMENT OF ENERGY

U.S. National Clean Hydrogen Strategy Remarks – Hydrogen Americas Summit

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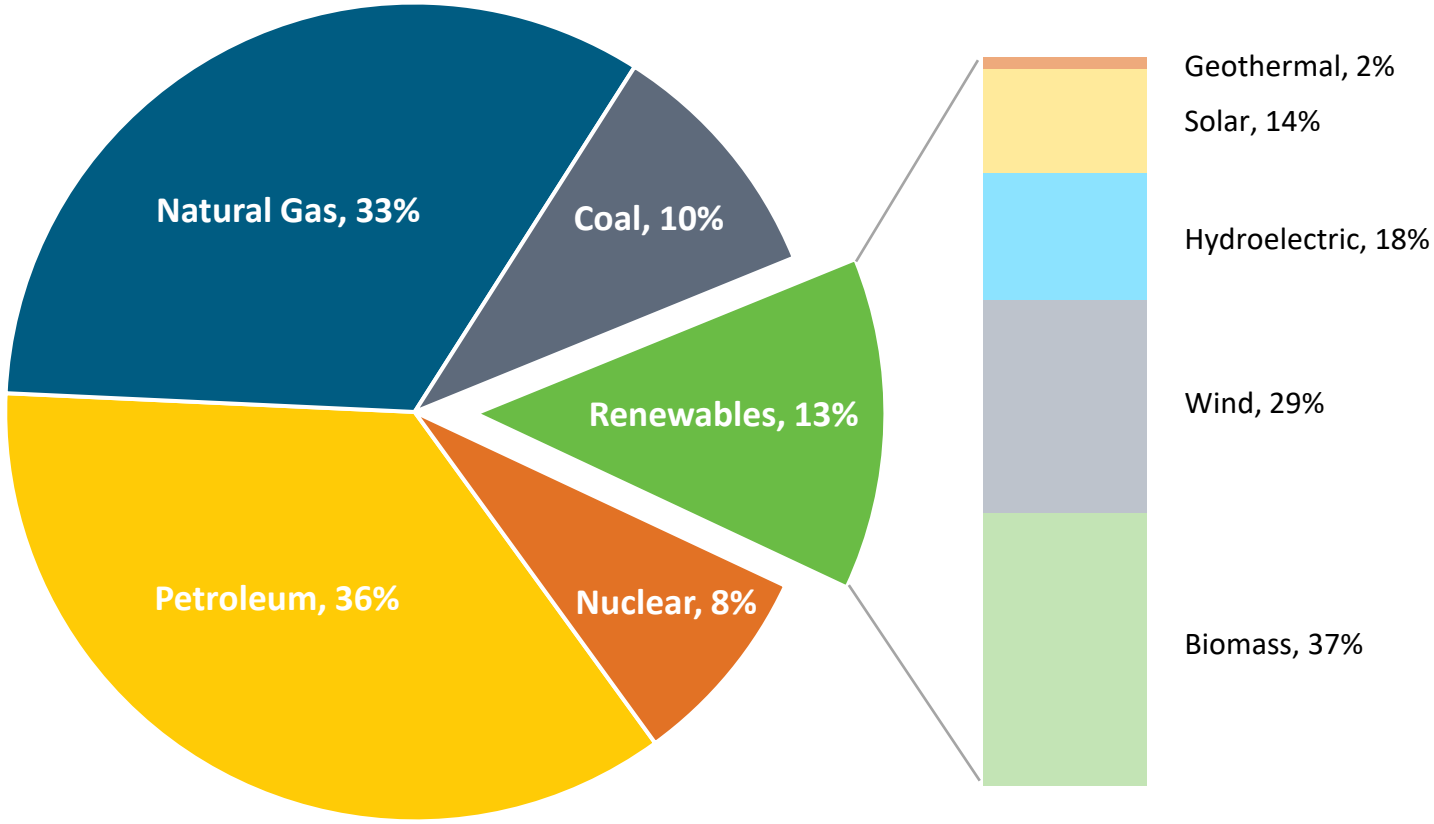
U.S. Department of Energy

Washington DC
October 2, 2023

U.S. Energy Landscape and Key Goals

U.S. primary energy consumption by energy source, 2022

Total = 100.4 quadrillion British thermal units (Btu)



Total = 13.1 quadrillion Btu

Note: Sum of components may not equal 100% because of independent rounding
Source: Data collected from U.S. Energy Information Administration, May 2023, *Monthly Energy Review,* preliminary data

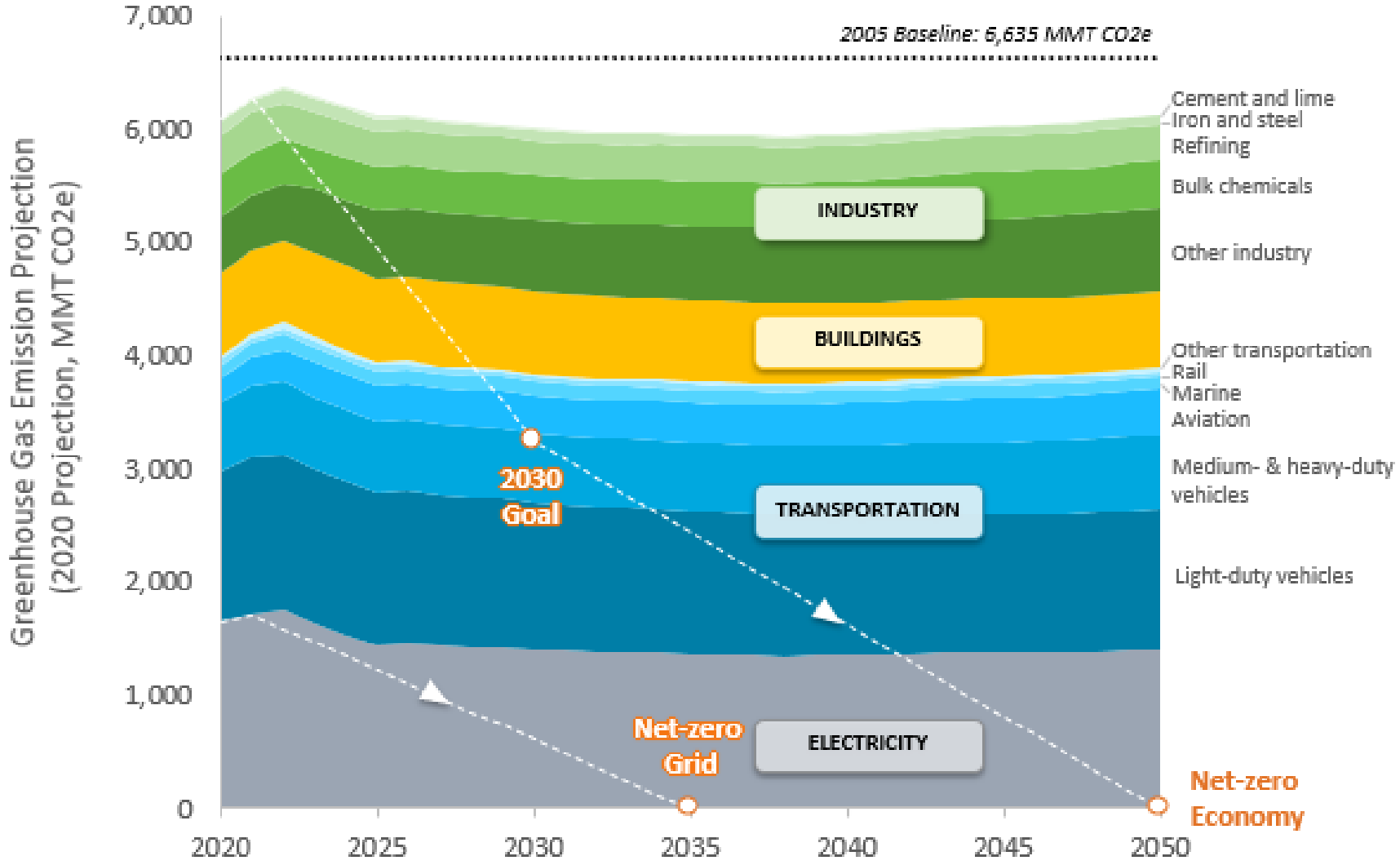
Administration Goals include:

- Net-zero emissions economy by 2050 and 50–52% reduction by 2030
- 100% carbon-pollution-free electric sector by 2035

Priorities: Ensure benefits to all Americans, focus on jobs, Justice40: 40% of benefits in disadvantaged communities

EJ: Environmental Justice

Carbon Dioxide Emissions by Sector



Source: Annual Energy Outlook 2021, DOE National Clean Hydrogen Strategy and Roadmap

Legislation Highlights: 2021 – 2022

Bipartisan Infrastructure Law

- **Includes $9.5B for clean hydrogen**:
  - $1B for electrolysis
  - $0.5B for manufacturing and recycling
  - $8B for at least four regional clean hydrogen hubs
- **Requires** developing a **National Clean Hydrogen Strategy and Roadmap**

President Biden Signs the Bipartisan Infrastructure Bill into law on November 15, 2021. Photo Credit: Kenny Holston/Getty Images

Inflation Reduction Act

- **Includes significant tax credits** (e.g., up to $3/kg for production of clean hydrogen)

U.S. National Clean Hydrogen Strategy and Roadmap

Strategy

1. **Target strategic, high-impact end uses**
   Achieve 10 MMT/year of clean hydrogen by 2030
2. **Reduce the cost of clean hydrogen**
   Enable $2/kg by electrolysis by 2026 and $1/kg H_2 by 2031
3. **Focus on regional networks**
   Deploy regional clean hydrogen hubs and ramp up scale

Vision:
Affordable clean hydrogen for a net-zero carbon future and a sustainable, resilient, and equitable economy

Benefits:
Emissions reduction; job growth; energy security and resilience

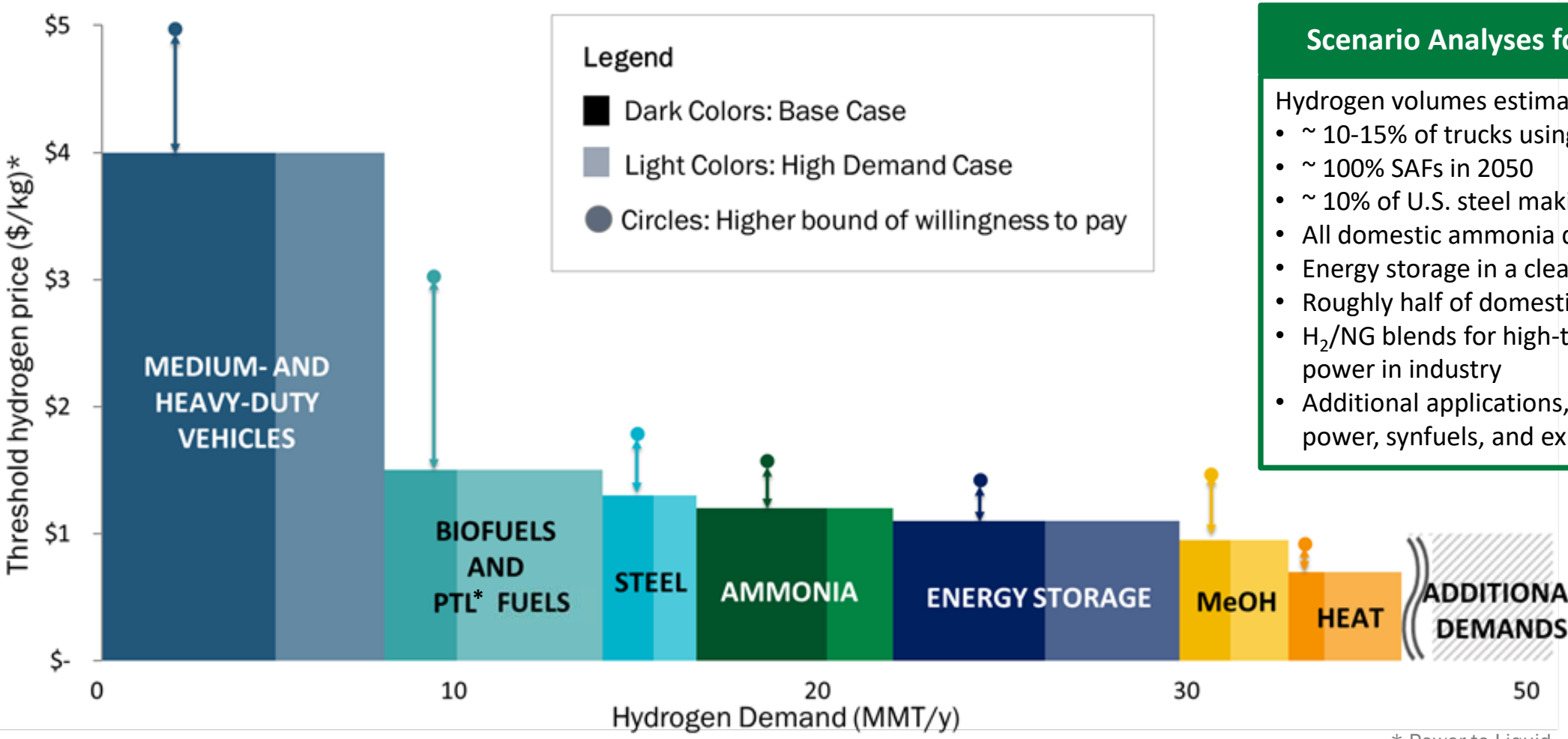
Enablers

Work with other agencies to accelerate market lift off

- Good Jobs and Workforce Development
- Safety, codes and standards
- Policies and incentives
- Stimulating private sector investment
- Energy and environmental justice

Strategy 1: Target High-Impact Uses of Hydrogen

Clean Hydrogen Demand and Costs for Market Penetration



Scenario Analyses for H_2 Demand**

Hydrogen volumes estimated for:

- ~ 10-15% of trucks using fuel cells
- ~ 100% SAFs in 2050
- ~ 10% of U.S. steel making
- All domestic ammonia demand
- Energy storage in a clean grid
- Roughly half of domestic methanol
- H_2/NG blends for high-temp heat and power in industry
- Additional applications, include stationary power, synfuels, and export potential

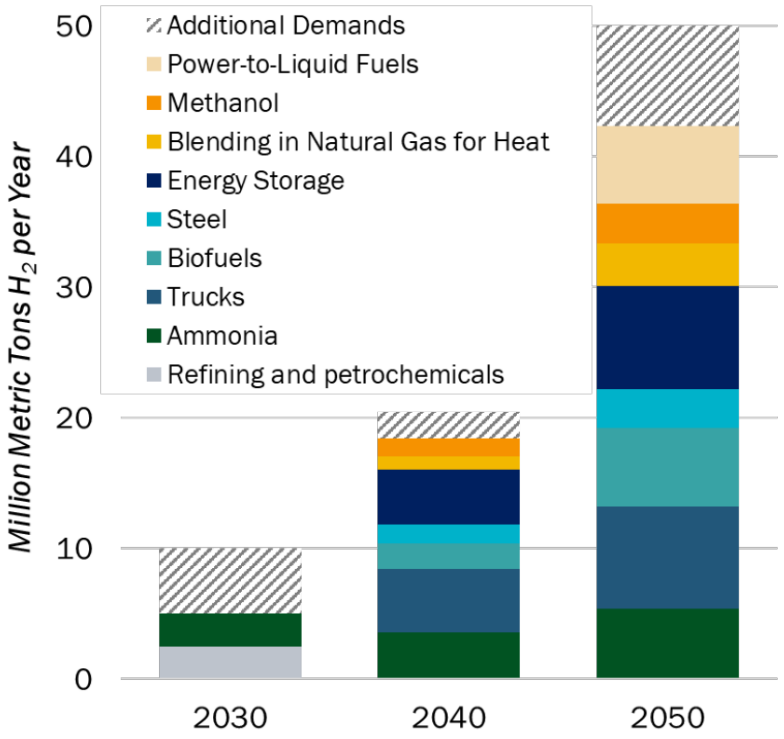
Costs include production, delivery, dispensing to the point of use (e.g., high-pressure fueling for vehicle applications)

* Power to Liquid

** Volumes dependent on multiple variables

U.S. National Clean Hydrogen Strategy and Roadmap

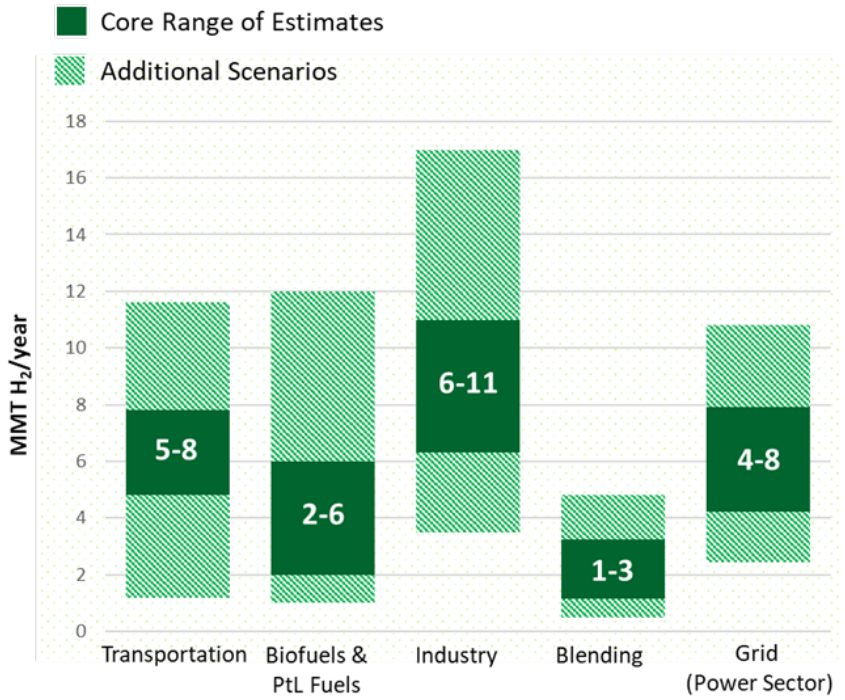
Opportunities for Clean Hydrogen Across Applications



Clean Hydrogen Use Scenarios

- Catalyze clean H_2 use in existing industries (ammonia, refineries), initiate new use (e.g., sustainable aviation fuels (SAFs), steel, potential exports)
- Scale up for heavy-duty transport, industry, and energy storage
- Market expansion across sectors for strategic, high-impact uses

Range of Potential Demand for Clean Hydrogen by 2050



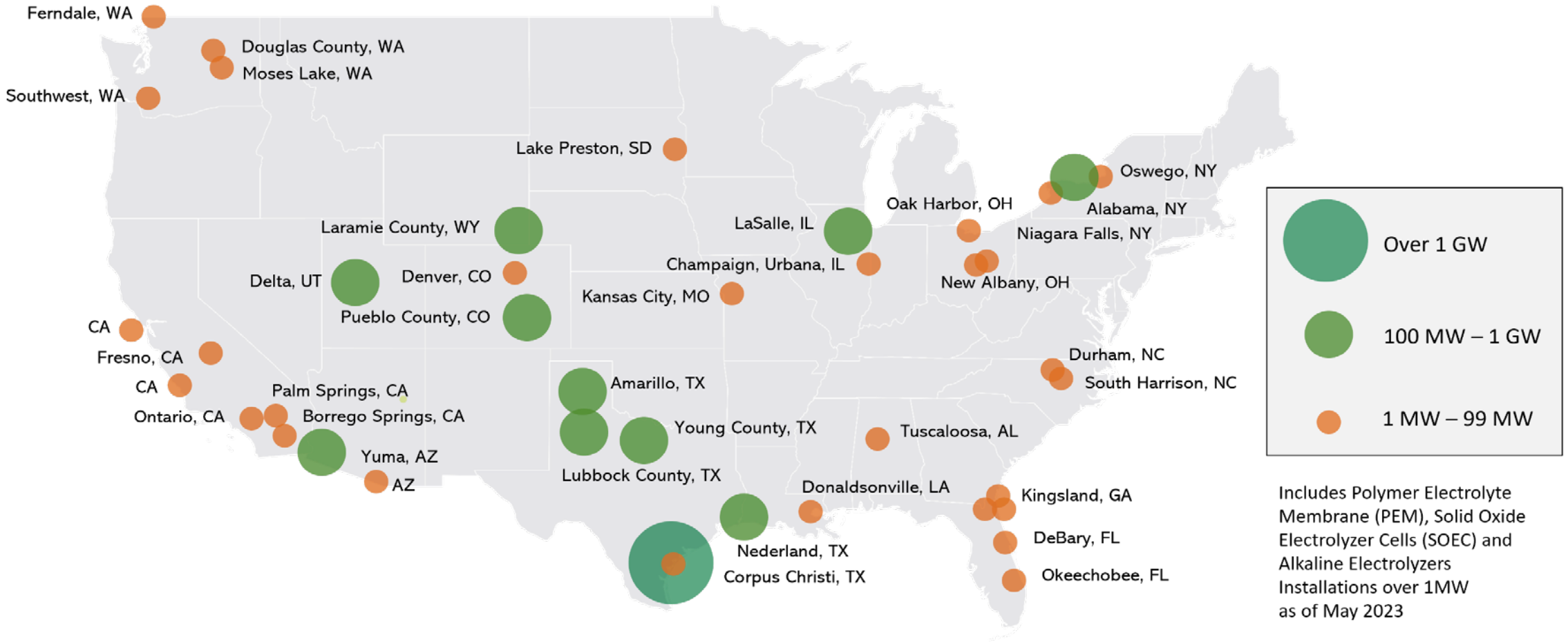
- **Core range: ~ 18–36 MMT H_2**
- **Higher range: ~ 36–56 MMT H_2**

U.S. Opportunity: 10MMT/yr by 2030, 20 MMT/yr by 2040, 50 MMT/yr by 2050. ~10% Emissions Reduction. ~100K Jobs by 2030

Refs: 1. NREL MDHD analysis using TEMPO model; 2. Analysis of biofuel pathways from NREL; 3. Synfuels analysis based off H2@Scale ; 4. Steel and ammonia demand estimates based off DOE Industrial Decarbonization Roadmap and H2@Scale. Methanol demands based off IRENA and IEA estimates; 5. Preliminary Analysis, NREL 100% Clean Grid Study; 6. DOE Solar Futures Study; 7. Princeton Net Zero America Study

Planned and Installed Electrolyzer Capacity in the US

Total 3.7 GW in Electrolyzer Capacity
5-fold increase since 2022

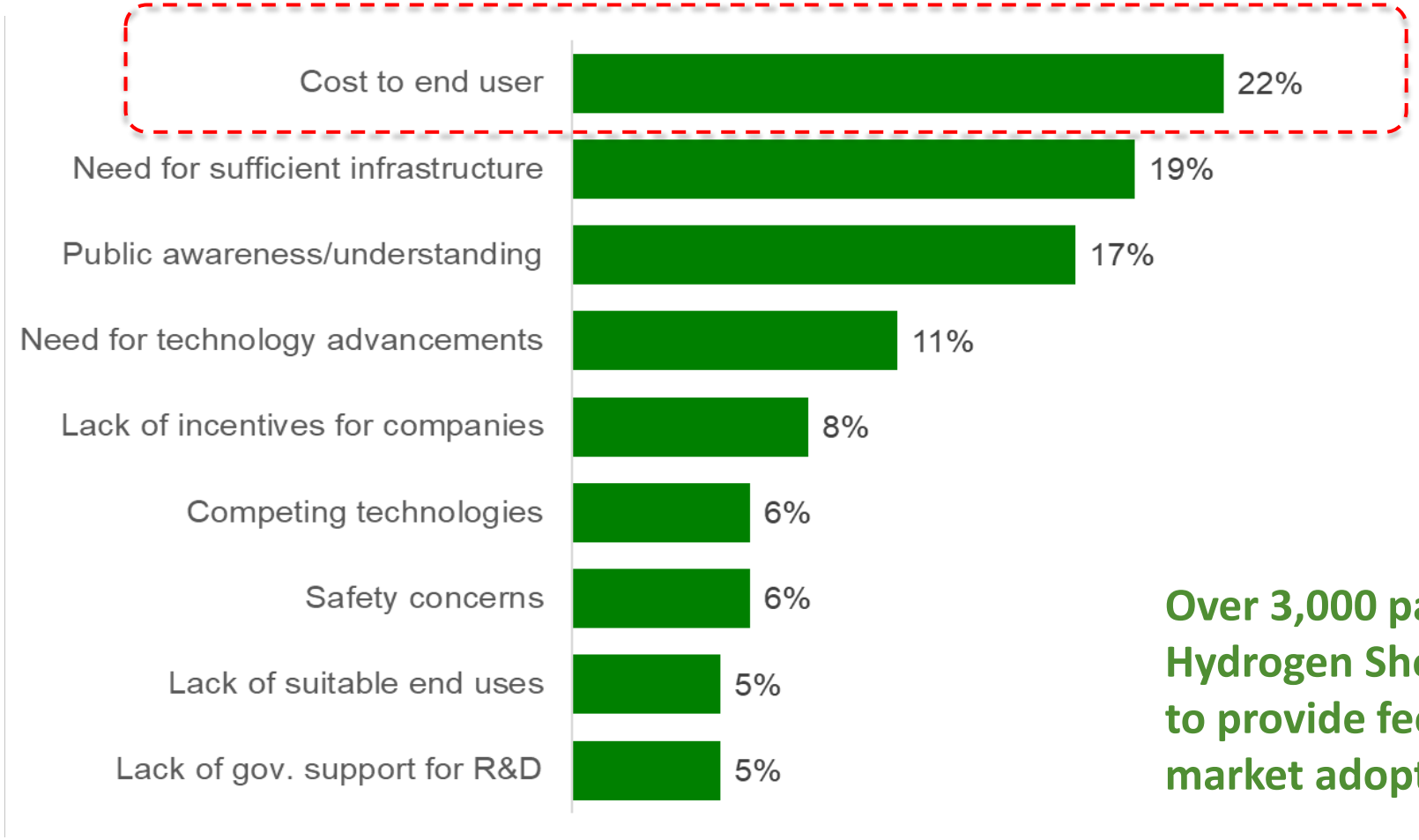


Includes Polymer Electrolyte Membrane (PEM), Solid Oxide Electrolyzer Cells (SOEC) and Alkaline Electrolyzers Installations over 1MW as of May 2023

Source: Arjona, DOE Program Record #23003, June 2023

Strategy 2: Focus on Cost-Reduction

Stakeholder Reported Barriers to Hydrogen Market Adoption



Over 3,000 participants at DOE Hydrogen Shot Summit were requested to provide feedback on key barriers to market adoption of hydrogen

Source: Hydrogen Shot Summit, Sept 2021

https://www.energy.gov/eere/fuelcells/hydrogen-shot-summit

Hydrogen Energy Earthshot

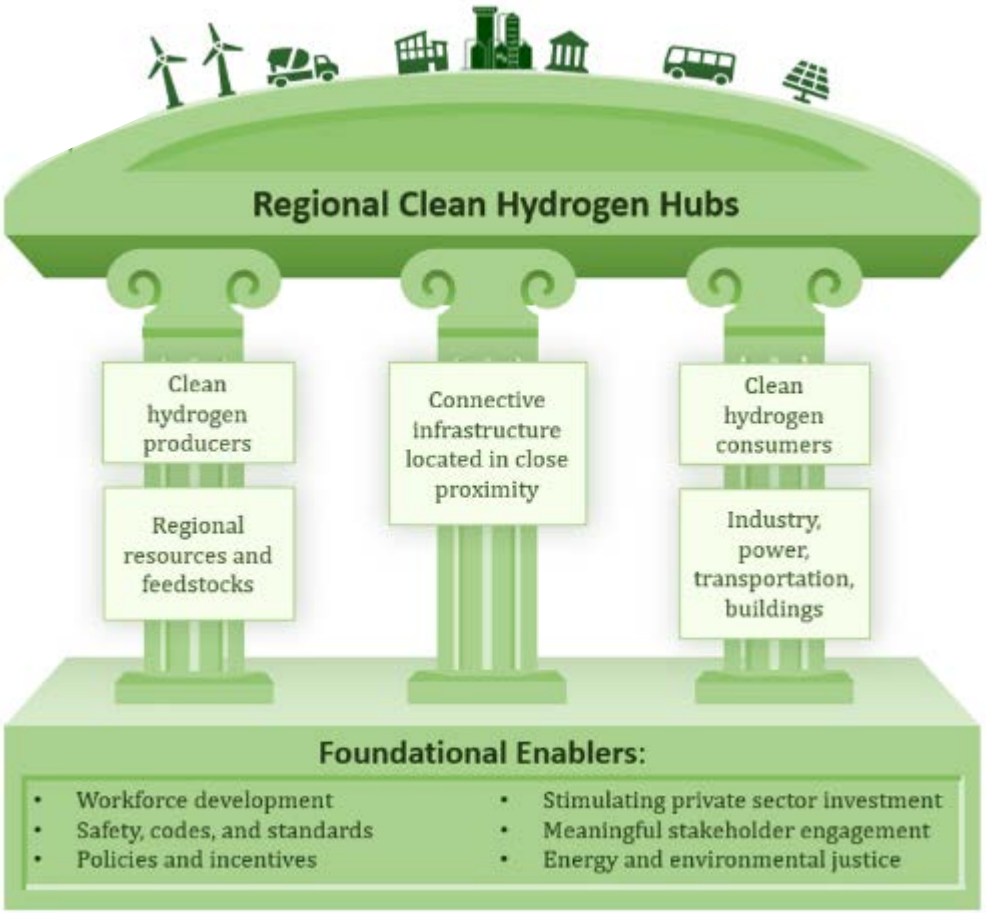
“Hydrogen Shot”

“1 1 1”
$1 for 1 kg clean hydrogen in 1 decade

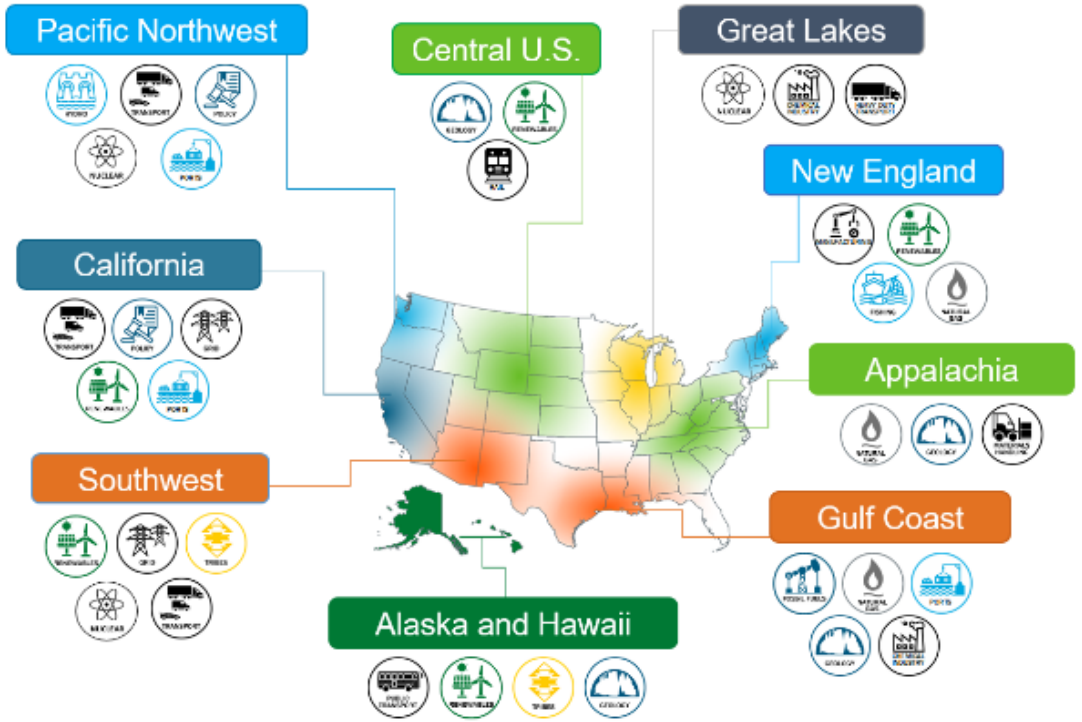
Strategy also includes delivery and storage infrastructure cost reduction

Strategy 3: Focus on Regional Networks and Ramp up Scale

Build Regional Networks through "Clean Hydrogen Hubs"



Examples of Stakeholder and RFI Input



Demand side strategy for Hubs announced

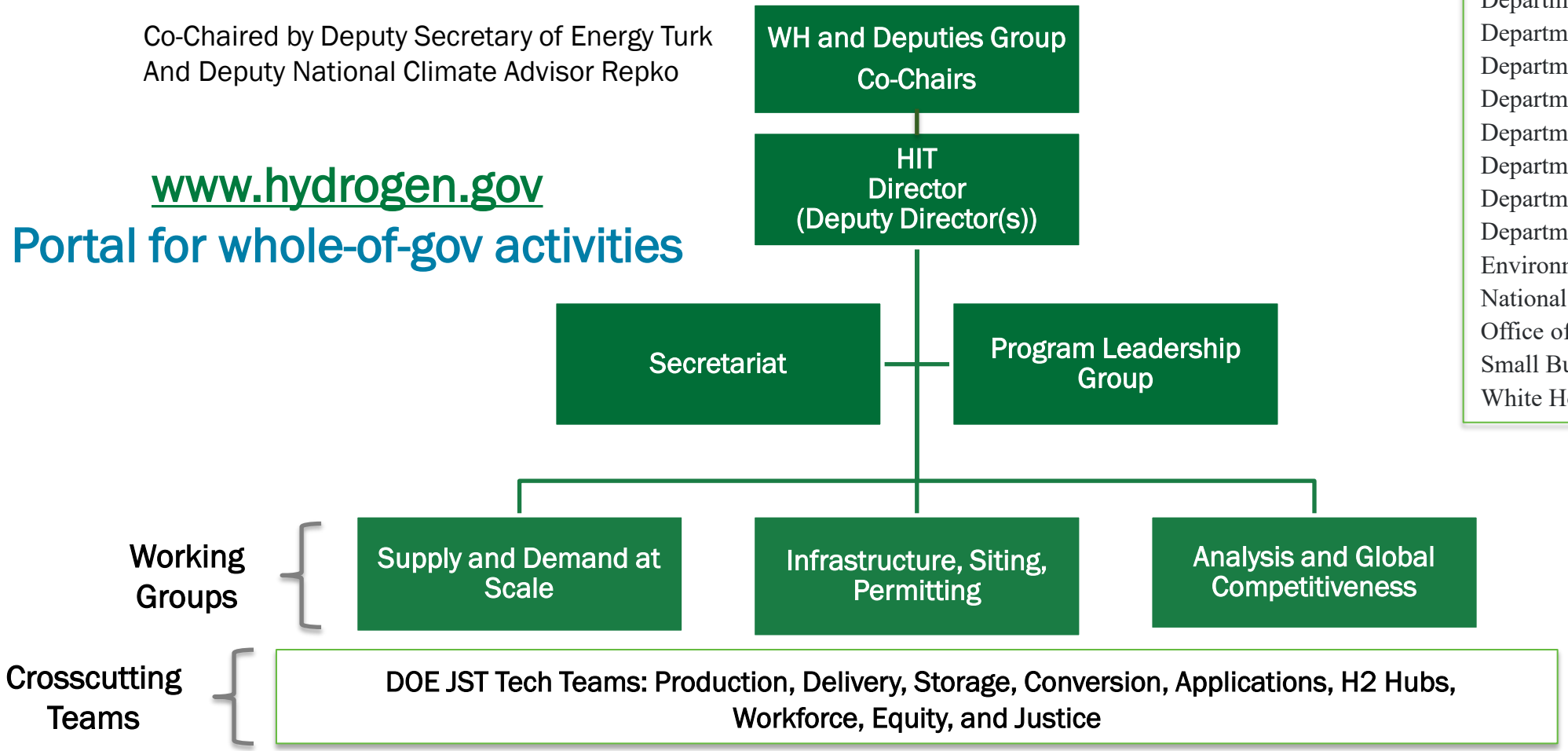
Whole-of-Government Approach

HIT
Hydrogen Interagency Task Force

Hydrogen Interagency Task Force (HIT) across 11 Agencies

Co-Chaired by Deputy Secretary of Energy Turk
And Deputy National Climate Advisor Repko

www.hydrogen.gov
Portal for whole-of-gov activities



- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Energy (Co-Chair)
- Department of the Interior
- Department of Labor
- Department of State
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- Office of Science and Technology Policy
- Small Business Administration
- White House Climate Policy Office (Co-Chair)

JST: Joint Strategy Team. Equity, Energy and Environmental Justice is a cross cutting priority across WGs.

HIT Director: Sunita Satyapal, DOE/HFTO; WG co-leads from across DOE and other agencies; Secretariat: Pete Devlin, Ben Gould, HFTO

The Energy Policy Act of 2005 authorized the establishment of an interagency task force on hydrogen and fuel cells. 42 U.S.C. 16155. Agencies have been collaborating under the existing IWG and are working to expand collaboration by developing a Hydrogen Interagency Taskforce. More details will be available on www.hydrogen.gov.

Energy and Environmental Justice

Diversity, Equity, Inclusion, and Accessibility

Equity and Environmental Justice Perspectives

I. Listening, Engaging & Increasing Transparency

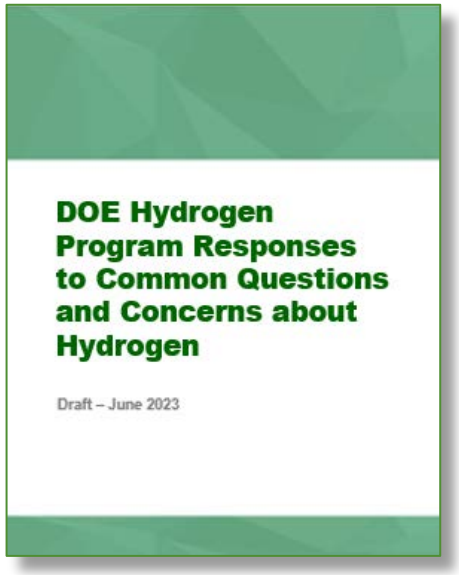
II. Prioritizing Safety and Positive Impacts

III. Lowering Barriers

IV. Diversifying the Clean Hydrogen Workforce

V. Building Capacity & Skills

VI. Environmental Justice in Permitting and Siting



Stay tuned for more information on Community Benefits Plans, Mapping Tools, and upcoming activities


Global Collaboration

Mapping of International Hydrogen Initiatives and Collaborations Underway

Hydrogen Breakthrough – Overview of the Priority Actions for 2023

BREAKTHROUGH AGENDA
a joint project of CEM & MI

Priority International Action	Coordinating initiative(s) To date
H.1: Standards & Certification Accelerate the development of standards for clean hydrogen	IPHE, IEA's Hydrogen TCP, IRENA's Collaborative Framework on Green Hydrogen
H.2: Demand Creation & Management Coordinate internationally to drive demand for clean hydrogen	First Movers Coalition, Clean Energy Ministerial Hydrogen Initiative, Mission Innovation Clean Hydrogen Mission
H.3: Research & Innovation Expand the number and scope of innovative clean hydrogen projects	Mission Innovation Clean Hydrogen Mission
H.4: Finance & Investment Scale and facilitate access to financial & technical assistance, particularly for developing countries	World Bank & UNIDO
H.5: Landscape Coordination Enhance the coordination and transparency of international collaboration on clean hydrogen	Breakthrough Agenda project team in close partnership with initiatives

Under discussion among partnerships

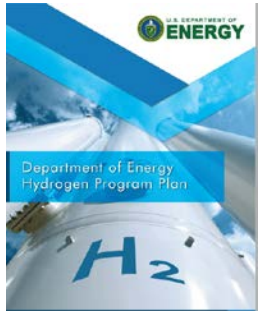
IEA · H2 Twin Cities · Clean Energy Ministerial (Advancing Clean Energy Together) · Hydrogen Initiative (An Initiative of the Clean Energy Ministerial) · Glasgow Breakthroughs @ COP26 · Mission Innovation · H2

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

20th Anniversary – Stay tuned this week for more

Resources and Opportunities for Engagement

Key Publications



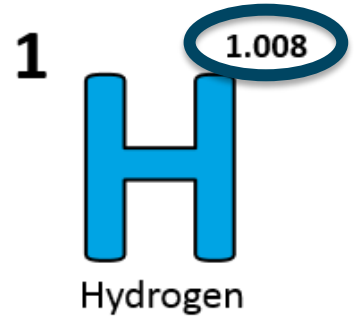
www.hydrogen.energy.gov

Save the date!

2024 DOE Annual Merit Review May 6-9, 2024

Hydrogen and Fuel Cells Day October 8

- Held on hydrogen's very own atomic weight-day



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Learn more at: energy.gov/eere/fuelcells AND www.hydrogen.energy.gov

Champions #1 for Element #1

Thank you

Dr. Sunita Satyapal
Director, Hydrogen and Fuel Cell Technologies Office
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U.S. Department of Energy
And
Director, Hydrogen Interagency Task Force

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