U.S. DEPARTMENT OF ENERGY

U.S. DOE Hydrogen Program Opening Remarks

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U.S. Department of Energy

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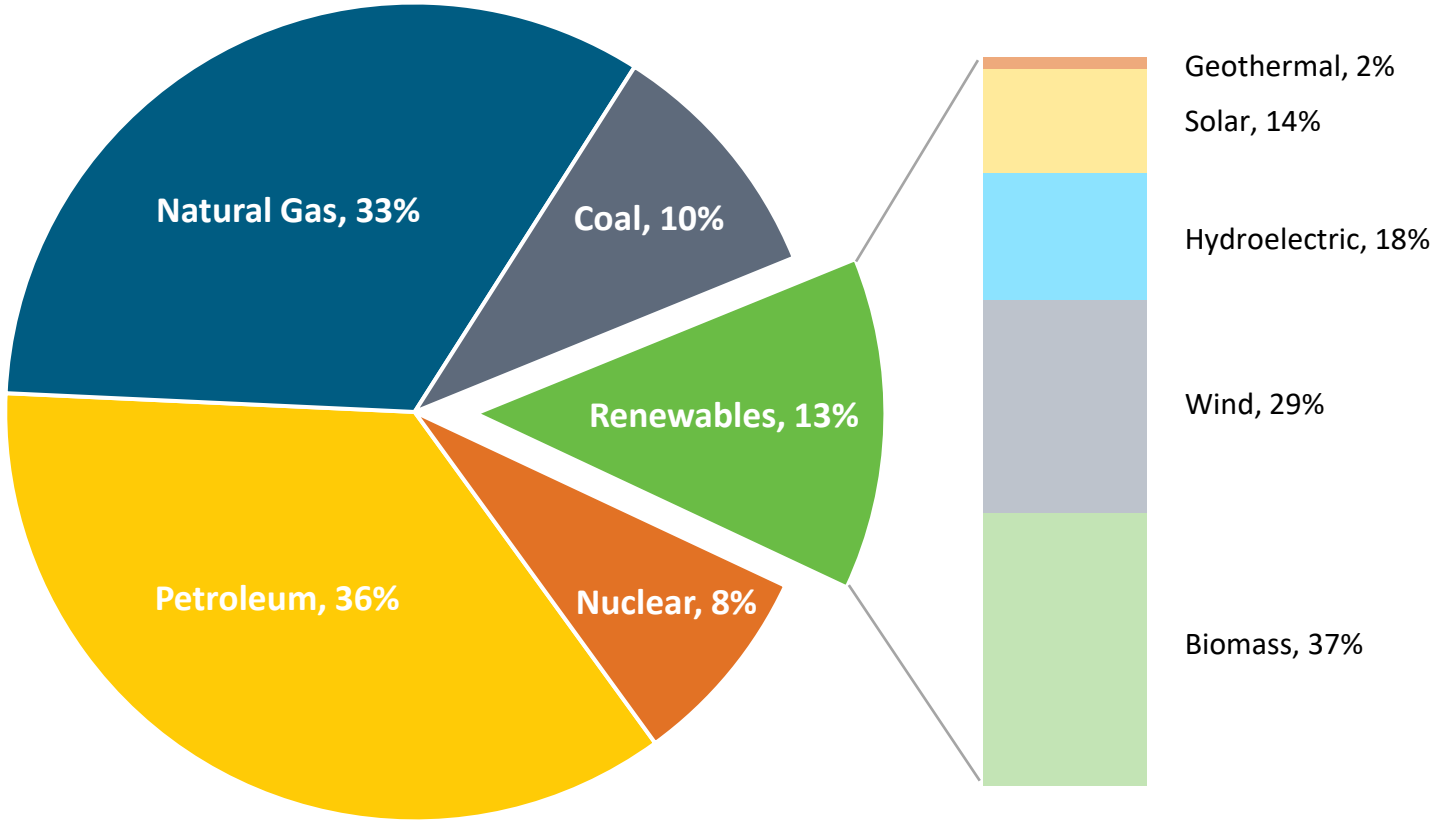
Hydrogen Infrastructure Priorities to Enable Deployment in High-Impact Sectors

U.S. Energy Landscape and Key Goals

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

Total = 100.4 quadrillion British thermal units (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

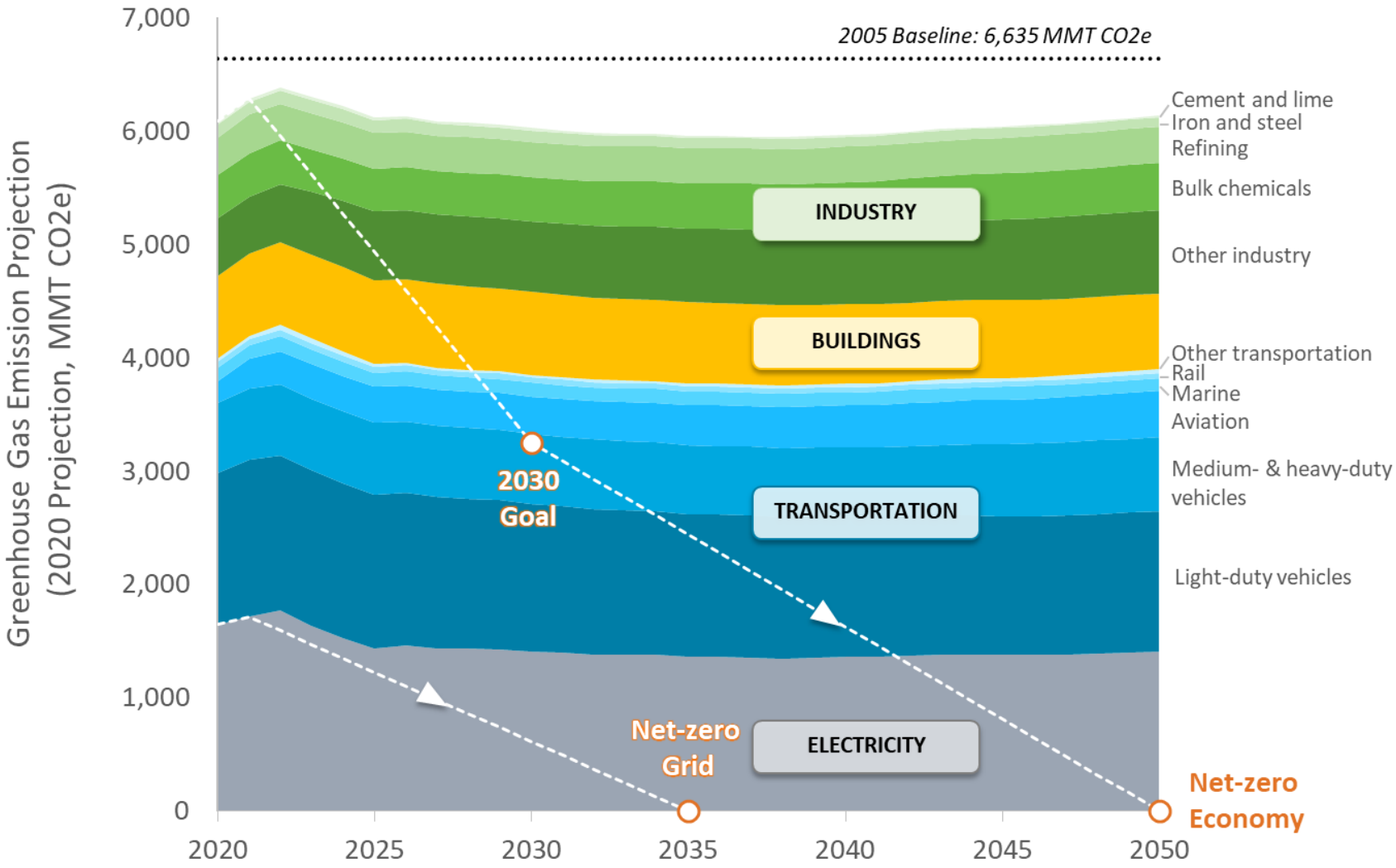
Administration Goals include:

- 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

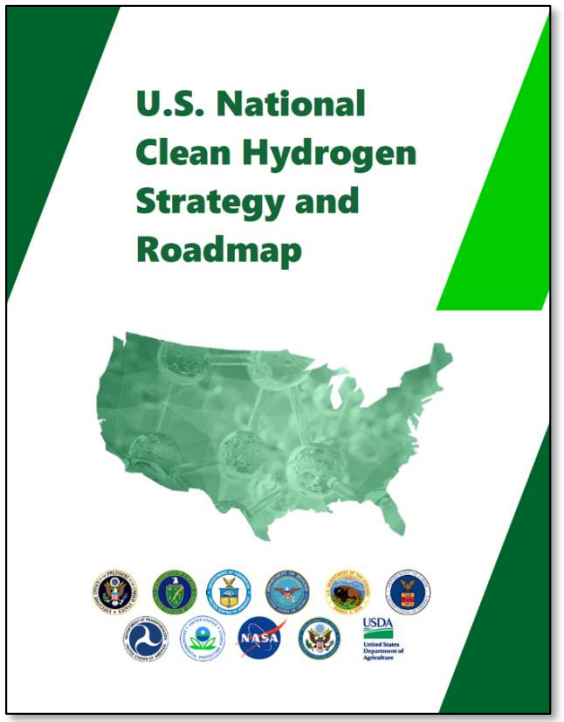
EJ: Environmental Justice

Carbon Dioxide Emissions by Sector



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

U.S. National Clean Hydrogen Strategy and Roadmap



www.hydrogen.gov

Released June 5, 2023

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

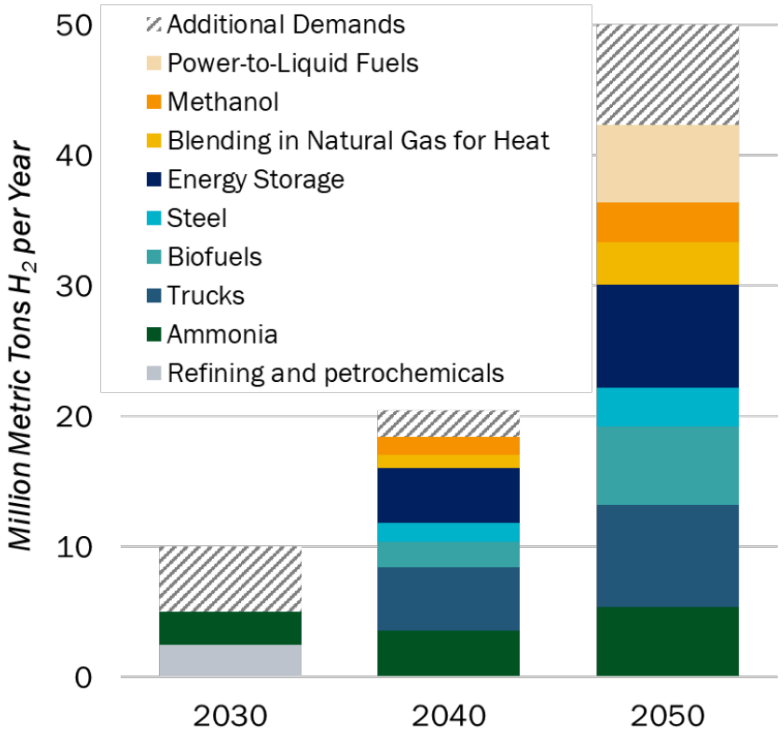
Enablers

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

U.S. National Clean Hydrogen Strategy and Roadmap

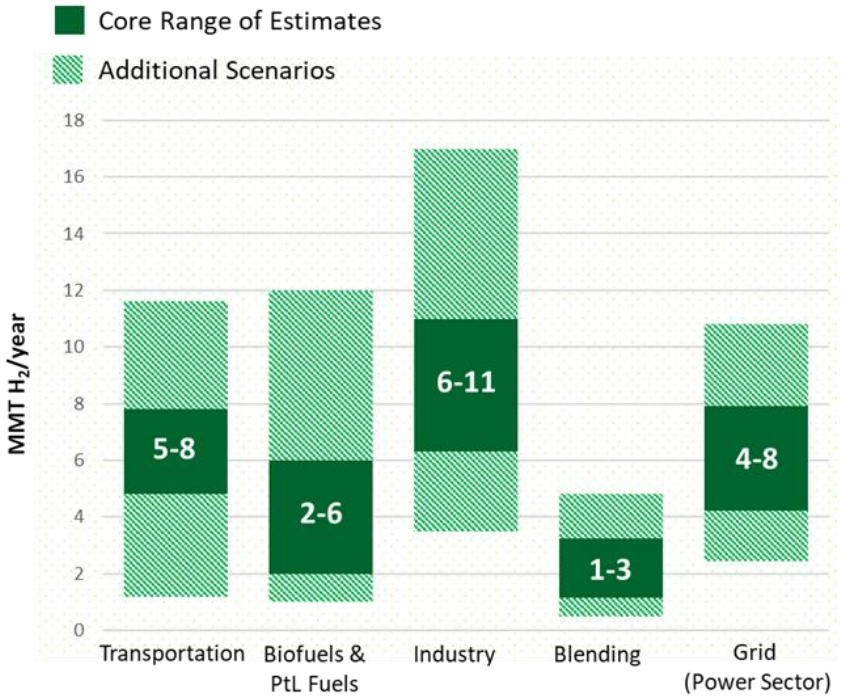
Opportunities for Clean Hydrogen Across Applications



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**

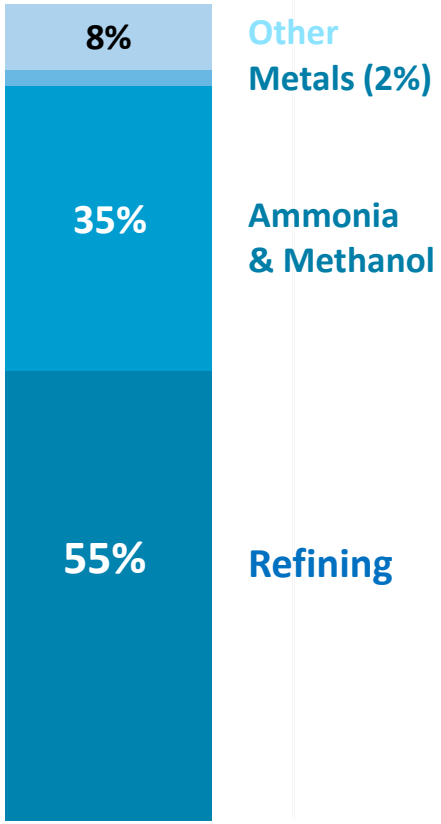
U.S. Opportunity: 10MMT/yr by 2030, 20 MMT/yr by 2040, 50 MMT/yr by 2050. ~10% Emissions Reduction. ~100K Jobs by 2030

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

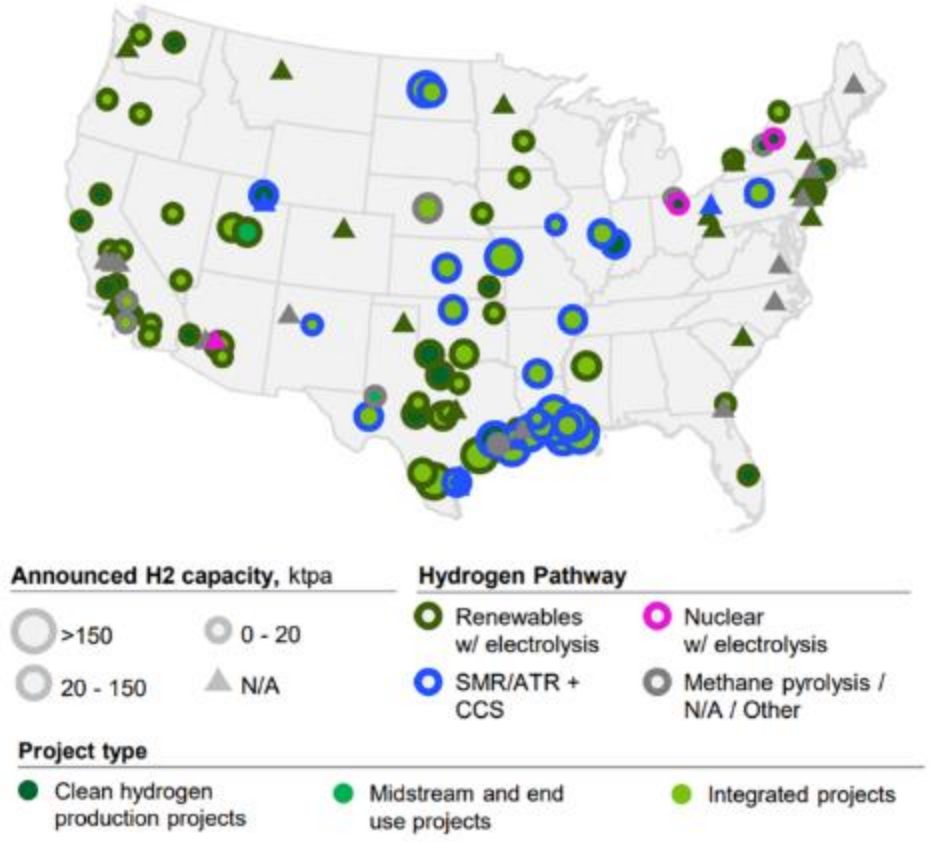
Snapshot of Hydrogen and Fuel Cells in the U.S.

- 10 million metric tons produced annually
- More than 1,600 miles of H_2 pipeline
- World's largest H_2 storage cavern

Use of Hydrogen in the U.S. Today



Current publicly announced clean hydrogen production projects*



*as of EOY 2022, DOE Commercial Liftoff Report

Examples of Deployments

- >500 MW — Backup Power
- >60,000 — Forklifts
- >3.7 GW — Electrolyzers
- ~80 – 150 — Fuel Cell Buses
- ~50 — H_2 Retail Stations
- >18,000 — Fuel Cell Cars

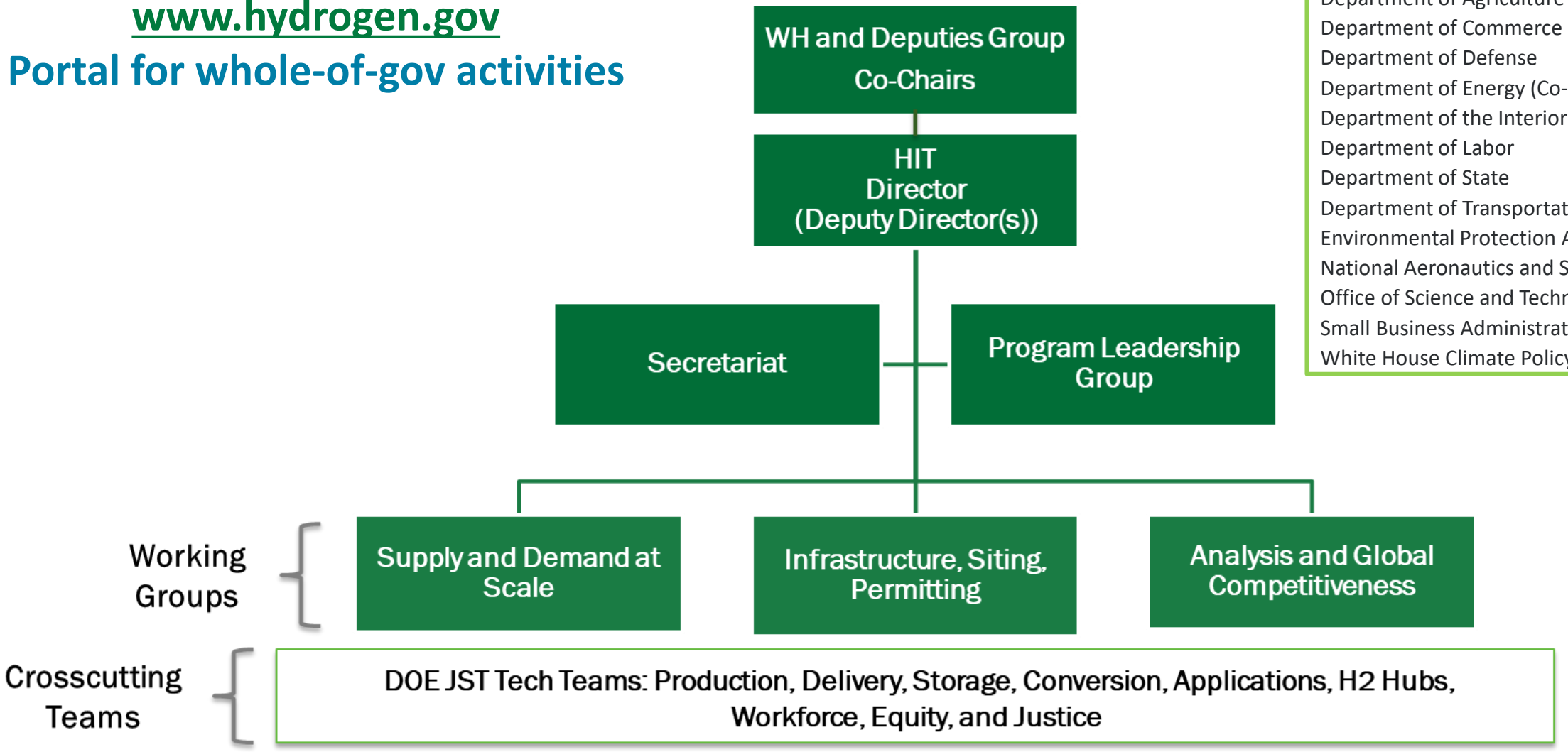
President Biden Announces $7 Billion for 7 H2 Hubs – October 13, 2023

Whole-of-Government Approach

HIT
Hydrogen Interagency Task Force

Hydrogen Interagency Task Force (HIT) across Agencies

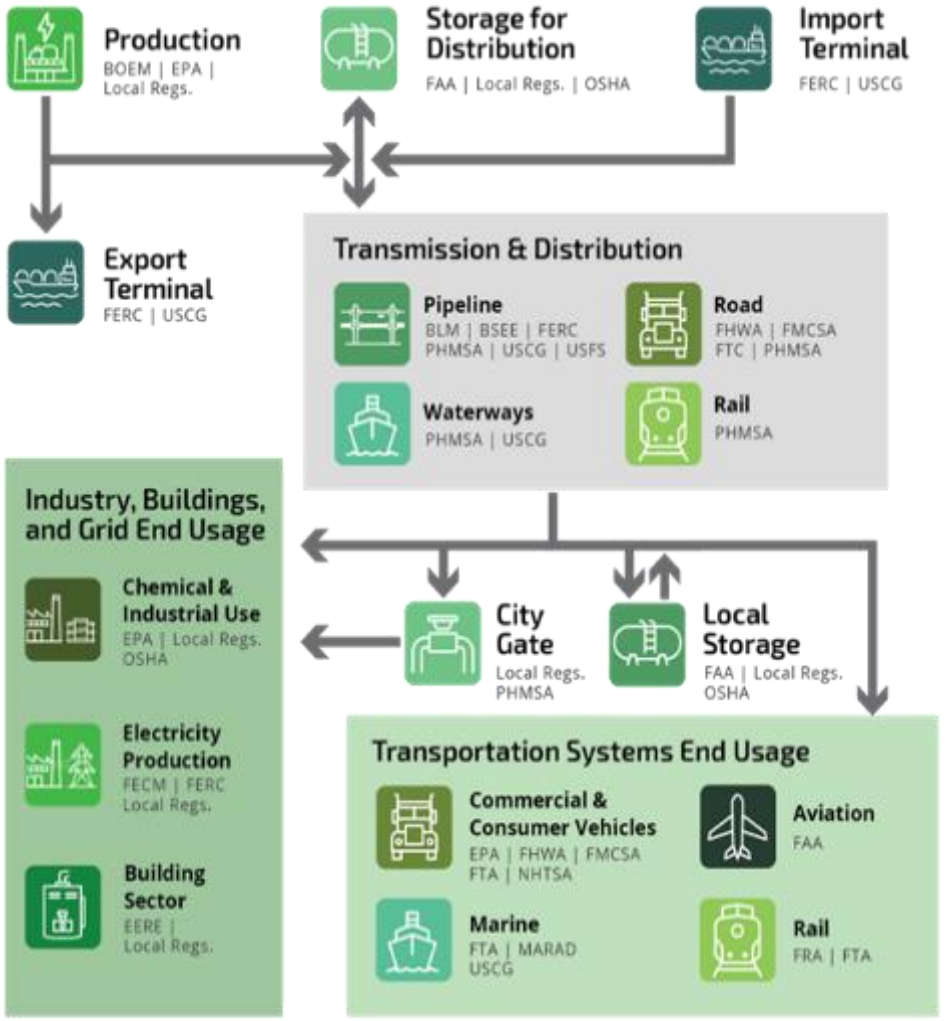
www.hydrogen.gov
Portal for whole-of-gov activities



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.

Key USG Focus Areas for Cross-Agency Collaboration and Coordination



National Clean Hydrogen Strategy and Roadmap

Enable National Goals: 10 MMT/yr supply and use by 2030, 20 MMT/yr by 2040, 50 MMT/yr by 2050

Supply and Demand at Scale

- Enabling large scale production and demand creation
- Financing, incentives, and compliance tools for commercial scale up
- Metrics for deployment and USG as offtaker
- Supply chains and resiliency (critical materials, strategic reserve)
- R&D to accelerate cost reductions and end use commercialization (JST interface)

Infrastructure, Siting, Permitting

- Siting, permitting, pipelines, storage, and infrastructure
- Harmonized codes and standards
- Interoperability and global standardization
- Safety, emissions (including secondary), sensors, risk mitigation, environmental impact
- Environmental review and best practices (NEPA, etc.)
- Pipeline and blending test facilities

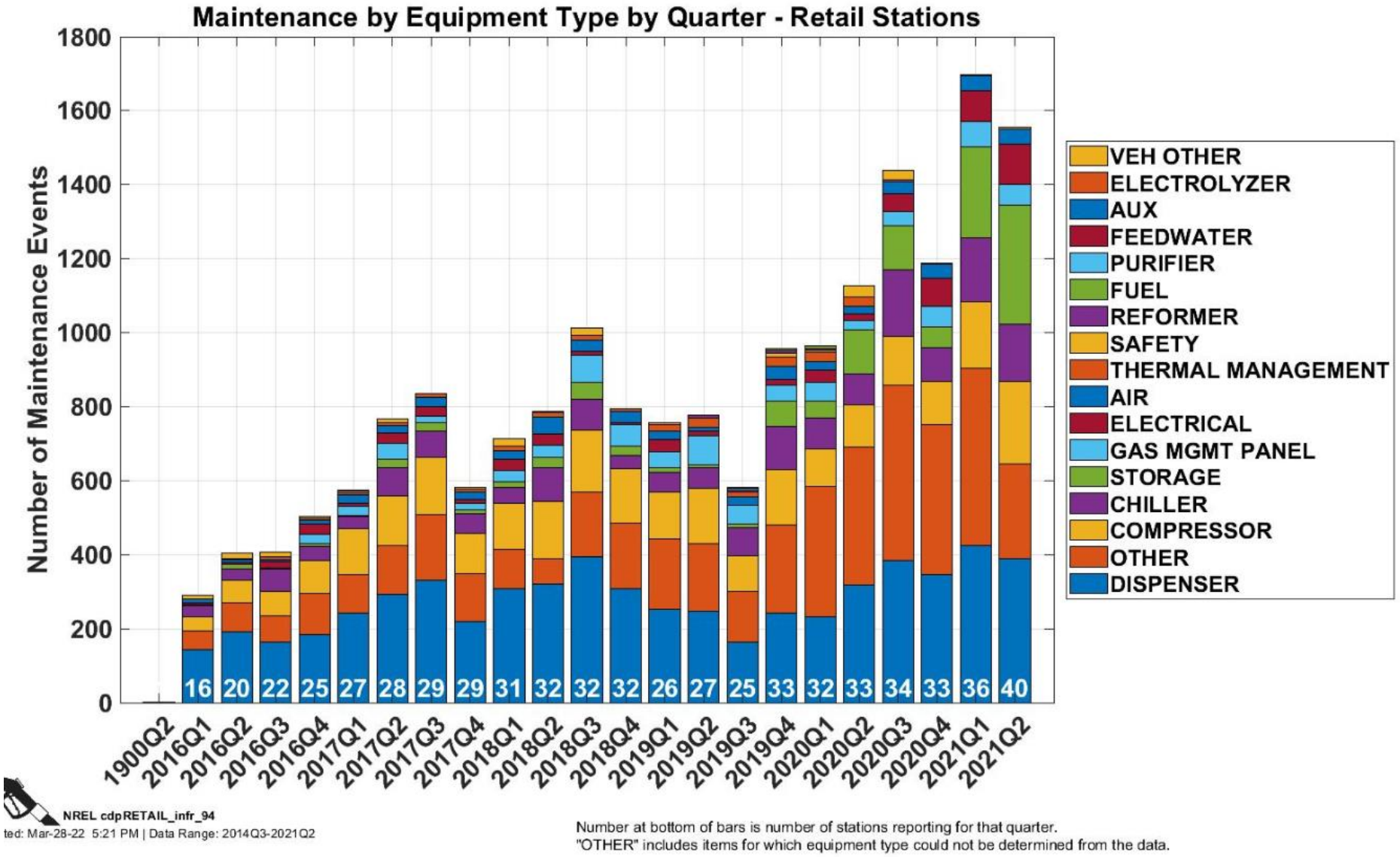
Analysis and Global Competitiveness

- National strategy and commercial liftoff analysis
- Impacts and gap assessments (technoeconomic analysis, incentives, resource/water availability, emissions, jobs, manufacturing, etc.)
- Intellectual property and global landscape assessment
- Export market analysis
- Systems integration and optimization

Clean Hydrogen Production, Delivery, Storage, Conversion, Applications, H2 Hubs

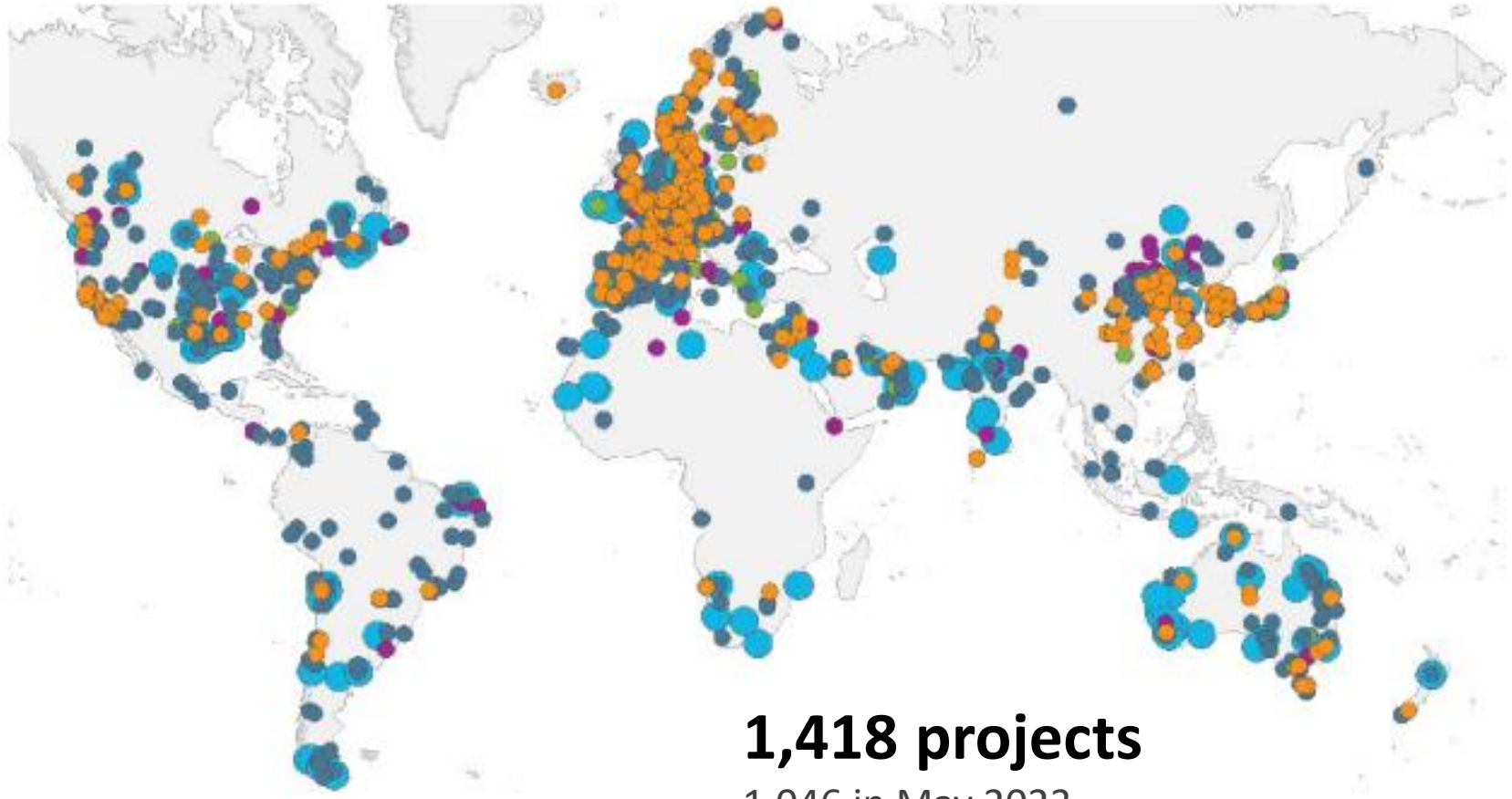
Workforce, Equity, and Justice

Historical Perspectives and Deep Dive Example- US DOE Learning Demo



Source: NREL

Snapshot of Global Projects



1,418 projects

1,046 in May 2023

166

Giga-scale production

719

Large-scale industrial use

256

Mobility

144

Integrated H_2 economy

126

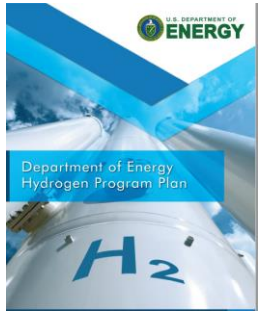
Infrastructure projects

Various estimates for ~$2.5 to $3.5 Trillion Market, 30 Million Jobs Globally and 10 to over 20% Emissions Reduction Potential

Source: Hydrogen Council – Hydrogen Insights 2023 December Update. Excludes 1 MW and below projects

Resources and Opportunities for Engagement

Key Publications



www.hydrogen.energy.gov

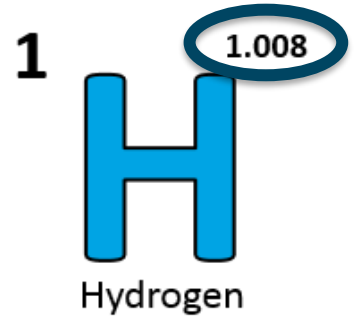
Save the date!

2024 DOE Annual Merit Review
May 6-9, 2024

Register here:
https://www.annualmeritreview.energy.gov/

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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U.S. Department of Energy
And
Director, Hydrogen Interagency Task Force

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