



U.S. DEPARTMENT OF  
**ENERGY**

## U.S. National Clean Hydrogen Strategy Perspectives

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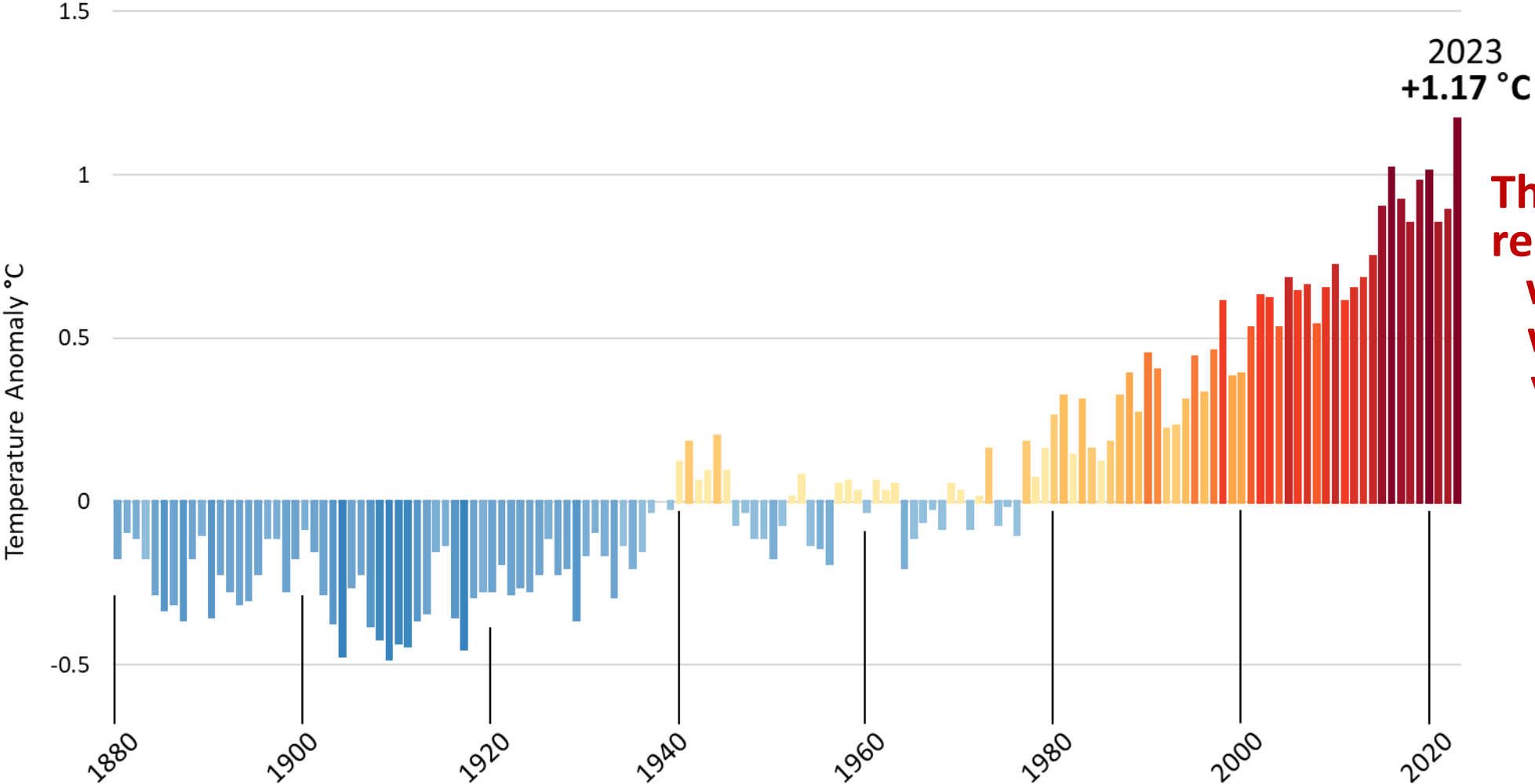
DOE Hydrogen Program Coordinator

U.S. Department of Energy



# The Global Challenge....

## Global Land-Ocean Temperature Index



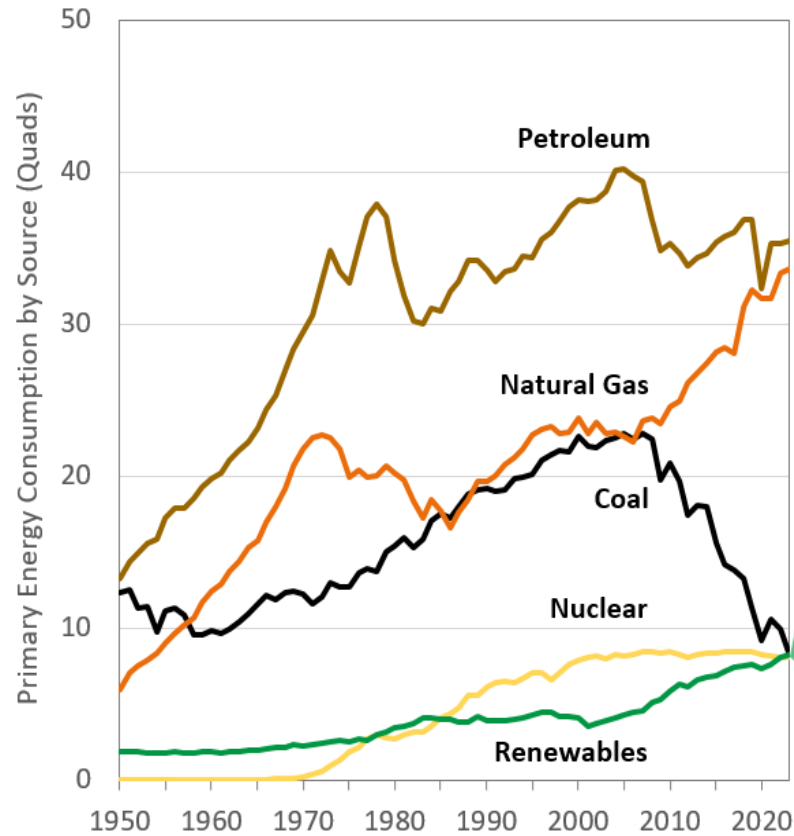
The 10 most recent years were the warmest years on record.

Source: [https://climate.nasa.gov/vital-signs/global-temperature/?intent=121-;](https://climate.nasa.gov/vital-signs/global-temperature/?intent=121-) Chilton, et al, DOE HFTO, based on NASA Goddard Institute for Space Studies reported data

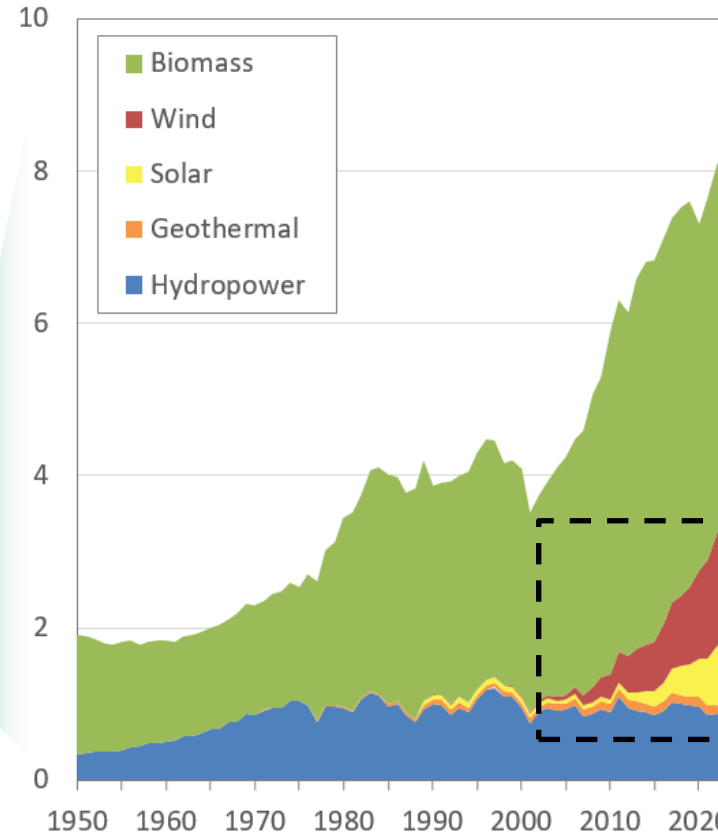
# U.S. Energy Landscape and Key Goals

## U.S. Primary Energy Consumption by Energy Source

Total = 93.6 quads



Renewable Total = 8.2 quads



## Biden-Harris Administration Goals include:

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

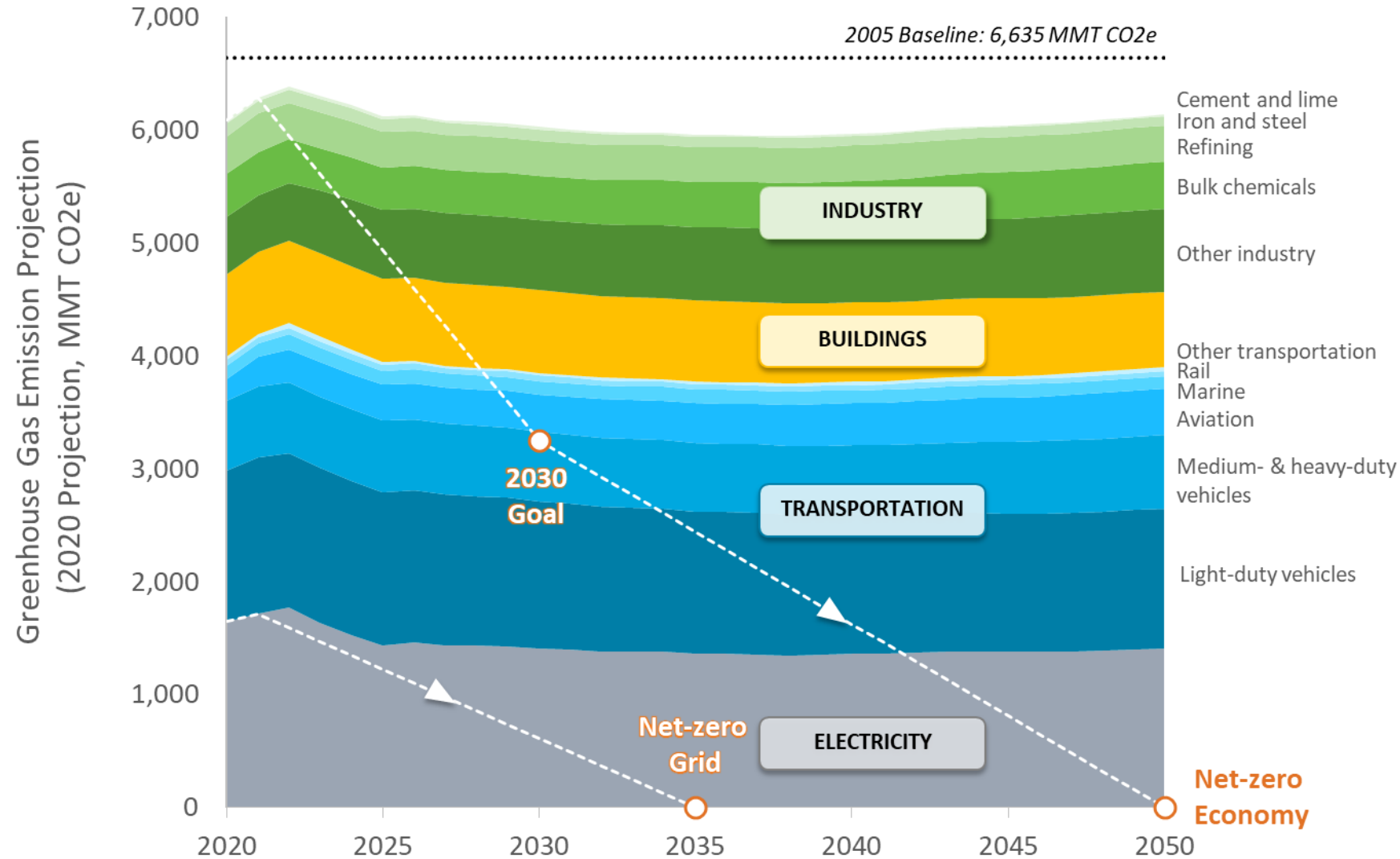
## Priorities include:

- Energy and environmental justice and benefits in disadvantaged communities

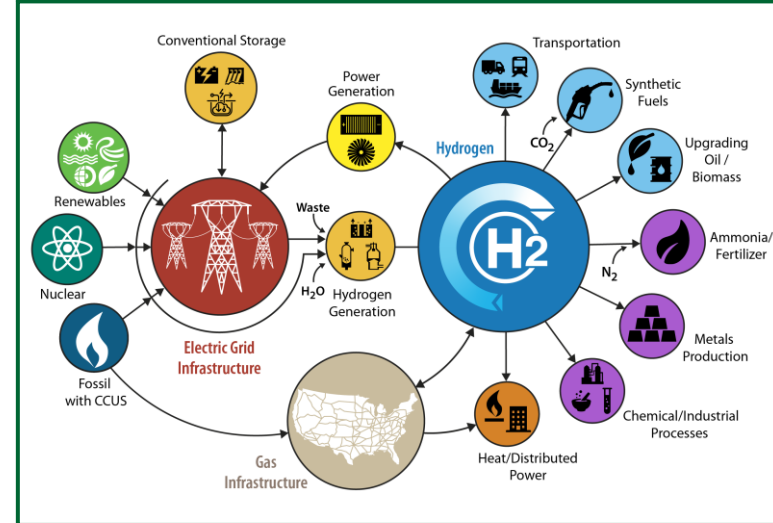
Quad= quadrillion British thermal units (Btu)

Source: Melaina, Chilton, et al, DOE HFTO, based on data collected from U.S. Energy Information Administration, *Monthly Energy Review*, April 2024, Table 1.3. <https://www.eia.gov/totalenergy/data/browser/?tbl=T01.03#/?f=A>

# Carbon Dioxide Emissions by Sector



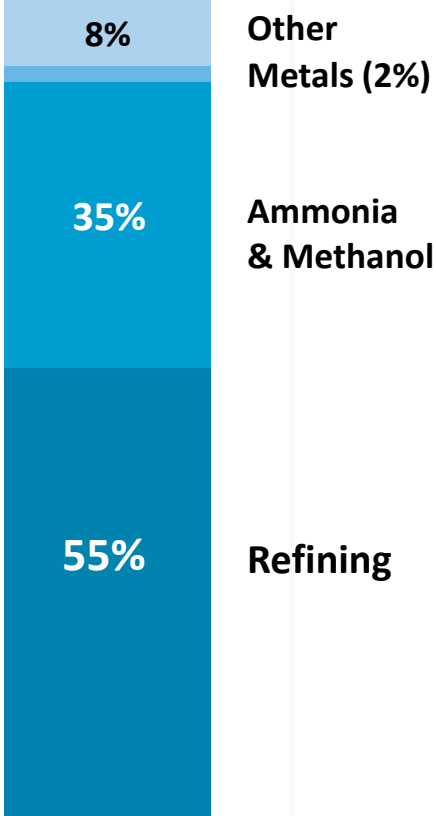
**Hydrogen is a key element of a comprehensive portfolio of solutions to enable net zero**



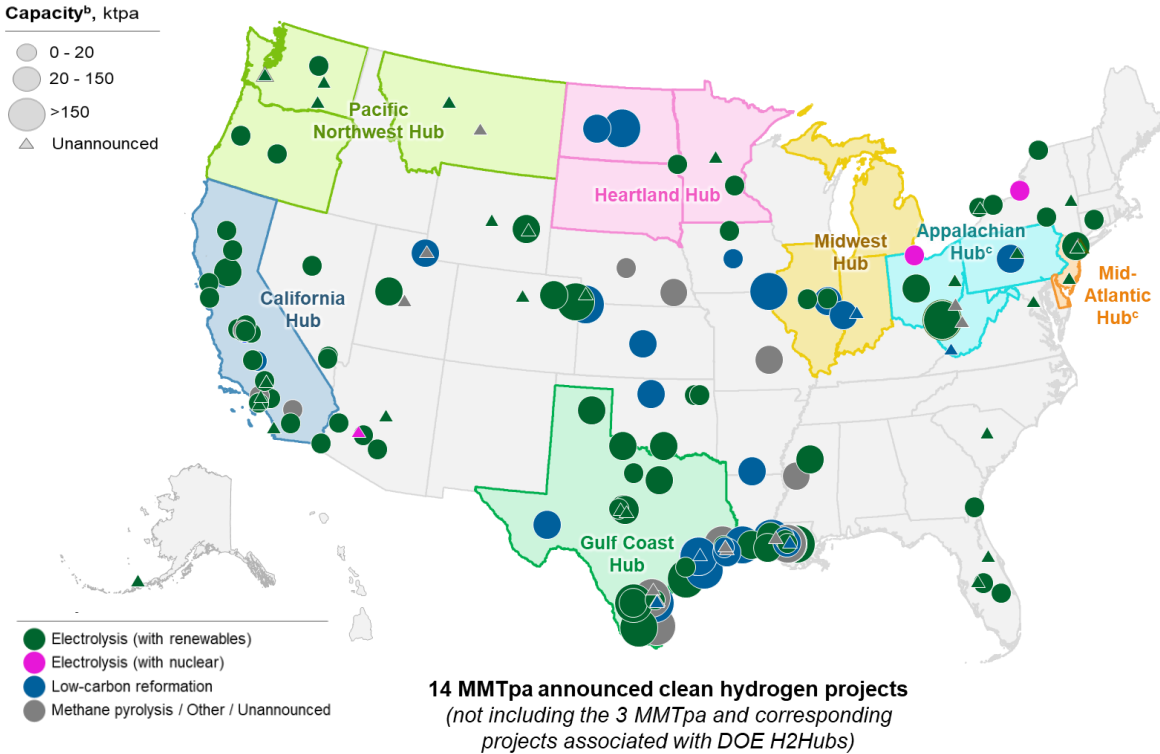
# Snapshot of Hydrogen and Fuel Cells in the U.S.

10 million metric tons H<sub>2</sub> produced annually | More than 1,600 miles of H<sub>2</sub> pipeline | World's largest H<sub>2</sub> storage cavern

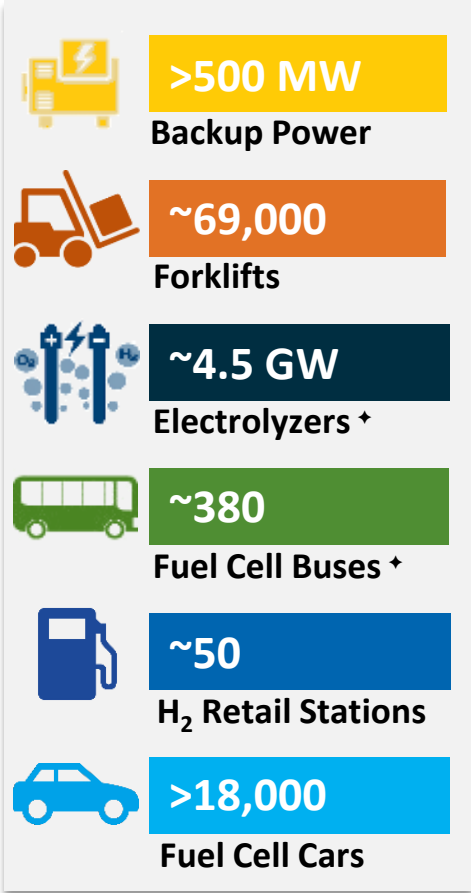
## Use of Hydrogen in the U.S. Today



## Clean hydrogen production projects announced as of Jan. 2024\*



## Examples of Deployments



\*DOE Commercial Liftoff Report Updates available soon.

<sup>†</sup>Buses and electrolyzers include planned / under construction / deployed

# President Biden Signs Key Bills into Law – Examples of Policies and Activities

## 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**

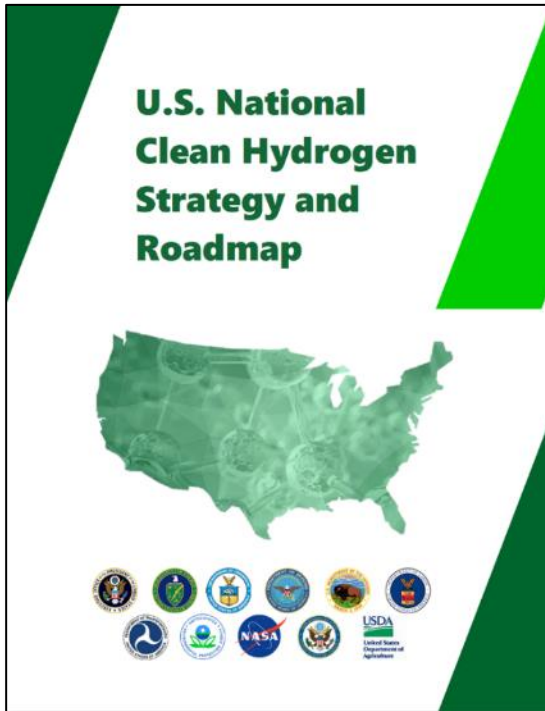


President Biden Signs the Bipartisan Infrastructure Bill into law on November 15, 2021. Photo Credit: Kenny Holston/Getty Images

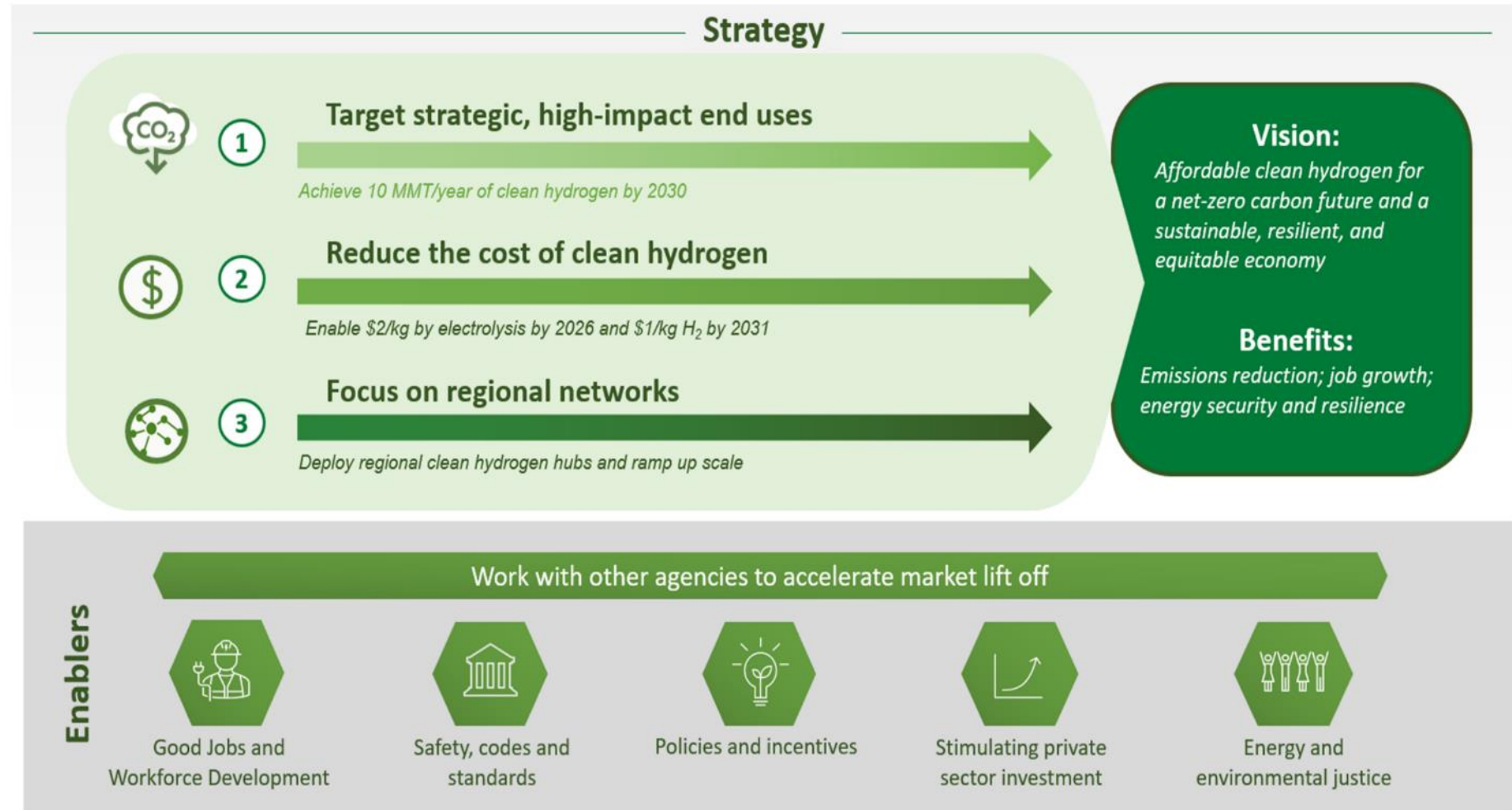
## Inflation Reduction Act

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

# U.S. National Clean Hydrogen Strategy and Roadmap



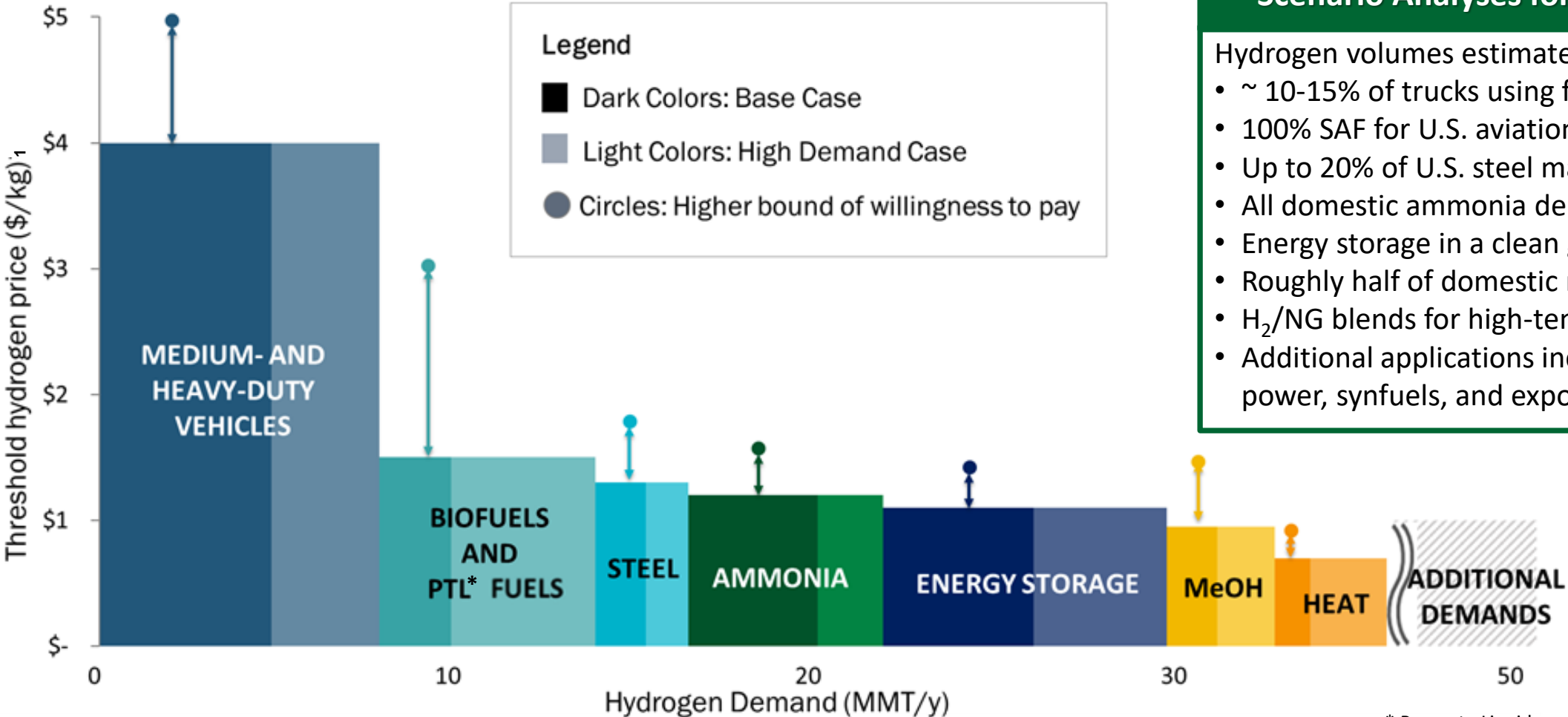
[www.hydrogen.gov](http://www.hydrogen.gov)  
Released June 5, 2023



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

# Strategy 1: Target High-Impact Uses of Hydrogen

## Clean Hydrogen Demand and Costs for Market Penetration



### Scenario Analyses for H<sub>2</sub> Demand\*\*

Hydrogen volumes estimated for:

- ~ 10-15% of trucks using fuel cells
- 100% SAF for U.S. aviation (35B gal) in 2050
- Up to 20% of U.S. steel making
- All domestic ammonia demand
- Energy storage in a clean grid
- Roughly half of domestic methanol
- H<sub>2</sub>/NG blends for high-temp heat in industry
- Additional applications include stationary power, synfuels, and export potential

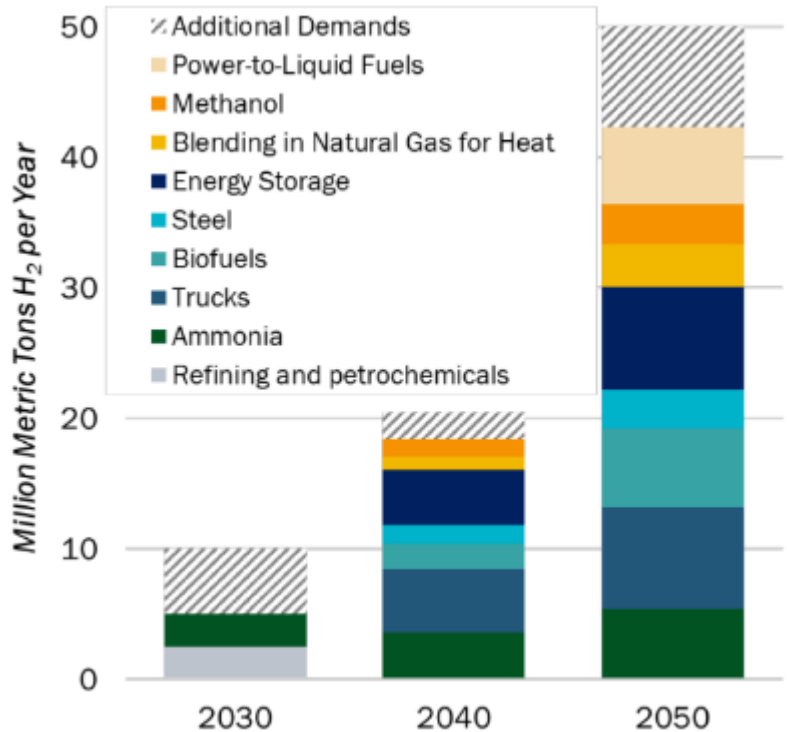
<sup>1</sup>Costs include production, delivery, dispensing to the point of use (e.g., high-pressure fueling for vehicle applications)

\* Power to Liquid  
 \*\* Volumes dependent on multiple variables



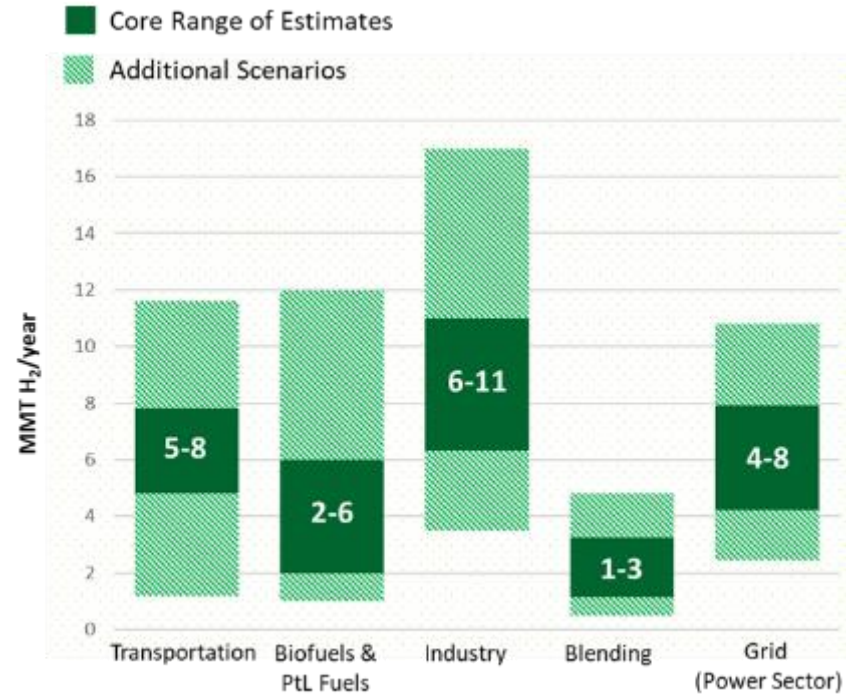
# Strategy 1: Target High-Impact Uses of Hydrogen

## Opportunities for Clean Hydrogen Across Applications



- ### Clean Hydrogen Use Scenarios
- Catalyze clean H<sub>2</sub> 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

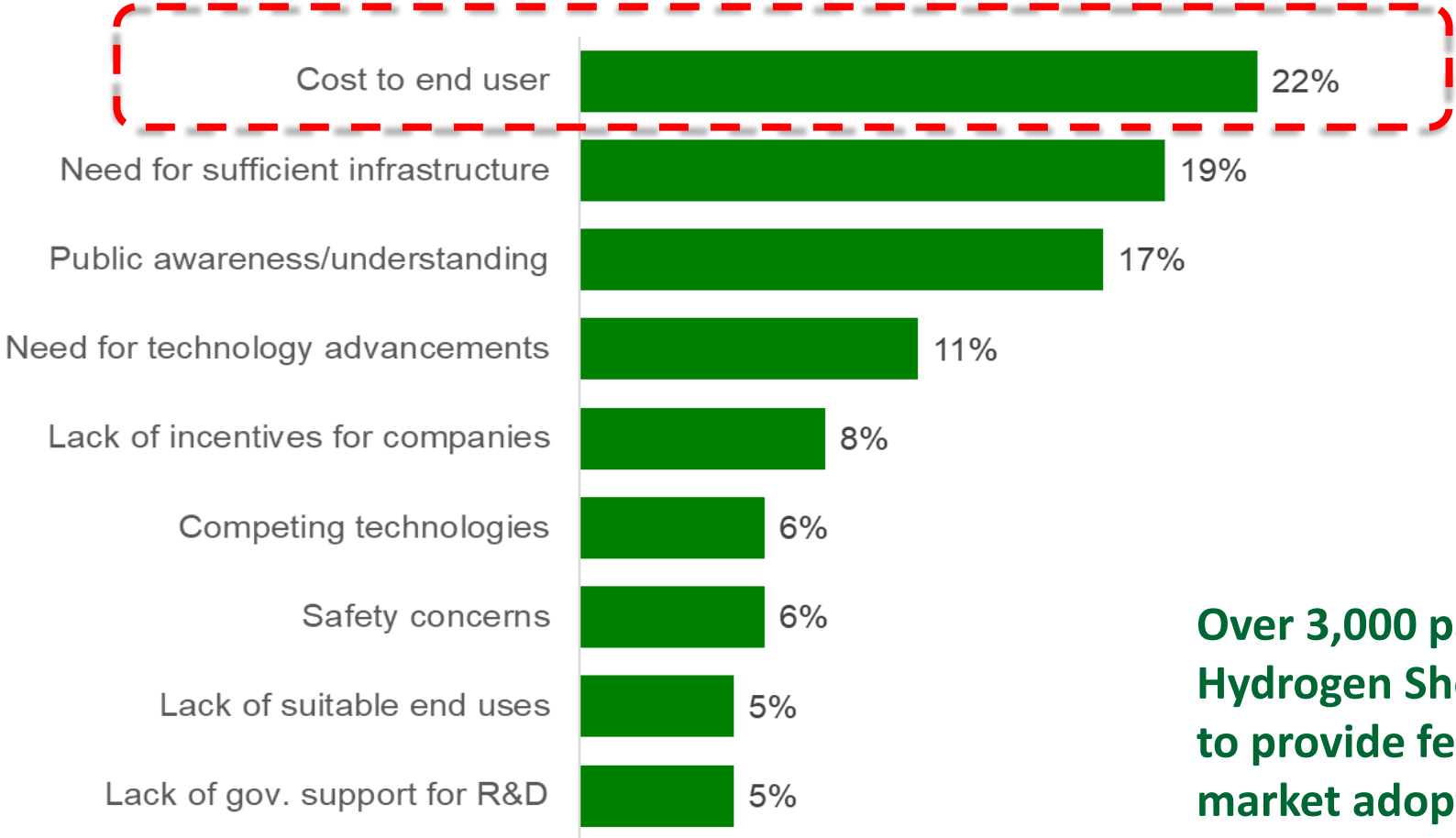


**U.S. Opportunity: 10MMT/yr by 2030, 20 MMT/yr by 2040, 50 MMT/yr by 2050; ~10% Emissions Reduction; ~100K Jobs by 2030**

- Core range: ~ 18–36 MMT H<sub>2</sub>
- Higher range: ~ 36–56 MMT H<sub>2</sub>

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

# Strategy 2: Focus on Cost-Reduction



**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

## 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

## President Biden announces \$7B for 7 H2 Hubs, Oct 2023



Demand side strategy for Hubs announced

DOE selects consortium to bridge demand for clean H<sub>2</sub> providing market certainty and unlock private capital Jan. 2024

See <https://www.energy.gov/oced/office-clean-energy-demonstrations>

A nighttime photograph of the United States Capitol building in Washington, D.C. The building is illuminated, and its lights are reflected in the water of the reflecting pool in the foreground. The sky is dark blue. The text is overlaid on the image in a white, bold, italicized font.

# *Whole-of-Government Coordination*

*And with the private sector, communities,  
and more*

# Hydrogen Interagency Task Force (HIT) across Agencies

[www.hydrogen.gov](http://www.hydrogen.gov)

Portal for whole-of-gov activities

**WH and Deputies Group  
Co-Chairs**

**HIT  
Director  
(Deputy Director(s))**

**Secretariat**

**Program Leadership  
Group**

- 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
- Department of the Treasury
- Environmental Protection Agency
- National Aeronautics and Space Administration
- Office of Science and Technology Policy
- Small Business Administration
- White House Climate Policy Office (Co-Chair)

Working  
Groups

**Supply and Demand at  
Scale**

**Infrastructure, Siting,  
Permitting**

**Analysis and Global  
Competitiveness**

Crosscutting  
Teams

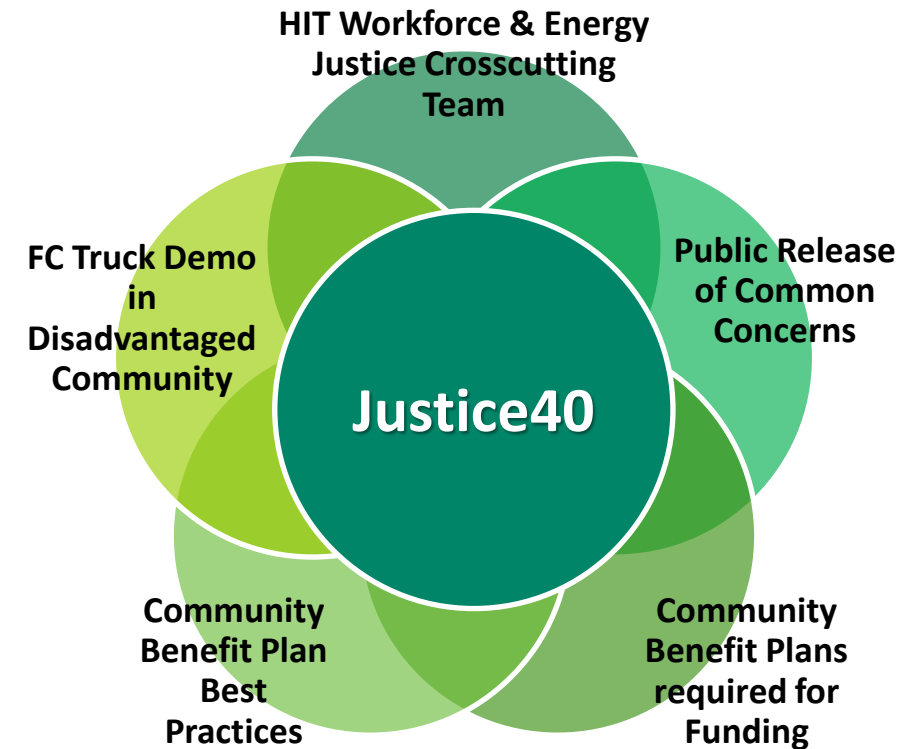
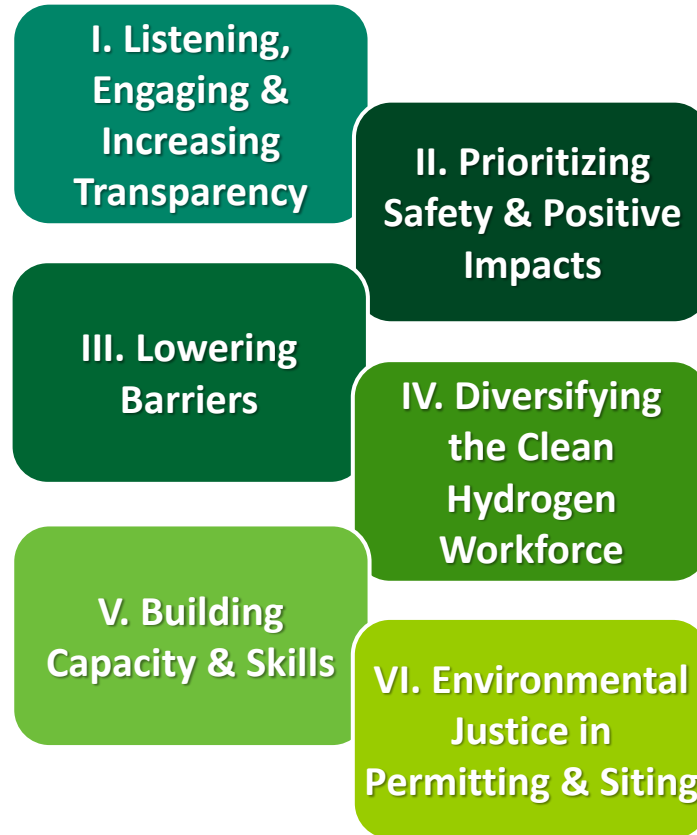
**DOE JST Teams: Production, Delivery, Storage, Conversion, Applications, H2 Hubs,  
Workforce, Equity, and Justice**

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



***Global Coordination***  
***Energy and Environmental Justice***  
***Diversity, Equity, Inclusion, and***  
***Accessibility***

# Environmental Justice Initiatives



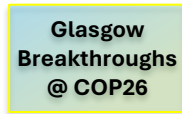
## Draft Responses to Frequently Asked Questions and Common Concerns About Clean Hydrogen

<https://www.energy.gov/eere/fuelcells/draft-responses-frequently-asked-questions-and-common-concerns-about-clean-hydrogen>



# Examples of International Collaboration

Collaborating through multiple global and bilateral partnerships—key priority is creating coordinated framework to leverage activities, identify gaps, and avoid duplication to accelerate progress



## BREAKTHROUGH AGENDA

### Priority Actions for International Collaboration — coordinated through the Hydrogen Breakthrough

Priority International Actions	Participating Initiatives (to date)*
<b>H.1: Standards &amp; Certification</b>	<b>Coordinating:</b> IPHE (with IEA H2-TCP) <b>Partners include:</b> IRENA, UNIDO
<b>H.2: Demand Creation &amp; Management</b>	<b>Coordinating:</b> CEM Hydrogen Initiative(w/ RMI) <b>Partners include:</b> First Movers' Coalition, World Economic Forum, Int'l H2 Trade Forum, MI Clean H2 Mission, H2 Global
<b>H.3: Research &amp; Innovation</b>	<b>Coordinating:</b> Mission Innovation Clean Hydrogen Mission <b>Partners include:</b> IEA H2 TCP
<b>H.4: Finance &amp; Investment</b>	<b>Coordinating:</b> World Bank and UNIDO
<b>H.5: Landscape Coordination</b>	<b>Coordinating:</b> H2 Breakthrough Facilitator (hosted by IPHE Secretariat) <b>Partners include:</b> Open to all globally focused H2 initiatives

\*Examples shown. Updated periodically by BTA.

# Global Collaboration – Certification, Outreach, and STEM

Department of Energy

## At COP28, Countries Launch Declaration of Intent on Clean Hydrogen

December 6, 2023



Declaration of Intent seeks to work toward mutual recognition of clean hydrogen certification schemes and to help facilitate a global market

<https://www.energy.gov/articles/cop28-countries-launch-declaration-intent-clean-hydrogen>



Shaping a skilled and diverse workforce for the future of the hydrogen economy.

New global platform dedicated to advancing diversity, equity, inclusion, and accessibility

<https://h2-deia.org/>



Students from 190 Countries and Team Hope (refugees) competed in Singapore for Hydrogen Day 2023

<https://first.global/fgc/>

Calling all hydrogen-enthusiast **STUDENTS**  
(undergraduate & graduate), **POST-DOCS**, and **EARLY  
CAREER PROFESSIONALS** worldwide!

Connect with peers, mentors, scientific researchers,  
industry professionals, and policymakers!

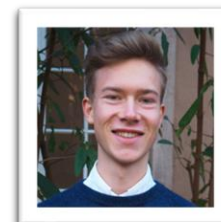
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500+ members from  
38 countries



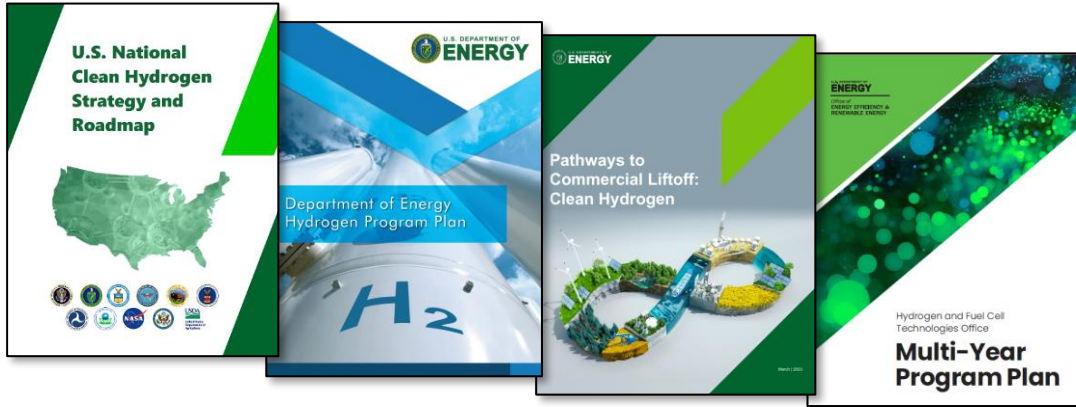
[www.iphe.net/early-career-chapter](http://www.iphe.net/early-career-chapter)



2023–2024 Leadership Team

# Resources and Opportunities for Engagement

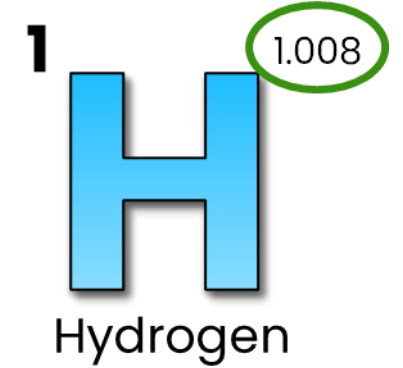
## Key Publications



[www.hydrogen.energy.gov](http://www.hydrogen.energy.gov)

## 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](http://energy.gov/eere/fuelcells) AND [www.hydrogen.energy.gov](http://www.hydrogen.energy.gov)

# Thank you

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Director, Hydrogen Interagency Taskforce

Also on **LinkedIn**

[www.energy.gov/fuelcells](http://www.energy.gov/fuelcells)  
[www.hydrogen.energy.gov](http://www.hydrogen.energy.gov)