INTERNATIONAL PARTNERSHIP FOR
HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update November 2022: United States

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1. New Initiatives, Programs, and Policies on Hydrogen and Fuel Cells

- In August 2022, the US House of Representatives passed the Inflation Reduction Act (IRA) and President Biden signed it into law. The IRA includes several incentives for hydrogen and fuel cell technologies including a clean hydrogen production tax credit. The US Department of Treasury is working closely with DOE and is collecting public comments regarding the tax credit.
- In September 2022, DOE released a draft of the "National Clean Hydrogen Strategy and Roadmap", required by the Bipartisan Infrastructure Law, for public feedback. The report provides an overview of the potential for clean hydrogen in the U.S., including the opportunity for 10 million metric tons (MMT) per year by 2030, 20 MMT per year by 2040, and 50 MMT per year by 2050.
- DOE also released draft guidance for a Clean Hydrogen Production Standard (CHPS) for public comment. This initial proposal establishes a target of 4.0 $kgCO_2e/kgH_2$ for lifecycle greenhouse emissions associated with hydrogen production.
- The DOE Hydrogen Program is working to increase diversity, equity, inclusion, and accessibility (DEIA) and environmental justice (EJ) through various outreach efforts, initiatives, and funding opportunities. These include public H2IQ webinars, workforce development programs, and deployment programs that benefit disadvantaged communities.
- Programs and activities in states and various regions continue. For example, California has allocated $2.6 billion in total investments for clean heavy-duty vehicles and off-road equipment, including those powered by fuel cells, through the state's Clean Transportation Incentives program. The state's Clean Transportation Program Investment Plan will also invest up to $90 million over the next three years for hydrogen fueling infrastructure development.

2. Hydrogen and Fuel Cell R&D Update

- In April 2022, DOE released the report from the Foundational Science for Carbon-Neutral Hydrogen Technologies virtual roundtable which was held in August 2021. Participants discussed the scientific and technical barriers for carbon-neutral hydrogen production, storage, and utilization and identified four priority research opportunities to address the underlying challenges.
- DOE released a program record documenting proton exchange membrane (PEM) electrolyzer installations in the U.S. The record indicates that as of May 2022, approximately 620 megawatts of PEM electrolyzers were either installed or announced in the United States.

3. Demonstration, Deployments, and Workforce Developments Update

- In June 2022, DOE announced the winners of the Hydrogen and Fuel Cell Technologies Office Postdoctoral Recognition Award during the Hydrogen Program's Annual Merit Review and Peer Evaluation Meeting. This award identifies outstanding postdoctoral fellows working on hydrogen and fuel cell technologies at DOE National Laboratories.
- On September 22, DOE announced $7 billion in funding to create regional clean hydrogen hubs (H2Hubs) across the U.S. The hydrogen hub program is funded through the Bipartisan Infrastructure Law and will help drive clean energy investments and employment and enhance energy security across the U.S. Six to ten hydrogen hubs will be selected through this funding opportunity.
- In November 2022, DOE announced $1.5 million in funding for five (5) university-led projects that will help achieve the Hydrogen Shot goal and enhance the knowledge and skills of students at Minority Serving Institutions.

4. Events and Solicitations

- DOE hosted the virtual Manufacturing Automation and Recycling for Clean Hydrogen Technologies Experts Meeting on May 24-26, 2022. This meeting convened clean hydrogen experts and stakeholders to discuss opportunities and challenges for clean hydrogen manufacturing and recycling efforts.
- DOE announced $60 million in total funding to advance clean hydrogen technologies and grid decarbonization in support of DOE's Hydrogen Shot goal. Forty million dollars ($40 million) is allocated to projects focused on advancing the development and deployment of clean hydrogen technologies, while $20 million will be used to establish a university research consortium focused on developing grid resilience programs.
- DOE Office of Fossil Energy and Carbon Management (FECM) announced more than $32 million in funding for projects that will advance clean hydrogen production and utilization, and address safe hydrogen transportation and long-term storage.

- In September 2022, DOE Office of Nuclear Energy, in collaboration with DOE Hydrogen and Fuel Cell Technologies Office, announced a funding opportunity for projects focused on nuclear-coupled hydrogen production and end use.
- In September 2022, the U.S. hosted the first Global Clean Energy Action Forum which jointly convened the 13th Clean Energy Ministerial (CEM) and the 7th Mission Innovation (MI) ministerial. Hydrogen was highlighted in multiple events including the CEM H2I/MI clean hydrogen mission event and the H2 global ports coalition panel.
- DOE, in collaboration with the Sustainable Energy Council, hosted the Hydrogen Americas Summit in Washington DC on October 10-11. This event brought together hundreds of government and industry representatives from across the Americas to discuss the latest projects and policy developments needed to advance the region's hydrogen industry.
- DOE celebrated National Hydrogen and Fuel Cell Week with a host of communications and outreach activities during the week October 5-12, 2022. Activities included a coffee hour, a 1.008-mile walk, a hydrogen fuel cell car ride and drive, and multiple news blasts including social media posts by US Energy Secretary Granholm.

- DOE held various H2IQ hours, including one in June focused on using the GREET model for hydrogen life cycle emissions and one in October focused on workforce development in hydrogen and fuel cells.
- The 2022 DOE Hydrogen Program Annual Merit Review and Peer Evaluation Meeting (AMR) was held virtually June 6-8, 2022 with over 1900 attendees. Presentations from DOE-funded hydrogen and fuel cell projects are available on the AMR website.

5. Investments: Government and Collaborative Hydrogen and Fuel Cell Funding

- DOE, in collaboration with the Clean Energy Ministerial Hydrogen Initiative, and the governments of Japan and the UK, announced the winners of the H2 Twin Cities 2022 program. Winning teams include a Sibling Cities partnership between Aberdeen, UK and Kobe, Japan, as well as a Mentor-Mentee Cities partnership between Namie Town, Japan and Lancaster, California and the County of Hawai'i in the US.
- DOE announced the winners of two prize competitions supporting innovative solutions to produce clean hydrogen, including:
  - Winners of the Hydrogen Business Case Prize for the development of practical financial tools that address hydrogen production and deployment.
  - Phase one winners of the $2.6 million Hydrogen Shot Incubator Prize for early-stage concepts for novel hydrogen production technologies.
- In June 2022, DOE announced a $504 million loan guarantee for the world's largest clean hydrogen energy storage facility in the state of Utah. This facility will be capable of providing long-term low-cost, seasonal energy storage.
- DOE Fossil Energy and Carbon Management Office (FECM) announced funding for several projects supporting hydrogen technologies including:
  - $25 million in funding for six (6) projects to develop technologies that will advance the use of clean hydrogen for electricity generation.
  - $29 million in funding for 15 projects to advance clean hydrogen production from biomass and other feedstocks.
  - $4.7 million in funding for six (6) projects to advance the development of ceramic-based materials to improve the efficiency of hydrogen-fueled turbines, reduce energy costs and lower greenhouse gas emissions.

6. Regulations, Codes & Standards, and Safety Update

- Revised separation distance requirements for bulk liquid hydrogen storage systems have been accepted by the National Fire Protection Association (NFPA) 2 Hydrogen Technologies Code Technical Committee. These changes will go into the 2023 edition of NFPA 2, which should be released in the first quarter of 2023.
- Technical discussions on The United Nations Economic Commission for Europe (UNECE) Global Technical Regulation No.13 Phase 2 (hydrogen and fuel cell vehicles) have been completed. The informal document has been submitted to the Working Party on Passive Safety (GRSP) and is expected to be approved by GRSP in December 2022. Following this approval, the regulation will be considered by the World Forum for Harmonization of Vehicle Regulations (WP.29) in March 2023 and submitted for final vote in June 2023.

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Summary Country Update November 2022: United States

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles[1]	1,000,000 by 2030 in CA	>14,000	Multiple state efforts and industry stakeholders	ZEV state mandate (currently implemented in CA, CT, MA, ME, MD, NJ, NY, OR, RI, and VT); state subsidies (rebates in CA, MA, CT etc.) Inflation Reduction Act (IRA) incentives: 30% credit for commercial fuel cell electric vehicles through 2032 and $7,500 credit for new fuel cell electric vehicle purchases.
Fuel Cell Buses	No target	>80	Federal Transit Authority (Department of Transportation); CARB; CEC, and multiple states	
Fuel Cell Trucks[2]	$80/kW by 2030 (Interim) $60 k/W (Ultimate)	As of September 2022, 10 Toyota/Kenworth Class 8 fuel cell trucks have been deployed out of the Port of Los Angeles	CTE, FedEx Express, UPS, CEC, SCAQMD, Nikola	ZEV MOU and action plan in place between California, Colorado, Connecticut, District of Columbia, Hawaii, Maine, Maryland, Massachusetts, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Rhode Island, Vermont, and Washington to support the deployment of medium- and heavy-duty ZEVs
Forklifts	No target	>50,000	Early market applications strategy	

[1] Includes Fuel Cell Electric Vehicles with Range Extenders

[2] https://www.hydrogen.energy.gov/pdfs/19006_hydrogen_class8_long_haul_truck_targets.pdf

H_2 Refueling Stations	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
70 MPa On-Site Production	1,000 by 2030 in CA 12-20 in Northeast	>50 open retail stations	State and private sector partnerships	California - $2.6 billion to build ZEV charging/refueling stations including 200 hydrogen stations (includes O&M grants) ZEV mandate Inflation Reduction Act (IRA) incentive: tax credit of 30% of the cost of alternative fuel refueling property placed in service before 2033.
70 MPa Delivered				
35 MPa On-Site Production	No target	N/A	2 stations for bus refuelling (California)	Solicitations from state and local agencies (e.g., South Coast Air Quality Management District, Air Quality Standards Attainment U.S. DOE in California)
35 MPa Delivered	No target			
Stationary	**Target Number[3]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Small[4]	$1,000/kW for backup units running directly on hydrogen	Installed stationary power (including large, medium and small	Industry-led	State/regional

[3] Targets can be units installed and/or total installed capacity in the size range indicated

[4] <5 kW (e.g., Residential Use)

	$1,500/kW for combined heat and power units running on natural gas	units) is over 500 MW.		
Medium[5]	$1,000/kW for combined heat and power units running on natural gas		Industry-led	State/regional
Large[6]	No target	N/A	Industry-led	State/regional
District Grid[7]	No target	N/A	Industry-led	State/regional
Regional Grid[8]	No target	N/A	Industry-led	State/regional
Telecom backup	No target	N/A	Industry-led	State/regional
H_2 Production	**Target[9]**	**Current Status**	**Partnerships, Strategic Approach**	**Support Mechanism**
Fossil Fuels[10]	$1/kg produced by 2030	$1.5/kg		

[5] 5kW – 400 kW (e.g., Distributed Residential Use)
[6] 0.3MW – 10 MW (e.g., Industrial Use)
[7] 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)
[8] 30MW plus (e.g., Grid Storage and Systems Management)
[9] Target can be by quantity (Nm^3, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target
[10] Hydrogen produced by reforming processes

Water Electrolysis[11] (PEM, Alkaline, SOEC)	$1/kg produced by 2030	$5-$6/kg for low volume >620 MW PEM electrolyzer capacity installed/underway	Continued government funding/cost share	State/regional (e.g., 33% renewables in CA) Inflation Reduction Act (IRA) incentives: Clean Hydrogen Production Tax Credit of up to $3.00/kg of H2 and up to 30% investment tax credit.
By-product H_2	N/A	N/A		
Energy Storage from Renewables	**Target[12]**	**Current Status**	**Partnership, Strategic Approach**	**Support Mechanism**
Power to Power[13] Capacity	N/A	N/A		
Power to Gas[14] Capacity	N/A	Project in CA is injecting H2 into NG pipeline		California Low Carbon Fuel Standard creates credits for use of low-carbon fuels. Blends of H_2 and natural gas could receive credits under this regulation.

[11] Please indicate if targets relate to a specific technology (PEM, Alkaline, SOEC)
[12] Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity
[13] Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity
[14] Operator has the opportunity to provide the stored energy in the form of hydrogen back to the energy system through multiple channels (e.g., merchant product, enriched natural gas, synthetic methane for transportation, heating, electricity)