



INTERNATIONAL PARTNERSHIP FOR HYDROGEN AND FUEL CELLS IN THE ECONOMY

IPHE Country Update April 2023: United States

Name	Sunita Satyapal
Contact Information	Sunita.Satyapal@ee.doe.gov Vanessa.Arjona@ee.doe.gov Joseph.Stanford@ee.doe.gov
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1. New Initiatives, Programs, and Policies on Hydrogen and Fuel Cells

- DOE is currently updating the National Clean Hydrogen Strategy and Roadmap based on feedback received during public comment period on the draft version (released in September 2022). The draft version articulates 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.
- In March, DOE announced its Pathways to Commercial Liftoff initiative which includes a set of reports to help strengthen engagement between the public and private sectors and accelerate the commercialization and deployment of key clean energy technologies. One of the reports is on hydrogen which examines how the clean hydrogen market is well-positioned to reach full-scale commercialization due to transformational policies and programs like the regional clean hydrogen hubs (H2Hubs), tax incentives in the Inflation Reduction Act, and ongoing RD&D in the DOE Hydrogen Program.
- In March 2023, the US Environmental Protection Agency (EPA) approved California's Clean Air Act waivers which will enable the state to enforce its Advanced Clean Trucks (ACT) rule. The ACT regulation stipulates the percentage of zero-emission new truck sales by 2035 to be as follows: Class 2b-3 55%, Class 4-8 75%, and Class 8 tractor trucks 40%. Six other states have moved to adopt California's ACT rules including Massachusetts, New Jersey, New York, Oregon, Vermont, and Washington.

2. Hydrogen and Fuel Cell R&D Update

- In April, a DOE-funded team of researchers spanning multiple DOE National Labs, industry, and an university published their work examining potential configurations, performance, cost, and safety of liquid hydrogen storage tanks for heavy-duty vehicles. This work provides a comprehensive insight into the potential for liquid hydrogen to help decarbonize the heavy-duty trucking industry.
- In January, DOE launched the Energy Earthshot Research Centers (EERCs) to address key basic research challenges associated with DOE's six Energy Earthshots, including the Hydrogen Earthshot goal of \$1 per 1 kilogram in 1 decade. DOE will fund up to \$200 million over four years to bring EERCs to life and enable research breakthroughs to accelerate progress towards more abundant and affordable clean energy.

3. Demonstration, Deployments, and Workforce Developments Update

- In March, clean hydrogen production began at the Nine Mile Point Nuclear Station in Oswego, New York as part of a \$14.5 million cost-shared project between the U.S. Department of Energy (DOE) and Constellation Energy Corporation. This is the first facility in



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the US to generate clean hydrogen using nuclear power. The hydrogen generated onsite will be used to help cool the power plant.

- In December 2022, DOE Fossil Energy and Carbon Management Office (FECM) announced \$2.5 million in funding for four (4) training and research projects at US universities, one of which will focus on zero-carbon dioxide hydrogen and carbon black production via pyrolysis.

3. Events and Solicitations

- In March 2023, DOE Hydrogen and Fuel Cell Technologies Office announced \$750 million in funding for research, development, and demonstration (RD&D) efforts to advance clean hydrogen technologies. This funding is the first phase of the \$1.5 billion in the Bipartisan Infrastructure Law (BIL) dedicated to advancing electrolysis technologies and improving manufacturing and recycling capabilities.
- In March, DOE Office of Clean Energy Demonstrations announced \$15 million in funding for DOE National Laboratories and facilities for work focused on industry alignment for clean hydrogen and long duration energy storage.
- In March, DOE Office of Fossil Energy and Carbon Management (FECM) announced up to \$11 million in funding to DOE National Laboratories and facilities for development and commercialization of promising energy technologies including hydrogen detection and quantification.
- In March, DOE Industrial Efficiency & Decarbonization Office (IEDO) announced \$156 million in funding for RD&D to reduce greenhouse gas (GHG) emissions across the US industrial sector, including through clean hydrogen utilization. IEDO also announced \$23 million in funding to establish a regional network of Onsite Energy Technical Assistance Partnerships to help increase the adoption of onsite energy technologies including stationary fuel cells.
- In March, US Department of Transportation (DOT) announced up to \$700 million in funding to deploy electric vehicle (EV) charging and infrastructure for alternative fuels, including hydrogen, in communities across the US, as well as along designated Alternative Fuel Corridors.
- In January, DOE announced up to \$47 million in funding to accelerate RD&D focused on hydrogen delivery and storage technologies as well as affordable and durable fuel cell technologies.
- The 2023 DOE Hydrogen Program Annual Merit Review and Peer Evaluation Meeting will be held June 5 to 8, 2023 in Arlington, Virginia. Hydrogen and fuel cell projects funded by DOE will be presented, and projects and programs reviewed for their merit. Both in-person and virtual attendance options are available.
- In March, DOE in collaboration with the International Partnership for Hydrogen and Fuel Cells in the Economy's Early Career Network and NOW GmbH hosted the H₂ Career Insights Webinar. The webinar featured discussion from professionals at different points in their hydrogen and fuel cell careers.
- In March, DOE Hydrogen and Fuel Cell Technologies Office celebrated Women's History Month with a Ride n' Drive event in collaboration with one of DOE's Employee Resource Groups, Professional Opportunities for Women at Energy Realized (POWER). Attendees were able to test drive a hydrogen fuel cell car and hear about hydrogen and fuel cell technologies.
- In March, DOE collaborated with Mission Innovation to host a webinar on perfluorosulfonic acid ionomers (PFSA) and environmentally friendly alternatives to standard PFSA when used in fuel cell and electrolyzer applications.
- DOE held various H₂IQ hours, including one in December focused on high-throughput hydrogen fueling technologies at the National Renewable Energy Laboratory (NREL) and one in January focused on research and development (R&D) within the H₂NEW (Hydrogen from Next-generation Electrolyzers of Water) Consortium.



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

- In March 2023, DOE announced \$7.4 million in funding for seven (7) projects to develop medium- and heavy-duty electric vehicle (EV) charging and hydrogen corridor infrastructure plans.
- DOE FECM announced funding for several projects supporting hydrogen technologies including:
 - \$4.5 million in funding to study ways to improve turbine performance and efficiency using advanced materials and through combustion simulations of fuels ranging from natural gas to hydrogen and hydrogen blends.
 - \$5.3 million in funding for five (5) projects to advance research that supports the domestic production of rare earth elements and other critical minerals necessary for manufacturing clean energy technologies such as hydrogen fuel cells.

6. Regulations, Codes & Standards, and Safety Update

- The 2023 version of the National Fire Protection Association Hydrogen Technologies Code (NFPA 2) has been released and is available to view at [nfpa.org](https://www.nfpa.org). NFPA 2 now has full ownership of hydrogen requirements and existing hydrogen requirements in NFPA 55 will be deleted, with a pointer to NFPA 2. NFPA 2 (2026 edition) is currently open for public input with a closing date of January 2024.
- SAE J2601-5 will establish high-flow, general purpose prescriptive hydrogen fueling protocols for the 35 MPa (H35) and 70 MPa (H70) pressure classes. A new MC Formula-based protocol, MC Formula High-Flow General (MCF-HF-G), is being developed for H35 and H70. SAE J2601-5 will initially be published as a Technical Information Report (TIR) with an expected publication date of October 2023.



Summary Country Update April 2023: United States

Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles ¹	1,000,000 by 2030 in CA	>15,000	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 <u>deployed</u> 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

¹ Includes Fuel Cell Electric Vehicles with Range Extenders

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



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				support the deployment of medium- and heavy-duty ZEVs
Forklifts	No target	>60,000	Early market applications strategy	
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

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



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Small ⁴	\$1,000/kW for backup units running directly on hydrogen \$1,500/kW for combined heat and power units running on natural gas	Installed stationary power (including large, medium and small units) is over 500 MW.	Industry-led	State/regional
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

⁴ <5 kW (e.g., Residential Use)

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)



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H ₂ Production	Target ⁹	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fossil Fuels ¹⁰	\$1/kg produced by 2030	\$1.5/kg		
Water Electrolysis ¹¹ (PEM, Alkaline, SOEC)	\$1/kg produced by 2030	<u>\$5-\$6/kg</u> 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 H ₂ 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		

⁹ Target can be by quantity (Nm³, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target

¹⁰ Hydrogen produced by reforming processes

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



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Power to Gas ¹⁴ Capacity	N/A	Project in CA is injecting H ₂ 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.
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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)