



IPHE Country Update October 2019¹: United States

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Covered Period	April to October 2019

1. New Initiatives, U.S. DOEs, and Policies on Hydrogen and Fuel Cells

- Congressional direction for 2020 ranges from \$144M to \$160M for hydrogen and fuel cells R&D funding, and an additional \$30M for solid oxide fuel cells R&D.
- Colorado [adopted](#) the Zero Emissions Vehicle Standards for vehicles joining ten other states in the ZEV standard U.S. DOE.
- California approved a new regulation to transition airports shuttles to zero emission shuttle at main 13 airports, which applies for public and private fleets.
- Several federal bills were introduced to address energy storage which may include opportunities for hydrogen.

2. Hydrogen and Fuel Cell R&D Update

- The U.S. DOE Hydrogen and Fuel Cell U.S. DOE is finalizing heavy and medium duty performance targets to help guide R&D in this area.
- The U.S. DOE published a [record](#) that estimates the range of hydrogen liquefaction cost from \$50M to \$800M for capacities ranging from 6,000 kg/day to 200,000 kg/day, respectively. This will feed into various models to evaluate status, gaps and R&D needed in hydrogen production and delivery.

3. Demonstration, Deployments, and Workforce Development Update

- The U.S. DOE [selected](#) three H2@Scale projects to demonstrate an integrated production, storage and end use application in Texas, Illinois and Florida. An additional project focused on integrating nuclear with a hydrogen system was also selected (funded through U.S. DOE's Nuclear Office).
- The U.S. DOE co-funded the [demonstration of a power to gas system](#) at NREL with renewable hydrogen from electrolysis to methane using a bioreactor.
- The U.S. DOE is kicking off the 2nd phase of delivery truck fleet demonstrations in the fall 2019.
- There are now 41 hydrogen retail stations (HRS) in California. In addition there are 5 HRS that have been completed (but not open to the public yet) in Massachusetts, Rhode Island, Connecticut (2), and New York.

4. Events

- The 2020 U.S. DOE [Annual Merit Review and Peer Evaluation Meeting](#) will be May 19 to 22 in Crystal City, Virginia. The U.S. DOE also released the [2019 AMR report](#) recently.

¹ This document reflects examples of key activities and U.S. DOE updates related to hydrogen and fuel cells since the previous IPHE Steering Committee meeting. It is not intended to be a comprehensive country overview.



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- The U.S. DOE held various workshops on data center, rail and ports during the spring/summer. Proceedings for the [data center](#) and the [rail](#) workshops are posted.
- The U.S. DOE is hosting a H2@Scale workshop on Nov 5 in conjunction with the Fuel Cell Seminar in Long Beach, CA.
- The U.S. DOE [celebrated](#) hydrogen and fuel cell day on Oct 8 with a week long campaign of [communications](#) and outreach activities including a 1.008 mile walk, a fuel cell car ride and drive, and multiple newsblasts including [social media](#) by U.S. Energy Secretary Perry. Activities reached over 30,000 people.

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

- The U.S. DOE announced \$40M in funding for [29 projects](#) to enable the H2@Scale and \$18M to go towards [13 projects](#) enabling gaseous fuel storage (including hydrogen) and fuel cells in medium and heavy duty trucks.
- The U.S DOE [announced](#) a collaboration with the Army to develop H2Rescue - a hydrogen fuel cell-powered emergency relief truck.

6. Regulations, Codes & Standards, and Safety Update

- AIChE and the U.S. DOE's Pacific Northwest National Laboratory launched a new partnership - the [Center for Hydrogen Safety](#) (CHS) – in April 2019. CHS is a global oriented non-profit dedicated to promoting hydrogen safety and best practices worldwide with access to 60,000 members in 110 countries. The CHS held a conference in Sacramento, California, October 14-16, 2019. Two other events, in Germany and in Japan are planned for 2020.
- UN Global Technical Regulation 13 Phase II work is ongoing. The next meeting of the working group will be held in Stuttgart, Germany, in November, and will include progress updates from the five task groups. The task group topics include medium- and heavy-duty vehicles and buses, fueling receptacles, recommendations for test procedures, and other topics.
- The 2020 edition National Fire Protection Association 2 was released in Summer 2019. This edition includes an up to 50% reduction in the separation distance for bulk gaseous storage and revisions to the manner in which the code is applied to hybrid (liquid and gaseous) installations.



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Transportation	Target Number	Current Status	Partnerships, Strategic Approach	Support Mechanism
Fuel Cell Vehicles ²	1,000,000 by 2030 (CA goal)	Over 7,800 as of October 2019	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.)
FC Buses ³	No target	35 active, 39 in development in OH, CA, CT, HI, IL, & NY (Nov 2018)	Federal Transit Authority (Department of Transportation); CARB; CEC, and multiple states	
Fuel Cell Trucks	No target	Prototype testing	CTE, FedEx Express, UPS, CEC, SCAQMD, Nikola	ZEV state mandate (e.g., CA)
Forklifts	No target	>26,000	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	41 open public retail in	State and private sector partnerships	

² https://cafcp.org/by_the_numbers. Includes Fuel Cell Electric Vehicles with Range Extenders

³ <https://www.nrel.gov/hydrogen/assets/docs/us-fcb-projects-2018.xlsx>



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70 MPa Delivered	12-25 in Northeast	California, 25 under development ⁴ 6 built in Northeast, 1 non-retail open in Hawaii		<ul style="list-style-type: none"> California - \$2.5 billion to build ZEV charging/refueling stations including 200 hydrogen stations (includes O&M grants) ZEV mandate
35 MPa On-Site Production	No target	2 as of 11/2018 (bus only stations). 70 MPa stations include 35 MPa	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 ⁵	Current Status	Partnerships, Strategic Approach	Support Mechanism
Small ⁶	\$1,000/kW for backup units running directly on hydrogen \$1,500/kW for combined heat	Negligible	Industry-led	State/regional

⁴ https://cafcp.org/by_the_numbers

⁵ Targets can be units installed and/or total installed capacity in the size range indicated

⁶ <5 kW (e.g., Residential Use)



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	and power units running on natural gas			
Medium ⁷	\$1,000/kW for combined heat and power units running on natural gas	As of 5/2016, system capacity installed ~555 kW	Industry-led	State/regional
Large ⁸	No target	Overall, more than 500 MW of large stationary (100 kW to multi-megawatt) fuel cells in the U.S.	Industry-led	State/regional
District Grid ⁹	No target	As of 5/2016, system capacity installed ~25 MW	Industry-led	State/regional
Regional Grid ¹⁰	No target	As of 10/23/2015,	Industry-led	State/regional

⁷ 5kW – 400 kW (e.g., Distributed Residential Use)

⁸ 0.3MW – 10 MW (e.g., Industrial Use)

⁹ 1MW – 30 MW (e.g., Grid Stability, Ancillary Services)

¹⁰ 30MW plus (e.g., Grid Storage and Systems Management)



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		system capacity installed 30 MW		
Telecom backup	No target	As of 5/2017 >8,000 (including on order)	Industry-led	State/regional
H ₂ Production and Delivery	Target ¹¹	Current Status	Partnerships, Strategic Approach	Support Mechanism
Overall ¹²	\$4/kg (produced, delivered, dispensed) ultimately \$7/kg by 2025, to supply early markets	~\$5/kg-\$10/kg (if state-of-the-art technologies were manufactured at high volume) \$13-\$16/kg (current price of hydrogen fuel in California, sourced primarily from natural gas reforming) ¹³	Limited government partnerships (commercial/industry focused)	State/regional funding and regulations (e.g., 33% of fuel sold from stations that are government-funded must be renewable in CA)

¹¹ Target can be by quantity (Nm³, kg, t) and by percentage of total production; also, reference to efficiency capabilities can be a target

¹² Hydrogen produced by reforming processes

¹³ https://www.hydrogen.energy.gov/pdfs/review18/h2f01_miller_2018_o.pdf



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Water Electrolysis ¹⁴ (PEM, Alkaline, SOEC)	<\$2/kg produced	Data collection in process	Continued government funding/cost share	State/regional (e.g., 33% renewables in CA)
By-product H ₂	N/A	Not tracked		
Energy Storage from Renewables	Target¹⁵	Current Status	Partnership, Strategic Approach	Support Mechanism
Power to Power ¹⁶ Capacity	N/A	N/A	N/A	N/A
Power to Gas ¹⁷ Capacity	N/A	60-kW demonstration at UC Irvine began in 2016	In process	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.

¹⁴ Please indicate if targets relate to a specific technology (PEM, Alkaline, SOEC)

¹⁵ Can be expressed in MW of Installed Capacity to use the electricity from renewable energy generation, and Annual MWh of stored energy capacity

¹⁶ Operator has an obligation to return the electricity stored through the use of hydrogen back to electricity

¹⁷ 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)