

U.S. Perspectives on Hydrogen Clusters/Valleys

Eric Miller, Senior Advisor, U.S. DOE Fuel Cell Technologies Office

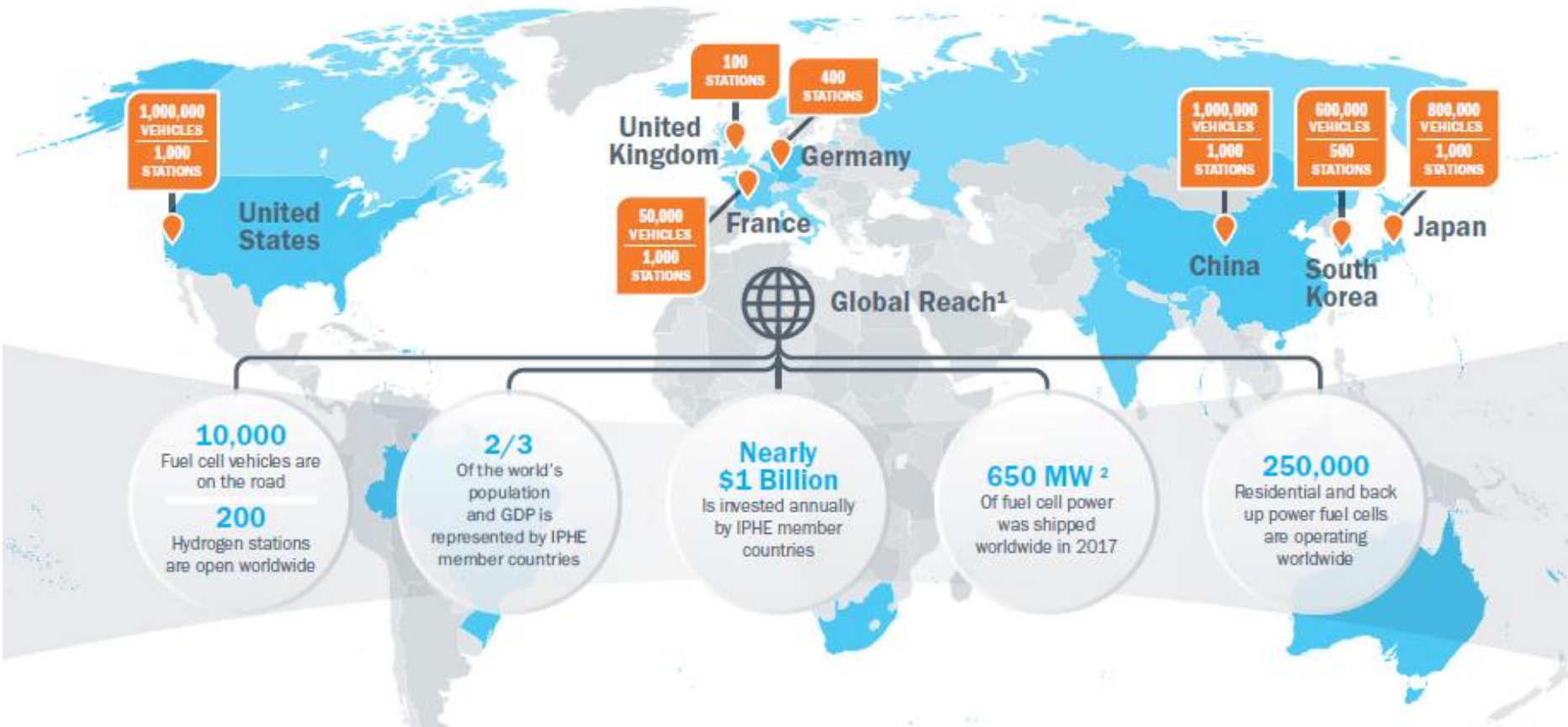
Cory Shumaker, Development Specialist, California Hydrogen Business Council

Mission Innovation Challenge 8: Hydrogen Valleys Workshop

26-27 March 2019 – Antwerp, Belgium



International Importance of Hydrogen & Fuel Cells



- 10,000** Fuel cell vehicles are on the road
- 200** Hydrogen stations are open worldwide
- 2/3** Of the world's population and GDP is represented by IPHE member countries
- Nearly \$1 Billion** Is invested annually by IPHE member countries
- 650 MW²** Of fuel cell power was shipped worldwide in 2017
- 250,000** Residential and back up power fuel cells are operating worldwide

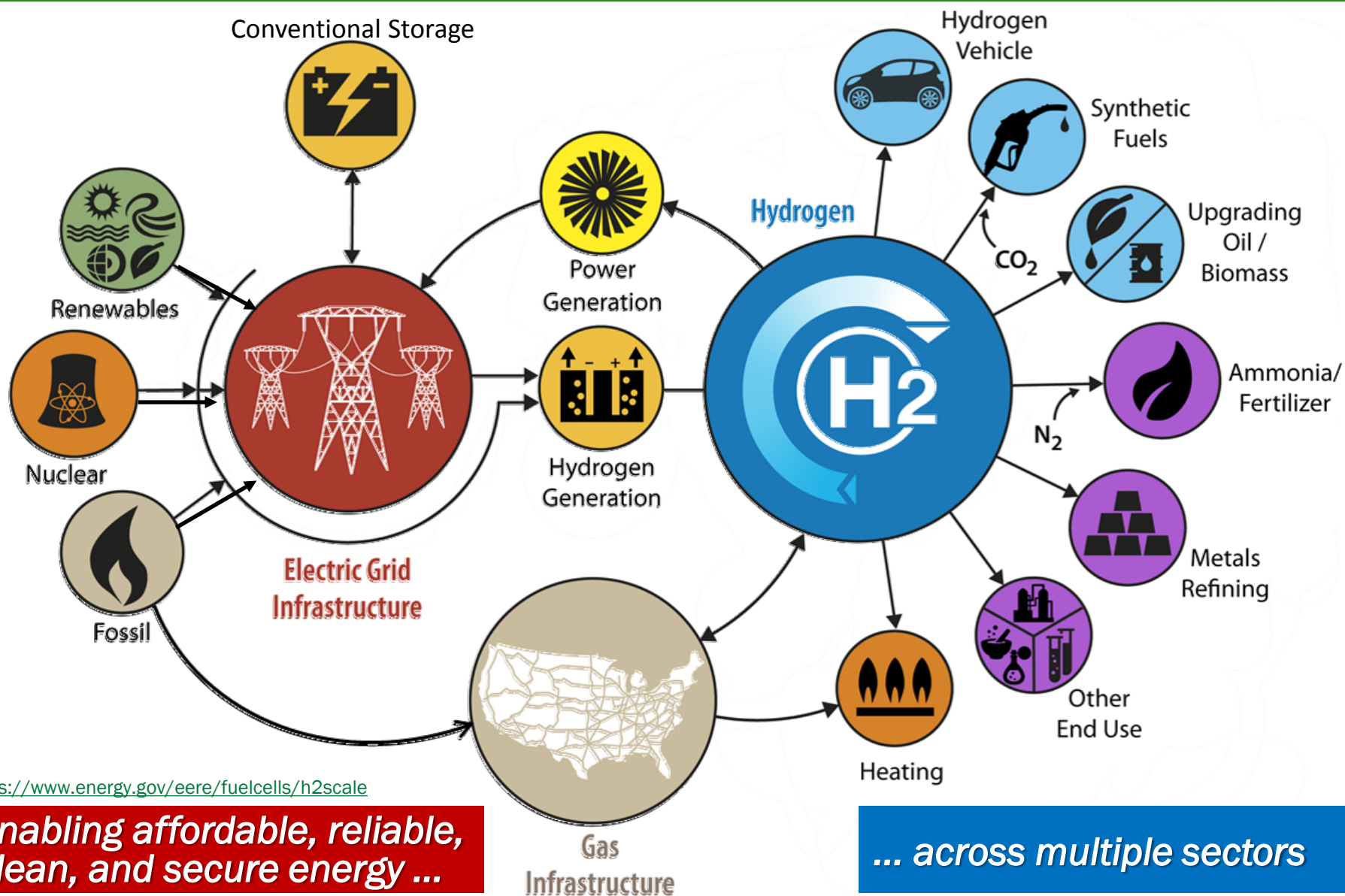
2050 Potential Impact³

- \$2.5 Trillion** ANNUAL REVENUE
- 30 Million** JOBS
- 18%** TOTAL ENERGY DEMAND
- 6 Gigatonnes** CO₂ EMISSIONS PREVENTED

¹ IPHE Country Updates ² U.S. Department of Energy, E4tech, 2018 ³ Hydrogen Scaling Up, Hydrogen Council, 2017

Source: IPHE

H₂@Scale: Foundation for U.S. H₂ Cluster Strategy



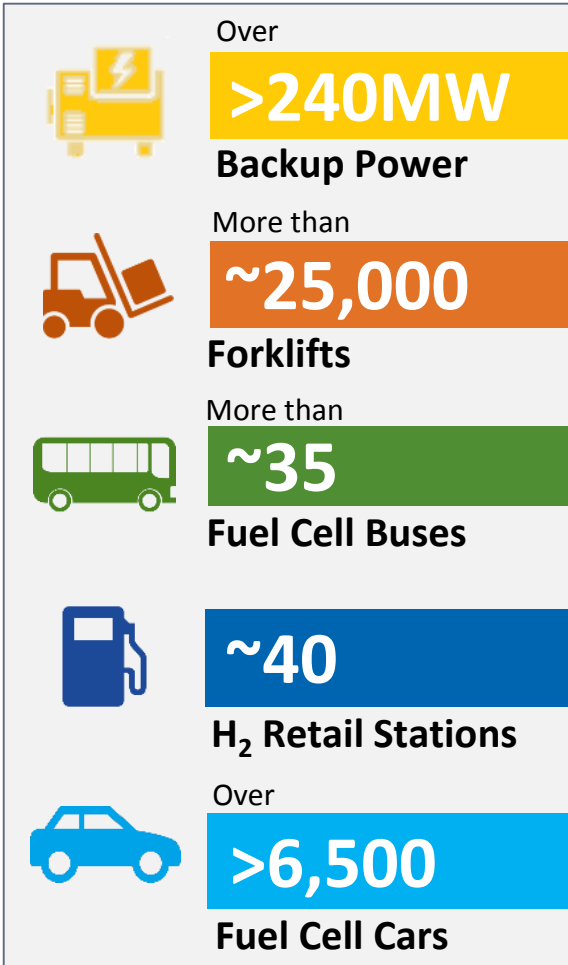
<https://www.energy.gov/eere/fuelcells/h2scale>

enabling affordable, reliable, clean, and secure energy ...

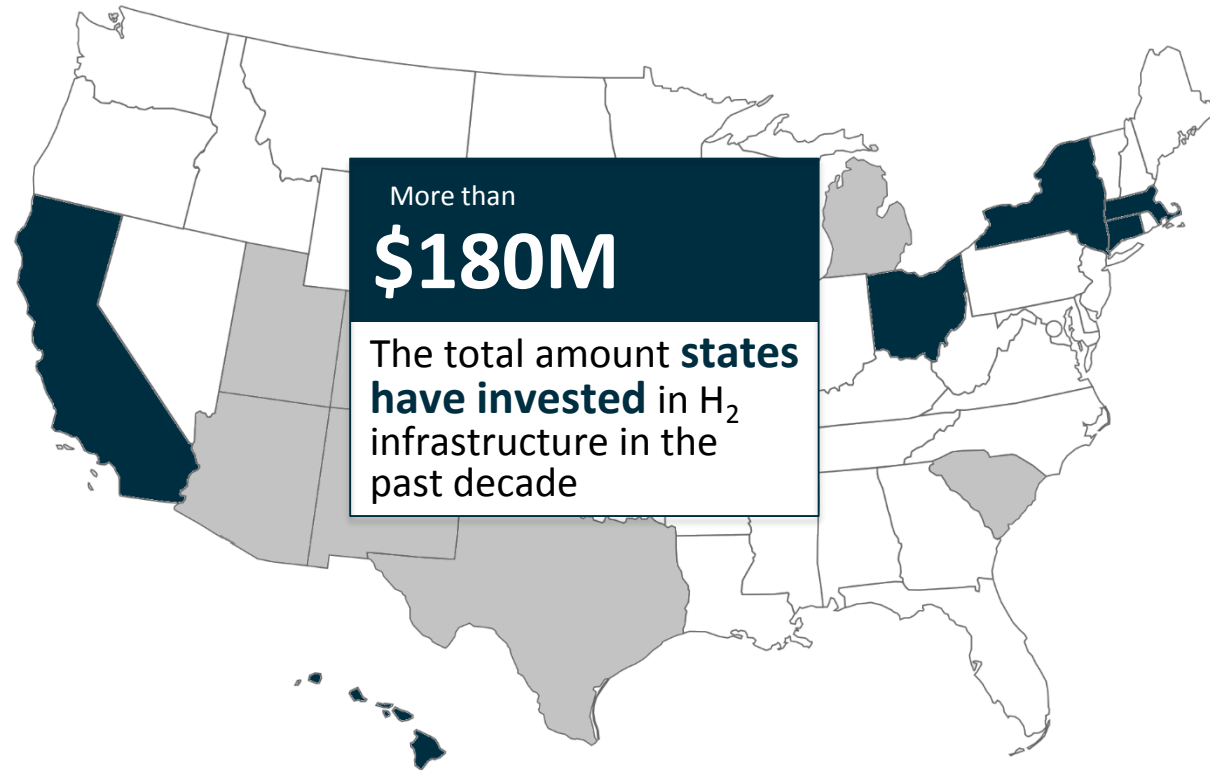
... across multiple sectors

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

Examples of Application in the United States



States with Growing Interest



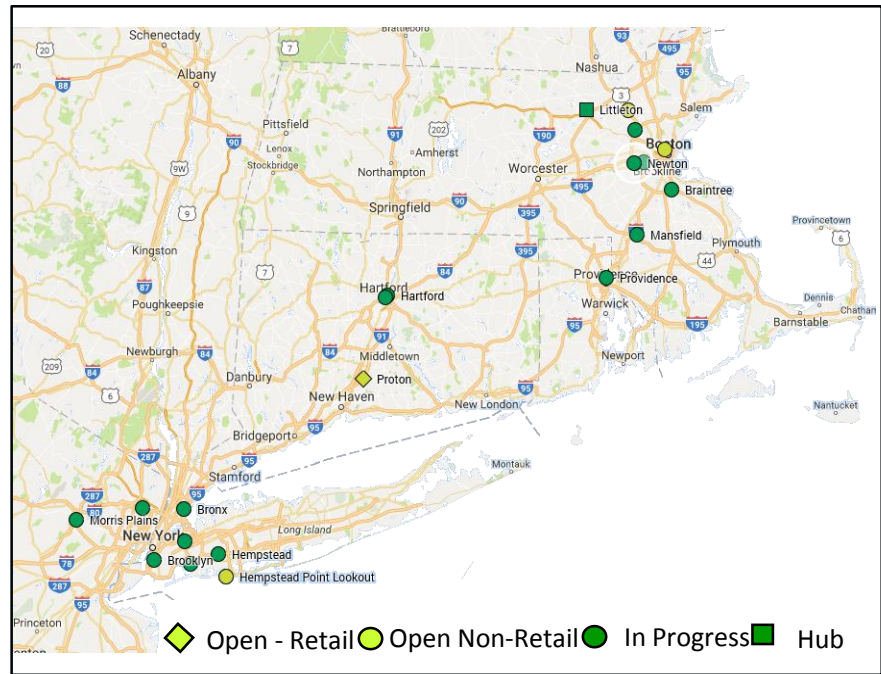
Hydrogen Stations: Examples of Plans Across States

California
1,000 stations
by 2030

Northeast
12 – 20 stations
planned

**HI, OH, SC, NY, CT, MA, CO,
UT, TX, MI, and others**
with interest

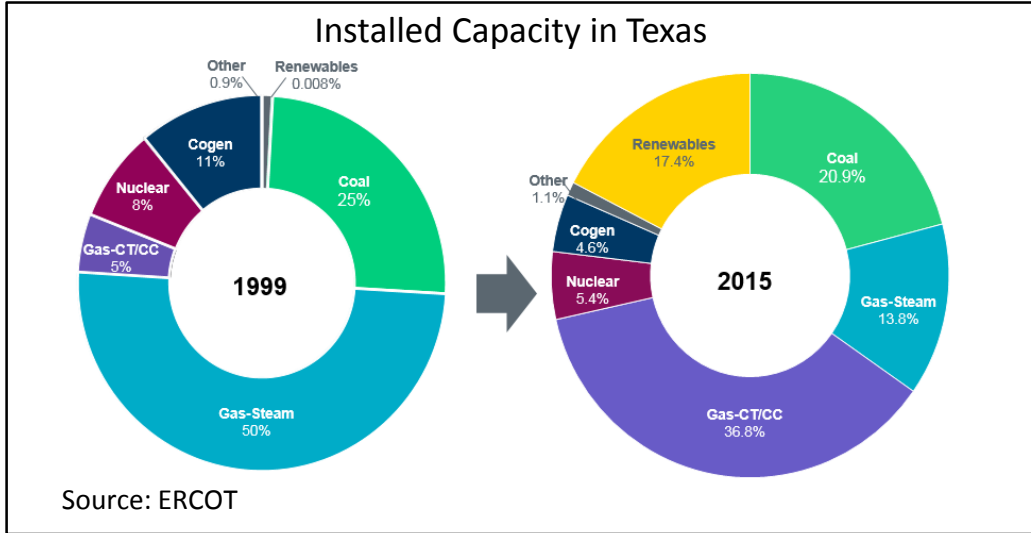
Hydrogen Clusters: from Coast to Coast



Emergence in Hawaii, Ohio, Texas, Colorado, South Carolina, and others

Hydrogen Clusters: Opportunities in Texas

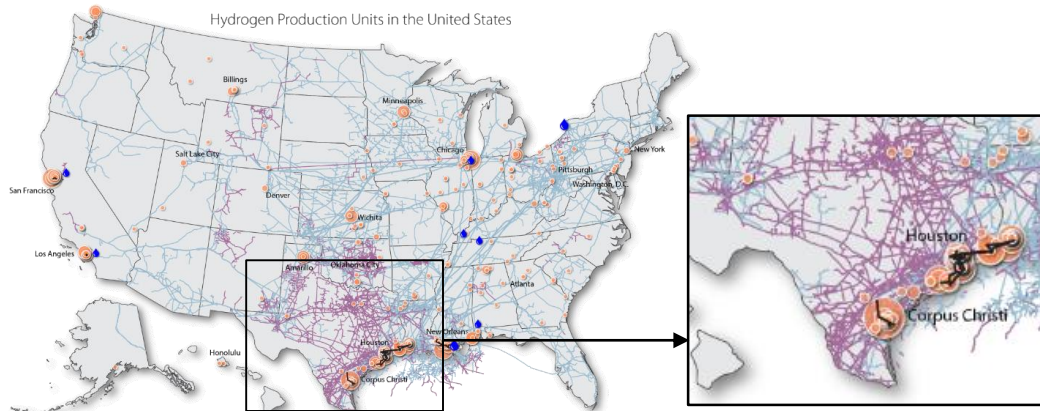
- Increased renewable (wind) capacity



- Increased interest hydrogen as an energy storage



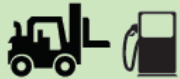
- H₂ delivery infrastructure is present



The Ohio Fuel Cell Corridor



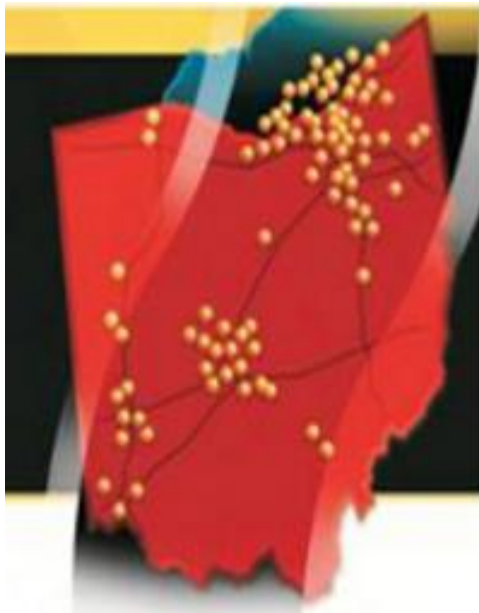
Fuel cells provide backup power to undisclosed government, railroad and telecommunications sites across the state.



There are several fuel cell forklift deployments in Ohio. Honda operates 51 at its Marysville manufacturing facility; The Home Depot has 177 at its Troy Township distribution center; and Ace Hardware has 35 fuel cell reach trucks, 36 fuel cell pallet jacks, and a fuel cell-powered floor scrubber at its West Jefferson retail support center. All are using Plug Power fuel cells.



By 2018, the Stark Area Regional Transit Authority (SARTA) in Canton will have the second largest fuel cell bus fleet in the nation. Ten buses will join the fleet in 2017 and 2018. The first bus debuted in March 2017 and will operate at Ohio State University.



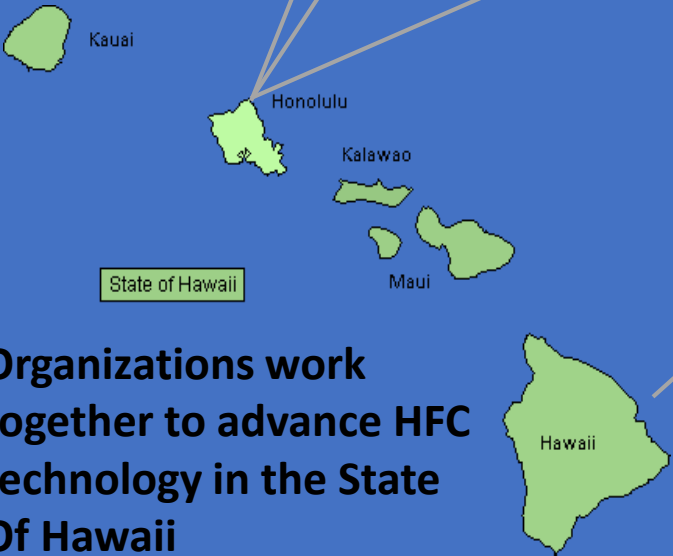
SARTA Hydrogen Fuel Cell Bus

The Ohio Fuel Cell Coalition

Hydrogen Clusters: Emergence in Hawaii



Hawaii Center for Advanced Transportation Technology



Organizations work together to advance HFC technology in the State Of Hawaii

Hawaii Natural Energy Insitute



Small renewable refueling system



Mobile light system



Bus being converted to fuel cell power



US Marine Corps Base, K-Bay refueling

Toyota Station



Toyota opens first public hydrogen station



First Mirai in Hawaii

Natural Energy Laboratory of Hawaii



Hydrogen station at NELHA



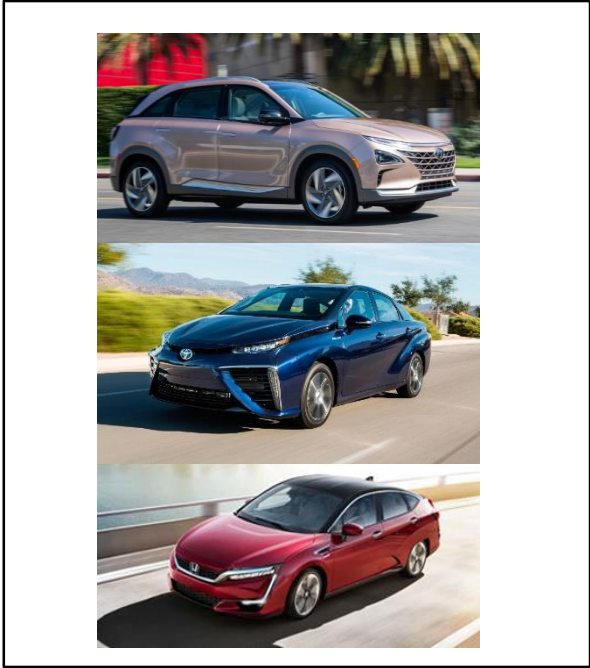
H2 tube trailer

Hydrogen Clusters/Valleys in California

- H₂ Stations Up and Running



- Fuel Cell Cars on the Road



- Increased interest from industry to invest H₂ liquefaction plants and heavy and medium duty applications



Collaboration: New H₂ Safety Partnership

Leverages new partnership to promote collaboration on safety



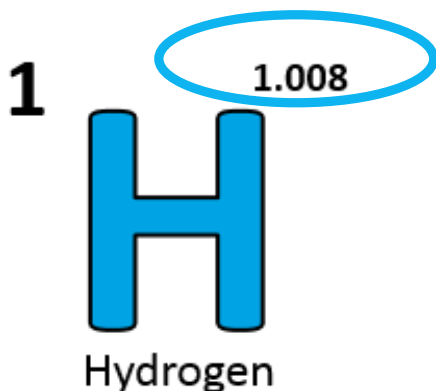
Launch 2 April 2019 in New Orleans

Stakeholder Engagement to support early stage R&D

**Celebrate
Hydrogen & Fuel
Cell Day**
October 8 or 10/8

**Use Safety
Information and
Training Resources**

**Attend workshops
enabling
H2@scale**



H2tools.org



INCREASE YOUR
H2IQ

Download for free at:

[energy.gov/eere/fuelcells/downloads/
increase-your-h2iq-training-resource](https://energy.gov/eere/fuelcells/downloads/increase-your-h2iq-training-resource)

- **Data Centers:** March 20 in Seattle, WA
- **H2@Rail:** March 26-27 in Lansing MI
- **H2@Ports:** Oct 2019, San Francisco, CA (tentative)



Sign up to receive hydrogen and fuel cell updates

www.energy.gov/eere/fuelcells/fuel-cell-technologies-office-newsletter

Learn more at: energy.gov/eere/fuelcells

2019 Annual Merit Review

April 29 - May 1, 2019

Washington, DC

hydrogen.energy.gov

Thank you

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[**energy.gov/eere/fuelcells**](https://energy.gov/eere/fuelcells)



San Pedro Bay Ports: Hydrogen Valley in the Making

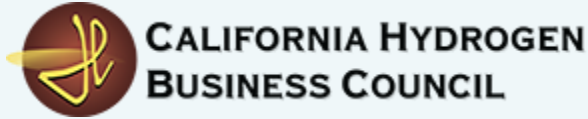
Projects Update



Cory Shumaker

Development Specialist

March 26, 2019



Mission & Sector Action Groups:

The California Hydrogen Business Council (CHBC) is comprised of over 100 companies, agencies and individuals involved in the business of hydrogen. Our mission is to advance the commercialization of hydrogen in the energy sector, including transportation, goods movement, and stationary power systems to reduce emissions and dependence on oil in California.

CHBC Activities:

- Advocacy
- Strategic Communications
- Goods Movement, Heavy-Duty Transportation, and Clean Ports
- Hydrogen Energy Storage and Renewable Hydrogen
- Public Transport
- Infrastructure

MEMBER ORGANIZATIONS

Platinum



Gold



Silver



Innovators



Affiliates



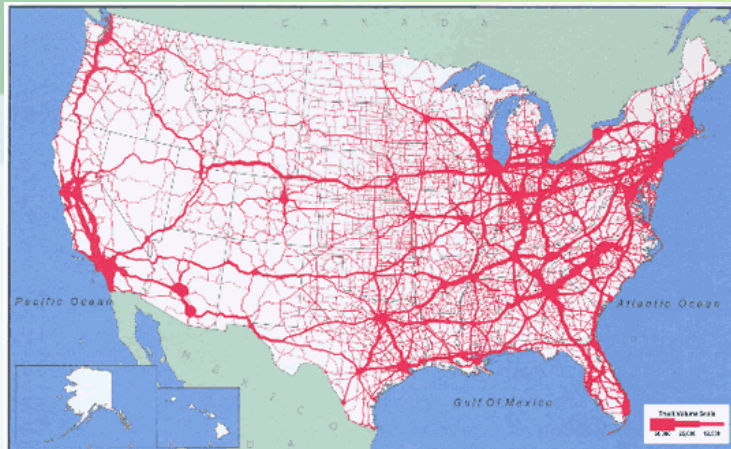
CHBC Members Include:

- Hydrogen producers and distributors
- Automotive companies
- Public transit systems and suppliers
- Fuel cell, electrolyzer, compressor and storage manufacturers
- Fueling station developers, engineers and consultants
- Municipal, state and federal agencies
- Component suppliers



San Pedro Bay Ports Los Angeles & Long Beach

- POLB: 27 terminals; POLA: 22 terminals
- Total twenty-foot container units (TEU) throughput in 2018:
 - POLB: 8,091,023
 - POLA: 9,458,748
 - Growing 4.8% YoY¹
- 31.2M total TEUs by 2030
- Rate study coming



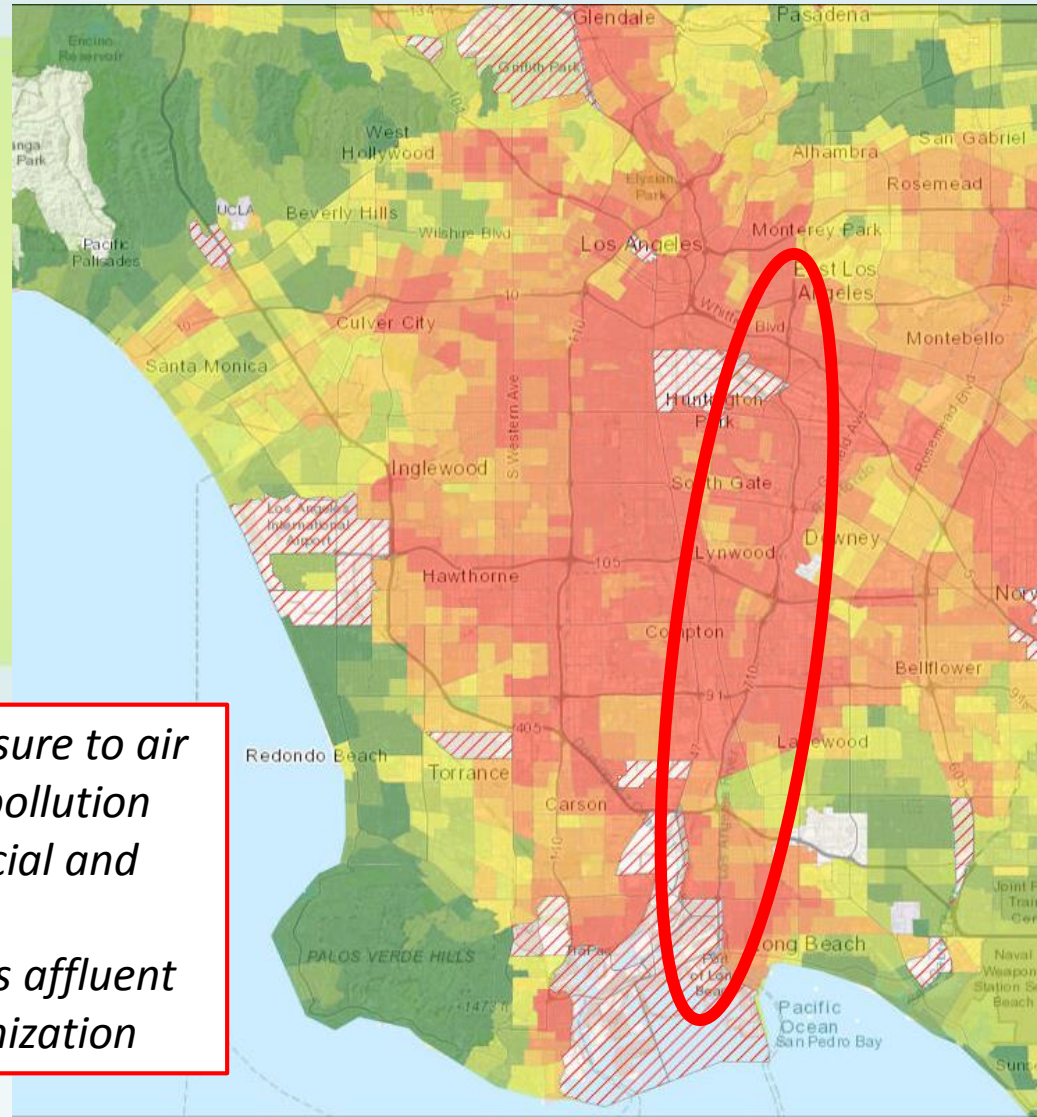
¹ https://transportgeography.org/?page_id=8952



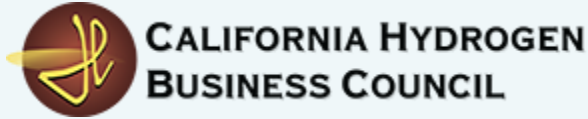
CALIFORNIA HYDROGEN
BUSINESS COUNCIL

South Coast Air Basin I-710 Corridor – A Need for Action

- Need to bring goods from port to railhead
- Dangerous PM2.5 & NOx emissions
- Disadvantaged communities disproportionately penalized for commerce
- Great opportunity for fuel cell trucks



“There is significant inequality in exposure to air pollution and related health risks: air pollution combines with other aspects of the social and physical environment to create a disproportionate disease burden in less affluent parts of society” – World Health Organization



Strong Government Drivers in Ports & Shipping

Governor Brown, the State Legislature, State agencies, Port Authorities and regional air quality management districts are driving toward improved air quality, and GHG and criteria pollutant reduction goals.

Goals

- Zero emission trucks by 2035
- Zero emission terminal equipment by 2030
- Reduce GHGs by 80% below 1990 levels by 2050
- CARB Indirect Source Rule



Incentives and Funding

- CEC Grant Funding Opportunity Solicitations
- CARB Compliance Incentive Funding
- Technology Advancement Program (CAAP)

Vehicles

Zero Emission Cargo Transport II



Hydrogen Projects in Ports and Maritime

- Port of Long Beach
 - Three fuel cell yard tractors
 - One hydrogen station (trigen)
- Port of Los Angeles
 - One fuel cell top handler
 - Two fuel cell yard tractors
 - 10 new fuel cell trucks
 - One hydrogen station
- Red & White Feet, San Francisco
 - World's first fuel cell passenger ferry
 - Begin operation in October 2019



Opportunities and Challenges For Hydrogen in the Ports

The Ports (LA & LB) are currently experiencing a transformation in the harbor to move toward greener technologies

- Hydrogen has been predominately absent in the ports, until now
- Maritime industry now being informed about hydrogen solutions
- Cost and economics of hydrogen solutions are key
- Other important considerations are reliability, reliability, scalability, and fueling infrastructure





CALIFORNIA HYDROGEN
BUSINESS COUNCIL

Thank You!



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Join us!

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