Massachusetts
Hydrogen
Coalition

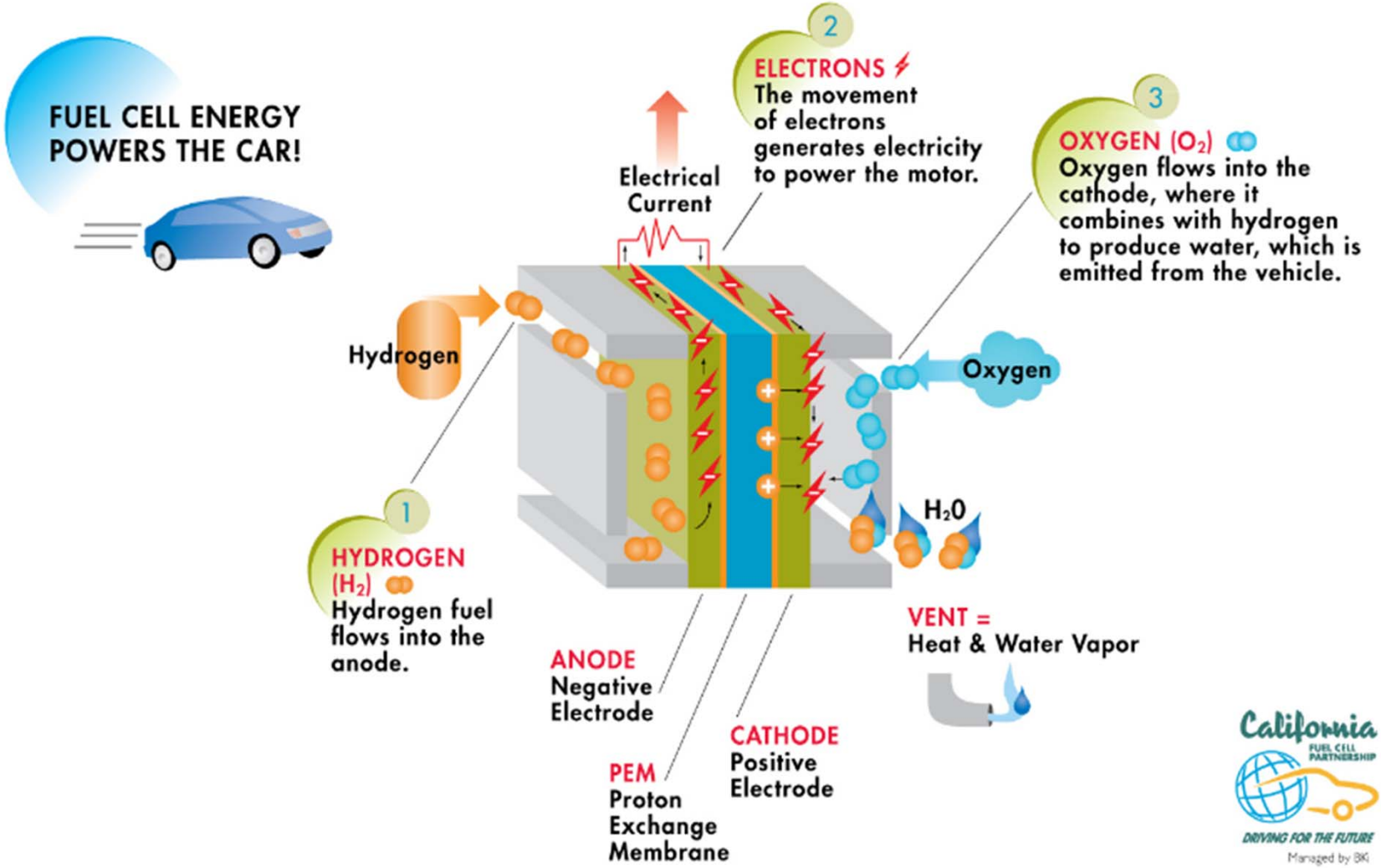
# Fuel Cell & Hydrogen Transportation Northeast Review


Charles Myers

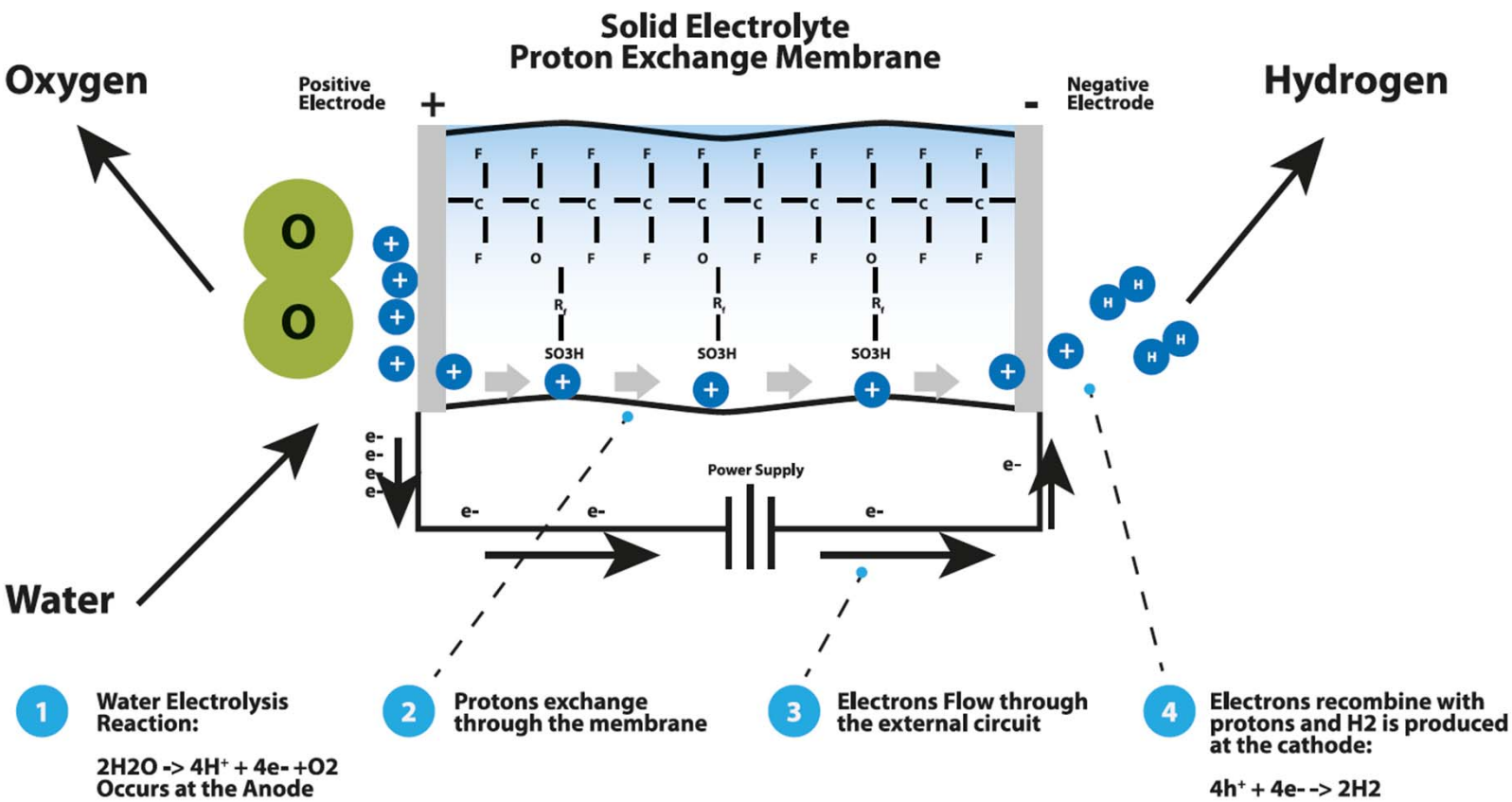
President – Massachusetts Hydrogen Coalition
Chair – Massachusetts Fuel Cell Electric Vehicle Working Group
Member – Rhode Island ZEV Working Group
Member – H2USA


April 26, 2019

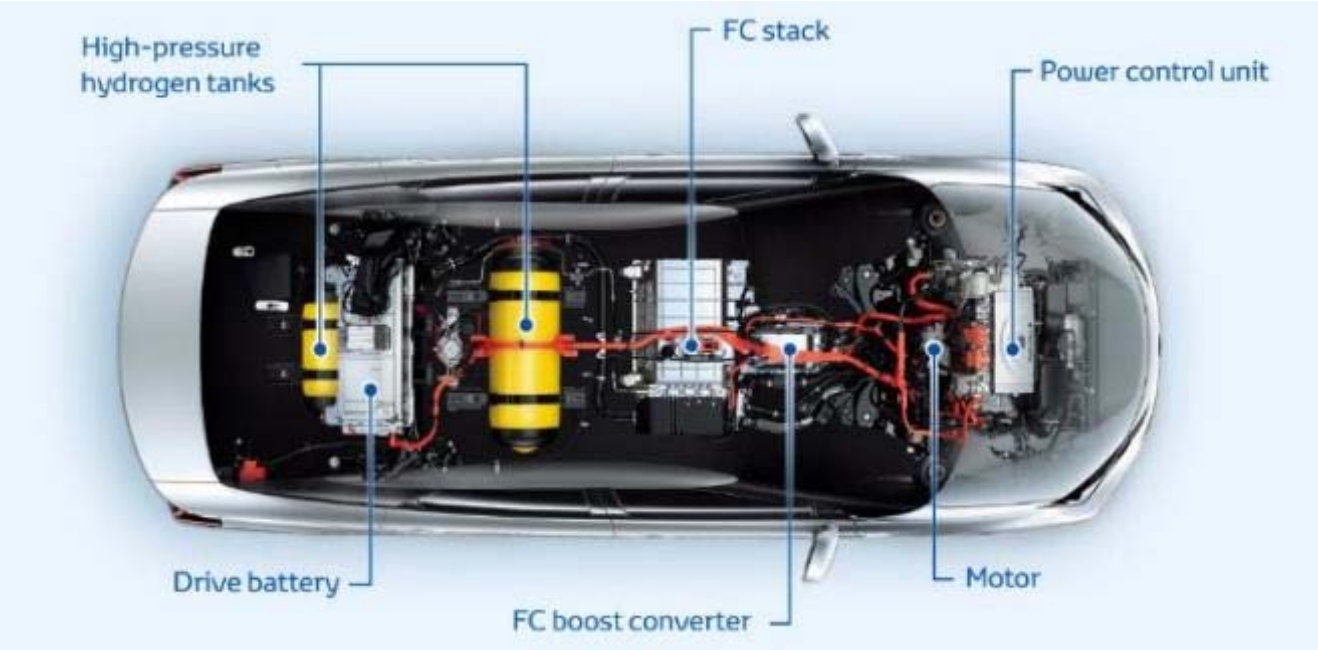
# How A Fuel Cell Works



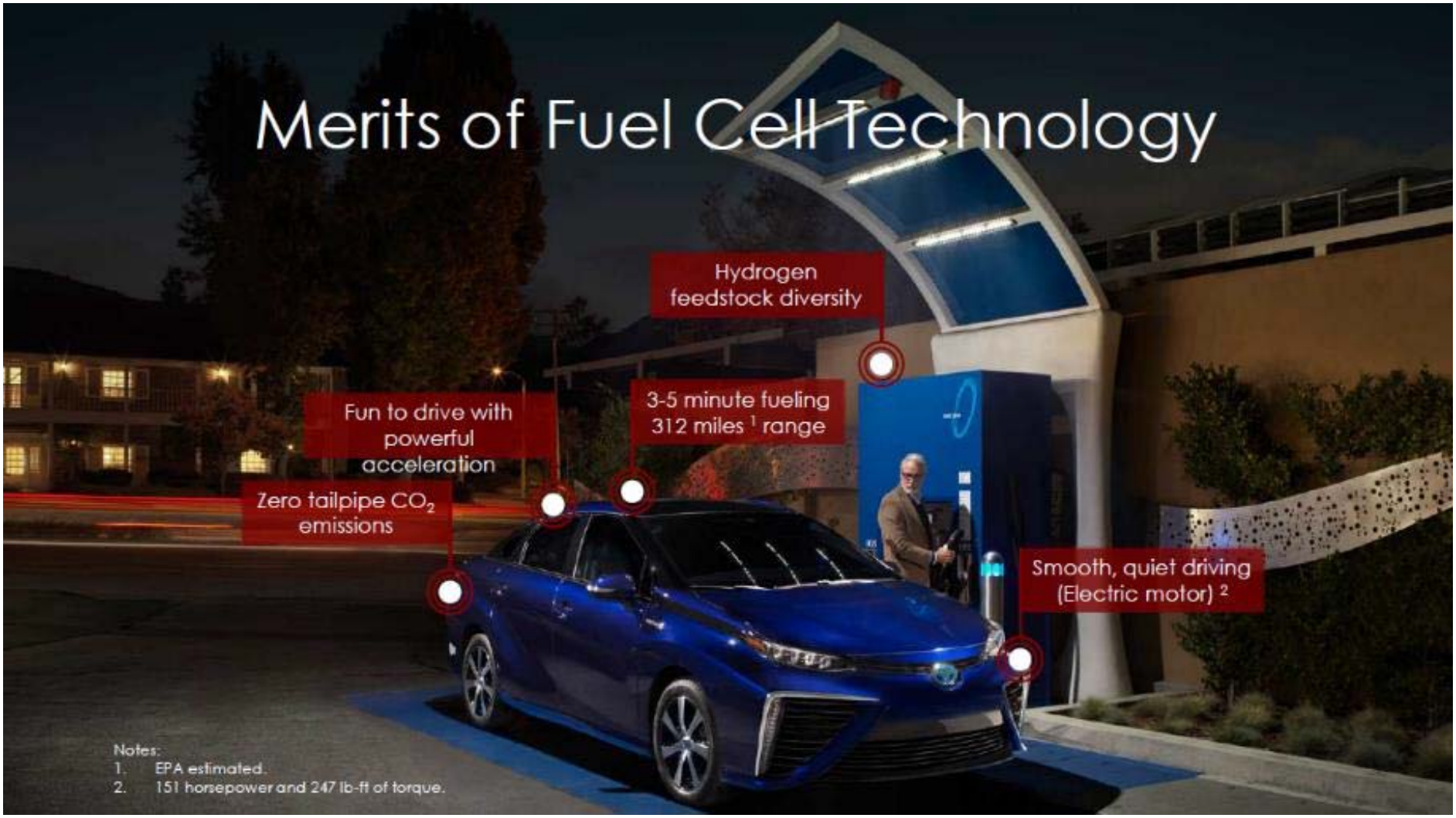
# PEM (Proton Exchange Membrane) Electrolysis



# Toyota Mirai



# Toyota View of Fuel Cell Vehicles



# Fuel Cell Electric Vehicles Available In California Now

**Toyota Motor Corporation - Mirai**

- Toyota Mirai available now in California and in the Northeast as stations open.
- MRSP $57,500.
- Lease $349 per month, 12,000 miles per year, includes $15,000 of fuel over 36 months and service.

**Honda Motor Company - Clarity**

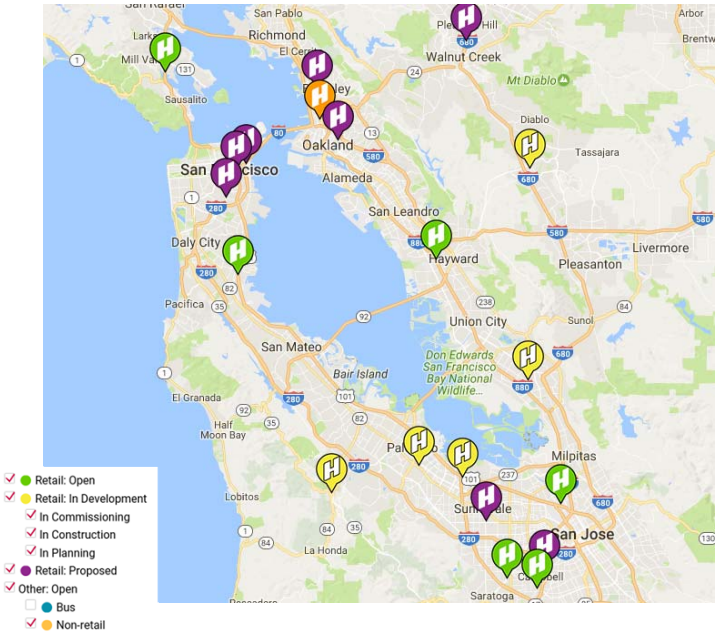
- Honda Clarity available now in California and in the Northeast as stations open.
- Lease $369/month, 20,000 miles per year, includes $15,000 of fuel over 36 months and service.

**Hyundai Motor America – Nexo**

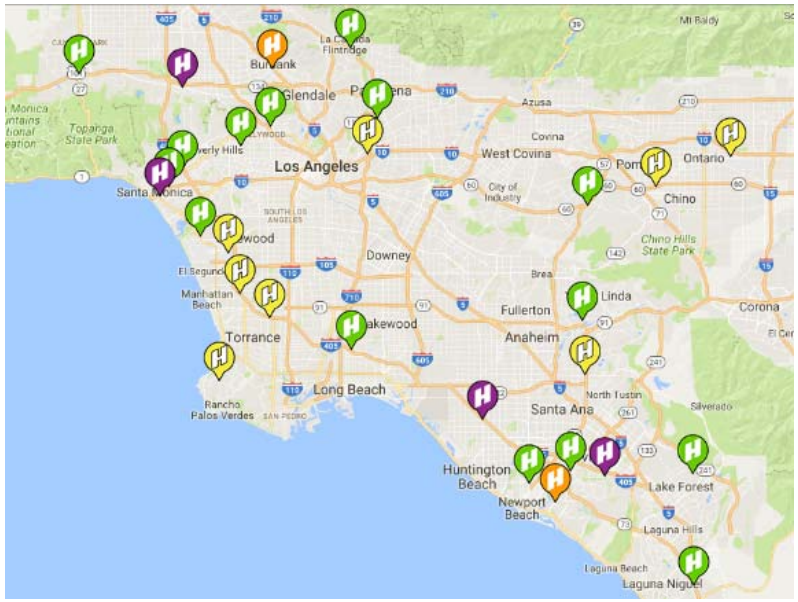
- Hyundai Nexo available now in California and in the Northeast as stations open.
- $499 per month, unlimited free hydrogen and concierge service.
- Nexo replaces the Tucson FCV

# California Hydrogen Infrastructure Today

## Northern California



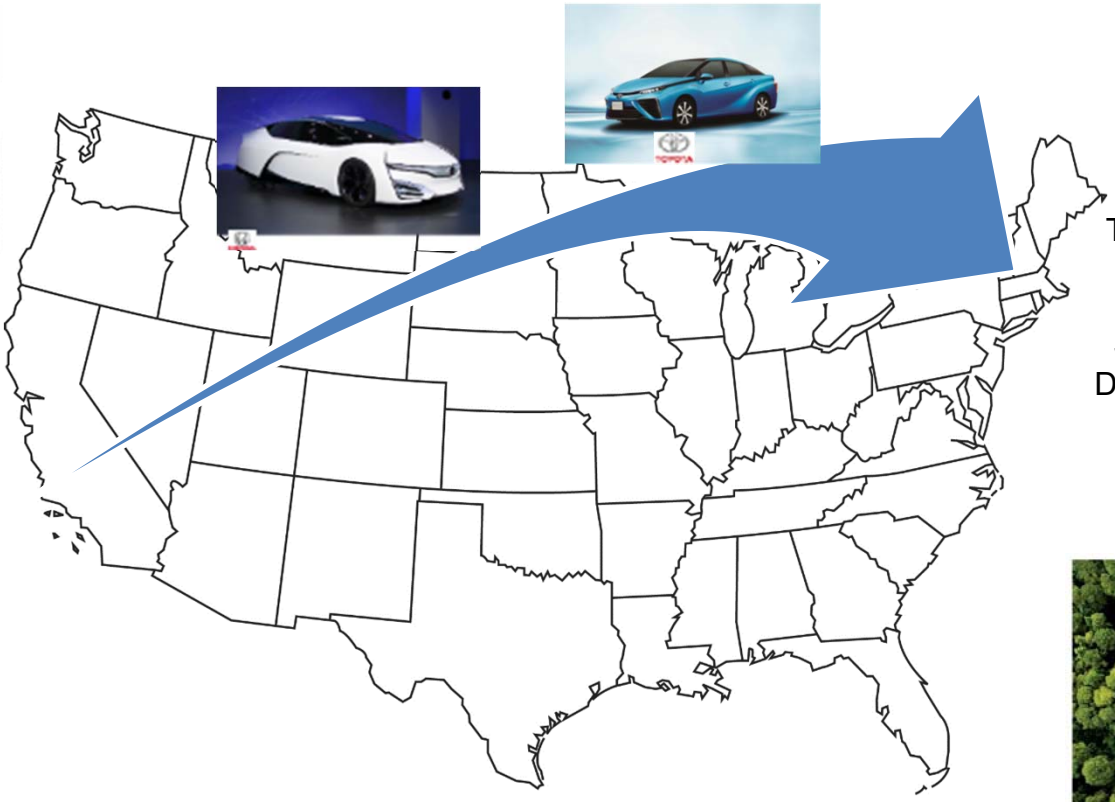

## Southern California




California has awarded 64 of the first 100 hydrogen stations. Nearly 40 of the 64 are in operation now with more coming on line as completed.

# Coast-to-Coast Hydrogen Infrastructure

California AB8 has funded 65 stations in three rounds of funding towards the goal of 100 stations.



Air Liquide, in partnership with Toyota, is self funding 12 stations. NEL upgrades theirs. Simplefuel, winner of DOE H Prize is building one in Somerville.

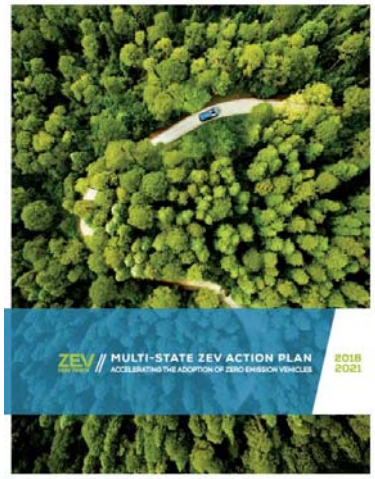
| | |
|---|---|
| Open - Retail | 39 |
| Open - Non-Retail | 0 |
| Commissioning | 3 |
| Under Construction | 4 |
| Approval to Build | 2 |
| Planning Approval | 11 |
| Permit in Process | 1 |
| Pre-Permit Application | 4 |
| *Establishing Site Control* | 0 |

Source: CAFCP April 1, 2019

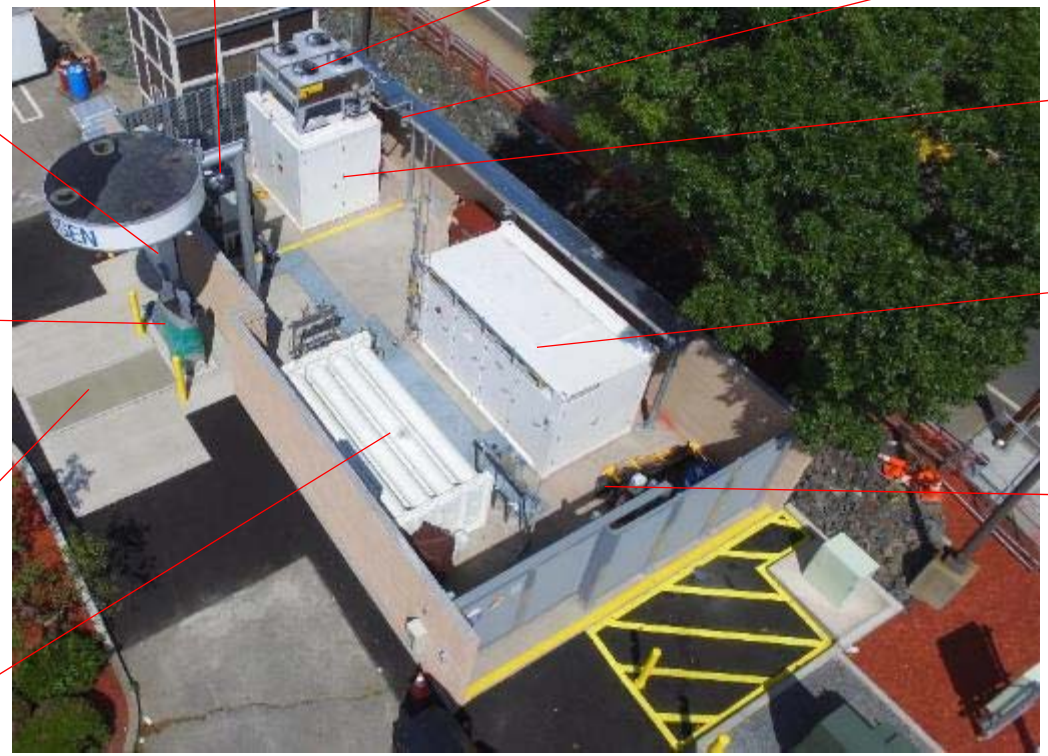
8 State ZEV Action Plan adopted May 2014 by CA, OR, MD, NY, VT, MA, CT, RI.

| 8 State MOU Unit Obligations based on CA 1,500,000 unit sales and R.L.Polk Proportional Sales | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | CA | MA | CT | RI | NY | MD | OR | VT |
| % Sales | 1 | 0.2 | 0.1 | 0.03 | 0.57 | 0.2 | 0.09 | 0.02 |
| Total | 1,500,000 | 300,000 | 150,000 | 45,000 | 855,000 | 300,000 | 135,000 | 30,000 |
| FCV | 173,097 | 34,619 | 17,310 | 5,193 | 98,665 | 34,619 | 15,579 | 3,462 |
| BEV | 389,972 | 77,994 | 38,997 | 11,699 | 222,284 | 77,994 | 35,098 | 7,799 |
| TZEV | 936,930 | 187,386 | 93,693 | 28,108 | 534,050 | 187,386 | 84,324 | 18,739 |

Source: Massachusetts Hydrogen Coalition

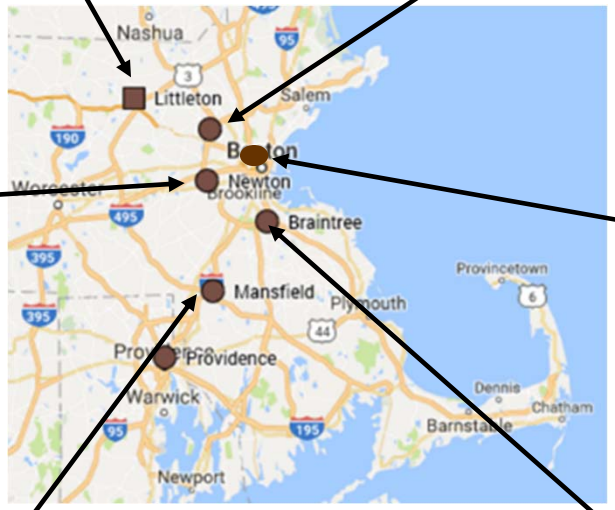


# Air Liquide's Typical NE H2 Station Major Components



# Massachusetts H2 Infrastructure Built, In Construction & Planned

Littleton – Hub Site



MBTA Somerville

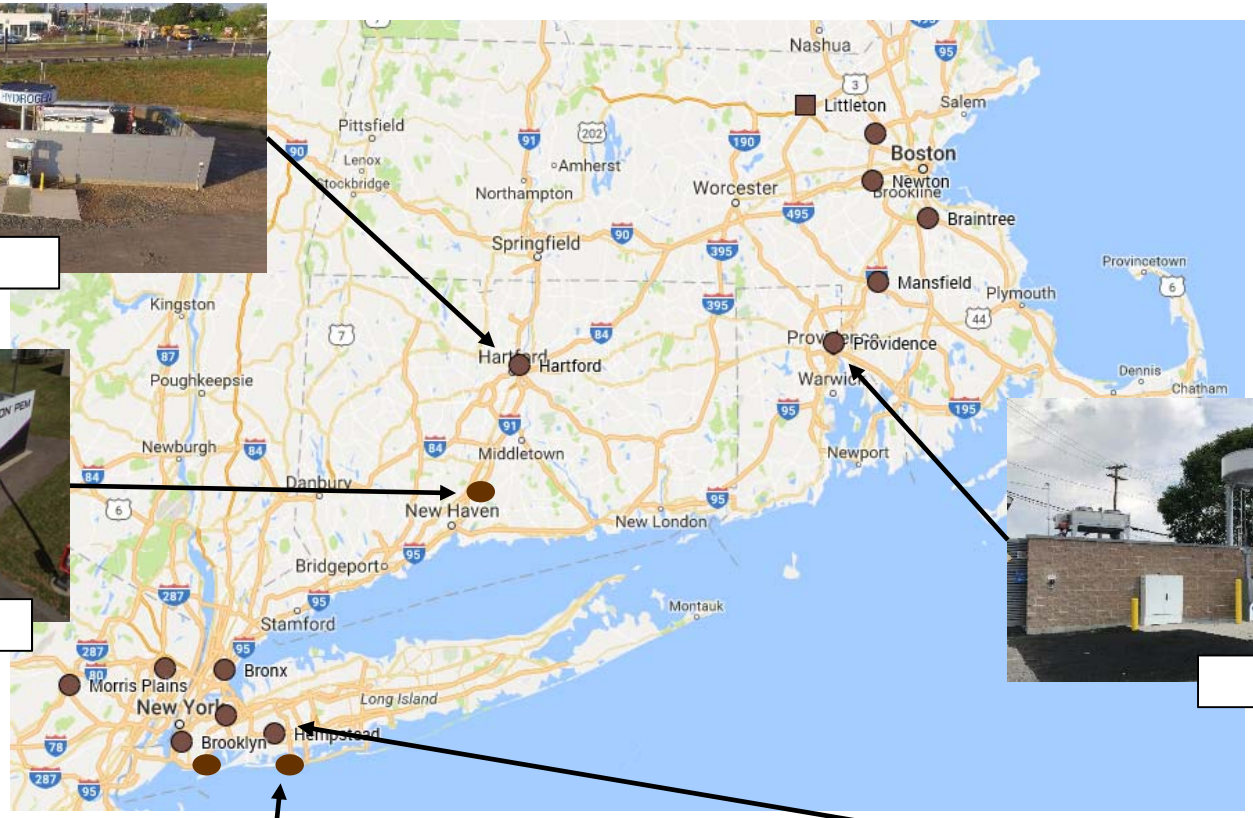
Mansfield

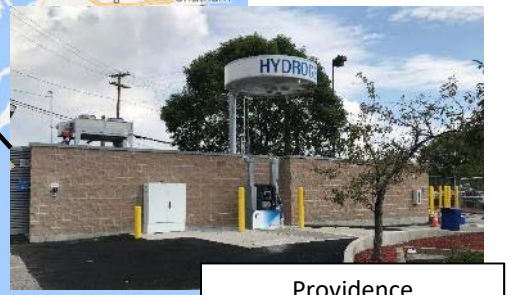
Braintree

# NY, CT & RI H2 Infrastructure Built, In Construction & Planned

Hartford

Wallingford




Providence

Town of Hempstead

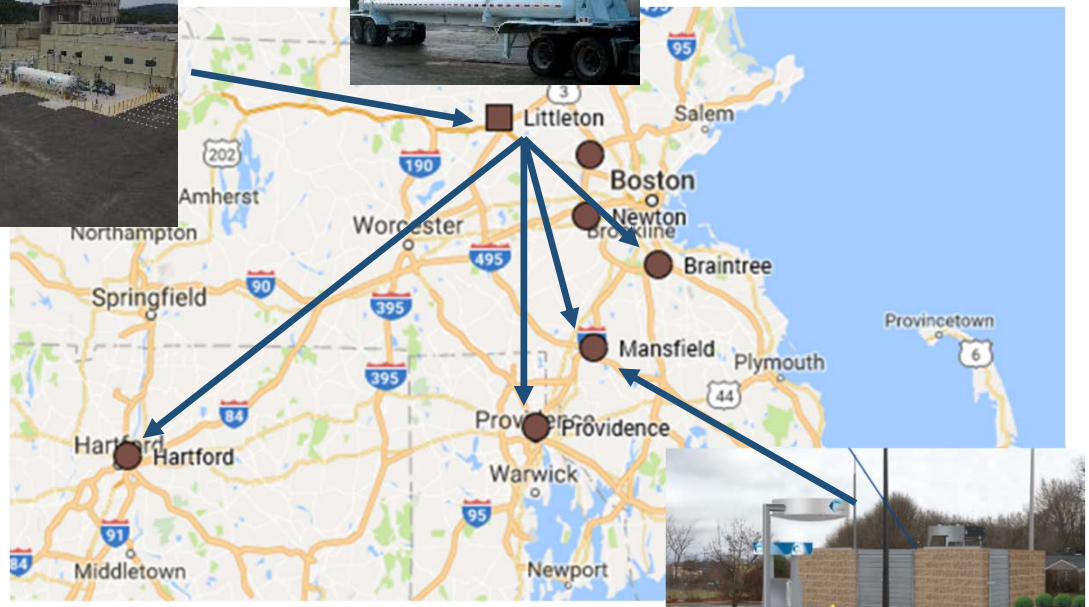
Hempstead

# Air Liquide Northeast Hydrogen Supply

LH2 Delivered from Source to Hub

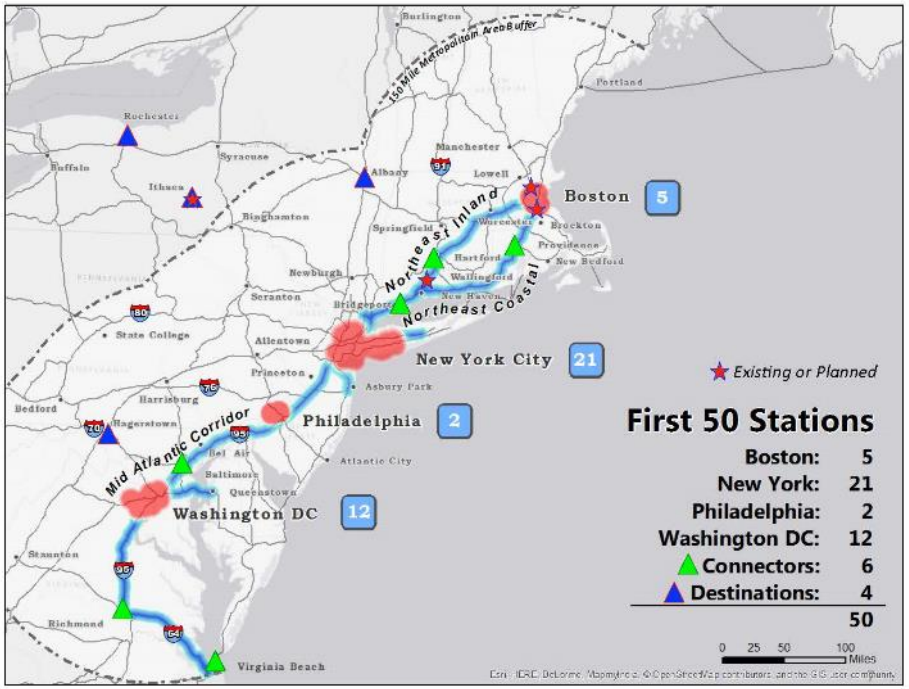
Littleton, MA Hub LH2 Storage
LH2 is vaporized on demand to GH2 For Delivery to Stations

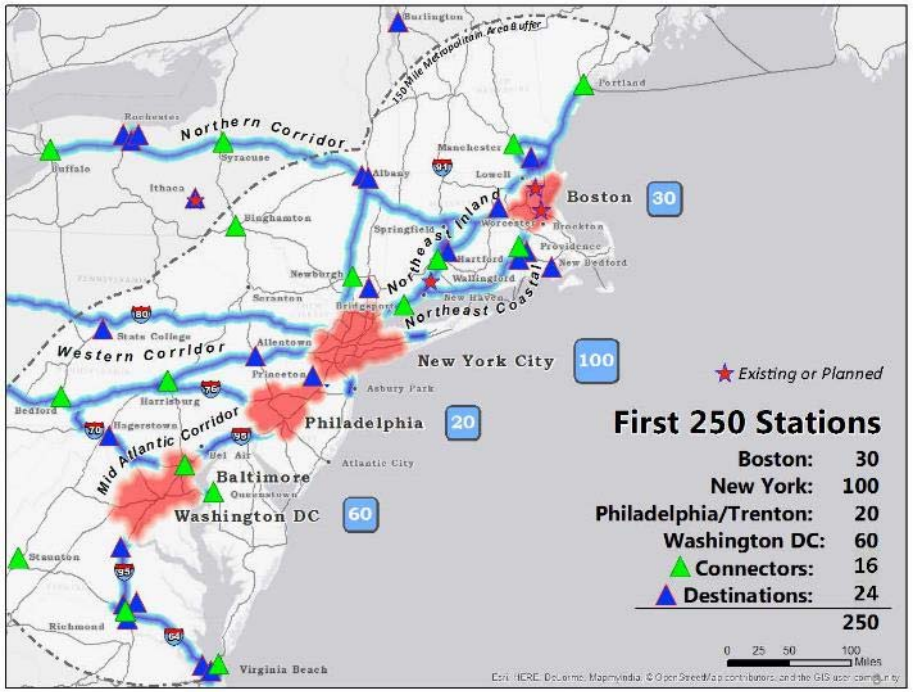
GH2 Tube Trailer Delivers to Stations



Mansfield, MA Station

# Northeast Hydrogen Corridor

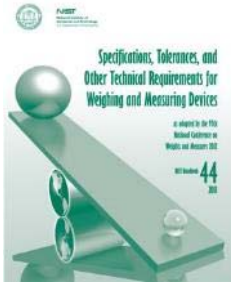



Maps created by NREL for the H2USA Locations Working Group

# Hydrogen Station Commissioning & State Testing

HDT Device Built by CSA and qualified by NREL for contract use in the Northeast



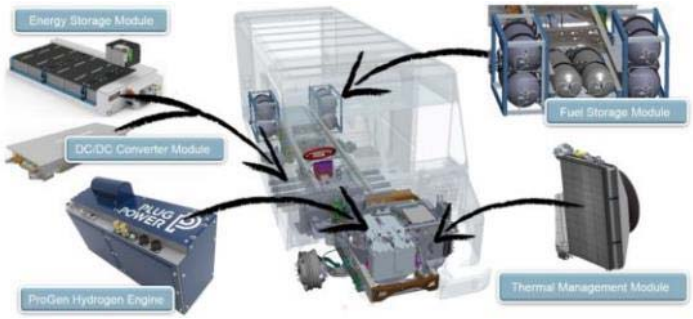

H2 metering standards unified for U.S.

NE adopts CA H2 gravimetric metering test procedures

NE adopts CA H2 quality sampling procedures

# Fuel Cell Medium & Heavy Duty Trucks

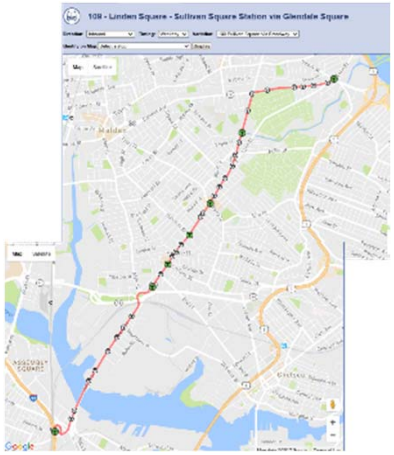
FedEx




Toyota Kenworth

Nikola

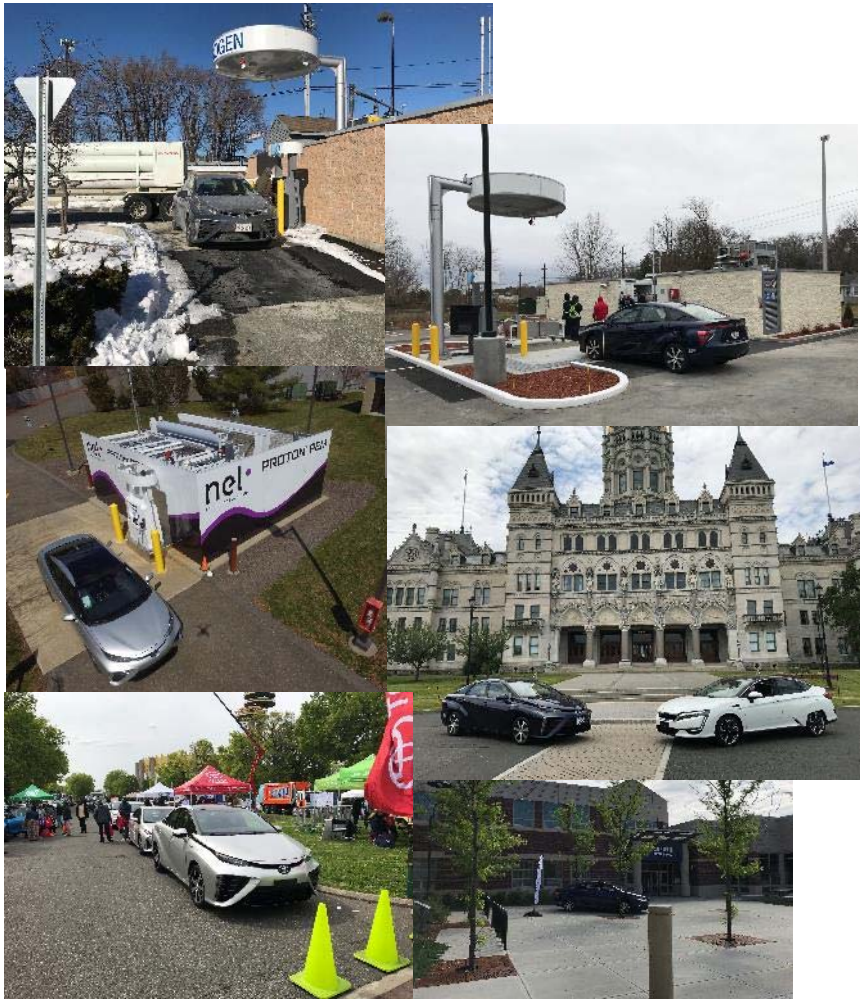
# MBTA Fuel Cell Bus



# Fuel Cell Vehicles Out & About In The Northeast

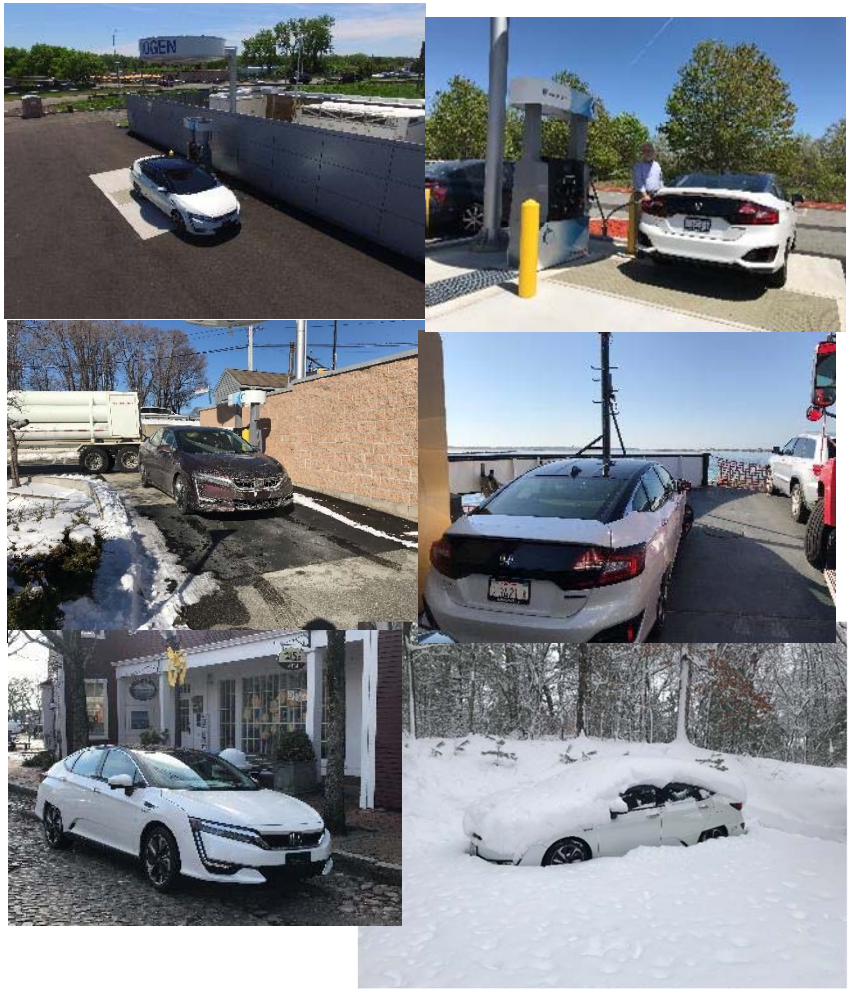
## Toyota Mirai

Providence, RI; Mansfield, MA; Auburn, MA; Wallingford, CT; Hartford, CT; Flushing, NY

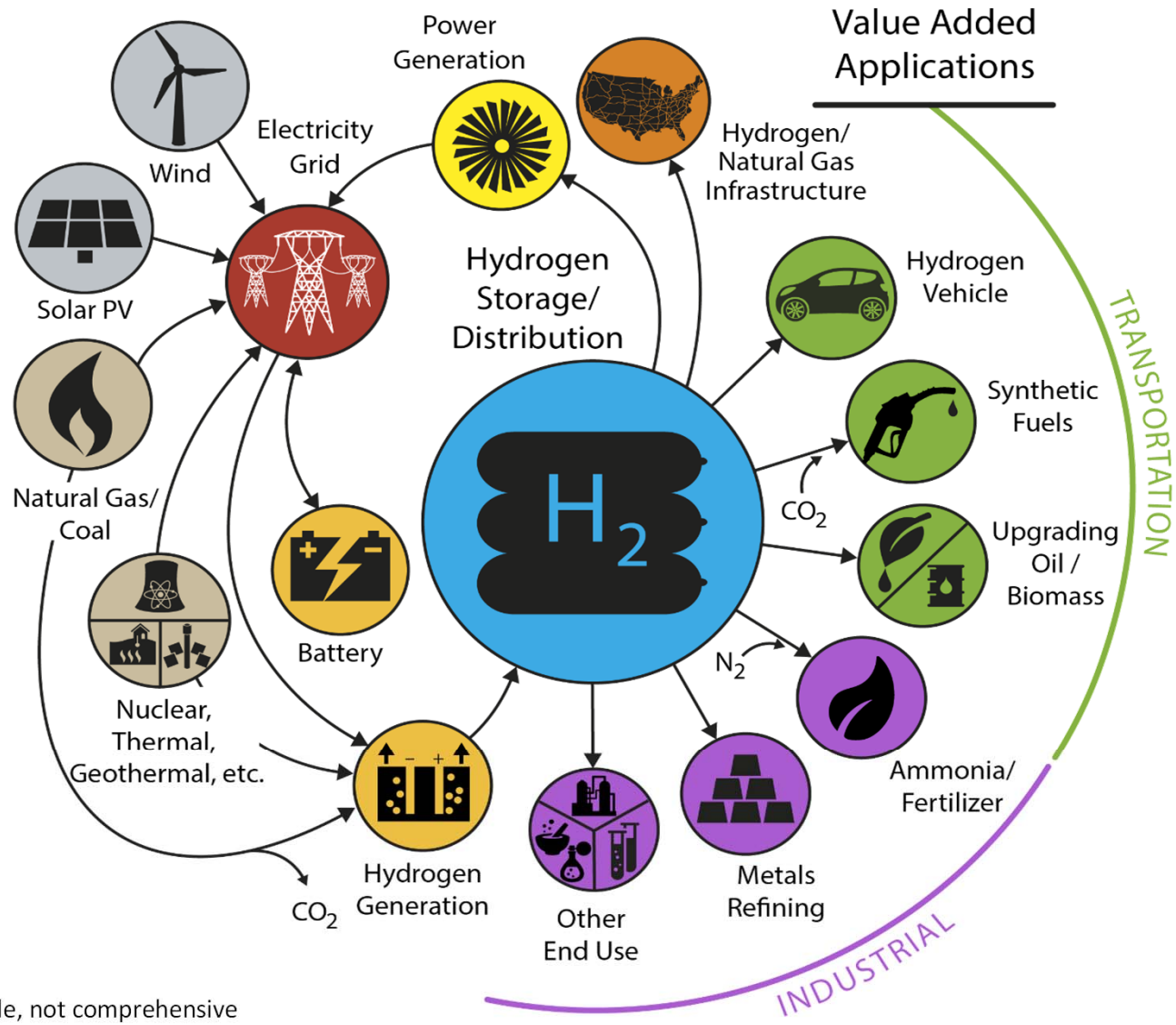



## Honda Clarity

Mansfield, MA; Hartford, CT; Providence, RI; Nantucket Island



# U.S. Dept of Energy – H2@Scale Program




*Illustrative example, not comprehensive
Source: NREL

# Fuel Cell Electric Vehicle Benefits

Grid Infrastructure

- Does not require upgrade of the existing grid system as hydrogen stations can be built in grid constrained locations.

Real Estate

- A single hydrogen station no bigger than current gasoline stations can support an equal number of vehicles.

Multi-Use Dwellings

- With a five minute time to refuel a vehicle, one station can support town and city centers with apartments and condominiums.

Cold Weather Performance

- Fuel cell vehicles are less impacted by cold weather and still refuel in only five minutes.

Range

- Ranges for current fuel cell vehicle offerings all exceed 330 miles per fill

# Hydrogen Benefits

Renewable Fuel Source

- Hydrogen can be made from solar, wind, and hydroelectric as well as from landfill and other biogas sources.

Local Generation (Energy Resilience)

- Hydrogen can be site or in-state generated thus eliminating the out of state supply system.

Multi Use Energy

- Hydrogen can be used for transportation, power generation or energy storage.

Transportable Energy

- Hydrogen can be moved by tanker or pipeline past points of grid congestion to areas and locations in need of energy.

# The Future – A Northeast Renewable Hydrogen Cluster

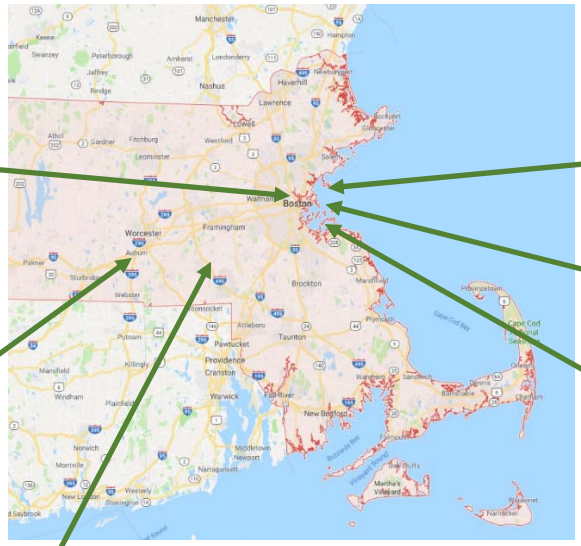
Renewably generated hydrogen supports these Massachusetts applications to strengthen resilience and support efforts to lower emissions: Light duty vehicles, Heavy duty vehicles, Mass transit bus, Mass transit rail, Port infrastructure, Power-to-gas and Department of Defense special projects.

**Freight Infrastructure**

Massport Connelly Terminal

Heavy Duty Truck

CSX Intermodal Terminal



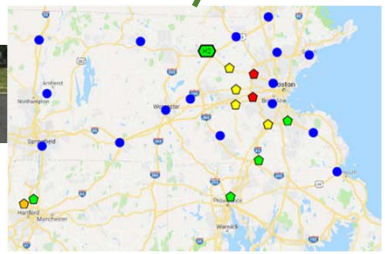

**Mass Transit**

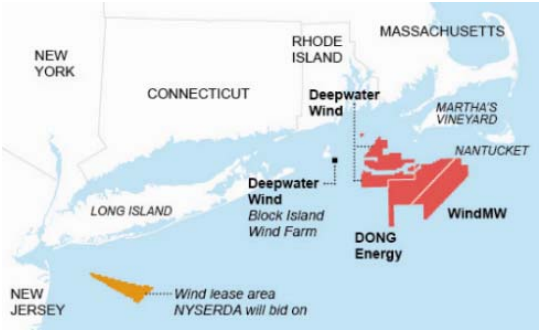
MBTA FCV Bus Fleet

Massport Harbor Ferries

MBTA Commuter Rail

Hydrogen Retail Station Network






Offshore Wind / MA & RI
Multiple Interconnect Points

# Thank You

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