



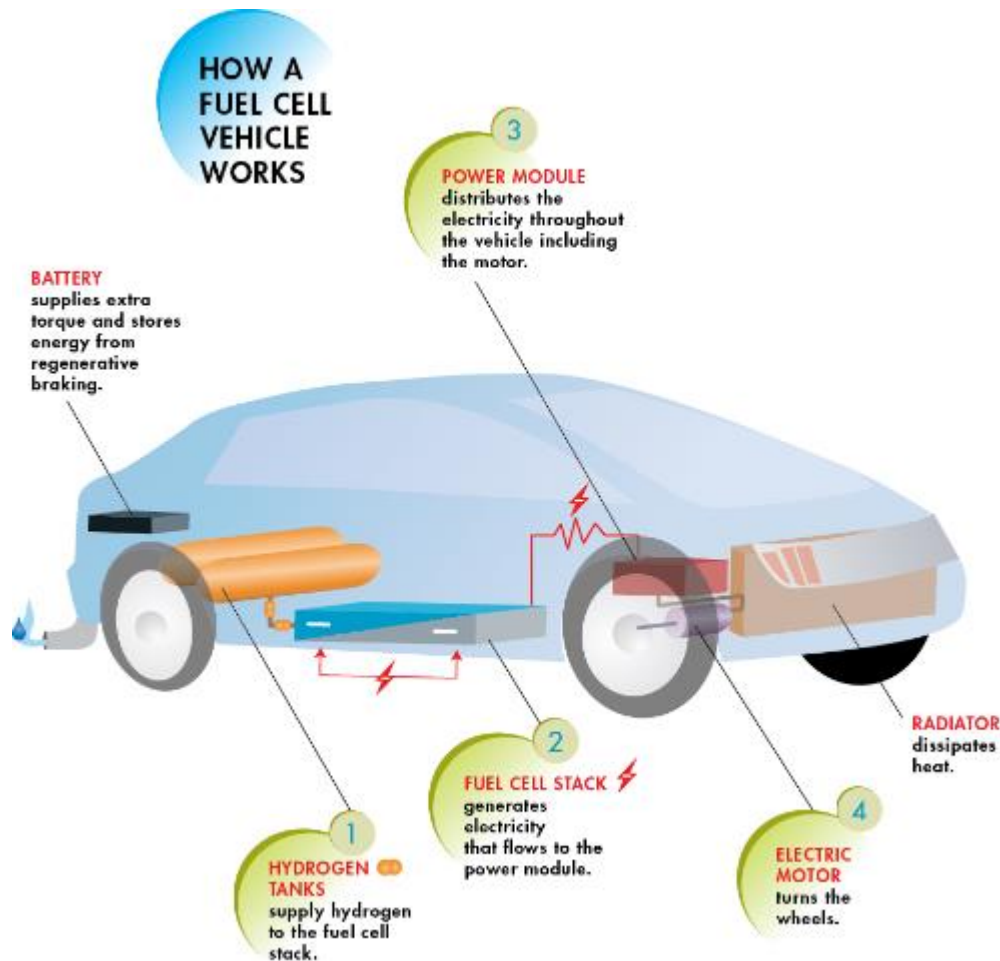
Fuel Cell Electric Vehicle and Hydrogen Fueling Update

September 19, 2016

This presentation is incomplete without the accompanying oral discussion.

What Are Fuel Cell Electric Vehicles (FCEV)

An FCEV is like a regular hybrid with the fuel cell replacing the ICE. The fuel is Hydrogen (H₂) gas compressed in a tank similar to Compressed Natural Gas (CNG).



	Battery Electric Vehicle (BEV)	Fuel Cell Electric Vehicle (FCEV)
Zero Emission Vehicle	Yes	Yes
Primary Drive	Electric motor	Electric motor
On Board Energy	Batteries	Hydrogen & batteries
Source of Energy	NE Mix, Solar, Wind, Hydro	NE Mix, Solar, Wind, Hydro
Range	Variable to 265 miles (Tesla S)	Greater than 300 miles
Temperature Effect	Shortens range	No effect
Recharge Time	22 mile range/hour charging	Less than four minutes

FCEV Automaker Launch Activity

Hyundai Motor America – Tucson Fuel Cell

- Available now in California
- \$499 per month, including unlimited free hydrogen and concierge service.



Toyota Motor Corporation - Mirai

- Toyota Mirai now in California and in the Northeast as the stations are commissioned.
- MRSP \$57,500.
- Lease \$499 per month, including free hydrogen and concierge service.
- Hydrogen station interests include financial and investment relationships with fuel providers in California and the Northeast.



Honda Motor Company

- Launched in Tokyo late 2015 - U.S. launch in H2 2016.
- Financial and investment relationship with fuel provider in California.



Fuel Cell Electric Vehicles Are Coming

Hyundai started delivering FCEVs in California May 2014.



California Energy Commission
Renewable and Renewable Fuel and Vehicle Technology Program
Hydrogen Refueling Station Development Grants
Public Program Awards
May 1, 2014

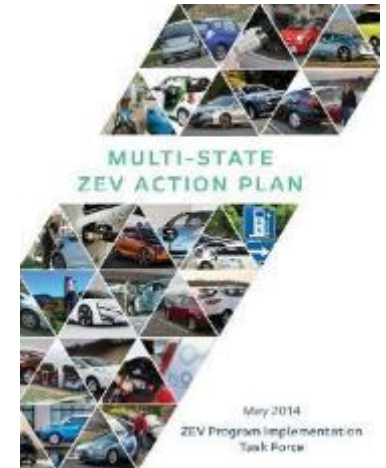
Project Name	Amount	Start Date	End Date	Applicant
Hydrogen Refueling Station Development Grant	\$1,000,000	2014	2016	Hydrogen Energy Research Center
Hydrogen Refueling Station Development Grant	\$1,000,000	2014	2016	Hydrogen Energy Research Center
Hydrogen Refueling Station Development Grant	\$1,000,000	2014	2016	Hydrogen Energy Research Center



H₂ USA



Both MA & RI created FCEV Working Groups to coordinate policy, legislation and programs supporting the ZEV Action Plan.



California statewide hydrogen stations becoming operational now with network by mid 2016 to compliment existing California stations of today.

National program established to promote the commercial introduction and widespread adoption of FCEVs across America through creation of a public-private partnership to overcome the hurdle of establishing hydrogen infrastructure.

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

Familiar Simple Refueling



Shell, Torrance, CA Hydrogen Station



Additional FCEV Will Increase Demand For Hydrogen



Full-size buses



Shuttle buses



Drayage Trucks



Garbage Trucks



Delivery Vehicles



Refrigerated Trucks



GSE Tow Tractors



Light Towers

All of these use the same hydrogen and will increase the demand for hydrogen as markets strive to reduce carbon emissions and noise.

H2 Fueling Infrastructure Status - 2016

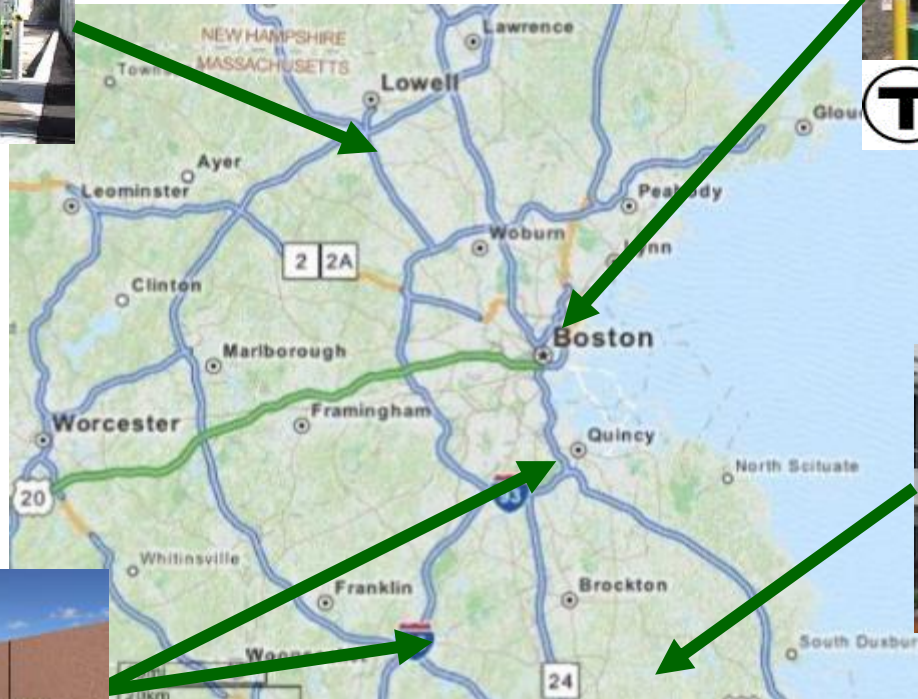


Nuvera, Billerica, MA
In Operation Now



T Massachusetts Bay Transportation Authority

MTBA Everett, MA
1 FC Bus now operating

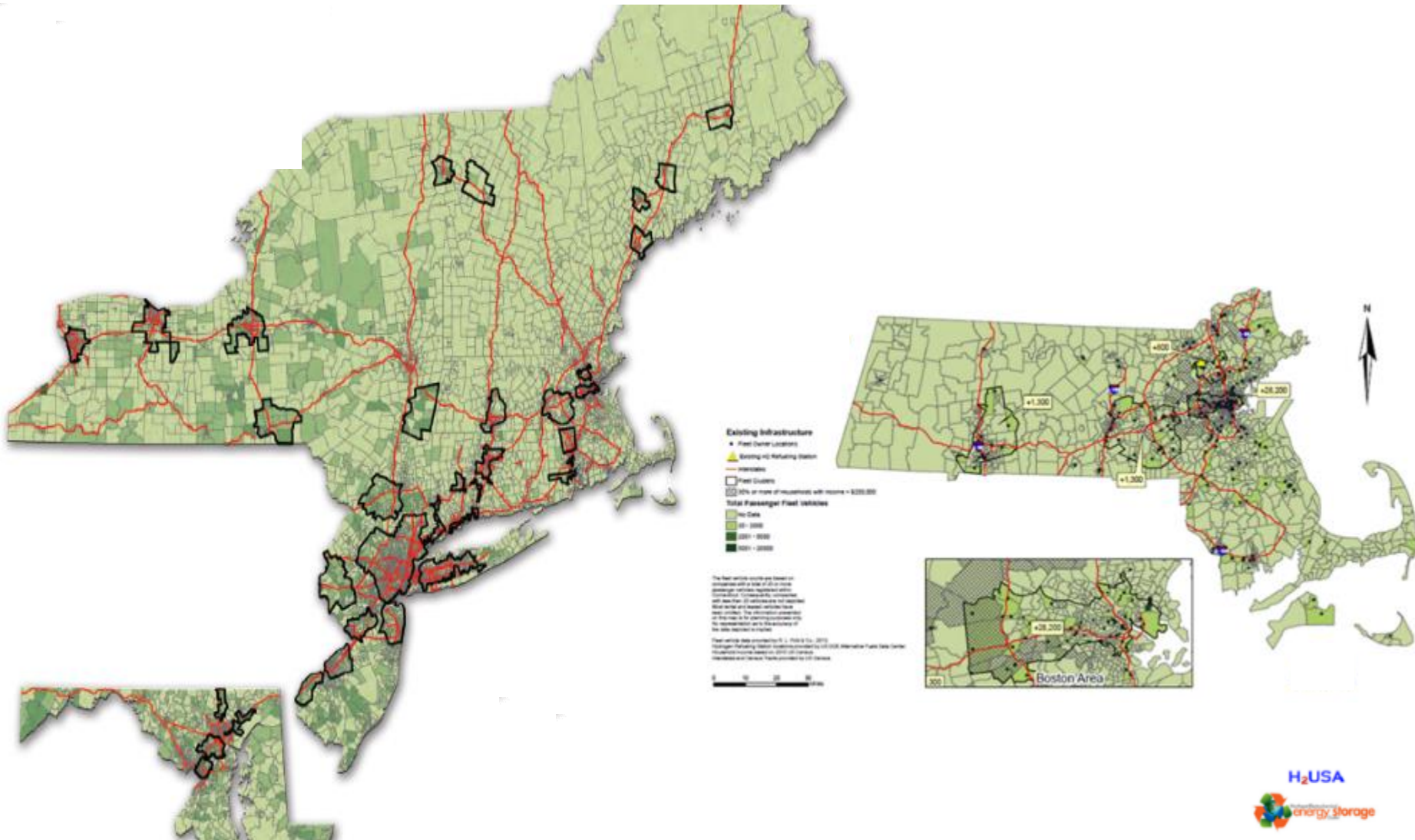


Air Liquide, Braintree & Mansfield, MA



SYSCO, Plympton, MA
Distribution Center relies "only" on FC powered fork lifts. Over 230 are on site.

Clustering – Markets - Corridors



Maps shown are draft and intended for discussion locating fleets and siting hydrogen locations.

Fuel Cell Vehicle Fleet Business Case

Feature	Benefit
High Efficiency	2 to 3 times more efficient than Internal Combustion Engines resulting in a 60 to 70+ miles per gallon equivalent.
Stable Fuel Costs	Fuel costs are not easily impacted by global geopolitical events.
Reliability	Fewer moving parts, no oil changes, remote monitoring capability
Nearly Silent	Expands hours of use to improve capital utilization.
Zero Emissions	Meets ZEV and EPA requirements.
Low Vibration	Improved passenger comfort.
Fuel Flexibility	Hydrogen can be generated onsite from renewables, biogas, natural gas, the grid.
Short Refueling Time	Less than 5 minutes.
Vehicle Performance	Not impacted by weather.
Energy Resilience	FCEV power plant can be used to power homes, commercial businesses and for remote power.
Vehicle-To-Grid Capability	FCEV power plant can be used in VTG applications.

The Past 12 Months – It's Really Happening

The 8 U.S. ZEV MOU states (CA, MA, CT, NY, OR, MD, RI, VT) sign an accord with 5 countries to form an international alliance that commits to a ban on the sale of gasoline or diesel Light Duty Vehicles in 2050, delivering the accord to the Paris COP-21 meeting in December 2015.

The 8 U.S. ZEV MOU states rename their group the ZEV Alliance and draft individual state ZEV action plans to realize the goals spelled out in the MOU.

California issues a second round bid for nearly 20 stations in addition to the 28 stations they previously awarded as they work toward their goal of 100 stations.

Hyundai continues leasing the Tucson FCV to retail customers where stations are available in California. Toyota starts both the sale and leasing of the Mirai in California. Honda releases the Clarity FCEV in Japan and later in 2016 in the U.S.

Air Liquide and Toyota announce a relationship enabling the construction of 12 hydrogen stations in the Northeast.

FCEV rebates are created in MA, CA, and CT.



Massachusetts Hydrogen Coalition
 Charles Myers
 cmyers@massh2.org
 (508) 380-1759

