



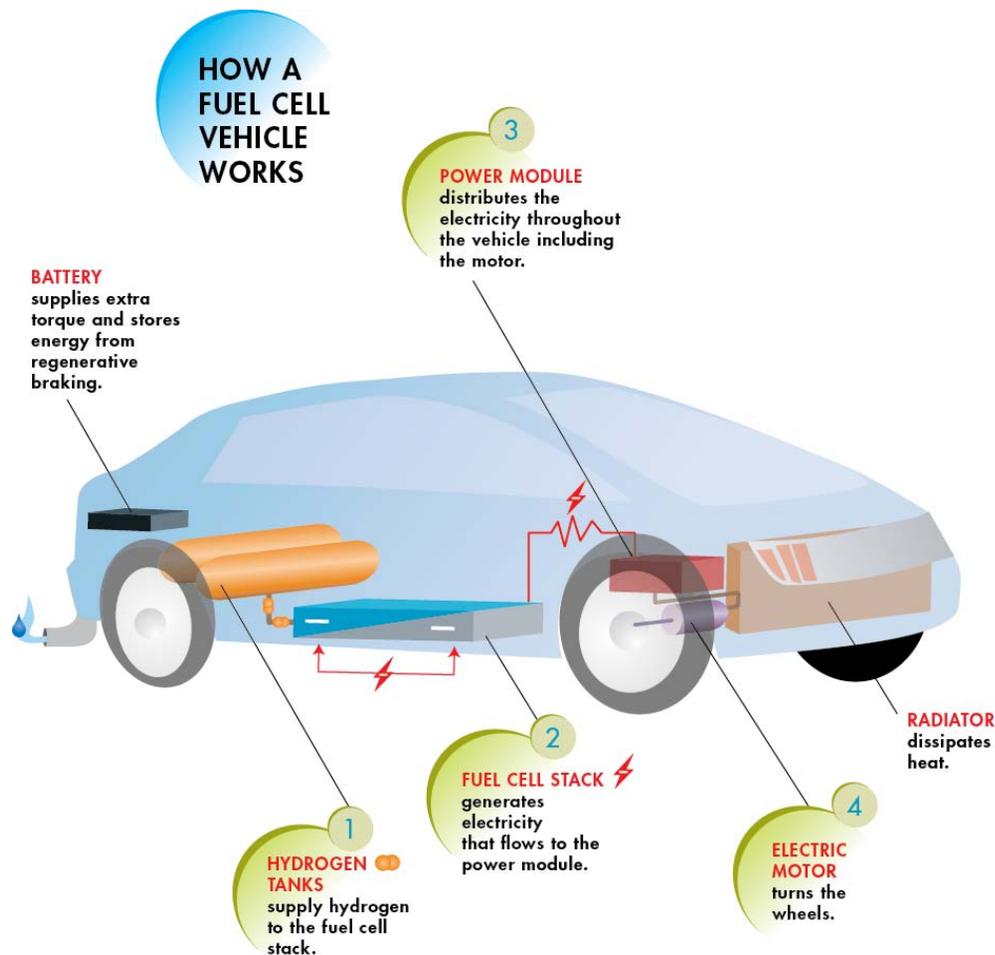
Fuel Cell Electric Vehicle and Hydrogen Fueling Update

New Hampshire Clean Cities – October 2015

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



Toyota Motor Corporation - Mirai

- Toyota Mirai available preorders now to California customers and in the Northeast in early 2016.
- 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 this week - U.S. launch in 2016.
- Financial and investment relationship with fuel provider in California.



Fuel Cell Electric Vehicles Are Coming

Hyundai started delivering FCEVs in California May 2014.

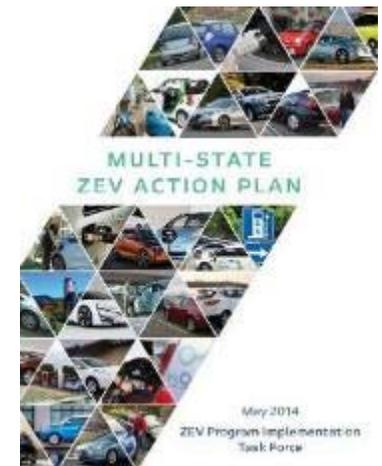


Both MA & RI created FCEV Working Groups to coordinate policy, legislation and programs supporting the ZEV Action Plan.



California Energy Commission
CALIFORNIA ENERGY COMMISSION
Hydrogen Refueling Station Development Grants
Number of Proposed Awards

Station Type	Station Name	Station Location	Station Status	Station Capacity	Station Cost	Station Completion
Proposed Awards for 20th Renewable Portfolio Standard						
1	California Fuel Cell	San Diego	Operating	1000	\$1,000,000	2014
2	California Fuel Cell	San Diego	Operating	1000	\$1,000,000	2014
3	California Fuel Cell	San Diego	Operating	1000	\$1,000,000	2014
Proposed Awards for 25th Renewable Portfolio Standard						
4	California Fuel Cell	San Diego	Operating	1000	\$1,000,000	2014
5	California Fuel Cell	San Diego	Operating	1000	\$1,000,000	2014
Proposed Awards for 30th Renewable Portfolio Standard						
6	California Fuel Cell	San Diego	Operating	1000	\$1,000,000	2014
7	California Fuel Cell	San Diego	Operating	1000	\$1,000,000	2014



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

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 Act 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.

MA FCEV Working Group & Deployment Plan

Industry	State & Federal	Fleets	Automakers	
				

Station Funding Program

1. Size the fleet to match the output of a 50 kg/day H2 station (18-50 cars).
2. Establish a Hydrogen Purchase Agreement (HPA) between the fleet owner and the station operator.
3. Station operator, using the HPA as collateral, uses 3rd party funding for his CAPEX in the same way the solar industry used PPA's.

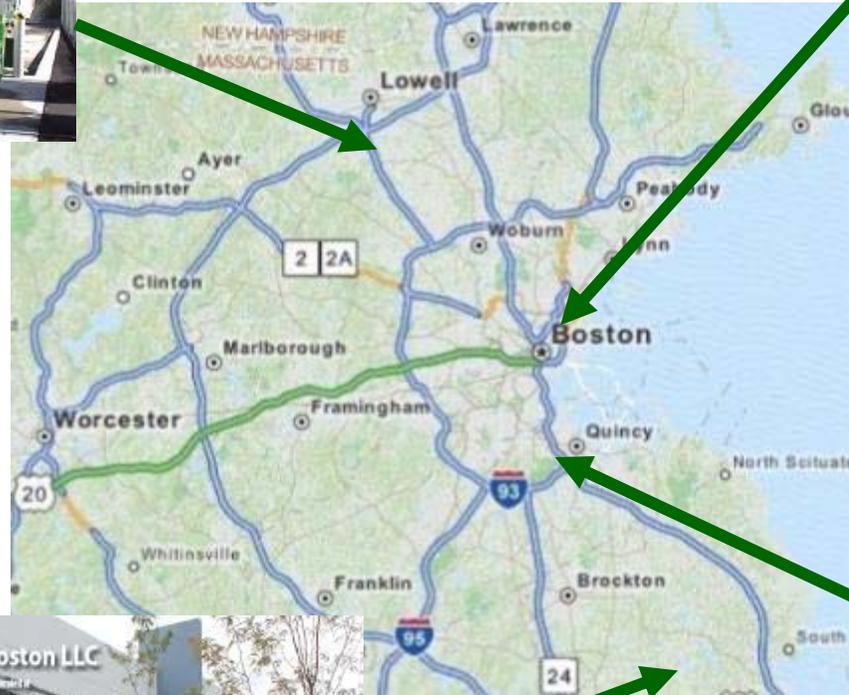
H2 Site Generation Industry Response – station makers each confirmed the HPA process allows them to fund stations - Nuvera Fuel Cells, Giner, Verde, McPhy and Nanoptek.

Transition from fleet to retail by end of 2016 - Reduce % HPA reliance at H2 stations to free capacity for retail use in phases – 30% reduction then 50% reduction to 75% to zero.

H2 Fueling Infrastructure Status - 2015



Nuvera, Billerica, MA
In Operation Now,
@ 350 bar



T Massachusetts Bay Transportation Authority
MTBA Charlestown, MA
1 FC Bus, Delivery
In 2015

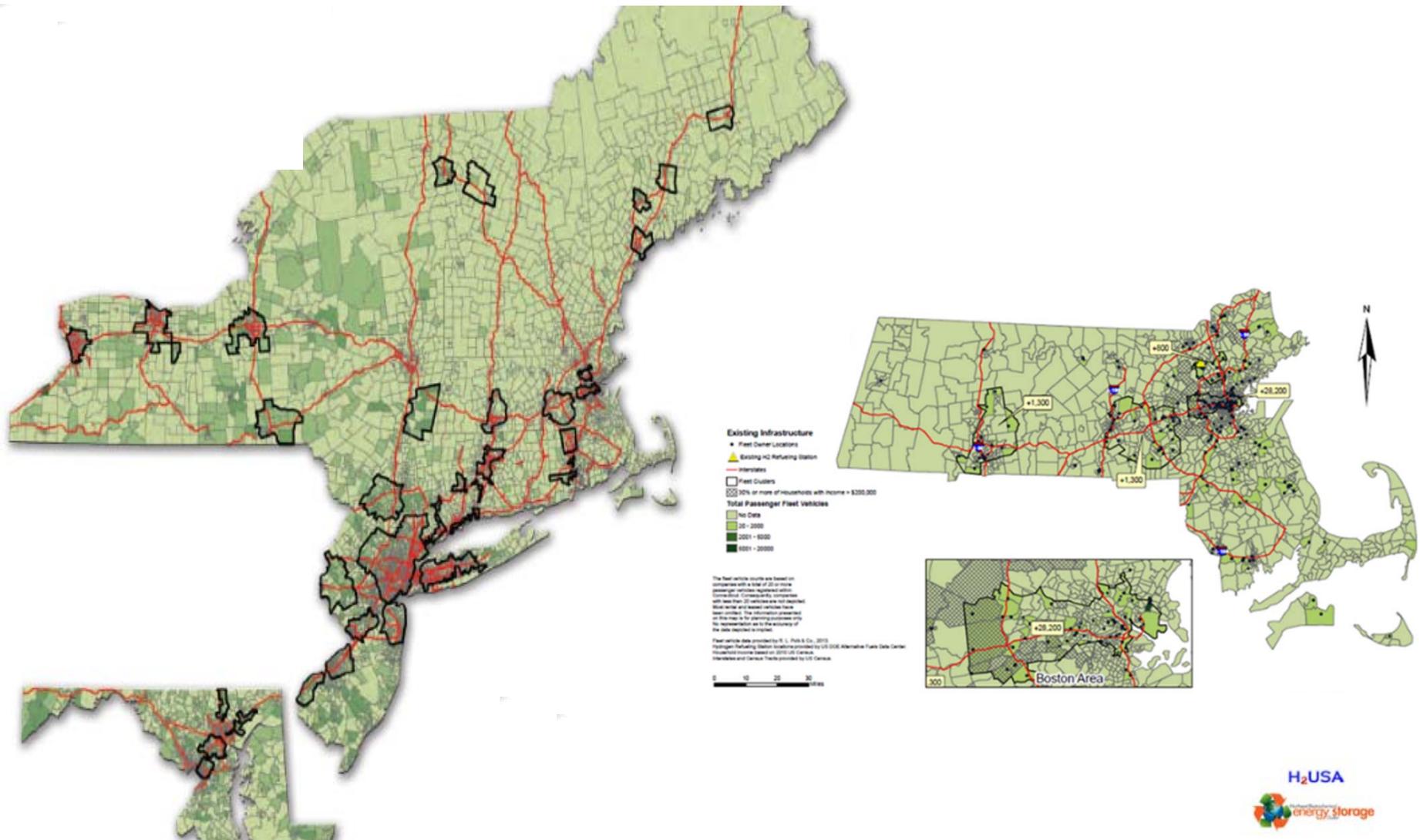
SYSCO, Plympton, MA
Distribution Center relies "only" on FC
powered fork lifts.
Over 230 are on
site.



Proton OnSite,
Braintree, MA
Permitted To Be Built



Clustering – Markets - Corridors



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



FCEV Programs – MA, CT, RI

Both Massachusetts Clean Cities and Rhode Island Clean Cities gives the same footing to FCEV that is given EV and CNG.

States with FCEV rebate programs now include:

- MA MOR-EV program offering a \$2500 rebate
- CT CHEAPR program offering a \$3000 rebate

In draft form now, a Massachusetts a vehicle efficiency / emissions standards for the Executive Branch with provisions for FCEV. CT is preparing an FCEV fleet bid for later this fall. When contacted by automakers with a ready signal, RI has agreed to add FCEV as an approved vehicle type.

MA ZEV Commission is now meeting regularly, giving equal status to FCEV that it gives to EV. The RI ZEV Working Group Plan draft has been approved with publication expected shortly.

The image shows a screenshot of the MOR-EV program's eligible vehicles list. The list is organized into three columns: 'EVs (Electric Vehicle Rebate)', 'FCEVs (Fuel Cell Electric Vehicle Rebate)', and 'PHEVs (Plug-in Hybrid Electric Vehicle Rebate)'. Each entry includes a small image of the vehicle, the model name, and the rebate amount. For example, under EVs, there are entries for Nissan Leaf (\$2,500), Chevrolet Spark EV (\$2,500), and Ford Focus Electric (\$2,500). Under FCEVs, there are entries for Honda FCX Clarity (\$2,500), Hyundai Tucson Fuel Cell (\$2,500), and Mercedes-Benz F-Cell (\$2,500). Under PHEVs, there are entries for Cadillac ELR (\$2,500), Chevrolet Volt (\$2,800), and Ford C-MAX Energi (\$1,900).



Hydrogen Infrastructure – MA, CT, RI

State agencies are now providing tangible support for hydrogen fueling infrastructure.

- MA Clean Cities included H2 provision in CNG station funding
- CT has grant funding for two stations in Greater Hartford to be awarded shortly totaling \$450K.
- MD has grant funding, \$300K/station, for hydrogen stations for 2016 award.

MA Fire Marshalls hosted a DOE Hydrogen Safety Training Program by PNNL and NREL.

Nuvera Charlestown, MA FTA FC Bus fueling station permitted and expected to be in operation shortly. Proton Billerica, MA site is fully permitted.





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