Massachusetts Hydrogen Coalition

Northeast Fuel Cell & Hydrogen Transportation Review

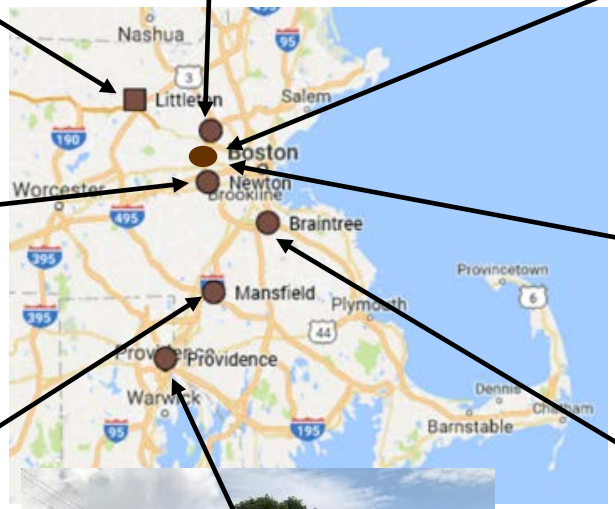
Charles Myers
Massachusetts Hydrogen Coalition

May 26, 2020

Massachusetts Hydrogen Infrastructure

Littleton – Hub Site

SimpleFuel, Somerville



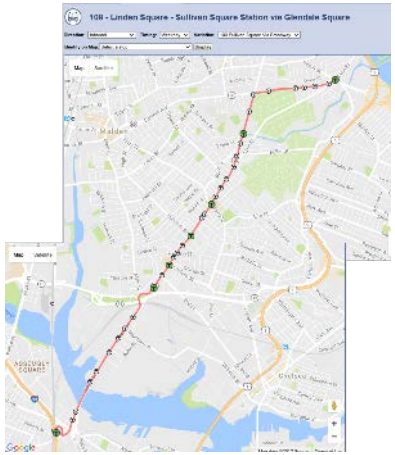
MBTA Somerville

Mansfield

Providence

Braintree

MBTA Fuel Cell Bus – Used In Revenue Service

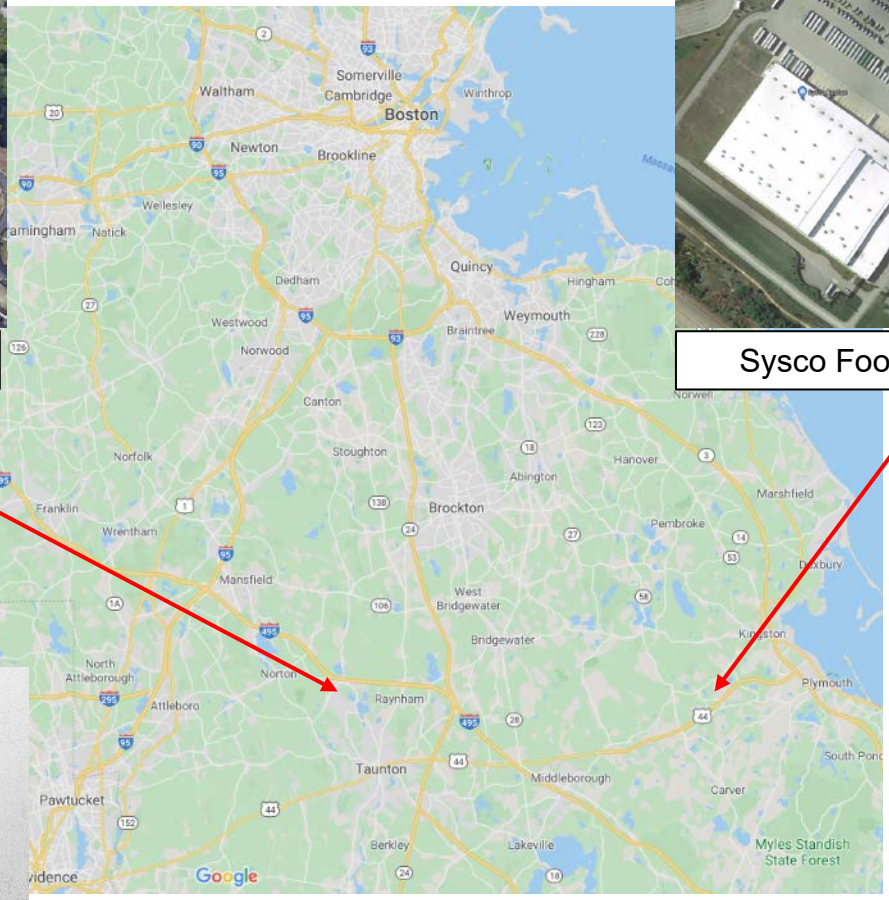


As part of a Federal Transit Agency grant, the MBTA used a fuel cell bus on a route between Linden and Sullivan Square. Program participants Nuvera Fuel Cells, Ballard and BAE Systems.

On right, fuel cell bus refueling at MBTA hydrogen station. Station makes hydrogen onsite from natural gas.

Massachusetts Distribution Centers Using Fuel Cell Forklifts

United Liquors, Taunton, MA



Sysco Foods, Plympton, MA

Nuvera Fuel Cell (Hyster Yale forklifts)

Refueling a Plug Power forklift in the distribution center indoors.

Massachusetts Aviation - Fuel Cell eVTOL

Skai Passenger

Skai Controls

Skai

Skai MedEvac

Skai Cargo

Skai

Liquid hydrogen fuel cell powered six electric motor eVTOL

- eVTOL – six rotors – 1,000 lb payload
- Liquid hydrogen fuel on-board storage
- Range up to 400 miles – 4 hours flight time.
- Liquid hydrogen onboard storage.
- Refueling – mobile liquid hydrogen truck
- FAA Certification Process is underway – experimental flight numbers have been assigned.
- Headquarters – Hopkinton, MA

Source: Alakai press release and published interviews

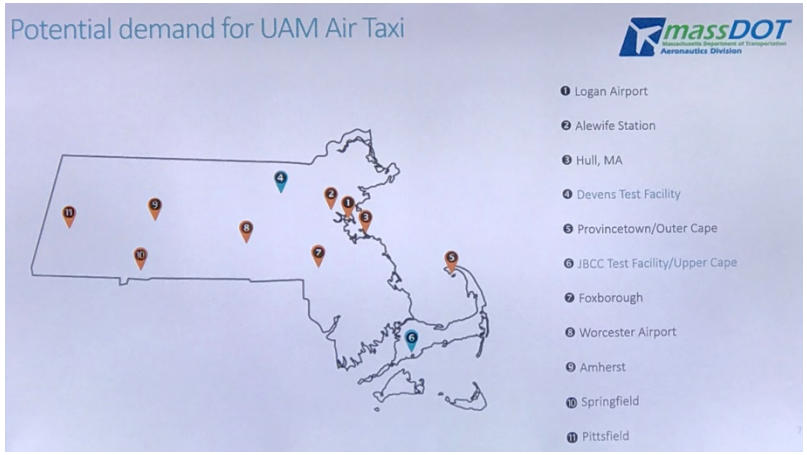
Massachusetts Fuel Cell Aviation / Drone / UAM Activities

EmbraerX (eVTOL)
Now has offices in Boston

Aurora Flight Services a Boeing Co (eVTOL)
Now has offices in Cambridge

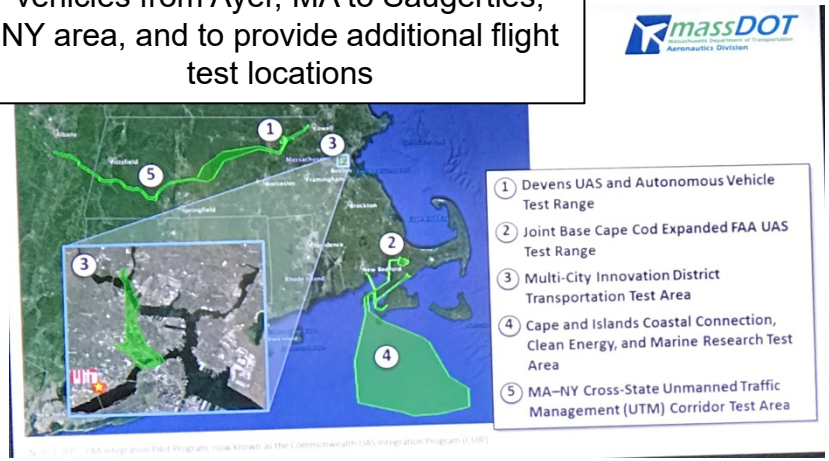
Alakai Fuel Cell UAM
Stow, MA

Planning locations for Urban Air Mobility (UAM) Air Taxi to operate from.



Ballard Fuel Cells Powering Rotary Drone and Fixed Wing UAV, Southborough, MA

MaDOT is working to create a corridor for proving unmanned autonomous vehicles from Ayer, MA to Saugerties, NY area, and to provide additional flight test locations



Massport Connelly Terminal Hydrogen Demand

Massport Connelly Terminal and Two Related Massachusetts Intermodal Terminal Containers Hydrogen Demand Forecast

Boston Connelly Terminal and Supporting Intermodal Terminal Container Handling Equipment (CHE)	Potential H2 Daily Use For Each Class of CHE (kg)
RTG Crane	622
Forklift	10
Container Hdlr Empty	179
Container Hdlr Loaded	134
Reach Stacker	296
Straddle Carrier	0
Yard (Terminal) Tractor	1021
Fuel Truck	0
Daily Hydrogen Use (kg)	2262

RTG Crane
45 kg/day

Container Handler
Loaded 56 kg/ day
Empty 25 kg/day

Yard (Terminal) Tractor
21 kg/day

Forklift
5 kg/day

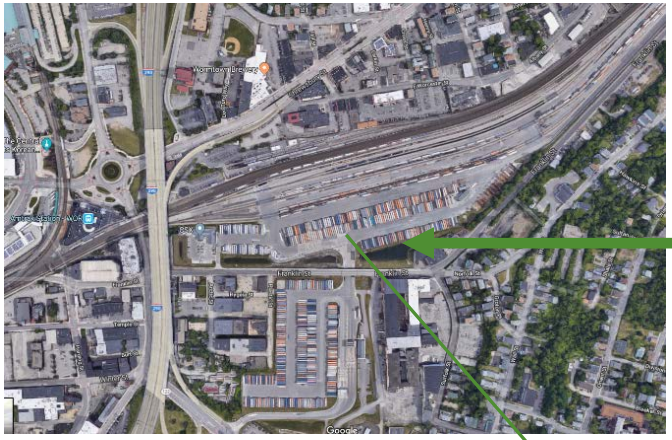
Massport Connelly Terminal Drayage Truck Hydrogen Demand Forecast

Approximate Number of Drayage Trucks	VMT per Truck	Miles/kg	Drayage Trucks Total Potential H2 Daily Use (kg)
284	105.0	5.5	5419

Container port and drayage truck daily potential hydrogen demand easily supports development of hydrogen infrastructure.

Massport Connelly Terminal FC Drayage Truck Program

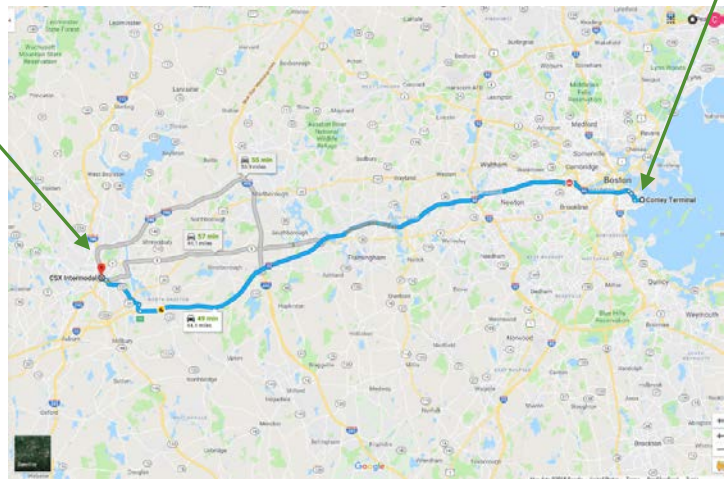
Class 8 Fuel Cell
Toyota / Kenworth combination uses the same hydrogen as cars, buses and rail.



Connelly Terminal

<u>Suggested Development of a Massachusetts Hydrogen Cluster based on Connelly Terminal and the CSX Intermodal Terminal, Worcester, MA</u>

1) Create a multi use hydrogen station in Connelly and CSX.
2) Refuel Class 8 drayage trucks transiting between Connelly and CSX Terminals
3) Place stations on site perimeter to allow use of the same source of hydrogen to support LDV fuel cell vehicles
4) Use hydrogen for CSX terminal CHE.
5) Use hydrogen for CSX switcher locomotive
6) Use hydrogen for MBTA Commuter Rail



The Future – A Northeast Renewable Hydrogen Cluster

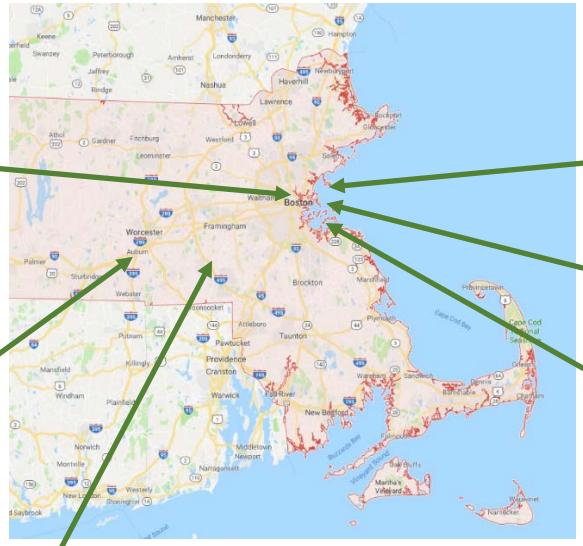
Renewably generated hydrogen available now in Massachusetts can power these fuel cell mobility applications creating a hydrogen cluster to strengthen resilience and support efforts to lower emissions: Light duty vehicles, Heavy duty vehicles, Mass transit bus, Mass transit rail, Port infrastructure, Power-to-gas projects.

Freight Infrastructure

Massport Connelly Terminal

Heavy Duty Truck

CSX Intermodal Terminal



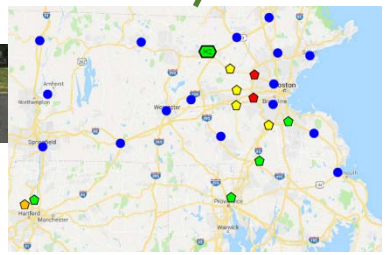
Mass Transit

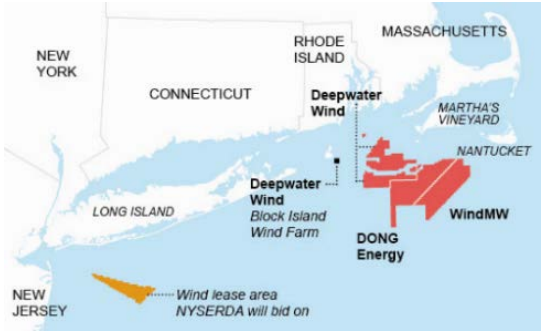
MBTA FCV Bus Fleet

Massport Harbor Ferries

MBTA Commuter Rail

Hydrogen Retail Station Network





Offshore Wind / MA & RI Multiple Interconnect Points

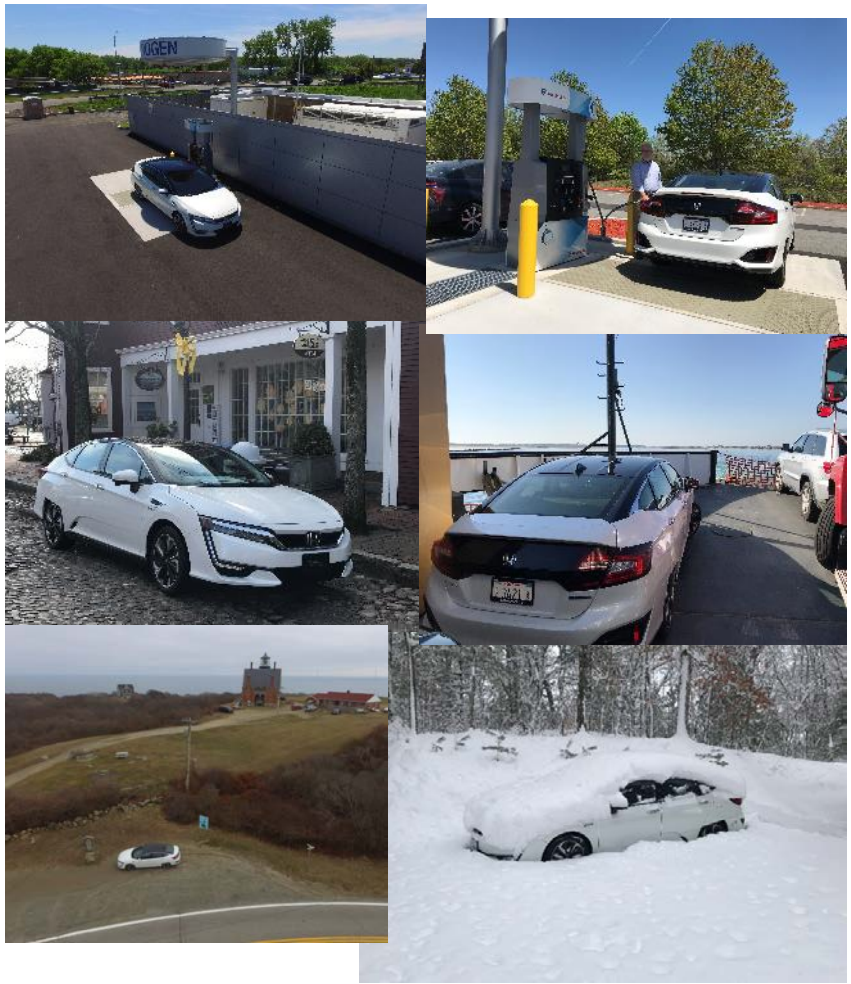
Fuel Cell Vehicles Out & About In The Northeast

Toyota Mirai

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

Honda Clarity

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



Thank You

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