Northeast Fuel Cell & Hydrogen Transportation Review

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Massachusetts Hydrogen Coalition

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Massachusetts Hydrogen Infrastructure

Littleton – Hub Site

SimpleFuel, Somerville

MBTA Somerville

Mansfield

Providence

Braintree
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.
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
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.

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

Potential demand for UAM Air Taxi

- Logan Airport
- Alewife Station
- Hull, MA
- Devens Test Facility
- Provincetown Outer Cape
- JSOC Test Facility Upper Cape
- Foxborough
- Worcester Airport
- Amherst
- Springfield
- Pittsfield

EmbraerX (eVTOL)
Now has offices in Boston

Alakai Fuel Cell UAM
Stow, MA

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

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

Massachusetts Fuel Cell Aviation / Drone / UAM Activities
Massport Connelly Terminal and Two Related Massachusetts Intermodal Terminal Containers Hydrogen Demand Forecast

<table>
<thead>
<tr>
<th>Container Handling Equipment (CHE)</th>
<th>Potential H2 Daily Use For Each Class of CHE (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTG Crane</td>
<td>622</td>
</tr>
<tr>
<td>Forklift</td>
<td>10</td>
</tr>
<tr>
<td>Container Hdlr Empty</td>
<td>179</td>
</tr>
<tr>
<td>Container Hdlr Loaded</td>
<td>134</td>
</tr>
<tr>
<td>Reach Stacker</td>
<td>296</td>
</tr>
<tr>
<td>Straddle Carrier</td>
<td>0</td>
</tr>
<tr>
<td>Yard (Terminal) Tractor</td>
<td>1021</td>
</tr>
<tr>
<td>Fuel Truck</td>
<td>0</td>
</tr>
</tbody>
</table>

Daily Hydrogen Use (kg) 2262

Massport Connelly Terminal Drayage Truck Hydrogen Demand Forecast

<table>
<thead>
<tr>
<th>Approximate Number of Drayage Trucks</th>
<th>VMT per Truck</th>
<th>Miles/kg</th>
<th>Drayage Trucks Total Potential H2 Daily Use (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>284</td>
<td>105.0</td>
<td>5.5</td>
<td>5419</td>
</tr>
</tbody>
</table>

Container port and drayage truck daily potential hydrogen demand easily supports development of hydrogen infrastructure.
Massport Connelly Terminal FC Drayage Truck Program

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

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.

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

Connelly Terminal
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.
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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