Hydrogen Infrastructure for the Next Generation of Fuel Cell Vehicles

Sustainable Transportation Summit

July 12, 2016

Dave Edwards
Air Liquide
Air Liquide - Hydrogen

Hydrogen: 40 years in industry

- $2.5B Revenue (refinery and chemicals)
- 1850 km of pipelines
- 1000 trucks
- 18 Billion Nm3/year from 46 large plants (enough for 15M vehicle refills)

- 75 filling stations
- 300+ fuel cell installations

Air Liquide Hydrogen Mobility:

Light vehicle refueling
- GM/Shell demo stations- NY and CA
- Germany - H2 mobility
- California - 4 stations in development
- NE Fueling network

Mass transit stations
- BC Transit - Whistler Station
- Oslo, Norway
- Birmingham, AL -Demo

Materials handling applications
- Walmart
- Coca Cola
- Procter & Gamble
Hydrogen Refueling Stations
Stations Projects Underway

12 Stations for the North East
- 4 - NYC and Long Island
- 4 - Boston Area
- 2 - Connector Stations: Hartford, CT & Providence, RI
- 2 - Northern New Jersey

Toyota - Air Liquide Partnership
North East Distribution Model - Hub & Spoke

Liquid H2 Source

Liquid Transport 300 - 600 miles

H2 Hub Location

- LH2 Storage
- LH2 Pumps
- Analytical
- GH2 Trailer Filling

Regional Hub

Gaseous Transport 0-150 miles

Stations in Regional Cluster

Liquid Transport 300 - 600 miles

7/12/2016
North East Fueling Network - Hubs

2 Regional Hubs – 1 Each for NYC and Boston clusters
- Delivered liquid from Canada with (5) back-up sources
- Capacity: 2100 kg/d (each hub) or 4200 kg/d total
- Allows for flexible demand growth
- Uses proven hub technology used in forklift applications

Boston Regional Hub
- Lease signed, approved by planning, and construction permitting underway
- Room for expansion

NYC Regional Hub
- Using existing Air Liquide fill facility
- Other sites being evaluated for planned expansion
### Current Station Schedules

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### Location-Specific Schedules

- **NYC**
  - Brooklyn: Lease signed 14 Apr-16
  - Queens: Lease signed 15 Apr-16
  - Nassau: Lease signed 27 Nov-15
  - Yonkers: 1st meeting with AHJ on 15 Jan-16
  - Lexington: 1st meeting with AHJ on 11 Feb-16
  - Cambridge: Lease signed 26 Jan-16
  - Mansfield: Lease signed 3 Mar-16
  - Teaneck: 
  - Morristown: 
  - Providence: 
  - Hartford: 
  - Connectors: 

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**Typical 12-Month Schedule After Lease Signature**

- Site engineering and permitting: 8 months
- Construction: 3 months
- Commissioning: 1 month
- Set equipment

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**Stations Online in First Half of 2017**
Hydrogen Production
Hydrogen Supply and Distribution

Green Pathways: Most Viable Options Today

Option 1: Reformer with CCS
- Natural gas
- Heavy fuel oil
- Coal
- Biomass
- Nuclear
- Solar
- Electricity

Option 2: Replace NG with Biogas
- Pyrolysis/Gasifier/Reformer with and without CCS

Option 3: Electrolysis from Green Grid
- Electricity
- Natural gas

Today’s Actual: Limited Pathways cover 95% of H2 Production

Hydrogen Supply and Distribution
Summary and Key Points

• The cars are coming
• The infrastructure will be ready

• California and Northeast states lead the way

• Targeting existing retail sites with enough space
• Hydrogen stations and fueling equipment are commercially available
• Blue hydrogen enables sustainable supply