Hydrogen Distribution: Lessons Learned

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About OneH2, Inc.

- Headquartered in North Carolina, OneH2 generation assets owned and operated in many states
- Specialize in on-site Hydrogen generation and agile distribution
- Typically provide on-site Hydrogen generation ‘as a service’ rather than sell equipment
- OneH2 distributors typically handle final mile distribution to refueling points where delivered Hydrogen is preferable to on-site generation

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Hydrogen Distribution - Overview

- There are three broad topics when discussing Hydrogen distribution for transportation:
- 1. Distribution to light passenger vehicle retail centers & small-scale industry
- 2. On-site generation for heavy truck & larger centralized transportation demands
- 3. Choosing feedstock for on-site fuel generation

1. Retail & Small scale H2 distribution

- Today, Hydrogen infrastructure is often highly complex at the point of refueling
- The high degree of complexity comes with a relatively high capital cost for each point of refueling (when compared to competing commercialized transportation fuel activity)
- This provides a barrier to investment in proliferation of commercially viable Hydrogen distribution infrastructure in transportation markets – which to date has been heavily subsidized by Government
- The complexity also contributes to the relatively high downtime rates experienced at today's Hydrogen refueling stations

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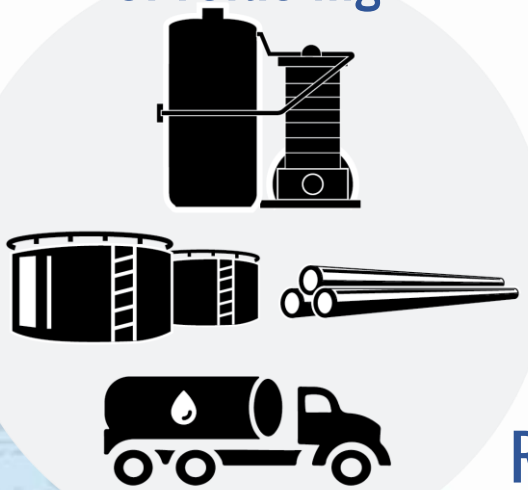
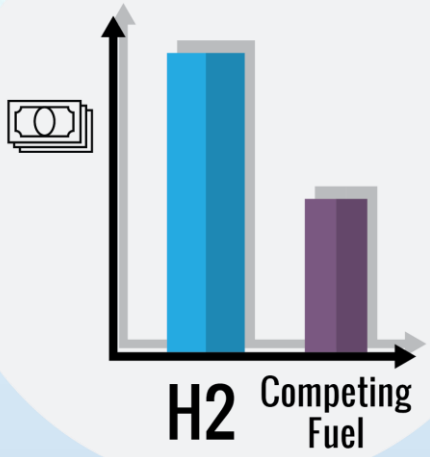
Complex gas process and storage Infrastructure at point of refueling



Barrier To Proliferation of Hydrogen Vehicles

Perceived Lack of Reliability, Redundancy and Accessibility

High Capital Cost Per Refueling Location



High Downtime at point of refueling

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Today's Distributed Hydrogen Fuel Product

- Today, for the passenger vehicle market, Hydrogen is produced at centralized locations in a state that is not ready for use or sale as a transportation fuel
- In some cases, Hydrogen is delivered to points of refueling in its liquid state
- In other cases, Hydrogen is delivered to points of refueling in a gaseous state at a pressure lower than that required for use
- In all cases, the Hydrogen product that is delivered to the retail point of refueling requires **additional processing on-site** before it is fit for sale as a transportation fuel
- Importantly – the reason why Hydrogen for light passenger vehicle retail applications is 'delivered' rather than generated at the point of sale is due to site space constraints and demand volumes unable to justify investment in on-site generation.

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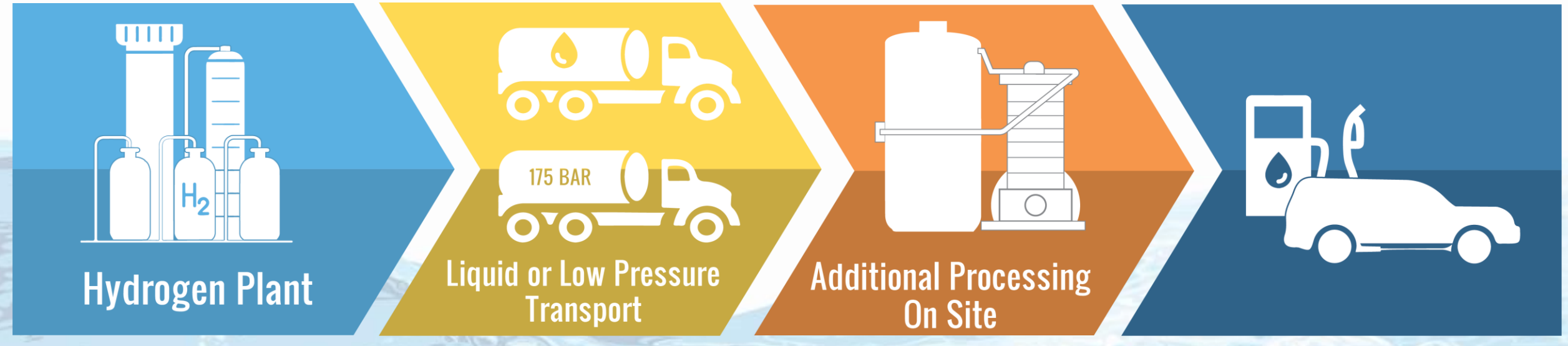
H_2
Hydrogen Plant
175 BAR
Liquid or Low Pressure Transport
Additional Processing On Site

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Best Case Distribution Model

- In the North American industrial equipment market, Hydrogen fuel is often delivered to the point of refueling at a customer location in a ready to use state
- That is, it requires no further processing in order to be dispensed into Hydrogen powered equipment
- In this distribution model, the Hydrogen is pressurized in small scale trailers to a pressure that permits it to be hosed to a dispenser and 'dispensed' until the trailer is near empty, at which point the near empty trailer is swapped for a full one
- Under this model – process complexity is centralized at the point of fuel generation – with simplified systems at the point of refueling leading to higher capital efficiency and reliability.

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Hydrogen Plant

Hydrogen Plant

175 BAR

Liquid or Low Pre ure Transpor

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Advantages of Centralizing the Complexity

- Due to simplicity, existing gasoline retailers could consider adding Hydrogen fuel as an additional source of revenue.

- Centralizing complex process equipment at the single point of production (rather than at the many points of refueling) makes sense from an energy and maintenance efficiency standpoint

- The simplicity of this model promotes investment, scalability, and reliability.

2. On-site H2 Generation

- Hydrogen fuel is an ideal source of zero emission energy for Class 8 trucks in constant use but fuel demand requirements for even small Class 8 truck fleets exceed the capability of a delivered gaseous hydrogen model

- On-site generation of Hydrogen is an important component of future infrastructure needs for a growing country-wide Class 8 fleet

- Decentralization of fuel generation assets is important to ensure a robust and redundant Hydrogen fuel network.

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Efficiency of On-site H2 Generation

- Choice of feedstock (methane, electricity or mix of both) that best suits the location
- At large demand, even if not choosing On-site generation – you still have significant infrastructure on-site (unavoidable)
- No (on-road) transportation costs or associated energy losses

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3. Choosing Feedstock for On-site H2 Generation

- An important point to note is that more than 60% of the investment in On-site fuel generation is in long life process equipment that is required for either electrolysis or methane reforming – the message is that you can start with one technology and recapitalize with another without starting over again
- If sourcing from the grid, in most US markets – methane sourced from the NG grid is the most reliable and lowest cost source of energy to produce Hydrogen on-site
- We are finding that end users 'boostrap' on-site Hydrogen generation using Natural Gas due to affordability, increase the feedstock mix with supplemental RNG to achieve increasing renewability as budget/incentives permit, with a vision to add CO2 capture infrastructure or switch core generating technology to electrolysis as it makes sense to do so. Cost effective pathways to zero emission transportation are important.

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