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# **Air Products Perspective on Hydrogen Infrastructure Development**

## **AB118 Investment Plan Hydrogen Workshop**

Edward C. Heydorn  
Air Products and Chemicals, Inc.  
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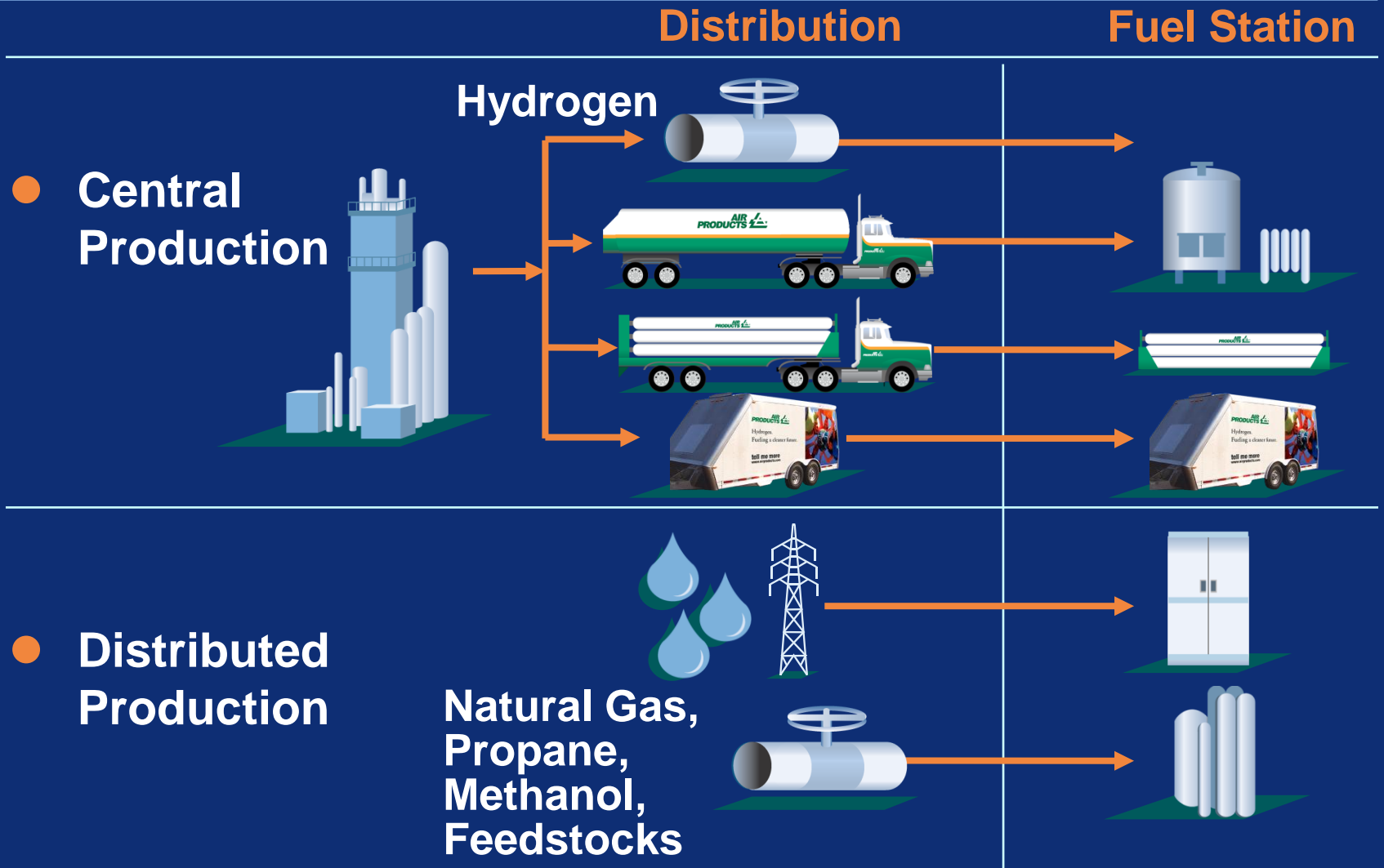
# Air Products

## 50+ years of hydrogen experience

- >2 billion cu ft per day H<sub>2</sub> production
- Liquid, Gas, and gas pipeline distribution
- H<sub>2</sub> energy projects since 1993
  - > 100 hydrogen station projects
  - > 120,000 fuelings/yr
- Stations in 16 countries



# Hydrogen Fuel Station Sourcing

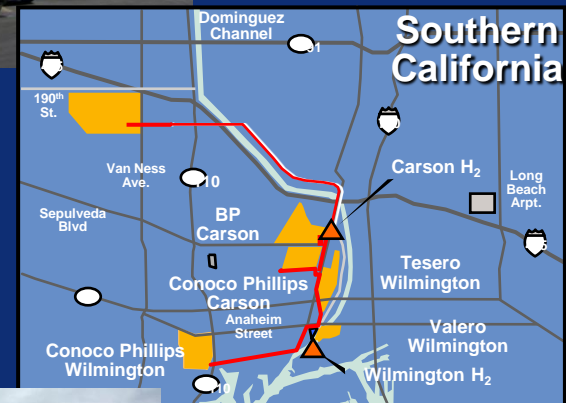


# Examples of H2 Delivery Systems for Vehicle Fueling in CA

- UC Irvine (liquid delivered)



- Torrance (pipeline supply)

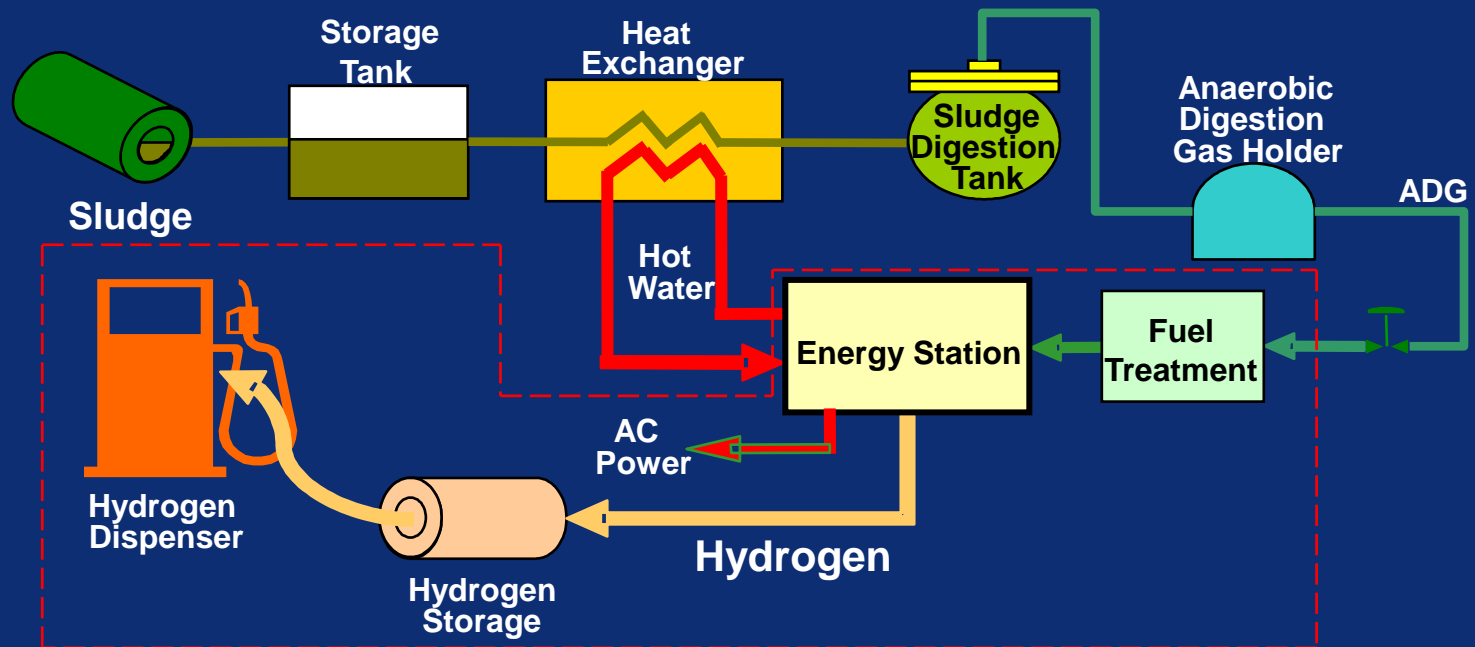


- South Torrance (pipeline delivered)

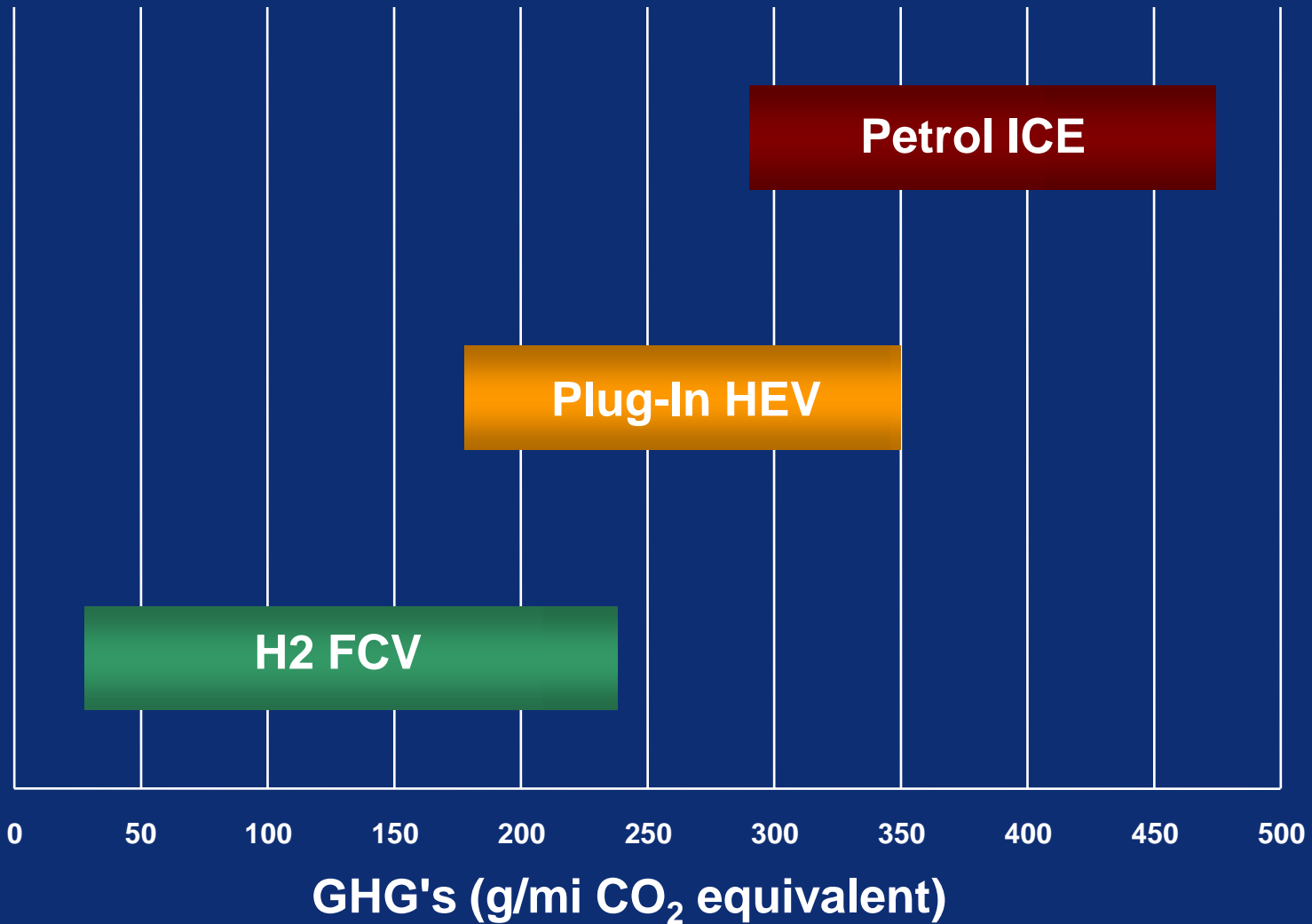


# H<sub>2</sub> from Renewable Feedstock

- Fountain Valley, CA
  - Anaerobic Digester Gas
  - High-Temperature Fuel Cell
  - Compression, Storage, Dispenser



# Well-to-Wheel Greenhouse Gas Emissions by Vehicle Platform



# Lessons Learned from Early H<sub>2</sub> Station Deployment Programs

- **Even the small station capacities exceeded the actual demand**
  - Programs need to consider underutilized assets in early years
- **Multiple options for production and delivery were tested**
  - Some should be eliminated due to cost and scalability, others should be given top consideration
- **Lowest-cost production methods exist at large central facilities, and can meet targets for H<sub>2</sub> pricing to consumer transportation market**
  - Minimize capital outlay by utilizing existing production infrastructure
  - Supply chain for delivery and dispensing is the issue
  - Renewable sources can be developed, with likely higher cost of production/delivery

# Concepts for Future Infrastructure Deployment Programs

- **FOCUS**
  - Critical mass of vehicles per station and stations per area are needed
  - Need to focus on targeted geography based on firm vehicle deployment commitment and existing sources of low-cost H<sub>2</sub> → Southern CA
- Stations must meet requirements of SB1505
- Deploy H<sub>2</sub> fueling capability at existing retail gasoline stations or equivalent forecourt locations to minimize cost and gain greater consumer acceptance
- Install sufficient stations over time to be prepared for large-scale vehicle deployment
  - Look at developers that can provide larger number of stations during single procurement to improve economies of scale



# Concepts for Future Infrastructure Deployment Programs (cont'd)

- Provide funding to manage station operator capital infusion and volume risk during early years of program
- Infrastructure should meet certain criteria:
  - Can be scaled to provide low-cost transition from low to full deployment of vehicles
  - Minimizes investment at point of use
  - Can provide value today, independent of current vehicle deployment
- Program needs to quickly reach point when tens of thousands of vehicles are deployed, nominal station capacities can approach 500 to 1,000 kilograms per day, and market demand replaces government-funded infrastructure deployment program

**Thank you !**

**[www.airproducts.com/H2energy](http://www.airproducts.com/H2energy)**