

## ***CEC Questions and Request for Panel Participation:***

- ***Panel Q: Are there critical technology issues that need to be resolved in order to drive down station costs, or are the cost issues a function of low volume and non-standardized station designs?***
- Requested Topics:
  - plans for retail station network development.
  - Opportunities and challenges.
  - Lessons from European initiative.



# Hydrogen Fueling Opportunities



California Energy Commission

**DOCKETED**

**14-IEP-1B**

TN 72897

APR 11 2014



# The Overall Opportunity

## “Big Picture” Market Perspective



Industrial  
Gas  
Business

X 2

“If 10 per cent of cars around the world were powered by fuel cells, it would amount to **[\$138B]** in sales for the industrial gas sector, which is **“twice the size of the entire global industry today”**, said Benoit Potier, Air Liquide’s CEO, in an interview with the Financial Times. “

- M. Stothard, “Air Liquide looks to fuel cells to drive results” Financial Times, 5Jan2014



# Global Network Planning

## Think Globally, Plan Locally!

“Air Liquide has built more than 60 fuelling stations worldwide in recent years and in September it agreed with partners to expand Germany’s network to 100 by 2017 and 400 by 2023” – *Financial Times* 5Jan2014

### Lessons from Americas

- California retail sales experience
- California secured and sustained government funding and regulatory support
- CA serves as regional & national model
- Broader opportunities exist in Americas

### Lessons from Asia

- Japanese leadership  
100 stations by 2018

### Lessons from Europe and Africa

- German leadership through CEP - 100 by 2017 and 400 by 2023
- Bus and car combined fueling is common



# Network Planning Sources

## AB 32 Compliance: Diversity of renewable feed stocks

Natural Gas  
C- Capture

Biomass  
Biogas

Solar  
Wind

“By 2020, Air Liquide is committed **to producing at least 50% of the hydrogen** necessary for these applications **through carbon-free processes**, by combining:

- renewable energy sources, water electrolysis and biogas reforming,
- carbon capture technologies during the hydrogen production process based on natural gas.”

- Reference: Air Liquide Annual Report 2012 “Innovate”

**Air Liquide’s corporate goals and California State 33% renewable requirements are aligned**





# Network Planning Fueling Infrastructure

**Flexible infrastructure products**  
to **supply various applications** and offer **competitive costs**



More deployments, helping **societal acceptance**



Forklifts  
35 MPa  
100-300 kg/day



Buses  
35 MPa  
100-300 kg/day

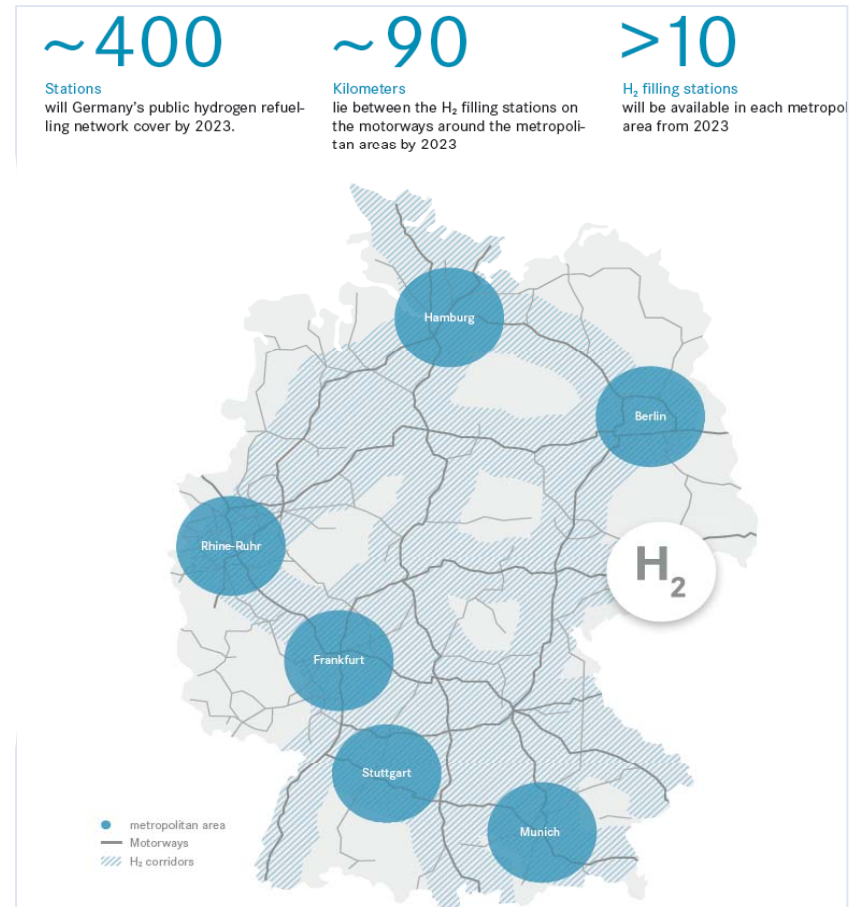


Cars  
70 MPa  
50-200 kg/day



# German H2 Mobility

- German government Initiative gathering all stakeholders together to advance infrastructure deployment
- A common structure to “de-risk” deployment
- 100 HRS by 2018
- 200 to 400 HRS by 2023
- 250,000 FCEVs in 2023
- 350 M€ (\$482M) planned



DAIMLER

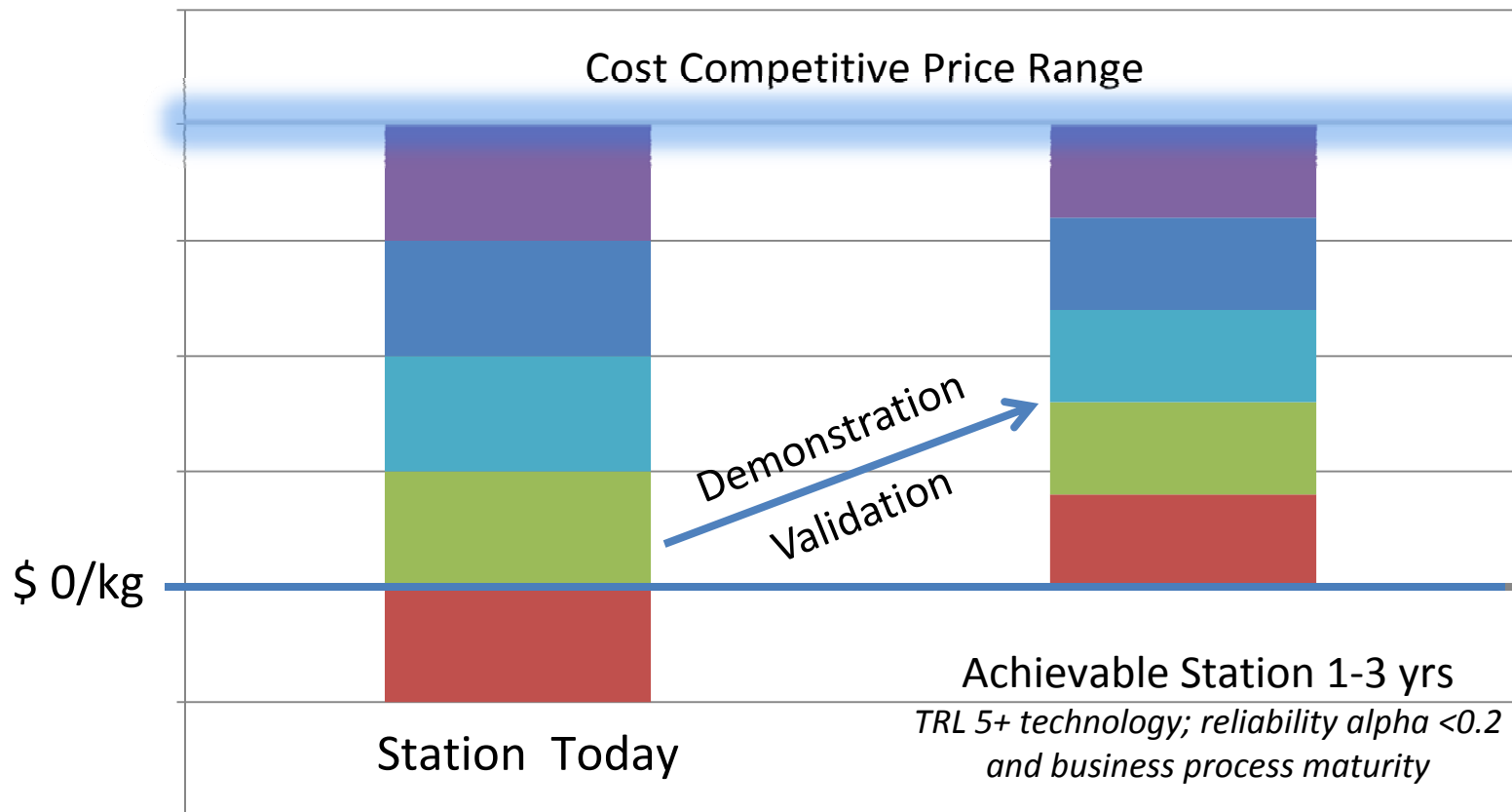




# Technology vs. Scale Investment

Emerging fueling technologies and business process improvements are narrowing the gap to a more competitive market.

## Need Technology Demonstration and Validation







# Technology vs. Scale Investment

## **Regulations, Codes and Standards affects station costs and availability**

### Flexibility to employ new and evolving approaches to permitting stations

- Risk assessment technology development and demonstration
- Published journal articles and reports documenting the methods for use in permitting
- Risk assessment and validation of active and passive mitigation methods which demonstrate equivalency to fire barriers

### Modeling and safety validation of liquid hydrogen bulk storage

- Enable risk-informed calibration of the LH2 prescriptive requirements
- Enable risk assessment and performance based approach for LH2 system permitting