State Experience in Hydrogen Infrastructure in California

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Hydrogen Infrastructure Market Readiness Workshop

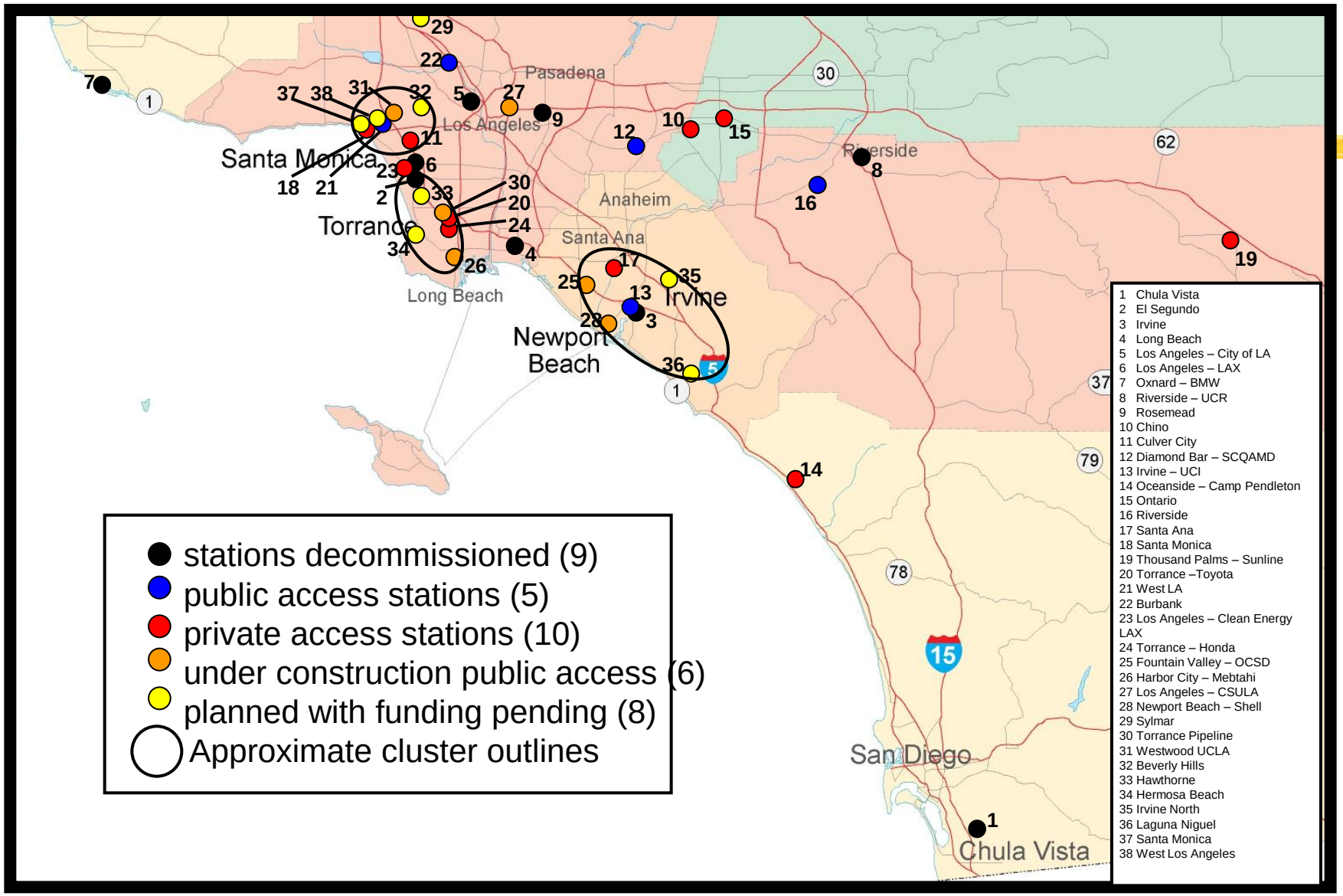
California Environmental Protection Agency

Air Resources Board

Agenda

- California Station History
- Approach for State Solicitations
- Stations under Construction
- Recently Awarded
- Learnings
- Other Considerations that Impact Hydrogen Infrastructure

Southern California Hydrogen Highway Network
Historical Region/Cluster Station Development



California's Approach to Hydrogen Infrastructure

- Phase I: Focus on major population centers (LA, Bay Area, Sacramento)
- Phase I ideals
  - Match infrastructure to size of vehicle and bus fleets
  - Meet consumer expectations
  - Service centers (economy of scale)
  - Outreach to:
    - Permitting officials
    - Trained first responders
    - Public education

Solicitations Considerations

- Meets renewable and environmental requirements (averaging allowed)
- Retail like settings 24/7 operation
- Goal of J-2601 700/350 Bar fills
- 60 – 100 kg/day upgradable minimum capacity
- Automakers written statement of specific location support

Solicitation Bonus Consideration

- Greater Capacity
- Greater Performance
- Exceed Renewable Requirement
- Multiple technologies encouraged -extra scoring points for fuel cell energy station integrated w/fueling
- Greater Demand
- Accelerated Construction Timeline

Current State Funded Stations

Station Proposer & Location	State Funds (Millions)	Total Cost Estimated (Millions)	Capacity Kg H2/ day	Unique Features
Newport Beach - Shell Hydrogen	$1.7	$4.0	100	First large capacity, dual pressure fully retail station on West Coast, on-site SMR Multiple simultaneous fuelings
Fountain Valley - APCI, Orange Count Sanitation District	$2.7	$8.2	100	Co-generating electricity & fuel cell quality hydrogen using high temperature fuel cell Demonstration of waste to electricity & hydrogen 100 percent renewable from digester gas
Harbor City - Mebtahi Station Services, APCI	$1.7	$2.5	100	First independent branded (Chevron) station High pressure delivered H2
Los Angeles - UCLA	$1.7	$4.3	140	Research focused, on-site SMR Will provide needed back up for Santa Monica
Los Angeles – CSULA	$2.7	$4.4	60	100% renewable station, on-site electrolyses Applied engineering focus
San Francisco Airport - SFO, Linde	$1.7	$2.4	120	Mixed use, medium duty airport shuttle and light duty vehicle station Liquid delivery, Includes HCNG
Emeryville – Alameda-Contra Costa County Transit District	$2.7	$5.6	60	First mixed use heavy duty transit/light duty station, on-site electrolysis Light duty is 100% renewable PV

Burbank – Co-funded continued operation

Current Awards - Continued
CEC New Station Awards

Applicant	Location	Award	% Eligible Cost Share
APCI	N. Irvine	$1.4M	70
APCI	Santa Monica	$1.5M	76
APCI	Beverley Hills	$1.3M	65
APCI	West Los Angeles	$1.3M	65
APCI	Hermosa Beach	$1.5M	76
APCI	Hawthorne	$1.2M	60
Linde	W. Sacramento	$1.9M	76
Linde	Laguna Nigel	$2.0M	76

Upgrades of U.C. Irvine, Diamond Bar, SFO

Integrated Infrastructure/Vehicle Rollout Strategy

Map from 2011 CaFCP Progress and Actions Document

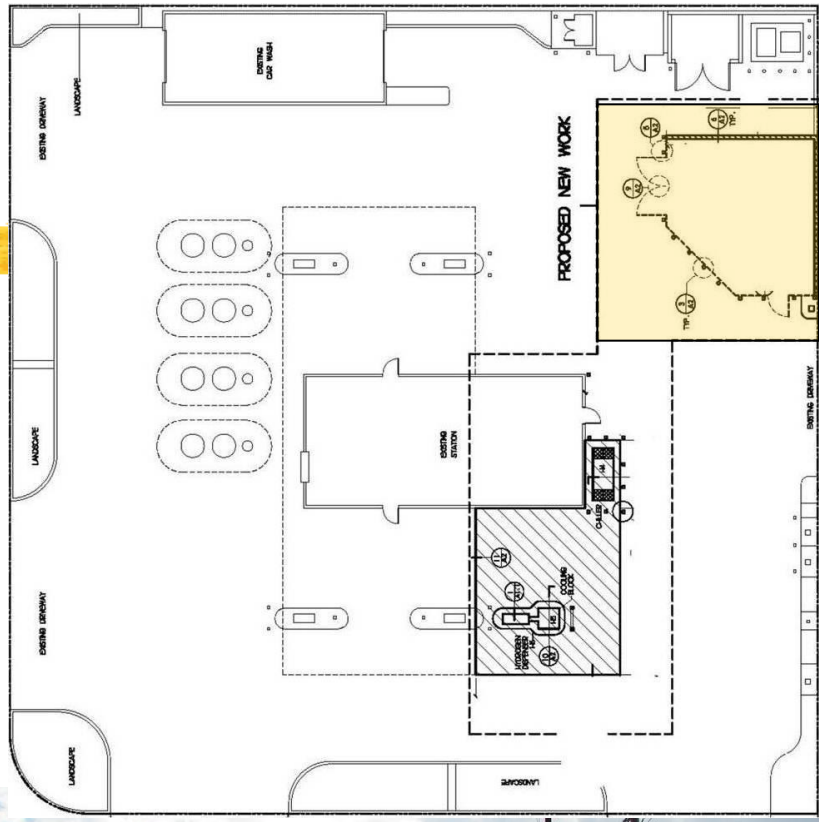
Learnings and Developments

- Two DOE/ARB co-funded stations feature hydrogen pressure vessels, manufactured by FIBA Technologies a design pressure of 15,000 psig.
- 48 months of R&D lead to ASME certification, high pressure storage and quicker fills
- This is a clear example of the process undertaken to move this technology forward in into the forecourt.

Learnings and Developments Continued

- At least two sites will use commercially available card reader/service (Broadlux) for station access
  - Creates a point of sale system
  - Can play video for training (similar to CNG)
  - Researching use of traditional gasoline dispenser shell for customer familiarity

Harbor City



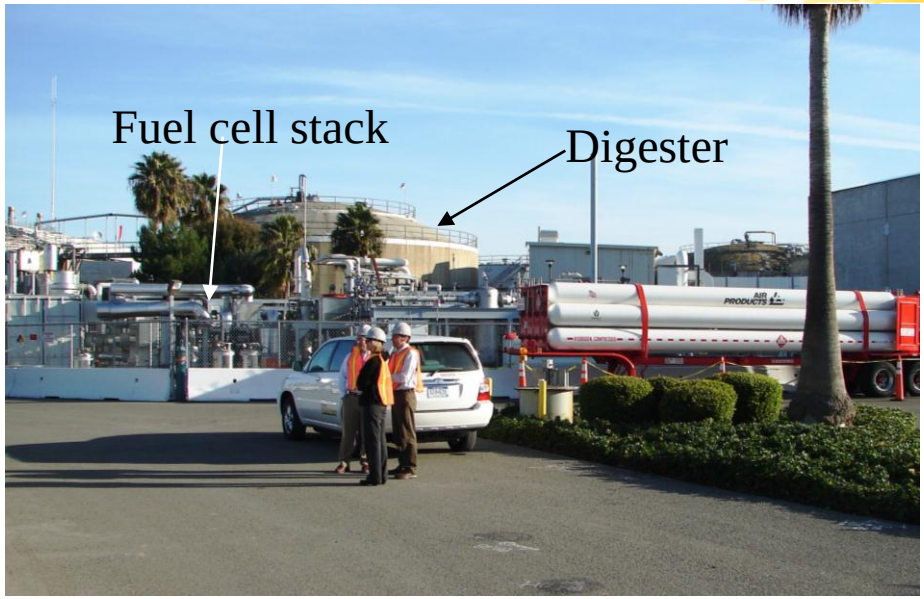
Mebtahi-Chevron

- 100kg/day added to existing station
- Delivered high pressure hydrogen gas = less compression on site
- 350 & 700 bar dispenser
- APCI small footprint for storage & compression (shaded area)

San Francisco Int'l Airport Modular Hydrogen Station

- Linde delivered liquid/dispensing
- 100+ kg/day medium/light duty fueling
- 20 kg/hour
- 350 & 700 bar hydrogen + Hythane
- ¼ mile off of Highway 101

Orange Co. Sanitation District Renewable Hydrogen Fueling Station



- Main partners, DOE, ARB, AQMD, FCE and APCI
- Fuel Cell Energy DFC 300 Molten Carbonate FC
- Mode hydrogen fuel, heat (used internally) and power (used on site)
- 100 kg/day minimum/day from ADG or NG
- FC and Station finished, building ADG skid
- FC has run successfully on NG producing H2 and electricity
- Operational on ADG est. Spring 2011

Hydrogen Quality and Quantity Standards

- Division of Measurements and Standards (Dept. of Food & Ag) with National Institute of Standards and Technology and Society of Automotive Engineers to develop:
- Dispenser Type approval
  - Develop testing and evaluation practices
  - NIST Handbook 44 (section 3.39) in development
  - General Code A.3 in interim use
- Fuel Quality Standards
  - Develop sampling techniques and test methods

(AB-118 funding from California Energy Commission)

Summary – California FCEV Rollout from Survey data

Region/year	2011	2012	2013	2014	2015-17
All California	253	312	430	1,389	53,000
SCAQMD	197	240	347	1,161	34,230
LA County	104	125	149	484	
Orange County	93	115	198	677	