California Hydrogen Refueling Infrastructure: Present Activities and Future Plans

Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP)

HTAC

April 6, 2016

Jean Baronas

ARFVTP Origins in Statute

Assembly Bill No. 8

CHAPTER 401

An act to amend Sections 41081, 44060.5, 44125, 44225, 44229, 44270.3, 44271, 44272, 44273, 44274, 44275, 44280, 44281, 44282, 44283, 44287, 44299.1, and 44299.2 of, to add and repeal Section 43018.9 of, and to repeal Section 44299 of, the Health and Safety Code, to amend Sections 42885 and 42889 of the Public Resources Code, and to amend Sections 9250.1, 9250.2, 9261.1, and 9853.6 of the Vehicle Code, relating to vehicular air pollution, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor September 28, 2013. Filed with Secretary of State September 28, 2013.]

LEGISLATIVE COUNSEL'S DIGEST

AB 8, Perea. Alternative fuel and vehicle technologies: funding programs.

(1) Existing law establishes the Alternative and Renewable Fuel and Vehicle Technology Program, administered by the State Energy Resources Conservation and Development Commission, to provide to specified entities, upon appropriation by the Legislature, grants, loans, loan guarantees, revolving loans, or other appropriate measures, for the development and deployment of innovative technologies that would transform California's fuel and vehicle types to help attain the state's climate change goals. Existing law specifies that only certain projects or programs are eligible for funding, including block grants administered by public entities or not-for-profit technology entities for multiple projects, education and program promotion within California, and development of alternative and renewable fuel and vehicle technology centers. Existing law requires the commission to develop and adopt an investment plan to determine priorities and opportunities for the program. Existing law also creates the Air Quality Improvement Program, administered by the State Air Resources Board, to fund air quality improvement projects related to fuel and vehicle technologies.

This bill would provide that the state board has no authority to enforce any element of its existing clean fuels outlet regulation or other regulation that requires or has the effect of requiring any supplier, as defined, to construct, operate, or provide funding for the construction or operation of any publicly available hydrogen-fueling station. The bill would require the state board to aggregate and make available to the public, no later than June 30, 2014, and every year thereafter, the number of hydrogen-fueled vehicles that motor vehicle manufacturers project to be sold or leased over the next 3 years, as reported to the state board, and the number of hydrogen-fueled vehicles registered with the Department of Motor Vehicles through April 30. The bill would require the commission to allocate $20 million annually, as specified, until there are at least 100 publicly available hydrogen-fueling

Established by Assembly Bill 118 (Nunez, 2007)

- ✓ $100 million per year

Funding extended through January 1, 2024 by Assembly Bill 8 (Perea, 2013)

"…develop and deploy innovative technologies that transform California's fuel and vehicle types to help attain the state's climate change policies."
(Health and Safety Code Section 44272(a))

ARFVTP Funding: 2009-2015

Investment Areas	Funding Amount (millions)	Percent of Total (%)	Number of Awards
Electric Vehicle Serv.Equip.	$199	33	153
Biofuels	$158	26	61
Hydrogen	$113	19	72
Natural Gas	$95	16	185
Workforce Development	$28	4	58
Market & Program Develop.	$13	2	16
Total	**$606**	**100**	**545**

Through Q4 2015

H2 USA Participation

- Codes and Standards: Larry Vettraino
- Infrastructure and Station Acceptance: Chris Jenks and Jean Baronas
- Roadmap: Phil Cazel

- Stations: Larry Vettraino, Esther Odufuwa, Chris Jenks, and Jean Baronas
- Market Support : Miki Crowell and Chris Jenks
- Investment : Brad Cole

NREL Technology Validation Participation

CDP-INFR

- 10, Cumulative Number of Stations
- 11, Hydrogen Stations by Type
- 27, Hydrogen Station Timeline
- 40 Stations Costs by Daily Capacity
- 41, Station Costs (Budget v. Actual)
- 42, Station Costs (State Funding v. Cost Share)
- 43, Station Cost by Type

Quarterly Submission to NREL

- Hydrogen feedstocks,
- Pathways (station configurations),
- Station capacities,
- Equipment, labor, and materials costs,
- Durations of major project implementation milestones,
- Invoiced expenditures, and
- Match funding.

Hydrogen Safety Panel: "Safety Planning for Hydrogen and Fuel Cell Projects"

- Organizational safety policies and procedures
- Hydrogen and fuel cell experience
- Safety vulnerabilities
- Risk reduction
- Equipment and mechanical integrity
- Change procedures

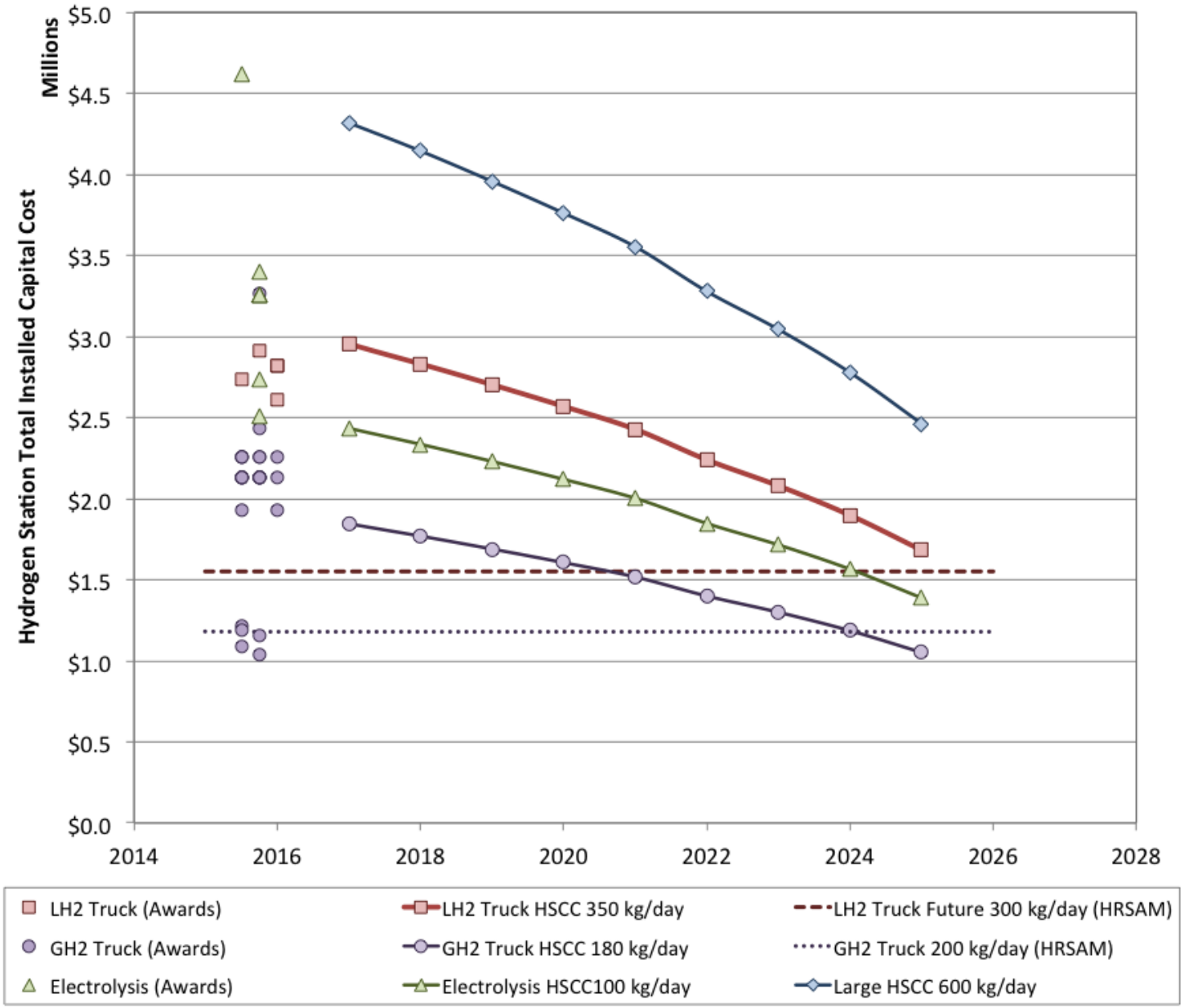
- Communications plan
- Training
- Safety reviews
- Safety events and lessons learned
- Emergency Response
- Self-audits

https://h2tools.org/sites/default/Safety_Planning_for_Hydrogen_and_Fuel_Cell_Projects-March_2016.pdf

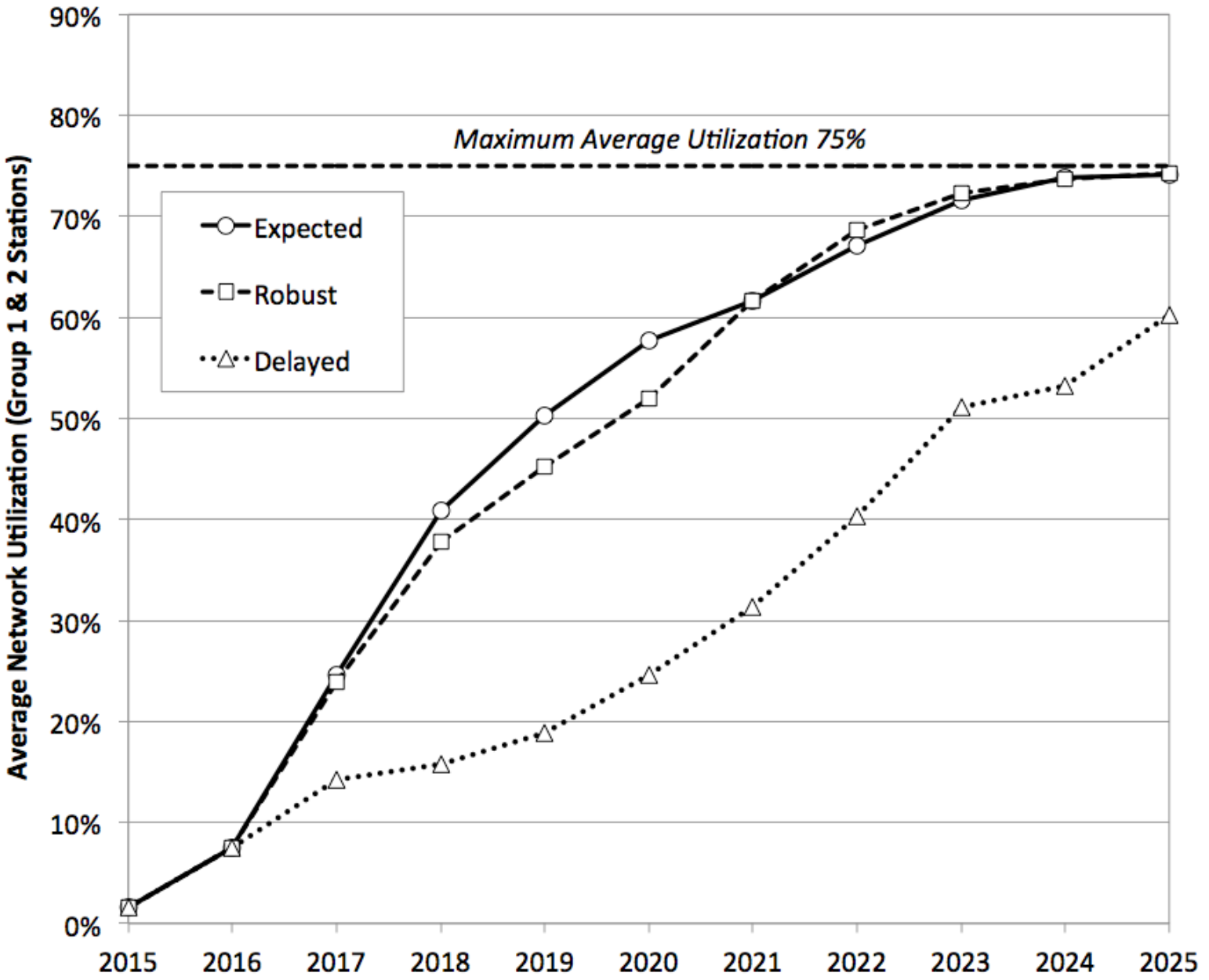
AB 8 Joint Agency Report

- *"Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California"*
  - *http://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-600-2015-016*
- Energy Commission and California Air Resources Board joint report to California Legislature
  - December 2015
  - Technical support from NREL

Station Costs (Source: AB 8 Joint Report)

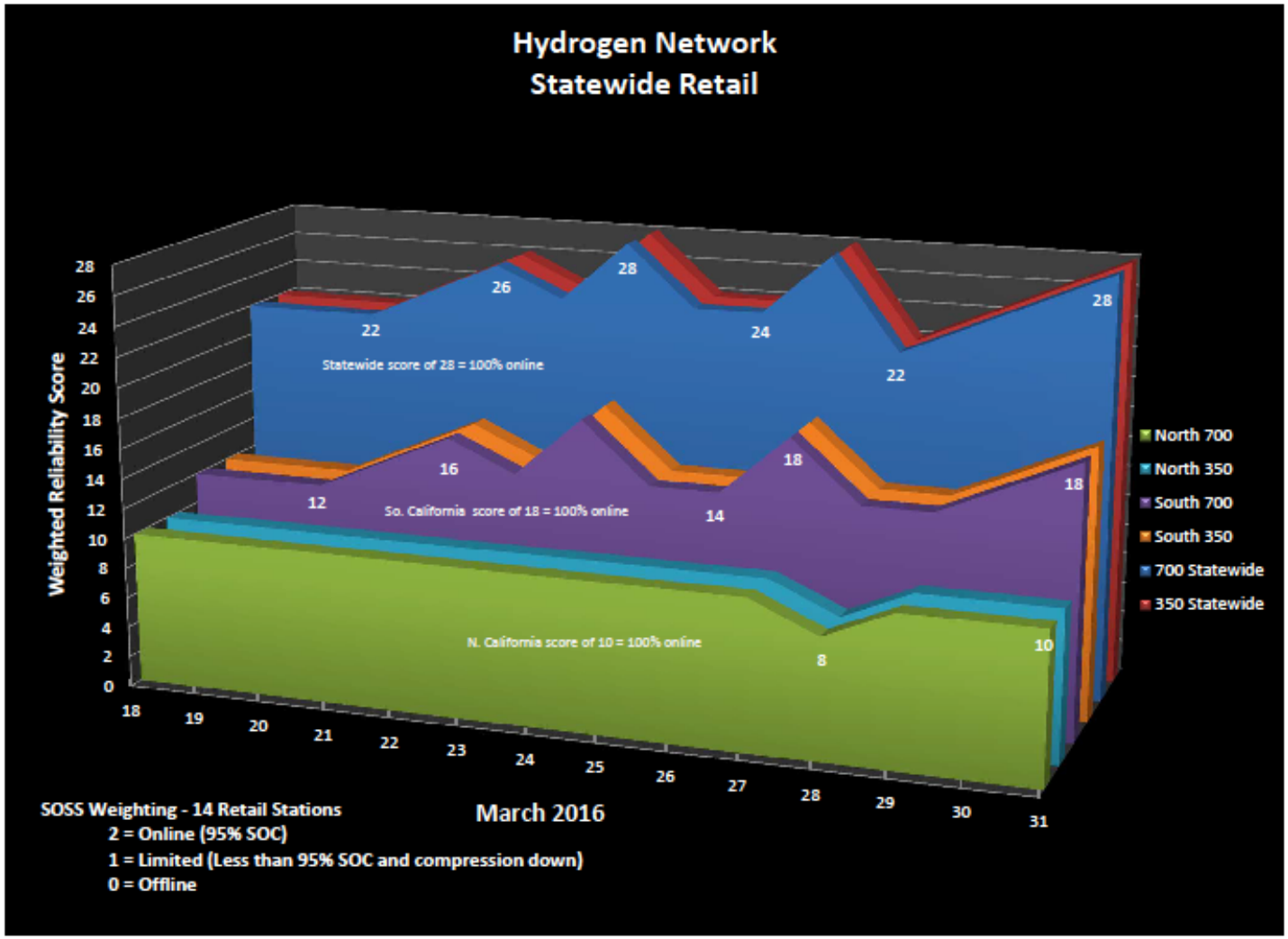


Network Over Time Source: AB 8 Report



Ongoing and Future Project Development

- Human-centered user interface: dispenser
- Third party component and station certification
- Regulations for fueling protocols (adopt voluntary standards)
- Mobile refueling critical pathway
- “Fueling Plaza” (multi-fuels, Interstate 5, State Route 99 and U.S. Highway 101)


Hydrogen Network
Statewide Retail
Weighted Reliability Score
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Statewide score of 28 = 100% online
So. California score of 18 = 100% online
N. California score of 10 = 100% online
22
26
28
24
22
28
12
16
18
14
18
10
8
18
19
20
21
22
23
24
25
26
27
28
29
30
31
March 2016
North 700
North 350
South 700
South 350
700 Statewide
350 Statewide
SOSS Weighting - 14 Retail Stations
2 = Online (95% SOC)
1 = Limited (Less than 95% SOC and compression down)
0 = Offline

Ongoing and Future Project Development

- State-wide coordination: biofuels for hydrogen delivery trucks and biogas for renewable hydrogen production
- NFPA 2 implementation
- Inline fuel quality testing capabilities
- Adjacent stations
  - Coordinate planned maintenance
  - Provide redundancy/backup fueling
  - Provide backup parts

Ongoing and Future Projects

- Upgrades through “bridge” standards
- HyStEP “use on the rise”
- Medium duty (MD) fueling protocols
- Standards that support > 0.75 nameplate capacity
- Airport locations (in proximity)

First Element: Long Beach, Costa Mesa, Coalinga

15

Linde's West Sacramento Station Opening

December 2014

Commissioner Janea Scott

For further information:

Jean Baronas
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814
Jean.baronas@energy.ca.gov

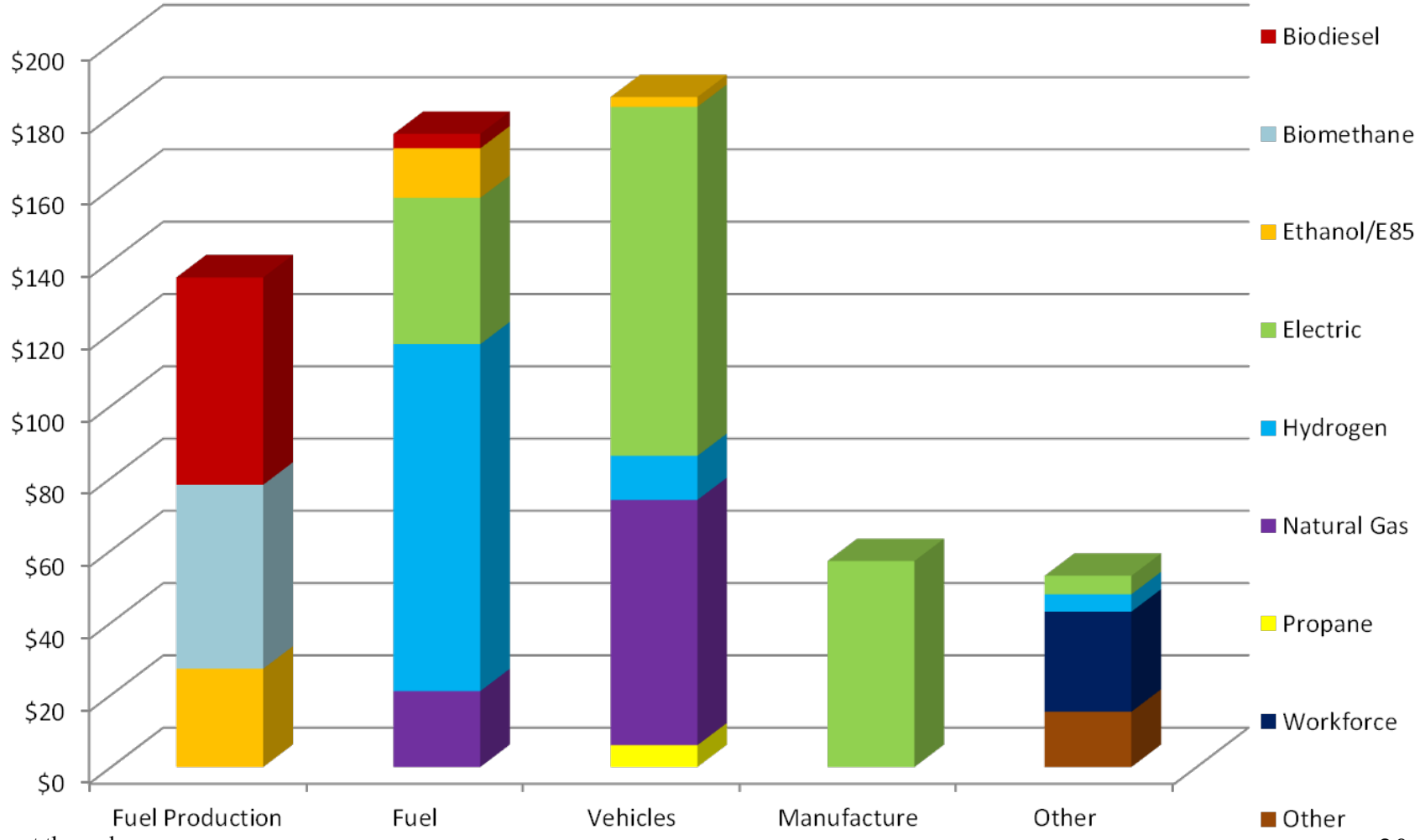
916-654-4526

Backup Slides

California Transportation: Nation-State Statistics

- Population: 38 million
- GDP: $2.0 trillion - 8th largest global economy
- GHG Emissions: 458 MMT (2012)
  - Transportation accounts for 37 % of all GHG emissions
- Air Pollution: Severe Non-Attainment for Ozone
  - San Joaquin and South Coast Air Basins
- Vehicles: 28.1 million cars + 0.9 million trucks
- Annual Fuel Consumption: 18.1 billion gallons
  - 14.5 billion gallons gasoline + 3.6 billion gallons diesel
- Primary Roadways: 170,000 miles

Existing Agreements: 2009-2015



Current through Q4, 2015

Hydrogen Station Funding To Date = $103 million

Public Station Funding

45 New Stations = $72.7 million
4 Station Upgrades = $6.7 million
44 Station O&M Grants = $12.5 million
1 Mobile Refueler = $0.9 million

Other Funding Activities

5 H2 Regional Readiness Plans = $1.4 million
AC Transit Fuel Cell Bus Station = $3 million
CDFA Div of Weights and Measures = $4 million
Retail Dispensing Fuel Standards
HyStEP Test Device = $0.1 million
UC Irvine STREET Model = $1.5 million
GoBiz ZEV Infrastructure Manager

Energy Commission Solicitations and Award Dates

Solicitation No.	Notice of Proposed Award	Total Capital Funding ($ millions)	Number of HRS Developers Awarded	Number of Stations Funded
PON-09-608	November 2010	15.7	2	10
PON-12-606	April 2013	11.9	4	7
PON-13-607	May 2014	46.6	8	28
South Coast Upgrades	August 2013	6.7	3	4
		80.9		49

Energy Commission Solicitations

Solicitation No.	CEC Capital Grant Share	Total Funding Available ($ million)	Incentive Funding	Results
PON-09-608	40% to 70%	19	Accelerated Completion Upon Permit Receipt	11 stations funded
PON-12-606	65% or $1.5 M	28.6	No	Undersubscribed by $6.7 M 5 stations funded
PON-13-607	70% to 85% or $1.75 to $2.1 M	46.6	For Speed of Development	Oversubscribed 28 stations funded

Representative Costs for 3 Station Technologies

Technology	Equipment Costs ($ million)	Installation Costs ($ million)	Total Cost (All-In) ($ million)	Levelized Costs ($/kg)	No. of Stations
Delivered Gaseous (180 kg/day)	1.6	0.4	**2.0**	$13.00	31
Delivered Liquid (350 kg/day)	1.9	0.8	**2.8**	$9.90	7
Electrolysis (130 kg/day	2.3	0.8	**3.2**	$24.00	8

- CEC solicitation and proposal files
- Represents most recent bid costs to CEC. Final costs may vary.
- Source: AB 8 Joint Report

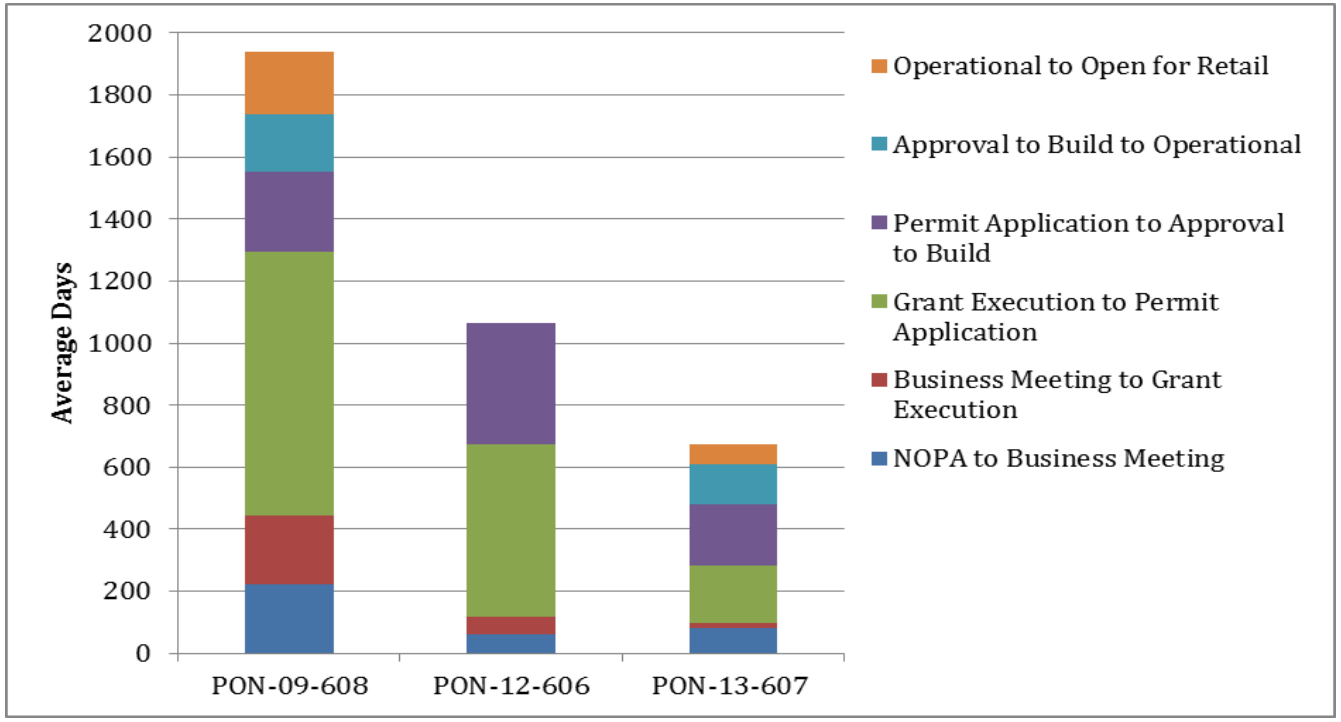
Stations, Capacity, Demand Source: AB 8 Joint Report

50 hydrogen refueling stations: 2016

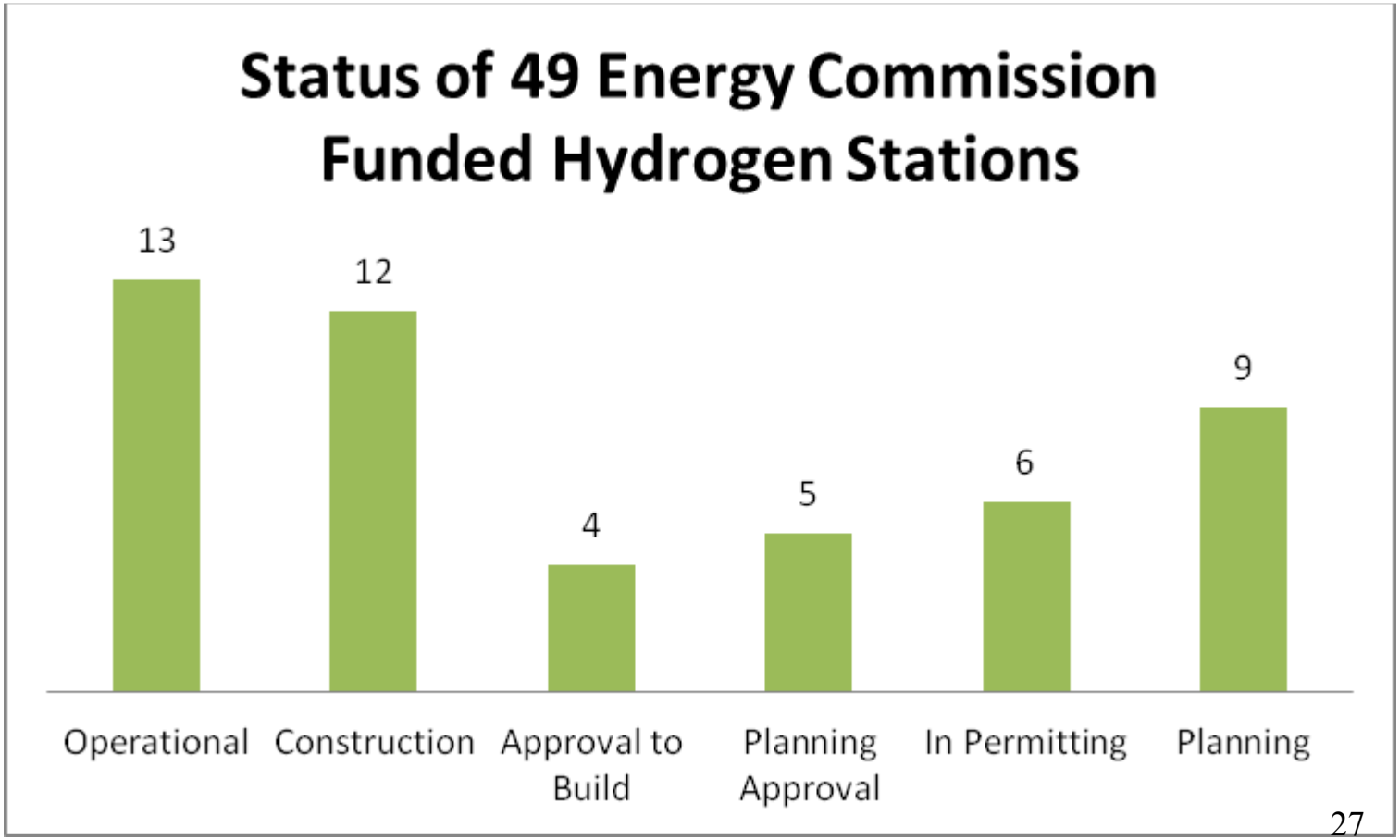
- With fueling capacity for 10,000 FCEVs
- Demand could outpace capacity in 2020-21 (CARB survey results include 10,500 FCEVs by 2018 and 34,300 FCEVs by the end of 2021)

Station Development Times
Source: AB8 Joint Report

Hydrogen Station Development Times Decreasing
from Nearly 5 Years (2009 funding) to 1.6 Years



Targets: 20 Operational Stations: 2015
49 Operational Stations: 2016



27