

MOVING

toward a commercial market
for hydrogen fuel cell vehicles



CaFCP MEMBERS



Promoting fuel cell vehicle commercialization as a means of moving towards a sustainable energy future, increasing energy efficiency and reducing or eliminating air pollution and greenhouse gas emissions.

AUTOMOTIVE

Chrysler
Daimler
General Motors
Ford
Honda
Hyundai
Nissan
Toyota
Volkswagen

ENERGY

Chevron
Shell Hydrogen

TECHNOLOGY

UTC Power
AFCC

GOVERNMENT

CA Energy Commission
CA Air Resources Board
National Automotive Center
South Coast AQMD
US EPA
US DOE
US DOT

ASSOCIATE

AC Transit
Santa Clara VTA
SunLine Transit
Air Products
Praxair
Proton Energy Systems
Powertech
Ztek
ISE Corporation
ITS – UC Davis
NFCRC – UC Irvine
CA Dept. of Food and Ag

CaFCP VEHICLES

250 vehicles – 1.9 million miles



Daimler



Nissan



GM



Ford



Honda



Ballard/VTA



Volkswagen



Toyota



Hyundai-Kia



VW/Audi



NAC/GM



UTC/AC Transit

25 STATIONS



DO WE NEED FCVs?



- Zero emissions
- Reduced greenhouse gas emissions
 - Enables goal of 80% GHG reduction by 2050
- Domestic, sustainable fuel from diverse sources
- Vehicles people want to drive

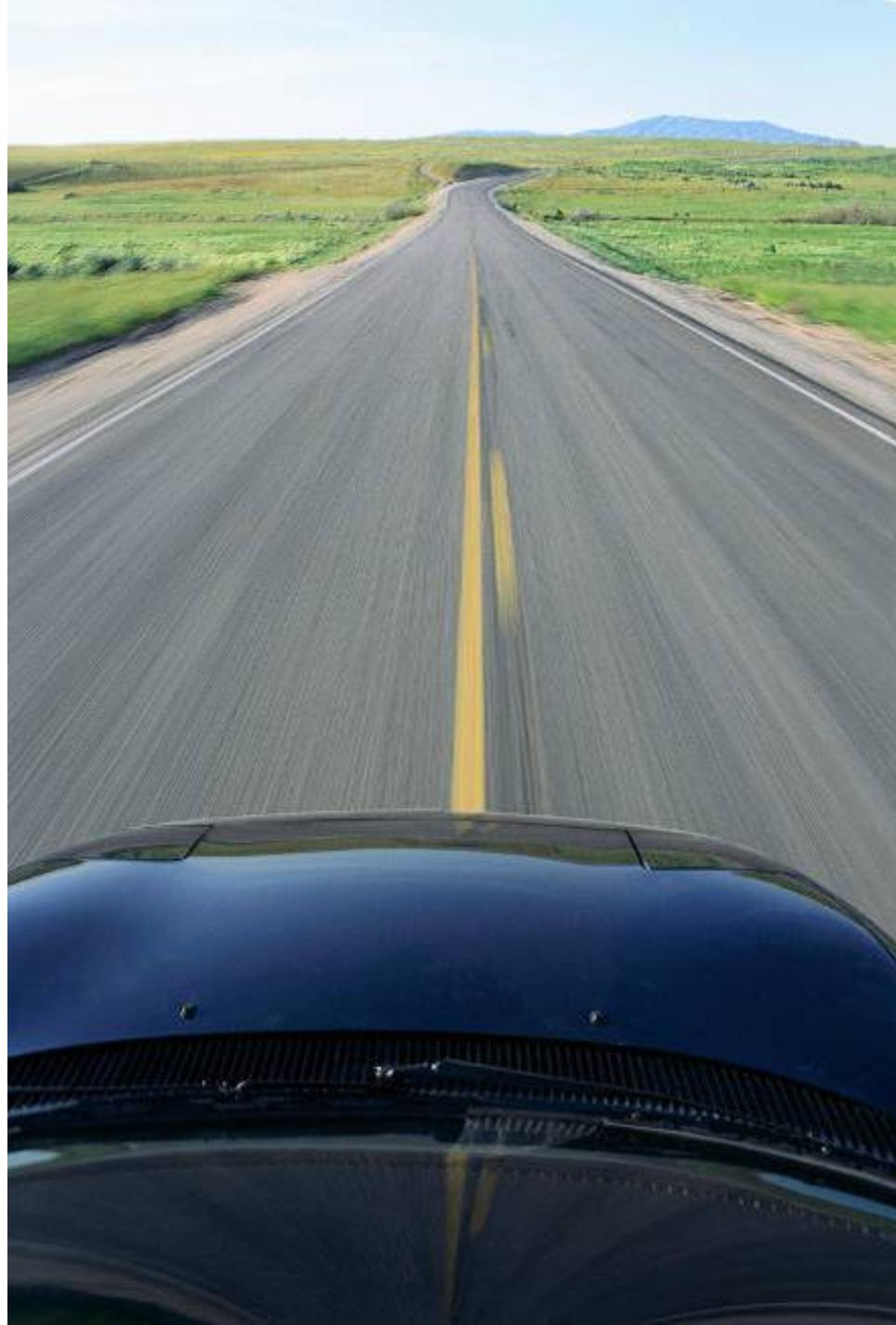
TRANSITION

Today – 250 vehicles
+ 25 stations

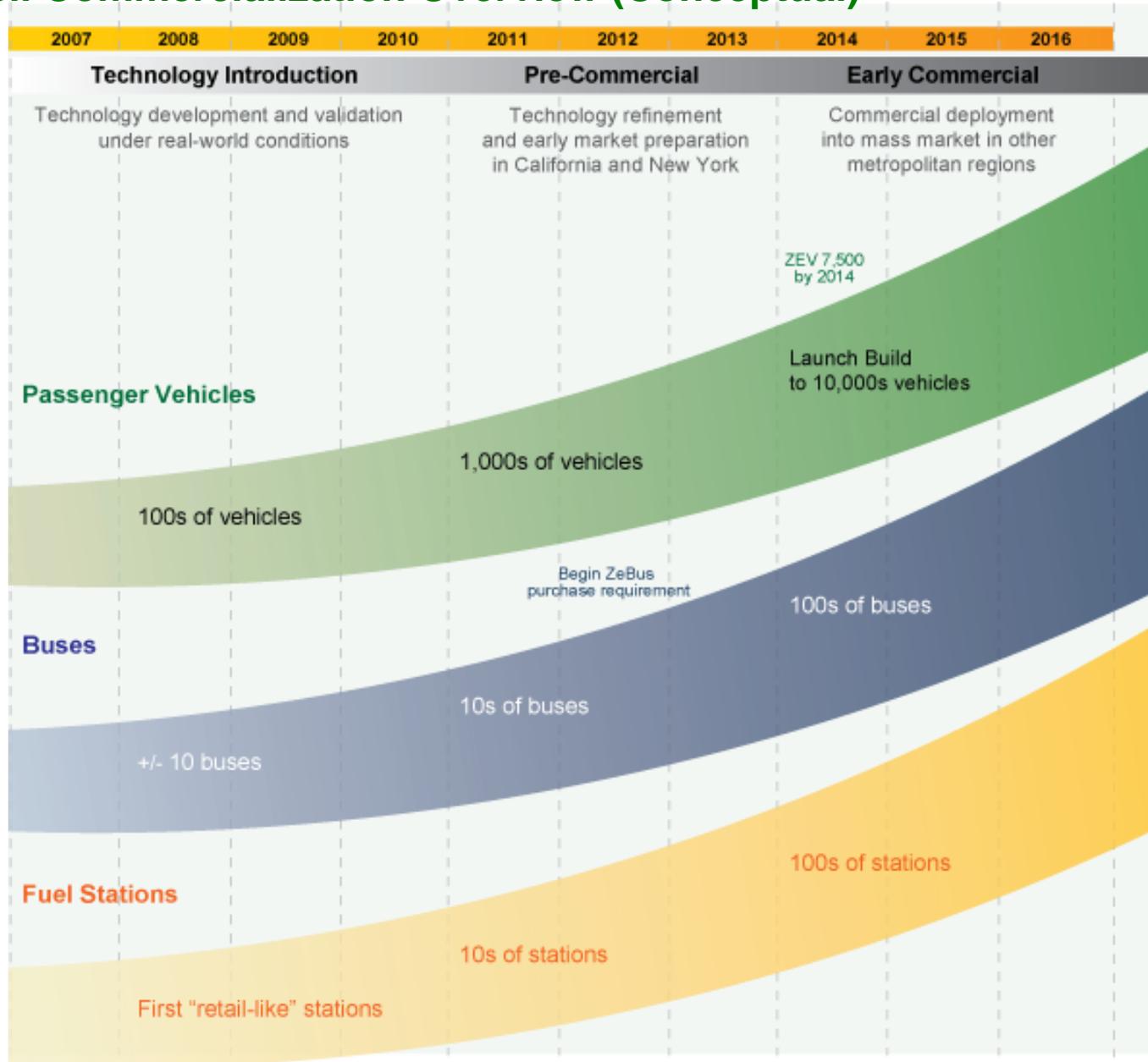


**How we
get there
from here**

2015-17 – 10,000s
vehicles + 100s stations



Fuel Cell Commercialization Overview (Conceptual)



AT WHAT COST?



Based on Oakridge National Laboratory scenario analysis:

- Total of \$10-45 billion between 2012-2025
- Peak annual costs between \$1-6 billion
- Includes costs for vehicles and fuel stations
- Sustainable market by 2025

How will we start?

Using best data available in July
2008, the consensus opinion
about the next few years....



HOW MANY FCVs?



California regulations for zero-emission vehicles (ZEV) and buses (ZeBus)

	2009-2011	2012-2014	2015-2017
ZEV ^a	2,500	25,000	50,000
	OR	OR	OR
	N/A	5,357 to 9,375 PLUS 58,000 silver+ ^c	at least 25,000 ^b
ZeBus	Up to 15	Up to 220	15% of new bus purchases

^a requirements for "Gold" ZEVs (fuel cell or battery vehicles)

^b 2015-2017 requirements to be considered in 2009

^c Silver+ vehicles are plug-in hybrid or hydrogen internal combustion engine vehicles

HOW MUCH HYDROGEN?



(# FCVs X .7 kg/day) + (# ZeBus X 30 kg/day) = daily kg H₂ demand

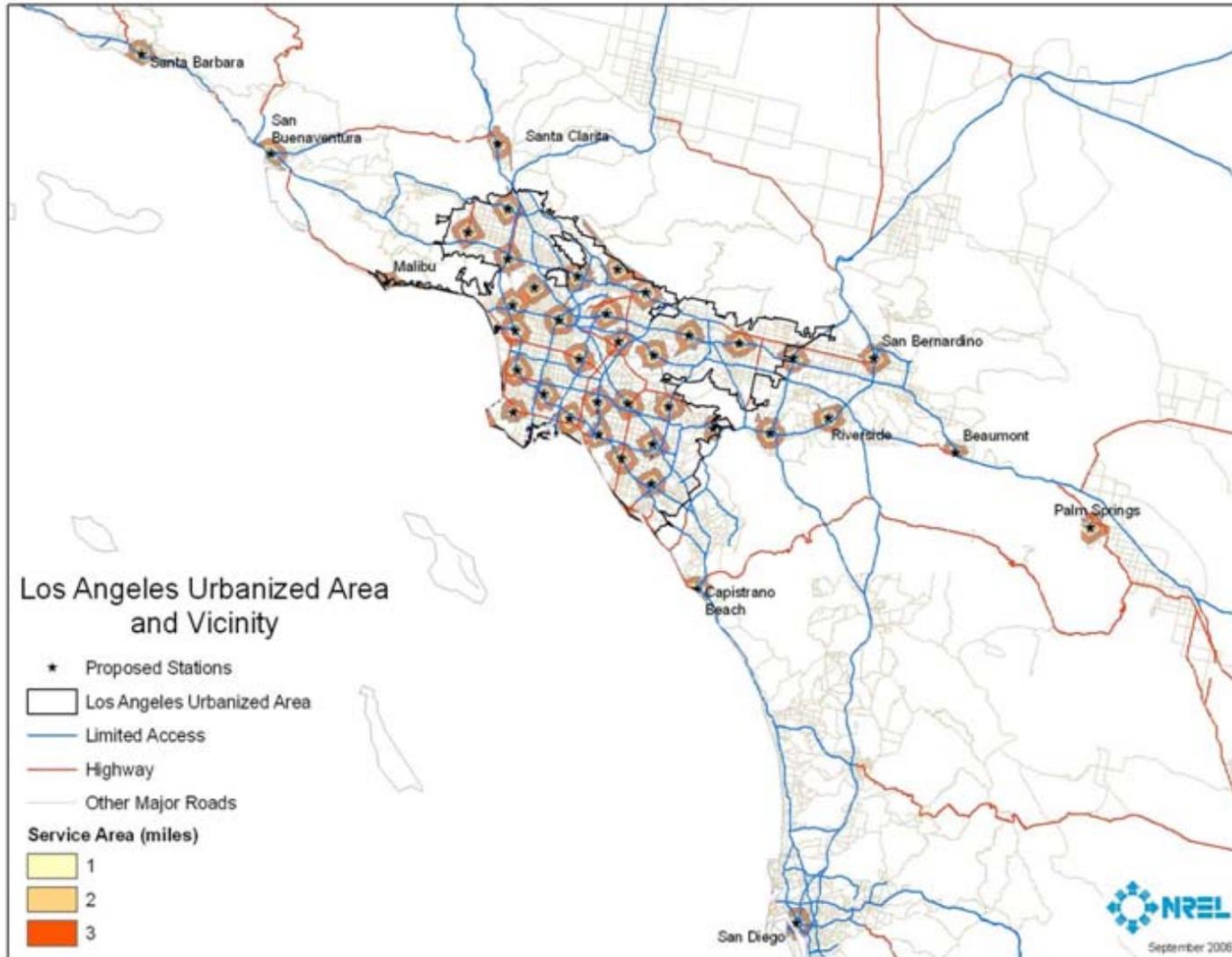
	2009-2011	2012-2014	2015-2017
ZEV	250-2,500	5,357-9,375	25,000
	<i>and</i>	<i>and</i>	<i>and</i>
ZeBus	up to 15	up to 220	15% of purchases
Projected daily H ₂ demand (kg/day)	270-2,220	3,750-13,200	20,000+

ROLLOUT STRATEGY



- Concentrate on key early-market regions
 - Los Angeles and San Francisco/Sacramento areas
- Cluster stations and vehicles
 - Maximize station utilization and vehicle support
- Coordinate multiple uses where possible
 - Passenger car/transit buses fueling, forklifts, stationary power generation

LA EXAMPLE



STATION COST



- Three types of stations:
 - Central production & delivery
 - Onsite reforming
 - Onsite electrolysis
- Capital costs: estimated at \$2-4 million
 - Excluding land and operating costs
- Hydrogen cost to consumers—\$8-13/gge*
 - \$4.00-6.50/gallon on a mileage basis
- Renewable H₂ more expensive

* Based on H2A analysis of liquid and gaseous delivery options for 20-40 station network

STATION FUNDING



- Cumulative \$80-90m through 2013 for California
- One or more approaches:
 - Cost-share through one-time grants
 - Ongoing incentives for H₂ dispensed
 - Tax incentives to station owners

Illustrative example:

	2010	2011	2012	2013
# new stations	4	4	12	20
Annual funding @ \$2m	\$8m	\$8m	\$24m	\$40m
Cumulative funding	\$8m	\$16m	\$40m	\$80m
Annual funding @ \$2/kg	\$584k	\$1.2m	\$29m	\$58m
Cumulative funding	\$584k	\$1.8m	\$31m	\$89m

CHALLENGES

- Station size
- Land availability
- Timing
- Renewable requirement
- Profitability
- Insurance and liability
- Permitting



TAKING THE NEXT STEP TOGETHER



A network of early hydrogen fuel stations focused in key markets.



CaFCP ACTIONS



- Identify 4-5 station builders to start
 - Working with CalSTART
- Conduct workshops for builders and permitters
 - Working with DOE, CARB
- Gain state and federal support
 - Outreach and education, e.g. Hydrogen Road Tour
- Provide station building guidance
 - Using existing and new resources



BUILDING MARKET FOUNDATIONS