



11/4/2019

The California Experience: Commercializing Hydrogen Fuel Cell Vehicles

Hydrogen and Fuel Cell Technical Advisory Committee

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California Fuel Cell Partnership



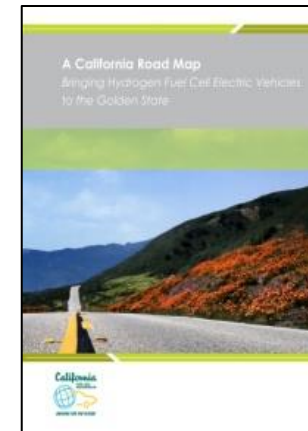
Overview

- ✓ Market status
- ✓ What comes next
- ✓ Opportunities and needs

How to launch the market?

2012 California Roadmap

- Establish initial network coverage to enable launch
 - *Stations must come first!*
- Early market clusters in big cities
- “Connector” & “destination” stations across California
- Common vision for starting commercial rollout



www.cafcp.org/roadmap

A CALIFORNIA ROAD MAP
Bringing Hydrogen Fuel Cell Electric Vehicles to the Golden State

COMMERCIAL LAUNCH OF FCEVS
EXPECTED AROUND 2015

Zero-emissions → 250-400 mile range
Minutes to refuel
Domestically produced hydrogen

THE NETWORK:
CLUSTERS
CONNECTORS
DESTINATIONS

“Consumers need CONFIDENCE in a hydrogen fueling network”
Initial station deployments will focus on geographic clusters in key markets with additional stations connecting these clusters into a regional network.

68 STATIONS
NEEDED TO LAUNCH THE EARLY FCEV MARKET

\$65 MILLION
IN ADDITIONAL FUNDING NEEDED!

Download A California Road Map at www.cafcp.org/roadmap

The California Fuel Cell Partnership is a collaboration of organizations that work together to promote the commercialization of hydrogen fuel cell electric vehicles.

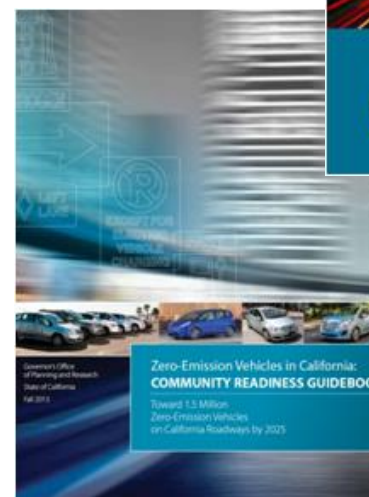
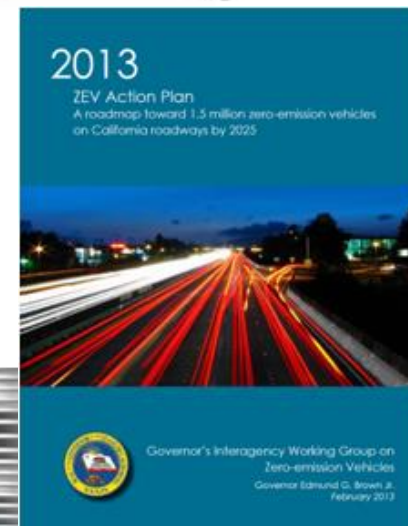
By working together, we help ensure that vehicles, stations, regulations and people are in step with each other as the technology comes to market.

www.cafcp.org



Market launch – leadership and commitments

- Governor's leadership
 - Executive Order – 1.5M ZEV target
 - ZEV program manager
 - ZEV Action Plan & Permitting Guidebook
- AB8 legislation
 - \$20M annually for HRS, to reach 100 stations
 - ARFVTP program confirms programmatic foundation
- Provided industry confidence
 - Automakers expanded FCEV deployment
 - Fleets of “100’s” by several automakers



Progress in California's Market Launch



The screenshot displays a web application interface for station locations in California. At the top, there is a search bar with the text "Search by Zip Code or Address" and a "GO" button. To the right of the search bar are two buttons: "Filter By" and "Station Types". Below the search bar, there are two tabs: "Map" (selected) and "Satellite". A "Download Station List" button is located on the left side of the map area. The map itself shows various cities in the San Francisco Bay Area and surrounding regions, with green and yellow pins indicating station locations. A search bar is also overlaid on the map. On the right side, there is a list of station details, each with a status label, a title, and an address. The stations listed are Hayward, Redwood City, South San Francisco, and Palo Alto. Each entry includes a small image of the station.

Station Name	Status	Address
Hayward	RETAIL: OPEN	391 West A Street Hayward, CA 94541
Redwood City	RETAIL: IN DEVELOPMENT	503 Whipple Avenue Redwood City, CA 94063
South San Francisco	RETAIL: OPEN	248 South Airport Blvd. South San Francisco, CA 94080
Palo Alto	RETAIL: OPEN	2601 El Camino Real



Numbers as of October 1, 2019	Total
Fuel cell cars sold and leased	7,570
Fuel cell buses in operation in California	31
Retail hydrogen stations open in California	41
Fuel cell buses & shuttles in development in California	25
Fuel cell trucks in development in California	35+
Retail hydrogen stations in development in California	22



https://cafc.org/by_the_numbers

#driveH2

#driveH2

#driveH2

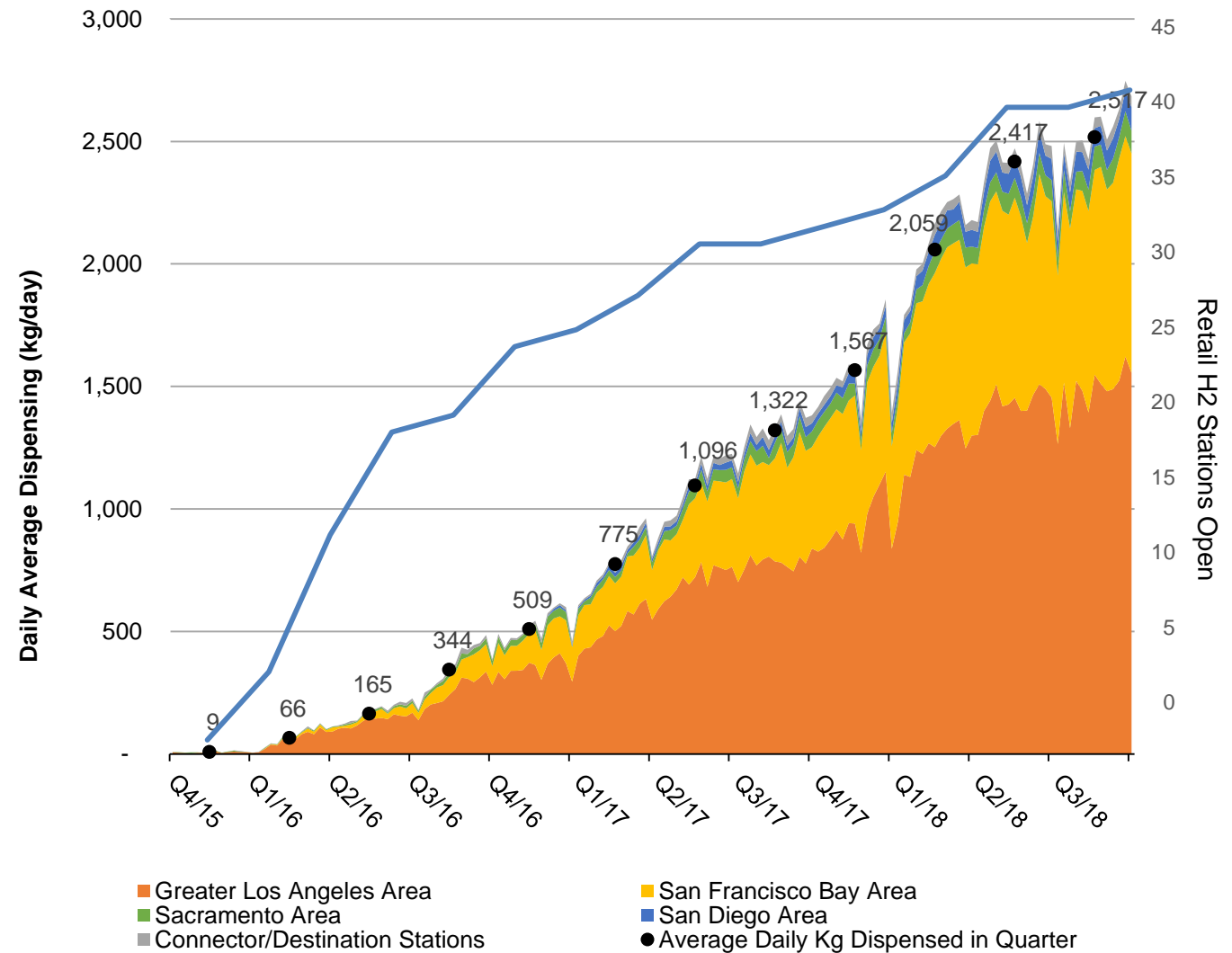


California's Experience – Customer Focus!

- The technology works – customers are coming!
- Need to know where, when and if hydrogen is available
- Tools for customers & stakeholders; quarterly webinars, Station Status (SOSS), reports



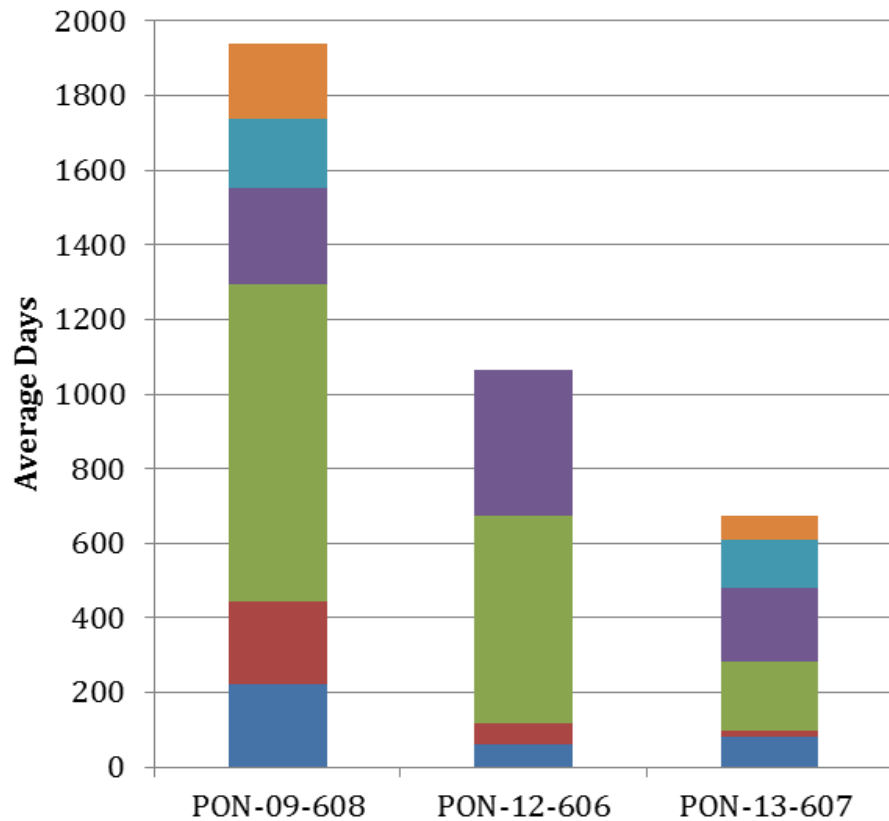
<http://m.cafrp.org>





California's Experience – Stakeholder Progress

Average Station Development Time (days)



Expected Annual Benefits from ARFVTP Investments to Date

Project Type	NOx Reductions (Tonnes/Year)			PM2.5 Reductions (Tonnes/Year)		
	2020	2025	2030	2020	2025	2030
Electric Chargers	1.89	1.57	1.57	0.19	0.19	0.07
Hydrogen	9.31	8.51	9.25	0.94	1.05	0.43

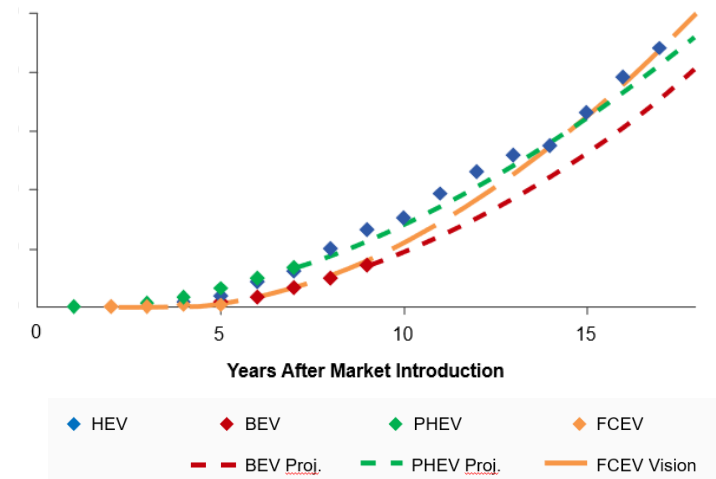
Project Type	Petroleum Displacement (Million Gallons)			Greenhouse Gas Emission Reductions (Thousand Tonnes CO2e)		
	2020	2025	2030	2020	2025	2030
Biodiesel	8.5	8.5	8.5	73.8	73.8	73.8
BEV Charging	2.8	2.6	2.6	20.9	20.0	20.0
Hydrogen	13.6	14.3	15.5	107.7	113.8	123.2
Natural Gas	35.3	35.3	35.6	87.1	87.8	87.8

Source CEC



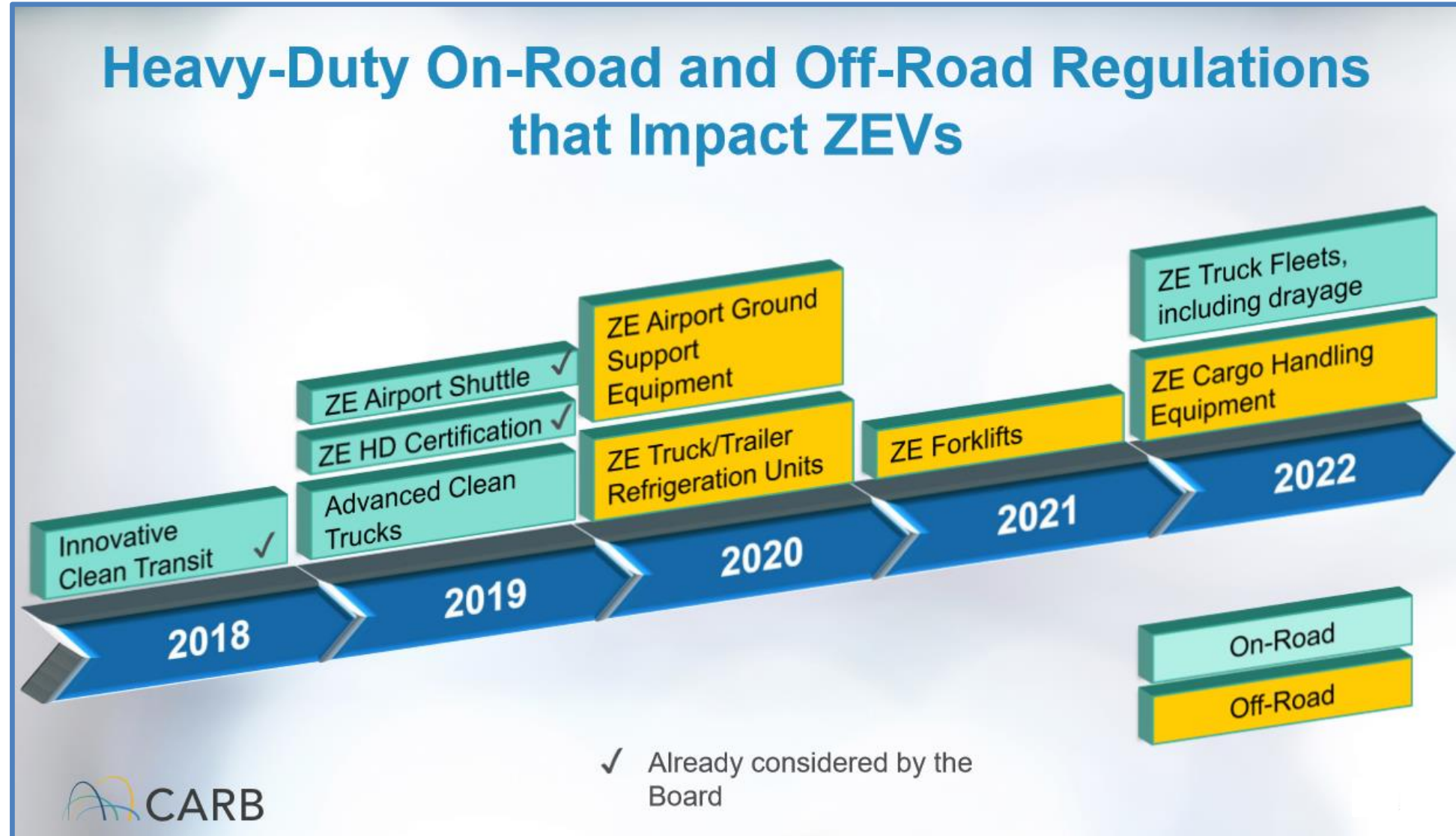
Positive Momentum

- Energy Commission's *Draft Solicitation Concepts* adopts market building strategies to achieve scale
- Low Carbon Fuel Standard Amendments enable credits for installed capacity of HRS and fast charging, increases renewable hydrogen content to 40%
- Air Liquide announces 30ton/day H2 production facility
- Air Products announces liquid H2 production facility
- Hyundai announces 17 ZEV models over next decade, 10 of those will be FCEVs
- Toyota announces FCEV production of 30,000 units/year
- Trajectory of customer FCEV rollout is positive



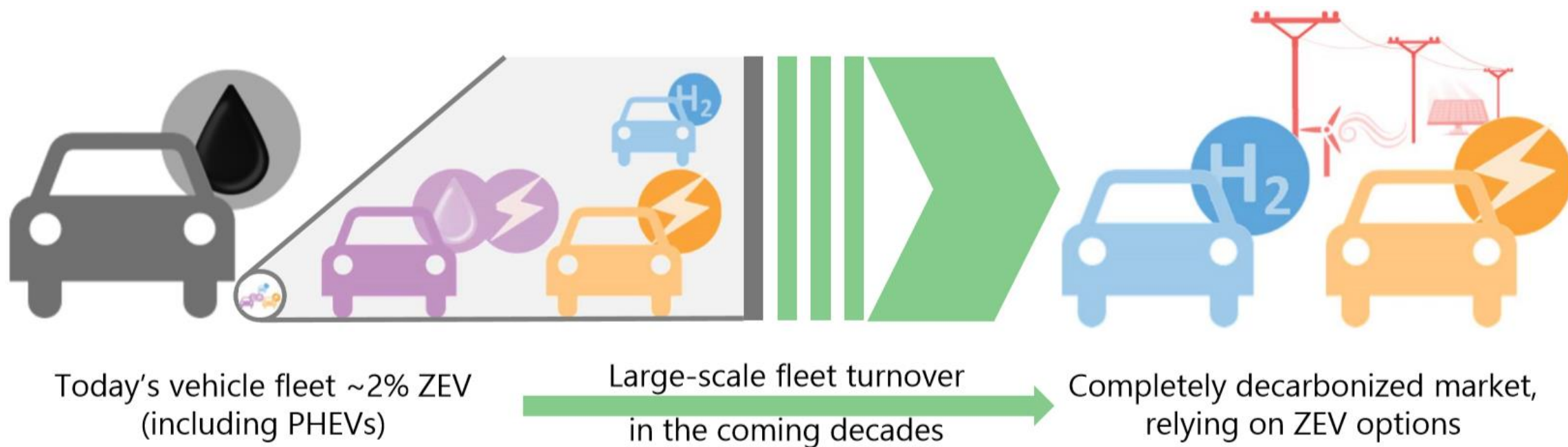


California Heavy-Duty ZEV Regulations





California's ZEV Strategy



- Success requires ZEVs on the market that meet all possible use cases
- Different drivers have different vehicle needs, usage patterns, and ZEV fueling ability
- FCEV and BEV compliment each other, where one faces challenges other typically excels
- Multiple technology options provides greater chance of success and potentially faster ramp up
- Both ZEV fuel pathways offer unique and exciting opportunities to enable greater renewable penetration on the electric grid

—MISSION—

accelerate

commercialization of hydrogen
and fuel cell vehicles





—California Fuel Cell Revolution—

Enable market conditions to support:

1,000 hydrogen stations

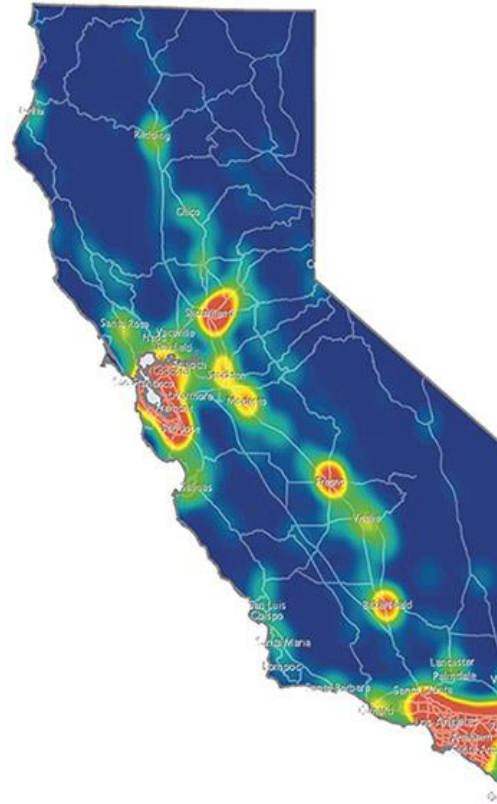
and

1,000,000 fuel cell vehicles

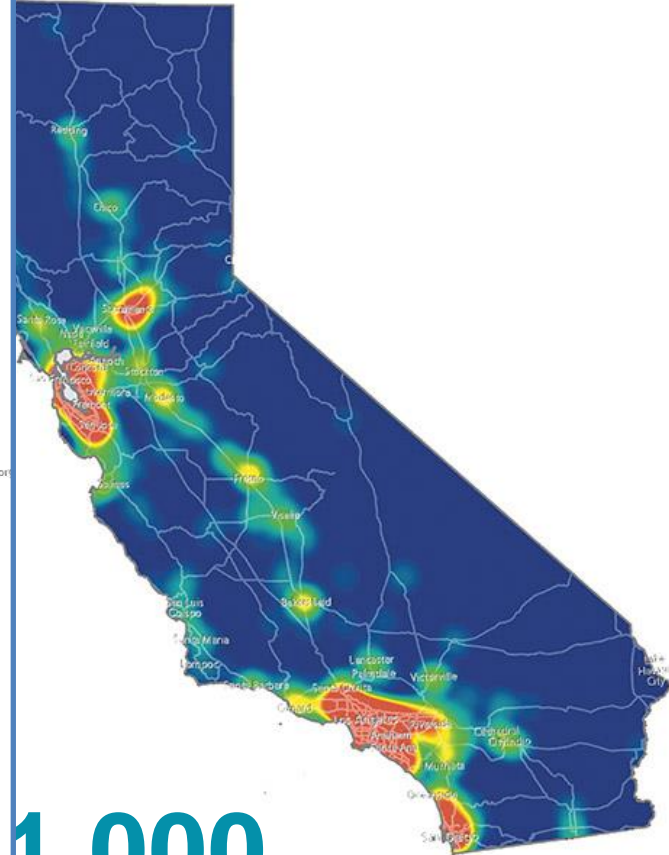
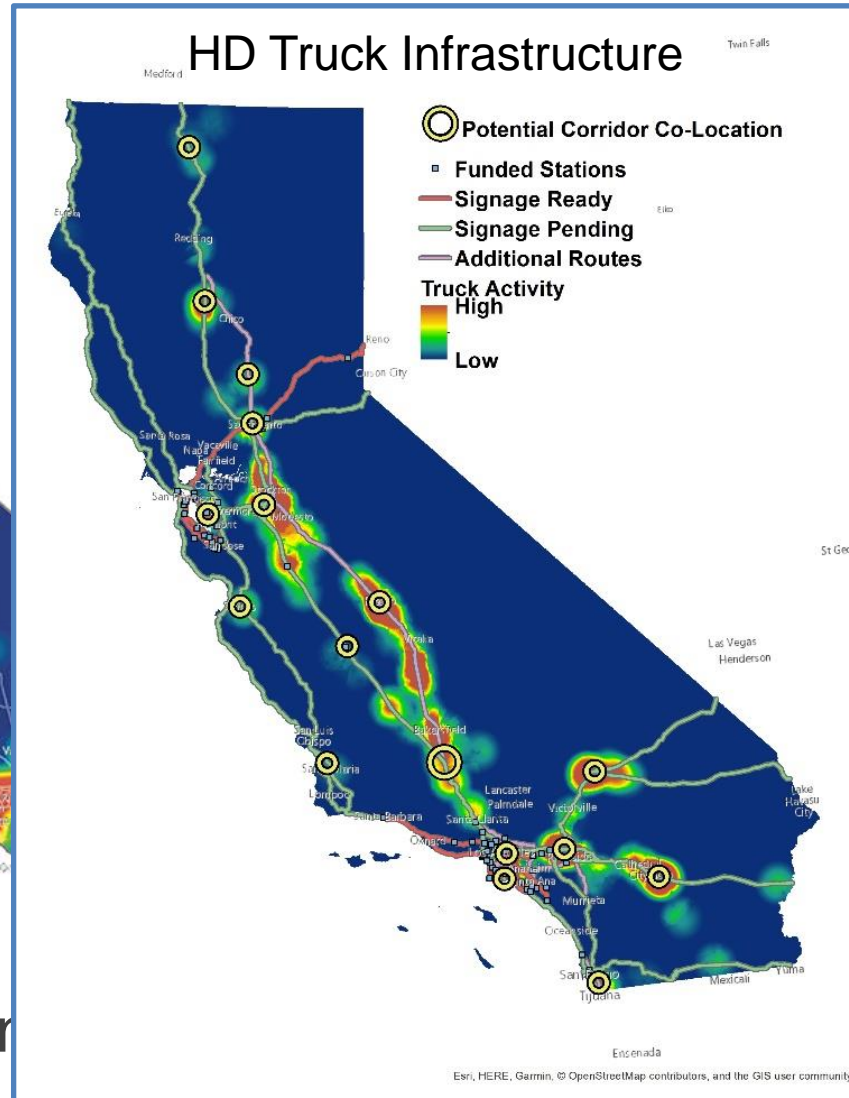
by **2030**



Image of a Successful Self-Sustaining Market



8,000
retail gas stations



1,000
retail H2 stations



Strategies for reaching market success





— Next for California —

- ✓ **Policies** that encourage **investment**
- ✓ Addressing **cost challenges**
- ✓ **Renewable** production pathways
- ✓ **Expanding Stations** across and beyond CA
- ✓ Sustainable **freight and transit**

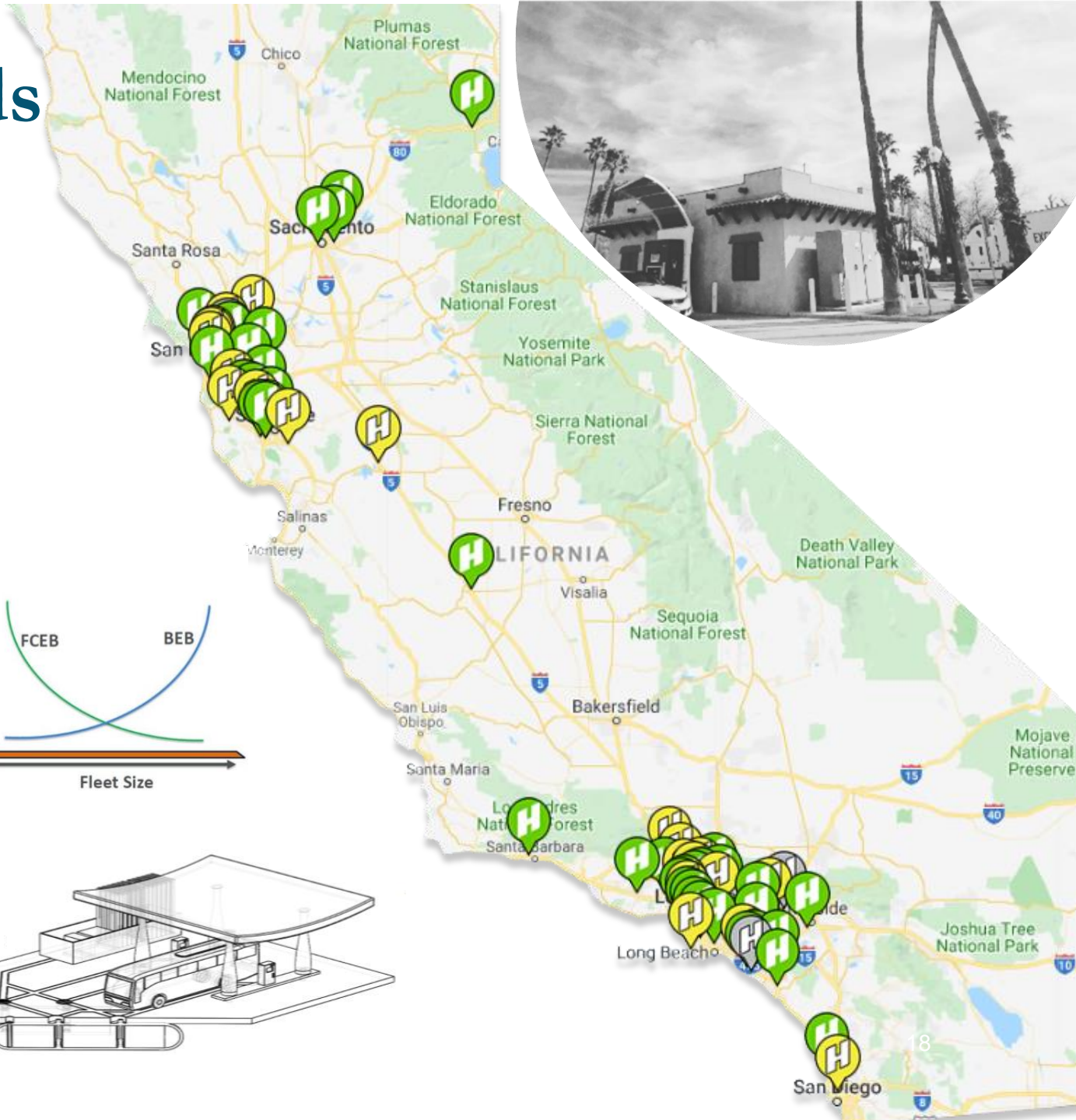
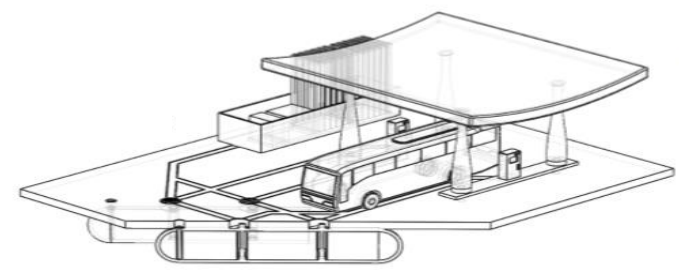
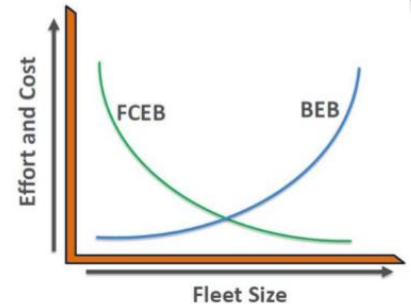


Lessons from California's Market Launch

- Three key lessons
 - State **leadership** was crucial
 - Shared vision or **plan** is fundamental
 - Policy and investment **commitments** move the market
- Partnership between industry and government
- Education and awareness is ongoing
- Safety and emergency response training – builds confidence, support and speed
- Models for guidance and consensus – then let industry drive the market
- Build a house you can grow into
- Scale is the keystone to market sustainability – *what drives us there faster?*

Opportunities & Needs

- H2@Scale
- H2 & Grid interaction and analysis
- FCEV to grid analysis
- Scale scenarios and analysis
- Cost reductions and analysis
- LD and HD synergies
- Codes and standards
- HD analysis and development
- Underground
- Safety and ER training
- Environmental analysis
- SOSS expansion





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