



Hydrogen Production & Distribution

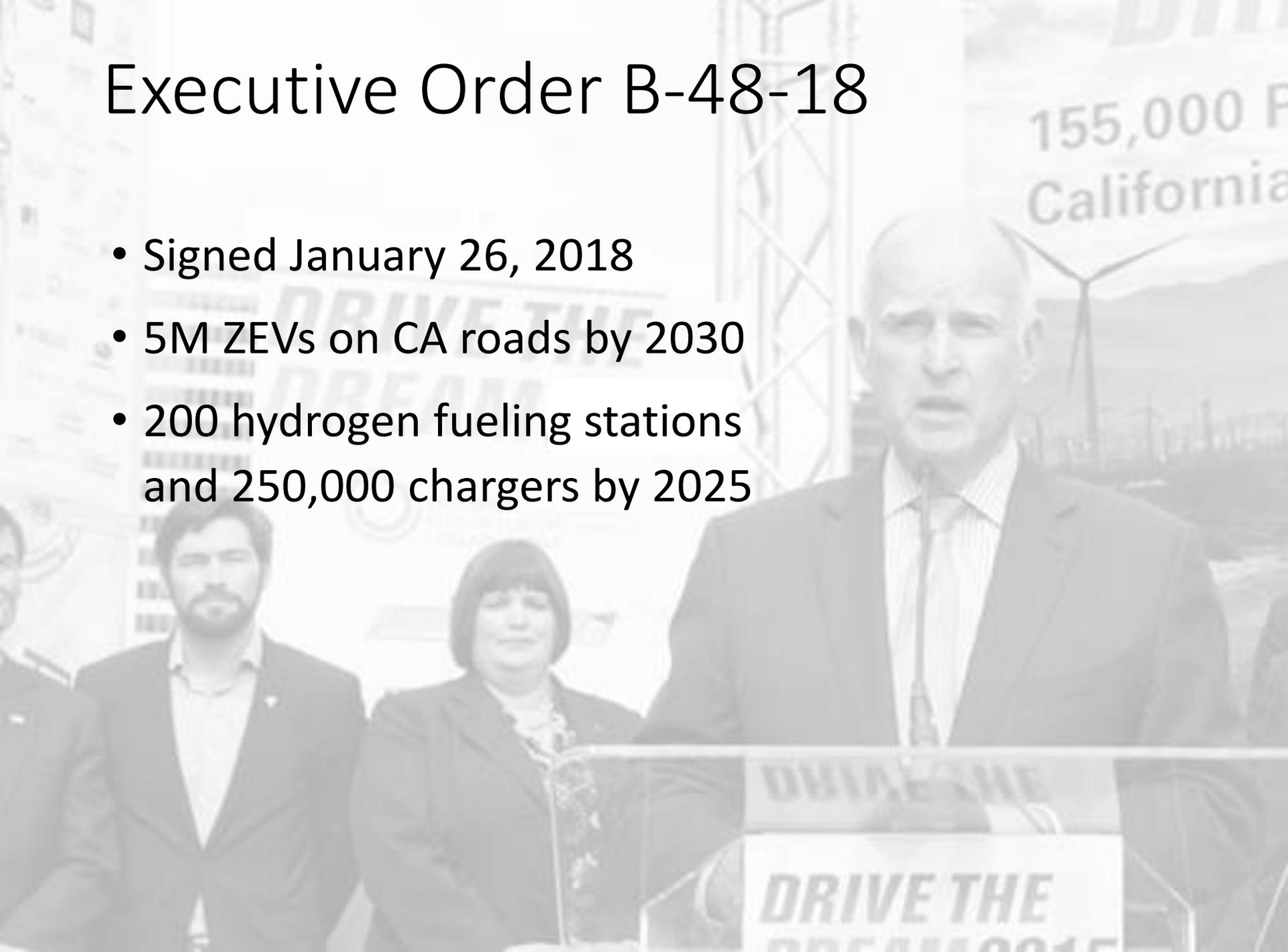
CPUC ZEV Rates Forum

June 8, 2018



Executive Order B-48-18

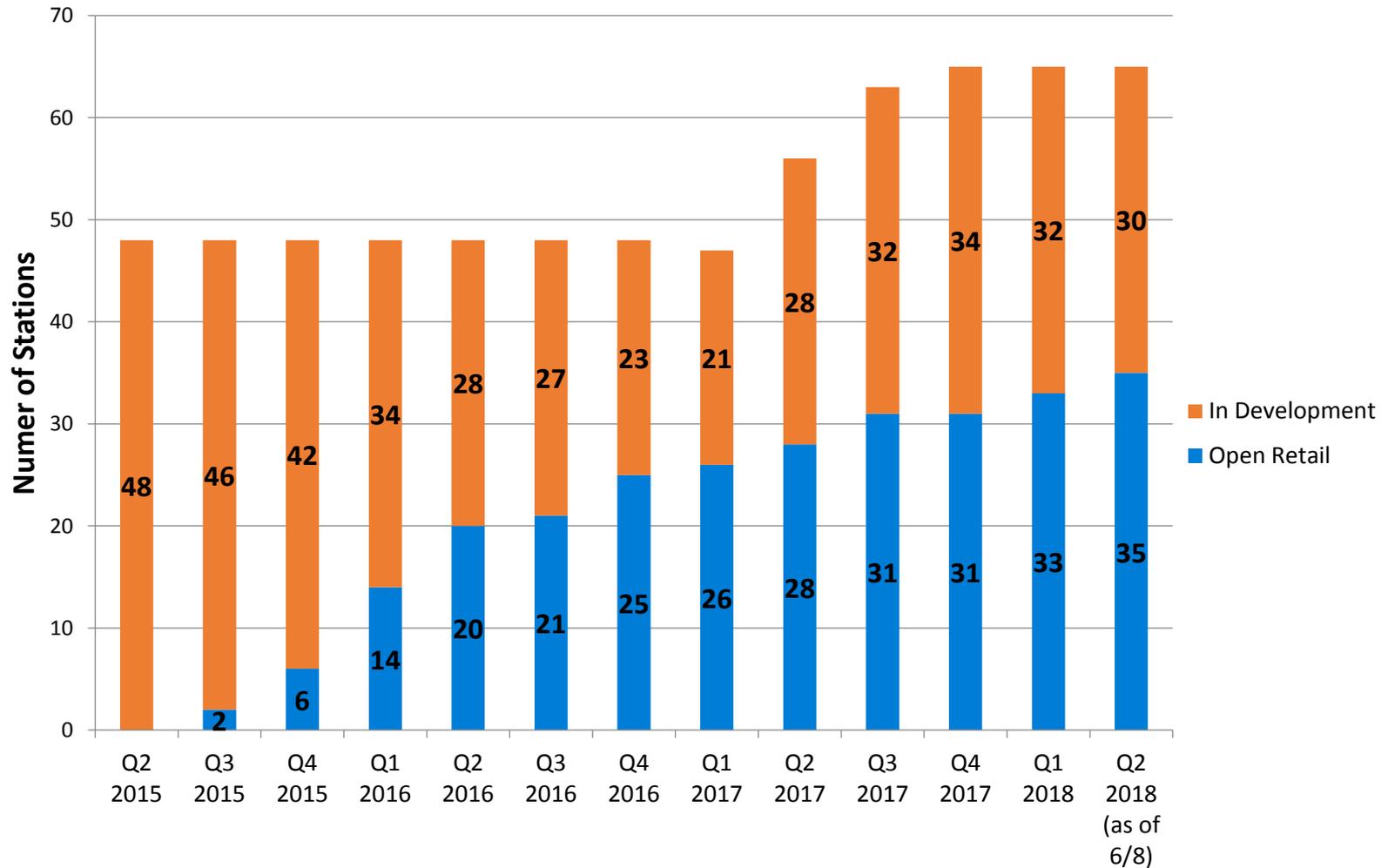
- Signed January 26, 2018
- 5M ZEVs on CA roads by 2030
- 200 hydrogen fueling stations and 250,000 chargers by 2025



Birth of the 1st Retail H₂ Network

- 2012: CaFCP's *A California Roadmap* described the launch of the early commercial market for FCEVs
 - 2013: AB-8 (Perea) gave CEC long-term funding authority to build at least 100 retail H₂ stations
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Historical Station Development



Source: 2017 AB 8 Joint Agency Staff Report (Q1/Q2 data added by GO-Biz)

Northern CA Hydrogen Stations

● Retail: Open

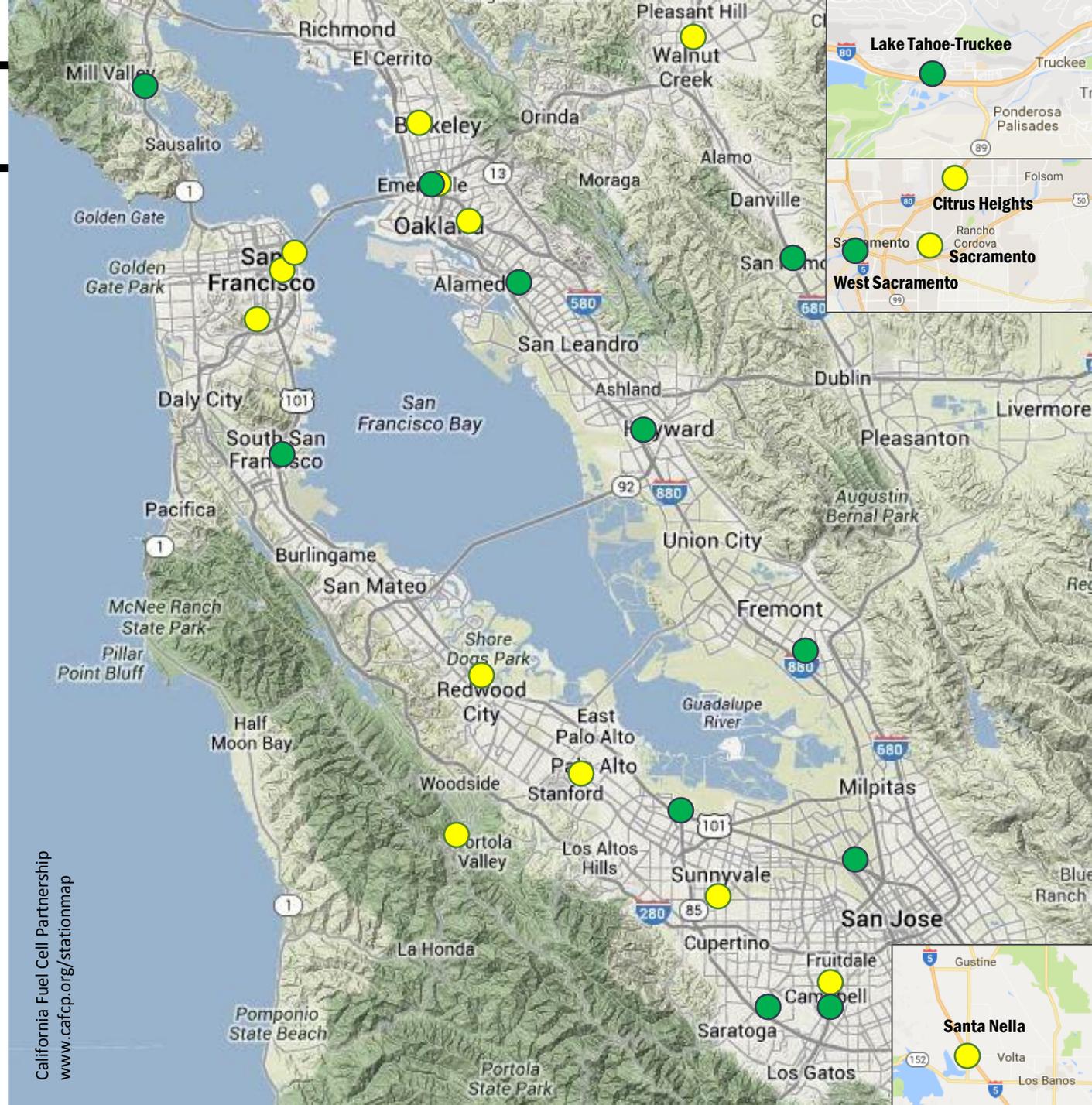
- Campbell - Winchester Blvd
- Fremont
- Hayward
- Mill Valley
- Mountain View
- San Jose
- San Ramon
- Saratoga
- South San Francisco
- Lake Tahoe-Truckee
- West Sacramento

● Other: Open

- Emeryville - AC Transit
- Oakland - AC Transit

● Retail: In Development

- Berkeley
- Campbell - East Hamilton Ave
- Citrus Heights
- Emeryville (Upgrade)
- Oakland - Grand Ave
- Palo Alto
- Redwood City
- Sacramento
- San Francisco - Third St
- San Francisco - Harrison St
- San Francisco - Mission St
- Santa Nella
- Sunnyvale
- Walnut Creek
- Woodside



Southern CA Hydrogen Stations

● Retail: Open

- Anaheim
- Costa Mesa
- Del Mar
- Diamond Bar
- Fairfax-LA
- Harris Ranch
- Hollywood
- La Cañada Flintridge
- Lake Forest
- Lawndale
- Long Beach
- Newport Beach
- Ontario
- Playa Del Rey
- Riverside
- San Juan Capistrano
- *Santa Barbara
- Santa Monica - Cloverfield Blvd
- South Pasadena
- Thousand Oaks
- Torrance
- UC Irvine
- West LA
- Woodland Hills

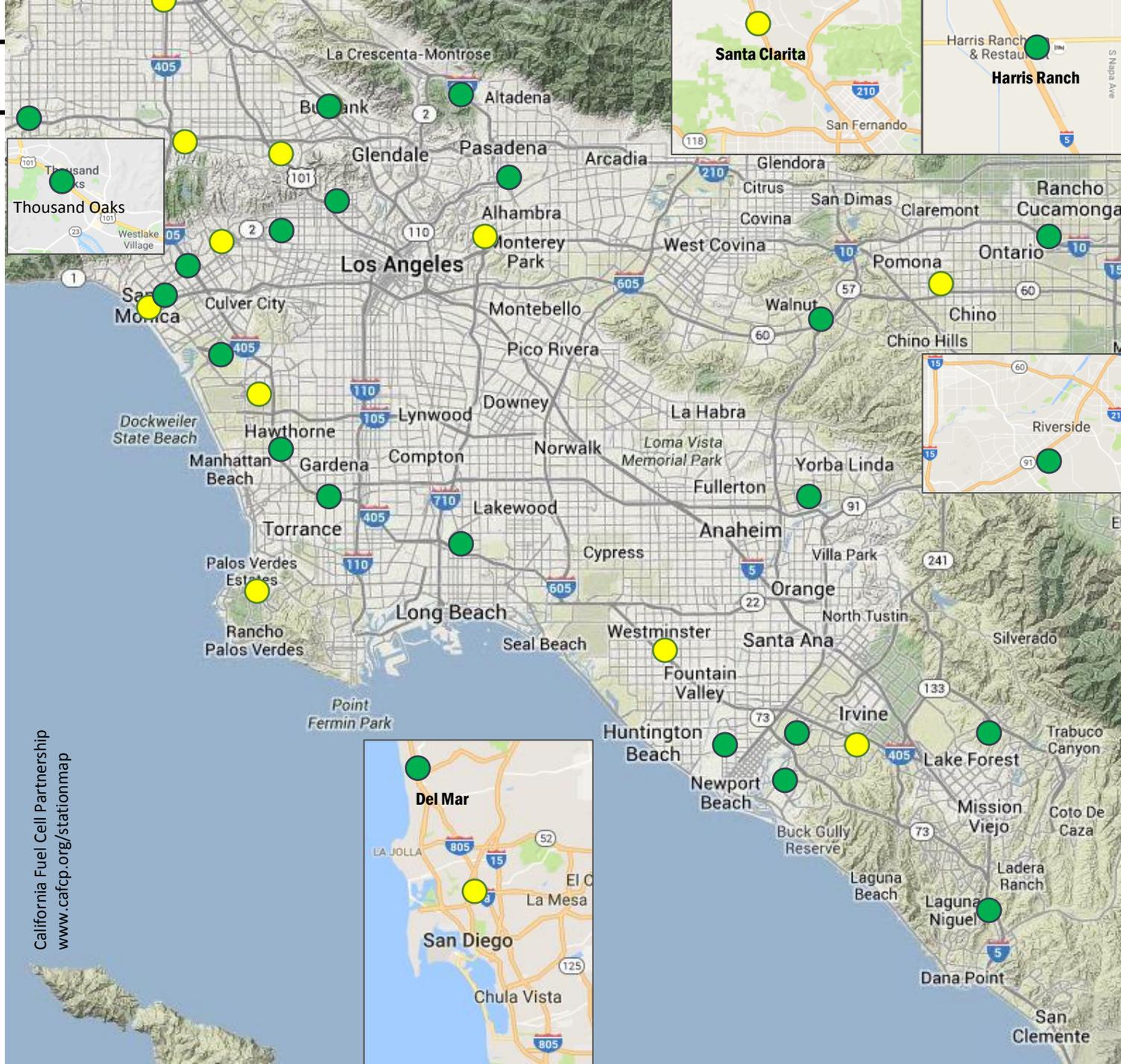
● Other: Open

- Burbank
- *Thousand Palms - SunLine Transit

● Retail: In Development

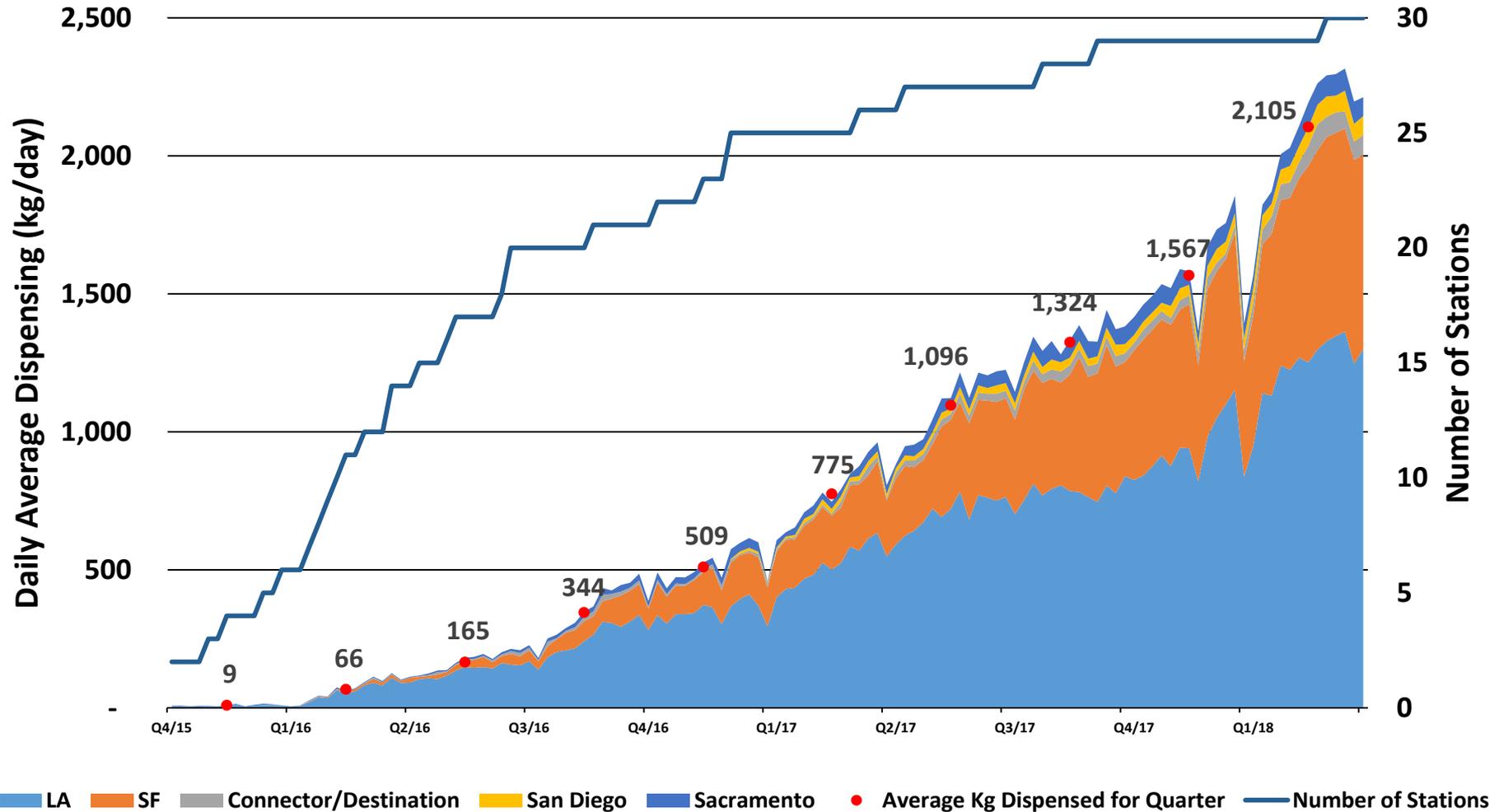
- Burbank (upgrade)
- Beverly Hills
- Cal State LA
- Chino
- Huntington Beach
- Irvine
- LAX (upgrade)
- Mission Hills
- Rancho Palos Verdes
- San Diego
- Santa Clarita
- Santa Monica - Lincoln Blvd
- Sherman Oaks
- Studio City

**Not shown on map*



California Fuel Cell Partnership
www.cafcp.org/stationmap

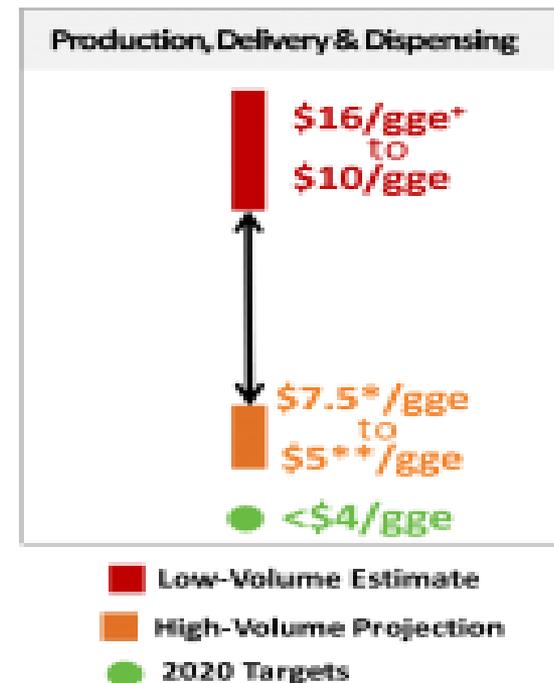
Hydrogen Fuel Demand is Growing...



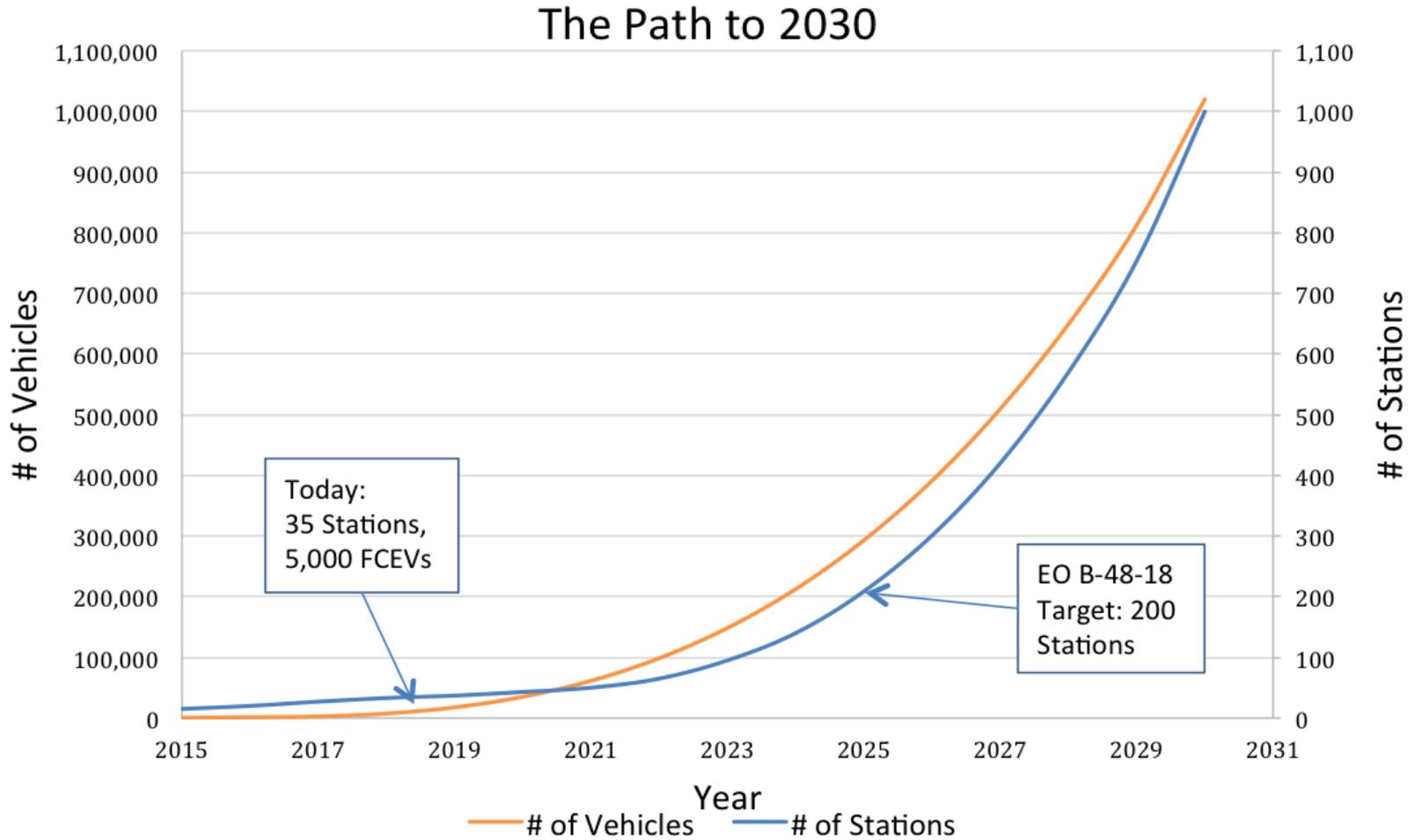
Source: CEC

Early Market Costs per kg are High

- 1kg H₂ = 1 gallon of gas (energy content)
- FCEV travels about 60-70 miles/kg
- Today's stations sell at approximately \$15/kg
- Targeting below \$6/kg
- OEMs are bridging the gap



2030 Hydrogen Vision



A Hydrogen Station's Connection to the Grid

- Electricity is used at all stages in the process – production, distribution, and dispensing
- Electrolysis (centralized or onsite) = ~ 50 kWh/kg
 - Time independent, creates opportunities for the grid
- Liquefaction (centralized) = ~ 7 kWh/kg
- Electricity is used for compression, chilling, dispensing (onsite) =
 - ~ 2 kWh/kg for gaseous; < 1 kWh/kg for liquid
 - On demand

H₂ Production Cost for Electrolysis

Cost of Hydrogen Produced by Electrolysis as a Function of Electricity Prices

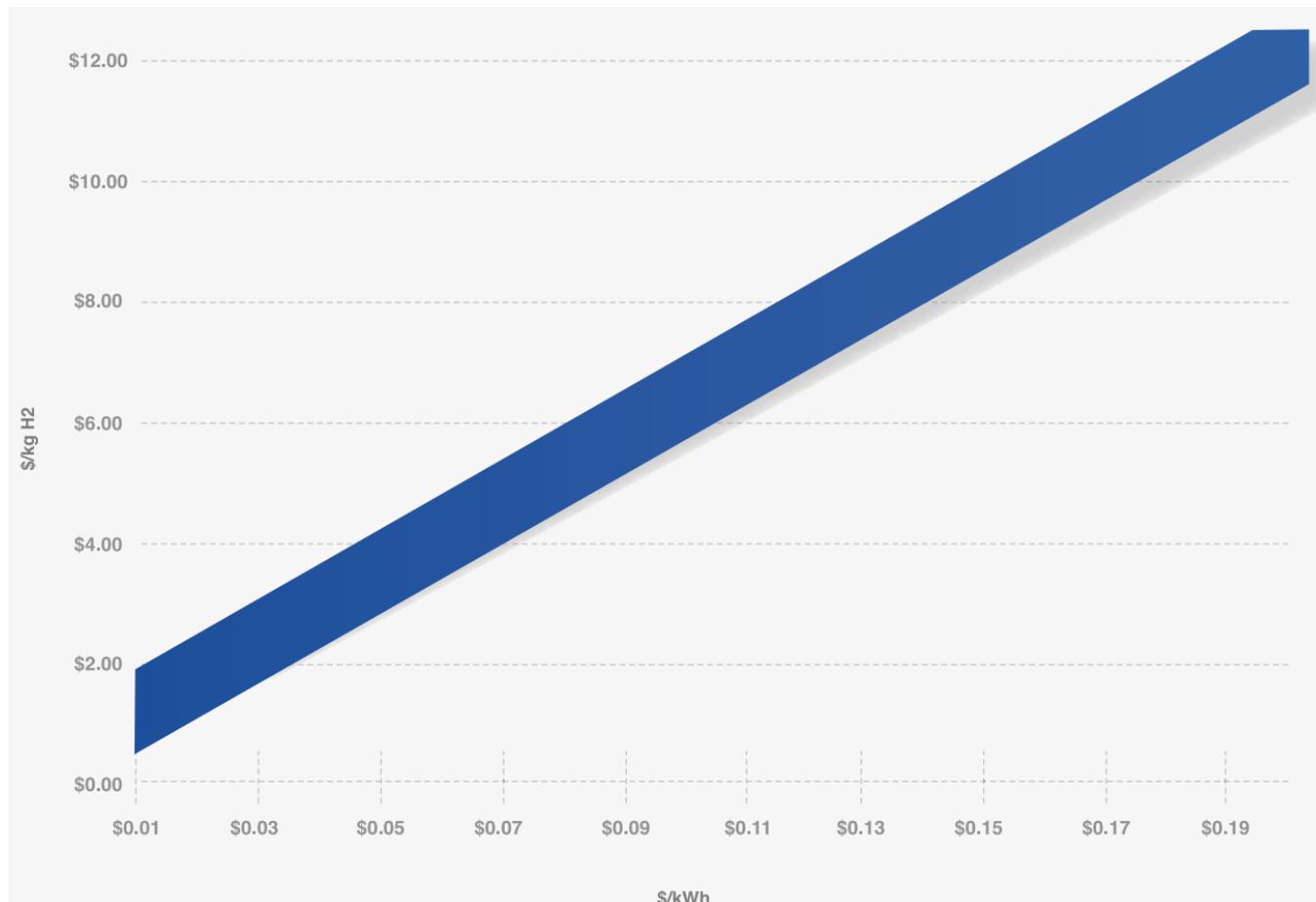
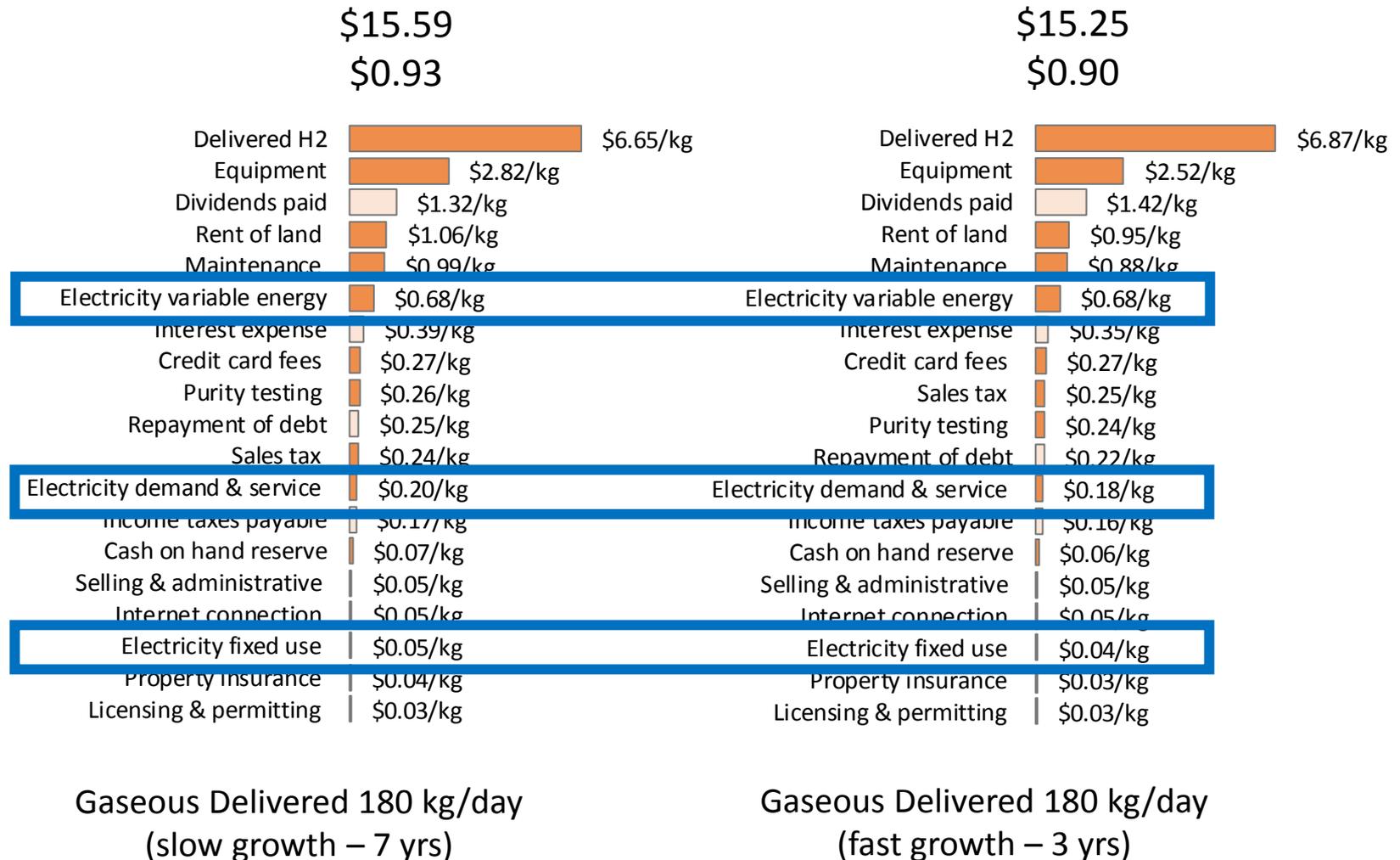


Image: EIN *Renewable Hydrogen Roadmap 2018*

Source data: ProtonOnsite - 2 MW PEM Electrolyzer at 2017 Costs

Costs: Delivered H₂ Gas



Key Question

How can rates sustainably encourage hydrogen production and distribution that benefit the grid and lower price at the pump?

Thank You!

Gia Brazil Vacin

gia.vacin@gobiz.ca.gov

916-319-9968

