Preparing for market launch

Fuel cell electric vehicles and hydrogen fueling stations in California

Joe Gagliano

California FUEL CELL PARTNERSHIP

DRIVING FOR THE FUTURE

CaFCP Members

Air Liquide
Air Products
Alameda-Contra Costa Transit District *(AC Transit)*
Automotive Fuel Cell Cooperation
BAE Systems
Ballard Power Systems
Bay Area Air Quality Management District
California Air Resources Board
California Department of Food and Agriculture
California Energy Commission
California State University - Los Angeles
CALSTART
The Center for Energy Efficiency and Renewable Technologies *(CEERT)*
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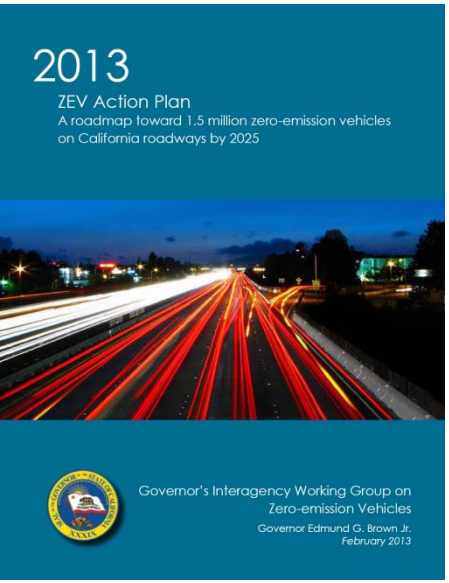
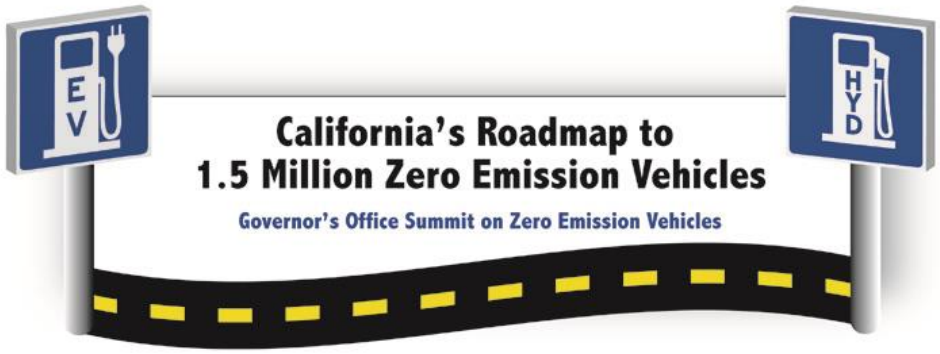
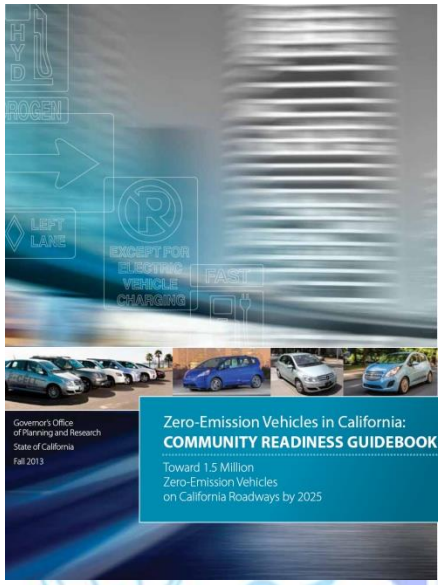
Daimler
Energy Independence Now
General Motors
Honda
Hydrogenics
Hyundai
ITM Power
Institute of Transportation Studies, UC Davis
Linde North America, Inc.
National Fuel Cell Research Center, UC Irvine
National Renewable Energy Laboratory *(NREL)*
Nissan
Sandia National Laboratories
South Coast Air Quality Management District
Southern California Gas Company
SunLine Transit Agency
Toyota
U.S. Department of Energy
U.S. Environmental Protection Agency
US Hybrid
University of California, Berkeley
Volkswagen

CA's Zero Emission Vehicle Action Plan

- By 2015: California major metropolitan areas "ZEV-ready" with infrastructure and streamlined permitting
- By 2020: California ZEV infrastructure can support up to 1 million vehicles
  - Including widespread use of ZEVs for freight and public transit
- By 2025: Over 1.5 million ZEVs in California







Visit www.cafcp.org/toolkits/cities to download the ZEV Action Plan

California commitments to FCEVs

- Assembly Bill 8
  - renewed AB 118 programs:
  - clean vehicle and equipment projects
  - research on biofuels production and the air quality impacts of alt fuels
  - workforce training
- $20 million a year until 2024
  - (or 20% of available funds)
- Funds up to at least 100 hydrogen stations
- Gives certainty to automakers, consumers, station developers, industrial gas producers, etc.

January 2015

Northern CA Hydrogen Stations

Open

Emeryville – AC Transit

In Development

Campbell
Cupertino
Foster City
Hayward
Mill Valley
Mountain View
Oakland
Palo Alto
Redwood City
*Rohnert Park
San Jose
San Ramon
Saratoga
South San Francisco
*Truckee
*West Sacramento
Woodside

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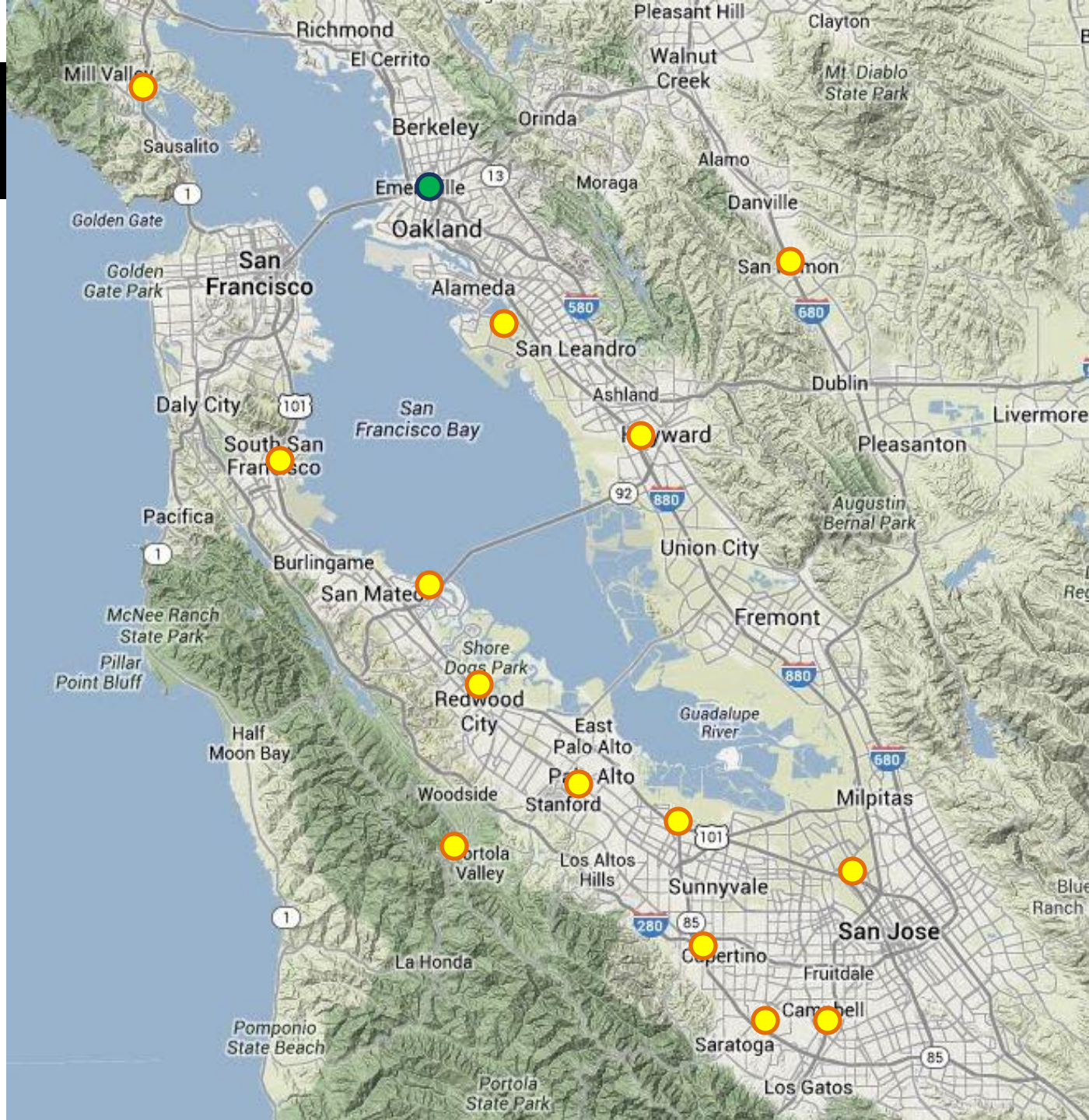

California FUEL CELL PARTNERSHIP
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January 2015

Southern CA Hydrogen Stations

Open

Burbank
Fountain Valley - OCSD
Irvine - UC Irvine
Los Angeles - Harbor City
Newport Beach
*Thousand Palms - SunLine Transit
Torrance

In Development

Anaheim
Chino (upgrade)
*Coalinga
Costa Mesa
Diamond Bar (upgrade)
Irvine - UC Irvine (upgrade)
Irvine - Walnut Ave.
La Canada Flintridge
Laguna Niguel
Lake Forest
Lawndale
Long Beach
Los Angeles - Beverly Blvd.
Los Angeles - Cal State LA
Los Angeles - LAX (upgrade)
Los Angeles - Lincoln Blvd.
Los Angeles - Hollywood Blvd.
Los Angeles - West LA 2
Los Angeles - Woodland Hills
Mission Viejo
Ontario
Orange
Pacific Palisades
Redondo Beach
*Riverside
*San Diego
*Santa Barbara
San Juan Capistrano
Santa Monica
South Pasadena

Not shown on map

California Fuel Cell Partnership
DRIVING FOR THE FUTURE
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California Fuel Cell Partnership
www.cafcp.org/stationmap

The cars are coming (buses, too)

Benefits

- **Passenger Cars**
- Fill up in less than 10 minutes
- Zero emissions
- 200 to 300+ miles

- **Hydrogen**
- Nonpolluting
- Reduced greenhouse gas emissions
- As safe as gasoline
- Domestic fuel

Fuel Cell Electric Buses

- 15 years of experience in California
- 14 years of data (NREL)
- 16 buses in daily operation
  - 12 in the Bay Area – AC Transit
  - 4 in the Coachella Valley – SunLine Transit
- More buses coming
  - 1 to UC Irvine
  - 4 more to SunLine

Incentives and investment

Energy Independence Now Report

ENERGY INDEPENDENCE NOW

EIN Briefing Paper

Crediting Hydrogen

An assessment of fuel incentives and renewable hydrogen investment in California.

Remy Garderet
Brian Goldstein

November 2014

Pathways to renewable hydrogen

1. Biogas-to-hydrogen technologies, using both centralized and onsite SMR

2. Electrolysis-based hydrogen using renewable power (wind and solar), also centralized and onsite.

3. Possible third source: waste hydrogen from the chloralkali process *

*not currently defined as one of the renewable resources under the PUC code

Linking utility and transportation sectors

- Hydrogen Energy Storage (HES) via electrolysis
  - aka Power-to-Gas in Europe
- Storing long-term seasonal energy
  - the natural gas pipeline network
  - underground salt caverns
- Electrolysis modules are always available to receive load by turning on (or release load by turning off)
  - Translation: candidate for demand side management of a highly renewable electricity grid

Questions?

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Resources

1. E3 study "Decarbonizing Pipeline Gas to Help Meet California's 2050 Greenhouse Gas Reduction Goal" (Jan 2015) - https://ethree.com/documents/E3_Decarbonizing_Pipeline_01-27-2015.pdf
2. Energy Independence Now study, "Crediting Hydrogen: An assessment of fuel incentives and renewable hydrogen investment in California," (Nov 2014). http://www.einow.org/images/stories/factsheets/ein_creditinghydrogen.pdf
3. Advanced Power and Energy Program (APEP) at UC Irvine study, "The Importance of Grid Integration for Achievable GHG Emissions Reductions from Alternative Vehicle Technologies." http://www.apep.uci.edu/3/ResearchSummaries/pdf/SustainableTransportation/ElectricGrid_VehicleIntegrationGHGimpacts.pdf