

# **U.S. DOE Hydrogen and Fuel Cell Program Annual Merit Review**

## **State-Funded Hydrogen and Fuel Cell Activities April 30, 2019**

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# What is the South Coast AQMD?

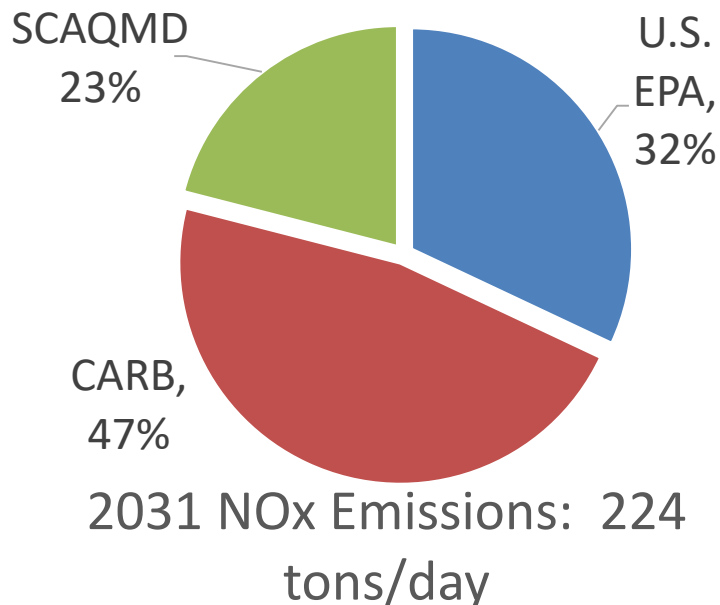


- **Air pollution control agency**
  - Orange County and the non-desert portions of Los Angeles, Riverside and San Bernardino counties
- **Responsibilities**
  - Control emissions from stationary sources (e.g., from power plants, refineries, gas stations, painting facilities, etc.)
  - Monitor air quality and meet federal and state air quality standards
  - Permit and inspect 28,400 affected businesses



# Legal Authority and Responsibility

- ~88% of NO<sub>x</sub> comes from mobile sources
- Limited local authority over mobile sources



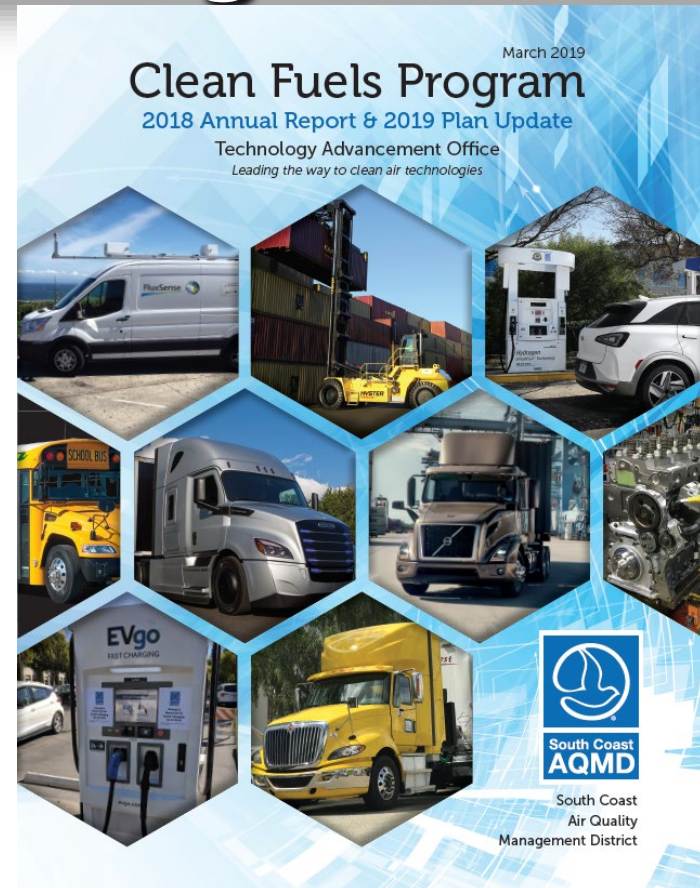
CARB  
SIP Strategy  
*including  
Federal  
source  
reductions*

SCAQMD  
control strategy  
SCAG Regional  
Transportation  
Plan and  
Transportation  
Control  
Measures



# Technology Demonstration Clean Fuels Program

- Established in 1988
- \$1 fee on DMV registrations (\$~12M/yr)
- Stationary source fee (~\$400k/yr)
- Research, develop, demonstrate, and deploy (RD3) clean technologies



- [H&SC Sections 40448.5 and 40512 and Vehicle Code Section 9250.11](#)
- <http://www.aqmd.gov/home/library/technology-research/reports>

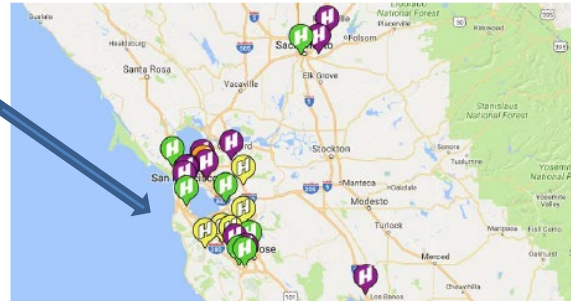


# California H2 Refueling Stations

## Snapshot



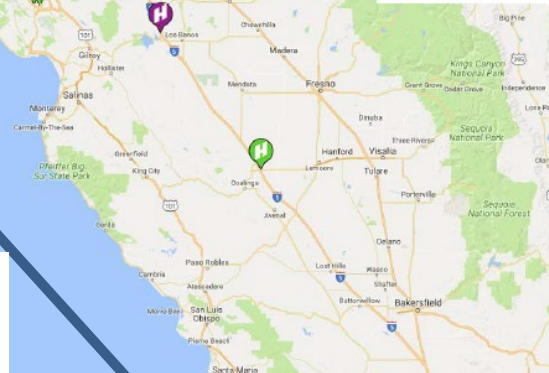
**A.C. Transit**



64 LDV stations in various stages

**Nel H2 - Proton**  
 350 bar, 900 kg/day  
 2 dispensers  
 5 New Flyer-10 min fill  
 8 FCB now – 20 min fill

**APCI Trailer**  
 350 bar, 300 kg  
 10 fills/day



**SunLine Transit\***



\* - SMR production for 10+ years

**POLA ZANZEFF**  
 Equilon (Wilmington & Ontario)  
 350 & 700 Bar  
 10 Kenworth Class 8 FC Trucks



**POLA**

**POLB**

**UC Irvine**  
 Upgrade to LH2 delivery  
 800 kg/day, 700 bar LD,  
 350 bar FC Bus (at night)

**OCTA**

Trillium, APCI LH2 delivery  
 350 bar, 1600 kg/day  
 10 New Flyer, 36 kg/bus,  
 6-10 min fill

**CEC NOPA 17-603**  
 Equilon, Toyota (w/ FCE tri-gen)  
 350 & 700 bar, 1000 kg/day  
 2 dispensers, 10 Toyota CL8 FCT



(Photo: Toyota)



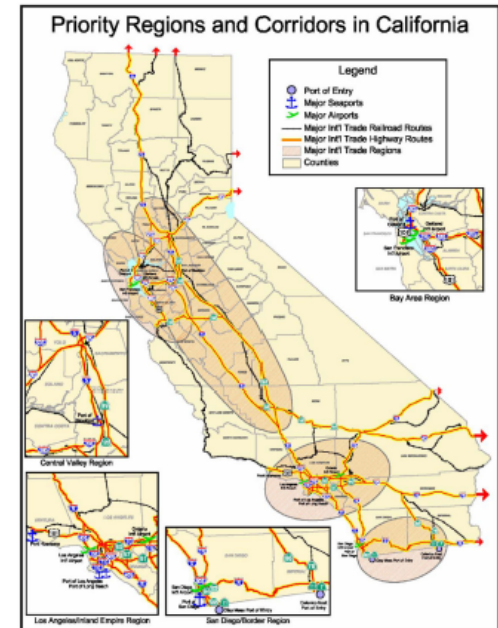
# Light Duty Retail H2 Stations

- Current retail stations
  - 200 kg/day (a couple smaller - legacy)
  - 5+ back to back fills/hour
  - 350/700 bar
  - Retail POS (credit cards)
  - Latest SAE standards
- 21 LD retail stations in our region (2 currently non-operational); SCAQMD co-funded 20 + 1 in development.  
4 additional in development
- CEC grant for three retail LD stations
  - Air Liquide (LAX)
  - H2 Frontier (Burbank)
  - Shell Equilon (Torrance)



# Medium & Heavy-Duty Station Parameters

- Optimized for truck application
- Location(s)
  - POLA/POLB
  - Inland Empire - Warehousing
  - Goods movement corridors
- Technology options
  - On-site Renewable production: SMR or Electrolysis
  - LH2 delivery
  - Combined w/ Heat & Power – enhanced efficiency
  - Pipeline connected plus on-site purification w/PSA



# H2Freight Project

- Advanced Freight Vehicle and Infrastructure Deployment:  
1,000 kg/day truck refueling to demonstrate zero emission goods movement at ports (H2Freight Project), with multiple fueling positions at 700 bar
- SCAQMD cost-share to refuel heavy-duty vehicles at 350 bar, supporting fuel cell demonstrations by multiple operators at local ports
- Evaluate fueling protocols, dispenser design, station throughput/reliability, etc.
- CEC \$8 Million (GFO-17-603)  
Equilon (dba Shell) \$1.4 Million  
Toyota \$1.4 Million  
SCAQMD \$1.2 Million





# Zero Emission Freight Project

POLA – Zero Emissions Freight “Shore to Store” (S2S) Project (\$82.5M total)

- CARB (\$41M) & CEC (\$26M)
- Port of Hueneme
- Develop and demonstrate ten fuel cell trucks
- H2 stations in Wilmington and Ontario
- SCAQMD \$1 Million



## Hydrogen Infrastructure Partnership Program

- Orange County –  
UCI Hydrogen Station Upgrade:  
MSRC for up to \$1M  
(PON 2018-02)  
CEC \$400k (ARFVTP)  
SCAQMD \$400k (Clean Fuels)
- Goal – Co-fund at least one  
hydrogen station per county
- Up to \$2M remains available  
<http://www.cleantransportationfunding.org>



# Zero-Emission Cargo Transport II

## Timeline

- Project Award: 10/1/14
- Contractor Kickoff: 12/16/15
- Project Completion: 9/30/19

## Budget

- DoE: \$10,000,000
- Funding partners: \$7,467,473
- Contractors: \$3,075,841
- Total Cost: \$20,543,314

## Contractors & Projects

- BAE/CTE: Fuel cell range extended drayage truck
- TransPower: Fuel cell range extended drayage truck
- U.S. Hybrid: Fuel cell powered drayage truck
- Hydrogenics: Fuel cell range extended drayage truck
- BAE/GTI: CNG hybrid with Near Zero CNG Engine



# Zero-Emission Cargo Transport II

## Progress

- First deployment began from Q2 2018 with two fuel cell range extended trucks
- Portable hydrogen fuel onsite is in operation
- Debugging and design improvement are in progress by lessons-learned from the first demo trucks

## 2018/2019 Objectives

- Complete all vehicle builds
- Data analysis and design improvement from demonstration

## Impact

- Pushing Zero Emission Technology and Industry Envelope by Demonstrating First Fleet of FCEV's in Drayage Service in California



# Zero-Emission Cargo Transport II

## Deployment of Fuel Cell Technology for Heavy-duty Sector

- Six of seven vehicle designs and integration are complete including CNG hybrid truck
- Design improvement and system optimization
- Analyze data collected and secure reliability



## Challenge

- Costs will remain a challenge for the near and mid term
- Penetration into mid or long range application

