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

State-Funded Hydrogen and Fuel Cell Activities

April 30, 2019

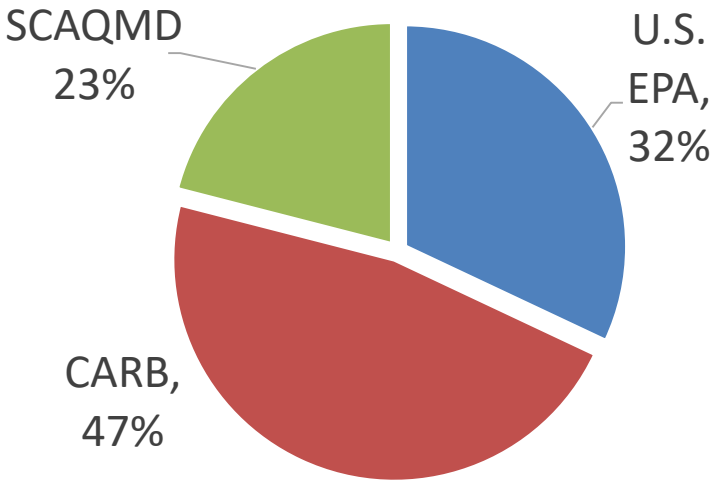
Joseph Impullitti
Technology Demonstration Manager
Science and Technology Advancement
South Coast Air Quality Management District

What is the South Coast AQMD?

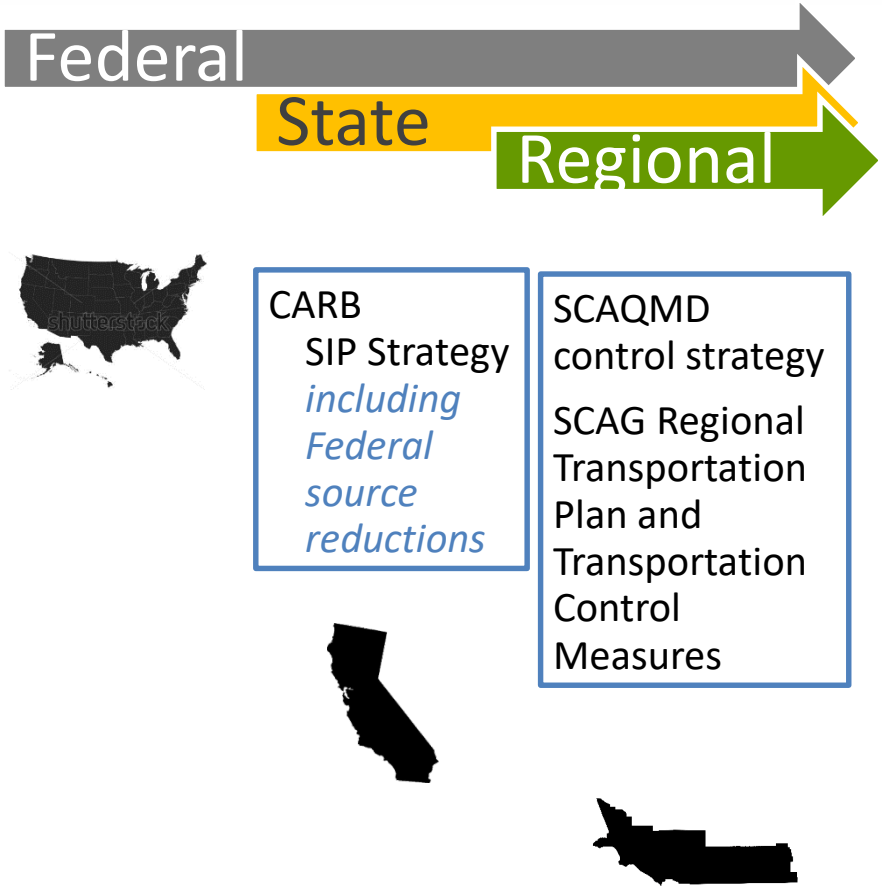
- **Air pollution control agency**
  - Orange County and the non-desert portions of Los Angeles, Riverside and San Bernardino counties
- **Responsibilities**
  - Control emissions from stationary sources (e.g., from power plants, refineries, gas stations, painting facilities, etc.)
  - Monitor air quality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

Legal Authority and Responsibility

- ~88% of NOx comes from mobile sources
- Limited local authority over mobile sources

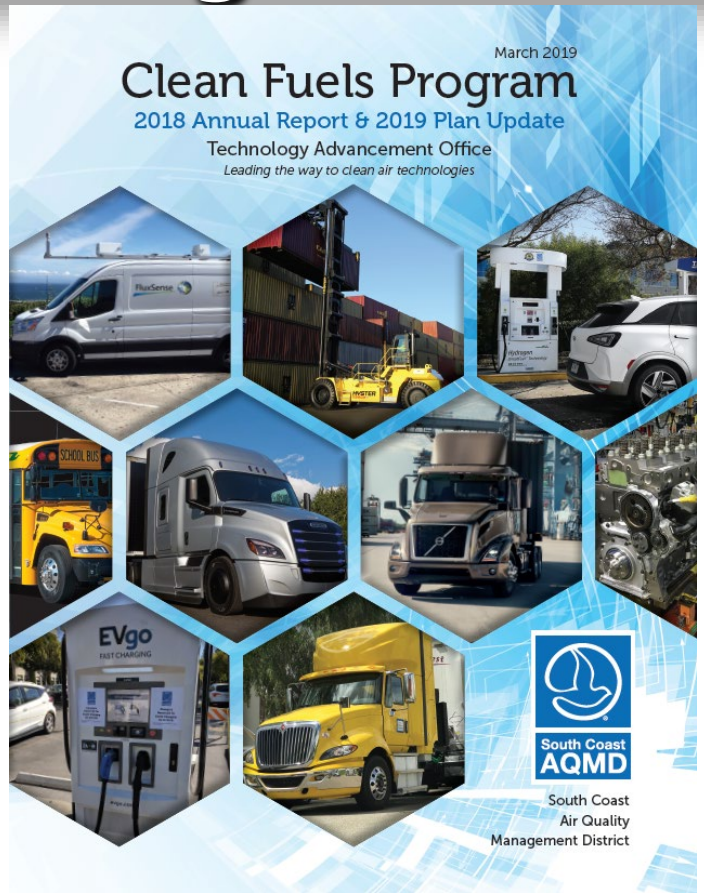


2031 NOx Emissions: 224 tons/day



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

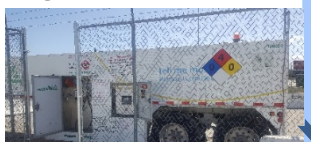
California H2 Refueling Stations

Snapshot

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

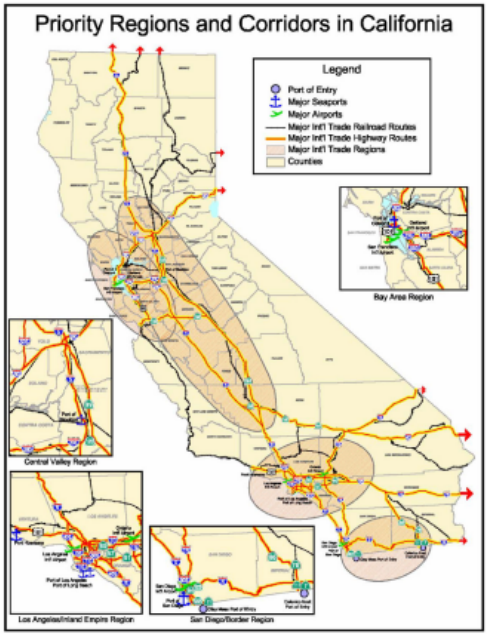
(Photo: Toyota)

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

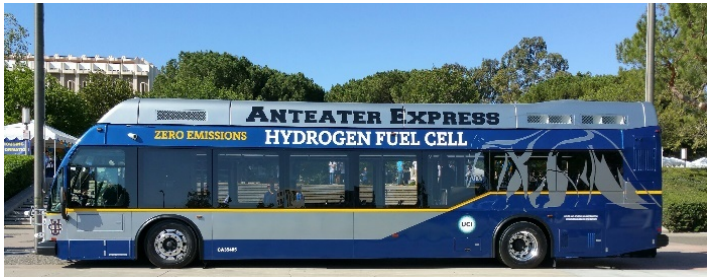
POLA – Zero Emissions Freight "Shore to Store" (S2S) Project ($82.5M total)

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

MSRC

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

BAE SYSTEMS INSPIRED WORK KENWORTH A PACCAR COMPANY

US Hybrid

TransPower

HYDROGENICS SHIFT POWER | ENERGIZE YOUR WORLD

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