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

State-Funded Hydrogen and Fuel Cell Activities

April 30, 2020

Joseph Impullitti

Technology Demonstration Manager

Science and Technology Advancement

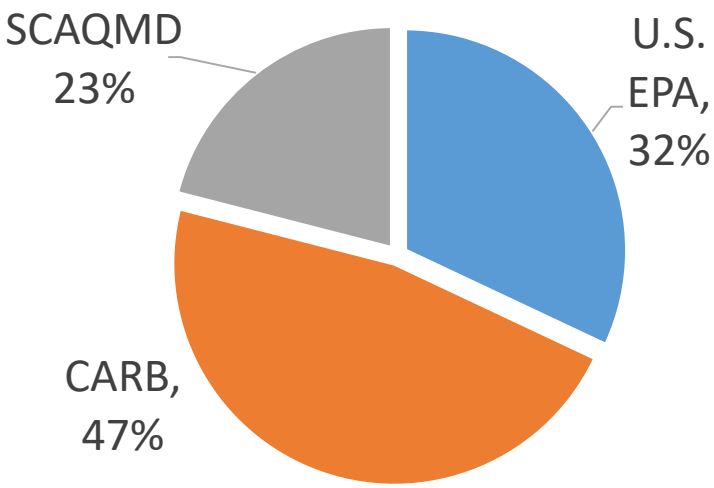
South Coast Air Quality Management District

What is the South Coast AQMD?

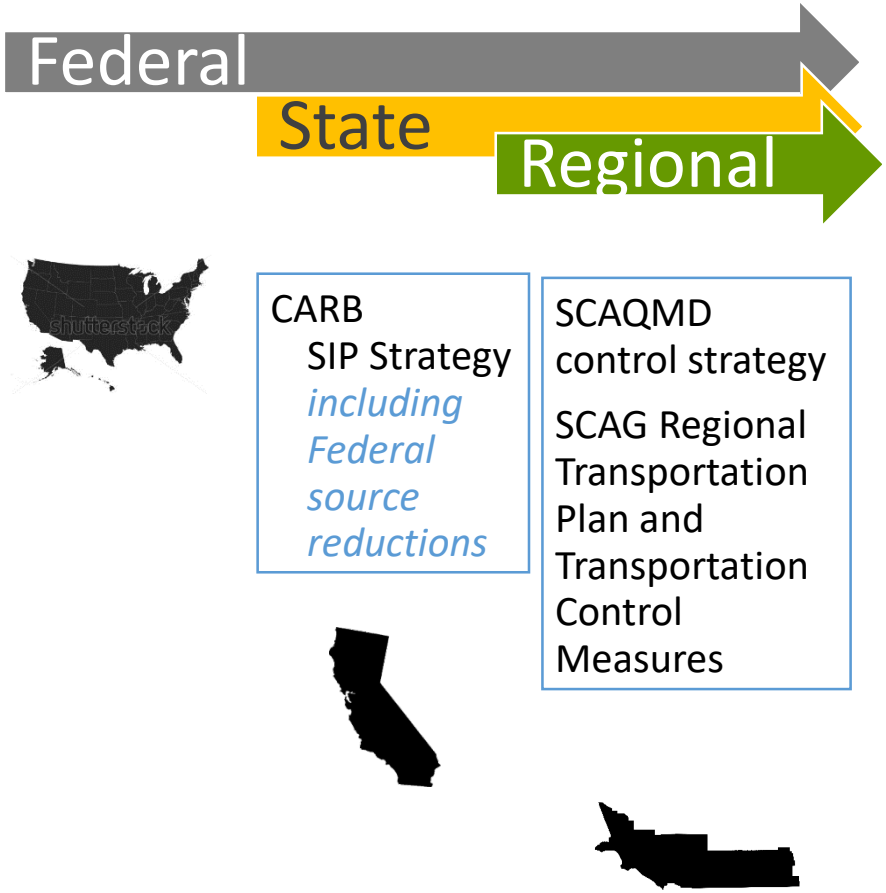
- **Air pollution control agency**
  - Orange County and the non-desert portions of Los Angeles, Riverside and San Bernardino counties
- **Responsibilities**
  - Control emissions from stationary sources (e.g., from power plants, refineries, gas stations, painting facilities, etc.)
  - Monitor air quality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

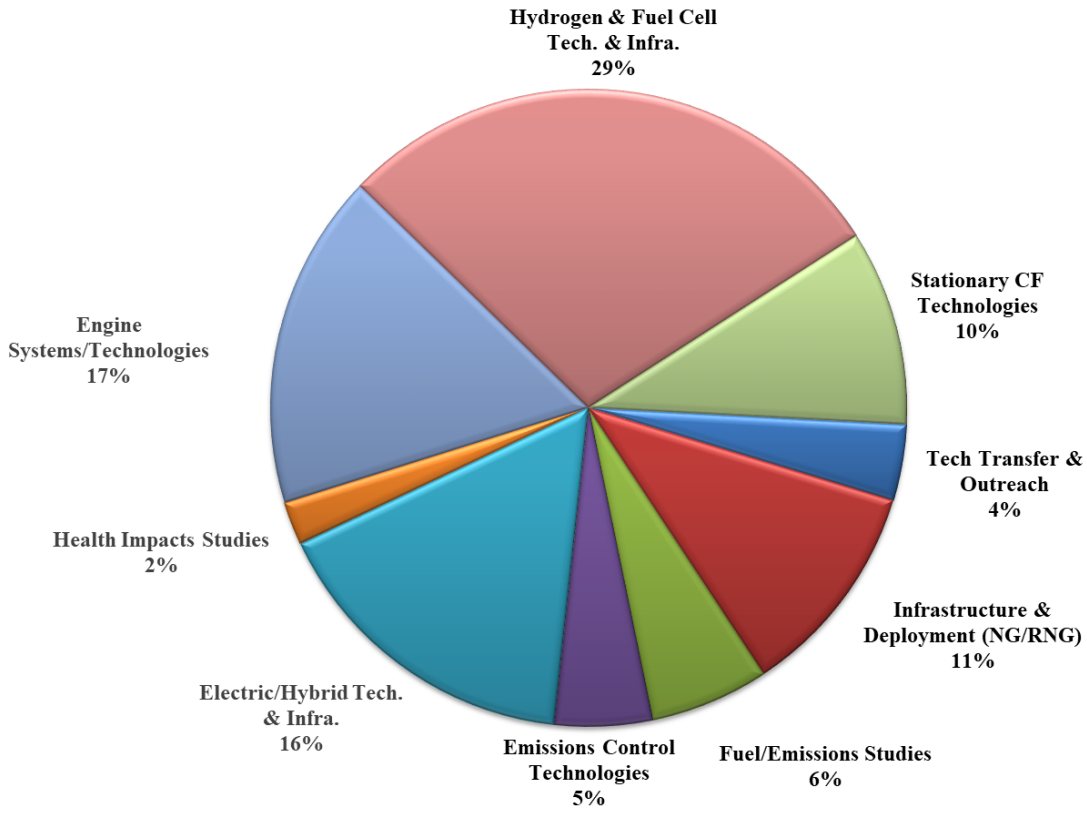


Technology Demonstration Clean Fuels Program

- 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

2020 Plan Distribution



$16.1M

SBCTA Rail

San Bernardino County agency orders its first zero-emission train for Redlands rail service

BY STEVE SCAUZILLO

November 15, 2019 at 4:07 pm

- Michigan State University (MSU) feasibility study
- Approved the hydrogen fuel cell-battery hybrid alternative propulsion technology for implementation as part of the future Arrow Service
- Potential site of joint use hydrogen station, west of 215 fwy, between 10 & 210 fwys
- 2024 Zero Emission in-service goal

https://www.gosbcta.com/project/redlands-passenger-rail-project-arrow/

CA Hydrogen Stations

63 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

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
350 & 700 bar, 1000 kg/day
2 dispensers, 10 Toyota CL8 FCT

(Photo: Toyota)

OCTA Liquid Hydrogen Fueling Station

- Trillium CNG with Air Products liquid hydrogen deliveries
- Hydrogen station event for partners January 31, 2020
- Fueling time 6 – 10 minutes/bus with 350 bar
- 280 kg peak back to back fills, 1,450 kg/day
- 10 New Flyer 40’ buses in operation
  85 kW Ballard fuel cell and 80 kWh Li-FePO4 batteries
- Each bus uses 35.6 kg/day to provide >300 miles range

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

Fuel Cell Range Extended Drayage Trucks

- Revised ZECT2 project scope from one battery electric and three plug-in hybrid electric to four fuel cell Class 8 drayage trucks (200+ mile ZE range)
- Hydrogenics will provide the fuel cells
- Complete and deliver vehicles in 2021 with 12-month demonstration
- Cummins will cover project cost increase

H2Freight Project

- CEC GFO-17-603 - Advanced Freight Vehicle and Infrastructure Deployment:
  Award to Equilon (dba Shell) for 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.

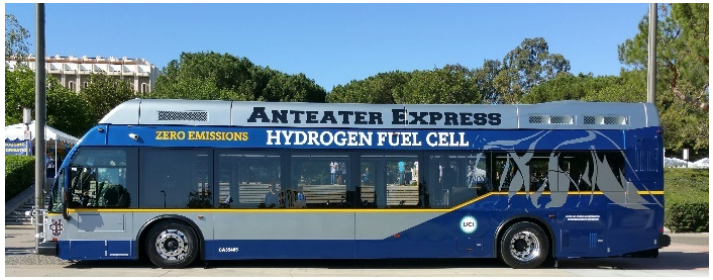
Zero Emissions Freight

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

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

UC Irvine Hydrogen Station Expansion

- Expansion to 800 kg/day with liquid delivery, increased storage, and four fueling positions
- Public use will continue 24/7, with buses scheduled to refuel at night
- Final design will incorporate state-of-the-art technology
- Co-funding approved & contracts executed:
  MSRC $1M (PON 2018-02)
  CEC $400k (ARFVTP)
  SCAQMD $400k (Clean Fuels)



How can the state help achieve greater penetration of this ZEV technology?

South Coast AQMD

Implementation - Incentive Funding

Program Title	Description	South Coast AQMD Funding Amount
Mobile Source Air Pollution Reduction Review Committee (MSRC)	Implement or monitor programs to reduce motor vehicle air pollution	$3M Hydrogen Infrastructure Partnership Program Status: $1M awarded for UC Irvine H2 station upgrade - includes bus fueling at night $3M remaining for 2019-21 Work Program
Community Air Protection Program (CAPP) Incentives	Approved by Governor as part of state budget each year. Funds projects that reduce emissions in disadvantaged and low-income communities. Supports the goals of AB 617.	Year 2 (SB 856) - $85.57 million Status: 85% of funds awarded to qualifying projects, 15% remaining for stationary source and other community-identified projects.
Carl Moyer Program	Provides incentives to owners to purchase cleaner-than-required vehicles/equipment, including infrastructure for zero and near-zero emissions vehicles.	$30.5 million (+ $4.6 million in local match) Status: Increased funding from AB 1274, all funds awarded in December 2019, begin contracting in Qtr 1 2020.
Volkswagen Environmental Mitigation Program	Intended to mitigate the excess NOx emissions caused by VW actions.	$165 million to South Coast AQMD (10-yrs) Status: Zero Emission Class 8 Freight & Port Drayage ($90M) solicitation 2020 tbd

California Hydrogen Infrastructure Research Consortium

- U.S. DOE H2@Scale program with national labs, CA GO-Biz, CEC, SCAQMD, and CARB
- Joint agreement led by NREL to continue hydrogen infrastructure research efforts, focused on California near-term priorities
- Project Management Plan 2020 tasks:
  H2 Station Data Collection
  Medium/Heavy Duty Fueling Report
  Hydrogen Contaminant Detection
  Nozzle Freeze Lock
  CA Hydrogen integration
  Technical Assistance

Summary

- Challenges remain to broader adoption of fuel cells in the transit and freight sectors
- Long term needs:
  - Scale-up of hydrogen dispensing and low carbon production
  - Scale-up of multiple supply chains
  - Long term policy support and funding predictability
- Short term needs:
  - Large freight fleets that are already familiar with fuel cell technology
  - Larger transit agencies adopting fuel cell transit
  - Microgrid integrated with hydrogen storage