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

State-Funded Hydrogen and Fuel Cell Activities
April 30, 2020

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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

Federal
State
Regional

CARB
SCAQMD
U.S. EPA

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
2020 Plan Distribution

- Hydrogen & Fuel Cell Tech. & Infra.: 29%
- Engine Systems/Technologies: 17%
- Health Impacts Studies: 2%
- Electric/Hybrid Tech. & Infra.: 16%
- Emissions Control Technologies: 5%
- Fuel/Emissions Studies: 6%
- Stationary CF Technologies: 10%
- Tech Transfer & Outreach: 4%
- Infrastructure & Deployment (NG/RNG): 11%

Total: $16.1M
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

A.C. Transit
APCI Trailer
350 bar, 300 kg
10 fills/day

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

CEC NOPA 17-603
Equilon, Toyota
350 & 700 bar, 1000 kg/day
2 dispensers, 10 Toyota CL8 FCT

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

SunLine Transit*
* - SMR production for 10+ years

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
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 $1 Million
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?

## Implementation - Incentive Funding

<table>
<thead>
<tr>
<th>Program Title</th>
<th>Description</th>
<th>South Coast AQMD Funding Amount</th>
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<tbody>
<tr>
<td>Mobile Source Air Pollution Reduction Review Committee (MSRC)</td>
<td>Implement or monitor programs to reduce motor vehicle air pollution</td>
<td>$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</td>
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<tr>
<td>Community Air Protection Program (CAPP) Incentives</td>
<td>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.</td>
<td>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.</td>
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<tr>
<td>Carl Moyer Program</td>
<td>Provides incentives to owners to purchase cleaner-than-required vehicles/equipment, including infrastructure for zero and near-zero emissions vehicles.</td>
<td>$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.</td>
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<tr>
<td>Volkswagen Environmental Mitigation Program</td>
<td>Intended to mitigate the excess NOx emissions caused by VW actions.</td>
<td>$165 million to South Coast AQMD (10-yrs) Status: Zero Emission Class 8 Freight &amp; Port Drayage ($90M) solicitation 2020 tbd</td>
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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
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