CARB'S H2 AND FCEV EFFORTS

2018 DOE FCTO Annual Merit Review

Andrew Martinez, PhD
Andrew.Martinez@arb.ca.gov
(916) 322-8449

CALIFORNIA
AIR RESOURCES BOARD

Motivations

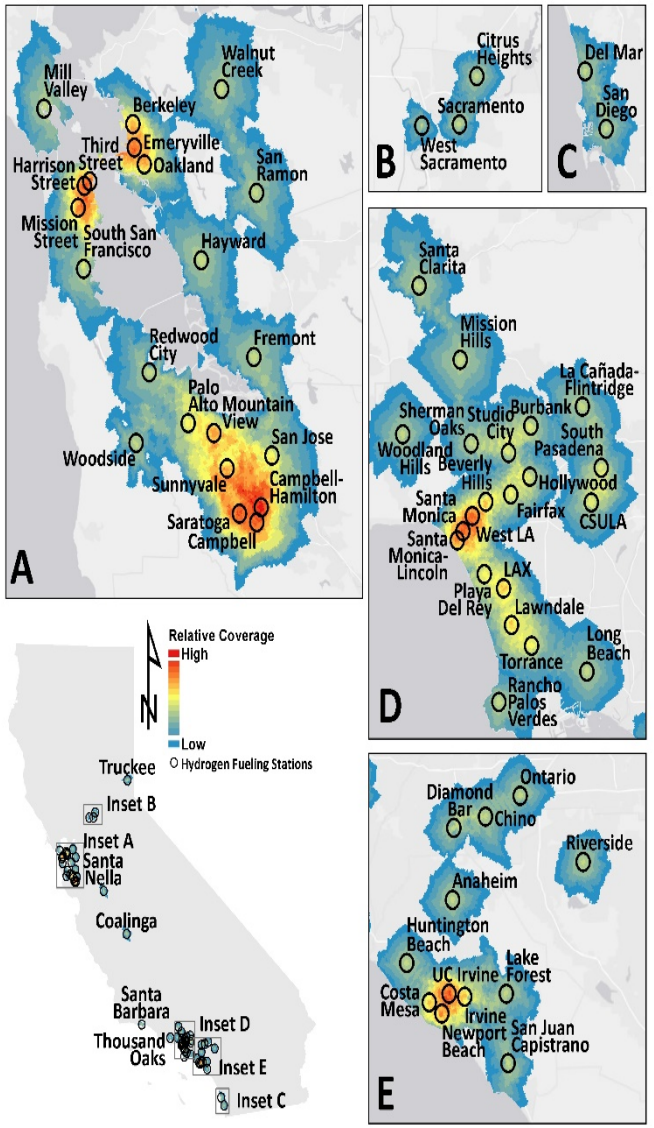
- CARB is charged with protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change
- Zero Emission Vehicle regulation is a vital part of CARB's Mobile Source Strategy for GHG reductions and criteria pollutant emission reductions
- CARB participates in multiple efforts to ensure the success of the ZEV rule generally and FCEV adoption specifically

AB 8 Reporting

- Annual evaluations of FCEV deployments, hydrogen station network development, FCEV customer data, and related techno-economic analyses
- Recommendations for Energy Commission hydrogen station grant funding programs
- Analysis and recommendations of station technical performance criteria

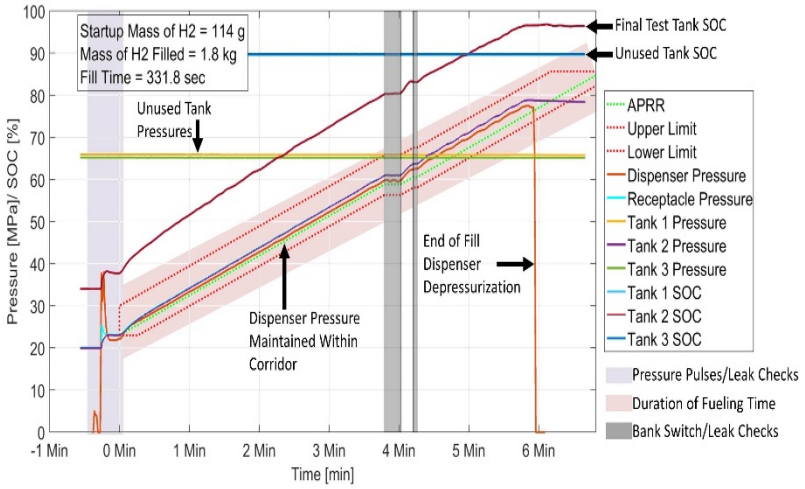
Network Analysis

- Evaluations of network development according to two key metrics:
  - Coverage provided by station network and gaps for expected FCEV adopter market
  - Capacity provided by station network and gaps for projected FCEV deployments
- Informed by geospatial analysis tool developed at CARB (CHIT)
- Tool freely available and can be applied to other regions with appropriate input data
  - https://www.arb.ca.gov/msprog/zevprog/hydrogen/h2fueling.htm
  - Interactive output data map: https://tinyurl.com/y7fcud4z



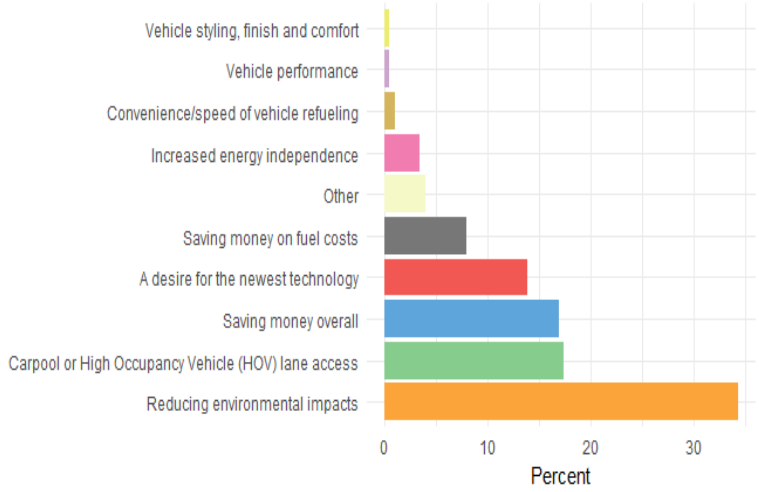
HyStEP

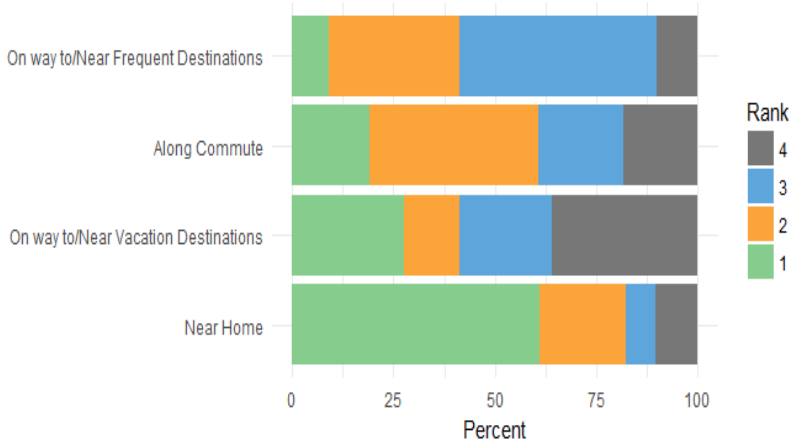
- Hydrogen Station Equipment Performance Device
  - Funding provided by DOE FCTO through H2FIRST
  - Developed by Powertech Labs under contract with NREL and SNL
  - Validated by testing at NREL
  - Evaluates stations' ability to provide fuel according to SAE J2601 protocol standard
  - Implements tests according to CSA HGV 4.3
  - Vital component to station validation process for Open-Retail status



CVRP and Analysis

- California Vehicle Rebate Project
  - Provides cash rebate for qualifying lease/purchase of Zero-Emission and Plug-In Hybrid vehicles
  - Program requirements evolved over time
    - Currently provide additional incentives for Low/Moderate Income Consumers
  - 3,661 rebates for FCEVs issued to date (236,258 for full program)
  - Consumer adoption survey used to assess market development and purchase decision factors





CALIFORNIA CLEAN VEHICLE REBATE PROJECT℠

Administered by CSE for the California Air Resources Board

CARB funding for MD/HD fuel cell technology

- Existing and potential funding for projects that include FC trucks, top loaders, yard trucks, buses, drayage trucks, and other applications. Funding also applies to fueling infrastructure in some cases:

  - On-Road Advanced Technology Demonstration Projects
  - Off-Road Advanced Technology Demonstration Projects
  - Zero-Emission Bus Pilot Commercial Deployment Projects
  - Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
  - Zero-Emission Off-Road Freight Voucher Incentive Project
  - Volkswagen Environmental Mitigation Trust

https://www.arb.ca.gov/msprog/aqip/demo.htm

https://tinyurl.com/yatjt9q9

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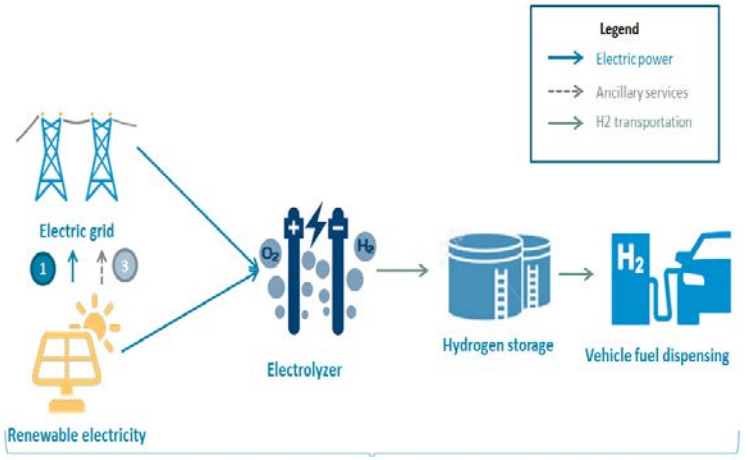
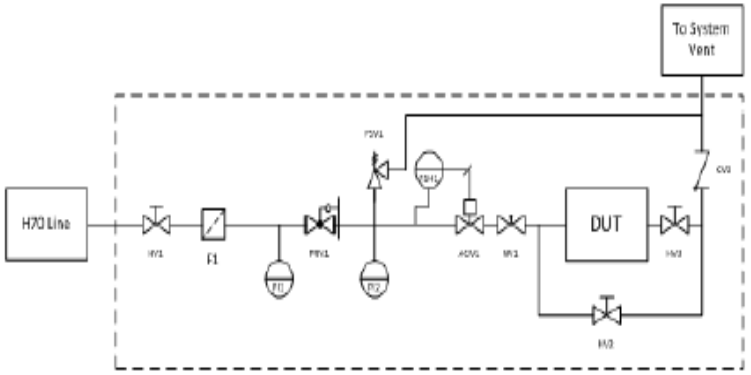
CALIFORNIA CLIMATE INVESTMENTS
Cap and Trade Dollars at Work

H2@Scale CRADA

- Anticipated participation in two CRADA projects
- Integrated Renewable Electrolysis
  - Partners: PG&E, NREL, CARB, GO-Biz
  - Modeling and design of optimized renewable electrolysis system and control
  - Characterize and understand potential value streams for various-sized Solar-Electrolysis plants
- California Hydrogen Infrastructure Research Consortium
  - Partners: NREL, CARB, Energy Commission, GO-Biz, SCAQMD
  - Addresses several near-term infrastructure deployment needs
  - Station Data Collection and Analysis, MD/HD Fueling, H2 Contaminant Detector, Nozzle Freeze-Lock, Hydrogen Energy Integration, Technical Assistance





FOR FURTHER INFO

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BACKUP SLIDES

Self-Sufficiency

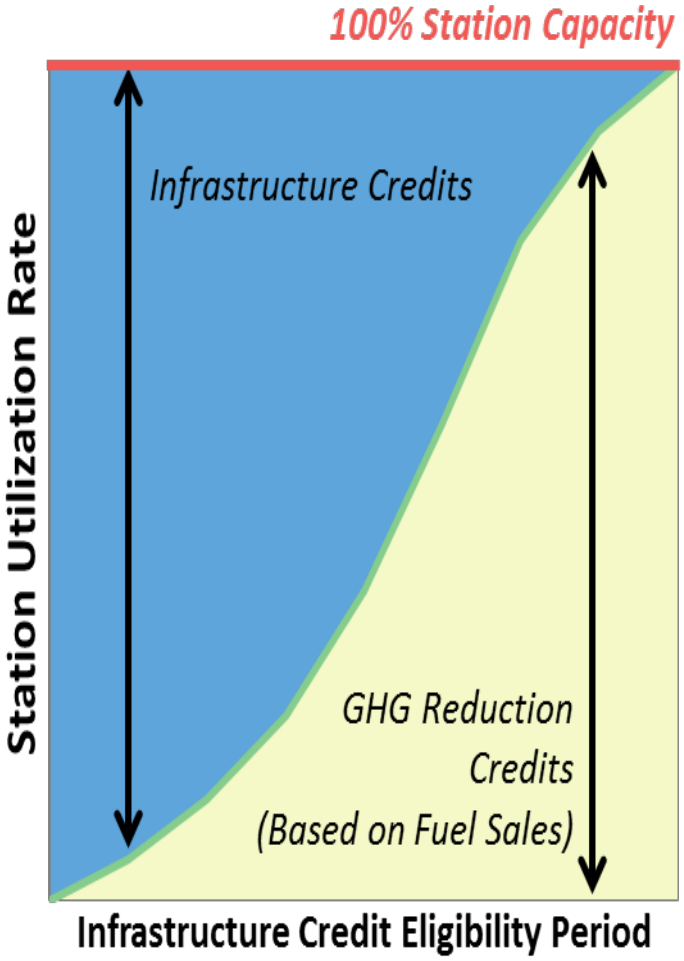
- Assessing the potential transition to greater industry self-reliance on funding hydrogen fueling infrastructure
- Goal to perform scenario analysis to approximate market conditions and timing
- Analyses to be informed by industry survey and interview process

Table A-1: Self-Sufficiency Framework

Value Proposition Entity	Value Proposition Metric	Previous Study?	Value Proposition Threshold	Affected by Fuel Cost Difference?	Candidate Entities	Study Round
Gas Station Owner	Revenue-opportunity costs (gasoline pump or other station services)	-	>$0, in X yrs.; X may be considered long-term	Yes	Costco, Harbor City Chevron, Noble, Ontario CNG, Safeway, Walmart	2nd
Industrial Gas Company	Revenue-opportunity costs (other hydrogen related ventures)	-	>$0, in X yrs.; X may be considered long-term	Indirect	Air Liquide, Air Products and Chemicals, Linde, Praxair, United Hydrogen	1st
Independent Operator	Traditional investment metrics, i.e., return on investment, and payback period	December 2015 AB 8 report	X yrs.	No	FirstElement Fuel, H2 Frontier, HydrogeNXT, HyGen Industries, HTEC, StratosFuel	1st
Auto Manufacturer	Cost differential of infrastructure investment vs. other sales-driving options to achieve target FCEV sales volume	-	X ≤ $0	No	Daimler, General Motors, Honda, Hyundai, Toyota	1st
Fleet Operator	Total cost of ownership parity w/gasoline	-	Equivalence or X% premium, including incentives available to fleet operator	Yes	A3 Labs, FedEx, Lyft, Maven, StratosFuel, Uber, UPS, Zipcar	2nd
Station Equipment Provider	Traditional investment metrics, like return on investment, and payback period	Variation on December 2015 Joint Report	X yrs.	No	Air Liquide, Air Products and Chemicals, FASTECH, Greenlight Innovation, Hydrogenics, ITM Power, Kobelco, Linde, McPhy, Nel Hydrogen, Next Hydrogen, Nuvera, PowerTech Labs	1st
Energy/Fuel Company	Revenue-opportunity costs (other fuel product ventures)	-	>$0, in X yrs.; X may be considered long-term	Yes	ENGIE, PG&E, Shell, SoCalGas, Total	1st
Public Agency	Monetary value of achieving policy goals, including quantified public health-benefits	National Academy of Sciences Report(s)	Within +/- X% of other state-funded options with similar goals	Indirect	AC Transit, BAAQMD, California Department of General Services, Caltrans, San Francisco Department of the Environment, SCAQMD, SunLine Transit Agency	2nd

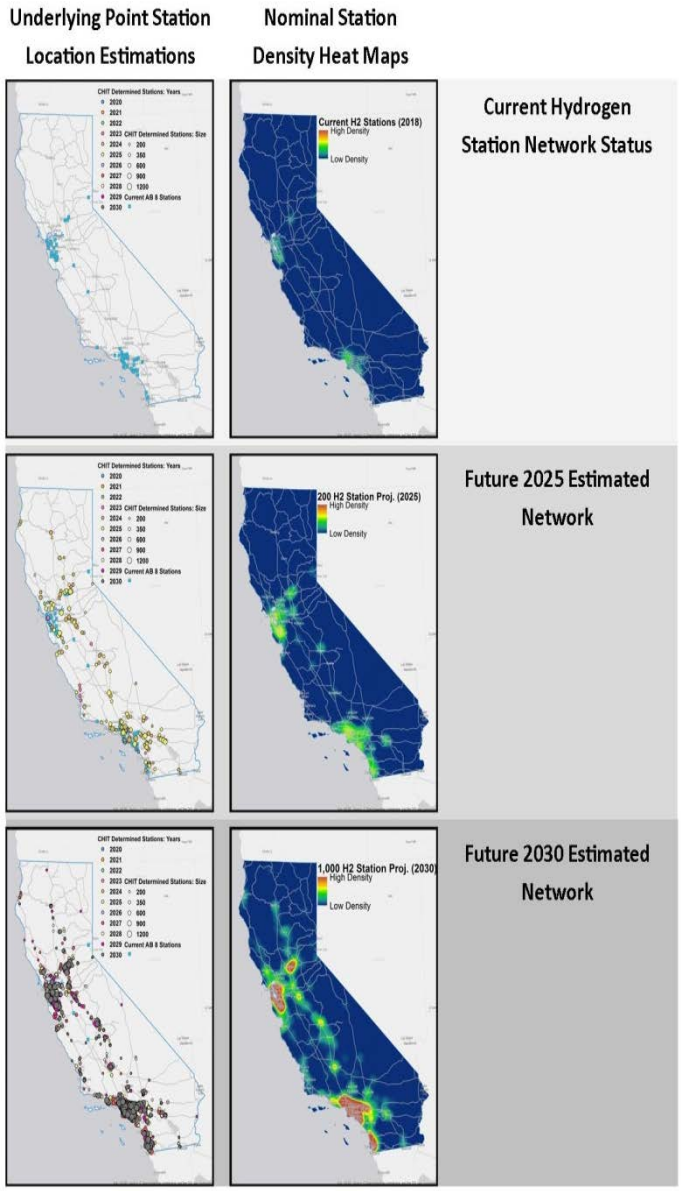
Low Carbon Fuel Standard

- Executive Order B-48-18 directed agency to consider the potential to leverage California's LCFS program to support hydrogen fueling station development
- LCFS regulation currently undergoing process of update
- April 27, 2018 Board Meeting directed staff to consider development of a provision to award LCFS credits based on a station's hydrogen fueling capacity



Public-Private Cooperation

- California Fuel Cell Partnership
  - Major current effort to develop a Vision for 2030 document
  - CARB participation in analysis of potential network development
  - Assessment of potential coordinated FC growth across sectors
- H2USA
- H2FIRST
- California Hydrogen Business Council



CARB funding for MD/HD fuel cell technology

- On-Road Advanced Technology Demonstration Projects
  - $5.1 million: 5 FC electric hybrid trucks with mobile H2 refueling and charging infrastructure in Ports of Los Angeles and San Diego
- Off-Road Advanced Technology Demonstration Projects
  - $6.5 million: electric top loader with FC range extender and wireless charging mobile H2 refueling in Port of Los Angeles
  - $6.2 million: comparing battery electric and FC electric technologies in yard trucks and top handlers in Port of Long Beach
  - One more FC project TBA – grant agreement pending

https://www.arb.ca.gov/msprog/aqip/demo.htm

Cap and Trade Dollars at Work

CARB funding for MD/HD fuel cell technology

- Zero-Emission Bus Pilot Commercial Deployment Projects
  - $22.3 million: 10 FCEBs and a new hydrogen station at Orange County Transit Authority, and 10 FCEBs plus a station upgrade at AC Transit
  - $12.6 million: 5 FCEBs and a new electrolysis hydrogen station at SunLine Transit
- Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
  - $300,000 for fuel cell buses and trucks + $100,000 infrastructure enhancement with 5 or more vehicles
- Zero-Emission Off-Road Freight Voucher Incentive Project
  - Will solicit for a state-wide administration by the end of June 2018

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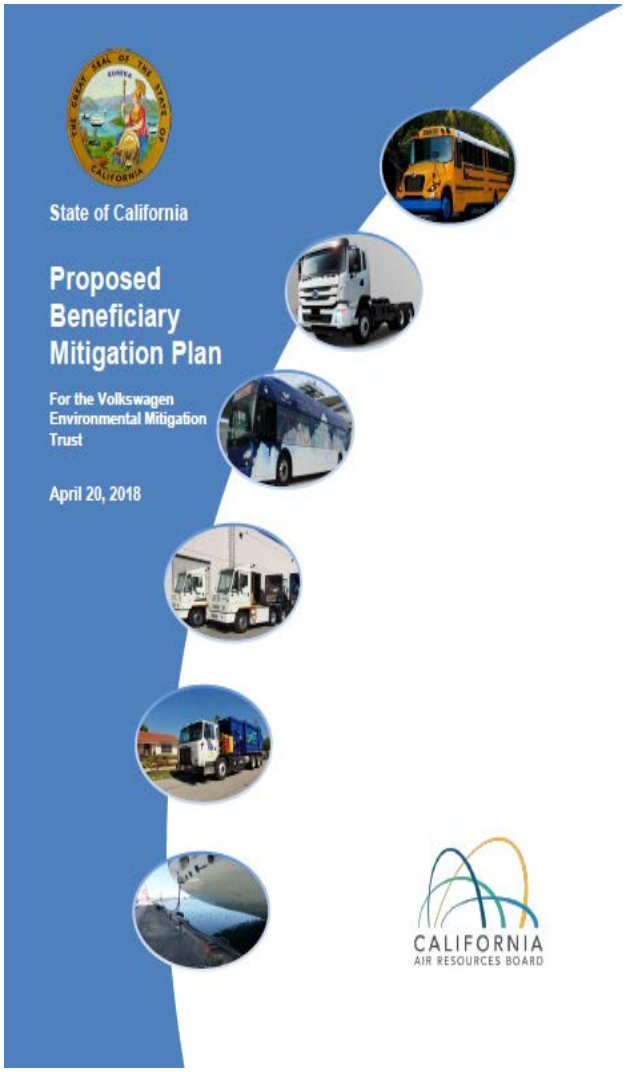
Cap and Trade Dollars at Work

Volkswagen Environmental Mitigation Trust

- $423 million – California's trust allocation to mitigate ~10,000 tons excess NOx over 10-year period
- Consent Decree Appendix D – Eligible project categories
- Scrap and replace of compliant vehicles and equipment
- Zero-Emission Projects in California's Beneficiary Mitigation Plan include:
  - $130 million – Transit, school and shuttle buses
  - $90 million – Class 8 freight and port drayage trucks
  - $70 million – Freight and marine projects
  - $10 million – light duty ZEV infrastructure



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