



State-level Off Road Actions and Perspectives

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Mission Innovation Hydrogen Fuel Cell Off-Road Equipment and Vehicles Virtual Workshop

September 22, 2021

CARB Tasks

- Climate
 - Regional Air Quality
 - Local Exposure
-
- Aggressive goals and targets for both Criteria and GHG emissions
 - Well beyond easiest first adopter cases:
Action required across economy and broadly within sectors



Governor Level Leadership

- **Carbon Neutrality by 2045**
across CA economy
- **On-Road MHD ZEV MOU**
15 State Gov's + D.C. Mayor
- **100% ZEV in 2035 for Off Road**
operations 'where feasible'
N-79-20 Executive Order
- NY governor just signed **100% ZEV in 2035** Off Road operations law



 **100% ZEV sales** by 2035

Full transition to
ZEV short-haul/drayage trucks
by 2035

Full transition to **ZEV buses & heavy-duty long-haul trucks**
by 2045*
*where feasible

Off-Road H₂ Opportunities

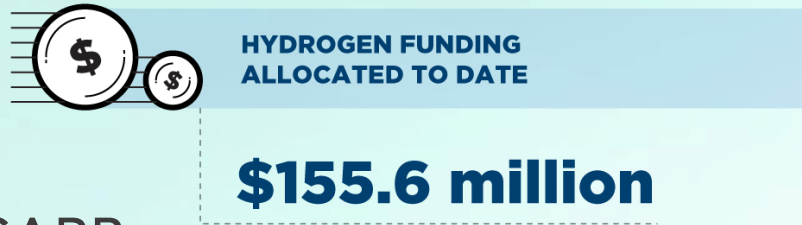
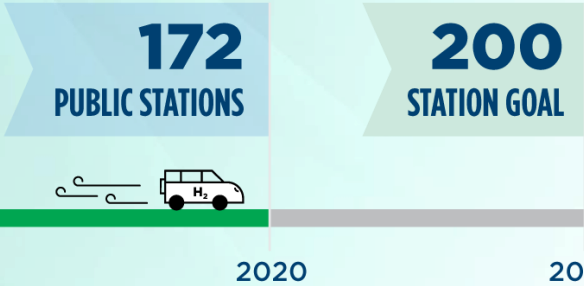
- Increasing total energy packaged on tractor/excavator/dozer
 - Higher energy/shift applications
 - Extending operating range
- Reaching ‘beyond the grid’: Enabling work locations
 - Mobile refueling “wet hose” options for H₂
 - Relocatable micro-grids to support temporary worksites:
Fuel Cells not necessarily on-board the equipment
- Shared fueling infrastructure’s flexibilities for small businesses

Multiple ways to enable new ZE applications and tasks

CEC: Building Out LD Hydrogen Stations

Progress Report

200 Hydrogen Fueling Stations by 2025



CEC: Clean Transportation Program Building out MD/HD H₂ Stations

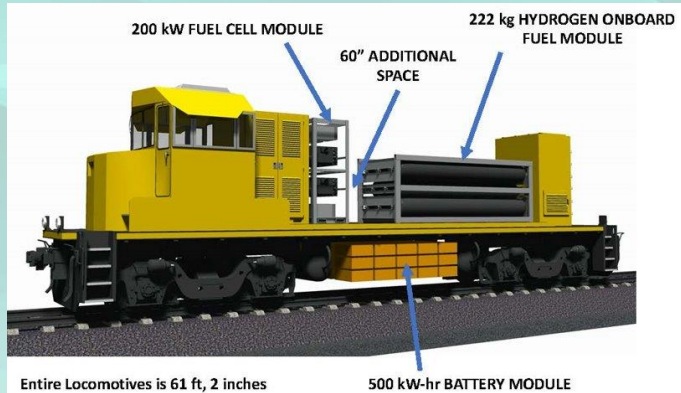


- Equilon Enterprises: Port of Long Beach Renewable H₂ station, *Freight*
\$8M, 1000kg/day
- Equilon Enterprises: West Sacramento *multimodal* H₂ station, *Drayage trucks & Rail locomotive*
\$4M, 1450kg/day
- CTE: NorCal *Drayage* H₂ station, Port of Oakland
\$9M, 1600 kg/day, 3000kg storage
- Sunline Transit: *Liquid H₂* for transit
\$5M, 1680kg/day
- N. Co. Transit District: Next Gen H₂ Infrastructure
\$4M, kg/day in design
- ACC Transit District: H₂ station upgrade
\$4.6M, kg/day in design



CEC: EPIC and NG R&D Program

Hydrogen Funding



Recipient Name	Purpose	Dollar Amount
Gas Technology Institute	H ₂ fuel cell switcher loco demo	\$4M
CALSTART	LH ₂ fuel cell harbor tug design and feasibility	\$498k
Zero Emission Industries	H ₂ FC small fast harbor craft powertrain and mobile refueler	\$2M
TBD (GFO-21-501)	Reduce TCO of H₂ FC trucks & buses on challenging duty cycles	\$4M
TBD (Future)	H₂ Infrastructure Innovations demo for heavy transport (on- and off-road) to reduce operating costs (fully mobile refuelers?)	\$4M
TBD (Future)	Renewable H₂ roadmap and strategic plan	TBD

Clean Off-Road Voucher Incentive Program (CORE)

- New program, \$41M in 2020
- Freight focused, zero-emission equipment
- Launched in February 2020
- Closed in August 2020
- >100% oversubscribed
- >70% of funds benefit priority populations
- Proposed relaunch of Program in Spring 2021, \$165M

➤ ***Proposed expansion to commercial ready:***
ZE Agriculture,
ZE Construction,
ZE Professional Landscaping Equipment



Funding Agricultural Replacement Measures for Emission Reductions Program

FARMER

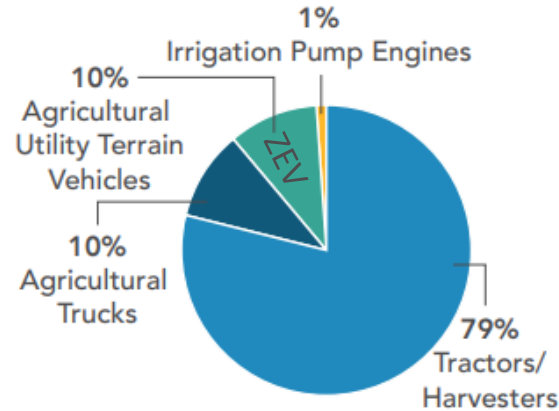


\$249.3 million
in implemented projects
statewide

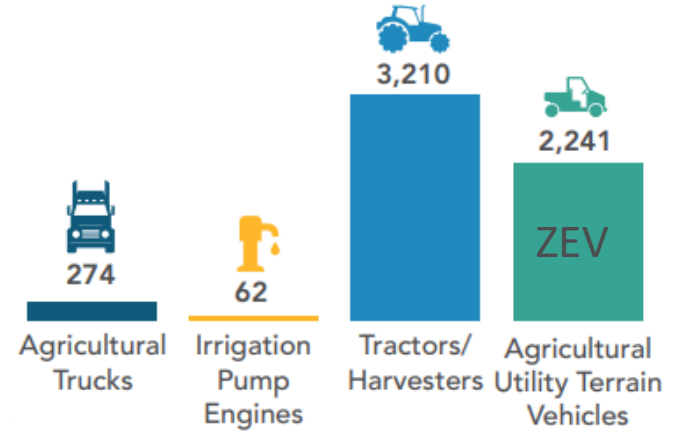


65% of funding
benefits disadvantaged
& low-income communities

Dollars Invested by Project Type



Implemented Projects



Current Off-Road Demo/Pilot Projects

- Support technologies on the cusp of commercialization
- Demonstration and Pilot Projects representing ~\$390 million in funding since 2014 across technologies

H₂ Demo Projects:

- Cargo Handling: Fuel cell hybrid electric top loader & 'mobile' refueler
- Marine: Hydrogen fuel cell ferry
- Cargo Handling: Fuel cell yard trucks



Upcoming Demo/Pilot Opportunities

- **\$40M** in Greenhouse Gas Reduction Funds proposed in CARB FY 21/22 Funding Plan
- Could include projects related to
 - construction
 - cargo handling equipment
 - ocean-going vessels
 - commercial harbor craft
 - locomotives



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