CARB Hydrogen and Fuel Cell Activities in Freight

DOE FCTO H2@Ports Workshop
September 10-12, 2019

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Path Forward on Freight

- Protect communities near freight facilities
  - Tighten CARB rules & add facility infrastructure/compliance
  - Support district facility-based measures & port initiatives
  - Pursue stricter federal & international standards
  - Coordinate & expand incentives for freight transition to zero emission operations
Pending Freight Regulations
New CARB Freight Actions

Zero Emission (ZE) Operation
- ZE truck certification
- ZE trucks-mfrs
- ZE ships at berth
- Rail yard idling
- ZE TRUs
- ZE forklifts
- ZE trucks-fleets
- ZE drayage trucks
- ZE cargo equipment

Lower Emissions

Year represents first board hearing date
Freight Regulations

Ocean-Going Vessels at Berth

• Require more visits to reduce emissions at berth
  – Include more visits, vessel types, ports
  – Hold ports, terminals, technology providers accountable for doing their part

• For more information: [https://ww3.arb.ca.gov/ports/shorepower/shorepower.htm](https://ww3.arb.ca.gov/ports/shorepower/shorepower.htm)

• Board Date: Late 2019

Shore Power  Barge-based Capture & Control  Land-based Capture & Control
• Focus on cleaner combustion for in-use and new engines
• Support introduction of zero-emission technologies wherever possible
• Next public meetings: late 2019
• For more information: https://ww2.arb.ca.gov/our-work/programs/commercial-harbor-craft
• Focus on Transition to full zero-emission technologies
• Phase-in anticipated to begin in 2026+
• Next public meetings: TBD
• For more information: [https://ww2.arb.ca.gov/our-work/programs/cargo-handling-equipment](https://ww2.arb.ca.gov/our-work/programs/cargo-handling-equipment)
Freight Regulations

Advanced Clean Trucks

• Manufacturer ZE truck sales requirement
  • 2024-2030 model year
• Large company and fleet reporting requirement
  • Information about vehicles and contracted trucking services
  • Support future fleet rules, ZE truck standard, and/or other
• Board hearing this December, final vote early 2020
• For more information, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks
## Freight Regulations

### Advanced Clean Trucks

<table>
<thead>
<tr>
<th>Model Year (MY)</th>
<th>Class 2B-3¹</th>
<th>Class 4-8</th>
<th>Class 7-8 Tractors</th>
</tr>
</thead>
<tbody>
<tr>
<td>2024</td>
<td>3%</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>2025</td>
<td>5%</td>
<td>9%</td>
<td>5%</td>
</tr>
<tr>
<td>2026</td>
<td>7%</td>
<td>11%</td>
<td>7%</td>
</tr>
<tr>
<td>2027</td>
<td>9%</td>
<td>13%</td>
<td>9%</td>
</tr>
<tr>
<td>2028</td>
<td>11%</td>
<td>24%</td>
<td>11%</td>
</tr>
<tr>
<td>2029</td>
<td>13%</td>
<td>37%</td>
<td>13%</td>
</tr>
<tr>
<td><strong>2030⁲</strong></td>
<td>15%</td>
<td>50%</td>
<td>15%</td>
</tr>
</tbody>
</table>

1. Excludes pickups until 2027 MY  
2. 2030 MY requirements continue after 2030
Incentive Programs

Demonstration Projects
Incentive Portfolio to Balance Investments

Cost-effective

Low NOx; some zero-emission

Not cost-effective yet

Zero-emission; some low NOx
Green House Gas Reduction Fund (GGRF)

Funded Hydrogen and Fuel Cell Projects

10 of 30 projects ($112M) awarded since FY 2014-15 involve hydrogen and fuel cell technology

- SunLine Transit, AC Transit and Orange County Transit
  - 25 FECBs and 3 hydrogen stations/or upgrades
- 10 Class 8 trucks – Kenworth/Toyota – Port of Los Angeles
  - 2 HD Shell hydrogen stations in Wilmington and Ontario
- 5 Class 8 plug-in hybrid fuel cell trucks
- 19 fuel cell delivery vans – 2 projects with UPS
- Fuel Cell Ferry – Golden Gate Marine
- 2 fuel cell 242,000 lb. capacity yard trucks
- Electric top loader with fuel cell and wireless charging
- Fuel cell yard truck and battery yard truck: side-by-side comparison
GGRF Demonstration Project
Fuel Cell Hybrid Electric Top Loader

• Funding: $6.5M grant, $8.8M total
• Electric top loader demonstration
  • Hyster-Yale – build and integrate
  • Nuvera – two 45kW fuel cell engines
  • WAVE – 250kW wireless charging systems
• Mobile refueler to provide hydrogen
• Fenix Marine Services will operate the top loader in Port of LA
• Project complete: Spring 2020
GGRF Demonstration Project
Zero-Emission Hydrogen Ferry

- Funding: $3M grant, $5.5M total
- Fuel cell ferry – 22 knots top speed and up to 84 passengers
  - BAE Systems – electric propulsion system
  - Hydrogenics – three 120kw fuel cells
  - On-board H2 storage for 2 days of operation
  - 350 bar tube trailer at dock
GGRF Demonstration Project

Port of Los Angeles Shore-to-Store

• Funding: $41.1M grant, $82.5M total
• 10 hydrogen fuel cell Class 8 trucks
  • Kenworth truck w/ Toyota FC technology
  • 60 kg on-board storage
  • Developed in partnership with California Energy Commission, DOE and SCAQMD
• Two large-capacity H2 refueling stations
  • Wilmington and Ontario, California
  • Delivered gas, 1500 kg/day capacity, 700 bar
• First truck delivered November 2019
• Stations complete September 2020
• Proposed $40 million allocation for competitive projects:
  • Zero-emission drayage truck pilot
    • Large-scale deployments of zero-emission drayage trucks at one or two fleets
  • Ships-at-berth bonnet system
    • Capture and treat criteria pollutant emissions from OGVs at ports
  • Inducement prize
    • Compete to achieve technological goal in winner-takes-all format
• CARB to consider adopting FY 2019-20 Funding Plan at October Board meeting (Oct. 24)
• Proposed Funding Plan release late September
• For more info: www.arb.ca.gov/aqip
Incentive Programs

Commercial and Other Incentives
GGRF Commercial Incentives

Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

- Established in 2010: ~7,500 vouchers and $380M committed
- HVIP-eligible on-road vehicles – 5,001 GVWR and up
  - Transit, school and shuttle buses; utility and delivery trucks
- Over 30 OEMS and 125 models in hybrid, zero-emission and low NOx options currently eligible
- Demand exceeds available funds
- Board to consider program changes this October
- [CaliforniaHVIP.org](https://CaliforniaHVIP.org)
GGRF Commercial Incentives

Clean Off-Road Equipment Voucher Incentive Project (CORE)

- Launched this year – CaliforniaCORE.org
- Finalizing Implementation Manual
- Proposed equipment:
  - On- and off-road terminal tractors
  - Transportable Refrigeration Units
  - Container handling equipment and forklifts >8000 lb lift capacity
  - Wide-body aircraft tugs
  - Railcar movers
  - Rubber-tired gantry cranes
  - Airport Cargo Loaders
  - Railcar movers
  - Rubber-tired gantry cranes
  - Airport Cargo Loaders
• California’s allocation: **$423 million**

• Approved Beneficiary Mitigation Plan details
  5 funding categories, 4 are open to hydrogen & fuel cell technology:

  1. **$130M** for Zero-emission transit, school and shuttle buses
  2. **$90M** for Zero-emission Class 8 freight and port drayage
  3. **$60M** for Combustion Freight/Marine (competitive)
  4. **$70M** for Zero-emission Freight/Marine (competitive)
  5. **$5M** for light duty H2 Infrastructure

• Funding available statewide starting this fall

• [ww2.arb.ca.gov/vwmitigationtrust](http://ww2.arb.ca.gov/vwmitigationtrust)
Volkswagen Mitigation Trust

Zero-Emission Truck and Freight Categories

- Administered statewide on behalf of CARB by 2 air districts
- All projects require scrappage of older compliant vehicle or equipment (except shorepower)
- Funds released in 2 installments starting Q4 2019

Class 8 Freight & Port Drayage Trucks

- South Coast AQMD
- First-come, first-served applications
- $27M in first installment
- Up to $200k for new truck
- www.aqmd.gov/vw

Freight and Marine Projects

- Bay Area AQMD
- Competitive solicitation
- $35M in first installment
- Incremental cost for airport GSE
- Up to $175k port CHE & heavy lift (>8,000 lbs)
- Up to $2.5M shorepower and ferry, tug or tow boat repower

www.aqmd.gov/vw
Community Air Protection (CAP) Incentives

- $740M appropriated since 2017 to support AB 617
  - Air districts fund projects according to priorities and concerns identified by community members
  - Includes mobile and stationary sources
  - *CAP Incentives 2019 Guidelines* approved in May 2019, and additional options coming soon
  - [www.arb.ca.gov/msprog/cap/capfunds.htm](http://www.arb.ca.gov/msprog/cap/capfunds.htm)

<table>
<thead>
<tr>
<th>Bay Area AQMD Focus</th>
<th>San Joaquin Valley APCD Focus</th>
<th>South Coast AQMD Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced technology at ports, including hybrid gantry cranes</td>
<td>Agricultural equipment near farming communities</td>
<td>Zero-emission and low-NOx trucks</td>
</tr>
<tr>
<td>Zero-emission and low-NOx CNG school buses, and associated infrastructure</td>
<td>Zero-emission school buses</td>
<td>Off-road equipment, including construction and agricultural</td>
</tr>
<tr>
<td></td>
<td>Locomotives</td>
<td>Marine vessels</td>
</tr>
</tbody>
</table>

[community.valleyair.org/](http://community.valleyair.org/)  
[www.aqmd.gov/ab617](http://www.aqmd.gov/ab617)
Low Carbon Fuel Standard (LCFS)

• Reduce carbon intensity (CI) of transportation fuel 20% by 2030

• Fuel providers can opt-into LCFS to generate credits for using lower-carbon fuels

• Two key inputs affect amount of credits earned per MJ of fuel
  • Carbon intensity (CI) of fuel relative to displacement fuel
  • Efficiency of equipment relative to baseline (EER) – need data to support developing EERs for HD fuel cell powered equipment.

• For more information: https://www.arb.ca.gov/fuels/lcfs/lcfs.htm
## EER Values for Fuels Used in Light-, Medium- and Heavy Duty Applications

<table>
<thead>
<tr>
<th>Fuel/Vehicle Combination</th>
<th>EER Values Relative To Displacement Fuel</th>
<th>Displacement Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasoline (including 6% and 10% ethanol blends) Used In Gasoline Vehicles or</td>
<td>1</td>
<td>Gasoline</td>
</tr>
<tr>
<td>85% Ethanol/15% Gasoline Blends Used In Flexible Fuel Vehicles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity Used in a Battery Electric or Plug-In Hybrid Electric Vehicle</td>
<td>3.4</td>
<td>Gasoline</td>
</tr>
<tr>
<td>On-Road Electric Motorcycle</td>
<td>4.4</td>
<td>Gasoline</td>
</tr>
<tr>
<td>Hydrogen Used in a Fuel Cell Vehicle</td>
<td>2.5</td>
<td>Gasoline</td>
</tr>
<tr>
<td>Diesel Fuel or Biomass-Based Diesel Blends Used In A Diesel Vehicle</td>
<td>1</td>
<td>Diesel</td>
</tr>
<tr>
<td>Electricity Used in a Battery Electric (BEV) or Plug-In Hybrid Electric (PHEV) Heavy-Duty Truck or Bus</td>
<td>5</td>
<td>Diesel</td>
</tr>
<tr>
<td>Electricity Used in a Fixed Guideway or Heavy Rail</td>
<td>4.6</td>
<td>Diesel</td>
</tr>
<tr>
<td>Electricity Used in a Fixed Guideway or Light Rail</td>
<td>3.3</td>
<td>Diesel</td>
</tr>
<tr>
<td>Electricity Used in a Trolley Bus, Cable Car, or Street Car</td>
<td>3.1</td>
<td>Diesel</td>
</tr>
<tr>
<td>Electricity Used in Forklifts</td>
<td>3.8</td>
<td>Diesel</td>
</tr>
<tr>
<td>eTRU</td>
<td>3.4</td>
<td>Diesel</td>
</tr>
<tr>
<td>eCHE</td>
<td>2.7</td>
<td>Diesel</td>
</tr>
<tr>
<td>eOGV</td>
<td>2.6</td>
<td>Diesel</td>
</tr>
<tr>
<td>Hydrogen Used in a Heavy-Duty Fuel Cell Vehicle</td>
<td>1.9</td>
<td>Diesel</td>
</tr>
<tr>
<td>Hydrogen Used in a Fuel Cell Forklift</td>
<td>2.1</td>
<td>Diesel</td>
</tr>
</tbody>
</table>

Source: Credit value calculator at ww3.arb.ca.gov/fuels/lcfs/dashboard/dashboard.htm
Contacts

• Freight Regulations
  • Ocean Going Vessels at Berth Angela.Csondes@arb.ca.gov
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