CARB Strategies for Reducing Emissions from Off-Road Construction Equipment

2022 AQMP Mobile Source Working Group

January 27, 2021
2022 AQMP

- Address the attainment of the 2015 8-hour ozone standard (70 ppb) for South Coast Air Basin and Coachella Valley in 2037, without reliance on black box measures.

**Timeline**

- **Preliminary 2018 inventory**
  - January 2020

- **Draft control measures**
  - June/August 2021

- **Late Fall 2021**
  - Release Draft AQMP

- **July 2022**
  - CARB Board Hearing

- **April 2021**
  - Updated base and future emissions inventory

- **June/August 2021**
  - Carrying Capacity

- **South Coast AQMD Board Hearing**
  - June 2022

- **70 ppb Ozone SIP due to EPA**
  - August 3, 2022
2037 Attainment Working Draft

SCAB NOx Emissions (tpd)

Baseline

Carrying Capacity 2037

More than 70% Reduction

Carrying Capacity

55-85 tpd

Stationary and Area

Cars/Light-Duty Trucks/SUVs/Motorcycles

Medium-Duty & Heavy-Duty Gas Trucks

Heavy-Duty Diesel Vehicles

Aircraft

Locomotives

Ocean Going Vessels

Commercial Harbor Craft

Recreational Boats

Off-Road Equipment and Vehicles

Stationary and Area

Off-Road Equipment and Vehicles

Ocean Going Vessels

Locomotives

Aircraft

Heavy-Duty Diesel Vehicles

Stationary and Area

Baseline

Carrying Capacity 2037

More than 70% Reduction
Controlling Federal Sources is Critical to Achieving our Clean Air and Climate Targets

- California-Regulated Sources: Cars, Trucks, & Equipment
  - Reductions from California Sources: 75% as of 2019, >85% by 2032
- Primarily Federally-Regulated Sources: Interstate Trucks, Planes, Trains, & Ships
  - Emissions from Primarily Federally Regulated Sources Will Surpass California Source Emissions by 2030

Growing Importance of Off-Road

Statewide Mobile Source NOx Emissions

On-Road Vehicles

Off-Road Equipment

Vessels/Ships/Boats (<24nm)

Locomotives

Aircraft

Ref: CEPAM 2019 Summer
Off-Road Emission Contribution

Mobile Source NOx emissions in SC in 2037

- OGV-100 nm 20%
- On-Road (Baseline) 43%
- Off-Road Equip. 22%
- Aircraft 11%
- Trains 4%

Off-Road Equipment NOx emissions in SC in 2037

- Construction 23%
- Forklifts 10%
- GSE 2%
- SORE 11%
- PERP 19%
- Pleasurecraft 12%
- TRU 11%
- CHC & CHE 10%
- Ag 2%
Current In-Use Off-Road Regulation

• Covers mobile off-road diesel equipment used in California
  (Exemptions: portable or stationary, agriculture, cargo handling, marine vessels, personal use, under 25 hp)

• Fleet average rule adopted in 2007, amended in 2010
  • Fleet average calculated based on model year average, end target is ~2012
  • Averaging allows continued use of some Tier 0 to Tier 2 indefinitely, without usage limits
  • By 2031, equipment from 175 to 750 hp:
    • Tier 0 will be 36 years old.
    • Tier 1 will be 28 years old.
    • Tier 2 will be 26 years old.

• Low use exemption
  • < 200 annual hours exempt from factoring in fleet average
Draft 2021 In-Use Emission Inventory

- Currently reported statewide population nearing 190k
- South Coast have ~40% of statewide equipment in 2011 inventory
- New inventory in progress, updated with 2020 reporting data, aiming for completion in summer 2021
- Initial distribution shows slightly more Tier 0 to Tier 2 than projected by the 2011 inventory

![Statewide In-Use Equip. Population in 2020 by Tier: Projected vs Reported](chart)

Projected by existing inventory: T0, T1, T2, T3, T4I, T4F
Actual 2020 Reporting: T0, T1, T2, T3, T4I, T4F
Cleaner Engine Technology Options

Existing Off-Road NOx Tier standards by engine model year

- Off-Road Tier 5
  - 50%-90% NOx and PM reduction from Tier 4F, adoption in 2024 timeframe, implementation starting in 2027/2028
  - Will require US EPA action on federally preempted equipment (under 175 hp)
- Electrification and hybridization both commercially viable in select applications, with applicability expanding

CARB
2020 Mobile Source Strategy (MSS) Concepts for Construction Equipment

- Phase out of Tier 0 to Tier 2 equipment by 2033
- Penetration of Tier 5 certified engines
- Electrification/hybridization wherever feasible
2020 Mobile Source Strategy Scenario

- **MSS Scenario**: Full turnover of Tier 0 to Tier 2 equipment by 2033, with Tier 5 penetration beginning in 2028.

*Reductions incorporate Tier 5 for all horsepower groups, which would require US EPA action*
Electrification & Hybridization

• Numerous hybrid technologies are commercially available and zero-emission technologies are expanding
  o Hybridization increases fuel efficiency by around 25% on average
  o CARB’s Clean Off-Road Equipment Voucher Incentive Project (CORE) is designed to accelerate deployment of cleaner off-road freight technologies

• Governor’s Exec Order in Sept. 2020 (N-79-20) requires CARB to develop and propose:

Full transition to ZE off-road equipment by 2035*

*where feasible
Electrification & Hybridization Implementation

- Ongoing research in off-road engine duty cycles comparing energy needs vs. power provided by battery technology and hybridization
- Daily operating cycle, overall energy demand, and peak energy demand all determine suitability for electrification and hybridization

- Electrification and hybridization requirements could be included with:
  - Tier 5 standards
  - In-use off-road rule or extension
  - New requirements similar to Advanced Clean Trucks
Potential Electrification & Hybridization Application

- Draft study to identify off-road population and horsepower range for electrification/hybridization through sample equipment duty cycle study
- Other zero-emission technologies being explored
- Chart shows conceptual approach to identify equipment targets
Next Steps

• Update construction emissions inventory by Summer 2021

• Future amendments to in-use off-road diesel regulations
  o Potentially ban older, high emitting vehicles from fleets
  o Encourage and incentivize zero-emission adoption where feasible
  o **Action date: 2024**

• More stringent off-road engine emissions standards
  o Tier 5 **adoption by 2024** and **implementation starting in 2028** (non-preempt equipment)
  o Work with US EPA on federally preempt equipment Tier 5 standards
  o Will consider efficiency and zero-emission-transitional strategies

• Further research and development on zero emission technologies and infrastructure needs in off-road
Questions, Comments, Feedback

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South Coast AQMD Incentives Update

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Technology Implementation Manager
Role of Incentives

• Accelerate deployment of new, cleaner technologies that have become commercialized
• Designed to offset the higher cost of new, cleaner technologies
• Higher incentive for the cleanest technologies (zero emissions)
• Existing programs require retirement of an older vehicle, engine or piece of equipment in order to maximize emission reductions
• Projects must achieve “surplus” emissions reductions – go beyond existing regulations
• Infrastructure to enable deployment of near-zero & zero emission heavy-duty vehicles and equipment
Incentive Project Types
Main Incentive Programs

**Carl Moyer Program**
- Trucks
- Transit buses
- Refuse trucks
- Public agency/utility vehicles
- Emergency vehicles
- Construction/Ag
- Marine Vessels
- Shore Power
- Locomotives
- Cargo Handling
- Infrastructure
- 1998 – Present
- $530 Million
- 7,977 vehicles
- Emissions Reduced (tpy): NOx: 8,600  PM: 248

**Prop 1B**
- Trucks
- Shore Power
- Locomotives
- Cargo Handling
- TRUs
- 2009 - Present
- $486 Million
- 7,503 vehicles/equipment
- Emissions Reduced (tpy): NOx: 7,285  PM: 220

**Replace Your Ride**
- Light-Duty Vehicles
- Alternative Mobility Options (transit passes, car sharing)
- Electric vehicle chargers
- 2015 - Present
- $59 Million
- 7,424 vehicles
- Emissions Reduced (tpy): NOx: 34  HC: 7.9

**Lower Emission School Bus Program**
- School buses
- Infrastructure
- CNG tank replacements
- 2001 - Present
- $325 Million
- 5,200 vehicles
- Emissions Reduced (tpy): NOx: 857  PM: 59
Other Incentive Programs

• Community Air Protection Program (supports AB 617)
• Voucher Incentive Program (for small fleets with ten or fewer vehicles)
• Commercial Electric Lawn and Garden Equipment Program
• Volkswagen Environmental Mitigation Trust Program
• Funding Agricultural Replacement Measures for Emission Reductions (FARMER)
Community Air Protection Program

- Financial incentives to support the goals of AB 617
- Approved by Governor as part of the State budget each year
- Specific bills:
  - AB 134 (2017) – $250M statewide ($107.5M to SCAQMD), for Moyer and Prop 1B projects
  - SB 856 (2018) – $245M statewide ($85.57M to SCAQMD) to reduce emissions from mobile and stationary sources
  - AB 74 (2019) - $245M statewide ($79.4M allocation to SCAQMD) to reduce emissions from mobile and stationary sources, and community-identified projects
The Board approves annually how to distribute revenues from $2 DMV fee among the following programs:

- Carl Moyer on- and off-road mobile source project
- Lower Emission School Bus Program (including zero emission buses)
- Metrolink passenger locomotive project (multiple phases)

South Coast AQMD’s AB 923 Distribution of Funds
Lower-Emission School Bus Program

• Replace older, high-emitting school buses with cleaner technologies
• Participants include public school districts, including JPA, charter schools and private transportation providers under contract with a public school district
  * Program strives to fund the cleanest bus technologies commercially available
  * School districts must pay at least $15K as their local match
    - Funds are often combined with HVIP funds to help offset the higher cost of the new near-zero or zero-emission school bus
    - Up to $400k for an electric school bus (with HVIP funds)
    - South Coast AQMD funds also available for infrastructure
# VW Mitigation Program

<table>
<thead>
<tr>
<th>Project Category</th>
<th>Technology</th>
<th>Allocation (millions)</th>
<th>Air District Administrator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero-Emission Transit, School and Shuttle Buses</td>
<td>Battery electric or fuel cell</td>
<td>$130</td>
<td>SJVAPCD</td>
</tr>
<tr>
<td>Zero-Emission Class 8 Freight and Port Drayage Trucks</td>
<td>Battery electric or fuel cell</td>
<td>$90</td>
<td>SCAQMD</td>
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<tr>
<td>Zero-Emission Freight and Marine Projects</td>
<td>Battery electric or fuel cell</td>
<td>$70</td>
<td>BAAQMD</td>
</tr>
<tr>
<td>Combustion Freight and Marine Projects (waste haulers, dump trucks, concrete mixers, switcher locomotives, ferries, tug boats)</td>
<td>Low NOx engine, Tier 4, or Tier 4 equivalent</td>
<td>$60</td>
<td>SCAQMD</td>
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<tr>
<td>Light-Duty Zero-Emission Vehicle Infrastructure</td>
<td>Electric charger or hydrogen fueling station</td>
<td>$10</td>
<td>BAAQMD</td>
</tr>
<tr>
<td>CARB Reserve</td>
<td></td>
<td>$63</td>
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<tr>
<td><strong>Total:</strong></td>
<td></td>
<td><strong>$423</strong></td>
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</table>
South Coast AQMD Incentive Programs (Past 4 Years)
## Emission Reduction Benefits from Incentive Programs (2020)

<table>
<thead>
<tr>
<th>Program</th>
<th>Funding Amount</th>
<th>No. of Equipment/Engines</th>
<th>NOx (tpy)</th>
<th>PM2.5 (tpy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carl Moyer</td>
<td>$33,959,122</td>
<td>162</td>
<td>222.1</td>
<td>4.0</td>
</tr>
<tr>
<td>Carl Moyer State Reserve</td>
<td>$1,086,505</td>
<td>6</td>
<td>3.7</td>
<td>0.1</td>
</tr>
<tr>
<td>AB 923 Match Funds</td>
<td>$4,618,441</td>
<td>18</td>
<td>6.1</td>
<td>0</td>
</tr>
<tr>
<td>FARMER</td>
<td>$706,804</td>
<td>2</td>
<td>5.8</td>
<td>0.4</td>
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<tr>
<td>AB 617 Community Air Protection Program (CAPP) Incentives</td>
<td>$37,762,509</td>
<td>172</td>
<td>123.4</td>
<td>6.0</td>
</tr>
<tr>
<td>EFMP (Replace Your Ride)</td>
<td>$13,532,012</td>
<td>1,649</td>
<td>4.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Proposition 1B</td>
<td>$39,610,000</td>
<td>399</td>
<td>151.1</td>
<td>0</td>
</tr>
<tr>
<td>Voucher Incentive (VIP)</td>
<td>$2,705,000</td>
<td>63</td>
<td>43.2</td>
<td>0.2</td>
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<tr>
<td>VW Mitigation Program</td>
<td>$4,980,238</td>
<td>69</td>
<td>25.1</td>
<td>N/A</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$138,960,631</strong></td>
<td><strong>2,540</strong></td>
<td><strong>584.7</strong></td>
<td><strong>11</strong></td>
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</table>

* EPA DERA/TAG awards and other smaller grants not included.
Carl Moyer Program – Funding Distribution by Project Category

- Off-Road: 58%
- Infrastructure: 15%
- Marine: 15%
- Locomotive: 1%
- On-Road: 10%
- TRUs: 1%
## CAPP Results

<table>
<thead>
<tr>
<th>Project Category</th>
<th>Technology</th>
<th>AB 134 (CAPP Year 1)</th>
<th>SB 856 (CAPP Year 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Funded Amount</td>
<td>No. of Units</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$12,566,150</td>
<td>66</td>
</tr>
<tr>
<td>On-Road</td>
<td>Zero emission</td>
<td>$22,858,674</td>
<td>415</td>
</tr>
<tr>
<td></td>
<td>Optional low-NOx</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Other (Emergency)</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Off-Road Agriculture</td>
<td>Tier 3/4F</td>
<td>$19,607,167</td>
<td>156</td>
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<tr>
<td>Off-Road Construction</td>
<td>Tier 3/4F</td>
<td>$22,698,620</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>Tier 3/4F</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cargo Handing Equipment</td>
<td>Zero emission</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Hybrid-Electric</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Tier 4F</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Marine</td>
<td>Tier 3</td>
<td>$9,490,812</td>
<td>57</td>
</tr>
<tr>
<td>Transport Refrigeration Unit</td>
<td>Electric</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Infrastructure</td>
<td>Electric charging</td>
<td>$122,500</td>
<td>1</td>
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<tr>
<td></td>
<td>Renewable natural gas</td>
<td>$12,243,034</td>
<td>13</td>
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<tr>
<td></td>
<td>Natural gas</td>
<td>$1,237,782</td>
<td>3</td>
</tr>
<tr>
<td>Locomotive</td>
<td>Tier 4</td>
<td>$11,533,500</td>
<td>6</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>$112,358,239</td>
<td>813</td>
</tr>
</tbody>
</table>
### Volkswagen Program Update

<table>
<thead>
<tr>
<th>Funding Category</th>
<th>1st Installment</th>
<th>Open</th>
<th>Closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZE Transit, School, and Shuttle Buses</td>
<td>$65 million</td>
<td>10/21/19</td>
<td>Still open (Shuttle and Transit only)</td>
</tr>
<tr>
<td>Combustion Freight and Marine Projects</td>
<td>$30 million</td>
<td>12/6/19</td>
<td>3/4/20</td>
</tr>
<tr>
<td>Light Duty Infrastructure – Hydrogen</td>
<td>$5 million</td>
<td>2/20/20</td>
<td>5/22/20</td>
</tr>
<tr>
<td>ZE Freight and Marine Projects</td>
<td>$35 million</td>
<td>6/18/20</td>
<td>8/31/20</td>
</tr>
<tr>
<td>ZE Class 8 Freight and Port Drayage Trucks</td>
<td>$27 million</td>
<td>8/18/20</td>
<td>Still open (backup list)</td>
</tr>
<tr>
<td>Light Duty Infrastructure - Battery Electric</td>
<td>$5 million</td>
<td>February 2021 (Est)</td>
<td>TBD</td>
</tr>
</tbody>
</table>
Off-Road Construction

- Off-Road Construction Equipment
  - Scrapers
  - Loaders/Tractors
  - Backhoes
  - Excavators
  - Rough-Terrain Forklifts
- Compression ignition or large-spark ignition engines >25 HP
- Subjected to CARB’s In-Use Off-Road Diesel and/or Large-Spark Ignition Regulation
South Coast AQMD Incentive Programs for Off-Road Construction

- Carl Moyer Program
- Surplus Off-Road Opt-In for NOx (SOON) Provision
- Other Smaller Grants (including State Reserve or Voluntary NOx Remediation Measure)
Incentive program to achieve additional NOx emission reductions from in-use off-road diesel fleets in California
- Covers up to 80% of the equipment replacement cost or 85% of the repower costs
- Must maintain compliance requirements of the off-road regulation throughout contract term
- Mandatory for large fleets (>20,000 hp) with >40% Tier 0 and Tier 1 vehicles
- Other fleets may apply on a voluntary basis
- South Coast AQMD sets aside about $5M of Carl Moyer Program funds each year for SOON
Total Investment in Off-Road Construction (Past 4 Years)
Funding Opportunities in 2021

- Lower Emission School Bus Program  
  Closing 1/26/21

- VIP for small fleets (first-come, first-served)  
  February 2021 (Est)

- Carl Moyer Program  
  (incl. SOON, FARMER and other programs if available)  
  March 2021

- Prop 1B – Goods Movement Program  
  Closing 4/30/21

- Volkswagen - Combustion and ZE Freight & Marine and Light Duty Infrastructure (Battery Electric)  
  Qtr. 2 2021

- AB 617 Community Air Protection Incentives  
  TBD

- Other Programs  
  Ongoing (until funds are depleted)
## Useful Links

<table>
<thead>
<tr>
<th>Program</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPP Incentives</td>
<td><a href="http://www.aqmd.gov/cappincentives">www.aqmd.gov/cappincentives</a></td>
</tr>
<tr>
<td>Proposition 1B - Goods Movement Emission Reduction Program</td>
<td><a href="http://www.aqmd.gov/prop1b">www.aqmd.gov/prop1b</a></td>
</tr>
<tr>
<td>Volkswagen Environmental Mitigation Program</td>
<td><a href="http://www.aqmd.gov/vw">www.aqmd.gov/vw</a></td>
</tr>
<tr>
<td>Carl Moyer Program</td>
<td><a href="http://www.aqmd.gov/moyer">www.aqmd.gov/moyer</a></td>
</tr>
<tr>
<td>Voucher Incentive Program (for small fleets of 10 trucks and less)</td>
<td>www/aqmd.gov/vip</td>
</tr>
<tr>
<td>Lower Emission School Bus Program</td>
<td><a href="http://www.aqmd.gov/schoolbus">www.aqmd.gov/schoolbus</a></td>
</tr>
<tr>
<td>Commercial Lawn and Garden Equipment Incentive Program</td>
<td><a href="http://www.aqmd.gov/lawngarden">www.aqmd.gov/lawngarden</a></td>
</tr>
<tr>
<td>Replace Your Ride (Clean Cars for All)</td>
<td><a href="http://www.replaceyourride.com">www.replaceyourride.com</a></td>
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</table>
Please submit comments, questions, or suggestions on control strategies for construction and industrial equipment to:

AQMPMobileSources@aqmd.gov