



CARB Strategies for Reducing Emissions from Off-Road Construction Equipment

2022 AQMP Mobile Source Working Group

January 27, 2021

1

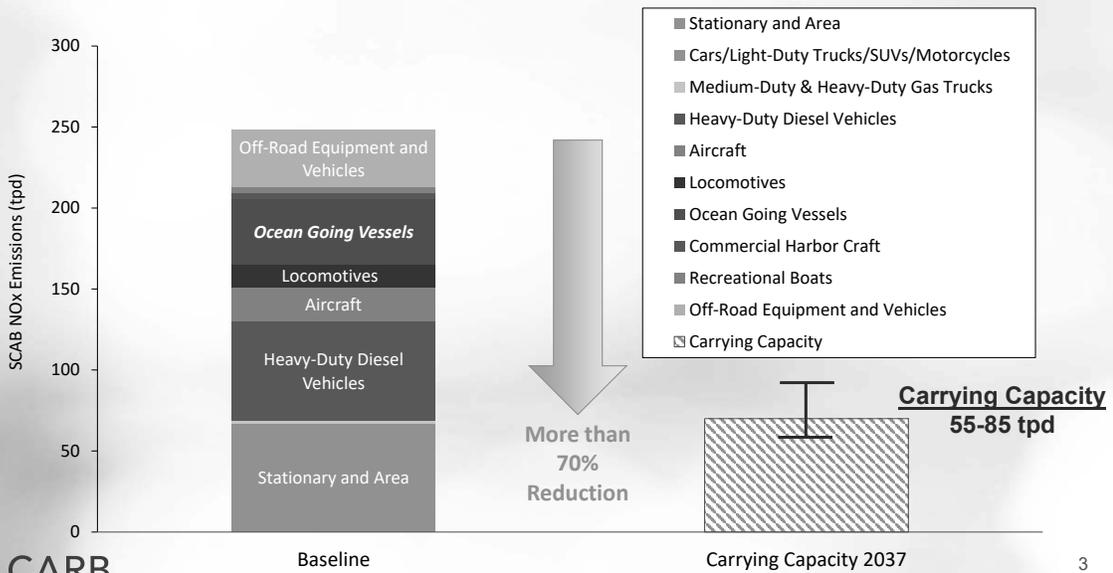
2022 AQMP

- 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

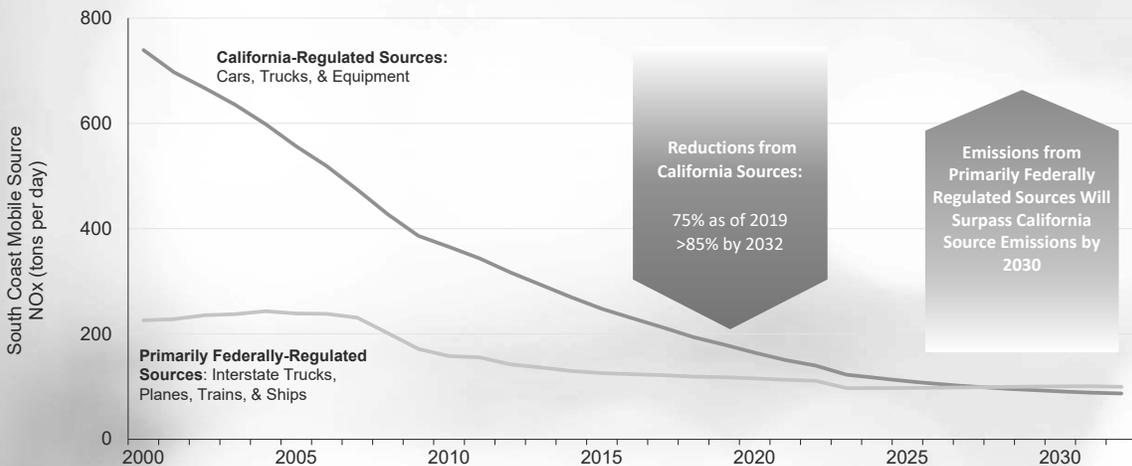


2

2037 Attainment Working Draft

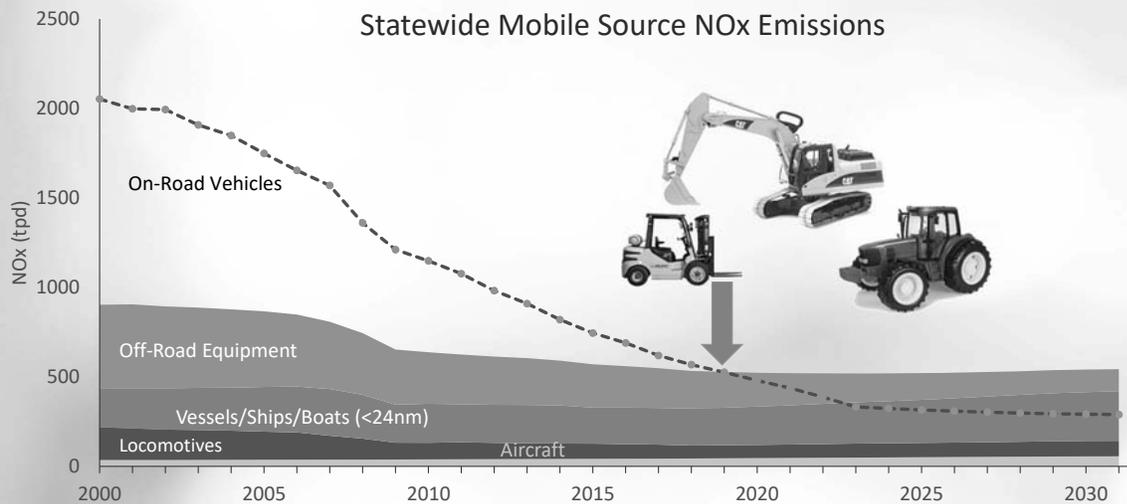


Controlling Federal Sources is Critical to Achieving our Clean Air and Climate Targets



Source: CARB, CEPAM 2016 SIP - Standard Emission Tool (v1.05), <https://www.arb.ca.gov/app/emsinv/fcemsumcat/fcemsumcat2016.php>

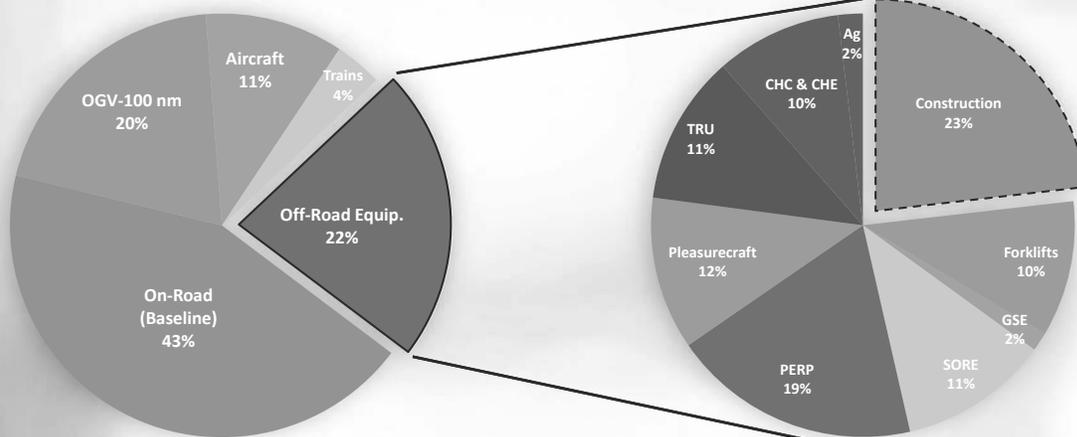
Growing Importance of Off-Road



Off-Road Emission Contribution

Mobile Source NOx emissions in SC in 2037

Off-Road Equipment NOx emissions in SC in 2037

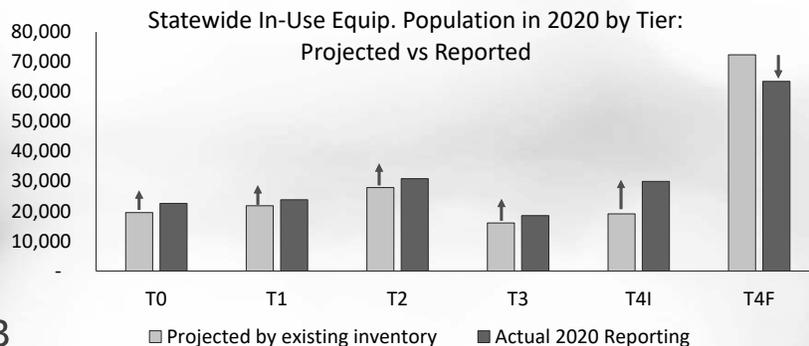


Current In-Use Off-Road Regulation

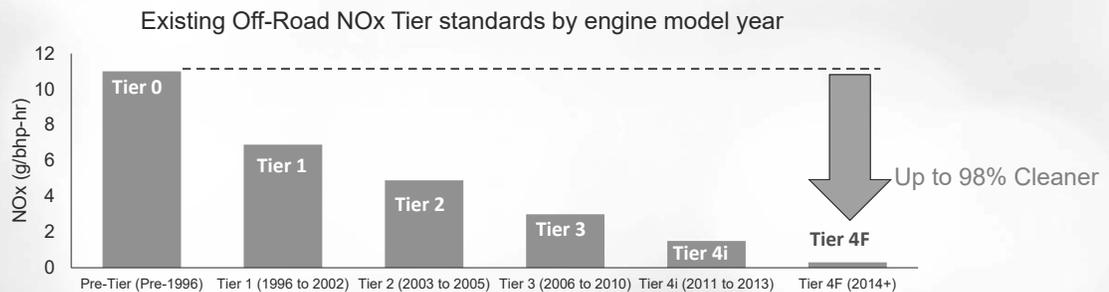
- Covers mobile off-road diesel equipment used in California
(Exemptions: portable or stationary, agriculture, cargo handling, marine vessels, personal use, under 25 hp)
- Fleet average rule adopted in 2007, amended in 2010
 - Fleet average calculated based on model year average, end target is ~2012
 - 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

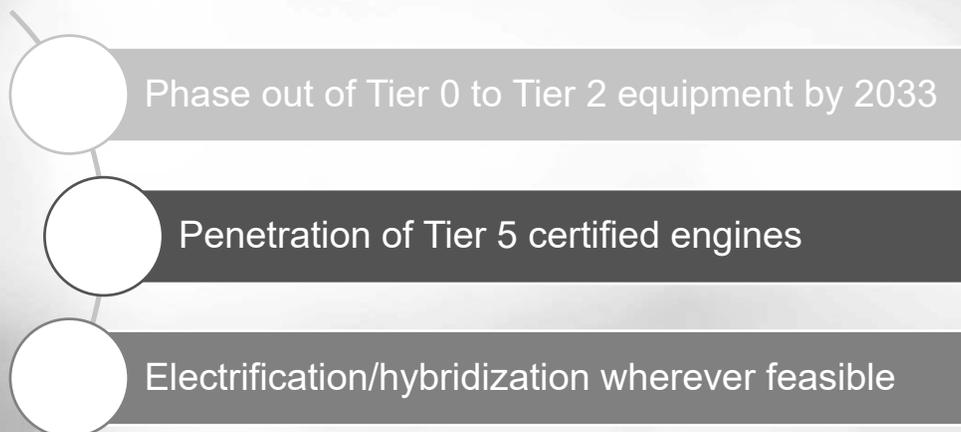


Cleaner Engine Technology Options



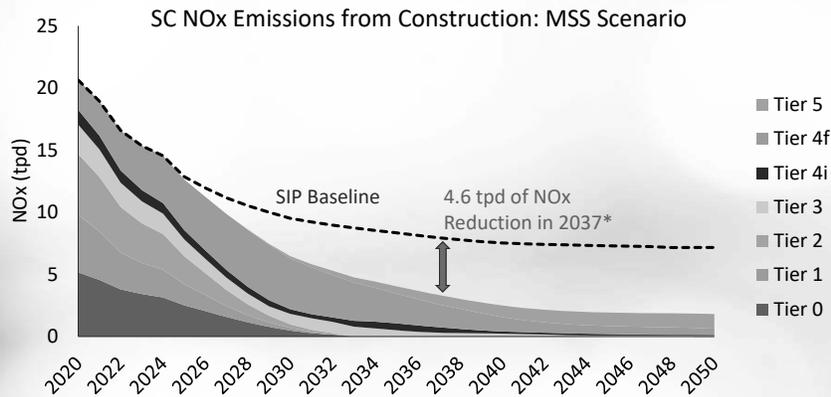
- Off-Road Tier 5
 - 50%-90% NOx and PM reduction from Tier 4F, adoption in 2024 timeframe, implementation starting in 2027/2028
 - **Will require US EPA action on federally preempted equipment (under 175 hp)**
- Electrification and hybridization both commercially viable in select applications, with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

2020 Mobile Source Strategy (MSS) Concepts for Construction Equipment



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



CARB *Reductions incorporate Tier 5 for all horsepower groups, which would require US EPA action ¹¹

Electrification & Hybridization

- Numerous hybrid technologies are commercially available and zero-emission technologies are expanding
 - Hybridization increases fuel efficiency by around 25% on average
 - 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

CARB

Electrification & Hybridization Implementation

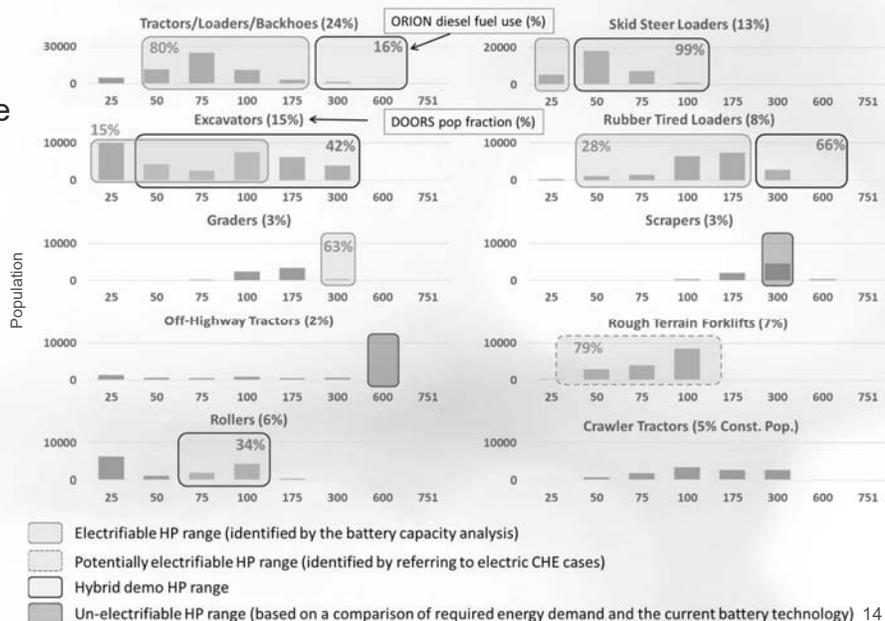
- Ongoing research in off-road engine duty cycles comparing energy needs vs. power provided by battery technology and hybridization
- Daily operating cycle, overall energy demand, and peak energy demand all determine suitability for electrification and hybridization
- Electrification and hybridization requirements could be included with:
 - Tier 5 standards
 - In-use off-road rule or extension
 - New requirements similar to Advanced Clean Trucks



Full electric excavator demo

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
 - Potentially ban older, high emitting vehicles from fleets
 - Encourage and incentivize zero-emission adoption where feasible
 - **Action date: 2024**
- More stringent off-road engine emissions standards
 - Tier 5 **adoption by 2024** and **implementation starting in 2028** (non-preempt equipment)
 - Work with US EPA on federally preempt equipment Tier 5 standards
 - 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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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

South Coast AQMD's AB 923 Distribution of Funds

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)



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

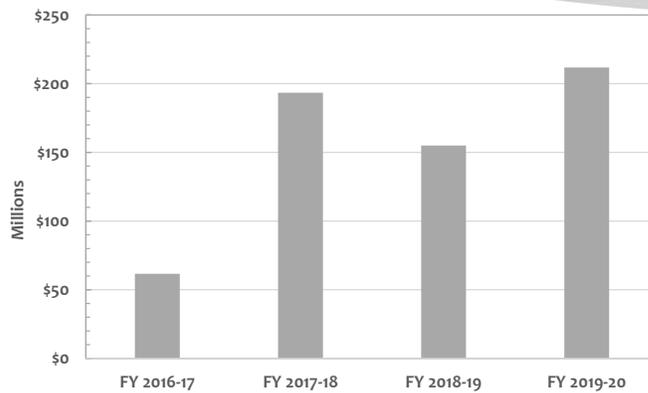


VW Mitigation Program

Project Category	Technology	Allocation (millions)	Air District Administrator
Zero-Emission Transit, School and Shuttle Buses	Battery electric or fuel cell	\$130	SJVAPCD
Zero-Emission Class 8 Freight and Port Drayage Trucks	Battery electric or fuel cell	\$90	SCAQMD
Zero-Emission Freight and Marine Projects	Battery electric or fuel cell	\$70	BAAQMD
Combustion Freight and Marine Projects (waste haulers, dump trucks, concrete mixers, switcher locomotives, ferries, tug boats)	Low NOx engine, Tier 4, or Tier 4 equivalent	\$60	SCAQMD
Light-Duty Zero-Emission Vehicle Infrastructure	Electric charger or hydrogen fueling station	\$10	BAAQMD
CARB Reserve		\$63	
	Total:	\$423	

9

South Coast AQMD Incentive Programs (Past 4 Years)



10

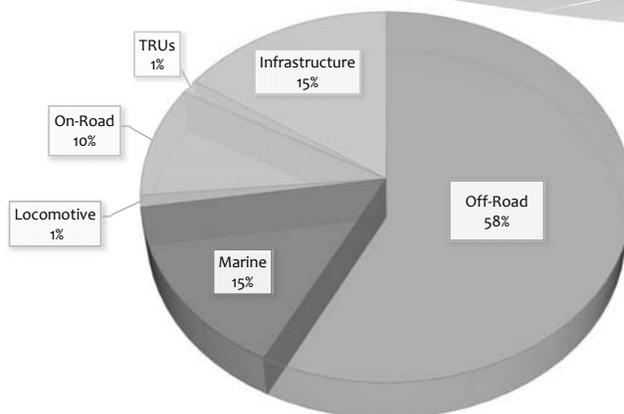
Emission Reduction Benefits from Incentive Programs (2020)

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

* EPA DERA/TAG awards and other smaller grants not included.

11

Carl Moyer Program – Funding Distribution by Project Category



12

CAPP Results

Project Category	Technology	AB 134 (CAPP Year 1)		SB 856 (CAPP Year 2)	
		Funded Amount	No. of Units	Funded Amount	No. of Units
On-Road	Zero emission	\$12,566,150	66	\$1,231,961	45
	Optional low-NOx	\$22,858,674	415	\$9,013,889	133
	Other (Emergency)	-	-	\$1,187,478	19
Off-Road Agriculture	Tier 3/4F	\$19,607,167	156	\$4,795,672	55
Off-Road Construction	Zero emission	-	-	\$2,226,833	9
	Tier 3/4F	\$22,698,620	96	\$2,754,835	32
Cargo Handling Equipment	Zero emission	-	-	\$349,845	16
	Hybrid-Electric	-	-	\$8,235,475	11
	Tier 4F	-	-	\$883,702	5
Marine	Tier 3	\$9,490,812	57	\$17,032,908	85
Transport Refrigeration Unit	Electric	-	-	\$1,411,528	31
Infrastructure	Electric charging	\$122,500	1	\$7,718,592	9
	Renewable natural gas	\$12,243,034	13	\$10,586,965	6
	Natural gas	\$1,237,782	3	-	-
Locomotive	Tier 4	\$11,533,500	6	\$1,243,280	1
TOTAL		\$112,358,239	813	\$68,672,963	465

13

Volkswagen Program Update

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

14

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



15

South Coast AQMD Incentive Programs for Off-Road Construction

- * Carl Moyer Program
- * Surplus Off-Road Opt-In for NO_x (SOON) Provision
- * Other Smaller Grants (including State Reserve or Voluntary NO_x Remediation Measure)

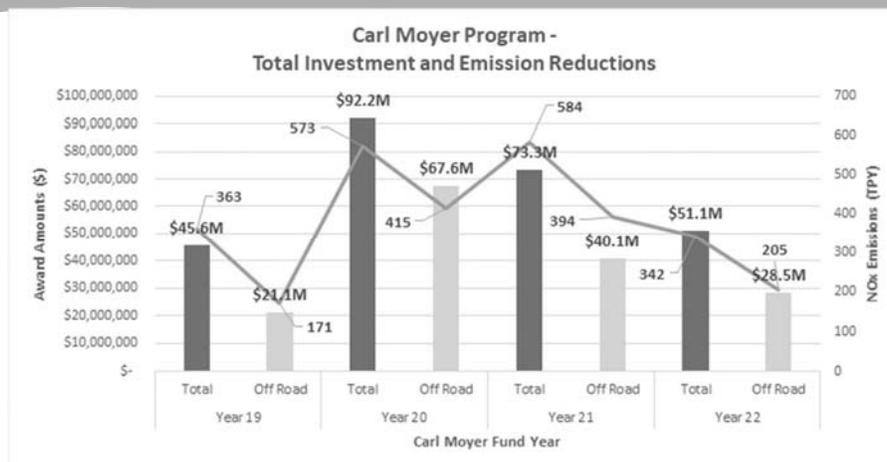
16

Surplus Opt-In Off-Road for NOx (SOON)

- * 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

17

Total Investment in Off-Road Construction (Past 4 Years)



18

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)

19

Useful Links

Program	Link
CAPP Incentives	www.aqmd.gov/cappincentives
Proposition 1B - Goods Movement Emission Reduction Program	www.aqmd.gov/prop1b
Volkswagen Environmental Mitigation Program	www.aqmd.gov/vw
Carl Moyer Program	www.aqmd.gov/moyer
Voucher Incentive Program (for small fleets of 10 trucks and less)	www.aqmd.gov/vip
Lower Emission School Bus Program	www.aqmd.gov/schoolbus
Commercial Lawn and Garden Equipment Incentive Program	www.aqmd.gov/lawngarden
Replace Your Ride (Clean Cars for All)	www.replaceyourride.com

20

20

Contact Information

Please submit comments, questions, or suggestions on control strategies for construction and industrial equipment to:

AQMPMobileSources@aqmd.gov