

Cal/EPA Headquarters
Mobile Source Control Division
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February 23rd, 2018

Re: Caterpillar Inc. comments regarding California's Request For Information on the Proposed VW Environmental Trust Beneficiary Mitigation Plan.

Caterpillar appreciates the opportunity to comment on California's proposed allocation plan for the State's share of the \$2.9B Mitigation Trust Fund (MTF) established under the Volkswagen Consent Decree. Pursuant to section 2.0.3 of the 2016 Consent Decree¹, the *primary* purpose of the Mitigation Trust Fund is to fund Eligible Mitigation Actions which have the goal of reducing NOx emissions in the United States. Caterpillar believes that California's plan could meet this objective by focusing funds towards Eligible Mitigation Actions which are more cost effective for the NOx reduction benefits.

Comment 1: California should invest its Mitigation Trust Funds in cost-effective Eligible Mitigation Actions which would realize greater NOx reductions and better meet the stated purpose of the Mitigation Trust Fund.

Marine, locomotive, and nonroad equipment have significantly longer service lives, higher load factors and higher usage rates than on-highway vehicles. As a result, emission reduction solutions offered by Caterpillar for these sectors have cost effectiveness that are up to 200 times better². For nonroad repowers, there are additional commercial options available with a waiver sought under EPA's DERA (Diesel Emissions Reduction Act) program. DERA funding for State programs is available under the Mitigation Trust Fund (MTF) action 10.

Many States have allocated a large portion of their Mitigation Trust Funds to fund electric and CNG powered on-highway vehicles, including buses. A comparison of cost effectiveness of Mitigation Actions to marine, locomotive, and nonroad options shows that buses obtain less NOx emissions reductions for a much higher cost.

California may be considering investing funding towards electric and clean diesel buses, when the cost effectiveness for NOx reduction is high relative to other mitigation options. Total cost effectiveness for CNG school buses is approximately \$440,000/ton³ (lifetime).

¹ Order Granting the United States' Motion to Enter Proposed Consent Decree, *In re: Volkswagen "Clean Diesel" Marketing, Sales Practices, and Products Liability Litigation*, Case No. 3:15-md-02672 (N.D. Cal., Oct. 25, 2016) ("2016 Consent Decree")

² See Figure 3

³ http://www.CNGAmericangvamerica.org/wordpress/wp-content/uploads/2017/06/CNGA-One-Sheet_School-Bus.pdfhttp://www.ngvamerica.org/wordpress/wp-content/uploads/2017/06/NGVA-One-Sheet_School-Bus.pdfhttp://www.ngvamerica.org/wordpress/wp-content/uploads/2017/06/NGVA-One-Sheet_School-Bus.pdf

There are several factors contributing to this poor cost effectiveness.

School buses:

1. Experience relatively low usage, approximately 12,000 mi/year on average⁴.
2. Experience relatively low engine load factors during usage.
3. Are relatively new with an average age of about 9 years and thus have engines that are relatively lower emitting compared to other sectors.⁵

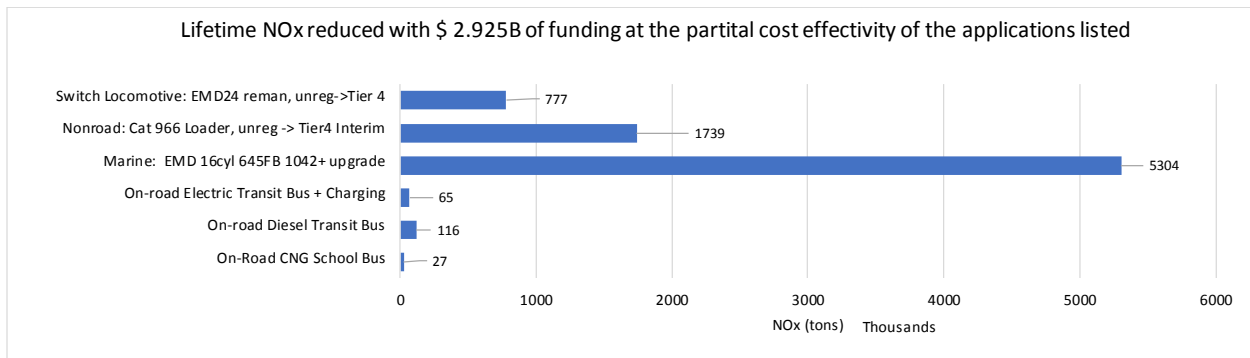


Figure 1: NOx emission reductions available with \$2.93B of MTF from Figure 3

Figure 1 above illustrates the difference in NOx reductions that could be achieved by applying the same amount of MTF towards reductions in different mobile sectors.

In addition to the higher cost per ton of NOx reduced, electric vehicle grants may be too optimistic about the actual environmental benefits. Currently 49.9%⁶ of the electric generation in the State comes from the combustion of fossil fuels. Only 37.2% of California's electricity is renewable. While California and the nation progress slowly towards the decarbonization of the electrical grid, the current sources of renewable electricity generation in the State are typically fully utilized; therefore, sudden increases in electrical demand (such as would occur by adding more EV's) will likely be met by increased fossil fuel combustion. In contrast, current diesel engines have a CO2 and NOx footprint per kWh that is comparable or slightly better than the average combustion electrical generation source in California.

One of the intended goals of the 2016 Consent Decree is to mitigate the total, lifetime excess NOx emissions from the Subject Vehicles to the 2016 Consent Decree. Accordingly, we recommend that California focus on targeting the maximum NOx reductions that can be achieved with the options available today to achieve that mitigation goal, rather than seeding technology to further a particular industry which will not result in immediate and/or significant emissions benefit.

⁴ <http://www.americanschoolbuscouncil.org/issues/environmental-benefits>

Note that NGV America uses an estimate of 15,000 mi/year for their cost effectivity calculations.

⁵ <http://files.schoolbusfleet.com/stats/SBF0317-MaintenanceSurvey.pdf>

⁶ U.S. Energy Information Administration, Washington, July 2017 Electric Generation Profile:

<https://www.eia.gov/state/?sid=CA>

Comment 2: California should invest a proportional amount of its allocated Trust Fund towards Eligible Mitigation Actions in the nonroad space of marine, locomotive, and nonroad mobile sectors, which have been shown to have better cost effectiveness for the NOx emissions reduced in line with the stated purpose of the Mitigation Trust Fund.

The California “emissions inventory” chart, Figure 2 below, is generated from data published by the EPA⁷. It shows that 48% of NOx emissions in California arise from the off-road sectors of marine, locomotive, and nonroad mobile sources combined. We believe these sectors should be addressed by the Mitigation Trust Funds because these sectors represent a significant portion of the emissions in California and far greater reductions in NOx emissions can be realized through Eligible Mitigation Actions in these sectors. Eligible Mitigation Actions in these sectors have the potential to help California realize greater NOx reductions compared to other Eligible Mitigation Actions.

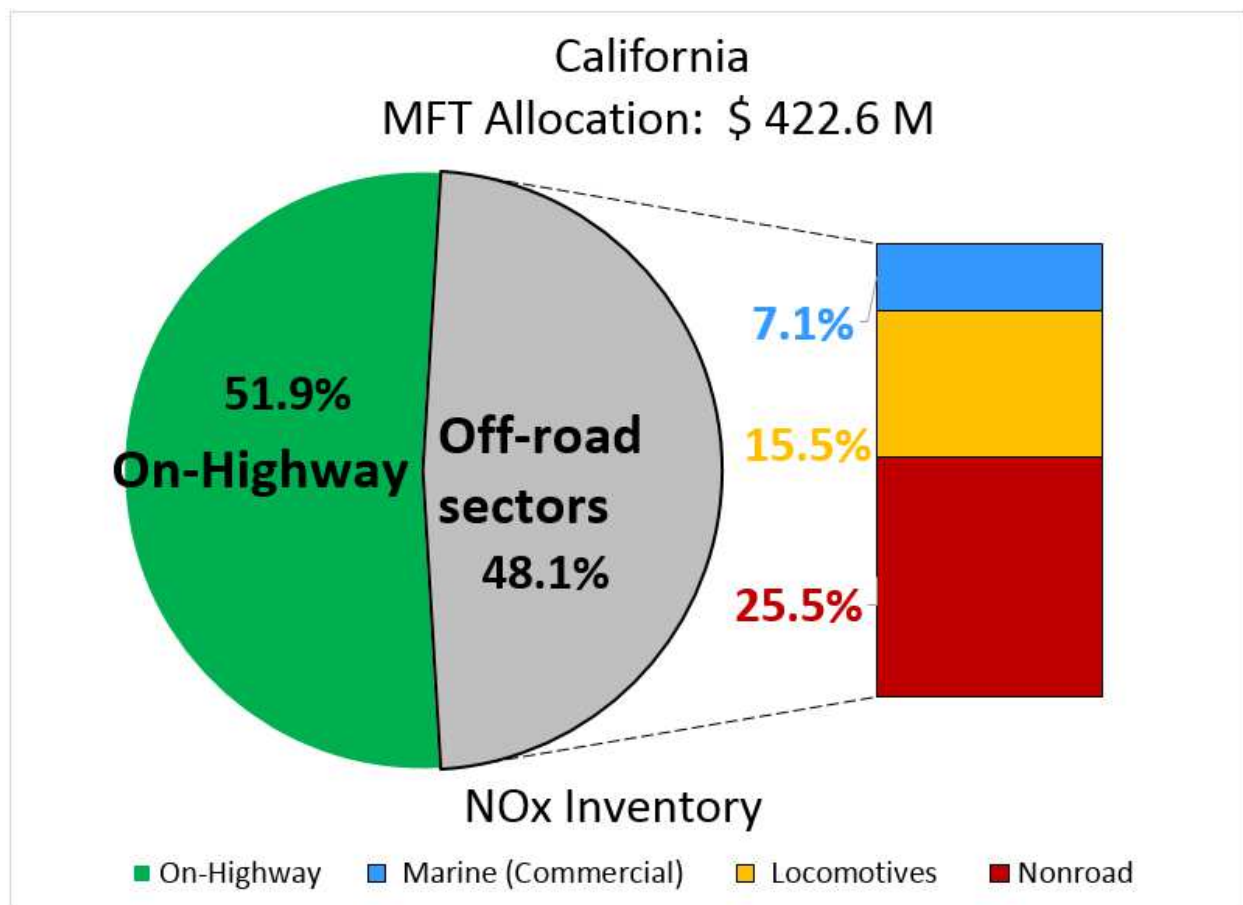


Figure 2: California Mobile NOx sources

⁷ USEPA National Emissions Inventory 2014;
<https://www.epa.gov/air-emissions-inventories/2014-national-emissions-inventory-nei-data>

According to the EPA Green Book⁸, California is listed as being Extreme Nonattainment for Ozone. California should focus on areas that historically have NAAQS attainment issues and those areas that *receive a disproportionate quantity of NOx emissions*. The most populated cities typically have the highest on-road NOx emissions and also the highest number of VW vehicles that are involved in the consent decree. Caterpillar's emission solutions are more cost effective and reduce far more annual tons of NOx than other MTF options. Figure 3 below provides a comparison of NOx reduction cost effectiveness between some key products that Caterpillar can offer in metropolitan areas.

Lifetime NOx reduced with \$ 2.925B of funding and the partial cost effectiveness of the applications listed														
	Cost	VW MTF Funding	Partial MTF Cost	Est out of pocket	NOx Reduced	Service Life*	Lifetime NOx	Total Cost Effectivity	Partial Cost Effectivity	Proposed Qty **	Total Cost	Partial MTF Cost	NOx Reduced	Lifetime NOx
On Road:	per unit	percent	per unit	%	tons/year	years	tons	\$/ton	\$/ton	units	all units	all units	tons/year	tons
CNG School Bus	\$ 148,000	25%	\$ 37,000	39%	0.067	5	0.34	\$ 441,133	\$ 110,283	79,054	\$ 11.7000 B	\$ 2.9250 B	5305	26523
Diesel Transit Bus	\$ 450,000	25%	\$ 112,500	-25%	0.446	10	4.46	\$ 100,800	\$ 25,200	26,000	\$ 11.7000 B	\$ 2.9250 B	11607	116071
Diesel Electric Bus + Charging	\$ 900,000	25%	\$ 225,000	50%	0.500	10	5.00	\$ 180,000	\$ 45,000	13,000	\$ 11.7000 B	\$ 2.9250 B	6500	65000
Caterpillar Nonroad Repowers														
Marine: EMD 16cyl 645FB 1042+ upg	\$ 475,000	40%	\$ 190,000	-29%	14.98	23	344.51	\$ 1,379	\$ 552	15,395	\$ 7.3125 B	\$ 2.9250 B	230593	5303642
Nonroad: Cat 777C C32 Repower, unreg -> Tier 2	\$ 265,000	40%	\$ 106,000	2%	8.29	10	82.91	\$ 3,196	\$ 1,279	27,594	\$ 7.3125 B	\$ 2.9250 B	228774	2287736
Switch Locomotive: EMD30 reman, unreg -> Tier 4	\$ 2,400,000	40%	\$ 960,000	31%	14.05	20	281.08	\$ 8,538	\$ 3,415	3,047	\$ 7.3125 B	\$ 2.9250 B	42821	856416

Figure 3: Cost Effectiveness Comparison

Total Cost Effectiveness is the total cost of the retrofit, repower, or replacement, divided by the lifetime NOx reduction.
Partial Cost Effectiveness is the funded portion of retrofit, repower, or replacement, divided by the lifetime NOx reduction.

Figure 3 above, illustrates the Cost Effectiveness of Caterpillar offerings compared to replacing school/metro buses. If all \$2.93B of the MTF money was spent on each of the listed products, it shows that the listed nonroad options could yield up to 200 times more NOx reductions, in tons, for the same money spent. This difference is due to the significantly better partial cost effectiveness of the off-road options as shown in the yellow column above. Although not a mandate of the MTF, the off-road reductions listed above also result in significant PM reductions.

⁸ USEPA Green Book, 8-hour Ozone (2008)
<https://www3.epa.gov/airquality/greenbook/hbtc.html>

Comment 3: California should consider distributing its proposed allocation for funding of emission reductions for marine vessels, switcher locomotives, and nonroad equipment in the top NOx counties in California as these Eligible Mitigation Actions provide the most cost-effective NOx reductions and would benefit the urban areas in California most impacted by the VW, Audi and Porsche vehicles.

Of the Trust Fund's list of Eligible Mitigation Actions, repowers and upgrade kits for marine vessels, switcher locomotives and nonroad equipment provide the most cost-effective NOx reductions for California. The following are just some examples of Eligible Mitigation Actions in these areas.

Switch Locomotives

California has at minimum 133 switcher locomotives in the State that have various reduction options available under the Eligible Mitigation Actions of Appendix D-2, section (3)(d)(1).



Remanufacture Switch Locomotive EMD24 to Tier 4

Total cost effectiveness:	\$ 9,411/Ton NOx
Partial cost effectiveness:	\$ 3,765/Ton NOx

Nonroad Mobile Machines

Caterpillar has been developing and providing retrofits to reduce emissions from older equipment since 2004. We have engineered 31 machine solutions that upgrade nonroad machines to Tiers 2, 3, and 4. Mitigation Trust Fund Appendix D-2, option 10, allows States to fund retrofit programs through EPA's Diesel Emissions Reduction Act (DERA). Options that replace only the engine rather than the entire machine achieve better cost effectiveness while significantly lowering the emissions of the engine/machine.

The following machines shown below with unregulated engines can be repowered to Tier 4, however, within the State, 31 machine solutions from Caterpillar could be applied to hundreds of machines under the DERA program, if a waiver is granted.

We recommend California apply for an EPA waiver to allow machines to be repowered to Tier 3 in addition to Tier 4. While upgrades to Tier 4 seem optimal, due to the differences in technologies utilized between Tier 3 and Tier 4, there are many more options available for Tier 3 repowers and they provide better cost effectiveness as well.

Nonroad Repowers – Upgrading from unregulated to Tier 4



657 Scraper, unregulated to Tier 4 (dual engine)

Tractor cost effectiveness:

1,682/Ton NOx

Total cost effectiveness: \$ 1,154/Ton NOx

Partial cost effectiveness: \$ 462/Ton NOx

Scraper cost effectiveness:

Total cost effectiveness: \$ 1,640/Ton NOx

Partial cost effectiveness: \$ 656/Ton NOx



966 Loader, Unregulated to Tier 4

Total cost effectiveness: \$ 4,204/Ton NOx

Partial cost effectiveness: \$

Marine Tugs

Caterpillar has a very large selection of emission reduction solutions for marine under Eligible Mitigation Actions of Appendix D-2, section (4)(d)(1). Marine repowers have the best cost effectiveness due to their continual rate of use.



EMD 645FB 1042+ upgrade kit w/ NOx reduction

Total cost effectiveness: \$ 1,379/Ton NOx

Partial cost effectiveness: \$ 551/Ton NOx

Closing Remarks

Large engines used in marine, locomotive, and nonroad mobile equipment, are often an “invisible fleet”. Buses and trucks receive higher visibility for funding for replacement and retrofits, since they are seen and used daily by the public. Trucks are the starting and end points of a transportation chain that frequently involve locomotive and marine in the middle. But despite a lower visibility for replacement and retrofits, locomotive, marine and nonroad equipment frequently have long service lives, up to 40 years for some applications. In contrast, school buses typically have a service life of 16 years and public metro buses typically have a service life of 12 years. There is equipment running in this invisible fleet that is over 50 years old. Without incentivizing the replacement or retrofit of engines in this invisible fleet, owners and operators will continue to overhaul the equipment to the same unregulated status for future decades. This is an important sector that makes up nearly half of California’s Mobile Source NOx emissions.

Based on these facts, Caterpillar recommends California consider the proposed allocation of funds from the VW Mitigation Trust Fund, to significantly improve the NOx reductions in the state. This can be achieved through an allocation to Options 10 (DERA), Option 3 (Freight Switchers), and Option 4 (Marine Tugs and Ferries). The significantly better cost effectiveness of the solutions available under these type of emission solutions justifies a significant allocation to these off-road sectors. This kind of investment will yield the greatest benefit to the State and help California provide improved air quality.

Caterpillar appreciates the opportunity to offer our suggestions for California’s Beneficiary Mitigation Plan for the Volkswagen, Audi, and Porsche Clean Air Act Settlement Funds, and looks forward to receiving California’s response on our comments. Caterpillar and its dealers are ready to accomplish these replacements and emission retrofits. We look forward to the opportunity to discuss these and more options with the California Air Resources Board.

Sincerely,



Rey Agama
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Caterpillar Inc.

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