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## INTRODUCTION

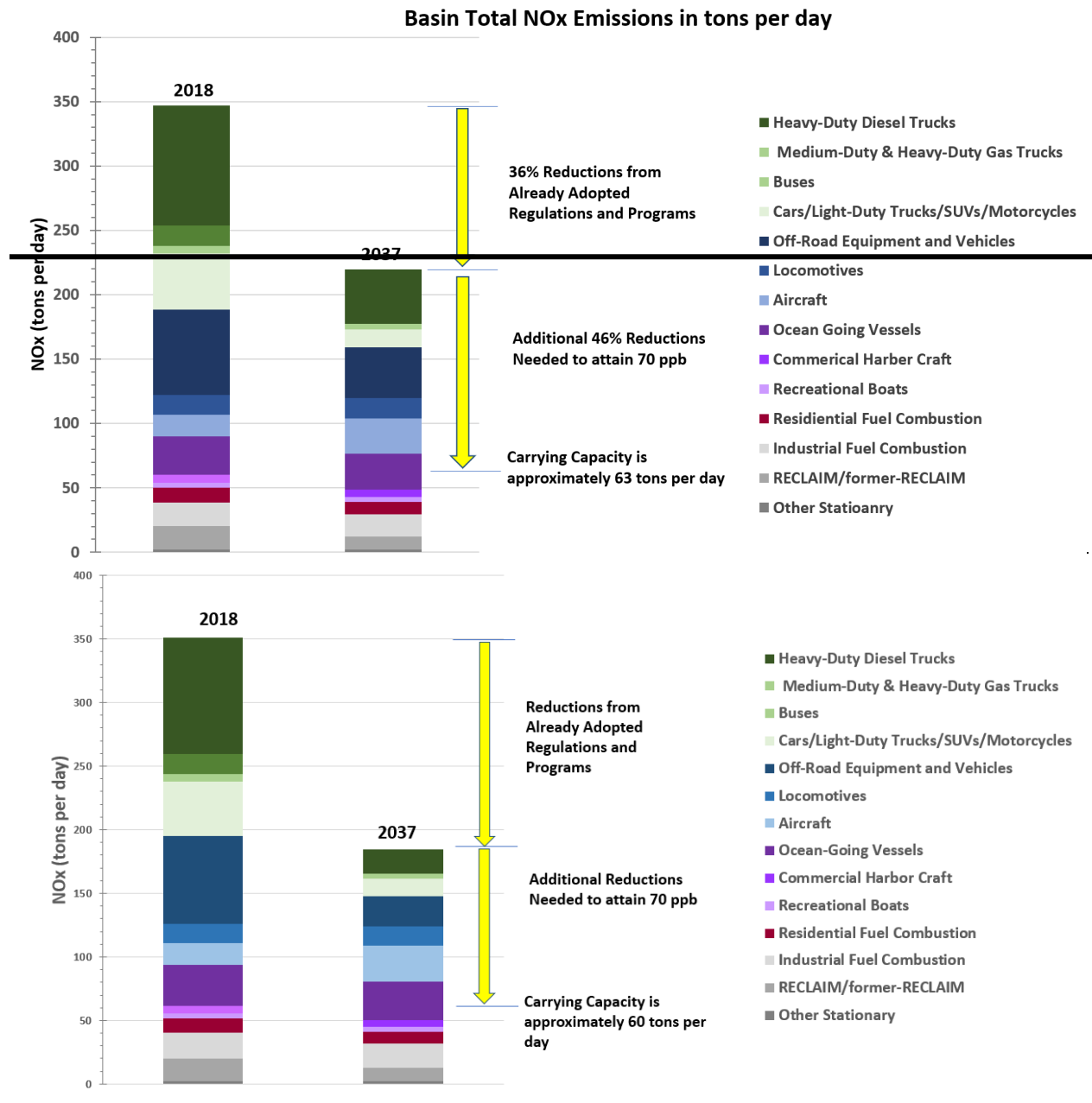
This is one of five briefing papers intended to provide policy background information supporting adoption and implementation of the 2022 Air Quality Management Plan (AQMP). This paper specifically addresses “black box” measures and their role in achieving the 2015 8-hour ozone standard.

The Clean Air Act (CAA) recognizes that clean technologies continually evolve and some technologies critical to meet the air quality standard may not exist or may not be available at a scale needed for attainment at the time of a plan development, but may become available during the 20-year period from the designation to the attainment date. Therefore, the CAA section 182(e)(5) allows “extreme” nonattainment areas to rely on the adoption of “new technologies” in their attainment demonstration with the expectation that new or improved control technologies will materialize. These measures are commonly referred to as “black box” measures because they are not defined specifically at the time of plan development.

Over 80 percent of the “black box” is assigned to emission sources under primarily federal regulatory authority including aircraft, ships, preempted off-road equipment, and interstate trucks. These sources are discussed in detail in an accompanying policy brief. Collectively, “black box” measures comprise 671 tons per day, or 439 percent of the emission reductions needed to reach attainment. All feasible measures including “black box” measures are necessary to demonstrate attainment of the standard by 2037. The following sections describe the need for emission reductions, how the “black box” measures were used in the 2022 AQMP, and current available technologies in various sectors.

## NEED FOR EMISSION REDUCTIONS

The South Coast Air Basin faces an enormous challenge to meet the 2015 8-hour ozone standard by 2037. The 2022 AQMP demonstrates that reducing emissions of Nitrogen Oxides (NOx) will be critical to attain the standard by 2037. The total NOx emissions in the entire Basin projected for 2037 reflecting already adopted regulations and programs – referred as 2037 baseline – is 184220 tons per day. However, the amount of NOx emissions that can be emitted into the atmosphere and still achieve attainment – referred to as the “carrying capacity” – is 603 tons per day for the entire Basin. Even though 2037 baseline emissions are already 4836 percent below the 2018 emissions (35147 tons per day), existing regulations and programs (i.e., “baseline” conditions) are not enough to meet the standard, and an additional 6771 percent reduction in NOx beyond the 2037 baseline levels are needed. This is about 832 percent below 2018 levels. The NOx baseline inventory and reductions required for attainment are depicted in Figure 1, illustrating the need for all sectors to reduce emissions substantially and for the adoption of all feasible measures.



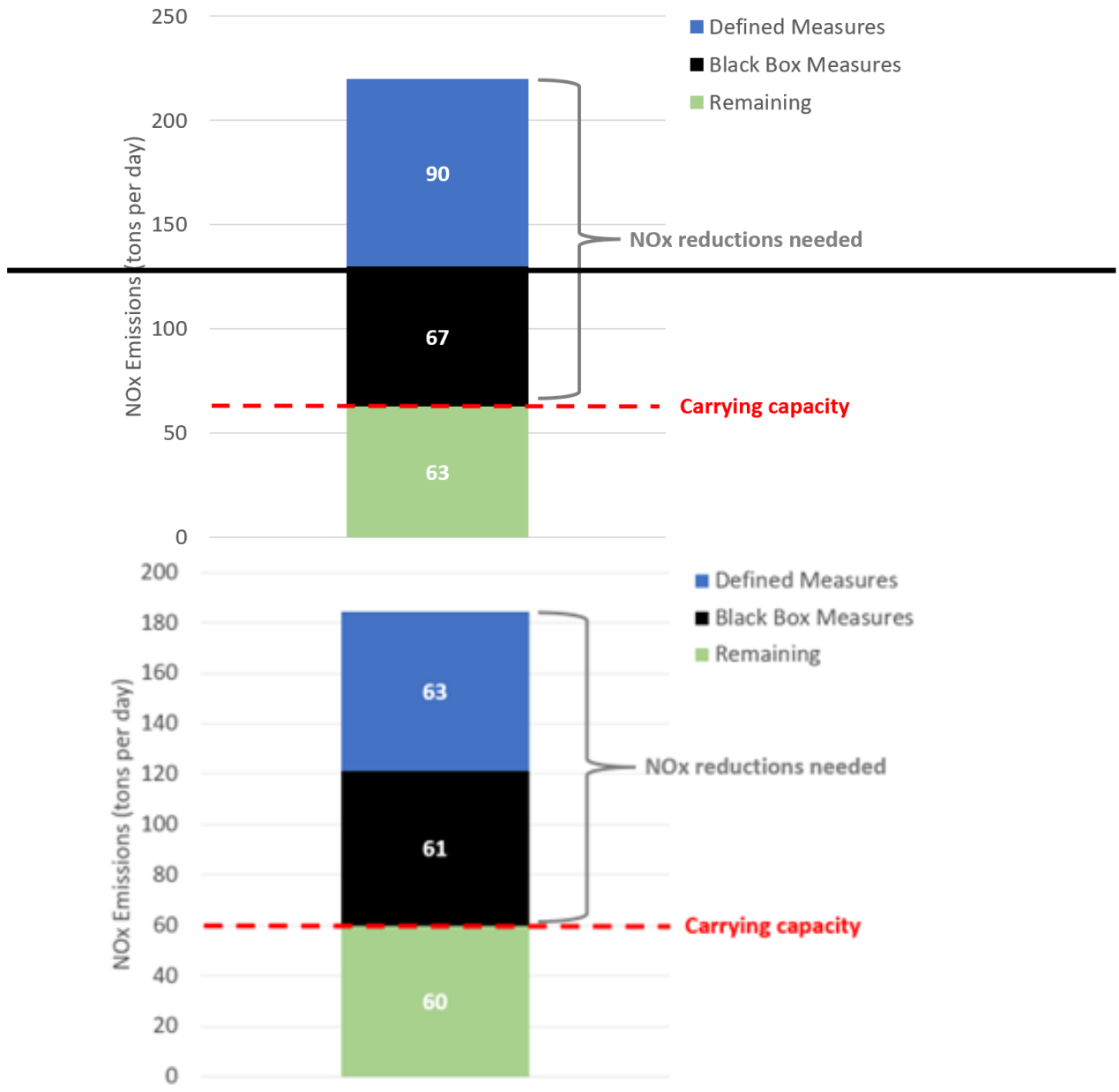
**FIGURE 1  
BASELINE NOX EMISSIONS INVENTORIES AND ADDITIONAL REDUCTIONS REQUIRED TO  
ATTAIN THE 2015 8-HOUR OZONE STANDARD**

**CONTROL STRATEGY AND “BLACK BOX” MEASURES**

The 2022 AQMP presents a comprehensive strategy to achieve the emission reductions needed for attainment including 48 defined control measures covering stationary and mobile sources. There are 30 control measures targeting stationary sources categorized into four groups: NOx control measures, co-

benefits from climate and energy programs, limited strategic Volatile Organic Compound measures, and other measures. The NO<sub>x</sub> measures are further grouped by residential combustion, commercial equipment, and large equipment. The residential and commercial measures are frequently referred to as “building measures,” which are in line with California’s aggressive climate goals to reduce greenhouse gas (GHG) emissions across various sectors. The remaining 18 control measures target mobile sources. They include Facility-Based Mobile Source Measures (FBMSM), emissions growth management measures, incentive programs, and other measures.

The emission reductions from the control measures included in the 2022 AQMP are depicted in Figure 2. The figure shows the total 2037 baseline, the reductions associated with defined measures and black box measures, and the carrying capacity. Reductions from defined measures are far short of the needed reductions to achieve the carrying capacity of 630 tons per day. Additional measures associated with the “black box” will therefore be necessary to attain the 2015 8-hour ozone standard. Collectively, “black box” measures represent 671 tons per day, or 4943 percent of the emission reductions needed to reach attainment. There are several different types of measures that can be considered as part of the “black box,” including cleaner technologies that have yet to be developed or deployed at a scale, emission reductions from sources subject to federal regulatory authority, and select incentive measures.



**FIGURE 2**  
**REDUCTIONS FROM DEFINED AND BLACK BOX MEASURES<sup>1</sup>**

CAA section 182(e)(5) “black box” measures point to the deployment of developing advanced technologies. The reliance on “black box” measures provides flexibility and time for the development of new technology and improvement of existing technologies. For example, South Coast AQMD includes modest “black box” NOx reductions of 3 tons per day for stationary sources. This largely reflects the lack

<sup>1</sup> Mobile source measures reflect CARB’s commitment from the 2016 and 2022 State SIP Strategies. Available online at: <https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy> [https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft\\_2022\\_State\\_SIP\\_Strategy.pdf](https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf) and <https://ww3.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf>.

of available clean technologies at scale for this sector. Examples of these technologies include zero-emission electric and hydrogen-based industrial heaters and boilers. These technologies are currently emerging, not available at scale, or incredibly expensive and difficult to deploy. However, such technologies are anticipated to become far more available and affordable before the 2037 attainment year, driven by the need to reduce GHG emissions as well as the need to reduce criteria air pollutants.

The second type of “black box” measures are those that seek reductions from emission sources under federal and international regulatory authority, namely aircraft, ships, preempted off-road equipment, and interstate trucks. These sources are projected to grow, and their emissions will have larger contributions in the future. For example, the contribution of aircraft NO<sub>x</sub> emissions in 2018 is 5 percent, but grows to over 15~~3~~ percent in 2037. While the U.S. EPA has not adopted aggressive controls targeting these sources, emission reductions from all sources — including federal sources — are necessary to meet the ozone standard. Thus, the 2022 AQMP includes a 70 percent NO<sub>x</sub> emission reduction from aircraft, which is approximately 19 tons per day. An additional 3~~25~~ tons per day of NO<sub>x</sub> reductions are expected from sources subject to U.S. EPA authority, including 4~~10~~ tons per day from interstate heavy-duty trucks, 2~~24~~ tons per day from ocean-going vessels, and 4~~3~~ tons per day from preempted off-road equipment. The U.S. EPA will likely perceive these reductions as “black box” measures. Cleaner technologies that could achieve these emission reductions are discussed in the next section.

Lastly, some incentive measures are also considered as “black box” measures since it is challenging to obtain SIP creditable emission reductions for these measures. One recent example is CARB’s South Coast On-Road Heavy-Duty Vehicle Incentive Measure<sup>2</sup> which sought 1 ton per day of NO<sub>x</sub> reductions based on an incentive-based voluntary approach. Although U.S. EPA initially approved the measure,<sup>3</sup> U.S. EPA subsequently issued an insufficiency finding and required CARB to adopt substitute measures to achieve emission reductions addressing the shortfall.<sup>4</sup> Due to these potential uncertainties, incentive measures are included in the “black box.” In this AQMP, South Coast AQMD includes NO<sub>x</sub> reductions of 7~~10~~ tons per day from mobile source incentives based on anticipated funding. These reductions target both on-road and off-road emission sources. The on-road incentive program targets accelerated replacement of passenger cars, sport utility vehicles, vans, light-duty pick-up trucks, and other vehicles that weigh over 8,500 lbs. The off-road component seeks to achieve emission reductions from commercial harbor craft, locomotives, and other off-road equipment through incentives. The incentives would prioritize funding for low NO<sub>x</sub> and zero-emission technologies, some of which have yet to be fully developed and deployed at scale. While mobile source incentives are considered “black box” measures, the reductions they produce will be critical to meet the ozone standard in 2037.

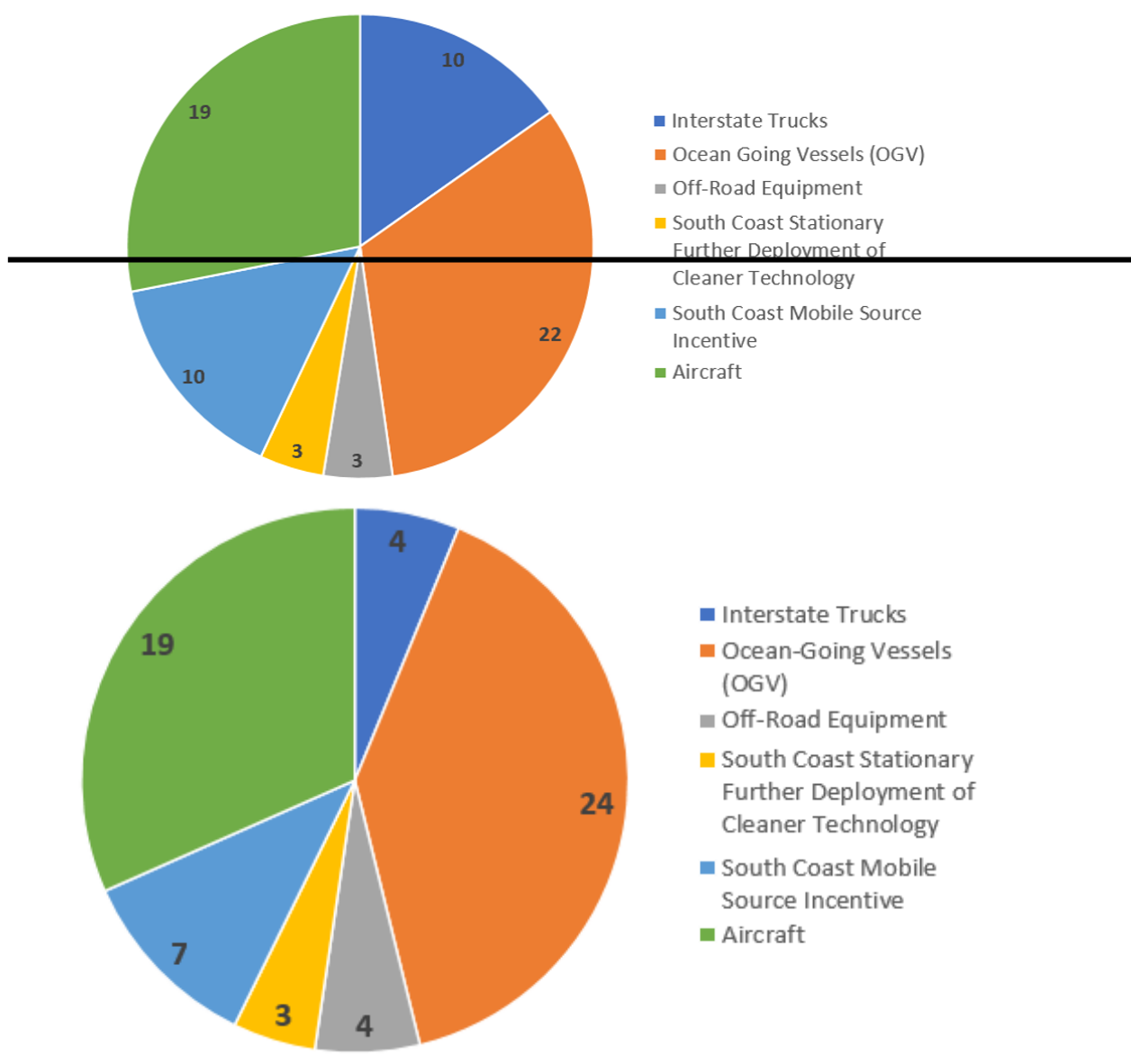
Collectively, “black box” measures represent 6~~7~~ tons per day of NO<sub>x</sub> reductions. A summary of emission reductions contained within the “black box” is presented in Figure 3.

<sup>2</sup> <https://ww3.arb.ca.gov/planning/sip/imp2016sip/finalreport.pdf>

<sup>3</sup> 86 FR 3820

<sup>4</sup> [https://www.epa.gov/system/files/documents/2021-07/south-coast-incentive-measure-finding\\_063021-final.pdf](https://www.epa.gov/system/files/documents/2021-07/south-coast-incentive-measure-finding_063021-final.pdf)





**FIGURE 3**

**SUMMARY OF BLACK BOX NO<sub>x</sub> REDUCTIONS (TONS PER DAY)**

**UPCOMING TECHNOLOGIES THAT REDUCE EMISSIONS FROM OFF-ROAD EQUIPMENT**

CARB’s Draft-2022 State SIP Strategy (SSS) includes reductions from mobile sources and other sectors. However, reductions from many off-road sources including locomotives and other off-road equipment account for a significant fraction of the “black box” measures since many off-road sources are subject to federal and international regulatory authority as previously discussed. Zero-emission technologies are currently limited or non-existent for many off-road categories. Thus, the focus of CARB’s Draft-2022 SSS is on the deployment of cleaner advanced technologies that still provide significant emission reductions. Emission standards for off-road equipment are commonly expressed in terms of tier levels where higher

tier levels achieve lower emission rates. This section discusses the current availability and implementation of higher tier off-road equipment.

Table 1 presents the implementation schedule for the various tier levels from major off-road categories and Figure 4 shows the overall breakdown of tier distribution in those categories. While the highest tiers are available, the deployment of cleaner tiers is still limited: for locomotives, Tier 4 only accounts for 4 percent of the activity at the ports of Los Angeles and Long Beach; for off-road equipment, 35 percent of the equipment population is Tier 4f; for ocean-going vessels, only 2 percent of the calls to the ports of Los Angeles and Long Beach are vessels with Tier 3 engines.

CARB’s Draft 2022 SSS calls for the introduction of new tiers for locomotives (Tier 5), off-road equipment (Tier 5) and OGV (Tier 4) and research is underway to demonstrate the feasibility for diesel engines that can meet these higher tiers. However, the reductions achieved by switching to cleaner tiers will likely be insufficient to meet the substantial emission reductions required to attain the ozone standards. Therefore, there is a need to switch to zero emission equipment wherever possible. There are electrification and hybridization options that are commercially viable in selected applications and the availability of zero emission options are expanding. For example, electrification of forklifts, ground support equipment at airports, and cargo handling equipment at ports and warehouses is already happening, and hybrid heavy-duty equipment and locomotives are already commercially available. However, for many applications a zero-emission option is still not yet fully developed or economically viable. Even though some of these options are not practical today, CAA section 182(e)(5) allows areas classified as “extreme” nonattainment to rely on these options with the understanding that they will become readily available by 2037. South Coast AQMD will be able to demonstrate the viability 3 years prior to the attainment deadline as part of the required contingency measure plan.

**TABLE 1**

**IMPLEMENTATION SCHEDULE FOR EMISSION STANDARD TIERS FOR OFF-ROAD EMISSION SOURCES**

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030+
<b>Locomotives</b>	Tier 0-1			Tier 2				Tier 3			Tier 4					Tier 5*															
<b>Non-Road Engines</b>	Tier 0-3					Tier 4-4f											Tier 5*														
<b>Marine Engines (Class 3)</b>		Tier 1				Tier 2			Tier 3					Tier 4*																	

\* These tier levels are proposed in the 2022 SSS and they are not yet defined

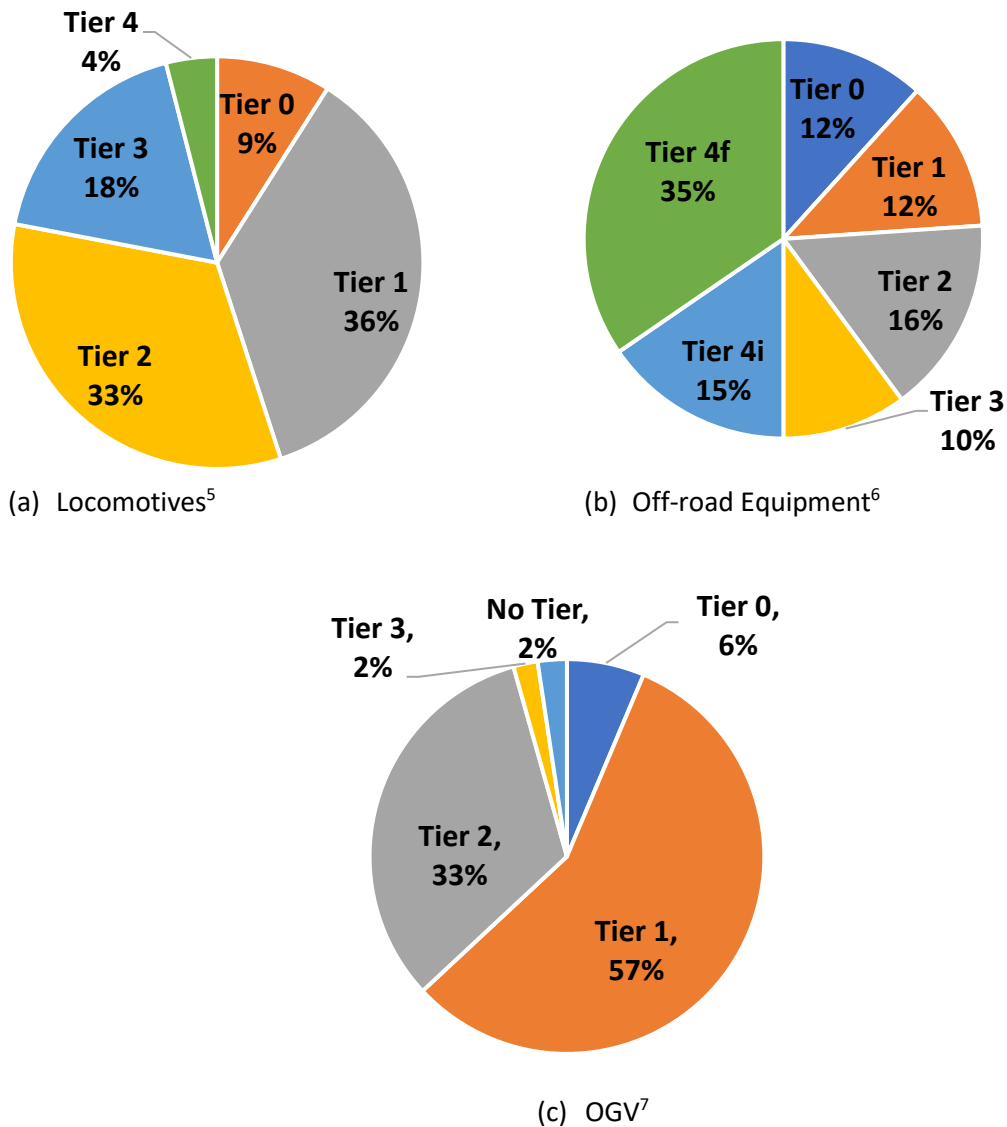


FIGURE 4

**BREAKDOWN OF TIER PREVALENCE AMONG OFF-ROAD CATEGORIES: (A) LOCOMOTIVES, BASED ON ACTIVITY REPORTED AT THE PORTS OF LOS ANGELES AND LONG BEACH, (B) OFF-ROAD EQUIPMENT POPULATION IN CALIFORNIA, (C) NUMBER OF CALLS IN THE PORTS OF LOS ANGELES AND LONG BEACH**

**SUMMARY**

South Coast AQMD acknowledges the daunting challenge of attaining the 2015 8-hour ozone standard by 2037. Even after accounting for implementation of the 2022 AQMP control strategy, a substantial

<sup>5</sup> Based on the locomotive activity at the Ports of Los Angeles (POLA) and Long Beach (POLB), reported in the POLA/POLB Emissions Inventory for 2020.

emission reduction shortfall will remain in 2037. Pursuant to CAA section 182(e)(5), South Coast AQMD is allowed to include black box measures that point to the deployment of developing advanced technologies in addition to addressing reductions associated with primarily federally regulated emission sources. The vast majority of emission reductions within the black box are attributable to sources for which South Coast AQMD lacks regulatory authority. Thus, the challenge of the black box is largely the same as that of federally regulated emission sources, which are discussed in an accompanying policy brief.

In total, the black box measures account for 671 tons per day of reductions, or about 493 percent of the ~~157-124~~ tons per day of NOx reductions beyond the 2037 baseline needed for attainment. When the black box is relied upon to demonstrate attainment, the State must make an enforceable commitment to submit contingency measures to the U.S. EPA three years before the reductions are needed to attain the standard. The State must either demonstrate that the assumed reductions from future technology were already achieved or submit contingency measures capable of achieving the remaining emission reductions. This submittal will be due to the U.S. EPA by 2034.

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POLA: ~~<https://www.portoflosangeles.org/environment/air-quality/air-emissions-inventory>~~  
<https://www.portoflosangeles.org/environment/air-quality/air-emissions-inventory>  
POLB: <https://polb.com/environment/air/#emissions-inventory>

<sup>6</sup> Based on the population of off-road equipment in California, presented by CARB staff at the 2022 AQMP Mobile Source Working Group, January 2021. Available at: <http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/2022-aqmp-mobile-source-working-groups>

<sup>7</sup> Based on the number of calls reported by tier in the POLA and POLB emissions inventory for 2020