2022 State Strategy for the State Implementation Plan: Draft Measures

October 6, 2021

CALIFORNIA
AIR RESOURCES BOARD

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Introduction

The *2022 State Strategy for the State Implementation Plan* (2022 State SIP Strategy) will describe the California Air Resources Board (CARB or Board) strategy and commitments to reduce emissions from State-regulated sources to support attainment of health-based federal air quality standards across California as part of State Implementation Plans (SIPs) due in 2022. This document, the *2022 State SIP Strategy: Draft Measures* (Draft Measures), is being released to facilitate public feedback on CARB staff's initial ideas on potential measures, prior to release of the full Draft 2022 State SIP Strategy in the coming months. The Draft 2022 State SIP Strategy will include additional measure details, measure timelines, emissions reductions commitments to attain the standards, and an economic analysis with the objective of achieving the 8-hour ozone standard of 70 parts per billion (ppb) within the federally defined timeframes.

This 2022 State SIP Strategy effort builds on the measures and commitments already made in the *2016 State Strategy for the State Implementation Plan* (2016 State SIP Strategy), and expands on the scenarios and concepts included in the *2020 Mobile Source Strategy*, CARB's multi-pollutant planning effort that identifies the pathways forward to achieve the State's many air quality, climate, and community risk reduction goals. CARB's current control program, along with efforts at the local and federal level, have been tremendously successful in reducing emissions of air pollutants and have resulted in significantly cleaner vehicles and equipment in operation today, but substantial additional reductions are needed.

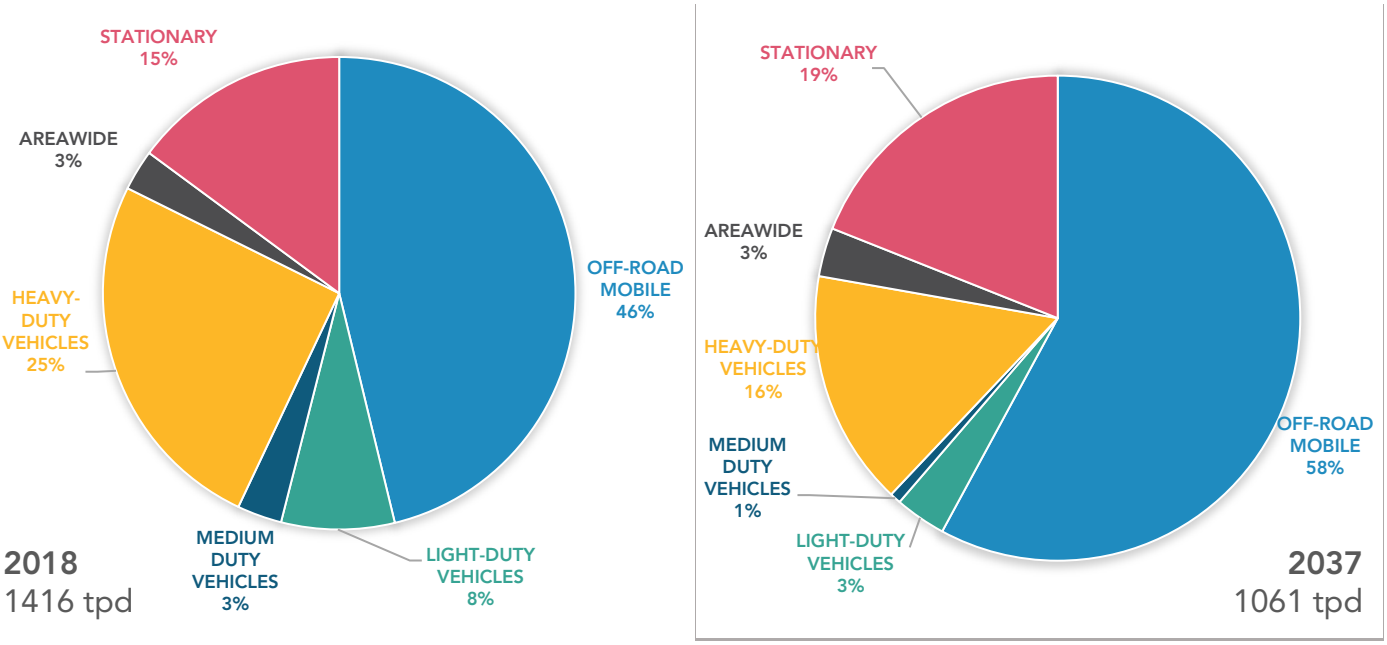
In 2015, U.S. Environmental Protection Agency (U.S. EPA) revised the 8-hour ozone standard from 75 parts per billion (ppb) to the more stringent and health protective level of 70 ppb. Nineteen regions in California are designated as nonattainment areas under the 70 ppb 8-hour ozone standard, with two areas having the most critical air quality challenges at a regional level – the South Coast Air Basin and the San Joaquin Valley. These regions are the only two areas in the nation classified as Extreme for the 70 ppb 8-hour ozone standard, and also record some of the nation's highest fine particulate matter (PM2.5) levels. While the 2022 State SIP Strategy will include measures and commitments for the 70 ppb 8-hour ozone standard, the emissions reductions will also support attainment of other national ambient air quality standards including the 75 ppb 8-hour ozone standard, and the 12 microgram per cubic meter ($\mu g/m^3$) annual and 35 $\mu g/m^3$ 24-hour PM2.5 standards.

Many low-income and disadvantaged communities within the nonattainment areas, and across the State, continue to experience disproportionately high levels of air pollution and the resulting detrimental impacts to their health. Central to CARB's planning efforts and programs going forward will be environmental justice, racial equity, and community engagement as CARB strives to address longstanding environmental and health inequities from elevated levels of toxics, criteria pollutants, and secondary impacts of climate change. It's imperative that CARB optimizes our control programs to maximize emissions reductions and provide targeted near-term benefits in the communities that continue to bear the brunt of poor air quality. The Draft Measures will reduce emissions and corresponding health risk in California's most impacted communities. Staff will continue to assess these potential actions

for environmental justice and racial equity as the process moves forward with the release of the Draft 2022 State SIP Strategy, and as each measure is developed through its own public rulemaking process.

Current control programs adopted by CARB and upcoming measures in 2016 State SIP Strategy, as well as the local air district and U.S. EPA programs, provide a significant down payment on the emissions reductions needed to meet the federal 70 ppb 8-hour ozone standard and improve air quality throughout the State. Even so, mobile sources including cars, trucks, tractors, and a variety of other on-road vehicles and off-road equipment contribute the majority of ozone-forming oxides of nitrogen (NOx) emissions (Figure 1).

Figure 1 - Statewide NOx Emissions by Sector[1]



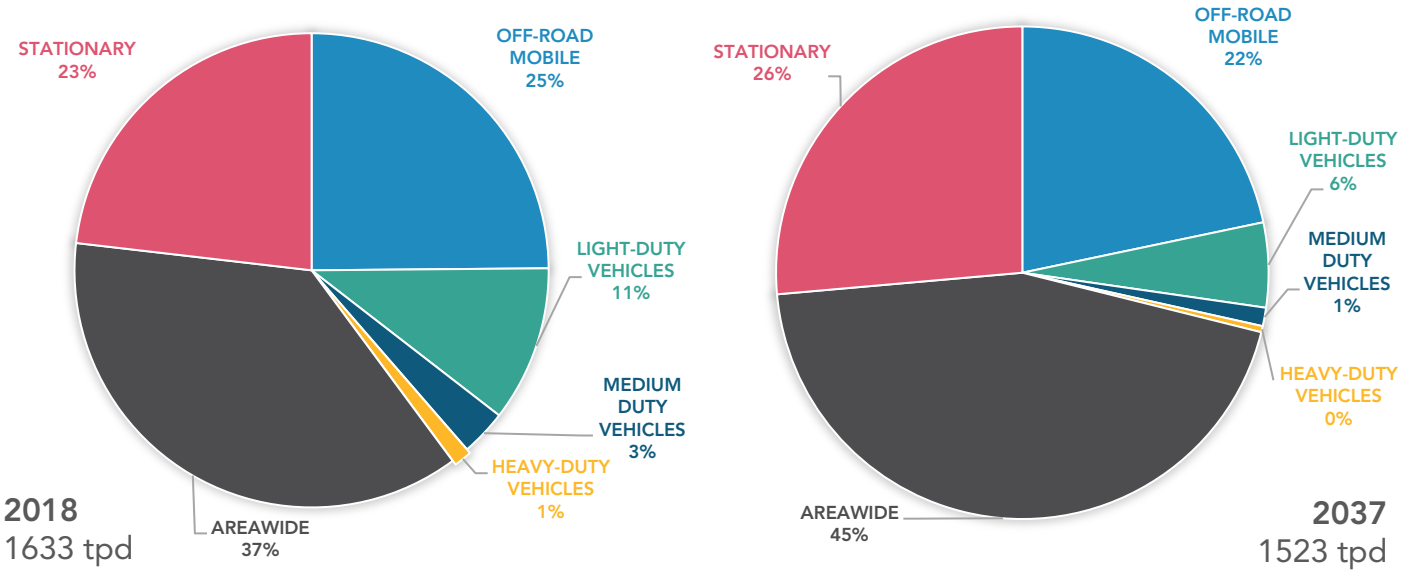
The CARB public process to develop and adopt regulations is nearing completion for a few measures included in the 2016 State SIP Strategy: Heavy-Duty Inspection and Maintenance Program, Advanced Clean Car II Program, Small Off-Road Engines, Transport Refrigeration Units Air Toxic Control Measure amendments, and Zero-Emission Forklift Regulation Phase I. Additional controls are still needed on these sources under State authority to reduce emissions of NOx and reactive organic gases (ROG, emissions shown in Figure 2), the two precursors to ozone, and reduce emissions of other criteria pollutants, toxics and greenhouse gases (GHG).

That said, action is needed at all jurisdictional levels – State, local, and federal – to achieve the magnitude of emissions reductions necessary to attain the 70 ppb 8-hour ozone standard

[1] Source: CARB 2019 CEPAM v1.03; represents the current baseline emissions with adopted CARB and district measures.

in our Extreme nonattainment areas, and across the State. Attainment is simply not possible without action by U.S. EPA and other federal entities to control emissions from sources under their respective authorities.

Figure 2 - Statewide ROG Emissions by Sector[2]



This document, the Draft Measures, discusses CARB's initial ideas on additional potential measures to be pursued in the 2022 State SIP Strategy to support attainment of the federal 70 ppb 8-hour ozone standard across California. This document includes measures being considered for on-road and off-road mobile sources and consumer products, in addition to actions needed at the federal level, and additional potential measures that CARB staff have heard as suggestions through public engagement efforts thus far. While some of the potential measures included in this document primarily target reductions in greenhouse gas (GHG) emissions or toxic air contaminants, they are included here as they will also achieve criteria pollutant co-benefits. For the most severely impacted areas in California to attain the 70 ppb 8-hour ozone standard, any and all potential reductions must be pursued, and a combination of State measures from the 2022 State SIP Strategy, local district measures, and federal action will be required.

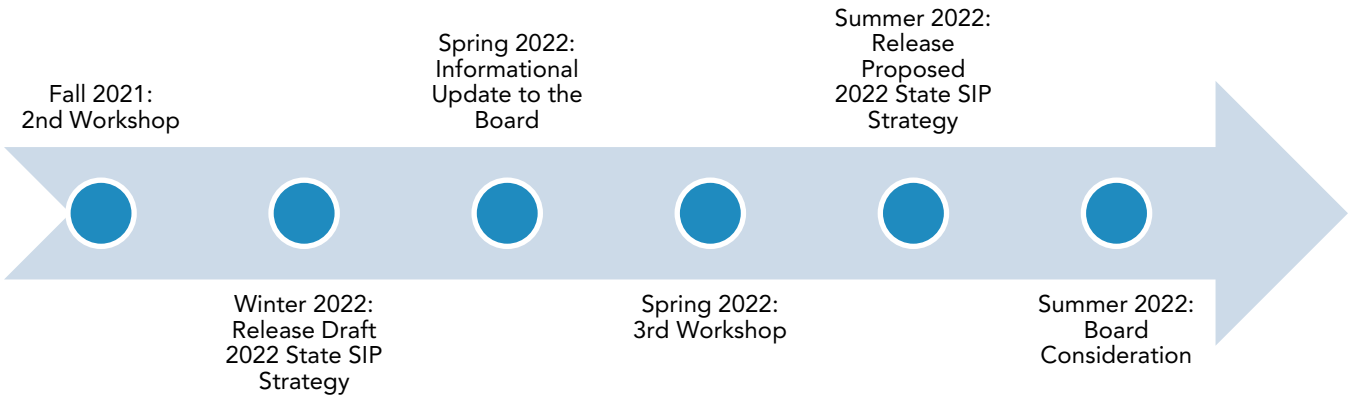
CARB has released the Draft Measures in advance of the October 19, 2021 public workshop where the potential measures will be discussed and provide the opportunity for public feedback, input, and ideas. Input provided through the public process will inform the development of the 2022 State SIP Strategy. These CARB-developed measures and suggested measures may or may not ultimately be included in the 2022 State SIP Strategy in

[2] Source: CARB 2019 CEPAM v1.03; represents the current baseline emissions with adopted CARB and district measures

the form described here; they are being offered at this stage for further input and review, as CARB continues to work in partnership with all levels of government, communities, and the private sector, to achieve challenging air quality targets. CARB invites additional suggestions, ideas and input from the public, as we are aware that additional measures will be necessary to achieve the emissions reduction needed in order for all areas in the State to meet the 70 ppb 8-hour ozone standard.

Public participation is and continues to be an essential part of developing the 2022 State SIP Strategy. CARB initiated the public process with a workshop in July 2021, and has solicited input from numerous interested stakeholders in individual meetings. Moving forward, CARB will release the Draft 2022 State SIP Strategy and provide an informational update to the Board in early 2022. CARB will release the final draft of the 2022 State SIP Strategy for Board consideration next summer, to be incorporated into the SIPs for the 70 ppb 8-hour ozone standard which are due to U.S. EPA in August 2022. Figure 3 summarizes the timeline and main opportunities for public participation, but we welcome feedback and engagement throughout the development process.

Figure 3 - 2022 State SIP Strategy Public Participation Opportunities

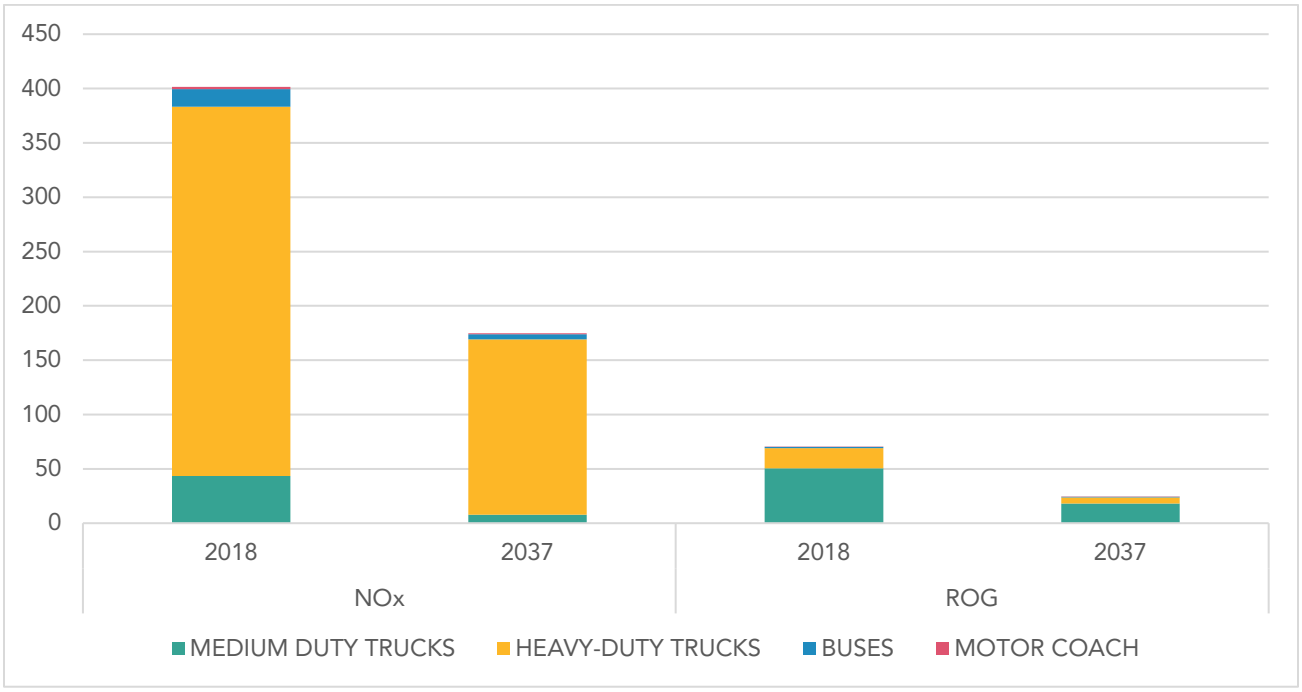


Proposed Measures: On-Road Medium- and Heavy-Duty Vehicles

Description of Source Category:

Medium and heavy-duty vehicles are defined as vehicles with a GVWR over 8,500 pounds and include heavier pick-up trucks and walk-in vans, as well as a wide range of vocational and drayage trucks (big-rig trucks) and buses. These vehicles are one of the fastest growing transportation sectors in the United States, responsible for about 32 percent of total Statewide NOx emissions, and are a significant source of Statewide diesel particulate matter and GHG emissions. CARB has numerous programs already in place to control emissions from medium- and heavy-duty vehicles including the Truck and Bus Regulation, Heavy-Duty Omnibus, Advanced Clean Trucks, as well as incentive programs such as the widely successful Carl Moyer Program. In addition, staff will be proposing a regulation to implement Heavy-Duty Inspection and Maintenance, a 2016 State SIP Strategy measure, later this year. Most of the NOx emissions from heavy-duty engines come from diesel-cycle engines, especially in the higher weight classes (Figure 4). Gasoline and natural gas otto-cycle spark-ignited engines are also used in heavy-duty trucks, to a lesser extent, and primarily in the lower weight classification vehicles.

Figure 4 - On-Road Medium and Heavy-Duty Vehicles: Statewide Baseline Emissions Inventory[3]



[3] Source: CARB 2019 CEPAM v1.03; represents the current baseline emissions with adopted CARB and district measures

Proposed Measures

Advanced Clean Fleets Regulation

Overview

CARB is developing measures to accelerate ZEV adoption in the medium- and heavy-duty sectors by setting zero-emission requirements for fleets. The proposed *Advanced Clean Fleets* regulation (ACF) will focus on strategies to ensure that the cleanest vehicles are deployed by government, business, and other entities in California to meet their transportation needs. This effort is part of a comprehensive strategy to achieve a ZEV truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments such as last mile delivery, drayage, and government fleets.

Background/Regulatory History

- NOx emissions from medium- and heavy-duty trucks are currently the largest category of mobile source emissions and will remain a major portion in the future.
- Freight trucking activity occurs at seaports, warehouses, railyards, and other major freight hubs throughout California. Nearby communities are disproportionately burdened by the cumulative health impacts from these facilities.
- In June 2020, CARB adopted the *Advanced Clean Trucks regulation* (ACT), a first-of-its-kind regulation requiring medium- and heavy-duty manufacturers to produce ZEVs as an increasing portion of their sales beginning in 2024. This regulation is expected to result in roughly 100,000 ZEVs by 2030 and nearly 300,000 ZEVs by 2035.
- With the adoption of the ACT, CARB *Resolution 20-19* directs staff to return to the Board with a zero-emission fleet rule and sets the following targets for transitioning sectors to ZEVs:
    - 100 percent zero-emission drayage, last mile delivery, and government fleets by 2035;
    - 100 percent zero-emission refuse trucks and local buses by 2040;
    - 100 percent zero-emission-capable vehicles in utility fleets by 2040; and
    - 100 percent zero-emission everywhere else, where feasible, by 2045.
- In September 2020, the Governor signed *Executive Order N-79-20* which directs CARB to adopt regulations to transition the State's transportation fleet to ZEVs. This includes transitioning the state's drayage fleet to ZEVs by 2035 and transitioning the state's truck and bus fleet to ZEVs by 2045 where feasible.

Proposed Action

For this measure, CARB would propose requirements to be phased-in for different fleets as follows:

Public fleets: Phased in purchase requirement

- Public fleets include cities, counties, public utilities, and the state fleet and excludes federal agencies. Public fleets would be required to purchase zero-emission vehicles starting at 50 percent of new purchases in 2024 and 100 percent starting in 2027. Fleets based in designated low population counties would begin with 100 percent zero-emission vehicle purchases starting in 2027.

Drayage trucks: Phased in registration requirement

- All trucks would be required to be in the CARB drayage truck registry if they transport containers or bulk goods to and from California's intermodal seaports and railyards.
- Trucks that are not zero-emission and in the registry in 2023, would remain in service until the model year of the engine exceeds 13 years or 800,000 miles with a maximum of 18 years from the truck engines certification date.
- In late 2023 any truck added to the Statewide Drayage Truck Registry would need to be a zero-emission vehicle.
- All drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035.

High priority private and federal fleets: Phased in zero-emission vehicle fleet percentage requirements

- High priority private fleets include any business or entity with an annual revenue greater than $50 million, fleets and brokers who own, direct, or operate more than 50 trucks under common ownership and control.
- High priority private and federal fleets would be required to phase in zero-emission vehicles as a percentage of the total fleet. Proposed fleet requirements are based on zero-emission suitability and are phased-in by vehicle body type as follows:
    - Vans, box trucks, and buses would start at 10 percent of the fleet being zero-emission in 2025 and 100 percent zero-emission by 2035.
    - Work trucks, day cab tractors, and motor coaches would start at 10 percent of the fleet being zero-emission in 2027 and 100 percent zero-emission by 2039.
    - Sleeper cab tractors and other specialty vehicles would start at 10 percent of the fleet being zero-emission in 2030 and 100 percent zero-emission by 2042.

100 percent ZEV Sales

- 100 percent of medium- and heavy-duty vehicle sales in California would be zero-emissions starting 2040.

In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Greenhouse Gas Emissions Standards for Medium- and Heavy-Duty Engines and Vehicles (Phase 3 GHG standards)

Overview

The goal of the proposed Greenhouse Gas Emissions Standards for Medium- and Heavy-Duty Engines and Vehicles (Phase 3 GHG standards) is to achieve additional GHG emission reductions through the introduction of the next generation of integrated engine, powertrain, vehicle, and trailer technologies designed to reduce climate emissions and fuel use. Phase 3 GHG standards would include a tightened stringency of the Phase 2 GHG standards, predicated on significant manufacture of zero-emission heavy-duty vehicles, and would have the potential for NOx emissions reduction co-benefits.

Background/Regulatory History

- The California Global Warming Solutions Act of 2006, Assembly Bill (AB) 32, established requirements for a comprehensive program of regulatory and market mechanisms to reduce GHG emissions in California. AB 32 also required CARB to develop and approve a Scoping Plan that describes California's approach to reducing GHG emissions to 1990 levels by 2020. The Scoping Plan was first approved by the Board in 2008 and updated for the first time in 2014.
- The *Tractor-Trailer GHG Regulation* was an early action measure from the 2008 Scoping Plan. First approved by the Board in late 2008 and later amended in 2010, this regulation required improved aerodynamics and tires for 53-foot and longer long-haul tractors and trailers operating on California's roads.
- The *Phase 1 GHG standards*, based on off-the-shelf technologies and applicable to 2014 and later model year medium- and heavy-duty engines and vehicles, were adopted by U.S. EPA in 2011 and by the Board in 2013. The Phase 1 GHG standards took effect with the 2014 model year and are projected to reduce CO_2 emissions by about 12 percent by 2030.
- The Phase 2 GHG standards, built on the Phase 1 GHG standards, established for the first time, federal emissions requirements for trailers hauled by heavy-duty tractors. Phase 2 GHG standards, adopted by U.S. EPA in 2016 and by the Board in 2018, are more ambitious, more technology-forcing, and longer-term than those of Phase 1 GHG standards. The requirements begin with model year 2018 for trailers (2020 in California) and model year 2021 for medium- and heavy-duty engines and vehicles and will be fully implemented by model year 2027. Phase 2 GHG standards is projected to lower carbon dioxide (CO_2) emissions beyond Phase 1 GHG standard levels by an additional 13 percent in 2030. By 2050, those reductions will grow to 24 percent.

Proposed Action

For this measure, CARB would work closely with U.S. EPA staff to develop new national GHG emission standards to achieve greater GHG emission reductions from future medium- and

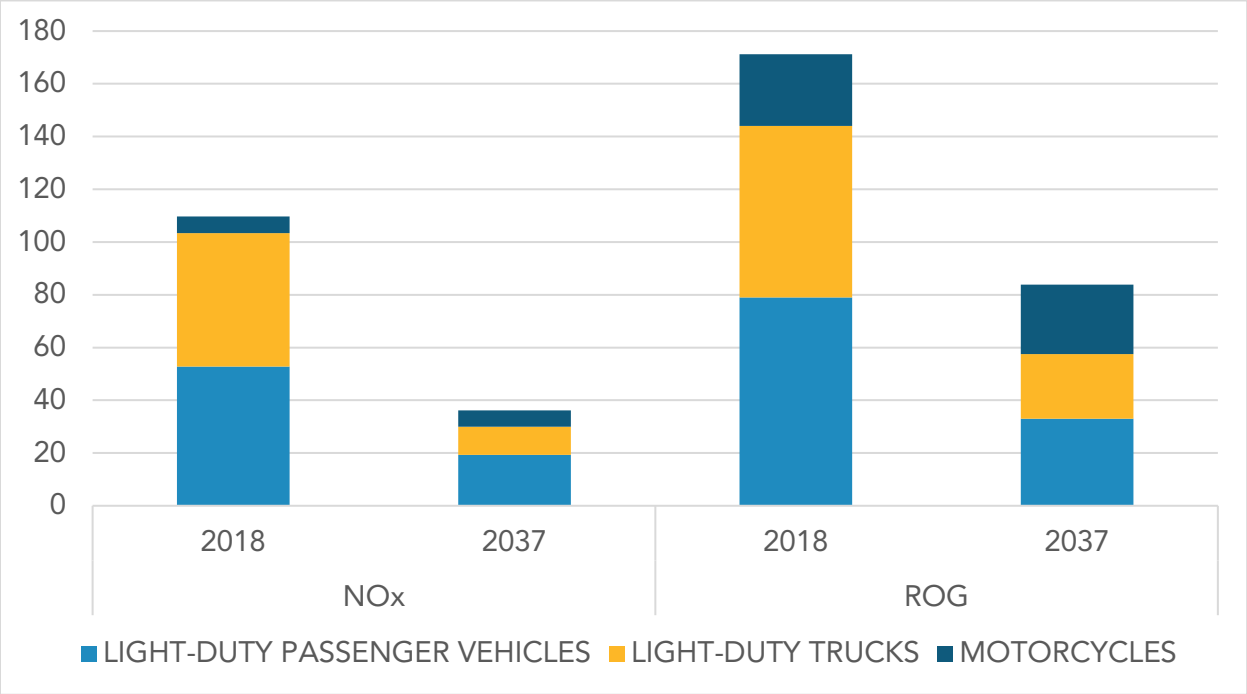
heavy-duty engines. The proposed Phase 3 GHG standards, which push technology improvements beyond what is currently in widespread commercial use, are expected to take effect with model year 2030 for all new medium- and heavy-duty vehicles (class 2b-8 with greater than 8,500 lbs. gross vehicle weight rating) sold in California. CARB anticipates the Phase 3 GHG standards stringency would be set assuming significant penetration of ZEVs nationally. Upon U.S. EPA adoption of sufficiently stringent national Phase 3 GHG standards, CARB would propose CARB adopt Phase 3 GHG standards as well, to align California's standards with the national standards (or, if needed, secure additional reductions) and to enable CARB to enforce them for California-certified vehicles. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Proposed Measures: On-Road Light-Duty Vehicles

Description of Source Category:

Passenger cars and light trucks (gross vehicle weight rating, or GVWR, up to 8,500 lbs.), otherwise called light-duty vehicles, are a major contributor to NOx and greenhouse gas (GHG) emissions in California. The State's 39 million residents collectively own over 26 million passenger vehicles and drive more than most other Americans. CARB has a number of programs to control emissions from light-duty vehicles and drive the introduction of zero-emissions vehicles into the fleet including Advanced Clean Cars, incentive projects like Clean Cars 4 All, and the recently-adopted Clean Miles Standard. Advanced Clean Cars 2 is a significant effort critical to meeting air quality standards that is still underway to cut emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035, and was a measure in the 2016 State SIP Strategy. Even with CARB's programs to accelerate the transition of the light-duty fleet to zero-emission, the vast majority of these vehicles on the road today still have internal combustion engines and use gasoline (Figure 5). A small portion today is powered by electric powertrains, and a smaller portion still has diesel compression ignition engines.

Figure 5 - On-Road Light-Duty: Statewide Baseline Emissions Inventory[4]



[4] Source: CARB 2019 CEPAM v1.03; represents the current baseline emissions with adopted CARB and district measures

Proposed Measures

On-Road Motorcycles New Emissions Standards

Overview

The primary goal of the *On-Road Motorcycle New Emissions Standard* is to reduce emissions from new, on-road motorcycles (motorcycles) by adopting more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. The exhaust standards would be more stringent than current U.S. EPA standards and largely harmonized with stringent European Union 5 (EU 5) standards. The evaporative standards would be more stringent than current U.S. EPA and EU 5 standards. This measure will also require an increase in new Zero-Emissions Motorcycle (ZEM) sales, starting at 10 percent in 2028 and progressing to 50 percent in 2035.

Background/Regulatory History

- CARB last updated motorcycle emissions standards for this category in 1998.
- In September 2020, the Governor signed *Executive Order N-79-20* which directs CARB to adopt regulations to transition to ZEVs.
- Since then, more stringent exhaust emissions standards have been developed by other jurisdictions around the world, most notably the European Union. These stringent exhaust standards have prompted the development of cleaner motorcycles than what are currently required in California.
- While CARB motorcycle evaporative standards are on par with most other jurisdictions around the world, additional evaporative reductions are technically feasible and other categories regulated by CARB have adopted much lower evaporative emissions standards. CARB's Off Highway Recreational Vehicle (OHRV) category, which includes vehicles closely related to motorcycles such as off-highway motorcycles, requires lower evaporative emissions limits with more robust test methods.
- Since 2017, CARB has been working closely with many other jurisdictions in the spirit of trying to achieve harmonization where possible on lower and more robust motorcycle emissions standards. Specifically, CARB has worked closely with U.S. EPA, Environment Climate Change Canada, the European Union and the United Nations.
- California currently has no inspection and maintenance program for motorcycles. CARB has determined that tampering with emissions controls is a significant problem for this category.
- In 2020, motorcycles accounted for:
    - 9.3 percent of all California mobile ROG emissions
    - 0.6 percent of all California mobile NOx emissions

- 3.6 percent of all California mobile carbon monoxide (CO) emissions

Proposed Action

For this measure, CARB would develop new exhaust emissions standards for HC, NOx, CO and NMHC that achieve a large degree of harmonization with more aggressive current European motorcycle emissions standards. CARB would also develop new evaporative emissions standards that largely harmonize with more aggressive current CARB OHRV emissions standards. In seeking to meet California's climate change goals and eliminate emissions related to tampering, CARB will also propose significant ZEM sales threshold beginning in 2028 and increasing gradually through 2035. It is expected that this comprehensive motorcycle regulation would rely heavily on technologies currently being used in other jurisdictions and in related vehicle categories that already have more stringent emissions standards. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Clean Miles Standard

Overview

The primary goal of the *Clean Miles Standard* (CMS) regulation, which is nearing finalization and will be jointly administered by CARB and the California Public Utilities Commission, is to reduce GHG emissions from ride-hailing services offered by transportation network companies (TNCs), on a per-passenger mile basis, and promote electrification of the fleet by setting an electric vehicle mile target. TNCs provide on-demand rides through a technology-based platform that connects passengers with drivers using personal vehicles. The TNC sector has potential for growth, and we have seen their market share rapidly increase since their inception in 2012. Given the potential for GHG emissions reductions and criteria pollutant co-benefits, they are well-positioned to help state and local agencies meet air quality and climate goals and have made public commitments to promote electrification in their fleet.

Background/Regulatory History

- Mobile sources account for around 80 percent of Statewide NOx emissions and are a significant source of toxic air contaminants. In addition, the transportation sector accounts for approximately 50 percent of GHG emissions in California when accounting for direct vehicle emissions and upstream fuel production facility emissions, with light-duty vehicles comprising 70 percent of the transportation sector's direct vehicle emissions. Transportation sector GHG emissions are increasing, despite increases in vehicle fuel efficiency, amplifying the need for new actions with mobility.

- In September 2018, Governor Brown signed into law Senate Bill 1014 (Skinner, Chapter 369, Statutes of 2018), which established the Clean Miles Standard and Incentive Program. The bill directs CARB to develop, and the CPUC to implement, annual electrification and GHG emission targets for TNCs that provide ride-hailing services.

- Though TNCs accounted for only 1.25 percent of the total light-duty vehicle miles traveled (VMT) in California in 2018, it was the fastest growing sector relative to other categories of commercial passenger vehicle fleets regulated by the CPUC. We expect ride-hailing to continue their previous growth trajectory in the years after the COVID-19 pandemic.

- Per Senate Bill 1014 (SB 1014), CARB used 2018 TNC data to determine the base year emissions for the ride-hailing sector on a per-passenger mile basis. From 1.4 billion trip records, CARB deduced the TNC base year emissions to be 301 grams carbon dioxide (CO_2) per passenger mile traveled (g CO_2/PMT). In comparison, the overall California fleet emissions in 2018 was 203 g CO_2/PMT. On a per-passenger mile basis, the GHG emissions of the TNC fleet were 50 percent higher than the overall California fleet.

- To develop the annual electrification targets, CARB assessed the availability of zero-emission vehicle (ZEV) models with adequate range for ride-hailing operation and utilized a cost optimization model to derive the maximum feasible percent electric vehicle miles traveled (eVMT) taking into account one year of operational costs.
- The potential GHG emission reductions are approximately three times higher for an electric vehicle in ride-hailing service compared to personal use in California, depending on the energy fuel mix in the grid and vehicle usage. Additionally, each ride-hailing vehicle serves numerous passengers, and thus TNCs can help facilitate widespread education and awareness about ZEVs.

Action

The new regulation, adopted by the Board in May 2021 and set for finalization shortly, includes two annual targets – eVMT target as well as a GHG target in the metric of g CO_2/PMT. The eVMT target would require TNCs to achieve 90 percent eVMT by 2030. The target would require TNCs to achieve 0 g CO_2/PMT by 2030 through electrification as well as other strategies to reduce g CO_2/PMT including increasing shared rides on their platform, improving efficiency, and obtaining optional GHG credits.

Optional GHG credits may be requested by the TNCs and approved by the CPUC for ride-hailing trips that are connected to mass transit through a verified booking process, and for investing in bicycle and sidewalk infrastructure projects that support active transportation.

Annual targets for the regulation are shown below in Table 1.

Table 1 - Clean Miles Standard Annual Targets

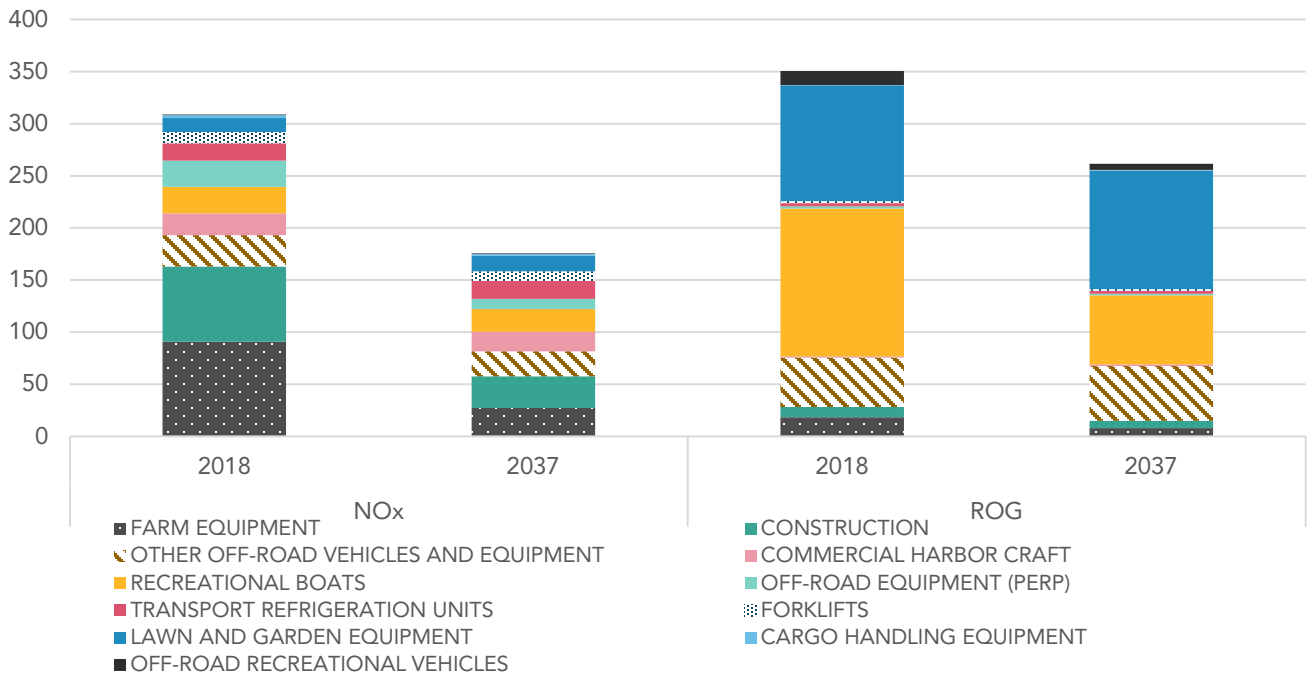
Calendar Year	Percent eVMT Target	g CO_2 / PMT Target
2023	2%	252
2024	4%	237
2025	13%	207
2026	30%	161
2027	50%	110
2028	65%	69
2029	80%	30
2030+	90%	0

Proposed Measures: Off-Road Vehicles and Equipment

Description of Source Category:

The Off-Road Vehicles and Equipment category includes lawn and garden equipment, transport refrigeration units, vehicles and equipment used in construction and mining, forklifts, cargo handling equipment, commercial harbor craft, farm equipment, and other industrial equipment. CARB has programs in place to control emissions from various off-road vehicles and equipment including the In-Use Off-Road Diesel Fueled Fleets Regulation and Large Spark-Ignition Engine Fleet Requirements Regulation, as well as incentive programs including the Clean Off-Road Equipment (CORE) Voucher Incentive Project. In addition, CARB will be proposing Small Off-Road Equipment, Zero-Emission Off-Road Forklift, and Transport Refrigerator Unit Part 1 regulations over the next year which were measures in the 2016 State SIP Strategy,. While CARB's programs have provided substantial emissions reductions, the Off-Road Vehicles and Equipment category continues to contribute significant NOx and ROG statewide (Figure 6). Given the diversity of equipment and duty cycles that comprises this category, each measure includes a more detailed description of the specific source.

Figure 6 - Off-Road Vehicles and Equipment: Statewide Baseline Emissions Inventory[5]



[5] Source: CARB 2019 CEPAM v1.03; represents the current baseline emissions with adopted CARB and district measures

Proposed Measures

Tier 5 Off-Road New Compression-Ignition Engine Standards

Overview

The goal of the Tier 5 Off-Road New Compression-Ignition Engine Standards is to reduce NOx and PM emissions from new, off-road compression-ignition (CI) engines by adopting more stringent exhaust standards for all power categories, including those that do not currently utilize exhaust aftertreatment such as diesel particulate filters (DPFs) and selective catalyst reduction (SCR). Compression-ignition engines are used in off-road equipment including tractors, excavators, bulldozers, graders, backhoes. As of model year 2020, more than half of all new off-road CI engine families continue to be certified in California to the Tier 4 final emission standards without DPFs. This means that the majority of new off-road CI engines are not reducing toxic diesel PM to the greatest extent feasible using the best available control technology because the current standards are insufficient. The standards considered for this measure would be more stringent than required by current U.S. EPA and European Stage V nonroad regulations, and would require the use of best available control technologies for both PM and NOx, while encouraging transitions to zero-emission equipment where feasible.

California is dependent on the U.S. EPA to regulate the emissions from farm and construction equipment under 175 horsepower because only U.S. EPA has the authority to set emission standards for this equipment under the Clean Air Act. These preempted equipment are responsible for approximately 30 percent of the NOx emissions inventory in California. Federal action is necessary to address preempted equipment by adopting standards similar in stringency to those proposed in the measure to achieve attainment with both federal and State ambient air quality standards – this is discussed further in the Federal Actions portion of this document.

Background/Regulatory History

- NOx emissions from land based off-road CI engines are currently the second largest category of mobile source emissions subject to CARB regulation. Off-road CI engine NOx emissions are projected to make up 24 percent of the mobile source diesel emissions inventory, and 34 percent of the PM inventory, in 2030.
- Lower NOx standards, coupled with lower PM standards, would force engine manufacturers to incorporate DPFs, which many do not currently do, and could result in PM emission reductions up to 90 percent below the current Tier 4 final emission standard levels. DPFs would also ensure greater reductions in ultrafine PM, which may pose a health concern separate from PM emissions as a whole.
- Small off-road CI engines less than 56 kilowatt (kW) (or 75 hp) are not currently required to comply with advanced NOx aftertreatment-based standards, and engines less than 19 kW (25 hp) are not required to comply with advanced PM

aftertreatment-based standards. Small off-road CI engines < 56 kW account for between 20 to 40 percent of the off-road diesel PM and NOx emissions inventories in California. CARB funded a research effort demonstrating the feasibility of advanced aftertreatment on small off-road CI engines less than 56 kW, which was completed by CE-CERT in 2019[6].

- The off-road in-use requirements (off-road Not-To-Exceed (NTE)) are not adequate to monitor in-use compliance.
- A recent research effort performed for CARB by the Center for Environmental Research and Technology (CE-CERT)[7] concluded that current reporting and recordkeeping requirements are insufficient for determining the number of engines and equipment sold in California with less-stringent emission levels under both the federal Average, Banking, and Trading (ABT) program and the federal Transition Program for Equipment Manufacturers (TPEM). Hence, it would be helpful to revise and improve the reporting and recordkeeping requirements.
- Recent demonstrations of ultra-low NOx on-road engines conducted at the Southwest Research Institute (SWRI) under contract to CARB shows that much lower NOx standards are feasible for on-road engines. Because off-road diesel engines are similar in technology to on-road heavy-duty diesel engines, this work suggests that lower NOx standards are likely feasible for off-road engines as well. Additionally, CARB has an ongoing off-road demonstration contract with SWRI to support determining the feasible stringency of the proposed standards for NOx, PM, and CO_2.
- Recent CARB test data and reputable diesel publications indicate that up to 40 percent of a typical off-road CI engine's operation may occur at idle[8], and that the frequency of low-load operation[9] is insufficient to keep exhaust temperature above 250 degrees Celsius to enable satisfactory SCR operation and NOx control in-use. Idle reduction strategies and low-load test cycles/standards are being investigated as part of this Tier 5 measure.

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[6] "Evaluation of the feasibility, cost-effectiveness, and necessity of equipping small off-road diesel engines with advanced PM and/or NOx aftertreatment" – CARB Contract No. 14-300, March 2019, https://ww2.arb.ca.gov/sites/default/files/2020-10/14-300.pdf

[7] "Evaluation of the Impacts of Emissions Averaging and Flexibility Programs for all Tier 4 Final Off-road Diesel Engines," CARB Contract No. 14-301, February 2018, https://ww2.arb.ca.gov/sites/default/files/classic//research/apr/past/14-301.pdf?_ga=2.127732621.1682659074.1620315165-1165705998.1587147934

[8] https://www.constructionequipment.com/blog/thinking-through-fuel-burn-rates

[9] Measurement of Particulate Matter (PM) and Gaseous Emissions from Cargo Handling Equipment (CHE) during Real-World Operation – David Quiros, 29th CRC Real World Emissions Workshop, March 2019

Proposed Action

For this measure, CARB would develop and propose aftertreatment-based PM standards for off-road CI engines less than 19 kW (25 hp), aftertreatment-based NOx standards for engines greater than or equal to 19 kW (25 hp) and less than 56 kW (75 hp), more stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp), enhanced in-use NTE certification requirements including a manufacturer-run in-use NTE program, and improved recordkeeping and reporting requirements for ABT- and TPEM-certified engines sold in California. It is expected that this comprehensive off-road Tier 5 regulation would rely heavily on technologies manufacturers are developing to meet the recently approved low-NOx standards and enhanced in-use requirements for on-road heavy-duty engines. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation

Overview

The primary goal of the Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation is to further reduce emissions from the in-use off-road diesel equipment sector by adopting more stringent requirements to the *In-Use Off-Road Diesel-Fueled Fleets Regulation*. These amendments would create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure. CARB could achieve this by adopting an operational ban on the oldest and dirtiest equipment and by putting limitations on vehicles added to a fleet.

Background/Regulatory History

- The in-use off-road equipment sector includes equipment used in industries such as construction, mining, industrial, oil drilling, and similar industries, and covers mobile diesel vehicles 25 horsepower or greater. Common examples are loaders, backhoes, excavators, forklifts, workover rigs, and other off-road equipment.
- The diesel equipment in this category is currently subject to CARB's In-Use Off-Road Diesel-Fueled Fleets Regulation, approved by the Board in 2007, and amended in 2009 and 2010. The regulation covers all self-propelled off-road diesel vehicles 25 horsepower or greater used in California and most two-engine vehicles (except on-road two-engine sweepers). The existing rule requires that fleets meet an increasingly stringent set of fleet average targets, culminating in 2023 for large and medium fleets (large fleets represent about 73 percent of vehicle ownership) and in 2028 for small fleets. The most stringent fleet average target generally corresponds to roughly a 2012 model year, or a Tier 3 average standard. In addition to the declining fleet emission targets, the regulation also includes idling limits, requires reporting and labeling, and restricts the adding of older vehicles into fleets.
- While this regulation has resulted in significant emissions reductions from the sector, the regulation does allow Tier 0, 1 and 2 equipment to continue operating indefinitely with no activity restrictions (dependent on the mix of other equipment owned by the fleet). For comparison, a single Tier 0 off-road engine in the 100-175 horsepower bin has 80 times higher NOx emissions than a Tier 4 Final off-road engine. By 2031, this Tier 0 equipment will be 32 years old or more, Tier 1 will be 28 to 31 years old, and Tier 2 will be 24 to 27 years old.

Proposed Action

For this measure, CARB would propose adding an operational backstop to the current In-Use Off-Road Diesel-Fueled Fleets Regulation for Tier 0, 1 and 2 engines between 2024 and 2033. This scenario will allow a 10-year phase out of these oldest engines. Along with the operational backstop, CARB would propose extending the adding vehicle provisions in the current regulation to phase in a limitation on the adding of Tier 3 and Tier 4i vehicles to fleets. CARB would also propose additional modifications to clarify implementation and to sunset provisions that would have allowed small fleets to continue to operate vehicles that

could not be retrofitted with a verified diesel emission control strategy indefinitely. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Transport Refrigeration Unit Regulation

Overview

CARB is developing new requirements to transition diesel-powered transport refrigeration unit (TRU) to zero-emission technology in two phases. In the 2016 State SIP Strategy, CARB proposed Part 1 amendments to the existing *TRU Airborne Toxic Control Measure* (ATCM) to require the transition of diesel-powered truck TRUs to zero-emission, a diesel PM emission standard for newly-manufactured TRUs in the remaining categories, and lower global warming potential refrigerant. The Board will consider the Part 1 rulemaking in early 2022. CARB plans to develop a subsequent Part 2 regulation to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, TRU generator sets, and direct-drive refrigeration units (in which the compressor is powered from the vehicle's diesel engine) for future Board consideration.

The new requirements would achieve additional emission and health risk reductions, increase the use of zero-emission technology in the off-road sector, and meet the directive of Executive Order N-79-20, which set a goal for 100 percent zero-emission off-road vehicles and equipment in the State by 2035 where feasible.

Background/Regulatory History

- TRUs emit multiple air pollutants, including diesel PM, PM2.5, NOx, and GHG.
- TRUs typically operate at refrigerated warehouses or distribution centers, grocery stores, seaport facilities, intermodal railyards, and other locations that are often near sensitive receptors, such as schools, hospitals, senior care facilities, and residential neighborhoods that are disproportionately burdened by the cumulative health impacts from these facilities.
- CARB adopted the existing TRU ATCM in 2004 to require TRU engines that operate in California to meet specific in-use PM performance standards.
- In September 2020, Governor Newsom signed Executive Order N-79-20 which directs CARB, in coordination with other State agencies, U.S. EPA, and local air districts, to develop and propose technologically feasible and cost-effective strategies to achieve 100 percent zero-emission from off-road vehicles and equipment operations in the State by 2035 where feasible.

Proposed Action

For this measure, CARB would propose the Part 2 rulemaking to require trailer TRUs, domestic shipping container TRUs, railcar TRUs, TRU generator sets, and direct-drive refrigeration units to use zero-emission technology. However, the specific proposed requirements have not been determined at this time. CARB is currently assessing zero-emission technologies for trailer TRUs and the remaining TRU categories. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Commercial Harbor Craft Amendments

Overview

Commercial harbor craft (CHC) include any private, commercial, government, or military marine vessels including, but not limited to ferries, excursion vessels, tugboats (including ocean-going tugboats), towboats, crew and supply vessels, work boats, pilot vessels, barges, dredges, and commercial and commercial passenger fishing boats. The majority of CHC have diesel engines, which are significant emitters of PM and NOx. CHC emissions are concentrated near the ports and pose significant health risks to nearby communities.

Background

- CARB's *Commercial Harbor Craft Regulation* was adopted in 2007 to reduce toxic and criteria emissions to protect public health. It was then amended in 2010 and will be fully implemented by the end of 2022. CARB The Board will consider amendments to the CHC Regulation in 2022. The amendments establish expanded and more stringent in-use requirements to cover more vessel categories. The amendments also mandate accelerated deployment of zero-emission and advanced technologies in vessel categories where technology feasibility has been demonstrated. This aligns with *Executive Order N-79-20* signed by the Governor in September 2020 which directs CARB to adopt regulations to transition to ZEVs.

Proposed Action

For this measure, CARB would propose the following:

- Starting in 2023 and phasing in through 2031, most CHC (except for commercial fishing vessels and categories listed below) would be required to meet the cleanest possible standard (Tier 3 or 4) and retrofit with DPF based on a compliance schedule. The current regulated CHC categories are ferries, excursion, crew and supply, tug/tow boats, barges, and dredges. The amendments would impose in-use requirements on the rest of vessel categories except for commercial fishing vessels, including workboats, pilot vessels, commercial passenger fishing, and all barges over 400 feet in length or otherwise meeting the definition of an ocean-going vessel. The amendments would also remove the current exemption for engines less than 50 horsepower;
- Starting in 2025, all new excursion vessels are required to be plug-in hybrid vessels that are capable of deriving 30 percent or more of combined propulsion and auxiliary power from a zero-emission tailpipe emission source;
- Starting in 2026, all new and in-use short run ferries are required to be zero-emission; and
- Starting in 2030 and 2032, all commercial fishing vessels would need to meet a Tier 2 standard at minimum.

In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Cargo Handling Equipment Amendments

Overview

Cargo handling equipment (CHE) includes any motorized vehicles used to handle cargo or perform routine maintenance activities at California's ports and intermodal rail yards. CHE includes yard tractors, rubber-tired gantry (RTG) cranes, container handlers, forklifts, etc. CHE can be a significant source of diesel PM emissions in communities near the ports and intermodal rail facilities.

Background

CARB initially adopted the *Cargo Handling Equipment* regulation on December 8, 2005, and it became effective on December 31, 2006. This regulation was fully implemented by the end of 2017 and has resulted in reductions of diesel PM and NOx at ports and intermodal rail yards throughout California. In September 2020, the Governor signed *Executive Order N-79-20* which directs CARB to adopt regulations to transition to ZEVs, with a target to transition all off-road equipment to zero-emission by 2035 where feasible. CARB is currently assessing the availability and performance of zero-emission and hybrid technologies to reduce emissions from a fleet predominantly powered by internal combustion engines and evaluating additional solutions that may include efficiency improvements.

Proposed Action

For this measure, CARB would propose to start transitioning CHE to full electric in 2026, with over 90 percent penetration of electric equipment by 2036. This assumption about aggressive electrification is supported by the fact that currently some electric RTG cranes, electric forklifts, and electric yard tractors are already commercially available. Other technologies are in early production or demonstration phases. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Off-Road Zero-Emission Targeted Manufacturer Rule

Overview

The goal of the Off-Road Zero-Emission Targeted Manufacturer Rule is to achieve criteria-pollutant and GHG emission reductions by accelerating the development and production of zero-emission off-road equipment and powertrains. Existing zero-emission regulations and regulations currently under development target a variety of sectors (e.g., forklifts, cargo handling equipment, off road fleets, small off-road engines, etc.)- however, as technology advancements occur, there are certain sectors (e.g., work positioning, material handling and moderately sized excavation equipment) that could be accelerated through a targeted manufacturer zero-emission regulation.

Background/Regulatory History

- Zero-emission off-road equipment has been consistently and successfully manufactured in a number of equipment categories (e.g., forklifts, man lifts, etc.) for decades, with wide fleet adoption taking place without mandates that required such equipment to be produced or purchased.
- For next-generation zero-emission off-road equipment, CARB and other air quality agencies have funded numerous successful demonstration and pilot projects, as well as commercial-launch voucher incentive programs, like the Clean Off-Road Equipment Voucher Incentive Project, and SIP creditable emission-reduction programs, like the Carl Moyer Program.
- Studies have been performed to identify the off-road equipment types and engine horsepower ranges that have greater potential to be zero-emission powered. Although more analysis is necessary, existing information suggests that zero-emission technology may be feasible in many applications in which zero-emission technology has not yet achieved meaningful penetration today. These studies have also identified potential electric powertrains and corresponding energy storage systems that could be used to replace existing internal combustion engines in said equipment types.
- Governor Newsom's Executive Order N-79-20 states that "it shall further be a goal of the State to transition to 100 percent zero-emission off-road vehicles and equipment by 2035 where feasible." The Governor's Executive Order further directs CARB to develop and propose "strategies, in coordination with other State agencies, U.S. EPA and local air districts, to achieve 100 percent zero-emission from off-road vehicles and equipment operations in the State by 2035."
- California has some of the most-impacted regions in the nation with respect to poor air quality. As such, significant NOx and PM reductions are needed to reduce air pollution and improve public health, particularly in communities that experience disproportionate burdens from exposure. Off-road equipment is one of the largest contributors to emissions in the state, and actions beyond current programs are needed to meet California's air quality and climate goals. Developing and successfully

implementing zero-emission measures for off-road equipment will be a key component to achieving said air quality goals.

Proposed Action

For this measure, CARB would propose to develop a regulatory measure that would require manufacturers of off-road equipment and/or engines to produce for sale zero-emission equipment and/or powertrains as a percentage of their annual statewide sales volume. A targeted manufacturer regulation would need to take into account parameters such as the number of equipment and engine manufacturers producing off road equipment for sale in California, along with sales volumes, to ensure that such an effort is cost effective and technologically feasible. Sales/production mandate levels would be developed based on the projected feasibility of zero-emission technology in the various off-road equipment types currently operating in California. This measure is expected to increase the availability of zero-emission options in the off-road sector and support other potential measures that promote and/or require the purchase and use of such options. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Clean Off-Road Fleet Recognition Program

Overview

The primary goal of the Clean Off-Road Fleet Recognition Program would be to create a non-monetary incentive to encourage off-road fleets to go above and beyond existing regulatory fleet rule compliance and adopt advanced technology equipment with a strong emphasis on zero-emission technology. This measure would provide a standardized methodology for contracting entities, policymakers, state and local government, and other interested parties to establish contracting criteria or require participation in the program to achieve their individual policy goals.

Background/Regulatory History

- All self-propelled off-road diesel vehicles 25 horsepower (hp) or greater used in California and most two-engine vehicles (except on-road two-engine sweepers) are subject to the Regulation for In-Use Off-Road Diesel-Fueled Fleets (Off-Road Diesel Regulation). The Off-Road Regulation achieves reductions of NOx and diesel PM by requiring fleet owners to meet declining fleet average emission targets by replacing, or repowering older engines, or installing Verified Diesel Emission Control Strategies (VDECS) i.e., exhaust retrofits. The regulation also includes limits on idling, reporting and labeling, and restricts the adding of older vehicles into fleets. While not the primary focus of the off-road regulation, fleets may use zero-emission and other advanced technology equipment to comply with the Off-Road Regulation.
- The Governor's Executive Order N-79-20 directs CARB to develop and propose strategies to achieve 100 percent zero-emission from off-road vehicles and equipment operations in the State by 2035 where feasible.
- Incentives are critical for supporting the advancement and wide-scale deployment of zero-emission technologies while simultaneously providing immediate emission reductions to help meet our air quality and climate goals. Traditional, monetary incentives from federal, state, and local sources have been used to demonstrate and assess feasibility of zero-emission technologies in various applications or to increase adoption of those technologies before required.
- CARB's existing programs and ongoing work has focused on advancing and increasing adoption of zero-emission technologies in off-road applications. Most of CARB's off-road demonstration projects are focused on advancing zero-emission technology in freight applications. Additional work, incentives, and program support is necessary to advance and assess the feasibility of zero-emission technology in other sectors, such as construction and agriculture.
- Non-monetary incentives can play a role in the suite of strategies used to transition fleets from conventional combustion technology to advanced technology and ZEVs. These strategies can be used to motivate businesses to take actions that may require a

change to normal business operations and allow regulators to provide early benefits prior to regulatory mandates.

Proposed Action

For this voluntary program, CARB would establish a framework that would encourage fleets to incorporate advanced technology and ZEVs into their fleets, prior to or above and beyond regulatory mandates. The program would provide standardized criteria or a rating system for fleet participation at various levels to reflect the penetration of advanced technology and ZEVs into a fleet. Levels could be scaled over time as zero-emission equipment becomes more readily available. CARB anticipates the next several years of technology advancements and demonstrations to drive the stringency of the rating system. Participation in the program would be voluntary for fleets; however, designed in a manner that provides them motivation to go beyond business as usual. The program would offer value for fleets to participate by providing them access to jobs/contracts, public awareness, and marketing opportunities.

The goal would be to create a single point of standardization so that contracting entities, policymakers, state and local government, and other interested parties could use the program to establish contracting criteria or require participation in the program to achieve their individual policy goals. These entities could point to a single program to achieve their policy goals. These entities would benefit by reducing resources needed to develop and implement individual programs, and could motivate smaller, or resource constrained, organizations to adopt policies they may not have been able to do without the statewide program. Fleets would benefit by only having to engage in a single streamlined program. The program could also be used by local air districts or other Lead Agency's as part of a CEQA mitigation strategy.

CARB would work with interested stakeholders over the next several years to develop a single, streamlined program, or to otherwise incorporate this concept into an existing program. While participation would be voluntary, it is expected that this program would rely heavily on existing reporting that fleets are already required to do as part of CARB's regulatory programs. CARB expects significant outreach and coordination among all interested parties, including fleets, equipment manufacturers, state and local government, and other policy makers to ensure a program that is streamlined and useable. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Clean Off-Road Equipment Voucher Incentive Project – Construction (CORE-CON)

Description

The goal of the proposed Clean Off-Road Equipment Voucher Incentive Project – Construction (CORE-CON) measure is to continue driving the deployment of advanced technology into the off-road sector. The measure would build upon an existing off-road advanced-technology project, the *Clean Off-Road Equipment Voucher Incentive Project (CORE)*, which established a first-come, first-served voucher program for off-road equipment that began funding equipment 2020. Specifically, the measure would expand the applicability of CORE, which is currently limited, by virtue of budget language direction to freight equipment, to include equipment used in construction and other industry applications.

Background

CORE established a first-come, first-served voucher program for off-road equipment that began funding equipment in February 2020. The project targets commercialized products that have yet to achieve a significant market foothold. It is designed to accelerate deployment of cleaner technologies by providing a streamlined process for fleets ready to purchase specific zero-emission equipment to receive funding to offset the higher cost of such technologies.

In August 2020, CORE closed to new voucher applications as all of its $44 million funding allocation had been reserved, six months from when the program began accepting voucher requests. CORE is currently limited to freight movement equipment due to restrictions included in the appropriation of its funds. That being said, a wide variety of freight movement equipment types (13 manufacturers with 57 different eligible model configurations), including terminal tractors, transport refrigeration units, mobile power units, large forklifts, and railcar movers, have received funding. In addition, 73 percent of the vouchers have been reserved for equipment domiciled in low-income and/or disadvantaged communities. Such communities are disproportionately burdened by air pollution and seek rapid transition to zero-emission.

CORE goals are to promote the purchase of zero-emission off-road equipment over internal combustion options; to reduce emissions, particularly in areas that are most impacted by pollution; and to help build confidence in zero-emission technologies and provide transferability, reductions of zero-emission component costs, and larger infrastructure investments.

The construction sector is, and is expected to continue to be, a high contributor to statewide emissions. In fact, in 2037, construction equipment is projected to represent close to one-quarter of the total NOx emissions from land-based off-road equipment. Various construction equipment types have already been successfully demonstrated in previous and ongoing advanced technology projects. In addition, globally, there are a growing number of examples of green construction benefiting urbanized areas.

Based on these and other information, staff believes there are several construction equipment types that have a high potential to transition to zero-emission or a transitional technology in the near future. CORE-CON aims to accelerate the pace of commercialization of zero-emission construction equipment and zero-emission equipment used in other non-freight industry sectors as well.

Proposed Action

For this measure, and as permissible via budget language, CARB would expand CORE to include certain equipment types used in construction, mining, and agriculture that appear primed for zero-emission technology growth given the equipment power-demand and duty-cycle, as well as the availability of product offerings. Consistent with CORE goals, CORE-CON would continue to promote the deployment of zero-emission technology in the off-road sector. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Spark-Ignition Marine Engine Standards

Description

The goal of this measure is to reduce emissions from new spark-ignition (SI) marine engines by adopting more stringent exhaust standards for outboard and personal watercraft, which currently do not use catalyst control technologies. Staff estimates that stricter standards could reduce combined HC and NOx by approximately 70 percent below the current HC+NOx standard (≈16.5 grams per kilowatt-hour (g/kW-hr)) for engines greater than or equal to 40 kilowatt (kW) in power, and by approximately 40 percent for engines less than 40 kW in power.

CARB staff is also evaluating whether some outboard and personal watercraft vessels could be propelled by zero-emission technologies in certain applications. For example, zero-emission powertrains have the potential to gradually replace most outboard engines less than 19 kW, as well as many new personal watercraft engines.

Reducing emissions from watercraft would help clear the air in the parks, beaches, and recreational areas where Californians go for family time and relaxation. To the extent watercraft are used in and near communities most impacted by air pollution, for example, near ports, cutting emissions from these engines to the maximum extent feasible is important for reducing exposure in such communities.

Background

- U.S. EPA first promulgated exhaust emission standards to reduce emissions of HC and NOx from new outboard and personal watercraft engines in 1996 which were to begin in 2006.

- In 1998, CARB adopted regulations that accelerated the federal standard's 2006 implementation date to 2001 in California. The regulations also set more stringent California standards for outboard and personal watercraft engines that took effect in 2004 and 2008.
- On July 26, 2001, the Board amended the SI marine regulations to include HC+NOx emission standards for new sterndrive and inboard marine engines. These standards initially capped HC+NOx emissions at 16.0 g/kW-hr from 2003 to 2006, but beginning in 2007, sterndrive and inboard engines had to meet a catalyst-based 5.0 g/kW-hr HC+NOx standard. Most sterndrive and inboard engines are derived from truck engines and their aftertreatment technology making the transition to catalysts far less complicated than for outboard and personal watercraft engines.
- In 2007, U.S. EPA harmonized with CARB's accelerated implementation schedule and more stringent exhaust standards for outboard and personal watercraft engines.

- In 2010, Mercury Marine Corporation demonstrated the ability of catalyst-equipped 45 kW and 150 kW outboard engines to meet a 5.0 g/kW-hr HC+NOx standard in a feasibility program sponsored by CARB.
- In 2013, Mercury Marine Corporation demonstrated that a catalyst-equipped 30 kW outboard engine was able to meet a 5.0 g/kW-hr HC+NOx standard in another feasibility program sponsored by CARB.

Proposed Action

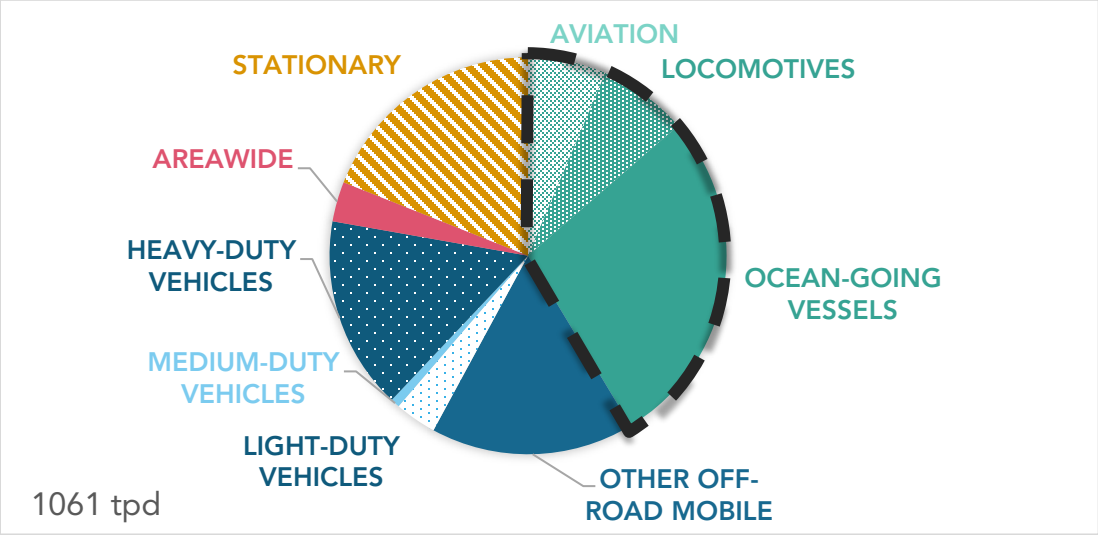
For this measure, CARB would develop and propose catalyst-based standards for outboard and personal watercraft engines greater than or equal to 40 kW in power that will gradually reduce emission standards to approximately 70 percent below current levels. For outboard and personal watercraft engines under 40 kW, more stringent exhaust standards will be developed and proposed based on the incorporation of electronic fuel injection that will gradually reduce emission standards 40 percent below current levels. These standards could be met directly or through corporate averaging.

In addition to adopting more stringent exhaust standards, CARB is considering actions per *Executive Order N-79-20* that would require a percentage of outboard and personal watercraft vessels to be propelled by zero-emission technologies for certain applications. Outboard engines less than 19 kW, which are typically not operated aggressively or for extended periods, could potentially be phased-out and gradually replaced with zero-emission technologies. Some personal watercraft applications could also potentially be replaced with zero-emission technologies. In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Off-Road Primarily-Federally and Internationally Regulated Sources

In addition to reducing emissions from on-road vehicles and off-road equipment, it is critical to achieve emissions reductions from sources that are primarily regulated at the federal and international level. CARB and the air districts in California have taken actions to not only petition federal agencies for action, but also to directly reduce emissions using programmatic mechanisms within our respective authorities. CARB continues to explore additional actions, many of which may require a waiver or authorization under the federal Clean Air Act, as described here under Proposed CARB Measures. That said, given that the emissions from aviation, locomotives, and ocean-going vessels are projected to contribute more than 40 percent of Statewide NOx emissions in 2037, actions by the U.S. EPA and other federal and international entities are needed to control emissions from sources under their respective authorities.

Figure 7 - 2037 Statewide NOx Baseline Emissions Inventory[10]



Description of Source Categories:

Locomotives

Locomotives are self-propelled vehicles used to push or pull trains, including both freight and passenger operations. Union Pacific Railroad (UP) and BNSF Railway (BSNF) are the two Class I, or major, freight railroads operating in California. There are also seven intrastate passenger commuter operators and up to 26 freight shortline railroads currently operating in California.

[10] Source: CARB 2019 CEPAM v1.03; represents the current baseline emissions with adopted CARB and district measures

UP and BNSF, however, generate the vast majority (90 percent) of locomotive emissions within the State, with most attributable to interstate line haul locomotives.

UP and BNSF operate three major categories of freight locomotives, both nationally and in California. The first category is interstate line haul locomotives, which are primarily ~4,400 horsepower (HP). The second category is made up of medium-horsepower (MHP) locomotives, as defined by CARB as typically between 2,301 and 3,999 HP. MHP locomotives are typically older line haul locomotives that have been cascaded down from interstate service. And lastly, there are switch (yard) locomotives, specifically defined by U.S. EPA as between 1,006 and 2,300 HP.

Locomotives operating at railyards and traveling throughout the nation are a significant source of emissions of diesel PM (which CARB has identified as a toxic air contaminant), NOx, and GHGs. These emissions often occur in or near densely populated areas and neighborhoods, exposing residents to unhealthy levels of toxic diesel PM, plus regional ozone and fine particulates that form in the atmosphere.

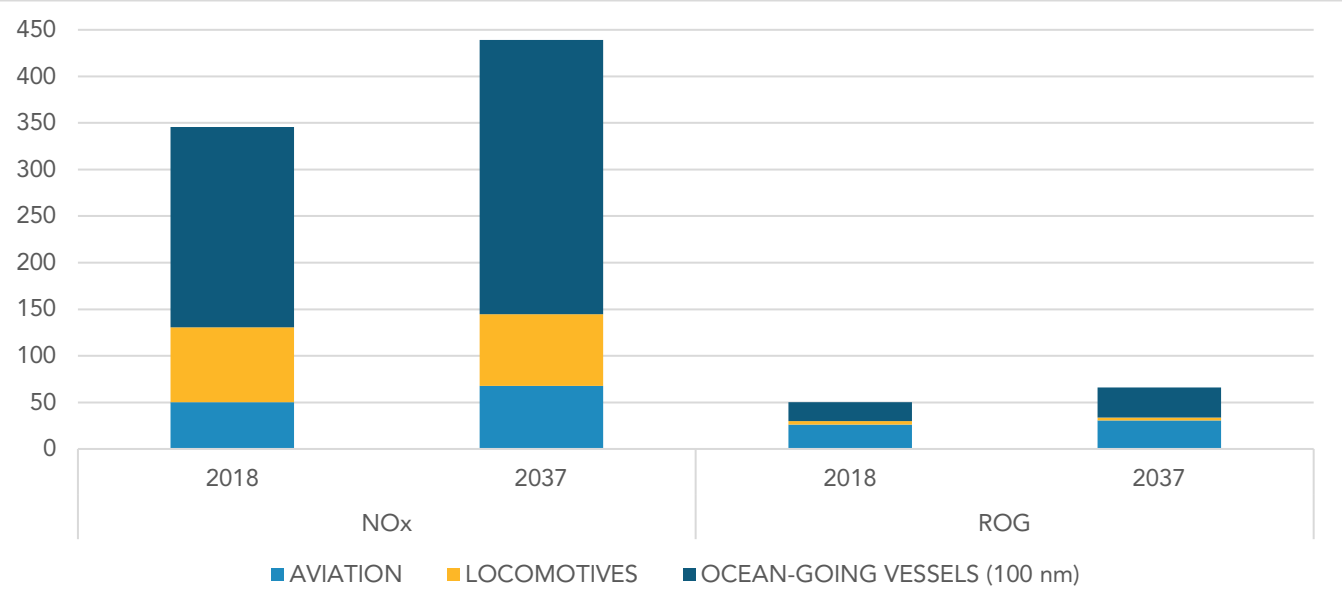
Aviation

According to CARB's official emissions inventory, five different aircraft categories contribute significantly to NOx emissions: piston aircraft (civil), agricultural aircraft (crop dusting), jet aircraft (military), jet aircraft (commercial), and jet aircraft (civil). The jet aircraft (commercial) contribute to about 90 percent of NOx emissions from aircraft in California, whereas jet aircraft (military) and jet aircraft (civil) each contribute about 4.5 percent of NOx. Together, the piston aircraft (civil) and agricultural aircraft (crop dusting) produce less than 1 percent of NOx emissions.

Ocean-Going Vessels

Ocean-Going Vessel (OGV or vessel) are very large vessels designed for deep water navigation. OGVs include large cargo vessels such as container vessels, tankers, bulk carriers, and car carriers, as well as passenger cruise vessels. These vessels transport containerized cargo; bulk items such as vehicles, cement, and coke; liquids such as oil and petrochemicals; and passengers. Ocean-going vessels travel internationally and may be registered by the U.S. Coast Guard (U.S.-flagged), or under the flag of another country (foreign-flagged). The majority of vessels that visit California ports are foreign-flagged vessels.

Figure 8 - Primarily-Federally Regulated Sources: Statewide Baseline Emissions Inventory[11]



Federally Certified On-Road Heavy-Duty Vehicles

As previously described, heavy-duty vehicles include a wide range of vocational and drayage trucks, as well as buses. California is the only state that may receive a waiver of Clean Air Act preemption of for new motor vehicles that differ from the federal emission standards. Since 1990, California's heavy-duty engine emission standards have become dramatically more stringent than federal emission standards. While California has more stringent emission standards for heavy-duty vehicle than the federal level, this does not prevent trucks from outside of California traveling within the state. Close to half of the vehicle miles traveled from on-road heavy-duty vehicles in the state is contributed by vehicles originally sold outside of California, otherwise known as federal-certified vehicles. These federal-certified vehicles are only required to meet the less stringent federal emission standards and not California's emission standards.

Preempted Off-Road Equipment

The off-road equipment category includes some equipment in the following categories: lawn and garden equipment, transport refrigeration units, vehicles and equipment used in construction and mining, forklifts, cargo handling equipment, commercial harbor craft, and other industrial equipment. California is the only state with authority to adopt and enforce emission standards for new and in-use off-road engines that differ from the federal emission

[11] Source: CARB 2019 CEPAM v1.03; represents the current baseline emissions with adopted CARB and district measures

standards. That said, the federal Clean Air Act does preempt California from establishing more stringent standards for equipment under 175 horsepower in a select group of off-road equipment categories. These preempted off-road equipment categories are only required to meet the less stringent federal emission standards and not California's emission standards.

Proposed CARB Measures

In-Use Locomotive Regulation

Overview

CARB is developing the *In-Use Locomotive Regulation* to accelerate the adoption of advanced, cleaner technologies, including zero-emission technologies, for locomotive operations. Locomotives have diesel engines, which are significant emitters of PM and NOx. Locomotive emissions are concentrated in locations like ports and railyards and pose significant health risks to nearby communities. This draft regulation would be implemented statewide and provide an opportunity for railroads to better address regional pollution and long-standing environmental justice concerns with communities near railyards.

Additionally, the measure includes a pathway to accelerate the immediate adoption of advanced cleaner technologies for all locomotive operations. These accelerated timelines for cleaner technologies are in response to Executive Order N-79-20, which calls for 100 percent of off-road vehicles and equipment operations to be zero-emission by 2035 where feasible.

Background/Regulatory History

- Locomotive emissions are projected to contribute 14 percent to the State's freight diesel emissions NOx inventory and 16 percent to the State's freight diesel emissions PM2.5 inventory in 2030.
- Locomotive activity occurs at seaports, railyards, and other major freight hubs throughout California. Nearby communities are disproportionately burdened by the cumulative health impacts from these facilities.
- In 2017, CARB petitioned U.S. EPA to promulgate a Tier 5 standard. The proposed standard would include the first-ever zero-emission capability using on-board batteries to support zero-emission rail operation in sensitive areas, as well as cut fuel consumption and GHG emissions. As of September 2021, U.S. EPA has taken no action on this petition.
- The proposed In-Use Locomotive Regulation is California's first regulation of Locomotives in-use. In the past, CARB obtained emissions reductions from locomotives through enforceable agreements with two Class 1 railroads: UP, and BNSF. The 1998 Locomotive NO_x Fleet Average Emissions Agreement in the South Coast Air Basin (1998 MOU[12]) mandated a Tier 2-average NOx emission standard throughout the South Coast Air Basin by 2010.

[12]CARB: 1998 Locomotive NO_x Fleet Average Emissions Agreement in the South Coast Air Basin <*https://ww2.arb.ca.gov/sites/default/files/2018-06/loco_flt.pdf*> accessed December 28, 2020.

- The 2005 Statewide Railyard Agreement (2005 Agreement[13]) initiated early use of low-sulfur diesel in locomotives, established a statewide idle-reduction program, and ensured that BNSF and UP would work with CARB to obtain Health Risk Assessments at 18 of California's major railyards.
- While enforceable agreements and federal locomotive standards have achieved emission reductions, more stringent emission standards are needed to address the air quality, public health, and climate change concerns associated with locomotive operations.
- In September 2020, Governor Newsom signed Executive Order N-79-20 which directs CARB to adopt regulations to transition the State's transportation fleet to ZEV. This includes transitioning the state's off-road fleet (including locomotives) to ZEVs by 2035 where feasible.

Proposed Action

For this measure, CARB would develop an In-Use Locomotive Regulation that would apply to all locomotives operating in the State of California with engines that have a total rated power of greater than 1,006 hp, excluding locomotive engines used in training of mechanics, equipment designed to operation both on roads and rails, and military locomotives. In addition to the measures described below, locomotive operators would report locomotive engine emissions levels and activity on an annual basis.

Spending Account: The goal of this action is to increase uptake of cleaner diesel locomotives and zero-emission locomotives.

- By July 1, 2023, a spending account would be established for each locomotive operator.
- Amount deposited annually into the operator's spending account is determined by the NOx and PM emission levels of the locomotive engines and activity in megawatt hours of each locomotive operated in California.
- Funds in the account would be required to go toward the cleanest commercially available locomotives or zero-emission equipment or infrastructure from 2023-2030, and toward zero-emission locomotives, zero-emission equipment, or zero-emission infrastructure from 2030 and beyond.
- At any time, the spending account funds may also be used for zero-emission infrastructure.

In-use Operational Requirements: Gradually eliminating the use of older, dirtier locomotives.

- Beginning January 1, 2030, all locomotives built in 2007 and older are banned from use in California.

[13] CARB: 2005 Statewide Railyard Agreement <*https://ww2.arb.ca.gov/resources/documents/2005-statewide-railyard-agreement*> accessed December 28, 2020.

- After January 1, 2030, every locomotive that is 23 years old or older will be banned from use in California.
- Starting January 1, 2030 all new Passenger, Switch and Industrial locomotives brought into California operations must be zero-emission.
- Starting January 1, 2035 all new Line Haul locomotives brought into California operations must be zero-emission.

Idling Limit: Reducing unnecessary idling.

- Locomotives equipped with automatic engine stop/start systems are to idle no more than 30 minutes unless an exemption applies.

In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Future Measures for Aviation Emissions Reductions

Overview

The primary goal of future measures for aviation is to reduce emissions from airport and aircraft related activities. The identified emission sources for the aviation sector are main aircraft engines, auxiliary power units (APU), and airport ground transportation. Controlling emission sources that are primarily regulated by the federal government is critical to protect public health and to achieve our clean air and climate targets. Despite the reductions achieved by existing federal programs, such as Federal Aviation Administration's (FAA) Continuous Lower Energy, Emissions and Noise (CLEEN) program, and National Aeronautics and Space Administration (NASA) programs; Advanced Air Vehicles Program, Integrated Aviation System Research Program, and the Environmentally Responsible Aviation Project, additional measures are needed to meet climate and air quality goals and obtain local health exposure reductions. While engine standards do exist at the federal and international level for new aircraft, these standards do not reflect the current state of technology. As a result, emissions from the aviation sector have not decreased at the same pace as those for other mobile sources in California. In order to achieve the magnitude of emission reductions necessary from this category, and due to the local, national and international nature of aircraft travel, strong action and advocacy is required at the federal and international level as well as advocacy and action at the state, district and local level.

At the State level, CARB has implemented regulations aimed at reducing on-ground emissions from airports and some local air districts have Memorandums of Understandings (MOU's) with airports to further reduce on-ground emissions. To achieve necessary emission reductions at the federal level, CARB would advocate and coordinate with local, district level, State, federal and international oversight and regulatory organizations to promulgate measures and regulations to achieve reductions while considering feasibility, preemption and authority – this is discussed further in the Federal Actions portion of this document.

Background/Regulatory History

- NOx emissions from aircraft are projected to grow significantly. In California, aircraft are projected to make up 9.5 percent of mobile source NOx emissions in 2035, increasing from 5.4 percent in 2020.[14]
- International Civil Aviation Organization (ICAO) is the United Nations body that sets and adopts civil aviation standards and practices for its 193 national government members. The Committee on Aviation Environmental Protection (CAEP) is a technical committee of ICAO. CAEP assists ICAO with formulating new policies and adopting

[14] 2021_line_haul_locomotive_emission_inventory_final.pdf (ca.gov)
ww2.arb.ca.gov/sites/default/files/2021-02/2021_line_haul_locomotive_emission_inventory_final.pdf

new standards and recommended practices. The most recent standards adopted by ICAO are:[15]

- CAEP/8: latest NOx standard adopted in 2011;
- CAEP/10: first CO_2 standard adopted in 2017; and
- CAEP/11: first non-volatile PM mass and number standard adopted in 2019.

- U.S. EPA has the authority to regulate factors that affect fuel consumption and greenhouse gas (GHG) emissions from aircraft.[16] The factors include engine emissions, aerodynamics, and aircraft weight. U.S. EPA is not bound by ICAO standards. U.S EPA has the authority to adopt standards that are stricter than those set by ICAO. EPA has historically adopted ICAO standards and has most recently proposed a GHG emission standard for aircraft that is equivalent to the ICAO standard.
- FAA's CLEEN program is a cost-sharing program aimed at accelerating the development and commercialization of new certifiable aircraft technologies and sustainable aviation fuels. The program has been successful in developing technologies relating to composite airframe technologies, advanced wing technologies, advanced fan systems, and many other technologies.[17]
- Emission regulations and standards from ICAO and U.S. EPA have been historically technology following and not technology forcing.
- There are certified aircraft engines available that achieve NOx emissions below the latest CAEP/8 standard, and engine manufacturers are also currently developing engines that achieve significant reductions beyond the current standards.
- CARB implemented the In-Use Off-Road Diesel-Fueled Fleets Regulation, Large Spark-Ignition Fleet Requirements Regulation, and the Zero-Emission Airport Shuttle Regulation, all aimed at targeting airport related on-ground emissions. Current regulations aim to reduce harmful emissions such as NOx, hydrocarbons, GHGs, and PM among others.

Proposed Action

Due to U.S. EPA's authority on setting emission standards, for this measure, CARB would strongly advocate for stricter emission regulations and highlight the need to reduce pollution

[15] Committee on Aviation Environmental Protection (CAEP) (icao.int) www.icao.int/ENVIRONMENTAL-PROTECTION/Pages/CAEP.aspx

[16] EPA, Proposed Finding That Greenhouse Gas Emissions From Aircraft Cause or Contribute to Air Pollution That May Reasonably Be Anticipated To Endanger Public Health and Welfare and Advance Notice of Proposed Rulemaking, 80 Fed. Reg. 37,758, 37,768-69 (July 1, 2015).

[17] FAA, CLEEN Phase I and II Projects, Feb. 27, 2020, available at https://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen/media/CLEENI_CLEENII_Projects.pdf.

to protect public health – this is discussed further in the Federal Actions portion of this document.

CARB would also explore requiring all larger airports to perform a comprehensive and standardized emission inventory. An accurate emission inventory that reflects all on-ground and near-ground emissions would establish a baseline and enable verifiable and quantifiable future emissions reductions. Accurate reporting would enable better emissions inventory development, technology assessment, and policy development, such as future regulatory and incentive programs.

CARB would evaluate federal, State, and local authority in setting operational efficiency practices to achieve emission reductions. Operational practices include landing, takeoff, taxi, and running the APU, and contribute to on-ground and near-ground emissions. Near ground emissions are emissions between ground level up to 3,000 feet. Operational practices such as de-rated take-off[18] and reduced power taxiing[19] have the potential to achieve emission reductions.

CARB would similarly work with U.S. EPA, air districts, airports, and industry stakeholders in a collaborative effort to develop regulations, voluntary measures and incentive programs. CARB would evaluate the incentive amounts that would be required to encourage aircrafts to voluntarily use cleaner engines and fuels. Incentives to encourage aircraft to use cleaner engines and fuels in California would involve identification of funding sources and implementation mechanisms such as development of new programs. In addition to the development process for the 2022 State SIP Strategy, the measure or measures as proposed by staff or adopted by the Board will be subject to full public processes.

[18] G.S. Koudis *et al.*, "Airport emissions reductions from reduced thrust takeoff operations," *Transportation Research Part D: Transport and Environment*, 52, 15-28 (2017).
[19] Sustainable Aviation, "Aircraft on the Ground CO2 Reduction Programme," UK's Airport Operators Association.

Future Measures for Ocean-Going Vessel Emissions Reductions

Overview

The primary goal of future measures for ocean-going vessels (OGVs) is to further reduce emissions from OGVs that are transiting, maneuvering, or anchoring in regulated California waters (RCW) and while docking at berth in California seaports.[20] California has two primary regulations currently in place to reduce emissions from OGVs: 1) the Vessel Clean Fuel Regulation, which was adopted in 2008 and requires all OGVs to use cleaner 0.1 percent sulfur distillate grade fuels while in RCW, and 2) the At Berth Regulation, which requires regulated vessels to connect to shore power or use an alternative emissions control technology to reduce emissions while docked at berth at regulated California seaports.[21,22] The original At-Berth Regulation was adopted in 2007, and requires 80 percent of regulated container, refrigerated cargo, and passenger cruise vessels to reduce emissions while berthed at regulated California seaports. The 2020 At Berth Regulation expansion extended emissions control requirements to auto carrier (also called "roll-on/roll-off" or "ro-ro") and tanker vessels, as well as new seaports and marine terminals that receive these two vessel types, and requires all regulated vessel types to connect to shore power or a CARB approved emissions control strategy during every visit to a regulated marine terminal.[23]

There are also existing voluntary incentive programs in place that encourage OGVs to reduce emissions, such as the Port of Los Angeles' Environmental Ship Index Program, the Port of Long Beach's Green Flag Incentive Program, and the various vessel speed reduction (VSR) zones that are in place off the Ports of Long Beach, Los Angeles, and San Diego, as well as in the Santa Barbara Channel and San Francisco Bay.

Despite the reductions achieved by existing regulatory and incentive programs, additional measures are needed to achieve further emissions reductions from OGVs in order to protect public health and meet federal air quality standards. OGVs have diesel engines, which are significant emitters of PM and NOx. OGV emissions are concentrated near the ports and pose significant health risks to nearby communities. Due to the international nature of OGVs, advocacy and coordination with federal and international oversight and regulatory organizations may be needed to achieve additional emissions reductions – this is discussed further in the Federal Actions portion of this document.

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[20] Regulated California Waters is defined as within 24 nautical miles of the California coast.

[21] Regulated container and refrigerated cargo fleets are any fleet making 25 or more visits to a regulated seaport, while regulated cruise fleets are any fleet making 5 or more visits to a regulated seaport.

[22] Under the 2007 At-Berth Regulation, six California seaports are subject to emissions control requirements: the Ports of Los Angeles, Long Beach, Oakland, San Francisco, San Diego, and Hueneme.

[23] Under the 2020 At Berth Regulation, any marine terminal receiving 20 or more visits from container, refrigerated cargo, cruise, ro-ro, or tanker vessels is subject to emission control requirements.

Background/Regulatory History

- Majority of emissions from OGVs occur while vessels are in transit and operating their large slow-speed marine engines, which are typically powered by heavy fuel oil (or "bunker fuel").[24] CARB's Vessel Clean Fuel Regulation requires OGVs to use 0.1 percent sulfur distillate grade fuels (marine diesel oil/marine gas oil) for all OGVs sailing within RCW to help reduce emissions from OGVs, namely sulfur oxide (SOx) emissions.
- OGV emissions (up to 100 nautical miles) are projected to make up 20 percent of mobile source NOx emissions in 2037, up from 10 percent in 2017.[25]
- Increased emissions are occurring from all modes of OGV operations (in transit, maneuvering, anchoring, and at berth) because of increased import/export activity and seaport congestion (which may be associated with a variety of factors, including the global pandemic, periodic labor disputes, tariff changes, etc.).
- OGVs and emissions standards are largely regulated on an international level by the International Maritime Organization (IMO), whose primary focus is reducing NOx and GHG emissions from OGVs. IMO marine engine standards for OGVs regulate NOx emissions only, with no PM standards in place. Tier I and II engine standards exist for any vessel with a keel-laid date of January 1, 2000, and January 1, 2011, respectively. Stricter Tier III IMO marine engines, which achieve a significant reduction in NOx emissions (around an 80 percent reduction from Tier II) are currently required for any OGV with a keel-laid date of January 1, 2016, or later. However, due to the long lifespan of OGVs and the fact that OGVs with keel laid dates after January 1, 2016, are only required to have Tier III engines when sailing within Emission Control Areas (ECA), turnover to Tier III engines is slow and not expected for most vessel categories until 2030+.[26]
- Significant reductions in SOx emissions from OGVs have been achieved through implementation of the Vessel Clean Fuel Regulation and North American ECA. Reductions in NOx, PM, and GHGs have also been achieved through the implementation of the At Berth Regulation, however, additional reductions of these pollutants are needed, particularly from OGVs in transit and anchoring near the

[24] California Air Resources Board. Staff Report: Initial Statement of Reasons. October 15, 2019. https://ww2.arb.ca.gov/sites/default/files/classic/regact/2019/ogvatberth2019/isor.pdf
[25] California Air Resources Board. CARB's Potential Future Measures for Reducing Emissions from OGVs. 2022 AQMP Mobile Source Working Group. April 1, 2021. Retrieved from http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/ogv-presentations-combined-04-01-21.pdf.
[26] CARB. Appendix H - Update to Inventory for Ocean-Going Vessels At Berth: Methodology and Results. October 9, 2019. Retrieved at https://ww2.arb.ca.gov/sites/default/files/classic/regact/2019/ogvatberth2019/apph.pdf

California coast, in order to achieve federal air quality standards and reduce health impacts from ultrafine diesel particles in portside communities.

- Advocacy at the federal/international level for measures such as cleaner vessel engine standards, cleaner fuels, and increased use of vessel speed reduction outside of RCW may be necessary to achieve further reductions from OGVs.
- Cleaner marine fuels being explored include hydrogen, methanol, ammonia, and liquid natural gas (LNG). There is no consensus within the maritime industry yet as to which alternative fuel(s) might be best suited for OGV applications.

Proposed Action

For this measure, CARB would pursue evaluating further regulatory actions to achieve additional reductions in NOx, PM, and GHG emissions from OGVs through the use of operational changes and new technologies currently in development, including advances in exhaust capture and control, mobile shore power connections, cleaner fuels (such as LNG, hydrogen, methanol, ammonia, etc.), alternative power sources (including batteries and fuel cells), as well as potential vessel-side technologies (such as water-in-fuel emulsion). In pursuing regulatory measures, CARB would work with U.S. EPA, California air districts, seaports, and industry stakeholders in a collaborative effort to determine which measure would provide the most effective emissions reductions, as well as CARB's ability to implement each potential measure. Advocacy at the federal and international levels may be necessary to achieving additional emissions reductions from OGVs given the international nature of sea trade.

Additionally, CARB staff have committed to assessing the feasibility, benefits, and cost-effectiveness of control technologies for bulk/general cargo vessels and vessels at anchor (which are not subject to emissions control requirements in the 2020 At Berth Regulation) as part of the 2020 At Berth Regulation's Interim Evaluation. This evaluation will occur in 2021-2022, with a public report due by December 1, 2022.

For incentive measures, CARB would similarly work with U.S. EPA, California air districts, seaports, and industry stakeholders in a collaborative effort to expand ongoing efforts already underway by air districts, such as the South Coast Air Quality Management District. Determining what amount of money would be required to encourage OGVs to voluntarily use cleaner engines/fuels, reduce emissions at anchor, or sail at slower speeds, would be key to supporting these efforts. Incentives to encourage ships using cleaner engines or fuels to visit California seaports would involve identification of funding sources and implementation mechanisms such as development of new programs or the enhancement of existing incentive programs, such as expanding existing VSR zones, developing a "Green Shipping Lane" to encourage incentives amongst multiple Pacific seaports, etc.

Incentive or regulatory measures could be pursed to achieve further emissions reductions from OGVs, including:

- Using cleaner engines or cleaner fuels than those required by U.S. EPA and the IMO;

- Reducing emissions while anchored within RCW;
- Sailing at slower speeds while in RCW; and
- Requiring bulk and general cargo vessels to reduce emissions while at berth.

In addition to the development process for the 2022 State SIP Strategy, the measure or measures as proposed by staff or adopted by the Board will be subject to full public processes.

Federal Actions Needed

The federal actions for primarily federally and internationally-regulated categories or sub-categories include on-road heavy-duty vehicles, off-road equipment, aviation, locomotives, and ocean-going vessels. Given the diversity that comprises this category, each measure includes a more detailed description of the specific source.

On-Road Heavy-Duty Vehicle Low-NOx Engine Standards

In the 2016 State SIP Strategy, CARB included a measure to petition for federal low-NOx standards that would apply to all new heavy-duty trucks sold nationwide starting in 2024 or later. This would ensure that all trucks traveling within California would eventually be equipped with an engine meeting the lower NOx standard. Federal action is critical to implement this emission standard, since emission reductions from a California-only CARB regulation would come mostly from Class 4-6 vehicles (as most Class 7 and 8 vehicles operating in California were originally purchased outside the State).

Due to the preponderance of interstate trucking's contribution to emissions in California, timely federal action to implement a national low-NOx engine standard is critical to provide the emission reductions needed for attainment. The 2016 State SIP Strategy called for U.S. EPA to develop a national low-NOx standard. In June of 2016, the South Coast, San Joaquin Valley and Bay Area air districts and nine other state and local air control agencies formally petitioned U.S. EPA to adopt 0.02 g/bhp-hr NOx standards for medium- and heavy-duty truck engines nationally. U.S. EPA responded to those petitions on December 20, 2016, stating that they will initiate the work necessary to issue a Notice of Proposed Rulemaking for a new on-road heavy-duty NOx program, with the intention of proposing standards that could begin in model year 2024, consistent with the lead-time requirements of the Clean Air Act. In November 2018, U.S. EPA announced the national program, known as the *Cleaner Trucks Initiative* (CTI), and an Advanced Notice of Proposed Rulemaking was released on January 21, 2020.[27] On August 5, 2021, U.S. EPA announced an update to CTI called the *Clean Trucks Plan* (CTP). CTP plans to reduce GHG and other harmful air pollutants from heavy-duty trucks through a series of rulemakings over the next three years. CARB will advocate to align the federal CTP with CARB's low-NOx omnibus regulations to the maximum degree possible, given the need for deep emissions reductions and the benefits of consistency in this area given the multiple jurisdictions in which trucks are purchased and used.

On-Road Heavy-Duty Vehicle Zero-Emission Requirements

In addition to the need for cleaner combustion engine standards, actions are also needed at the federal level to drive the introduction of zero-emission heavy-duty vehicles into the on-road fleet nation-wide. CARB would petition and/or advocate to U.S. EPA for federal

[27] *Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine Standards*, 85 Fed. Reg. 3306 (Jan. 21, 2020). *https://www.govinfo.gov/content/pkg/FR-2020-01-21/pdf/2020-00542.pdf*

zero-emission on-road heavy-duty vehicle requirements, along with more stringent GHG standards for medium- and heavy-duty vehicles that would apply to new heavy-duty trucks sold nationwide. Additionally, CARB would advocate that U.S. EPA enable state leadership on zero-emission trucks by prioritizing federal grants toward zero-emission technology and their associated infrastructure.

Off-Road Equipment Tier V Standard for Preempted Engines

Off-road equipment regulated at the federal level also contributes significant ozone precursor emissions in California. Included in this document is a potential measure for Tier V standards on State-regulated off-road equipment. CARB would also petition and/or advocate to U.S. EPA to promulgate off-road equipment Tier V standards for preempted engines, akin to those that CARB is pursuing for equipment under State authority to prevent the availability of equipment meeting a less stringent standard.

Off-Road Equipment Zero-Emission Standards Where Feasible

Given the availability of zero-emission equipment in certain off-road sectors, zero-emissions requirements are also feasible and needed, as discussed in various CARB measures in the Off-Road Equipment portion of this document. CARB would also petition and/or advocate to U.S. EPA to require zero-emission standards for off-road equipment where the technology is feasible. Zero-emission technology is maturing and penetrating the off-road equipment categories, and federal zero-emission standards for off-road equipment would provide a clear path for zero-emission technology to continue maturing.

More Stringent Aviation Engine Standards

CARB would petition and/or advocate to U.S. EPA for more stringent criteria and GHG standards for aircraft engines. With innovative research and advanced optimization of engine design, it has been demonstrated that NOx emissions can be further reduced beyond the CAEP/8 standards. For example, under the FAA's Continuous Lower Energy, Emissions, and Noise Phase II (CLEEN II) Program, FAA awarded five-year agreements to Aurora Flight Sciences, Boeing, Collins Aerospace, Delta Tech Ops/MDS Coating Technologies, General Electric, Honeywell, Pratt & Whitney, and Rolls-Royce to accelerate the development of new aircraft and engine technologies. The goal of the program is to achieve 70 percent NOx and 40 percent fuel burn reduction below the CAEP/8 standards. In 2016, GE's Twin Annular Premixing Swirler (TAPS) II combustor matured under CLEEN I and entered into service as part of CFM International's TAPS Leading Edge Aviation Propulsion (LEAP) engine, currently onboard Airbus 320neo, Boeing 737 MAX, and COMAC C919 aircraft. Under CLEEN I, GE engine emissions tests of TAPS II had results that were more than 60 percent below the 2004 ICAO CAEP NOx standards. The FAA anticipates that more of these technologies could go into service in the next several years.[28]

[28] *https://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/*

Cleaner Fuel and Visit Requirements for Aviation

In addition to needing more stringent engine standards, there are other mechanisms by which regulatory entities could require emissions reductions from aircraft in California. CARB would petition and/or advocate to U.S. EPA to require aircraft to use cleaner fuels when travelling through California, and to require visits from cleaner aircraft.

Zero-Emission On-Ground Operation Requirements at Airports

The on-ground operations at airports present additional emissions reductions for aviation. Typical aircrafts include an auxiliary power unit (APU) which is a small turbine engine that starts the aircraft main engines and powers the electrical systems on the aircraft when the main engines are off. Requirements for switching to the on-board rechargeable batteries as the power supply, it would reduce the usage of the gas turbine APU and hence emissions. Taxiing is another on-ground operation where emissions can be reduced through reduced power during taxiing, improved taxi-time, and the use of new technologies such as Taxi-bot. Taxi-bot is utilized during pushback operations and allows immediate taxiing with the engines stopped eliminating bottlenecks in the gate area. CARB would petition and/or advocated to U.S. EPA to require zero-emission on-ground operation at California airports.

More Stringent National Locomotive Emission Standards

In the 2016 State SIP Strategy, CARB included a measure to petition for more stringent national locomotive emission standards. The goal of a more stringent national locomotive emission standard is to reduce emissions from locomotives in order to meet air quality and climate change goals. On April 13, 2017, *CARB petitioned U.S. EPA* to promulgate both Tier 5 national emission standards for newly manufactured locomotives, and more stringent national requirements for remanufactured locomotives, to reduce criteria and toxic pollutants, fuel consumption, and GHG emissions.

Zero-Emission Standards for Switch Locomotives

Switchers move railcars and sections of trains in and around railyards (but should not be confused with rubber-tired railcar movers, smaller off-road vehicles than move individual railcars in yards, but are not considered switchers). Switchers that account for about 10 percent of freight diesel use could be converted to electric. For this measure, CARB would petition and/or advocate to U.S. EPA to promulgate national zero-emission standards for switchers to reduce criteria and toxic pollutants, fuel consumption, and GHG emissions.

Address Locomotive Remanufacturing Loophole

Federal rules currently define remanufactured locomotives as “new” when they are remanufactured, and do not set limits on how often locomotives can be remanufactured. The result is continued remanufacturing of old and polluting locomotives to the same pollution tier standards, and persistent pollution from these sources. For this measure, CARB would petition and/or advocate to U.S. EPA to remove this regulatory loophole, in addition to the state-level rules discussed above.

More Stringent NOx and PM Standards for Ocean-Going Vessels

Emissions from main engines and auxiliary engines of ocean-going vessels during transit, anchorage, and maneuvering must be addressed in order to achieve NOx reductions needed to meet California's near- and mid-term air quality goals. Currently, very few vessels with Tier 3 main engines visit California ports, even though the Tier 3 engine standard applied to new marine engines beginning in 2016. Tier 2 vessels emit three times higher NOx than Tier 3 vessels; thus, phasing out of older Tier vessels is key to reducing criteria and toxics emissions from OGVs.

CARB would petition and/or advocate to U.S. EPA and IMO for cleaner marine standards. While marine Tier 3 is considerably cleaner than Tier 2, the Tier 3 NOx standard is still 5 to 10 times higher than the standards for other diesel equipment sectors, and does not include a PM standard. CARB will work with U.S. EPA, U.S. Coast Guard, and other partners to urge IMO to adopt more stringent Tier 4 marine standard and establish efficiency requirements for existing vessels.

Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels

CARB would petition and/or advocate to U.S. EPA to require vessels to use cleaner fuels and visits from cleaner OGVs. To the maximum extent possible all Tier 0, Tier 1, and Tier 2 vessel visits should be replaced with visits made by Tier 3 or cleaner vessels by 2031. Current Tier 3 vessel manufacturing data suggest that there may not be sufficient Tier 3 to meet the vessel visits, even if California were to receive a large majority of the worldwide Tier 3 vessels. However, these reductions may be achieved by incentivizing visits from Tier 2 vessels that have been retrofitted to reduce NOx emissions. Current retrofit technologies for marine engines include water-in-fuel emulsion, exhaust gas recirculation (EGR) and selective catalytic reduction (SCR). Both EGR and SCR have shown potential to reduce emissions by up to 80 percent. Water-in-fuel emulsion strategies have shown up to 40 percent reduction in NOx emissions and may provide significant and cost-effective reductions options (particularly at near-port and low load conditions where Tier 3 and other retrofit options may not operate at full potential). Biofuels, renewable hydrogen and other hydrogen-derived fuels such as ammonia, methanol, batteries and fuel cells are being considered as potential fuel choices for vessels. All options need to be considered to achieve the needed emissions reductions.

Proposed Measures: Consumer Products

Description of Source Category:

Chemically formulated consumer products such as personal care products, household care products, and automotive care products are a significant source of reactive organic gases (ROG) emissions and have been regulated as a source of ROG in numerous rulemakings since 1989. Consumer products are the largest source category of ROG emissions in the South Coast Air Basin and statewide.

Although it is not possible to meet the 70 ppb 8-hour ozone standard without significant NOx reductions, ozone modeling has shown that reductions in ROG emissions remain an effective strategy for control of ozone in certain geographic areas of California. This is the case with western portions of the South Coast Air Basin, and to a lesser extent in other highly populated areas of coastal California. Emission-rich upwind areas in the South Coast Air Basin contribute to ozone formation further downwind and may themselves experience ozone concentrations above the health-based ambient air quality standards. Modeling also shows that for these upwind areas, the effectiveness of ROG reductions declines as ozone concentrations fall. Therefore, ROG reductions are more impactful in the South Coast Air Basin–which features the nation's highest ozone levels—than elsewhere in California. Ozone modeling indicates that much of the South Coast Air Basin, and particularly its more densely populated western and central areas, will continue to benefit from reductions in volatile organic compounds (VOC)—the more volatile portion of ROG—in the post-2031 timeframe. Given that population tracks closely with consumer product use, further emission reductions from consumer products would significantly contribute to expeditious attainment of ozone standards in the South Coast Air Basin.

Consumer Products Standards

Overview

Current regulations have been effective in substantially reducing VOC emissions from consumer products. The consumer products program, broadly, consists of a number of regulations that, over the past 30 years, have led to an over 50 percent reduction in emissions. However, benefits from the adopted standards are being eroded by California's population growth and associated product usage, and VOC emissions from consumer products now exceed those from any other emission source category. The primary goal of this measure is to help attain federal ozone standards in the South Coast Air Basin by addressing projected growth in consumer product emissions. While this measure focuses on attaining federal air quality standards in the South Coast, where nearly 15 million residents face the most extreme and persistently high ambient ozone levels in the nation, it will also facilitate attainment of State and federal air quality standards in other California regions.

Background/Regulatory History

- Consumer products are a diverse group of chemically formulated products used by household and institutional consumers and are a significant source of both VOC and ROG emissions. The California Air Resources Board (CARB) has regulated consumer products by setting regulatory standards applicable to their chemical constituents. CARB first adopted consumer product VOC content standards in 1989.
- As part of the State's effort to reduce air pollutants, in 1988 the Legislature added section 41712 to the California Clean Air Act (Act) in the Health and Safety Code. Along with subsequent amendments, this section requires CARB to adopt regulations to achieve the maximum feasible reduction in VOC emissions from consumer products. In doing so, the Board must first determine that adequate data exist to establish that the regulations are necessary to attain State and federal ambient air quality standards. Commercial and technological feasibility of the regulations must also be demonstrated. The Act requires that regulations must not eliminate any product form, and that recommendations from health professionals must be considered when developing control measures for health benefit products.
- Historically, regulated consumer products have been subject to standards that limit VOC content by mass. Some regulated product categories—aerosol coatings and multi-purpose lubricants—have subsequently been regulated by setting reactivity-based limits. Both regulatory approaches are intended to reduce ozone formation from consumer products. The relative effectiveness of each regulatory approach varies by product category. Product manufacturers have complied with VOC content standards and reactivity limits by reformulating products. CARB's progressively declining VOC standards and reactivity limits have reduced VOC emissions by 250 tons per day.

- Several reformulation approaches may be used to comply with VOC content standards. These include: substituting much lower-reactive VOCs (known as exempt VOCs) for more reactive chemical species; using less volatile organic constituents (known as low vapor pressure VOCs, or LVP-VOCs); increased use of water and other volatile inorganic ingredients; and increased use of non-volatile constituents. Chemicals in the four groupings listed above are not included when determining whether the VOC content of a product exceeds the applicable VOC standard.

- CARB controls emissions from aerosol coating products using a reactivity-based regulation. This regulation uses product-weighted reactivity-based limits to reduce product ozone formation potential. Reactivity limits apply to the entirety of a product's volatile organic content, including VOCs, LVP-VOCs, and exempt VOCs. This approach emphasizes use of less reactive rather than less volatile ingredients. Historically, reductions from reactivity limits are expressed as either VOC reductions or equivalent VOC reductions.

- CARB has reduced exposure to toxic air contaminants (TACs) by prohibiting use of certain chlorinated compounds in 83 categories of consumer products. Total emissions of TACs have been reduced by over 13 tons per day (tpd). Furthermore, when setting VOC or reactivity-based limits, CARB has applied California Environmental Quality Act provisions requiring that environmental impacts of proposed regulations be evaluated.

- CARB prohibitions on use of ingredients with a global warming potential (GWP) above 150 in several consumer product categories have reduced GHG emission growth by approximately 0.24 million metric tons of carbon dioxide equivalents by 2030. However, increased use of HFC-152a propellant, an exempt VOC with a GWP of 124, is projected to offset the benefits of adopted high GWP compound prohibitions and contribute to increasing consumer product GHG emissions in the years ahead.

- CARB staff periodically conducts consumer product surveys which assess the sales volume and formulations of consumer products sold in California. Over the past 30 years, CARB has conducted at least eight of these data collection efforts.

Proposed Action

For this measure, CARB is seeking further emission reductions to support ozone attainment in the South Coast and elsewhere in California, CARB staff anticipates casting a wide net in its review of product categories. CARB staff will conduct additional targeted product surveys to guide rule development and ensure emission reductions are based on the state-of-science. Staff will consider opportunities for ozone formation reductions both from already regulated product categories as well as previously unregulated categories. Given the maturity of the Consumer Products Program and its success in reducing the VOC content of well over 100 categories of products, securing necessary further emission reductions from already regulated categories may be challenging. Similar challenges exist in terms of reducing emissions from previously unregulated categories, many of which have undergone scrutiny in previous rulemaking efforts. Reasons for not setting VOC standards in the past include lack

of reformulation options because of an already low VOC content across the category; or high cost to reformulate and relatively poor cost-effectiveness. For categories with relatively high contributions to ozone formation, whether currently regulated or unregulated, staff will evaluate the merits of proposing reactivity limits.

Approaches to be considered also include investigating concepts for expanding manufacturer compliance options, market-based approaches, and reviewing existing exemptions. Staff will work with stakeholders to explore mechanisms that would encourage the development, distribution, and sale of cleaner, very low, or zero-emitting products. In undertaking these efforts staff will prioritize strategies that achieve the maximum feasible reductions in ozone-formation, TACs and greenhouse gas (GHG) emissions. This action complements a parallel measure in CARB's Climate Change Scoping Plan Update, to be considered by the Board in 2022, to phase down use of HFC-152a and other GHGs in consumer products.

In summary, efforts to reduce the ozone impact of consumer products will include CARB staff's consideration of control strategies that utilize VOC standards and reactivity-based limits. Staff will also consider other innovative approaches to most effectively meet emission reduction targets and help California meet its air quality, climate and public health goals.

In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Proposed Measures: Residential and Commercial Buildings

Description of Source Category

Residential and commercial buildings are responsible for roughly 25 percent of California's GHG emissions when accounting for fossil fuels consumer onsite and electricity demand, and a significant portion of Statewide NOx emissions. The fuels we use and burn in our homes, primarily natural gas, for space and water heating contribute the vast majority of these criteria pollutant emissions and provide an opportunity for substantial emissions reductions where zero-emission technology is available.

Zero-Emission Standard for Space and Water Heaters

Overview

The primary goal of this measure is to reduce emissions from space and water heaters installed in new and existing residential and commercial buildings. CARB would set an emission standard for space heaters and water heaters to go into effect in 2030. The emission standard would be more stringent than current air district rules in place. CARB would adopt a statewide zero GHG emission standard, which would have criteria pollutant co-benefits. Beginning in 2030, 100 percent of sales of new space heaters and water heaters would need to comply with the emission standard. CARB would design any such standard in collaboration with energy and building code regulators, and with air districts, to ensure it was consistent with all state and local efforts, and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions and energy demand from these appliances can generate cost-savings and health benefits with properly designed standards.

Background/Regulatory History

- Natural gas combustion in buildings caused 5 percent of statewide NOx emissions in the 2019 inventory.
- Natural gas combustion in buildings emits about 65 tpd of NOx[29] to the ambient air, about 4 times of the emissions from electric utilities and nearly 2/3 the emissions from light-duty vehicles statewide.
- Nine air districts regulate NOx emissions from space heaters and water heaters. Bay Area, San Joaquin Valley, South Coast, Yolo-Solano, San Diego County, and Sacramento Metro enforce the most stringent emission limit of 10 ng/J NOx for water heaters. San Joaquin Valley and South Coast enforce the most stringent emission limit of 14 ng/J NOx for space heaters.

[29] CARB's Criteria Emission Inventory CEPAM: 2019 Version - Standard Emission Tool.

- Even with low NOx emission limits in place, NOx emissions from space heating and water heating in residential and commercial buildings are projected to total 33 tpd in the year 2030[30]. If no further action is taken to further limit emissions for space and water heating, emissions are projected to total 6 tpd of NOx in South Coast and 5 tpd of NOx in San Joaquin Valley by 2030.
- A statewide zero GHG emission standard for space and water heaters has the potential to reduce 8.08 tpd of NOx in 2031 and 11.74 tpd of NOx per day in 2037.

Proposed Action

For this measure, CARB would develop and propose zero GHG emission standards for space and water heaters sold in California; CARB could also work with air districts to further tighten district rules to drive zero-emission technologies. This measure would not mandate retrofits in existing buildings, but some buildings would require retrofits to be able to use the new technology that this measure would require. Beginning in 2030, 100 percent of sales of new space and water heaters (for either new construction or replacement of burned-out equipment in existing buildings) would need to meet zero-emission standards. It is expected that this regulation would rely heavily on heat pump technologies currently being sold to electrify new and existing homes.[31] In addition to the development process for the 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

[30] Ibid.

Public Measure Suggestions

As a result of outreach and engagement efforts to date, CARB has received suggestions from the public for State measures to be included in the 2022 State SIP Strategy. Many of the items below have been included or discussed as a part of various Community Emissions Reduction Programs developed by selected communities, together with their air district partners, under CARB's Assembly Bill 617 Community Air Protection Program. CARB is exploring the ways in which these concepts could be included as measures in the 2022 State SIP Strategy and welcomes feedback and additional suggestions from the public.

On-Road Heavy-Duty Vehicle Useful Life Regulation

CARB has in place numerous regulations to control emissions from on-road heavy-duty vehicles, and continues to pursue additional measures as described in this document. This measure would involve CARB developing a regulation, potentially paired with new incentives or legislative measures, to require on-road heavy-duty vehicles that have reached the end of their useful life as defined in Senate Bill 1, (Beall, Chapter 5, Statutes of 2017) as the earlier of 800,000 vehicles miles traveled or 18 years from the engine model year to retire, replace, retrofit, or repower the on-road heavy-duty vehicle or engine, and upgrade to zero-emission trucks

Additional Incentive Programs - Zero-Emission Trucks

Additional incentive programs are needed to send clear signals to the market and support new scrap and replace regulatory programs, specifically to help ensure that smaller trucking companies have more consistent access to zero-emission truck incentives. This measure would involve CARB working to develop incentive programs which should include consideration of policies other jurisdictions have employed such as supporting local zero-emission zones and/or differentiated registration fees so that dirtier trucks pay more and zero-emission trucks have a consistent source of incentive funding.

Enhanced Transportation Choices

The bulk of emissions from the vehicle fleet come from existing vehicles, meaning that measures that can give people choices not to use their personal vehicles, and instead to walk, bike, take public transit, or adopt other transportation modes, at least some of the time, can significantly reduce emissions. This suggested measure, or measures, would have CARB work with state and local transportation planning organizations, local governments, and communities to advance vehicle miles travelled (VMT) reductions via enhanced choice. Measures for consideration could include, but are not limited to, travel demand management programs, incentive programs that fund enhanced transportation planning, or zoning changes that encourage dense, walkable, infill development.

Suggested Control Measure – Indirect Source Rule

An indirect source can be any facility, building, structure, or installation, or combination thereof, which attracts or generates mobile source activity that results in emissions – these include warehouses, railyards, ports, airports, and mobile sources attracted to those warehouses, railyards, ports, and airports. Only a few air districts in California have indirect source rules to limit emissions of this nature on a facility basis. This measure would involve CARB writing a Suggested Control Measure which acts as a model rule to assist the air districts in the rule development process.

BACT/BARCT Determination

This measure would involve CARB developing Best Available Control Technology (BACT) and/or Best Available Retrofit Control Technology (BARCT) determinations. New stationary sources, sources that undergo significant modification, and relocated sources are subject to emissions control requirements depending on the jurisdiction in which they are located. A BACT or BARCT determination defines limits that would be enforced at the local level for a specific piece of equipment or process for a stationary source, such as commercial cooking char broilers and deep-frying, wood burning devices, water treatment plants, autobody shops, metal recycling, storage tank leaks, and flaring. Once a BACT or BARCT determination is in place, air districts could be required under applicable State and federal laws to implement the defined levels of control through local rules and regulations, thereby reducing emissions from the relevant sources.

Additional Building and Appliance Emission Standards

CARB could propose additional emissions standards for appliance combustion sources used in buildings (for example, including stoves and furnaces), work with air districts to set further such standards, work with building and energy code agencies to ready more buildings for zero-emission appliances, or take other actions (including potentially incentive programs) to accelerate the removal of fossil fuels from the building stock in both new and existing buildings. Such measures could potentially significantly accelerate the transition away from pollution associated with combustion in these sources while creating economic opportunities for building retrofits. Any such measures would be developed with careful consideration for community needs, and housing cost concerns, with full community engagement.

Pesticides Regulation

Pesticides are used in commercial and agricultural operations across the State, and are a source of VOC and other types of emissions. This measure would involve CARB working with the California Department of Pesticide Regulation to develop new regulations to further reduce VOC emissions from commercial and agricultural pesticides used in California through reformulation, reduced usage, and innovative technologies and practices.

Enhanced Bureau of Automotive Repair Consumer Assistance Program

The California Bureau of Automotive Repair (BAR) has in place a *Consumer Assistance Program* to offer eligible low-income consumers repair assistance and vehicle retirement options to help reduce emissions and improve air quality. The repair assistance program currently offers up to $1,200 for emissions-related repairs which correct problems contributing to a vehicle's failure to pass a Smog Check inspection. The vehicle retirement option currently offers income-eligible consumers $1,500 to retire their vehicle. This measure would involve CARB working with BAR to enhance the Consumer Assistance Program by expanding the eligibility threshold and/or amounts of funding offered for consumers towards repair assistance and vehicle replacement options.