2022 State Strategy for the State Implementation Plan

Adopted
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CALIFORNIA
AIR RESOURCES BOARD

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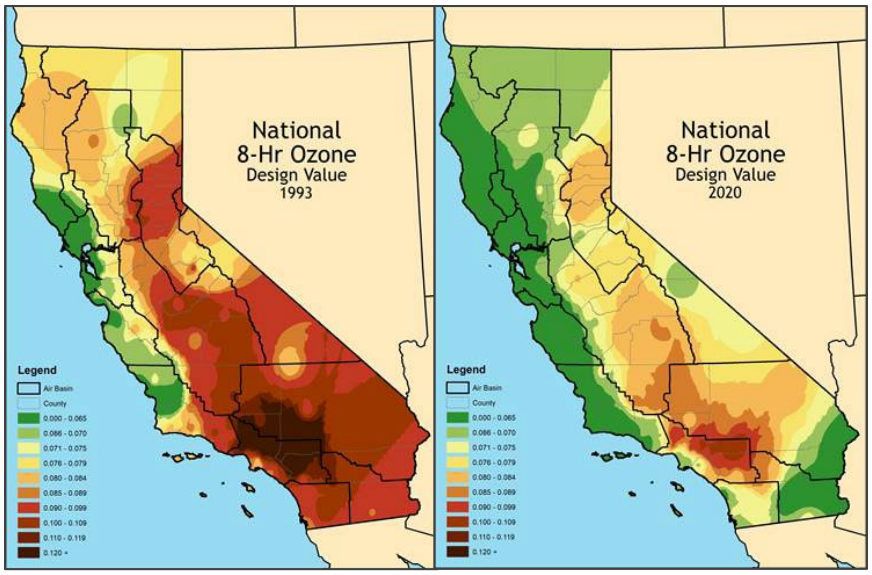
Executive Summary

The *2022 State Strategy for the State Implementation Plan* (2022 State SIP Strategy) is a Statewide planning document that identifies the strategies and controls under State authority that are needed to reduce emissions to reduce ground-level ozone, otherwise known as smog. These measures are needed across the State of California for areas to meet the federal 70 parts per billion (ppb) 8-hour ozone standard (70 ppb ozone standard) set by the U.S. Environmental Protection Agency (U.S. EPA) in 2015. More specifically, this document describes the State's proposed commitments to develop control measures and reduce emissions from State-regulated sources as needed to support attainment by the required attainment dates; these State measures and commitments will be incorporated into regional State Implementation Plans (SIPs) for the 70 ppb ozone standard for each nonattainment area, due to U.S. EPA in 2022.

This document, the Proposed 2022 State SIP Strategy, is California Air Resources Board's (CARB or Board) release of the 2022 State SIP Strategy being proposed for Board consideration. On January 31, 2022, the CARB released the *Draft 2022 State SIP Strategy* which built off of the *2022 State SIP Strategy: Draft Measures* document released in October 2021 and included additional measures and information needed to support nonattainment areas SIPs. This document now identifies all of the proposed measures, associated emissions reductions, and other elements needed to support attainment of the 70 ppb ozone standard. With the Proposed 2022 State SIP Strategy, CARB is exploring and proposing an unprecedented variety of new measures to reduce emissions from the sources under our authority using all mechanisms available. This level of action is needed to ensure federal air quality standards are attained and to deliver on our commitments to protect public health, particularly in light of the growing body of evidence on the adverse impacts of air pollution.

CARB has over 50 years of experience reducing emissions from mobile and other sources of pollution under State authority that have improved air quality and helped mitigate climate change. During the 1960s, there were as many as 186 smog alerts in a single year; today, alerts have been eliminated due to improvement in air quality. The State and our most polluted regions have seen dramatic improvements in air quality, all while California has achieved prosperous economic growth and become a world leader in environmental policies and clean technologies. Even with this progress, more than half (21 million out of nearly 40 million) of Californians live in areas that exceed the most

Figure 1 – Ozone Air Quality Progress in California



stringent 70 ppb ozone standard[1], with many areas also exceeding the previous ozone standards of 75 and 80 ppb, as seen in Figure 1. Further, a disproportionate number of those most impacted by high ozone levels live in low-income and disadvantaged communities that also typically experience greater exposure to diesel exhaust and other toxic air pollutants compared to surrounding areas.

In 2015, U.S. EPA lowered the 8-hour ozone standard from 75 ppb to the more health protective level of 70 ppb. Nineteen areas in California are nonattainment for the 70 ppb ozone standard (Figure 2); included within these nonattainment areas are over 99 percent of the disadvantaged communities in the State. Controlling ozone precursor emissions, in particular oxides of nitrogen (NOx), is key to attaining the federal ozone standards. Since mobile sources account for about three-fourths of NOx emissions statewide, many of these nineteen areas in California will need significant mobile source emissions reductions to meet the 70 ppb ozone standard in attainment years which range from 2020 through 2037. The 2037 attainment year applies to Extreme classified areas who have the most critical ozone air quality challenges. California has the only two areas in the nation with an Extreme classification for the 70 ppb ozone standard, the South Coast Air Basin (South Coast) and the San Joaquin Valley (Valley). While the Proposed 2022 State SIP Strategy is being developed primarily as a roadmap for attaining the 70 ppb ozone standard, the emissions reductions will also support attainment of other ozone (e.g. 80 ppb, 75 ppb) and fine particulate (PM2.5) national ambient air quality standards (NAAQS), make progress towards the State air quality standards, and improve visibility across the State.

Figure 2 - 70 ppb Ozone Nonattainment Areas

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. Research shows large disparities in exposure to pollution between white and non-white populations in California, and between disadvantaged communities and other communities, with Black and Latino populations experiencing significantly greater air pollution impacts than white populations. Mobile source pollution shows some of the highest disparities; a CARB-funded study indicated that on average, mobile sources account for over 30 percent of total PM2.5 exposures.[2] Research has shown that mobile sources are the largest sources of pollution exposure disparity for Black populations and disadvantaged community residents, when compared to the average population in California. Specifically, mobile sources accounted for 45 percent of exposure disparity for the

[1] Based on 2020 monitored ozone design values contoured over population by census tract

[2] Apte et al (2019). A Method to Prioritize Sources for Reducing High PM2.5 Exposures in Environmental Justice Communities in California. CARB Research Contract Number 17RD006

Black population, and 37 percent of exposure disparity for people in disadvantaged communities.

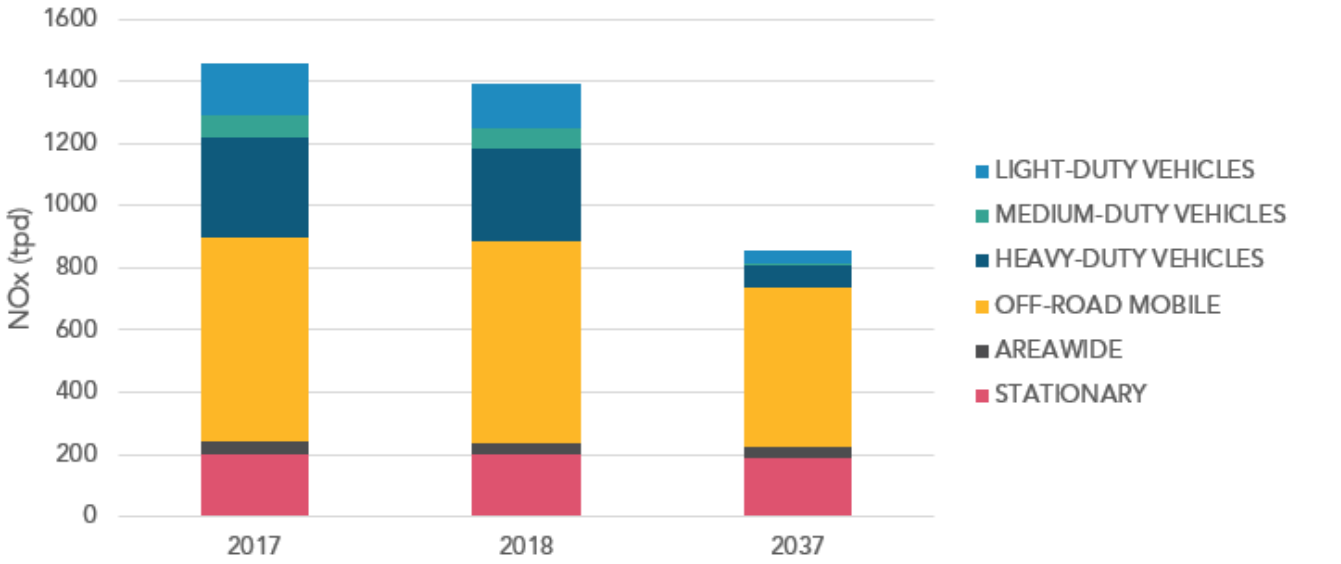
Central to CARB's planning efforts and programs going forward will be prioritizing environmental justice, incorporating racial equity, and conducting meaningful community engagement as CARB strives to address the longstanding environmental and health inequities from elevated levels of toxics, criteria pollutants, and secondary impacts of climate change. It's imperative that we optimize our control programs to maximize emissions reductions and provide targeted near-term benefits in those communities that continue to bear the brunt of poor air quality. The Proposed 2022 State SIP Strategy will reduce emissions and the corresponding health risk in California's most impacted communities. As development and implementation of the Proposed 2022 State SIP Strategy progresses and forms the basis for future regulations, staff will continue to identify opportunities to mitigate air pollution associated racial inequities and meaningfully engage and partner with communities most impacted to address long standing challenges.

This Proposed 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* (2020 MSS), 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 finalized the 2020 MSS in October 2021, as a conceptual road map for potential future measures. The measure concepts in the 2020 MSS form the basis for many of the measures in this document and have since been developed further and translated into detailed measures with, where possible, anticipated emissions reductions. This document, the Proposed 2022 State SIP Strategy, will be considered for adoption by the Board and embodies input from stakeholders and the Board, and staff assessment of the feasibility of specific measures. Board consideration is scheduled for September 2022. The Proposed 2022 State SIP Strategy is also being developed in parallel with the 2022 Climate Change Scoping Plan Update (2022 Scoping Plan Update); the 2022 Scoping Plan Update is on a similar development timeline and will lay out the State's path to achieving carbon neutrality by 2045. The 2022 Scoping Plan Update will incorporate actions in the Proposed 2022 State SIP Strategy and rely on these actions included in the SIP to also deliver greenhouse gas reductions.

On October 6, 2021, CARB staff released, in conjunction with a public workshop, the *2022 State SIP Strategy: Draft Measures* (Draft Measures) to solicit public feedback on potential measures. After incorporating feedback and further development, CARB released the Draft 2022 State SIP Strategy on January 31, 2022 for a public comment period which closed on March 4, 2022. CARB facilitated additional public review and input by hosting another Public Workshop on February 10, 2022 and presenting a Board Informational update on February 24, 2022. The Draft Measures and Draft 2022 State SIP Strategy included not only CARB proposed measures, but also suggestions made by the public as part of our outreach to stakeholders across the State. These public suggestions are included in Chapter 3 below, with some being developed as proposed measures in the Proposed 2022 State SIP Strategy, as shown in Chapter 5. CARB staff will continue to assess the viability of all public suggestions as SIP measures. This document, the Proposed 2022 State SIP Strategy, also expands on the previous iterations to include additional proposed measure details, proposed measure timelines, and potential emissions reductions commitments to attain the standards with the objective of supporting attainment of the 70 ppb ozone standard within the attainment deadlines.

Control programs already adopted by CARB and upcoming measures that were included in the 2016 State SIP Strategy, as well as the local air district and U.S. EPA programs, provide a significant down payment on reducing the NOx emissions needed to meet the 70 ppb ozone standard and improve air quality throughout the State. As shown in Figure 2, these measures will by 2037, achieve almost a 36 percent reduction in total NOx emissions relative to 2018, with especially significant reductions in emissions from light-, medium-, and heavy-duty on-road vehicles. State control programs have also substantially reduced emissions of reactive organic gases (ROG), the other precursor to ozone, and will continue to do so into the future.

Figure 3 - Statewide NOx Emissions by Sector under Current Control Program[3]



However, more NOx emissions reductions from sources under local, State, and federal jurisdiction will be needed to attain the 70 ppb ozone standard, especially in the South Coast. Figure 4 lists the CARB measures currently being considered to support attainment of the 70 ppb 8-hour ozone standard statewide, and Table 1 lists the estimated emissions reductions from the measures as potential commitments for the nonattainment areas across the State. The SIPs for each nonattainment area are still under development, and the emissions reductions may change as each attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources to be proposed for Board consideration will be found in CARB's staff report for the respective nonattainment area's SIP.

[3] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles, with adopted CARB and district measures

Figure 4 - Proposed 2022 State SIP Strategy Measures

On-Road Vehicles

- Advanced Clean Fleets Regulation
- Zero-Emissions Trucks Measure
- On-Road Motorcycles New Emissions Standards
- Clean Miles Standard

Off-Road Vehicles and Equipment

- Tier 5 Off-Road New Compression-Ignition Engine Standards
- Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation
- Transport Refrigeration Unit Regulation Part 2
- Commercial Harbor Craft Amendments
- Cargo Handling Equipment Amendments
- Off-Road Zero-Emission Targeted Manufacturer Rule
- Clean Off-Road Fleet Recognition Program
- Spark-Ignition Marine Engine Standards

CARB Action: Off-Road Primarily-Federally and Internationally Regulated Sources

- In-Use Locomotive Regulation
- Future Measures for Aviation Emission Reductions
- Future Measures for Ocean-Going Vessel Emission Reductions

Other Categories

- Consumer Products Regulation
- Zero-Emission Standards for Space and Water Heaters
- Enhanced Regional Emission Analysis in State Implementation Plans
- Pesticides: 1,3-Dichloropropene Health Risk Mitigation

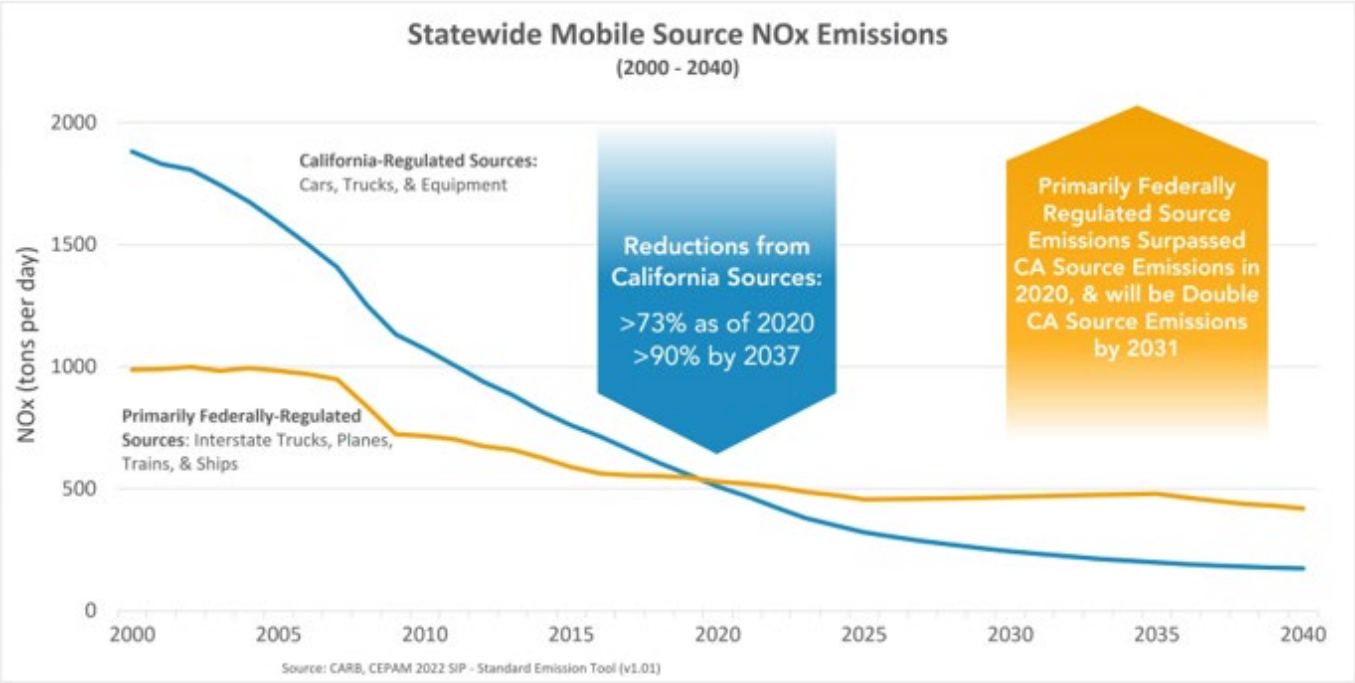
Table 1 – Potential Emissions Reductions Commitments

Nonattainment Area	2026 NOx (tpd)	2032 NOx (tpd)	2037 NOx (tpd)	2037 ROG (tpd)
Ventura County	0.3	n/a	n/a	n/a
Eastern Kern County	n/a	1.8	n/a	n/a
Sacramento Metro Area	n/a	6.1	n/a	n/a
Western Mojave Desert	n/a	20.6	n/a	n/a
Coachella Valley	n/a	n/a	5.2	0.6
San Joaquin Valley	n/a	n/a	25.3	4.2
South Coast*	n/a	n/a	95.7	18.2

*Includes emissions reductions from Federal Actions Needed

For California to meet air quality standards, it is imperative that the federal government act decisively to reduce emissions from primarily-federally regulated sources of air pollution, including interstate trucks, ships, locomotives, aircraft, and certain categories of off-road equipment. CARB and air districts are exploring their respective authorities with regard to these sources and associated facilities, but federal action is critical. In 2020, NOx emissions from primarily-federally regulated sources exceeded emissions from California-regulated mobile sources statewide and, absent federal action, by 2031, NOx emissions from primarily-federally regulated sources will be double California-regulated mobile sources (Figure 5).

Figure 5 – Federal Action Is Critical[4]



Since the adoption of the 2016 State SIP Strategy, CARB and our local partners in California have taken concrete actions to not only petition federal agencies for action, but also to directly reduce emissions using programmatic mechanisms within our respective authorities. Unfortunately, U.S. EPA action to limit emissions from most of these sources has yet to materialize, and action on heavy-duty trucks is still in the proposal stage, making it more challenging to meet air quality standards and reduce air pollution that harms public health in California.

Moreover, as a result of the COVID-19 pandemic, countries across the world have seen supply chain disruption and an all-time high demand for goods and freight movement. Although CARB's regulations such as the Ocean-Going Vessels At Berth Regulation, the Mobile Cargo Handling Equipment Regulation, and the Drayage Truck Regulation can help to reduce emissions from increased freight movement, increased demand and strain on the supply chain reemphasizes that action by U.S. EPA and other federal and international entities to control sources primarily under their regulatory authority remains critical. These dramatic increases and congestion at port facilities, railyards, warehouses, and in surrounding communities in California emphasize the need for federal action to address freight sources including ocean-going vessels, locomotives, and interstate trucks to protect the health of California residents. This congestion is particularly acute at the San Pedro Bay Ports which include the Ports of Los Angeles and Long Beach. Port congestion has led to a significant increase in the number of container vessels sitting at anchor, with as many as 114 vessels continuously using auxiliary engines to provide power for shipboard functions as of November 2021.[5] This has resulted in average daily emissions from container ships increasing by 24.4 tpd of NOx and

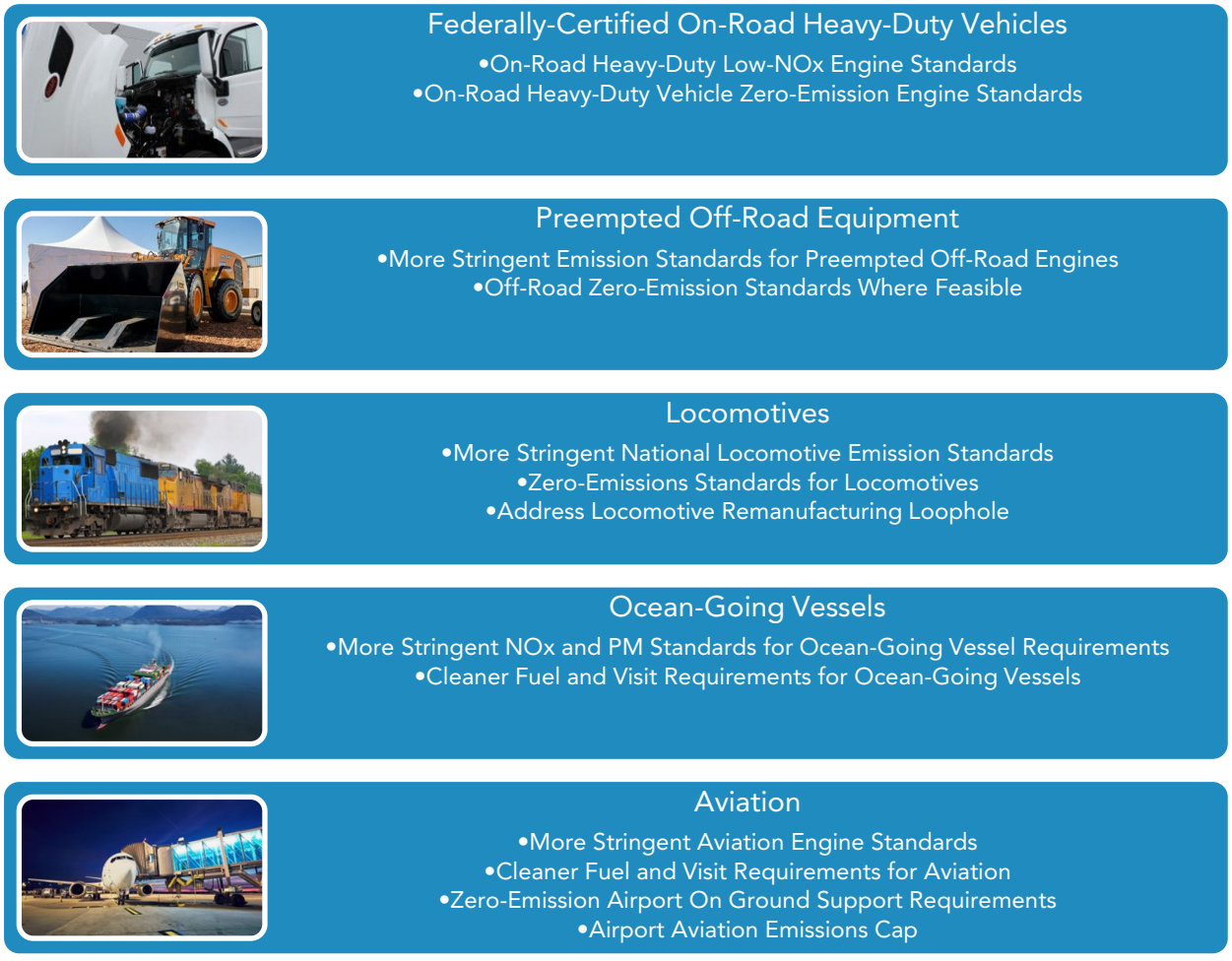
[4] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

[5] CARB. Emissions Impact of Freight Movement Increases and Congestion near Ports of Los Angeles and Long Beach. *https://ww2.arb.ca.gov/sites/default/files/2022-01/SPBP_Freight_Congestion_Emissions_Jan2022.pdf*

0.6 tpd of particulate matter (PM) in the South Coast in November. As for increased freight movement, based on increased in containers moved between May and October 2021, increased freight movement in and out of the ports is expected to increase the activity of trucks, cargo handling equipment, and locomotives such that combined emissions from these sources increase by 5.6 tpd NOx and 0.1 tpd PM. These emission increases from ocean-going vessel congestion and freight movement negatively impact air quality, especially in communities near ports. During the worst of the port congestion in November 2021, the increased marine vessel anchorage emissions was comparable to the exhaust PM emissions from more than 100,000 Class 8 diesel trucks. Due to implementation of *new policies* for vessels queuing at the ports, congestion from containerships at anchor have since returned to normal pre-congestion conditions. However, these dramatic emission increases from vessels and related freight demonstrate how important immediate action is by federal and international entities to control emissions from sources under their regulatory authorities.

The Proposed 2022 State SIP Strategy reinforces the 2020 MSS call to action for air quality regulatory agencies, not only at the State and local level, but more importantly by the federal government. Figure 6 lists the actions needed at the federal and international levels for which CARB is proposing in the Proposed 2022 State SIP Strategy to undertake petitions and/or advocacy.

Figure 6 – Federal Actions Needed



For most areas in California to attain the 70 ppb ozone standard, any and all potential reductions must be pursued, and a combination of State authority measures from the Proposed 2022 State SIP Strategy, local district measures, and federal action will be required. Although some of the potential measures included in this document primarily target reductions in greenhouse gas (GHG) emissions or toxic air contaminants, they are nonetheless included as they will also achieve criteria pollutant co-benefits.

The measures proposed in this document, in combination with ongoing implementation of current control programs, will reduce NOx emissions from mobile sources by at least 64 percent from today's levels Statewide by 2037, as well as reduce emissions of ROG by 58 percent. Of these Statewide reductions, a large portion will occur in and around communities near major roadways and freight facilities like ports, airports and warehouses, providing substantial health benefits. As outlined further in Chapter 3 and 4, the proposed measures and commitments will provide the reductions needed from these sources for meeting the 70 ppb ozone standard in the South Coast, the San Joaquin Valley, and the other nonattainment areas for which emissions reductions from new measures will be needed for attainment. In addition to the reductions identified above from CARB's proposed measures, actions to advance deployment of cleaner technologies will continue to be critical to supporting attainment of the 70 ppb ozone standard in the South Coast.

Public participation has been an essential part of developing the Proposed 2022 State SIP Strategy. CARB initiated the public process with a workshop in July 2021, released the Draft Measures document and held a second workshop in October 2021, released the Draft 2022 State SIP Strategy in January 2022, held a third workshop and informational update to the Board in February 2022, and has solicited input from numerous interested stakeholders in individual meetings. These workshops and Board updates provided forums for the proposed measures to be discussed in a public setting and provide additional opportunity for public feedback, input, and ideas. CARB initiated a 45-day California Environmental Quality Act (CEQA) comment period on March 29, 2022. Also, each measure in the Proposed 2022 State SIP Strategy will go through a thorough public process prior to being brought to the Board for consideration as a regulation or other program.

CARB is releasing this Proposed 2022 State SIP Strategy in advance of local air districts adopting plans for their respective nonattainment areas that rely on emissions reductions from measures in this document, and in advance of an August 23, 2022 public workshop. Moving forward, the Board will consider the Proposed 2022 State SIP Strategy on September 22, 2022, to be incorporated into the 70 ppb ozone standard SIPs due to U.S. EPA in 2022.

CARB staff recommends that the Board adopt the Proposed 2022 State SIP Strategy including the proposed commitments to pursue the list of measures according to the schedule in Table 3.

Chapter 1: Introduction

Overview of Strategy

The Proposed 2022 State SIP Strategy describes CARB staff's roadmap for reducing emissions from State sources to help local air districts attain the health-based 70 ppb ozone standard over the next fifteen years. Under State law, CARB is responsible for developing SIP emission reduction strategies for cars, trucks, and other mobile sources, as well as consumer products and other sources under State authority. The California Department of Pesticide Regulation (DPR) is the State agency responsible for controlling pesticide emissions. Local air districts are primarily responsible for controlling emissions from stationary sources such as factories and power plants. The upcoming SIPs for each of the ozone nonattainment areas in California will be developed jointly by CARB and the local air districts, building upon the Proposed 2022 State SIP Strategy, as well as local air district air quality planning documents.

Given that in 2015, U.S. EPA established a lower, more health protective ozone standard of 70 ppb, substantial reductions from all sources – mobile, area-wide and stationary – will be necessary to reach attainment. This will require comprehensive actions to transform the technologies and fuels we use, the design of our communities, and the way we move people and freight throughout the State. Nineteen areas in California, as shown in Figure 6, are designated as nonattainment for the 70 ppb ozone standard. Of the nineteen areas, ten areas are classified under the federal Clean Air Act as Moderate or above, and thus are required to develop a SIP revision including an attainment plan demonstrating how the area will attain the standard by the relevant date. Two areas of the State have the most critical air quality challenges – the South Coast and the San Joaquin Valley. These regions are the only two areas in the nation with an Extreme classification for the 70 ppb ozone standard.

Statewide, more than 21 million out of over 39 million Californians live in areas that exceed the federal ozone standards[6]; within these areas, there are many low-income and disadvantaged communities that are exposed to not only ozone, but also particulate and toxic, pollutant levels significantly higher than the federal standards which have immediate and detrimental health effects. That said, the health and economic impacts of exposure to elevated levels of ozone in California are also considerable; meeting the standards will pay substantial dividends in terms of reducing costs associated with emergency room visits and hospitalization, lost school days, and most critically, premature mortality. This year's SIPs are therefore an important step in bringing healthy air to all Californians.

In October 2021, CARB finalized the 2020 MSS which continues CARB's multi-pollutant planning approach to determine potential pathways forward for the various mobile sectors that are necessary to help achieve California's numerous air quality and climate goals over the next 30 years. Though the MSS itself is conceptual, and multiple combinations of regulations, incentive programs, and other actions can realize its goals, it serves as an important foundation for measure development. Because meeting the State's near- and longer-term goals requires action across the full spectrum of mobile sources, the 2020 MSS discussed on-road light- and heavy--duty vehicles, as well as a wide range of off-road equipment sectors. California's goals fostered an integrated planning approach in which, building off the success

[6] Based on 2020 monitored ozone design values contoured over population by census tract

of the 2016 MSS, the 2020 MSS demonstrated the need for a comprehensive transformation to cleaner vehicle technologies, fuels, and energy sources.

The 2020 MSS provides a framework that complements multiple related planning efforts that are currently underway at CARB. These other plans include regional SIPs described in this document, as well as the 2022 Scoping Plan Update which is focused on achieving GHG emissions reductions, and Community Emissions Reduction Programs developed by selected communities and their district partners as a part of CARB's Community Air Protection Program. Each of these planning efforts draws from the 2020 MSS released by CARB in October 2021 by taking concepts and developing specific roadmaps for meeting climate and air quality targets. As with these other planning efforts, the measures included in the Proposed 2022 State SIP Strategy build upon the concepts included in the 2020 MSS but have been further refined based on public and Board input. Further, the 2022 Scoping Plan Update will incorporate actions in the Proposed 2022 State SIP Strategy and rely on these actions included here to also deliver greenhouse gas reductions.

Blueprint for Success

CARB's current control programs have achieved tremendous success in reducing NOx and ROG emissions. Ongoing implementation of these programs will result in substantial further emissions reductions through 2037 and provide a significant down payment for meeting the 70 ppb ozone air quality standard. As shown in Figure 7 existing control programs will reduce statewide NOx from 1395 tpd in 2018 to 858 tpd in 2037. Mobile sources, especially on-road control programs, will provide the majority of the anticipated emissions reductions such that the relative contribution of stationary sources will increase from 14 percent in 2018 to 22 percent in 2037. As shown in Figure 8, these same control programs will also reduce emissions of ROG which also contribute to ozone formation, from 1580 tpd in 2018 to 1356 tpd in 2037. As with NOx, relatively more emissions reductions will be achieved from mobile sources, with the relative contribution of stationary and area (i.e. widely dispersed) sources of ROG increasing.

Figure 7 - Statewide NOx Emissions by Sector under Current Control Program[7]

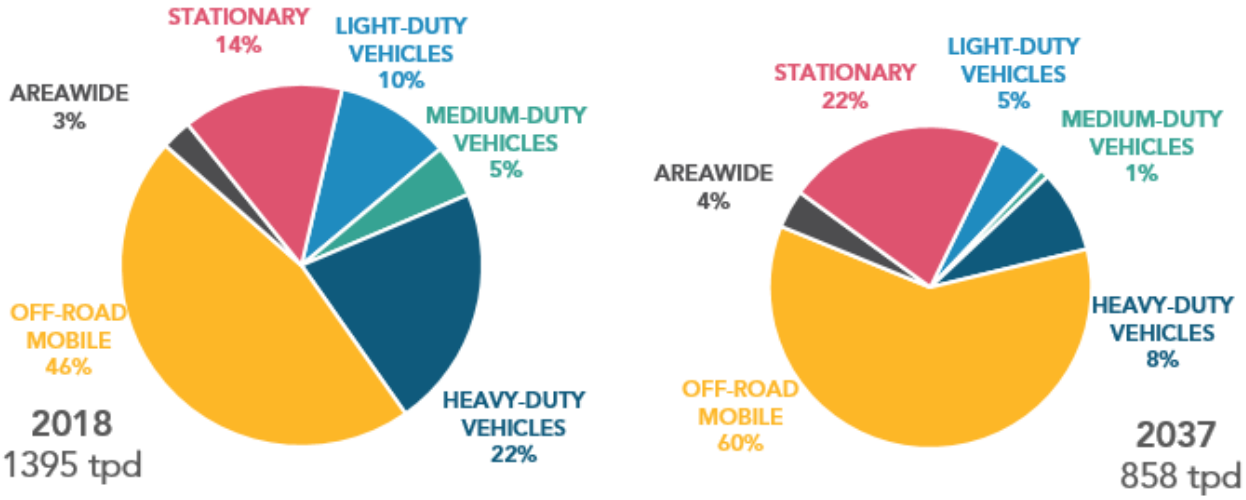
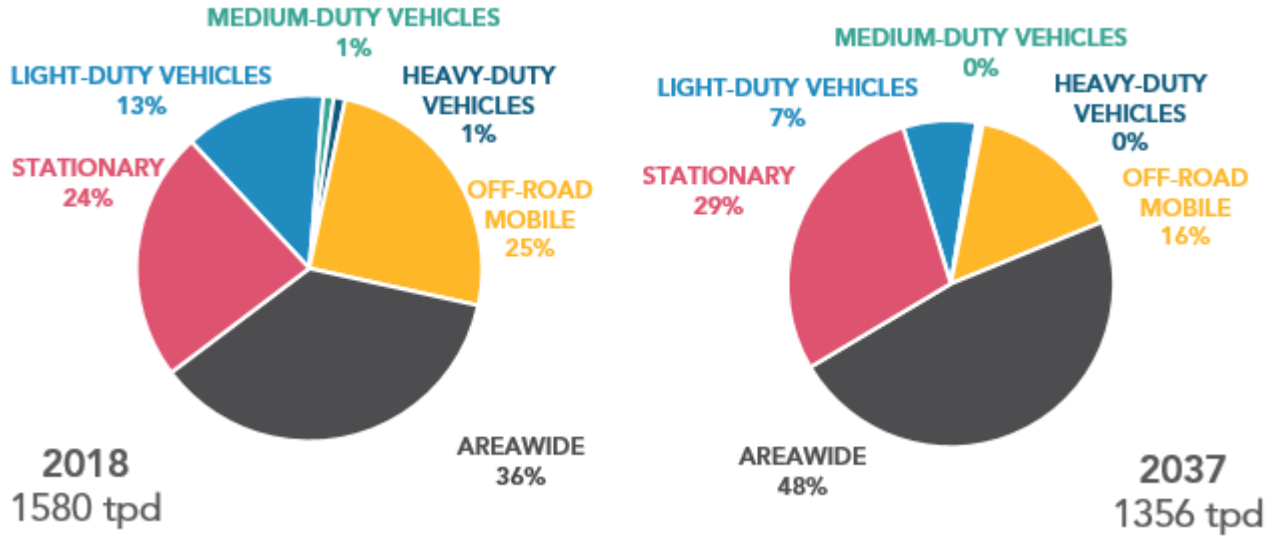


Figure 8 – Statewide ROG Emissions by Sector under Current Control Program[8]



Nonetheless, significant further reductions will be required to meet air quality standards across the State. Zero-emission vehicle (ZEV) commercialization in the light-duty sector is well underway. Longer-range battery electric vehicles are coming to market that are cost-competitive with gasoline fueled vehicles and fuel cell vehicles are now also seeing significant sales. Autonomous and connected vehicle technologies are being installed on an increasing number of new car models. A growing network of retail hydrogen stations is now available, along with a rapidly growing battery charger network. In the heavy-duty sector, cleaner combustion technologies are available in the market, and zero-emission technologies are commercially available for many uses and are being further demonstrated in a range of targeted applications, with model availability steadily growing across uses. Advanced

[7] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

[8] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

technologies for aircraft, locomotives, and ocean-going vessels pose a greater challenge, but further reductions can be achieved through cleaner engine standards, cleaner fuels, investment in promising zero-emission technologies, and greater system efficiencies.

The success of California's long-standing mobile program provides a blueprint for how to effectively implement CARB's long-term vision for reducing the State's air quality and climate footprint. The mobile source blueprint takes a portfolio approach that combines technology -forcing emissions standards for new vehicles, an accelerating transition to zero--emissions adoption for new and existing vehicles, targeted in-use regulations where needed, cleaner burning fuels in remaining combustion uses, durability requirements and inspection programs to ensure clean in-use performance, sales requirements for advanced technologies, pilot programs to demonstrate technologies, and incentive programs and other actions to accelerate technology deployment. Continuing partnerships across transportation and housing planning bodies to reduce vehicle miles travelled and shift to less polluting transportation sectors are another critically important part of this portfolio. Moreover, the portfolio operates on multiple scales: federal efforts on certain sources and district programs that can reduce emissions from indirect sources that increase mobile source emissions, such as ports and warehouses, further reduce emissions. The SIP measures described in this document continue this successful approach of pursuing in parallel regulatory, incentive, and market-based approaches.

Proposed Actions

The proposed SIP measures identify the regulatory and programmatic approaches necessary to deploy cleaner technologies and fuels and ensure sufficient penetration to meet air quality standards by deadlines established in the Clean Air Act. Together, these efforts will provide CARB's commitment to achieve all of the reductions necessary from State-regulated sources to meet the 70 ppb ozone standard.

For passenger vehicles, the Proposed 2022 State SIP Strategy includes actions to increase the penetration of ZEV by targeting ride-hailing services offered by transportation network companies and, for motorcycles, the Proposed 2022 State SIP Strategy proposes more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. For heavy-duty vehicles, the Proposed 2022 State SIP Strategy calls for zero-emission requirements for fleets, and a requirement to transition heavy-duty vehicles to zero-emissions technologies at the end of their useful life.

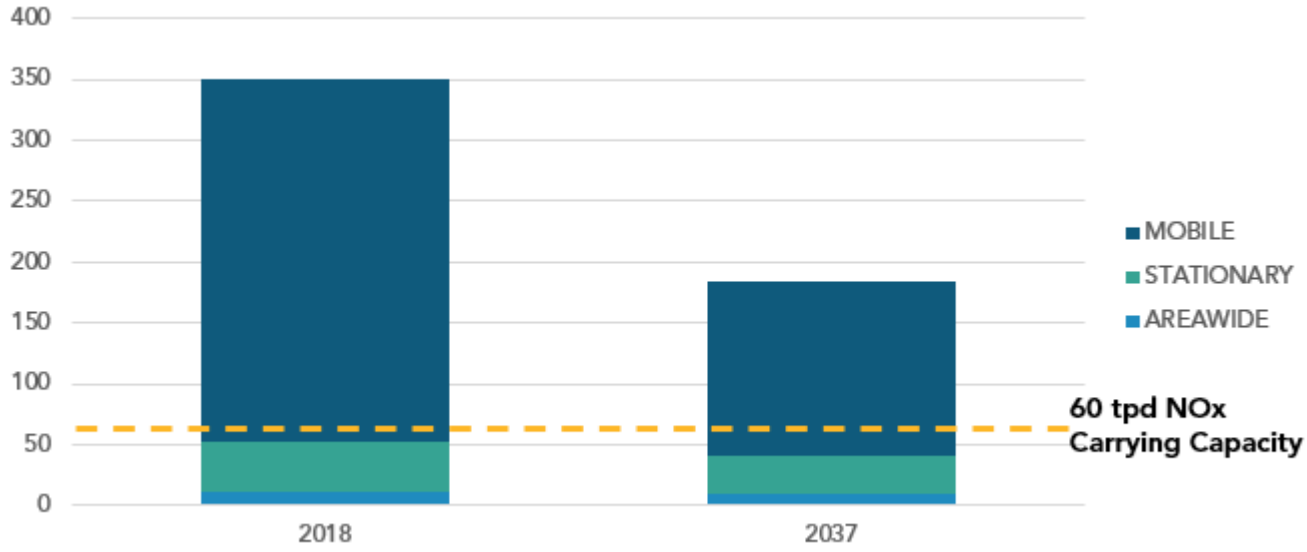
Similar actions are proposed for off-road sources, with a focus on deployment of more stringent exhaust and evaporative emissions standards and ZEV technologies where feasible. For other sources including consumer products and residential and commercial buildings, the Proposed 2022 State SIP Strategy proposes reducing emissions through use of zero-emission technologies and cleaner product formulations.

Finally, for sources that are primarily-federally and internationally regulated, such as interstate trucks, preempted off-road equipment, locomotives, aviation, and ocean-going vessels, the Proposed 2022 State SIP Strategy includes proposed commitments for certain CARB actions within our authority. Further, this strategy proposes petitions and other advocacy calling for U.S. EPA and other federal and international entities to take action to provide the needed emissions reductions. Actions needed at the federal and international levels include setting more stringent engine standards, requiring zero-emission technologies where feasible, and

potential requirements to require that only the cleanest vessels and aircraft visit California, given the severity of our attainment challenges. Strong federal and international action is critical as these sources represent an increasing fraction of ozone-forming emissions in California.

California's South Coast is the region facing the greatest challenge in meeting the 70 ppb ozone standard, and continues to drive towards attainment of the previous 75 and 80 ppb 8-hour ozone standards. That said, approximately 47 percent of the reductions needed to meet the standard in South Coast by 2037 will come from ongoing implementation of the existing control program.

Figure 9 – South Coast Air Basin NOx Emissions under Current Control Program (emissions out to 100 nautical miles)[9]



However, more emissions reductions are needed in South Coast beyond the existing control program to reach the NOx carrying capacity of approximately 60 tpd established by the South Coast Air Quality Management District needed to meet the 70 ppb ozone standard. Figure 9 shows that although existing control programs are expected to reduce total NOx in South Coast from 350 tpd in 2018 to 184 tpd in 2037, an additional 124 tpd of reductions are needed by 2037 to achieve the 60 tpd NOx emissions carrying capacity. Of the 124 tpd of NOx emissions reductions needed, the Proposed 2022 State SIP Strategy measures will provide an estimated 89.3 tpd of NOx emissions reductions in 2037 for the South Coast. Further, an additional 6.4 tpd of NOx emissions reductions will be achieved from measures in the 2016 State SIP Strategy that were very recently adopted or are to be adopted in the coming year, and are thus yet to be incorporated into the baseline emissions inventory, as discussed in Chapter 4. The multipronged approach described in this document is critical to driving the technology development and deployment of the most stringent engine standards and zero-emission technologies into the fleet, needed not just to attain the 70 ppb ozone standards but also to meet California's GHG emission reduction goals.

[9] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district measures

Implementing the Proposed 2022 State SIP Strategy will require early and sustained action, and include efforts not only by CARB, but also air districts, U.S. EPA, and other federal and international agencies. Partnerships with the private sector will also be critical for continued market development of identified technologies. Lessons learned through implementing policies that have helped to drive the commercialization of passenger ZEV technologies have illustrated the importance of coupling regulatory market signals with targeted actions to support demonstrations and incentives to accelerate their penetration when commercially available. Pilot and demonstration projects can help to prove the feasibility of new technologies in real-world applications, reducing barriers to entering the market, and potentially increasing private sector investments. To accelerate penetration once commercially available, targeted incentives play a critical role in reducing barriers to future market growth by ensuring that the needed zero--emission technologies can economically compete with existing technologies, as discussed further in Chapter 7. While significant investments will be necessary, California has a long and successful legacy of building a world class economy in concert with innovative and effective environmental and public health policies, including focused incentive programs.

Health Impacts

Despite decades of progress in improving air quality, large areas of California still suffer some of the worst air quality in the nation. Air pollution, including emissions from mobile sources, contribute to a wide range of heart and lung illnesses, chronic health conditions, increased cancer rates, and premature death. Every year, over 5,000 premature deaths and hundreds of illnesses and emergency room visits for respiratory and cardiovascular disease in California are linked to PM2.5 pollution, of which more than half is produced by mobile sources.[10] Recent research demonstrates that fine particulate pollution impacts not only the heart and respiratory system, but also brain health and adverse birth outcomes.[11] The health impacts of exposure to elevated levels of ozone in California are also considerable, including higher levels of emergency room visits and hospitalization, lost school days, and most critically, premature mortality. Moreover, for the millions of California residents living in low-income and disadvantaged communities and experiencing disproportionate levels of negative health impacts from air pollution,[12] actions to reduce fossil fuel combustion and move to cleaner power sources are even more important.

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[10] CARB. (2016). Mobile Source Strategy. *https://ww2.arb.ca.gov/resources/documents/2016-state-strategy-state-implementation-plan-federal-ozone-and-pm25-standards*

[11] USEPA. (2019a). Integrated Science Assessment for Ozone and Related Photochemical Oxidants (External Review Draft). Retrieved from *https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=344670*.

U.S. EPA (2019b). Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter, External Review Draft

[12] American Lung Association. (2020). State of the Air; Union of Concerned Scientists, U. (2019). Inequitable Exposure to Air Pollution from Vehicles in California (2019); Cushing et al. (2015). Racial/ethnic disparities in cumulative environmental health impacts in California: evidence from a statewide environmental justice screening tool (CalEnviroScreen 1.1). American journal of public health, 105(11), 2341-2348.

[12] U.S. EPA (2019b). Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter, External Review Draft.

[12] Ibid.

Health Impacts from Mobile Source Emissions

Fossil fuel combustion from cars, trucks, buses, and on- and off-road equipment emits criteria air pollutants and their precursors, including NOx and oxides of sulfur (SOx) emissions. While NOx and SOx emissions are harmful in themselves, NOx is also a precursor to ozone, which can cause irritation and damage lung tissue, worsen asthma and chronic illnesses including obstructive pulmonary disease and reduce lung function.[13] Studies have linked short-term ozone exposure with increased risk of death.[14]

In addition to contributing to ozone, the biggest impact on health from NOx and SOx emissions comes when they combine in the atmosphere to form secondary PM2.5, often miles downwind of the sources. PM2.5 pollution contributes to more fatalities than other air pollutants, and can lodge deep in the lungs or pass through the lungs to enter the blood stream and affect the heart, brain, and other organs.[15] Short-term exposure to PM2.5 pollution is associated with increased hospitalizations and emergency room visits for heart and lung illnesses, and can lead to premature death.[16] Adverse health effects from long-term exposure to PM2.5 pollution include increased risk of heart attacks and heart disease, impaired lung development in children, the development and exacerbation of asthma, and premature death.[17] Other possible impacts from PM2.5 exposure that are being investigated include low birth weight and impacts to the brain.[18]

Diesel engines emit a complex mixture of air pollutants, including both gaseous and solid material. The solid material in diesel exhaust is known as diesel particulate matter (DPM or diesel PM). More than 90 percent of DPM is less than 1 µm in diameter (about 1/70th the diameter of a human hair), and thus is a subset of PM2.5.[19] DPM is typically composed of carbon particles ("soot", also called black carbon) and numerous organic compounds, including over 40 known cancer-causing organic substances such as benzene and formaldehyde. In 1998, CARB identified DPM as a toxic air contaminant which has been linked to increased cancer risk, respiratory and cardiac illnesses and premature deaths.[20] CARB estimates that about 70 percent of total known cancer risk related to air toxics in California is attributable to DPM.[21] Diesel exhaust also contains gaseous pollutants, including ROG and NOx that lead to the formation of secondary PM2.5 and ozone. Most major sources of diesel

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[13] U.S. EPA (2019b). Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter, External Review Draft.
[14] Ibid
[15] U.S. EPA. (2019a). Integrated Science Assessment for Ozone and Related Photochemical Oxidants (External Review Draft).
[16] Ibid.
[17] Ibid.
[18] Boothe, V. L., Shendell, D. G. (2008). Potential health effects associated with residential proximity to freeways and primary roads: review of scientific literature, 1999–2006. Journal of Environmental Health, 70(8), 33-41.; Wang et al (2020). Traffic-related Metrics and Adverse Birth Outcomes: A Systematic Review and Meta-analysis. Environmental Research, 109752.
Woods et al (2017). The influence of the built environment on adverse birth outcomes. Journal of Neonatal-Perinatal Medicine, 10(3), 233-248.
CARB (2018) Air Pollution and the Brain *https://ww2.arb.ca.gov/resources/fact-sheets/air-pollution-and-brain*
[19] CARB (2020). Overview: Diesel Exhaust & Health *https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health*
[20] Ibid.
[21] Ibid.

emissions, such as ships, trains, and trucks, operate in and around ports, rail yards, and heavily traveled roadways, which are often located near densely populated and disadvantaged communities.

Increased cargo imports and congestion of ocean-going vessels at ports across California, together with the related increased activity of trucks and locomotives moving containers in and out of the ports, has recently led to significant emissions increases. The increases in NOx emissions can contribute to elevated ozone and PM2.5 concentrations in areas near ports and freight facilities, areas that have major freeways and freight corridors such as throughout the San Joaquin Valley, and downwind areas such as the South Coast's Inland Empire. Further, these freight sources also emit DPM which, as just discussed, can have detrimental health impacts, especially in communities near ports such as the Ports of Los Angeles and Long Beach, and the Port of Stockton.

Environmental Justice and Pollution Exposure Disparities

Low-income and disadvantaged communities have long faced disproportionate burdens from exposure to air pollution. Research shows large disparities in exposure to pollution between white and non-white populations in California, and between disadvantaged communities and other communities, with Black and Latino populations experiencing significantly greater air pollution impacts than white populations. Mobile source pollution shows some of the highest disparities; a CARB-funded study indicated that on average, mobile sources account for over 30 percent of total PM2.5 exposures.[22] Research has shown that mobile sources are the largest sources of pollution exposure disparity for Black populations and disadvantaged community residents, when compared to the average population in California. Specifically, mobile sources accounted for 45 percent of exposure disparity for the Black population, and 37 percent of exposure disparity for people in disadvantaged communities.

Recently, there has been increased interest in the development of new warehousing facilities within disadvantaged communities, which can significantly increase emissions in those communities. In response, some local governments have adopted moratoriums to halt development of future warehousing facilities while the emissions impacts are evaluated. Other local governments have adopted good neighbor policies to promote the use of available advanced technologies. These actions are excellent examples of local leadership that will result in near-term emissions reductions in environmental justice communities, and support reductions needed to provide for attainment of federal standards. CARB's unique authority to set emission reduction standards will continue to establish these cleaner advanced technologies

CARB's current control programs have drastically reduced emissions and improved air quality across the State over the last 50 years. As we continue to adopt and implement new regulations, including the measures included in the Proposed 2022 State SIP Strategy, we expect that we will continue to see air quality improvements such that we will meet federal and State air quality standards, as well as California's many other targets, and substantially reduce negative health impacts.

[22] Apte et al (2019). A Method to Prioritize Sources for Reducing High PM2.5 Exposures in Environmental Justice Communities in California. CARB Research Contract Number 17RD006

Economic and Environmental Analyses

CARB has developed an economic analysis for the Proposed 2022 State SIP Strategy, as described in *Appendix A: Economic Analysis*. Appendix A describes the estimated statewide costs and benefits of all proposed measures through 2037, and includes an assessment of the broader macroeconomic impacts. In addition to the economic analysis included in the Proposed 2022 State SIP Strategy, a more detailed economic analysis will be developed for each specific measure as it progresses through the regulatory development process.

To evaluate the potential for significant adverse environmental impacts associated with implementation of the Proposed 2022 State SIP Strategy, CARB prepared a Draft Environmental Analysis (Draft EA), pursuant to its regulatory program certified by the Secretary of the Natural Resource Agency[23]. In accordance with the Public Resources Code[24], public agencies with certified regulatory programs are exempt from certain CEQA requirements, including but not limited to preparing environmental impact reports, negative declarations, and initial studies[25]. The resource areas from the CEQA Environmental Checklist are used as a framework for assessing the potential for significant impacts[26].

The Draft EA was released on March 29, 2022 and added as Appendix B to the Proposed 2022 State SIP Strategy. The Draft EA was released for public review and comment, and a docket was opened for a 45-day public review period. CARB will summarize and respond in writing to all comments submitted on the Draft EA in a supplemental response to environmental comments document. Prior to final action on the Proposed 2022 State SIP Strategy, the Board will consider for approval the Final EA and a response to environmental comments document.

Next Steps

CARB is continuing to work with the local air districts on development of their SIPs for the 70 ppb ozone standard; as the measures and commitments from the 2022 State SIP strategy will be incorporated into these regional SIPs, CARB will continue to solicit additional stakeholder input on the potential commitments in the Proposed 2022 State SIP Strategy. CARB will present the Proposed 2022 State SIP Strategy for Board consideration at the September 2022 Board meeting. The Board will also consider the analysis of potential environmental impacts of the Proposed 2022 State SIP Strategy, which are analyzed and will be included in *Appendix B: The Final Environmental Analysis for the proposed 2022 State Strategy for the State Implementation Plan*. Further, the Board will hear the discussion of the overall impacts of the Proposed 2022 State SIP Strategy on the California economy.

The proposed measures included in the Proposed 2022 State SIP Strategy provide the basis for specific legal commitments in SIPs for individual air districts that will first be considered at the regional level. CARB will then consider approval of the regional SIPs and individual SIP emissions reduction commitments prior to submitting the plans to U.S. EPA. As part of this

[23] 14 CCR 15251(d); 17 CCR 60000–60008
[24] Section 21080.5 of CEQA
[25] 14 CCR 15250
[26] 17 CCR 60005(b)

effort, CARB has been closely coordinating with staff at each of the local air districts for which an attainment plan is required.

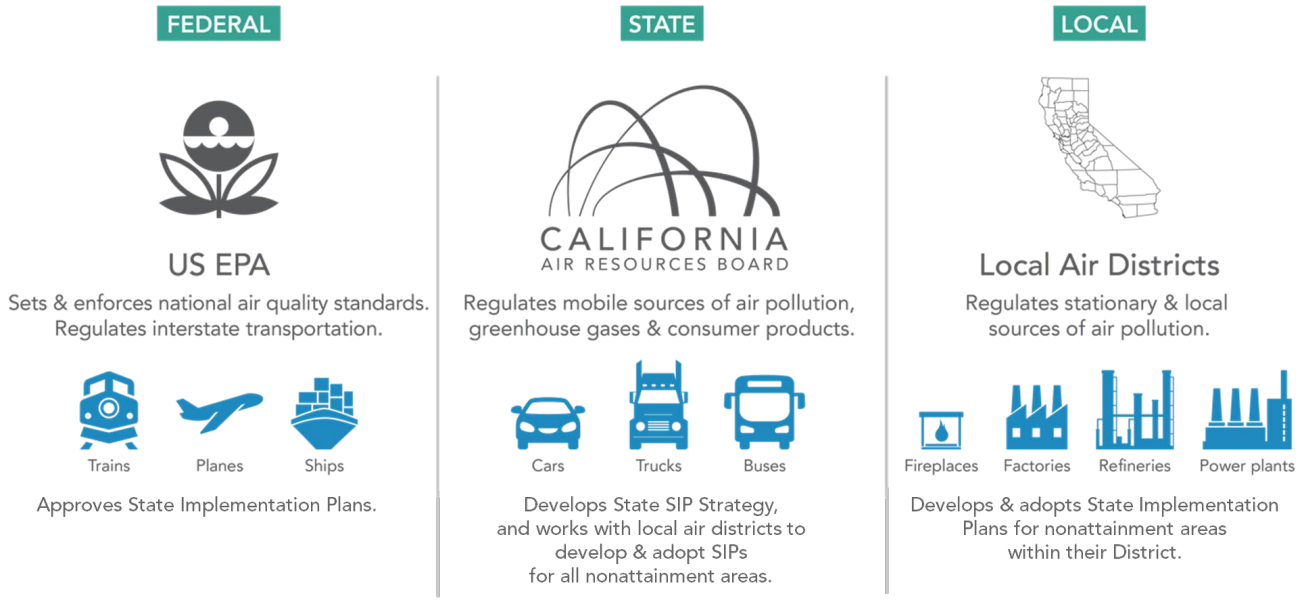
Chapter 2: Nonattainment Areas and Emissions Reduction Needs

Federal Clean Air Act Requirements

The federal Clean Air Act sets out requirements for adoption of air quality standards, as well as the required elements of SIPs, which must demonstrate how a nonattainment area will meet the standards by the required attainment deadline. SIPs must identify both the magnitude of reductions needed and the actions necessary to achieve those reductions. SIPs also include a demonstration that the area will make reasonable further progress towards attainment, is implementing reasonably available control technology on all major sources, has a program in place to address emissions from new stationary sources, and meets transportation conformity requirements.

As shown in Figure 10, the work of developing and implementing a SIP is shared between CARB and local districts and CARB plays multiple roles in the SIP development and approval process. Under State law, CARB is responsible for controlling emissions from consumer products and mobile sources (except where federal law preempts CARB's authority), developing fuel specifications, and coordinating SIP strategies with Bureau of Automotive Repair and DPR. Local air districts are primarily responsible for controlling emissions from stationary and area-wide sources (with the exception of consumer products) through rules and permitting programs. Finally, U.S. EPA has primary authority to control emissions from certain mobile sources, including sources all or partly under federal jurisdiction (such as interstate trucks, some farm and construction equipment, aircraft, marine vessels, and locomotives), which it shares in some cases with local districts and CARB.

Figure 10 – Air Agency Roles and Responsibilities



Decades of research programs and technical work conducted by CARB, air districts, U.S. EPA, academic institutions, other research organizations, and the private sector provide the scientific foundation for determining effective control approaches. Because of the critical role of State-regulated sources towards attainment, CARB staff continue to work closely with air districts in development of the overall Proposed 2022 State SIP strategy. As part of this effort,

air districts develop corresponding strategies for sources under their authority. These strategies are included in area-specific SIPs that are first considered at the local level. As the lead air quality agency for the State, CARB must then evaluate these SIPs to ensure they meet State law and federal Clean Air Act requirements. These SIPs are then considered by the Board, and if approved, submitted to U.S. EPA.

Nonattainment Areas

U.S. EPA is required to periodically review the latest health research to ensure that standards remain protective of public health. Based on research demonstrating adverse health effects at lower exposure levels, U.S. EPA has set a series of increasingly health protective air quality standards. This year, CARB will be considering SIPs to address the 70 ppb ozone standard. Of the nineteen areas designated as nonattainment in the State, ten areas in California are classified as Moderate and above for the 70 ppb ozone standard and need to develop a SIP. They include California's large urban regions, as well as rural downwind areas. Ozone nonattainment areas are classified according to the severity of their air pollution problem; areas with higher pollution levels are given more time to meet the standard (i.e. attainment date), but are also subject to more stringent control requirements. The South Coast and San Joaquin Valley are the only two Extreme areas in the nation with an attainment deadline of 2037. Table 2 shows the nonattainment areas, classifications, attainment years, and 2020 design values.

Table 2 - Ozone Nonattainment Areas for 70 ppb 8-Hour Ozone Standard

Nonattainment Area	Classification	Attainment Year	2020 Design Value (ppb)
South Coast Air Basin	Extreme	2037	114
San Joaquin Valley	Extreme	2037	93
Western Mojave Desert	Severe	2032	90
Coachella Valley	Severe	2032	88
San Diego County	Severe	2032	79
Ventura County	Serious	2026	75[27]
Sacramento Metro	Serious[28]	2026	86
Eastern Kern County	Serious[28]	2026	86
Western Nevada County	Serious	2026	75[29]
Mariposa County	Moderate[30]	2023	79
Amador County	Marginal	2020	69
Butte County	Marginal	2020	70[31]
Calaveras County	Marginal	2020	69[32]
Imperial County	Marginal	2020	78
San Francisco Bay Area	Marginal	2020	69
E. San Luis Obispo County	Marginal	2020	70[33]
Sutter Buttes	Marginal	2020	70[34]
Tuolumne County	Marginal	2020	70[35]
Tuscan Buttes-Tehama	Marginal	2020	70[36]

In addition to showing progress towards the most recent air quality standards, nonattainment areas must also continue to show progress towards attainment of earlier standards they have not yet achieved, including the 8-hour ozone standard of 80 ppb (Extreme area attainment year of 2023), and the 8-hour ozone standard of 75 ppb (Extreme area attainment year of 2031). The proposed measures in the Proposed 2022 State SIP Strategy will also serve as a down payment for anticipated future SIPs developed to meet more stringent ozone standards that U.S. EPA might establish in the coming years and providing emissions reductions for the next round of Regional Haze SIPs. The progressive tightening of federal ambient air quality

[27] Design value when excluding days impacted by wildfires, identified and submitted as Exceptional Events to U.S. EPA for approval

[28] Air District has indicated to staff of requesting to voluntarily bumping up to Severe with a 2032 attainment year

[29] Ibid.

[30] Pending final U.S. EPA action to reclassify (proposed reclassification published on April 13, 2022, *https://www.govinfo.gov/content/pkg/FR-2022-04-13/pdf/2022-07513.pdf*)

[31] Design value when excluding days impacted by wildfires, identified and submitted as Exceptional Events to U.S. EPA for approval

[32] Ibid.

[33] Ibid.

[34] Ibid.

[35] Ibid.

[36] Ibid.

standards will require sustained emissions reductions strategies over coming decades and underscores the ongoing need for continuing transformation of California's transportation sector to non-combustion sources of energy.

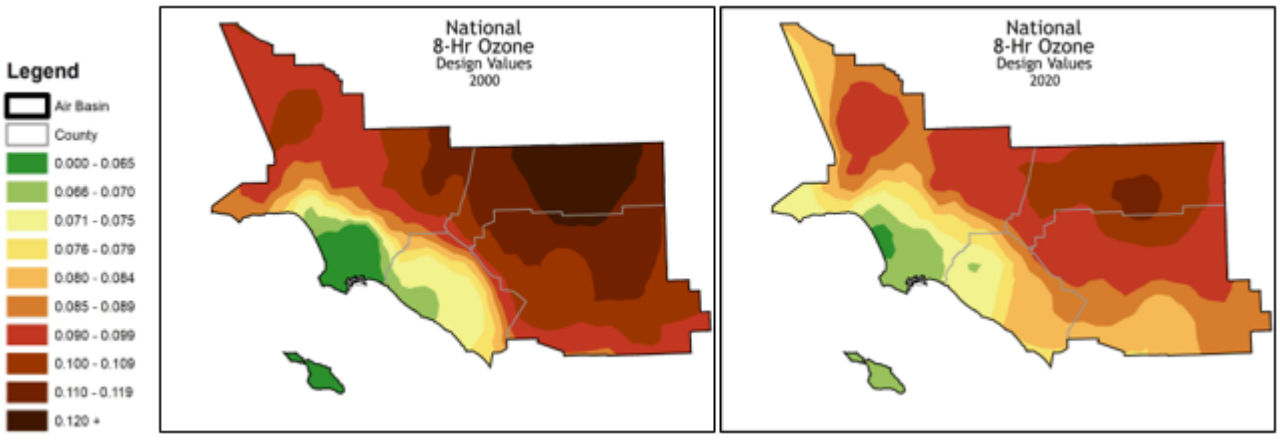
Emission Reduction Needs

As discussed in Chapter 1, the reductions that will continue to accrue from implementation of the existing mobile source control program will reduce NOx emissions in 2037 by over 42 percent[37] statewide from today's levels. The key challenges driving the need for emissions reduction measures are meeting ozone standards in the South Coast and San Joaquin Valley. Further reductions will also be necessary to provide for attainment in other nonattainment areas including the Coachella Valley, Eastern Kern County, the Sacramento Metro area, Ventura County, and Western Mojave Desert. The potential emission reduction commitments have been identified and are included here in the Proposed 2022 State SIP Strategy. However, they will be proposed for consideration at the time each nonattainment area SIP is brought to the Board for consideration.

South Coast Emission Reduction Needs

Figure 11 illustrates the ozone air quality progress that has occurred in the South Coast over the past twenty years. In 2000, the entire South Coast region violated the 70 ppb ozone standard and the less stringent ozone standards of 75 and 80 ppb, with some communities experiencing 8-hour ozone levels over 120 ppb. Today, ozone concentrations have declined significantly. However, millions of people in South Coast still breathe unhealthy air, many of them living in the Inland Empire and Northern Los Angeles County. Further, there are communities that exceed not only the 70 ppb ozone standard, but the previous 75 and 80 ppb 8-hour ozone standards as well. The measures in the Proposed 2022 State SIP Strategy provide emissions reductions towards attaining all standards and will provide critical health benefits for communities across the region.

Figure 11 - South Coast Ozone Progress



[37] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district measures

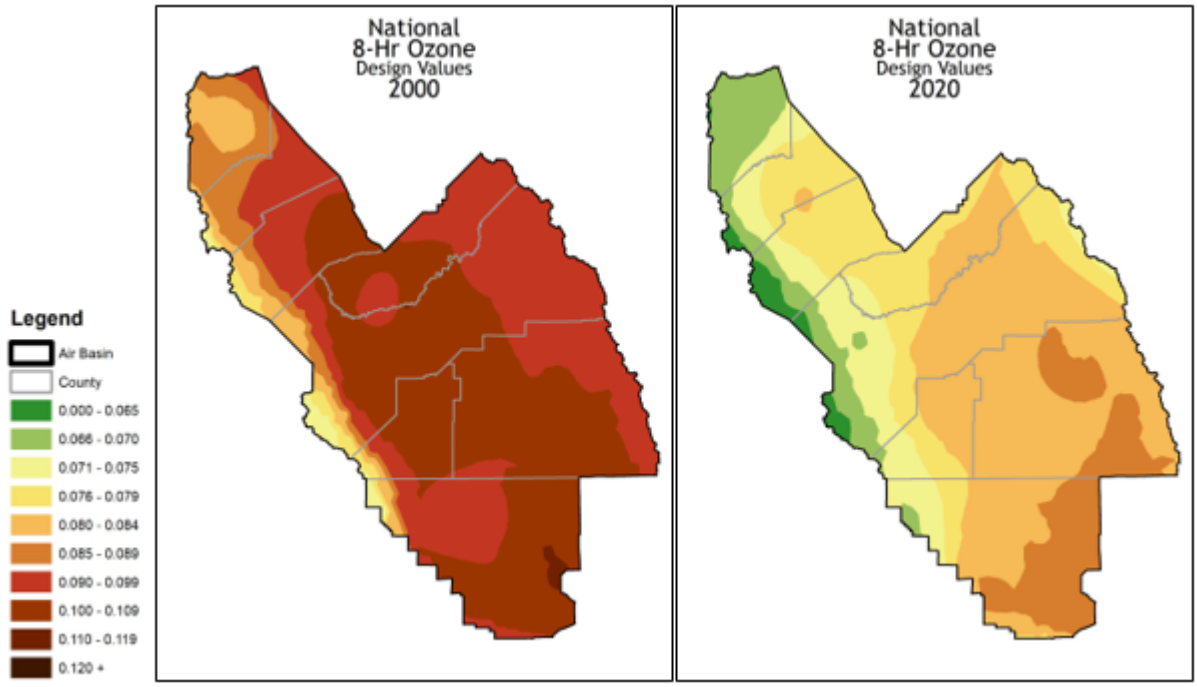
CARB and the South Coast Air Quality Management District (AQMD) collaborated to determine the reductions needed to attain the 70 ppb ozone standard. Meeting the ozone standards continues to drive overall emission reduction needs in the South Coast, and substantial reductions beyond those being achieved with the current control program will be needed to meet the standard in 2037. While ROG reductions will provide near-term benefits in some portions of the South Coast, the 70 ppb ozone standard can only be met through significant NOx emissions reductions. The air quality modeling indicates NOx emissions will need to be at a level of 60 tpd, requiring a decline of approximately 124 tpd from baseline 2037 levels, to provide for attainment in the remaining portions of the region that do not yet meet the standard. From today's levels, reaching 60 tpd will require an approximately 83 percent reduction by 2037.

Achieving an 83 percent reduction in NOx emissions will require comprehensive and coordinated efforts to address emissions from both stationary and mobile sources through ongoing implementation of already adopted measures, as well as new actions. Actions at the federal, State, and local levels have resulted in significant reductions for both mobile and stationary source NOx emissions between 1990 and today. These efforts have been the driver for the substantial air quality progress that has occurred to date in the South Coast region. Looking forward, continued implementation of current controls will reduce mobile source NOx emissions a further 52 percent by 2037.

San Joaquin Valley Emission Reduction Needs

Ozone levels in the San Joaquin Valley have shown ongoing improvement over the last twenty years. While there was relatively modest progress in the early years, ozone levels over the last decade have decreased significantly in response to accelerated NOx emissions reductions, as shown in Figure 12. Since 2000, peak ozone concentrations have decreased drastically, and the number of days exceeding the standard has dropped significantly. Current control programs will continue the pace of NOx reductions from mobile sources, with a further 65 percent reduction by 2037.

Figure 12 - San Joaquin Valley Ozone Progress



Even with this substantial progress, additional reductions are needed in the San Joaquin Valley to address the significant challenges that remain, including to provide for attainment of the 70 ppb ozone standard, and to accelerate attainment of other ozone and PM2.5 standards. Further, controls to reduce emissions emissions of ozone and PM2.5 precursors will also help to reduce diesel PM and minimize the detrimental health impacts of toxics in communities across the Valley.

Remaining Nonattainment Areas – Reduction Needs

CARB evaluated the need for emission reduction commitments for the remaining nonattainment areas for the 70 ppb ozone standard. Given the stringency of the 70 ppb ozone standard, preliminary air quality modeling has shown that five additional nonattainment areas outside the South Coast and San Joaquin Valley will require emissions reductions beyond those from current control programs. These nonattainment areas are the Coachella Valley, Eastern Kern County, Sacramento Metro, Ventura County, and Western Mojave Desert. In the Proposed 2022 State SIP Strategy, CARB is including potential commitments to achieve the emissions reductions necessary from State-regulated sources to provide for attainment of the 70 ppb ozone standard in these areas.

Coachella Valley

The Coachella Valley nonattainment areas is the portion of Riverside County that lies in the Salton Sea Air Basin. The Coachella Valley is surrounded by large mountain ranges and have average daytime temperatures in the summer months of over 100 degrees. These conditions, coupled with transport of ozone and ozone precursors from the South Coast through the San Gorgonio Pass, along with local emissions, result in higher ozone levels. Although substantial reductions in emissions and ozone levels have occurred over the last twenty years, additional reductions are needed upwind in the South Coast, and could be supplemented with

reductions in the Coachella Valley, to address the challenge of attaining the 70 ppb ozone standard.

Eastern Kern County

Eastern Kern County is sparsely populated with a few small cities around the intersections of State roads and interstate highways, which limits ozone precursor emissions from sources in the nonattainment area. Eastern Kern County is within the Mojave Desert Air Basin and is primarily bordered by several mountain ranges that separate it from populated valleys and coastal areas with other nonattainment areas to the west (San Joaquin Valley), and south (South Coast). Passes through surrounding mountain ranges serve as "transport corridors" for ozone to Eastern Kern County. Eastern Kern County is influenced primarily by transport through the Tehachapi Pass corridor, which connects the San Joaquin Valley and the Mojave Desert Air Basin. Although substantial reductions in emissions and ozone levels have occurred over the last twenty years, additional reductions are needed in the areas upwind, and could be supplemented with reductions in Eastern Kern County, to address the challenges towards attaining the 70 ppb ozone standard.

Sacramento Metro

The Sacramento Federal Nonattainment Area, or Sacramento Metro, is comprised of all of Sacramento and Yolo Counties and includes portions of El Dorado, Placer, Solano, and Sutter Counties. The area includes mountainous terrain, agricultural land, lakes and rivers, as well as one of California's larger urban areas. While winters in the valley are mild, summer generally brings hot weather to the valley floor, and mountain areas are considerably cooler in both summer and winter. Ozone levels in the region is affected by both local emissions and ozone precursor emissions transported from upwind areas. Although substantial reductions in emissions and ozone levels have occurred over the last twenty years, additional reductions are needed in upwind areas and in Sacramento Metro to address the challenge of attaining the 70 ppb ozone standard.

Ventura County

Ventura County is located northwest of South Coast, south of Kern County, east of Santa Barbara County, and is bordered to the west by the Pacific Ocean. Ventura County has a combination of undeveloped and agricultural lands, as well as developed urban areas. Ozone in Ventura County is caused by both locally generated emissions and transport from the South Coast and other surrounding areas. Substantial reductions in emissions and ozone levels have occurred over the last twenty years, but additional reductions are needed upwind in the South Coast, and could be supplemented with reductions in Ventura County, to address the challenge of attaining the 70 ppb ozone standard.

Western Mojave Desert

The Western Mojave Desert is part of the Mojave Desert Air Basin which is shared between the Mojave Desert and Antelope Valley AQMDs. The Mojave Desert AQMD portion of the Western Mojave Desert includes the southwestern desert portion of San Bernardino County and the segment of eastern Riverside County known as the Palo Verde Valley. The Antelope Valley AQMD portion of the Western Mojave Desert includes the northeastern desert portion of Los Angeles County. The Mojave Desert AQMD portion is characterized by hot, dry summers and cool winters, with little precipitation. The Antelope Valley AQMD portion is characterized by a wide, arid valley with verly little precipitation and high summer

temperatures. The Western Mojave Desert serves as a growing bedroom community for the greater Los Angeles area, and the primary roadways carry a substantial amount of daily commute traffic from Western Mojave Desert into Los Angeles. Ozone and ozone precursors are often transported inland by the prevailing winds from the South Coast and to lesser extent from the San Joaquin Valley. While substantial reductions in emissions and ozone levels have occurred over the last twenty years, additional reductions are needed in upwind areas, and could be supplemented with reductions in the Western Mojave Desert, to address the significant challenge that remain, including to provide for attainment of the 70 ppb ozone standard.

Chapter 3: Public Process and Measure Suggestions

CARB staff engaged in an open public process in developing the Proposed 2022 State SIP Strategy. Staff first invited public and stakeholder participation in July 2021 with a public webinar at which preliminary measures, and the expected direction of the Proposed 2022 State SIP Strategy were presented. Subsequently, CARB staff met with community-based organizations for input on ways CARB could support community level emissions reductions as part of the Proposed 2022 State SIP Strategy. The community-based organizations provided measure suggestions which are reflected in this document and the prior releases. CARB staff published the *2022 State SIP Strategy: Draft Measures* document on October 6, 2021 which included the new "Public Measure Suggestions" section based on the input from community-based organizations and members of the public. Staff then hosted a 2nd public webinar on October 19, 2021 discussing the Draft Measures document. The 2nd webinar presented a detailed discussion on the potential measures and allowed for the public and stakeholders to comment on every facet of each potential measure. After release of the Draft 2022 State SIP Strategy in January 2022, CARB hosted a 3rd public webinar and a Board information update in February 2022 to discuss and obtain public feedback.

As a result of outreach and engagement efforts to date, CARB has received the suggestions for the potential State measures listed below to be included in the Proposed 2022 State SIP Strategy. Many of the items below have also 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 explored the ways in which these concepts could be included as measures in the Proposed 2022 State SIP Strategy and welcomes feedback and additional suggestions from the public during the remainder of the Strategy development process.

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 suggestion 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.

CARB staff has been investigating the feasibility and potential benefits of this suggested measure and have included in Chapter 5 of this document a proposed measure to similarly target the increase in the number of heavy-duty ZEVs and cleaner engines as soon as possible, and reduce emissions from fleets not affected by the Advanced Clean Fleets measure – see the Zero-Emission Trucks measure.

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.

CARB staff has been investigating the feasibility and potential benefits of this suggested measure, and have included it as one potential element of the Zero-Emission Trucks measure in Chapter 5.

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.

CARB staff is continuing to explore this suggested measure and how it can meet the Clean Air Act requirements for SIP measure approvability, but at this time it is not included in the Proposed 2022 State SIP Strategy. That said, CARB is pursuing VMT reductions via other approaches through the Enhanced Regional Emission Analysis in State Implementation Plans measure, included in Chapter 5. Additionally, CARB is currently developing the 2022 Scoping Plan Update as well which will assess the progress towards achieving the 2030 target and lay out a path for achieving carbon neutrality no later than 2045. To meet these goals, the Scoping Plan will include VMT strategies that reduce petroleum use in vehicles.

Indirect Source Rule – Suggested Control Measure or Regulation

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 could involve CARB writing a Suggested Control Measure which acts as a model rule to assist the air districts in the rule development process. In addition, CARB staff will explore opportunities to expand existing State law to provide partnership opportunities for CARB and air districts to work together to develop, adopt, and implement indirect source rules.

CARB staff has been investigating the feasibility and potential benefits of this suggested measure, and have included it as one potential element of the Zero-Emission Trucks measure in Chapter 5.

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, local 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.

CARB staff is continuing to explore the BACT and BARCT Determination suggested measure and how it can meet the Clean Air Act requirements for SIP measure approvability, but at this time it is not included in the Proposed 2022 State SIP Strategy. That said, through implementation of AB 617, CARB is working closely with local air districts to identify existing *BACT determinations* and *BACT guidelines* across the State in order to better support Statewide consistency and collaboration.

Additional Building Emission Standards

Residential and commercial buildings in California are the source of about 66 tpd NOx[38] statewide due to natural gas combustion. Nearly 90 percent of building NOx emissions are due to space and water heating and the remaining 10 percent are due to cooking, clothes drying, and other miscellaneous end uses. At the regional level, approximately one-third of projected building related emissions in South Coast could be reduced by 2037 if zero-emission standards were implemented in 2030 for space and water heating.

CARB could propose additional emissions standards for combustion sources used in buildings by working with air districts to set such standards and, with building and energy code agencies on standards for new construction, or by taking 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.

CARB staff has been investigating the feasibility and potential benefits of this suggested measure and are including in the Zero Emission Standard for Space and Water Heaters measure the potential to include other end-uses.

Pesticides Regulation

Pesticides are used in commercial and agricultural operations across the State and are a source of ROG and other types of emissions. This measure would involve CARB working with the DPR to develop new regulations to further reduce ROG emissions from commercial and

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

agricultural pesticides used in California through reformulation, reduced usage, and innovative technologies and practices.

CARB staff coordinated with the DPR and a measure is included in Chapter 5 of the Proposed 2022 State SIP Strategy.

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.

CARB staff is continuing to explore this suggested measure and how it can meet the Clean Air Act requirements for SIP measure approvability, but at this time it is not included in the Proposed 2022 State SIP Strategy. That said, the proposed Advanced Clean Cars II regulation along with existing CARB regulations and current State incentive programs such as the Clean Cars 4 All achieve a significant amount of benefits this suggested measure would accomplish. Further, the Clean Cars 4 All Program is under development for statewide expansion and will continue to focus on supporting the lowest income and disadvantaged communities.

Light-Duty Vehicle Fleet Regulation

CARB has a suite of regulations in place to control emissions from light-duty vehicles, and continues to pursue new regulatory actions, in addition to incentives and other complementary programs that can help to accelerate emissions reductions. One such action that will be brought to CARB's Board in the coming months is the Advanced Clean Cars II program, which will set manufacturer sales requirements and continue to drive introduction of ZEVs into the light-duty fleet. Even so, additional fleet average requirements could potentially support a faster rate of transition to zero-emissions, especially in public and private fleets which are particularly suited for electrification. This measure would involve CARB developing a regulation to implement fleet requirements for public and rental passenger vehicle fleets. This could take the form similar to the recently adopted Clean Miles Standard, which requires an increasing number of electric miles service for ride hailing platforms, or it could take the form of a more traditional fleet rule that mandates the purchase of ZEVs.

CARB staff is continuing to explore this suggested measure, but at this time it is not included in the Proposed 2022 State SIP Strategy. That said, CARB staff anticipate that the proposed Advanced Clean Cars II regulation, along with existing CARB regulations and current State incentive programs, achieve a significant amount of benefits this suggested measure would accomplish.

Chapter 4: Proposed SIP Commitment

Overview of Commitment

SIPs may contain enforceable commitments to achieve the level of emissions necessary to meet federal air quality standards, as defined by the attainment demonstration. The Proposed 2022 State SIP Strategy lists proposed new SIP measures and quantifies potential emissions reduction SIP commitments for seven areas of the State – the South Coast, San Joaquin Valley, Coachella Valley, Eastern Kern County, Sacramento Metro, Ventura County, and Western Mojave Desert – based on the measures identified and quantified to date. Adoption of the Proposed 2022 State SIP Strategy and the measure schedule by the Board will form the basis of the commitments for emissions reductions by the attainment deadlines for each region that will be proposed for Board consideration alongside the respective nonattainment area's SIP. The commitments will consist of two components:

1. A commitment to bring an item to the Board for defined new measures or take other specified actions within CARB's authority; and
2. A commitment to achieve aggregate emissions reductions by specific dates.

As part of each SIP needing emissions reductions from the State, the total aggregate emissions reductions and the obligation to make certain proposals to the CARB Board or take other actions within CARB's authority specified in the Proposed 2022 State SIP Strategy would become enforceable upon approval by U.S. EPA. While the Proposed 2022 State SIP Strategy discusses a range of proposed measures and actions, those proposed measures and actions would still be subject to CARB's formal approval process and would not be final until the Board formally takes action.

Commitment to Act on Proposed Measures

For each of the proposed SIP measures shown in Table 3 and Table 4, CARB staff proposes to commit to address each measure as described in this document. For each measure committed to, CARB staff would undertake the actions detailed for each measure. In the instance of Proposed Measures that involve the development of a rule under CARB's regulatory authority, CARB would commit to bring a publicly noticed item before the Board that is either a proposed rule, or is a recommendation that the Board direct staff to not pursue a rule covering that subject matter at that time. This recommendation would be based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. This public process and CARB hearing would provide additional opportunity for public and stakeholder input, as well as ongoing technology review, and assessments of costs and environmental impacts.

The measures, as proposed by staff to the Board or adopted by the Board, may provide more or less than the initial emission reduction estimates. In addition, action by the Board may include any action within its discretion.

Commitment to Achieve Emissions reductions

The following sections describe the estimated emission reduction and potential commitments from the proposed SIP measures identified and quantified to date for the South Coast, the San Joaquin Valley, Coachella Valley, Eastern Kern County, Sacramento Metro, Ventura County,

and Western Mojave Desert. The SIPs for each nonattainment area are still under development, and the emissions reductions may change as each attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources to be proposed for Board consideration will be found in CARB's staff report for the respective nonattainment area's SIP.

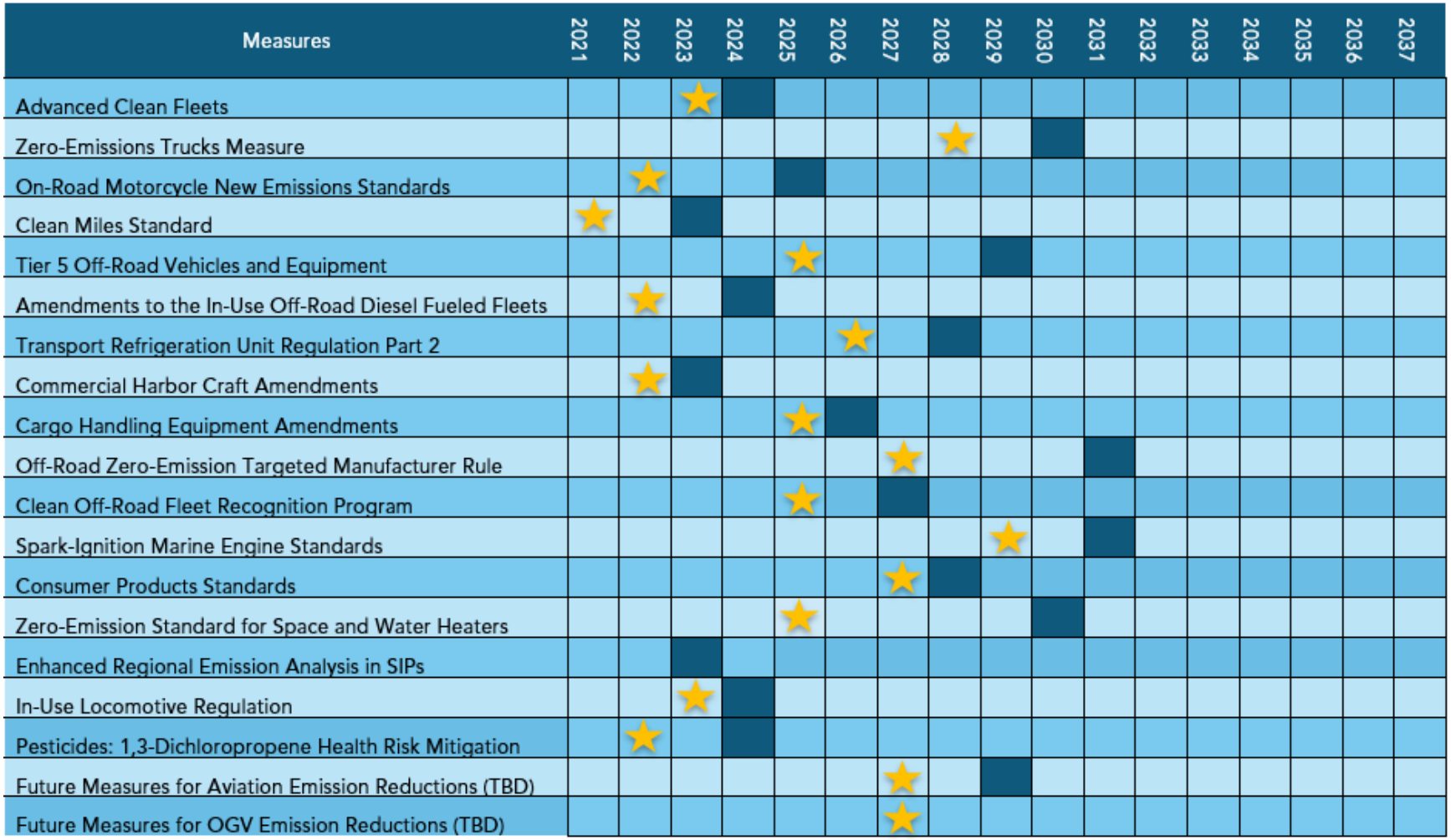
While the Proposed 2022 State SIP Strategy includes estimates of the emissions reductions from each of the individual new measures, CARB's overall commitment is to achieve the total emissions reductions necessary from State-regulated sources to attain the federal air quality standards, reflecting the combined reductions from the existing control strategy and new measures. Therefore, if a particular measure does not get its expected emissions reductions, the State's overall commitment to achieving the total aggregate emissions reductions still exists. If actual emission decreases occur that exceed the projections reflected in the current emission inventory and the Proposed 2022 State SIP Strategy, CARB will submit an updated emissions inventory to U.S. EPA as part of a SIP revision. The SIP revision would outline the changes that have occurred and provide appropriate tracking to demonstrate that aggregate emissions reductions sufficient for attainment are being achieved through enforceable emission reduction measures. CARB's emission reduction commitments may be achieved through a combination of actions including but not limited to the implementation of control measures; the expenditure of local, State or federal incentive funds; or through other enforceable measures. In some cases, actions by federal and international agencies will be needed. In others, programmatic approaches must be developed and funding secured to achieve reductions through additional transition to cleaner technologies and systems in the relevant sectors. For such situations, the Clean Air Act includes a provision for approval under Section 182(e)(5) advanced technology provisions to allow this future flexibility for Extreme areas such as the South Coast needing additional reductions to meet the ozone standard.

Table 3 - Proposed Measures and Schedule

Proposed Measure	Agency	Action	Implementation Begins
On-Road Heavy-Duty			
Advanced Clean Fleets Regulation	CARB	2023	2024
Zero-Emissions Trucks Measure	CARB	2028	2030
On-Road Light-Duty			
On-Road Motorcycle New Emissions Standards	CARB	2022	2025
Clean Miles Standard	CARB	2021	2023
Off-Road Equipment			
Tier 5 Off-Road Vehicles and Equipment	CARB	2025	2029
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	CARB	2022	2024
Transport Refrigeration Unit Regulation Part 2	CARB	2026	2028
Commercial Harbor Craft Amendments	CARB	2022	2023
Cargo Handling Equipment Amendments	CARB	2025	2026
Off-Road Zero-Emission Targeted Manufacturer Rule	CARB	2027	2031
Clean Off-Road Fleet Recognition Program	CARB	2025	2027
Spark-Ignition Marine Engine Standards	CARB	2029	2031
Other			
Consumer Products Standards	CARB	2027	2028
Zero-Emission Standard for Space and Water Heaters	CARB	2025	2030
Enhanced Regional Emission Analysis in State Implementation Plans[39]	CARB	2025	2023
Pesticides: 1,3-Dichloropropene Health Risk Mitigation	DPR[40]	2022	2024
Primarily-Federally and Internationally Regulated Sources – CARB Measures			
In-Use Locomotive Regulation	CARB	2023	2024
Future Measures for Aviation Emissions reductions	CARB	2027	2029
Future Measures for Ocean-Going Vessel Emissions reductions	CARB	2027	TBD
Primarily-Federally and Internationally Regulated Sources – Federal Action Needed[41]			
On-Road Heavy-Duty Vehicle Low-NOx Engine Standards	U.S. EPA	2022	2027
On-Road Heavy-Duty Vehicle Zero-Emission Requirements	U.S. EPA	TBD	TBD
Off-Road Equipment Tier 5 Standard for Preempted Engines	U.S. EPA	TBD	TBD
Off-Road Equipment Zero-Emission Standards Where Feasible	U.S. EPA	TBD	TBD
More Stringent Aviation Engine Standards	U.S. EPA/ICAO[42]	TBD	TBD
Cleaner Fuel and Visit Requirements for Aviation	U.S. EPA	TBD	TBD
Zero-Emission On-Ground Operation Requirements at Airports	U.S. EPA	TBD	TBD
Airport Aviation Emissions Cap	U.S. EPA	TBD	TBD
More Stringent National Locomotive Emission Standards	U.S. EPA	TBD	TBD
Zero-Emission Standards for Locomotives	U.S. EPA	TBD	TBD
Address Unlimited Locomotives Remanufacturing	U.S. EPA	TBD	TBD
More Stringent NOx and PM Standards for Ocean-Going Vessels	U.S. EPA/IMO[43]	TBD	TBD
Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels	U.S. EPA	TBD	TBD

[39] Proposed CARB finalization
[40] California Department of Pesticide Regulation (DPR)
[41] Request U.S. EPA approval under the provisions of Section 182(e)(5) of the Clean Air Act
[42] International Civil Aviation Organization (ICAO)
[43] International Maritime Organization (IMO)

Table 4 – Proposed Measures and Schedule*



*Yellow star represents the year for which action is proposed; dark blue represents the beginning years of implementation.

Statewide Emissions Reductions

The proposed measures in the Proposed 2022 State SIP Strategy will provide emission reduction benefits throughout the State. Some of these benefits will come from current programs while the remainder of the benefits will come from new measures. Although the existing control program will provide mobile source emissions reductions necessary to meet the attainment needs of many areas of the State, the new measures in the Proposed 2022 State SIP Strategy will provide further reductions to enhance air quality progress and achieve the 70 ppb ozone standard.

Emissions reductions from Current Programs

Table 5 provides the remaining mobile source emissions under CARB and district current programs for the State as a whole. Ongoing implementation of current control programs is projected to reduce mobile source NOx emissions statewide from today's levels by 521 tpd in 2037. Achieving the benefits projected from the current control program will continue to require significant efforts for implementation and enforcement and thus represents an important element of the overall strategy.

Table 5 – Mobile Source Emissions under CARB and District Current Control Programs[44]

Mobile Sources	NOx (tpd)			ROG (tpd)		
	2018	2037	Change	2018	2037	Change
Statewide	1156.7	635.3	-45%	638.3	319.5	-50%

Although most of the 2016 State SIP Strategy measure commitments have been adopted, there is two (Advanced Clean Cars II, Zero-Emission Forklift) that the Board will be acting upon over the next year, and one that was recently adopted but is not yet accounted for in the baseline emissions inventory (Transport Refrigeration Unit Part 1). Table 6 below shows the timeline and anticipated Statewide emissions reductions for these three measures.

Table 6 – Emissions Reductions from Remaining 2016 State SIP Strategy Measures

Measure	Action	Implementation Begins	Statewide 2037 NOx (tpd)	Statewide 2037 ROG (tpd)[45]
Advanced Clean Cars II	2022	2026	13.5	10.8
Transport Refrigeration Unit Part I	2022	2023-2024	1.3	1.0
Zero-Emission Forklift	2023	2026	1.7	0.3
Total			16.5	12.0

[44] Source: 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

Emissions reductions from Proposed New Measures

The new measures contained in the Proposed 2022 State SIP Strategy commitment reflect a combination of State actions, and petitions and advocacy for federal and/or international action. Table 7 shows expected emissions reductions from the new measures identified and quantified to date in the Proposed 2022 State SIP Strategy to be 205.6 tpd of NOx and 40.9 tpd of ROG in 2037 Statewide. Even with the emissions reductions associated with ongoing implementation of the existing control program, these additional reductions from new measures are needed to provide for attainment of the 70 ppb ozone standard in certain areas of California.

Table 7 - Statewide Expected Emissions Reductions from Proposed New Measures[45]

Proposed Measure	2037 NOx (tpd)	2037 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	19.3	1.7
Zero-Emissions Trucks Measure	14.3	1.3
Total On-Road Heavy-Duty Reductions	33.6	3.1
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	2.3	5.8
Clean Miles Standard	<0.1	0.2
Total On-Road Light-Duty Reductions	2.4	6.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	10.4	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	4.0	0.3
Transport Refrigeration Unit Regulation Part 2	15.2	2.0
Commercial Harbor Craft Amendments	8.7	0.5
Cargo Handling Equipment Amendments	0.7	0.5
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	2.1	4.2
Total Off-Road Equipment Reductions	41.5	7.8
Other		
Consumer Products Standards	-	20.0
Zero-Emission Standard for Space and Water Heaters	13.5	1.5
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Pesticides: 1,3-Dichloropropene Health Risk Mitigation	-	NYQ
Total Other Reductions	13.5	21.5
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	63.2	2.5
Future Measures for Aviation Emissions reductions	NYQ	NYQ
Future Measures for Ocean-Going Vessel Emissions Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	63.2	2.5
Primarily-Federally and Internationally Regulated Sources – Federal Action Needed[46]		
On-Road Heavy-Duty Vehicle Low-NOx Engine Standards	3.8	<0.1
On-Road Heavy-Duty Vehicle Zero-Emission Requirements	NYQ	NYQ
Off-Road Equipment Tier 5 Standard for Preempted Engines	1.5	NYQ
Off-Road Equipment Zero-Emission Standards Where Feasible	2.2	NYQ
More Stringent Aviation Engine Standards	NYQ	NYQ
Cleaner Fuel and Visit Requirements for Aviation	10.2	NYQ
Zero-Emission On-Ground Operation Requirements at Airports	NYQ	NYQ
Airport Aviation Emissions Cap	9.1	NYQ
More Stringent National Locomotive Emission Standards	NYQ	NYQ
Zero-Emission Standards for Locomotives	NYQ	NYQ
Address Unlimited Locomotives Remanufacturing	NYQ	NYQ
More Stringent NOx and PM Standards for Ocean-Going Vessels	0.8	NYQ
Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels	23.6	NYQ
Total Primarily-Federally and Internationally Regulated - Federal Action Needed Reductions	51.5	<0.1
Aggregate Emissions Reductions	**205.6**	40.9

[45] Numbers may not add up due to rounding

[46] Emissions reductions only for the South Coast; CARB to request U.S. EPA approval under the provisions of Section 182(e)(5) of the Clean Air Act

South Coast

Air quality modeling indicates that total NOx emissions from all sources in the South Coast will need to decrease to approximately 60 tpd in 2037, representing an approximate 80 percent reduction from current levels. A significant fraction of the needed reductions will come from the existing control program, which is projected to reduce NOx emissions from all sources by approximately 47 percent by 2037, providing a significant down payment on the emissions reductions needed.

In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 8 below. Action will be taken on the remaining measures in the coming year.

Table 8 – South Coast Emissions Reductions from Remaining 2016 State SIP Strategy Measures[47]

Measure	Action	Implementation Begins	2037 NOx (tpd)	2037 ROG (tpd)
Advanced Clean Cars II	2022	2026	5.0	3.8
Transport Refrigeration Unit Part I	2022	2023-2024	0.5	0.4
Zero-Emission Forklift	2023	2026	0.9	0.1
Total			6.4	4.4

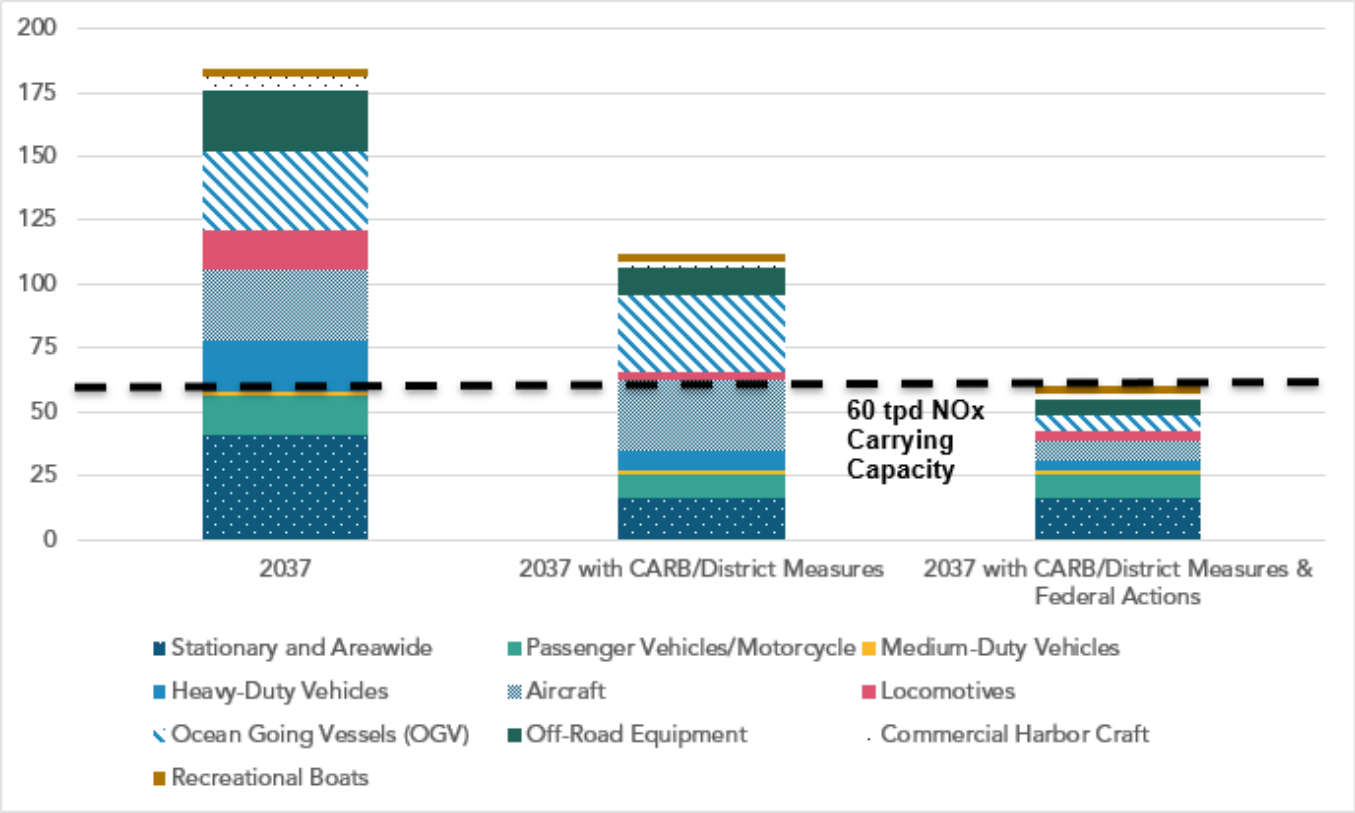
Collectively, emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and reductions estimated from the measures identified and quantified to date at the time of release of the Draft 2022 State SIP Strategy were not enough to show attainment of the 70 ppb ozone standard in the South Coast. Since the release of the Draft, CARB and the South Coast AQMD have identified the additional measures and reductions needed, such that this proposal now includes all measures and commitments needed from State sources to support attainment in the South Coast. Table 9 and Figure 13 summarize the reductions from the identified and quantified measures. That said, the SIP is still under development and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources to be proposed for Board consideration will be found in CARB's staff report for the South Coast AQMD 2022 Air Quality Management Plan (AQMP).

[47] Numbers may not add up due to rounding

Table 9 - South Coast NOx Emissions Reductions from CARB Programs[48]

CARB Programs in South Coast	2037 NOx Emission Reductions (tpd)
Current Control Program	166.4
Potential CARB Emissions Reductions Commitments	95.7
2016 State SIP Strategy Measures (Not yet in baseline inventory)	6.4
New Proposed Measures	89.3
Total Reductions	262.1

Figure 13 - 2037 South Coast NOx Emissions with Measures and Federal Actions[49] **(emissions out to 100 nautical miles)**



[48] Numbers may not add up due to rounding; Current Control Program represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures (Source 2022 CEPAM v1.01)

[49] Source: 2022 CEPAM v1.01 out to 100 nautical miles; left column represents the current baseline emissions with adopted CARB and district measures; center column includes proposed CARB measures quantified to date and South Coast AQMD Draft 2022 AQMP quantified control measures; right column further includes federal actions quantified to date.

Table 10 - South Coast Expected Emissions Reductions from the 2022 State SIP Strategy[50]

Proposed Measure	2037 NOx (tpd)	2037 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	6.6	0.5
Zero-Emissions Trucks Measure	4.1	0.4
Total On-Road Heavy-Duty Reductions	10.7	0.9
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	0.8	2.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	0.8	2.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	2.7	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	1.0	0.1
Transport Refrigeration Unit Regulation Part 2	5.0	0.7
Commercial Harbor Craft Amendments	2.6	0.2
Cargo Handling Equipment Amendments	0.6	0.4
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	0.3	0.7
Total Off-Road Equipment Reductions	12.2	2.0
Other		
Consumer Products Standards	-	8
Zero-Emission Standard for Space and Water Heaters[51]	3.2	0.5
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Pesticides: 1,3-Dichloropropene Health Risk Mitigation	-	NYQ
Total Other Reductions	3.2	8.5
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	10.9	0.4
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Future Measures for Ocean-Going Vessel Emissions Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	10.9	0.4
Primarily-Federally and Internationally Regulated Sources – Federal Action Needed[52]		
On-Road Heavy-Duty Vehicle Low-NOx Engine Standards	3.8	<0.1
On-Road Heavy-Duty Vehicle Zero-Emission Requirements	NYQ	NYQ
Off-Road Equipment Tier 5 Standard for Preempted Engines	1.6	NYQ
Off-Road Equipment Zero-Emission Standards Where Feasible	2.2	NYQ
More Stringent Aviation Engine Standards	NYQ	NYQ
Cleaner Fuel and Visit Requirements for Aviation	10.2	NYQ
Zero-Emission On-Ground Operation Requirements at Airports	NYQ	NYQ
Airport Aviation Emissions Cap	9.2	NYQ
More Stringent National Locomotive Emission Standards	NYQ	NYQ
Zero-Emission Standards for Locomotives	NYQ	NYQ
Address Unlimited Locomotives Remanufacturing	NYQ	NYQ
More Stringent NOx and PM Standards for Ocean-Going Vessels	0.8	NYQ
Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels	23.7	NYQ
Total Primarily-Federally and Internationally Regulated -Federal Action Needed Reductions	51.5	<0.1
Aggregate Emissions Reductions	89.3	13.9

[50] Numbers may not add up due to rounding

[51] Reductions may be achieved through CARB and/or complementary South Coast AQMD control measures for this sector.

[52] Request U.S. EPA approval under the provisions of Section 182(e)(5) of the Clean Air Act

San Joaquin Valley

Air quality modeling indicates that total NOx emissions from all sources in the San Joaquin Valley will need to decrease to approximately 60 tpd in 2037, representing an approximate 73 percent reduction from current levels. A significant fraction of the needed reductions will come from the existing control program. In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 11 below. Action will be taken on the remaining measures in the coming year.

Table 11 - San Joaquin Valley Emissions Reductions from Remaining 2016 State SIP Strategy Measures[53]

Measure	Action	Implementation Begins	2037 NOx (tpd)	2037 ROG (tpd)
Advanced Clean Cars II	2022	2026	1.6	1.3
Transport Refrigeration Unit Part I	2022	2023-2024	0.3	0.3
Zero-Emission Forklift	2023	2026	<0.1	<0.1
Total			1.9	1.7

Table 12 shows that collectively, emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and emissions reductions from the measures in the Proposed 2022 State SIP Strategy provide the emissions reductions needed from State sources to support attainment of the 70 ppb ozone standard in the San Joaquin Valley. The proposed measures in Table 13 reflect CARB commitments for State actions and the estimated emissions reductions for the San Joaquin Valley. Additional emissions reductions and controls remain critical in the Valley to accelerate attainment of other federal ozone and PM2.5 standards, and to support reductions of DPM and other toxic air contaminants in communities across the Valley. That said, the SIP is still under development and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources in the San Joaquin Valley to be proposed for Board consideration will be found in CARB's staff report for the San Joaquin Valley South 70 ppb 8-hour ozone SIP.

[53] Numbers may not add up due to rounding

Table 12 - San Joaquin Valley NOx Emissions Reductions from CARB Programs[54]

CARB Programs in San Joaquin Valley	2037 NOx Emission Reductions (tpd)
Current Control Program	134.5
Potential CARB Emissions Reductions Commitments	25.3
2016 State SIP Strategy Measures (Not yet in baseline inventory)	1.9
New Proposed Measures	23.4
Total Reductions	159.8

Table 13 - San Joaquin Valley Expected Emissions Reductions from the 2022 State SIP Strategy[55]

Proposed Measure	2037 NOx (tpd)	2037 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	5.9	0.4
Zero-Emissions Trucks Measure	NYQ	NYQ
Total On-Road Heavy-Duty Reductions	5.9	0.4
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	0.3	0.6
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	0.3	0.6
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	1.4	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	0.6	<0.1
Transport Refrigeration Unit Regulation Part 2	3.8	0.5
Commercial Harbor Craft Amendments	<0.1	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	0.3	0.6
Total Off-Road Equipment Reductions	6.1	1.2
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Pesticides: 1,3-Dichloropropene Health Risk Mitigation	--	NYQ
Total Other	NYQ	NYQ
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	11.2	0.4
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	11.2	0.4
Aggregate Emissions Reductions	23.4	2.5

[54] Numbers may not add up due to rounding; Current Control Program represents the current baseline emissions with adopted CARB and district measures (Source 2019 CEPAM v1.04)

[55] Numbers may not add up due to rounding

Coachella Valley

Air quality modeling indicates that NOx emissions reductions are needed in the South Coast Air Basin and within the Coachella Valley by 2037 in order to provide for attainment. A significant fraction of the needed reductions will come from the existing control program. In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 14 below. Action will be taken on the remaining measures in the coming year.

Table 14 – Coachella Valley Emissions Reductions from Remaining 2016 State SIP Strategy Measures[56]

Measure	Action	Implementation Begins	2037 NOx (tpd)	2037 ROG (tpd)
Advanced Clean Cars II	2022	2026	0.2	0.2
Transport Refrigeration Unit Part I	2022	2023-2024	<0.1	<0.1
Zero-Emission Forklift	2023	2026	<0.1	<0.1
Total			0.2	0.2

Table 15 shows that collectively, emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and emissions reductions from the measures in the Proposed 2022 State SIP Strategy provide the emissions reductions needed from State sources to support attainment of the 70 ppb ozone standard in the Coachella Valley. The proposed measures in Table 16 reflect CARB commitments for State actions and the expected emissions reductions for the Coachella Valley. That said, the SIP is still under development and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources in the Coachella Valley to be proposed for Board consideration will be found in CARB's staff report for the South Coast AQMD 2022 AQMP.

Table 15 – Coachella Valley NOx Emissions Reductions from CARB Programs[57]

CARB Programs in Coachella Valley	2037 NOx Emission Reductions (tpd)
Current Control Program	9.7
Potential CARB Emissions Reductions Commitments	5.2
2016 State SIP Strategy Measures (Not yet in baseline inventory)	0.2
New Proposed Measures	5.0
Total Reductions	14.9

[56] Numbers may not add up due to rounding

[57] Numbers may not add up due to rounding; Current Control Program represents the current baseline emissions with adopted CARB and district measures (Source 2022 CEPAM v1.01)

Table 16 – Coachella Valley Expected Emissions Reductions from the 2022 State SIP Strategy[58]

Proposed Measure	2037 NOx (tpd)	2037 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	0.7	<0.1
Zero-Emissions Trucks Measure	0.8	<0.1
Total On-Road Heavy-Duty Reductions	1.5	0.2
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	<0.1	0.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	<0.1	0.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	0.1	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	<0.1	<0.1
Transport Refrigeration Unit Regulation Part 2	0.3	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	<0.1	<0.1
Total Off-Road Equipment Reductions	0.4	0.1
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Pesticides: 1,3-Dichloropropene Health Risk Mitigation	-	NYQ
Total Other	NYQ	NYQ
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	3.0	0.1
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	3.0	0.1
Aggregate Emissions Reductions	5.0	0.4

[58] Numbers may not add due to rounding

Eastern Kern County

Air quality modeling indicates that NOx emissions reductions are needed in areas upwind and within Eastern Kern County by 2032 in order to provide for attainment. A significant fraction of the needed reductions will come from the existing control program. In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 17 below. Action will be taken on the remaining measures in the coming year.

Table 17 – Eastern Kern County Emissions Reductions from Remaining 2016 State SIP Strategy Measures

Measure	Action	Implementation Begins	2032 NOx (tpd)	2032 ROG (tpd)
Advanced Clean Cars II	2022	2026	<0.1	<0.1
Transport Refrigeration Unit Part I	2022	2023-2024	<0.1	<0.1
Zero-Emission Forklift	2023	2026	<0.1	<0.1
Total			<0.1	<0.1

Table 18 shows the emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and emissions reductions from the measures in the Proposed 2022 State SIP Strategy, which, when paired with emissions reductions in upwind and surrounding areas, will provide the emissions reductions needed from State sources to support attainment of the 70 ppb ozone standard in Eastern Kern County. The proposed measures in Table 19 reflect CARB commitments for State actions and the expected emissions reductions for Eastern Kern County. That said, the SIP is still under development, and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources in Eastern Kern County to be proposed for Board consideration will be found in CARB's staff report for the Eastern Kern County 70 ppb 8-hour ozone SIP.

Table 18 – Eastern Kern County NOx Emissions Reductions from CARB Programs[59]

CARB Programs in Eastern Kern County	2032 NOx Emission Reductions (tpd)
Current Control Program	3.1
Potential CARB Emissions Reductions Commitments	1.8
2016 State SIP Strategy Measures (Not yet in baseline inventory)	<0.1
New Proposed Measures	1.8
Total Reductions	4.9

[59] Numbers may not add up due to rounding; Current Control Program represents the current baseline emissions with adopted CARB and district measures (Source 2019 CEPAM v1.04)

Table 19 – Eastern Kern County Expected Emissions Reductions from the 2022 State SIP Strategy[60]

Proposed Measure	2032 NOx (tpd)	2032 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	0.1	<0.1
Zero-Emissions Trucks Measure	NYQ	NYQ
Total On-Road Heavy-Duty Reductions	0.1	<0.1
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	<0.1	<0.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	<0.1	<0.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	<0.1	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	<0.1	<0.1
Transport Refrigeration Unit Regulation Part 2	0.1	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	<0.1	<0.1
Total Off-Road Equipment Reductions	0.2	<0.1
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Total Other	NYQ	NYQ
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	1.5	<0.1
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	1.5	<0.1
Aggregate Emissions Reductions	1.8	0.1

[60] Numbers may not add due to rounding

Sacramento Metro

Air quality modeling indicates that NOx emissions reductions are needed in the Sacramento Metro nonattainment area by 2032 in order to provide for attainment. A significant fraction of the needed reductions will come from the existing control program. In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 20 below. Action will be taken on the remaining measures in the coming year.

Table 20 – Sacramento Metro Emissions Reductions from Remaining 2016 State SIP Strategy Measures[61]

Measure	Action	Implementation Begins	2032 NOx (tpd)	2032 ROG (tpd)
Advanced Clean Cars II	2022	2026	0.4	0.4
Transport Refrigeration Unit Part I	2022	2023-2024	<0.1	<0.1
Zero-Emission Forklift	2023	2026	<0.1	<0.1
Total			0.5	0.4

Table 21 shows the emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and emissions reductions from the measures in the Proposed 2022 State SIP Strategy, which will provide the emissions reductions needed from State sources to support attainment of the 70 ppb ozone standard in Sacramento Metro. The proposed measures in Table 22 reflect CARB commitments for State actions and the expected emissions reductions for the Sacramento Metro area. That said, the SIP is still under development and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources in Sacramento Metro to be proposed for Board consideration will be found in CARB's staff report for the Sacramento Metro 70 ppb 8-hour ozone SIP.

Table 21 – Sacramento Metro NOx Emissions Reductions from CARB Programs[62]

CARB Programs in Sacramento Metro	2032 NOx Emission Reductions (tpd)
Current Control Program	31.5
Potential CARB Emissions Reductions Commitments	6.1
2016 State SIP Strategy Measures (Not yet in baseline inventory)	0.5
New Proposed Measures	5.6
Total Reductions	37.5

[61] Numbers may not add due to rounding

[62] Numbers may not add up due to rounding; Current Control Program represents the current baseline emissions with adopted CARB and district measures (Source 2019 CEPAM v1.04)

Table 22 – Sacramento Metro Expected Emissions Reductions from the 2022 State SIP Strategy[63]

Proposed Measure	2032 NOx (tpd)	2032 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	0.8	<0.1
Zero-Emissions Trucks Measure	NYQ	NYQ
Total On-Road Heavy-Duty Reductions	0.8	<0.1
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	0.1	0.2
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	0.1	0.2
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	0.2	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	0.5	0.1
Transport Refrigeration Unit Regulation Part 2	0.4	<0.1
Commercial Harbor Craft Amendments	0.3	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	<0.1	0.1
Total Off-Road Equipment Reductions	1.5	0.3
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Pesticides: 1,3-Dichloropropene Health Risk Mitigation	-	NYQ
Total Other	NYQ	NYQ
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	3.2	0.1
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	3.2	0.1
Aggregate Emissions Reductions	5.6	0.7

[63] Numbers may not add due to rounding

Western Mojave Desert

Air quality modeling indicates that NOx emissions reductions are needed within Western Mojave Desert by 2032 to provide for attainment. A significant fraction of the needed reductions will come from the existing control program. In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 23 below. Action will be taken on the remaining measures in the coming year.

Table 23 – Western Mojave Desert Emissions Reductions from Remaining 2016 State SIP Strategy Measures[64]

Measure	Action	Implementation Begins	2032 NOx (tpd)	2032 ROG (tpd)
Advanced Clean Cars II	2022	2026	0.2	0.1
Transport Refrigeration Unit Part I	2022	2023-2024	<0.1	<0.1
Zero-Emission Forklift	2023	2026	<0.1	<0.1
Total			0.2	0.1

Table 24 shows the emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and emissions reductions from the measures identified and quantified in the Proposed 2022 State SIP Strategy will provide the emissions reductions needed from State sources to support attainment of the 70 ppb ozone standard in Western Mojave Desert. The proposed measures in Table 25 reflect CARB commitments for State actions and the expected emissions reductions for the Western Mojave Desert. That said, the SIP is still under development and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources in the Western Mojave Desert to be proposed for Board consideration will be found in CARB's staff report for the Western Mojave Desert 70 ppb 8-hour ozone SIP.

Table 24 – Western Mojave Desert NOx Emissions Reductions from CARB Programs[65]

CARB Programs in Western Mojave Desert	2032 NOx Emission Reductions (tpd)
Current Control Program	11.1
Potential CARB Emissions Reductions Commitments	20.6
2016 State SIP Strategy Measures (Not yet in baseline inventory)	0.2
New Proposed Measures	20.3
Total Reductions	31.6

[64] Numbers may not add due to rounding

[65] Numbers may not add up due to rounding; Current Control Program represents the current baseline emissions with adopted CARB and district measures (Source 2022 CEPAM v1.01)

Table 25 – Western Mojave Desert Expected Emissions Reductions from the 2022 State SIP Strategy[66]

Proposed Measure	2032 NOx (tpd)	2032 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	0.6	<0.1
Zero-Emissions Trucks Measure	0.6	<0.1
Total On-Road Heavy-Duty Reductions	1.2	0.1
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	<0.1	0.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	<0.1	0.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	<0.1	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	0.2	<0.1
Transport Refrigeration Unit Regulation Part 2	0.4	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	<0.1	<0.1
Total Off-Road Equipment Reductions	0.7	0.1
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Total Other		
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	18.3	0.7
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	18.3	0.7
Aggregate Emissions Reductions	20.3	1.0

[66] Numbers may not add due to rounding

Ventura County

Air quality modeling indicates that NOx emissions reductions are needed within Ventura County by 2026 in order to provide for attainment. A significant fraction of the needed reductions will come from the existing control program. In addition, as described above, a few measure commitments included in the 2016 State SIP Strategy have not yet been acted upon or were very recently adopted and are thus not yet in the baseline emissions inventory, as outlined in Table 26 below. Action will be taken on the remaining measures in the coming year.

Table 26 – Ventura County Emissions Reductions from Remaining 2016 State SIP Strategy Measures

Measure	Action	Implementation Begins	2026 NOx (tpd)	2026 ROG (tpd)
Advanced Clean Cars II	2022	2026	<0.1	<0.1
Transport Refrigeration Unit Part I	2022	2023-2024	<0.1	<0.1
Zero-Emission Forklift	2023	2026	<0.1	<0.1
Total			<0.1	<0.1

Table 27 shows the emissions reductions from CARB's current control program, reductions from the remaining 2016 State SIP Strategy measures, and emissions reductions from the measures in the Proposed 2022 State SIP Strategy, which will provide the emissions reductions needed from State sources to support attainment of the 70 ppb ozone standard in Ventura County. The proposed measures in Table 28 reflect CARB commitments for State actions and the expected emissions reductions for Ventura County. That said, the SIP is still under development and the emissions reductions may change as the attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources in Ventura County to be proposed for Board consideration will be found in CARB's staff report for the Ventura County 70 ppb 8-hour ozone SIP.

Table 27 – Ventura County NOx Emissions Reductions from CARB Programs[67]

CARB Programs in Ventura County	2026 NOx Emission Reductions (tpd)
Current Control Program	4.4
Potential CARB Emissions Reductions Commitments	0.3
2016 State SIP Strategy Measures (Not yet in baseline inventory)	<0.1
New Proposed Measures	0.3
Total Reductions	4.8

[67] Numbers may not add up due to rounding; Current Control Program represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures (Source 2022 CEPAM v1.01)

Table 28 – Ventura County Expected Emissions Reductions from the 2022 State SIP Strategy[68]

Proposed Measure	2026 NOx (tpd)	2026 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	<0.1	<0.1
Zero-Emissions Trucks Measure	<0.1	<0.1
Total On-Road Heavy-Duty Reductions	<0.1	<0.1
On-Road Light-Duty		
On-Road Motorcycle New Emissions Standards	<0.1	<0.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	<0.1	<0.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	<0.1	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	<0.1	<0.1
Transport Refrigeration Unit Regulation Part 2	<0.1	<0.1
Commercial Harbor Craft Amendments	0.2	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	<0.1	<0.1
Total Off-Road Equipment Reductions	0.3	<0.1
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Pesticides: 1,3-Dichloropropene Health Risk Mitigation	-	NYQ
Total Other	NYQ	NYQ
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	<0.1	<0.1
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Future Measures for Ocean-Going Vessel Emissions Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	<0.1	<0.1
Aggregate Emissions Reductions	0.3	<0.1

[68] Numbers may not add due to rounding

Commitment to Emissions Reduction from On-Road Mobile Sources

As a part of the aggregate emission reduction commitment for each nonattainment area, CARB staff will propose to commit to emissions reductions specifically from on-road mobile sources (Table 29). CARB will continue to have an aggregate emission reduction commitment which is a sum of emissions reductions from on- and off road mobile sources, consumer products, and other State-regulated sources as outlined in Chapter 4 of the 2022 State SIP Strategy. The on-road mobile source commitment will provide the enforceability needed to support the use of motor vehicle emissions budgets that factor in reductions from the on-road mobile source measures in the 2022 State SIP Strategy – these budgets will be set by CARB and included in the 70 ppb 8-hour ozone attainment plans for nonattainment areas across the State for transportation conformity purposes. The on-road mobile source commitment will be a subset of emissions reductions from the aggregate emission reduction commitment and will not be additive to the aggregate emission reduction commitment. As the SIPs for each nonattainment area are still under development, the emissions reductions may change as each attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources, including the subset from on-road mobile sources, to be proposed for Board consideration will be found in CARB's staff report for the respective nonattainment area's SIP.

Table 29 – Emissions Reductions from On-Road Mobile Source Measures in the 2022 State SIP Strategy

On-Road Mobile Source Reductions	2026 NOx (tpd)	2032 NOx (tpd)	2037 NOx (tpd)
South Coast Air Basin	--	--	11.6
San Joaquin Valley	--	--	7.5
Coachella Valley	--	--	0.9
Western Mojave Desert	--	0.8	--
Eastern Kern County	--	0.2	--
Sacramento Metro	--	1.2	--
Ventura County	0.03	--	--

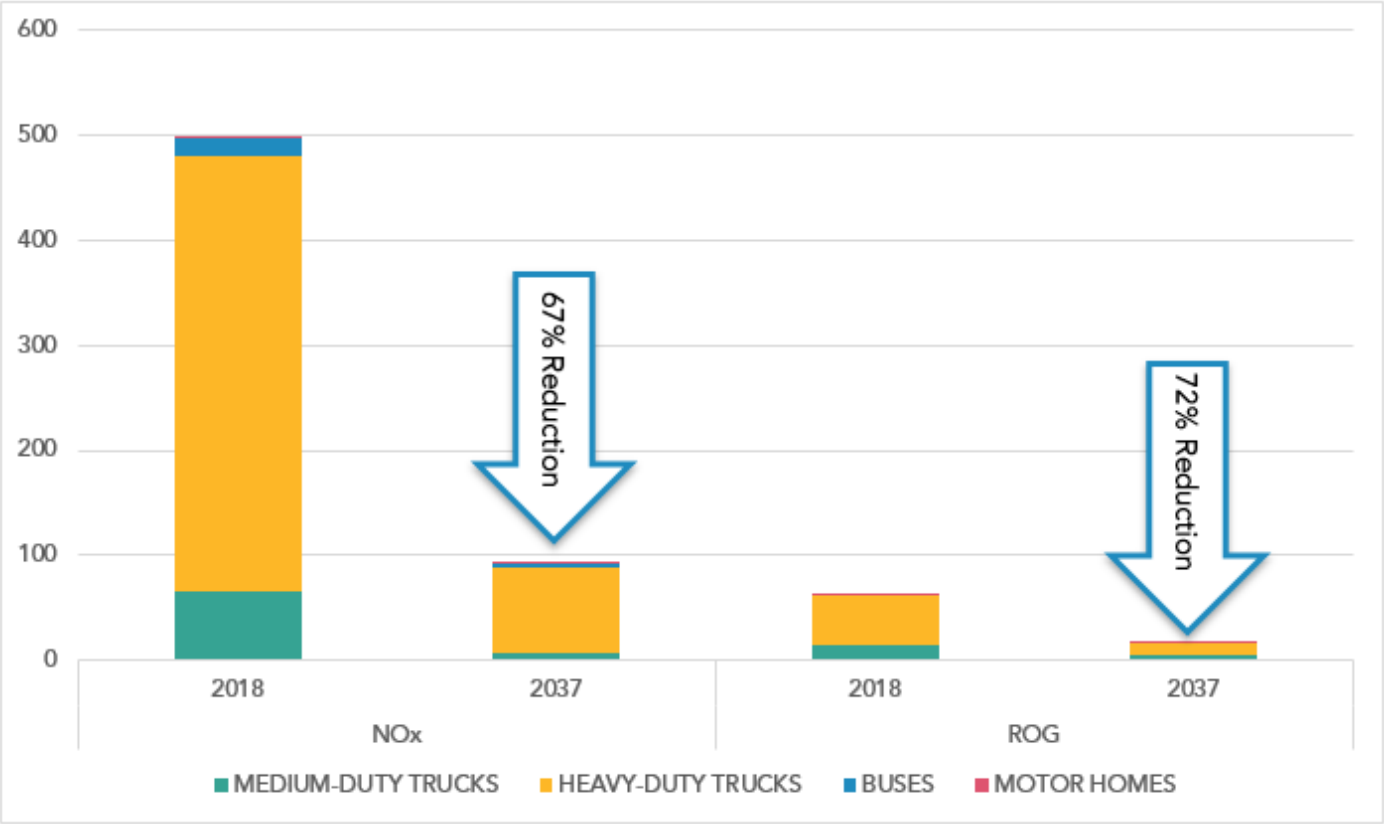
Chapter 5: State SIP Measures

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 PM 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, CARB recently adopted the Heavy-Duty Inspection and Maintenance regulation, a 2016 State SIP Strategy measure. Most of the NOx emissions from heavy-duty engines come from diesel-cycle engines, especially in the higher weight classes (Figure 14). 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 14 - On-Road Medium- and Heavy-Duty Vehicles: Statewide Baseline Emissions Inventory with Current Control Program[69]



[69] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district 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 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 regulation, 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 phase in ZEV requirements for different fleets as follows:

<u>State and Local Government fleets</u>:

- State and local government fleets including cities, counties, special districts, and other municipalities would be required to add only ZEVs to their fleets starting at 50 percent of new additions in 2024 and 100 percent starting in 2027. Public fleets that are based in designated low population counties would begin with 100 percent ZEV additions starting in 2027.

Drayage trucks:

- All drayage trucks would need to be reported in the CARB reporting system if they transport containers or bulk goods to and from California's intermodal seaports and railyards.
- Legacy trucks that are reported prior to 2024 would be able to 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.
- Beginning January 1, 2024, any truck added to drayage service would need to be a ZEV.
- All drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035.

High priority and federal fleets:

- Affected 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 and federal fleets would be required to report all vehicles that operate in California starting 2024.
- Affected fleet owners would have to meet one of two compliance options:
    - First, starting in 2024, all additions to the fleet would be ZEVs and existing trucks would be upgraded to ZEVs when 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.
    - Second, affected fleets could use a more flexible alternative compliance option to meet zero-emission fleet milestones as a percentage of the fleet. This option would provide fleet owners the flexibility to manage their fleet consistent with their normal vehicle purchase patterns provided they continue to meet the ZEV fleet milestones. The fleet milestones are phased-in based on ZEV suitability by vehicle body type as follows:
        - Vans, box trucks, light-duty package delivery vehicles, 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 in 2040.

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

Estimated Emissions Reductions

The estimated emission benefits associated with the proposed Advanced Clean Fleets regulation are calculated with CARB's motor vehicle emissions inventory model, EMFAC2017. Staff assessed the impacts of the proposed Advanced Clean Fleets regulation on affected fleets. This calculation considers medium and heavy-duty trucks and buses with gross vehicle weight rating (GVWR) greater than 8,500 pounds (Class 2b - 8). Emissions reductions are calculated relative to the business-as-usual scenario. Table 30 shows the estimated emissions benefits for this measure.

Table 30 - Advanced Clean Fleets Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	19.3	1.7
South Coast (2037)	6.6	0.5
San Joaquin Valley (2037)	5.9	0.4
Coachella Valley (2037)	0.7	<0.1
Eastern Kern County (2032)	0.1	<0.1
Sacramento Metro (2032)	0.8	<0.1
Western Mojave (2032)	0.6	<0.1
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2023
Proposed implementation schedule: 2024-2045

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in The estimated emission benefits associated with the proposed Advanced Clean Fleets regulation are calculated with CARB's motor vehicle emissions inventory model, EMFAC2017. Staff assessed the impacts of the proposed Advanced Clean Fleets regulation on affected fleets. This calculation considers medium and heavy-duty trucks and buses with gross vehicle weight rating (GVWR) greater than 8,500 pounds (Class 2b - 8). Emissions reductions are calculated relative to the business-as-usual scenario. Table 30 shows the estimated emissions benefits for this measure.

Table 30 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2023 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the

Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

Zero Emissions Trucks Measure

Overview

This measure would seek to accelerate the number of zero-emissions (ZE) trucks beyond existing measures (including the proposed Advanced Clean Fleets regulation). This strategy is a modification of the publicly suggested On-Road Heavy-Duty Vehicle Useful Life Regulation. The already adopted ACT regulation will result in almost 420,000 ZE trucks on the road by 2037, and the proposed Advanced Clean Fleets (ACF) regulation would increase the number of ZE trucks by another 220,000 to a total of 640,000. However, in 2037, even after the implementation of the ACT and ACF regulations, about 480,000 heavy-duty combustion powered trucks will still be on the road. In this modified approach, staff would seek to upgrade these remaining heavy-duty combustion trucks to new or used ZE trucks rather than to trucks with cleaner combustion engines. For this measure, staff would implement regulatory strategies to achieve the goal of transitioning the remainder of the heavy-duty combustion fleet to ZE trucks.

Options:

A. With new authority to use market signal tools such as differentiated registration fees, restrictions and fees for combustion trucks entering low and ZE zones, and/or indirect source rules (ISR) would allow for a smoother and more equitable path to get to a 100 percent ZEs California fleet. This combination of policies would help ensure that we are moving as quickly as possible to a ZE trucking future, everywhere feasible.
   Or
B. Require combustion (methane and diesel) scrap and ZE replacement for truck fleets of all sizes when combustion trucks reach their useful lives.

This measure would potentially be heard by the Board in 2028 and would be a significant step in the comprehensive strategy to achieve zero-emissions medium- and heavy-duty vehicles everywhere feasible by 2045.

Background/Regulatory History

- NOx emissions from trucks are currently the largest category of on-road mobile source emissions and will remain a major portion of pollution in the future absent acceleration of fleets to ZE technology.
- 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, the Board adopted the ACT regulation, a first-of-its-kind regulation requiring medium- and heavy-duty manufacturers to produce ZEV 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 operating in California.
- With the adoption of the ACT regulation, Resolution 20-19 directs staff to return to the Board with a ZE fleet rule and sets the following targets for transitioning sectors to ZEVs:
    - 100 percent ZE drayage, last mile delivery, and government fleets by 2035;
    - 100 percent ZE refuse trucks and local buses by 2040;
    - 100 percent ZE-capable vehicles in utility fleets by 2040; and

    - 100 percent ZE 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.
- Staff are developing the ACF regulation which targets drayage, public, and other high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. If adopted as proposed in 2022, the number of medium- and heavy-duty ZEV will be about 1.2 million by 2045 operating in California.
- The public suggested a measure to turn over in-use heavy-duty vehicles at the end of their useful life to ZE trucks or newer combustion engines in the secondary market. The staff proposed measure would phase-in used ZEVs in the secondary market and would not include upgrades to trucks with combustion engines (given the deterioration of combustion engine control systems over time).
- Even after the implementation of ACT and ACF, about 480,000 heavy-duty combustion trucks will still be on California's roads in 2037 and 400,000 would remain by 2045.
- The proposed new measure would go beyond proposed ACF requirements to further increase the number of ZEVs with the goal of achieving a full ZEV fleet by 2045 everywhere feasible.
- The experience of developing, implementing, and enforcing the 2008 Truck and Bus regulation highlights the challenges of using a regulatory mechanism to require widespread fleet turnover. Such an approach has economic consequences and takes a great deal of time to phase-in (Truck and Bus took 15+ years to full implementation).
- The new measure would seek to expand the ZEV market in a manner that is economically feasible for more than 100,000 fleets where some cannot afford to purchase new trucks and will not be able to operate without access to retail ZEV infrastructure, especially for long-haul and inter-state vehicles.
- An approach using new authorities could minimize administrative burden for fleet owners and CARB. New tools such as differentiated registration fees would create market mechanisms that can be leveraged to tip the scales to encourage those who have operations that are suitable for electrification to act early and would allow more time for those who can't.
- These new approaches would build on ACT and ACF. When combined with the significant investment California is making to upgrade trucks to ZEVs, install needed ZE infrastructure, and other strategies described in this document if granted new authorities, these approaches will rapidly accelerate the transition from combustion to ZE trucks needed throughout the State and particularly in priority communities.
- Without new authorities to facilitate approaches such as differentiated registration fees and ISR, staff would use existing authority to implement direct fleet rules to phase-in new ZE trucks or used ZE trucks from the secondary market.

- Low mileage natural gas vehicles certified to the optional 0.02 g/bhp-hr NOx emissions standard pollute in the field more than expected[70]; if this continues to be the case, staff commit to explore additional measures to subject more natural gas vehicles to the HD I/M requirements, and any future regulations and programs designed to ensure a clean future fleet of heavy-duty trucks.

Proposed Action

The proposed measure (Option A) would use market signal tools, if given authority to implement differentiated registration fees, restrictions or fees for heavy-duty combustion trucks entering low/zero-emission zones, and/or indirect source rules to establish ZE zones by 2035. The combined strategies would maximize emissions reductions in disadvantaged communities disproportionately affected by emissions associated with warehouses, and other freight hubs. The dirtiest trucks would be assessed higher fees to enter low-emission zones, would have higher costs to register their vehicles to operate in California, and eventually only ZEVs would be allowed to enter these zones. Collected fees could be used to encourage early action or to assist small fleets to upgrade to ZEVs.

These new strategies and authorities provide the air quality benefits of accelerated turnover as well as strong incentives and disincentives that provide more choice and flexibility for fleets.

Without these new strategies or authorities (Option B), CARB may need to implement an inflexible requirement for all fleets to phase-in ZEVs and to remove legacy trucks from service in California. This could achieve the same emissions benefits but would occur without the aligned market signals that the above strategies would provide, and at a much higher cost. The strategy would consider the most economical compliance options available in the secondary markets to upgrade to ZEVs, including used ZEVs, everywhere feasible.

Additionally, staff commit to monitor data collected by the Board-adopted HD I/M program to identify where trucks are still polluting to continue to identify strategies to accelerate cleaning up the existing combustion fleet.

Estimated Emissions Reductions

The estimated potential emission benefits associated with the Zero Emission Truck Measure are calculated with CARB's motor vehicle emissions inventory model, EMFAC2017. Starting in calendar year 2030, staff assumed that Class 4-8 vehicles will be replaced with ZEVs once they reach the end of their useful life. Emissions reductions are calculated relative to the business-as-usual scenario. Table 31 shows the estimated emissions benefits for this measure.

[70] CARB. *In-Use Emission Performance of Heavy Duty Natural Gas Vehicles: Lessons Learned from 200 Vehicle Project*. July 2021. Last Accessed: December 15, 2021. Web link: https://ww2.arb.ca.gov/sites/default/files/2021-04/Natural_Gas_HD_Engines_Fact_Sheet.pdf

Table 31 – Zero-Emissions Trucks Measure Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	14.3	1.3
South Coast (2037)	4.1	0.4
Coachella Valley (2037)	0.8	<0.1
Western Mojave (2032)	0.6	<0.1
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2028
Proposed implementation schedule: 2030-2045

Proposed SIP Commitment

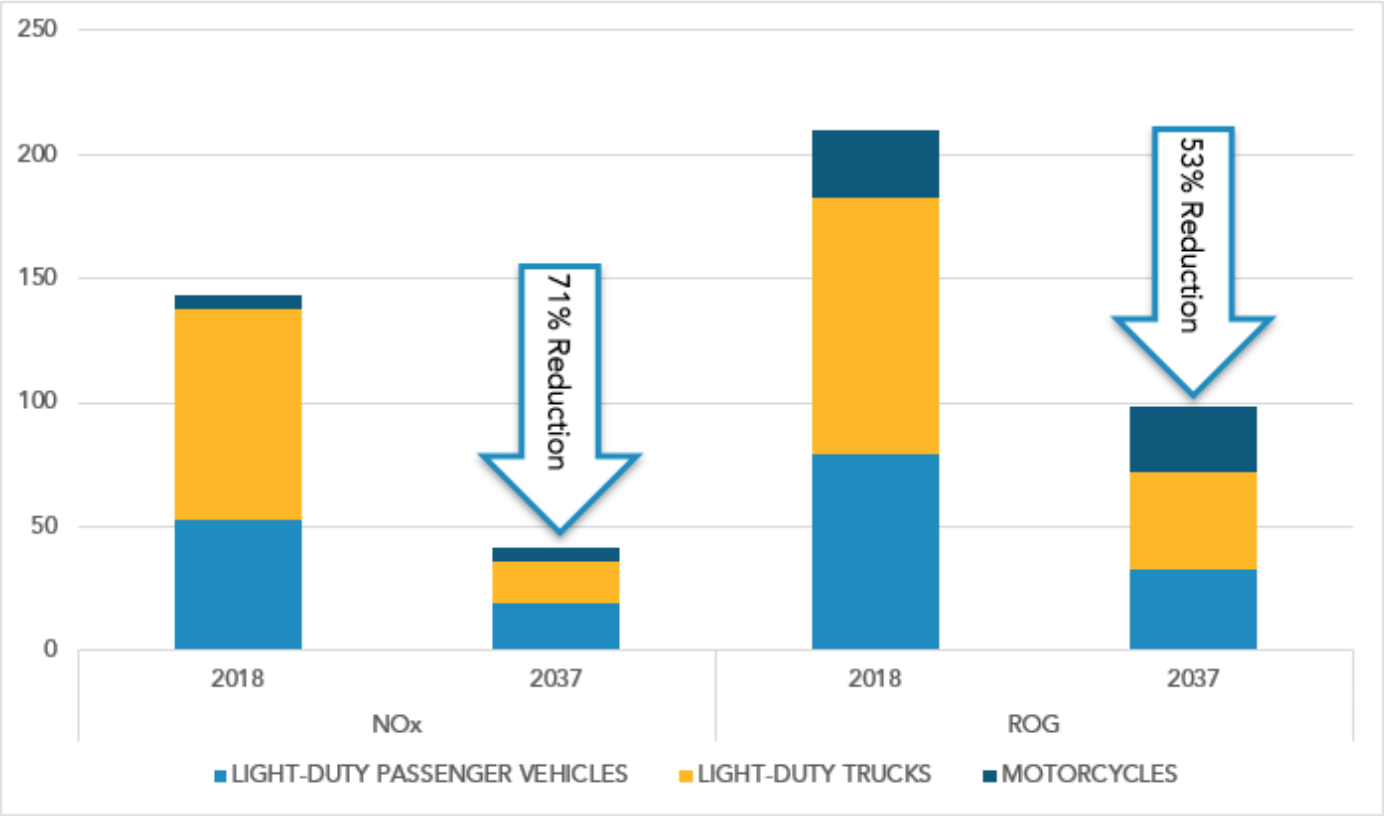
CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 31 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2028 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

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 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 ZEVs into the fleet including Advanced Clean Cars, incentive projects like Clean Cars 4 All, the recently adopted Clean Miles Standard and soon to be adopted Advanced Clean Cars 2. Advanced Clean Cars 2 was a measure in the 2016 State SIP Strategy and is a significant effort critical to meeting air quality standards to cut emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035. 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, as shown in Figure 15. A small portion today is powered by electric powertrains, and a smaller portion still has diesel compression ignition engines.

Figure 15 - On-Road Light-Duty: Statewide Baseline Emissions Inventory with Current Control Program[71]



[71] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district 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 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 zero-emissions.
- Since then, more stringent exhaust emissions standards have been developed by other jurisdictions around the world, most notably the European Union's EU5 standard which became effective in 2020. 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 vehicle categories regulated by CARB have adopted much lower evaporative emissions standards. For example, 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 hydrocarbons (HC), NOx, CO and nonmethane HC (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 thresholds 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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full independent public process.

Estimated Emissions Reductions

The estimated emission benefits associated with adoption of the proposed ZEM thresholds and lower exhaust and evaporative emissions standards were calculated using CARB's motor vehicle emissions inventory model, EMFAC2017. Table 32 shows the estimated emission benefits for this measure.

Table 32 - On-Road Motorcycles New Emissions Standards Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	2.3	5.8
South Coast (2037)	0.8	2.1
San Joaquin Valley (2037)	0.3	0.6
Coachella Valley (2037)	<0.1	0.1
Eastern Kern County (2032)	<0.1	<0.1
Sacramento Metro (2032)	0.1	0.2
Western Mojave (2032)	<0.1	0.1
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2022
Proposed implementation schedule: 2025-2035

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 32 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2022 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

Clean Miles Standard

Overview

The primary goal of the *Clean Miles Standard* (CMS) regulation, which was adopted by CARB in 2021 and will be implemented by the California Public Utilities Commission (CPUC), 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 or rented vehicles. The TNC sector has potential for continued growth beyond their market share rapid expansion after their inception in 2012. Given the potential for GHG emissions reductions and criteria pollutant co-benefits, the sector is well-positioned to help state and local agencies meet air quality and climate goals and Lyft and Uber, the largest TNCs, 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 (SB) 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. Staff expect ride-hailing to continue their previous growth trajectory in the years after the COVID-19 pandemic.
- Per SB 1014, CARB staff 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 staff 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 light duty vehicle 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 emissions reductions are approximately three times higher for an electric vehicle in ride-hailing service compared to personal use in California, depending

on the energy source mix in the electric 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 implementation to begin in 2023, includes two annual targets – an 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 GHG target would require TNCs to achieve 0 g CO_2/PMT by 2030 through electrification as well as other strategies, including increasing shared rides on their platform, improving operational efficiency (route planning and reduced mileage without passengers), 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.

Estimated Emissions Reductions

The cumulative Statewide emissions reductions associated with the Clean Miles Standard are estimated to be 298 tons NO_X, 93 tons $PM_{2.5}$ and 1.8 MMT of GHG (well-to-wheel emissions accounting for fuel production) from 2023 to 2030. The estimated emission benefits associated with the Clean Miles Standard are calculated with CARB's motor vehicle emissions inventory model, EMFAC2017. Emissions reductions are calculated relative to the business-as-usual scenario. Table 33 shows the estimated emissions benefits for this measure.

Table 33 - Clean Miles Standard Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	<0.1	0.2
South Coast (2037)	<0.1	<0.1
San Joaquin Valley (2037)	<0.1	<0.1
Coachella Valley (2037)	<0.1	<0.1
Eastern Kern County (2032)	<0.1	<0.1
Sacramento Metro (2032)	<0.1	<0.1
Western Mojave (2032)	<0.1	<0.1
Ventura County (2026)	<0.1	<0.1

Timing

CARB Board hearing: 2021
Implementation schedule*: 2023-2030

* Pending CPUC proceedings in 2022 to establish implementation rules and decisions.

Proposed SIP Commitment

The Board adopted the CMS regulation on May 20, 2021. CARB staff will pursue to achieve the NOx and ROG emissions reductions shown in Table 33 for the relevant nonattainment areas in the relevant years.

Proposed Measures: Reducing Vehicle Miles Travelled

Description of Source Category

In addition to the potential measures described above to control emissions from on-road mobile sources, reducing vehicle miles traveled (VMT) is also necessary to directly and immediately reduce mobile source NOx and ROG emissions, to provide congestion mitigation and improved community mobility, and also to reduce fuel demand and the related investments and land-use impacts from advanced fuel sources (e.g. biofuels, build out of solar and wind, etc.). CARB works cooperatively with other State agencies, and the local air districts, metropolitan planning organizations (MPOs), and other local entities to implement the Sustainable Communities and Climate Protection Program and related efforts; this involves developing, adopting and implementing Sustainable Communities Strategies which include VMT reduction targets as required under Senate Bill 375. That said, reducing VMT is difficult; many factors influence an individual's travel choices, and they interact with one another in a complex manner that is not always well understood.

CARB's *2022 Progress Report to the Legislature on SB 375 Implementation* indicates that we are not on track to reduce the necessary VMT to meet State climate and air quality goals. Despite our collective efforts to put in place transportation plans with more coordinated land use plans and policies that would reduce transportation emissions, implementation of those plans is not occurring as envisioned. These shortcomings do not rest fully on any particular entity, but fixing them will require greater leadership across all levels of government. In the 2020 Mobile Source Strategy, CARB identified several strategies CARB could undertake to assist in achieving additional reductions and support implementation of regional SCSs. Building on the strategies identified in the 2020 MSS, CARB staff is proposing measures as described below for inclusion in the SIP to support attainment of the 70 ppb ozone standard across California. Beyond these measures being proposed for inclusion in the SIP, CARB staff is continuing to work and collaborate on additional and more comprehensive actions to reduce VMT as articulated in the 2022 Scoping Plan Update, through continued implementation of SB 375, and through its partnership with other State agencies, including the California State Transportation Agency on its Climate Action Plan for Transportation Infrastructure.

Enhanced Regional Emission Analysis in State Implementation Plans

Overview

The primary goal of this measure is to reduce criteria pollutant and GHG emissions that come from on-road mobile sources. Reducing VMT is necessary to achieve federal air quality standards and the State's climate goals and is an essential element of the State's strategy to reduce emissions. In addition, lowering VMT will help alleviate traffic congestion, improve public health, reduce consumption of fossil fuels, and reduce infrastructure costs. Unfortunately, despite State and regional efforts to reduce VMT, per capita VMT continues to increase, threatening the achievement of the State's air quality and climate goals.

To assist in reversing this trend, CARB is exploring three options to reduce ROG and NOx emissions through reductions in VMT. First, in response to stakeholders' suggestions and recognizing the considerable need for further reductions from on-road sources, CARB will consider whether and how to change the process for developing Motor Vehicle Emissions Budgets (MVEB) to NAAQS. In addition, CARB will evaluate the process for identifying Transportation Control Measures (TCM) for purposes of analyzing Reasonably Available Control Measures (RACM) for inclusion in the SIP. Finally, to achieve these goals, CARB will also consider updating the criteria and guidelines for the California Motor Vehicle Registration Fee (MV Fees) Program and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program to fund a broader range of cost-effective projects that advance new approaches and technologies in reducing air pollution.

Background/Regulatory History

- Transportation conformity refers to the federal regulatory procedure for coordinating the transportation and air quality planning processes to ensure transportation plans support the attainment of air quality standards. Under section 176(c) of the federal Clean Air Act, federal agencies may not approve or fund transportation plans and projects unless they conform with a region's SIP. Conformity with the SIP requires that transportation activities not (1) cause or contribute to new air quality violations, (2) increase the frequency or severity of any existing violation, or (3) delay timely attainment of the NAAQS. Demonstrating transportation conformity entails evaluating whether a transportation project or plan would increase emissions beyond the MVEB established in a SIP. In this way, the MVEB acts as a ceiling on emissions from the on-road mobile sources within that air basin.
- The federal Clean Air Act requires States and air districts in all nonattainment areas to include RACM in the SIP. For areas projected to attain within five years of designation of NAAQS, areas must include reasonable control measures, potential emissions reductions, and the timeline to implement these measures. Those areas that cannot reach attainment within five years must conduct a thorough analysis of all control measures (including measures considered by federal, state, and other air districts) and implement those measures in the earliest practical manner to achieve attainment at least one year earlier than otherwise projected. If not, air districts must include justifications and demonstrate that no additional control measures are available to advance the attainment date.

- Control measures, including TCMs, that meet the criteria for RACM must be included in the SIP. These criteria include:
    - The control measure is technologically feasible.
    - The control measure is economically viable.
    - The control measure does not cause substantial widespread and long-term adverse impacts.
    - The control measure is not absurd, unenforceable, or impracticable.
    - The control measure can advance the attainment date by at least one year.
- U.S. EPA defines TCMs as strategies that reduce emissions or concentration of air pollutants by reducing the number of vehicle trips or VMT or improving traffic flow. The U.S. EPA guidance on RACM analysis indicates that the State should consider TCMs as a potential air quality control option if it meets the RACM requirements.
- Section 450.322 of the Federal Highway Administration (FHWA) regulation requires Metropolitan Planning Organizations (MPOs) to coordinate and ensure the regional transportation plan includes TCMs committed in the SIPs. In addition, the Transportation Improvement Programs (TIPs) (section 450.324) must provide priority funding for those projects identified as TCMs in the applicable SIP.
- There are several funding programs that regional and local agencies may use to support the implementation of TCMs. The CMAQ Program provides funding to state, regional, and local agencies for transportation projects and programs to ensure the timely implementation of TCMs in the applicable SIPs. CMAQ funds may also be used for electric vehicle infrastructure and vehicle-to-infrastructure communications equipment.
- In addition, the California Clean Air Act of 1988 authorized local air districts to assess motor vehicle fees to reduce motor vehicle emissions, referred to as the California Motor Vehicle Fees Program. The priorities for these funds should be consistent with SIPs and reflect the nature and scope of each district's air quality problem and potential multi-pollutant benefits. Under H&SC Section 44220(b), CARB is authorized to develop criteria and guidelines to fund cost-effective projects and advance new technologies through this program. CARB last updated the criteria and guidelines the air districts must follow for using motor vehicle fees in The Methods to Find the Cost-Effectiveness of Funding Air Quality Projects handbook in 2005.

Proposed Action

CARB will consider the following measures to further reduce ROG and NOx emissions from on-road motor vehicles by reducing VMT:

Change MVEB Development Process: CARB would evaluate the existing MVEB development process, including tools and the latest planning assumptions used in the analysis. Based on the review, CARB could modify the framework for developing MVEBs when considering how to address gaps in emissions reductions needed to demonstrate attainment of different NAAQS. This framework could explore additional emissions reductions from the on-road sector to attain the 70 ppb 8-hour ozone standard and progress towards State air quality goals. This framework

would need to ensure that the MVEB is consistent with other applicable requirements such as emission inventory, reasonable further progress, control measures, and attainment demonstration.

RACM Analysis: CARB would compile a comprehensive list of TCMs implemented or considered by federal, state, regional, and local agencies. This list would provide more choices and new measures subject to RACM analysis for potential inclusion as an enforceable measure in the SIP. This effort may also evaluate the emission reduction potential, feasibility, and cost-effectiveness of each TCM on the list. In addition, CARB could consider providing a quantification methodology to improve and standardize the RACM analysis as part of SIPs across air districts. In pursuing this measure, CARB would work in a collaborative effort with U.S. EPA, California MPOs, and air districts to develop the guidance and implement each potential TCM identified through the RACM.

Update Guidance for CMAQ and Motor Vehicle Fees: CARB would update the methodology and guidelines for estimating the cost-effectiveness of some of the most widely implemented transportation-related air quality projects using CMAQ and motor vehicle fees. Further, these guidelines would establish methods to quantify emission benefits and cost-effectiveness of new available transportation options and technologies. This update may also include critical inputs associated with emissions estimation to streamline the quantification of cost-effectiveness of various transportation projects. This action will accelerate the penetration of new strategies and maximize the emissions reductions from the transportation sector in the near-term. CARB would work with FHWA, the California Department of Transportation, MPOs, and air districts in pursuing this measure.

Estimated Emissions Reductions

While emissions reductions have not been identified at this time, CARB will quantify any emissions reductions from the proposed measures during the development process.

Timing

Proposed implementation begins:	2023+
Proposed CARB finalization:	2025

Proposed SIP Commitment

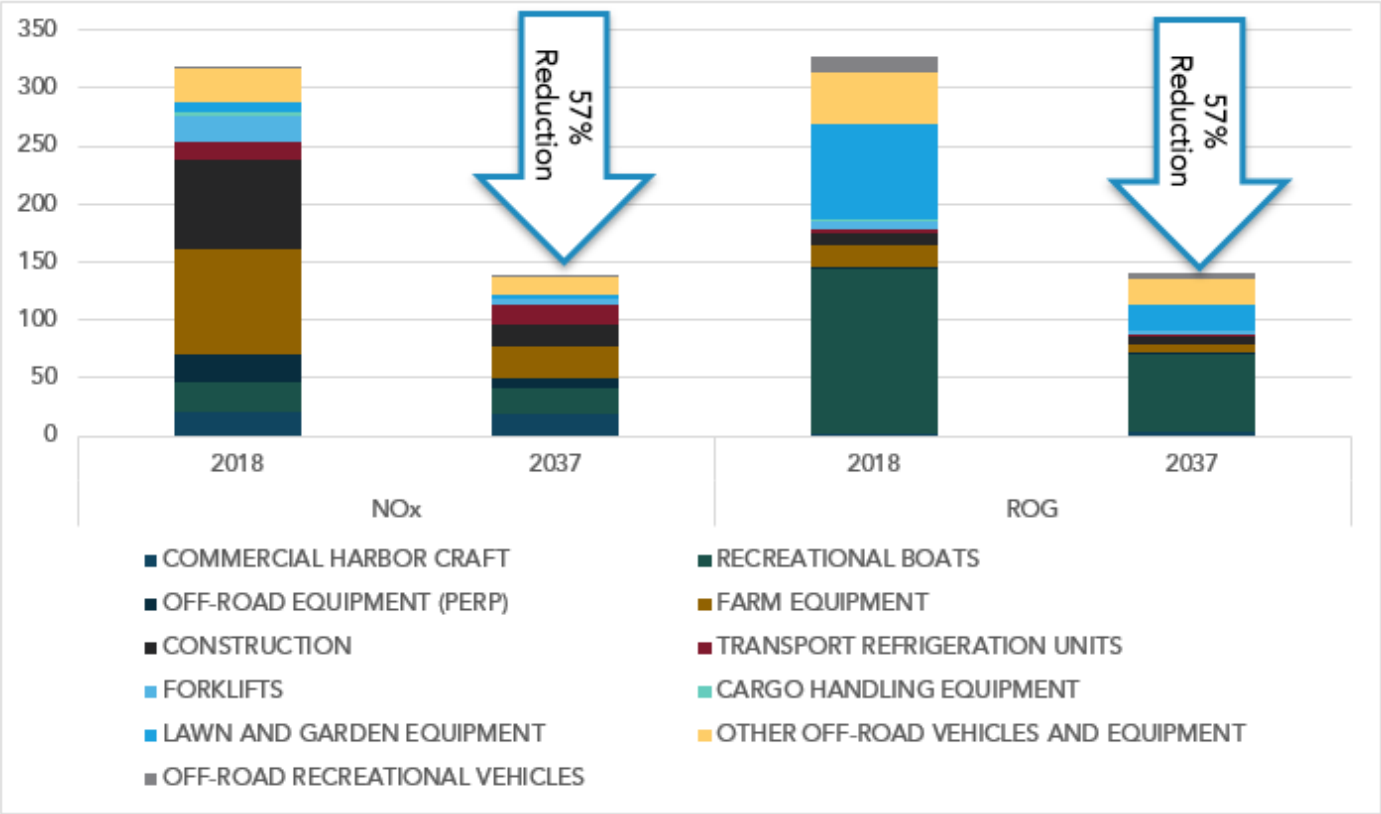
CARB staff proposes to commit to investigating the measures outlined above to support reductions in emissions and VMT from the on-road sources. Staff further proposes to commit to preparing the relevant written guidance and/or web tool and making them available to the public by 2025.

Proposed Measures: Off-Road 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, generators, forklifts, cargo handling equipment, commercial harbor craft, farm equipment, and other industrial equipment. CARB has programs in place to control emissions from various new off-road vehicles and equipment. CARB also has in-use programs for 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. CARB adopted amendments to the small off-road engine regulations in December 2021, and will be proposing Zero-Emission Off-Road Forklift and Transport Refrigeration Unit Part 1 regulations this year. While CARB's control programs to date have provided substantial emissions reductions, the Off-Road Vehicles and Equipment category continues to contribute a significant and growing fraction of the overall NOx and ROG emissions statewide. As shown in Figure 16 below, by 2037, existing control programs will reduce ROG and NOx emissions from Off-Road Vehicles and Equipment by 43 percent and 25 percent, respectively, compared to 2018 levels.

Figure 16 - Off-Road Vehicles and Equipment: Statewide Baseline Emissions Inventory[72]



[72] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district measures

Tier 5 Off-Road New Compression-Ignition Engine Standards

Overview

This measure is to establish more stringent standards and test procedures for new, off-road compression-ignition (CI) engines to reduce NOx, PM, and carbon (CO_2) emissions (referred to as Tier 5) for all off-road engine power categories, including those that do not currently utilize exhaust aftertreatment such as diesel particulate filters (DPF) and selective catalytic reduction (SCR). CI engines are used in a wide range of off-road equipment including tractors, excavators, bulldozers, graders, and backhoes. As of model year 2020, more than half of all new off-road CI engine families continue to be certified to California's most stringent (Tier 4 final) emission standards without the need for DPFs. This means that most new off-road CI engines are not reducing toxic diesel PM to the greatest extent feasible using the best available technology. The proposed new Tier 5 standards and test procedures 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 technologies for both PM and NOx.

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 50 percent of the NOx off-road 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 the 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, up to 90 percent below the current Tier 4 final emission standard levels, coupled with lower PM standards, would force engine manufacturers to incorporate DPFs, which many currently do not have. 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 a subset of these engines that are less than 19 kW (25 hp) are not required to comply with advanced PM aftertreatment--based standards. Small off-road CI engines 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, which was completed by the Center for Environmental Research and Technology (CE-CERT) in 2019[73].

- The off-road in-use requirements (off-road Not-To-Exceed) are not adequate to monitor in-use compliance.
- A recent research effort performed for CARB by CE-CERT[74] 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 program and the federal Transition Program for Equipment Manufacturers. Hence, it would be helpful to revise and improve the reporting and recordkeeping requirements.
- Recent CARB funded demonstrations of ultra-low NOx on-road engines conducted at the Southwest Research Institute (SWRI) show 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 is currently funding an off-road demonstration project with SWRI to support determining the feasibility of more stringent off-road standards for NOx, PM, and CO_2.
- Recent CARB test data, consistent with test data presented by reputable diesel publications, indicate that up to 40 percent of a typical off-road CI engine's in-use operation occur at idle[75], and that the frequency of in-use low-load- operation[76] is insufficient to keep exhaust emission aftertreatment temperature above 250 degrees Celsius, that enables efficient SCR operation to control NOx emissions. Establishing new idle emission reduction strategies and a low-load test cycle are also being investigated as part of this Tier 5 measure.

Proposed Action

CARB would develop and propose standards and test procedures for new off-road CI engines including the following: aftertreatment-based PM standards for 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), and more stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp) and first time CO_2 tailpipe standards targeting a 5 to 8.6 percent reduction. Other possible elements include enhancing in-use compliance, proposing more representative useful life periods, idle requirements and developing a low load test cycle. It is expected that Tier 5 requirements would rely heavily on technologies manufacturers are

[73] "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

[74] "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

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

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

developing to meet the recently approved low-NOx standards and enhanced in-use requirements for on-road- heavy-duty engines.

Estimated Emissions Reductions

The estimated emission benefits associated with the Tier 5 measure were calculated using CARB's off-road emissions inventory model, OFFROAD2017,[77] assuming 90 percent NOx reductions and 75 percent PM reductions from the Tier 4 standards for new engines within the 56 kW to 560 kW power categories, and up to 75 percent NOx and PM reductions for new engines less than 56 kW. Engines greater than 560 kW were modeled using a 50 percent reduction for both NOx and PM. Table 34 estimates the emission benefits of this measure for the non-preempted off-road CI engines under CARB's authority to regulate.

Table 34 – Tier 5 Off-Road New Compression-Ignition Engine Standards Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	10.4	NYQ
South Coast (2037)	2.7	NYQ
San Joaquin Valley (2037)	1.4	NYQ
Coachella Valley (2037)	0.1	NYQ
Eastern Kern County (2032)	<0.1	NYQ
Sacramento Metro (2032)	0.2	NYQ
Western Mojave (2032)	<0.1	NYQ
Ventura County (2026)	<0.1	NYQ

Timing

Proposed CARB Board hearing: 2025
Proposed implementation begins: 2029

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 34 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2025 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

[77] OFFROAD2017 contains estimates from the 2011 In-use Off-road Inventory.

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 phase-out of 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 54 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 adding 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 a Tier phase-out to the current In-Use Off-Road Diesel-Fueled Fleets Regulation for Tier 0, 1 and 2 engines between 2024 and 2032. CARB would propose that all low-use Tier 0 vehicles be subject to the phase-out in 2036. This scenario will allow 12-year phase out of these oldest engines. Along with the Tier phase-out, 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 propose that all fleets must use renewable diesel with some limited exceptions. Requiring the use of renewable diesel will achieve significant near-term NOx and PM reductions, reductions especially needed in

highly impacted communities. CARB would propose some voluntary compliance flexibilities for fleets that are incorporating ZEVs into their 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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board is in the process of a full independent public rulemaking proceeding where, to date, multiple public workshops and workgroups have occurred.

Estimated Emissions Reductions

The estimated emission benefits associated with the amendments to the In-Use Off-Road Diesel-Fueled Fleet Regulation were calculated using CARB's 2011 In-Use Off-Road Model, assuming turnover of all non-exempt Tier 0, 1, and 2 engines to Tier 4 final engines by 2033. Table 35 shows the estimated emissions benefits for this measure.

Table 35 - Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	4.0	0.3
South Coast (2037)	1.0	0.1
San Joaquin Valley (2037)	0.6	<0.1
Coachella Valley (2037)	<0.1	<0.1
Eastern Kern County (2032)	<0.1	<0.1
Sacramento Metro (2032)	0.5	0.1
Western Mojave (2032)	0.2	<0.1
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2022
Proposed implementation schedule: 2024-2036

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 35 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2022 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

Transport Refrigeration Unit Regulation Part 2

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 adopted the Part 1 amendments to the TRU ATCM on February 24, 2022. CARB plans to develop a subsequent Part 2 regulation to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets 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 Governor Newsom's 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.

Proposed Action

For this measure, CARB would propose the Part 2 rulemaking to require trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets 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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full independent public process.

Estimated Emissions Reductions

The emissions reductions were calculated using the 2021 TRU emission inventory baseline. Emissions reductions were estimated by converting any new purchase in 2028 and after for trailers, gensets, and railcar TRUs (effectively everything but trucks) to zero-emission units. The benefit in each is the emissions from model years that would have been diesel powered but are zero emission in the scenario (e.g. in 2037, the benefits are equal to the emissions from model year 2028 to 2037 units). Table 36 shows the estimated emissions benefits for this measure.

Table 36 - Transport Refrigeration Unit Regulation Part 2 Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	15.2	2.0
South Coast (2037)	5.0	0.7
San Joaquin Valley (2037)	3.8	0.5
Coachella Valley (2037)	0.3	<0.1
Eastern Kern County (2032)	0.1	<0.1
Sacramento Metro (2032)	0.4	<0.1
Western Mojave (2032)	0.4	<0.1
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2026
Proposed implementation begins: 2028

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 36 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2026 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

Commercial Harbor Craft Amendments

Overview

Commercial harbor craft (CHC) include any private, commercial, or government 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. The Board approved amendments to the CHC Regulation in March 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.

Action

The Commercial Harbor Craft Amendments were adopted by the Board in March 2022 and include the following approved requirements of the CHC regulation:

- Starting in 2023 and phasing in through 2031, most CHC (except for commercial fishing vessels and categories listed below) are 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 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 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 need to meet a Tier 2 standard at minimum.

In addition to the development process for the Proposed 2022 State SIP Strategy, the measure as proposed by staff and approved by the Board was subject to a full independent public process.

Estimated Emissions Reductions

The emissions reductions were calculated using the 2021 Harbor Craft emission inventory. The CHC Amendments would require most vessels to meet the Tier 3 or Tier 4 standard in effect and be retrofitted with a diesel particulate filter (DPF) following an 8-year phase-in schedule starting in 2023 and extending until 2031. Exceptions include commercial fishing vessels that would be required to meet a Tier 2 standard between 2030 and 2032, short-run ferries that would be required to be zero-emission by the end of 2025, and any new excursion vessel that would be required to be zero-emission capable by the end of 2024. Table 37 shows the estimated emission benefits for this measure.

Table 37 – Commercial Harbor Craft Amendments Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	8.7	0.5
South Coast (2037)	2.6	0.2
San Joaquin Valley (2037)	<0.1	<0.1
Sacramento Metro (2032)	0.3	<0.1
Ventura County (2026)	0.2	<0.1

Timing

CARB Board hearing: 2022
Proposed implementation schedule: 2023-2034

Proposed SIP Commitment

The Board adopted the CHC regulation on March 24, 2022. CARB staff will pursue to achieve the NOx and ROG emissions reductions shown in Table 37 for the relevant nonattainment areas in the relevant years.

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.

Proposed Action

For this measure, CARB would propose to start transitioning CHE to full zero-emission beginning in 2026. Based on the current state of zero-emission CHE technological developments, the transition to zero-emission would most likely be achieved largely through the electrification of CHE. Staff anticipates that all yard trucks and forklifts would be zero-emission by 2030, rubber-tired gantry cranes would be zero-emission by 2032, and 90 percent of other CHE will be zero-emission by 2036. These assumptions are 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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full independent public process. The proposed zero-emission CHE phase-in schedules may be adjusted based upon updated technology feasibility determinations and discussions with public stakeholders during the rulemaking process.

Estimated Emissions Reductions

The emission benefits were calculated using the 2022 CHE Inventory. Emissions reductions are based on transitioning to zero-emission over a period of 5 years, which begins in 2026 for yard tractors and forklifts, in 2028 for RTG cranes, and in 2032 for other types of CHE. Staff modeled 100 percent zero emissions for all equipment at full implementation, except for other CHE, which was modeled to reach 90 percent zero-emissions by 2037. Table 38 shows the estimated emissions benefits for this measure.

Table 38 – Cargo Handling Equipment Amendments Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	0.7	0.5
South Coast (2037)	0.6	0.4
San Joaquin Valley (2037)	<0.1	<0.1
Coachella Valley (2037)	<0.1	<0.1
Eastern Kern County (2032)	<0.1	<0.1
Sacramento Metro (2032)	<0.1	<0.1
Western Mojave (2032)	<0.1	<0.1
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2025
Proposed implementation schedule: 2026-2036

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 38 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2025 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

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 emissions 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, more sectors, including wheel loaders, excavators, and bulldozers, could be accelerated through this measure. Fully addressing control of emissions from new farm and construction equipment under 175 horsepower that are preempt, will require partnership on needed Federal zero-emission standards for off-road equipment.

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 are 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.
- Zero-emission off-road equipment examples are already appearing and entering demonstration and commercialization across a range of other applications and across operating weight classes from small compact equipment to >35 ton machines with deployments ongoing in Norway, Denmark, Netherlands, Germany, China, Canada and elsewhere. Such examples include agricultural specialized implements and utility tractors, paving including rollers, compactors, slipform pavers and screeds, asphalt and concrete delivery and placement, municipal equipment including landscaping maintenance and full-sized street sweepers, and earthmoving including skidsteers, compact trackloader, mini and full-sized excavators, mini and full-sized wheel loaders and various foundation drill, piledriver, demolition and large crane applications. There are 20 ton battery electric bulldozers and wheel loaders already operating in industrial settings. A number of manufacturers have already commercialized a variety of compact construction equipment and indicated a long-term zero-emission shift for the compact size class.

- 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 to ensure these globally emerging zero-emissions products and related innovations come to California. A targeted manufacturer regulation will need to be structured to make timely progress while accounting for diversity in parameters such as the number of equipment and engine manufacturers producing off-road equipment for sale in California, along with sales volumes, founding a transition effort that is cost-effective and technologically feasible. Sales/production mandate levels would be developed based on the projected feasibility of zero-emission technology to enter and grow 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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full independent public process.

Estimated Emissions Reductions

CARB will quantify any emissions reductions from this measure during the program development process.

Timing

Proposed CARB Board hearing:	2027
Proposed implementation begins:	2031

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve emissions reductions as described above. Staff proposes to commit to bring a publicly noticed item before the Board by 2027 that is either a proposed rule, or is a recommendation that the

Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

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 guidelines for 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 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 Diesel 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 emissions 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 programs, incentives, and policy 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 guidelines for 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 agencies 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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full independent public process.

Estimated Emissions Reductions

Given this is a voluntary program, reductions will be predicated on availability of advanced technology and zero-emissions equipment, as well as interest from policy partners using the program. CARB will quantify any emissions reductions from this measure during the program development process.

Timing

Proposed CARB finalization:	2025
Proposed implementation begins:	2027

Proposed SIP Commitment

CARB staff proposes to commit to engage in a public process and finalize a program by 2025.

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 or ROG and NOx emissions 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 kilowatts (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, 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 makes 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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full independent public process.

Estimated Emissions Reductions

The estimated emission benefits associated with this measure were calculated using CARB's off-road recreational marine vessel emissions inventory model, RMV2022, assuming a 5.0 g/kW-hr HC+NOx standard for outboard engines and personal watercraft engines at or above 40 kW in power and a 10.0 g/kW-hr HC+NOx standard for engines less than 40 kW, phased-in from 2031 to 2033. The potential benefits from electrification assume both a 100 percent phase-in for outboard engines less than 19 kW and a 50 percent phase-in for personal watercraft engines of all power ratings. Table 40 shows the estimated emissions reductions for this measure.

Table 39 – Spark Ignition Marine Engine Standards Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	2.1	4.2
South Coast (2037)	0.3	0.7
San Joaquin Valley (2037)	0.3	0.6
Coachella Valley (2037)	<0.1	<0.1
Eastern Kern County (2032)	<0.1	<0.1
Sacramento Metro (2032)	<0.1	0.1
Western Mojave (2032)	<0.1	<0.1
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2029
Proposed implementation schedule: 2031-2033 phase-in for exhaust standards
2031-2035 phase-in for zero-emissions

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 39 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2029 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

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 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 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 with high NOx emissions. This is the case with the South Coast, and to a lesser extent in other highly populated areas of coastal California. Emission-rich upwind areas in the South Coast 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 with continued NOx reductions. Therefore, ROG reductions are more impactful in the South Coast–which features a high concentration of NOx emissions sources and the nation's highest ozone levels—than elsewhere in California. Ozone modeling indicates that much of the South Coast, and particularly its more densely populated western and central areas, will continue to benefit from reductions in volatile organic compounds —the more volatile portion of ROG—in the post-2031 timeframe. Given that population tracks closely with consumer product use, further emissions reductions from consumer products would significantly contribute to ozone attainment progress in the South Coast.

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 have led to an over 50 percent reduction in emissions over the past 30 years. 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 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. CARB has regulated consumer products by setting regulatory standards applicable to their chemical constituents.

- As part of the State's effort to reduce air pollutants, in 1988 the Legislature added section 41712 to the California Clean Air Act (California 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 California 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. Since the program's inception, CARB's progressively declining VOC standards and reactivity limits have reduced VOC emissions by 250 tpd.
- Several reformulation approaches may be used to comply with VOC content standards. These include: substituting much less 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. Since the first prohibition on TAC became effective in 2002, CARB has achieved a total emissions reduction of over 13 tpd of TACs. 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, could offset the benefits of adopted high GWP compound prohibitions.

- CARB staff periodically conducts consumer product surveys which assess the sales volume and formulations of consumer products sold in California.

Proposed Action

For this measure, CARB is seeking further emissions reductions to support ozone attainment in the South Coast and elsewhere in California. To accomplish this, 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 emissions reductions are based on the state-of-the-science. Staff will consider opportunities to reduce ozone formation from both already regulated product categories as well as previously unregulated categories. 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 GHG emissions.

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 Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full independent public process.

Estimated Emissions Reductions

The proposed measure would address consumer product emissions growth by 2037 to help meet federal ozone standards in the South Coast and would contribute to attainment of State and federal standards statewide. Staff will use Survey data, along with other technical information, to propose control strategies to mitigate projected emission increases due to increased product use over time in the South Coast and statewide.

Staff intends to continue performing survey work in support of Consumer Product Program implementation. Survey results will enable staff both to track emissions trends and to project future emission levels for use in ozone modeling. That modeling would be used in the future to evaluate the need for further consumer product emissions reductions. Survey work would also inform CARB staff about the emergence and market acceptance of products that could be the basis, should the need arise, for more stringent, technologically achievable and commercially viable regulatory limits.

Emission reduction targets in this measure are expressed as VOC reductions or equivalent VOC reductions, as has historically been the case when describing SIP-creditable emissions reductions resulting from more stringent VOC standards or reactivity limits, respectively. The term

equivalent VOC reduction recognizes that reductions in ozone formation may be achieved by reformulating a product to use less reactive VOCs. For example, ozone formation reductions could be achieved by substituting less reactive VOC for more reactive VOC in a product. While total VOC content may not be reduced by such a reformulation, a reactivity limit would translate to an equivalent VOC reduction, based on the resulting ozone formation reduction. Similarly, equivalent VOC reductions could result from substitution of less reactive VOCs for LVP-VOCs in a product. In such a case, the total VOC content of a product could increase even as its ozone formation potential decreases. The benefits of such a regulatory approach would be appropriately expressed as equivalent VOC reductions.

Table 40 - Consumer Products Estimated Emissions Reductions

Region	NOx (tpd)	VOC (tpd)
Statewide (2037)	-	20.0
South Coast (2037)	-	8.0

Timing

Proposed CARB Board hearing: 2027
Proposed implementation schedule: 2028-2037

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the VOC emissions reductions shown in Table 40 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2027 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

Proposed Measures: Residential and Commercial Buildings

Description of Source Category

Residential and commercial buildings are responsible for roughly 5 percent of statewide NOx emissions due to natural gas combustion. California's buildings emit about 66 tpd of NOx[78] to the ambient air, about four times the emissions from electric utilities and nearly two-thirds the emissions from light-duty vehicles statewide. Space and water heating comprise nearly 90 percent of all building-related natural gas demand.[79] Buildings also contribute to approximately 25 percent of California's GHG emissions when accounting for fossil fuels consumed onsite and through electricity demand as well as refrigerants used in air conditioning systems and refrigerators. The fuels we use and burn in buildings, primarily natural gas, for space and water heating contribute significantly to building-related criteria pollutant and GHG 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 new residential and commercial space and water heaters sold in California. CARB would set an emission standard for space and water heaters to go into effect in 2030. Through meaningful engagement with communities and the process outlined below, CARB would adopt a statewide zero-emission standard which would have criteria pollutant benefits as a key result along with GHG reductions. 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 from space and water heaters can generate health benefits and cost-savings with properly designed standards. CARB understands that this measure needs to be part of a suite of equity-promoting and complementary building decarbonization policies deeply informed by public process that include scaling back natural gas infrastructure, expanding construction of zero-emission buildings, and building a sustainable market by increasing affordability and accessibility through expanding incentive programs, ensuring utility rates are supportive of electrification, developing the workforce, and increasing consumer education. Although this measure is the only component appropriate for including in the SIP, before setting an emission standard, CARB will work in collaboration with other agencies, industry, environmental stakeholders, and community representatives to ensure that the measure is developed and implemented in an equitable manner to benefit low-income and

[78] CARB's Criteria Emission Inventory CEPAM: 2022 Version 1.01 - Standard Emission Tool. NOx emission estimates are based on annual average daily emissions.

[79] Kenney, Michael, Nicholas Janusch, Ingrid Neumann, and Mike Jaske. 2021. California Building Decarbonization Assessment. California Energy Commission. Publication Number: CEC-400-2021-006-CMF. Web link: https://www.energy.ca.gov/data-reports/reports/building-decarbonization-assessment.

disadvantaged communities. As such, community engagement will be a critical aspect of the entire process. Furthermore, as this proposal is developed, this measure may be expanded to include other end-uses.

Background/Regulatory History

- 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.
- Even with low NOx emission limits in place, NOx emissions from natural gas combustion in residential and commercial buildings are projected to total 37.7 tpd NOx in the year 2030 and 36.2 tpd NOx in the year 2037[80]. If no further action is taken to further limit emissions from natural gas combustion, building-related emissions are projected to total 11.2 tpd NOx in South Coast and 4.6 tpd NOx in San Joaquin Valley by 2037.
- A statewide zero-emission standard for space and water heaters has the potential to reduce 13.55 tpd NOx in 2037. If the statewide zero-emission standard was expanded to include cooking, clothes drying, and all other end-uses of natural gas in residential and commercial buildings, it would have the potential to reduce 19.96 tpd NOx in 2037.

Proposed Action

For this measure, CARB would develop and propose zero-emission standards for space and water heaters sold in California using its regulatory authority for GHGs (which includes consideration of related criteria pollutant reduction benefits). CARB would collaborate with the U.S. Department of Energy and the California Energy Commission which are responsible for establishing appliance standards focused on maximizing energy efficiency at the federal and state level. CARB would consult with the California Building Standards Commission, Housing and Community Development and the California Energy Commission which have authority to develop building standards for new construction, additions, and alterations of residential and commercial buildings to ensure this measure is complementary. At the regional level, CARB would work with air districts in the development of a statewide zero-emission standard and to further tighten district rules to drive increased adoption of zero-emission technologies. Finally, CARB would engage with community-based organizations and other key stakeholders to incorporate equitable considerations for low-income and environmental justice communities where feasible. This proposed measure is a key component of a broader portfolio of strategies to advance equitable building decarbonization in California.

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 new space and water heaters (for either new construction or

[80] CARB's Criteria Emission Inventory CEPAM: 2022 Version 1.01 - Standard Emission Tool. NOx emission estimates are based on summer average daily emissions as opposed to annual average daily emissions.

replacement of burned-out equipment in existing buildings) sold in California would need to meet the zero-emission standard. It is expected that this regulation would rely heavily on heat pump technologies currently being sold to electrify new and existing homes. In addition to the development process for the Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board will be subject to a full public process.

Estimated Emissions Reductions

The estimated emission benefits associated with a zero-emission standard measure were quantified based on CARB's CEPAM 2022 v1.01. Preliminary estimated emission benefits are presented below. The estimated emissions benefits for this measure in the Draft 2022 State SIP Strategy were estimated based on annual-averaged emissions, but were updated for the Proposed 2022 State SIP Strategy for consistency with the other measures to represent summer-averaged emissions. The change in estimated emissions benefits are expected and the difference occurs due to household seasonal usage of space and water heaters.

Table 41 – Water Heating and Space Heating Estimated Emissions Reductions (Summer Average)[81]

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	13.5	1.5
South Coast (2037)	3.2	0.5

Timing

Proposed CARB Board hearing: 2025
Proposed implementation begins: 2030

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 41 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2025 that is either a proposed rule or is a recommendation that the Board direct staff to not pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

[81] Reductions may be achieved through CARB and/or complementary South Coast AQMD control measures for this sector

Proposed Measures: Pesticides

Description of Source Category

Pesticides are used for urban and agricultural pest management across the State and are an area-wide source of ROG and other types of emissions.

Pesticides are regulated under both federal and state law. Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the U.S. EPA has authority to control pesticide distribution, sale, and use. Pesticides used in the United States must first be registered (licensed) by the U.S. EPA and subsequently registered by DPR prior to being distributed, sold or used in California. Registration ensures that pesticides will be properly labeled and will not cause significant adverse effects to human health or the environment.

DPR is the agency responsible for regulating the sale and use of pesticides in California. DPR can generally reduce exposures to pesticides through the development and implementation of necessary restrictions on pesticide sales and use and by encouraging integrated pest management. Mitigation measures may be implemented by several methods, including regulations, local permit conditions, pesticide label changes, or product cancellation.

DPR is working to accelerate the transition toward safer, more sustainable pest management practices in order to improve the health of all Californians and protect the environment, while also continuing to support a strong agricultural economy and effectively manage urban pest pressures. DPR launched the Sustainable Pest Management Work Group in 2021 to develop a roadmap for how to achieve this vision. The group will release its recommendations later in 2022. Future developments from this workgroup's recommendations could potentially result in VOC emissions reductions in addition to minimizing reliance on more hazardous pesticides.

1,3-Dichloropropene Health Risk Mitigation

Background/Regulatory History

Considered a volatile organic compound (VOC), 1,3-Dichloropropene (1,3-D) is a fumigant used to control nematodes, insects, and disease organisms in soil. 1,3-D has major uses in California in fruit and nut trees, strawberries, grapes, carrots, and a host of other food and non-food crops. It is commonly injected into soil on a pre-plant basis. It is also applied through drip irrigation prior to planting. The potential for 1,3-D volatilization creates the opportunity for off-site transport and subsequent human exposure.

DPR's 2015 Risk Characterization Document indicates possible unacceptable exposures to non-occupational bystanders, particularly infants and children. DPR also observed air concentration detections near the acute health screening levels from ambient air monitoring performed throughout the state.

DPR's 2021 Risk Management Directive established the regulatory target of limiting short-term air concentrations to no more than 55 parts per billion as a 72-hour average to mitigate acute exposures.

DPR conducted five pilot studies in 2020-2021 to develop and assess mitigation measures to reduce 1,3-D exposures. The resulting mitigation measures from this study will help inform the basis for DPR's regulation to address exposure to non-occupational bystanders.

Proposed Action

DPR is developing a regulation to address both cancer and acute risk to non-occupational bystanders from the use of 1,3-D. The regulation will be developed in consultation with the County Agricultural Commissioners (CACs), the local air districts, the California Air Resources Board (CARB), the Office of Environmental Health Hazard Assessment (OEHHA), and the California Department of Food and Agriculture (CDFA). Once implemented, DPR's regulation would require applicators to use totally impermeable film (TIF) tarpaulins or other mitigation measures that provide a comparable degree of protection from exposure.

Potential Emissions Reductions

Once implemented, DPR's regulation would reduce non-occupational bystander exposure to 1,3-D by shifting to application methods with lower 1,3-D emissions or that use other measures to reduce exposure. Due to a variety of factors, a small number of allowable application methods may not result in emissions reductions. This regulation would not address any mandatory state implementation plan (SIP) element or other Clean Air Act requirement but may reduce VOC emissions from the use of this fumigant once fully implemented. While emissions reductions have not been identified at this time, DPR will quantify any emissions reductions once mitigation measures have been adopted.

Timing

DPR notices rulemaking:	2022
1,3-D Regulations effective:	2024

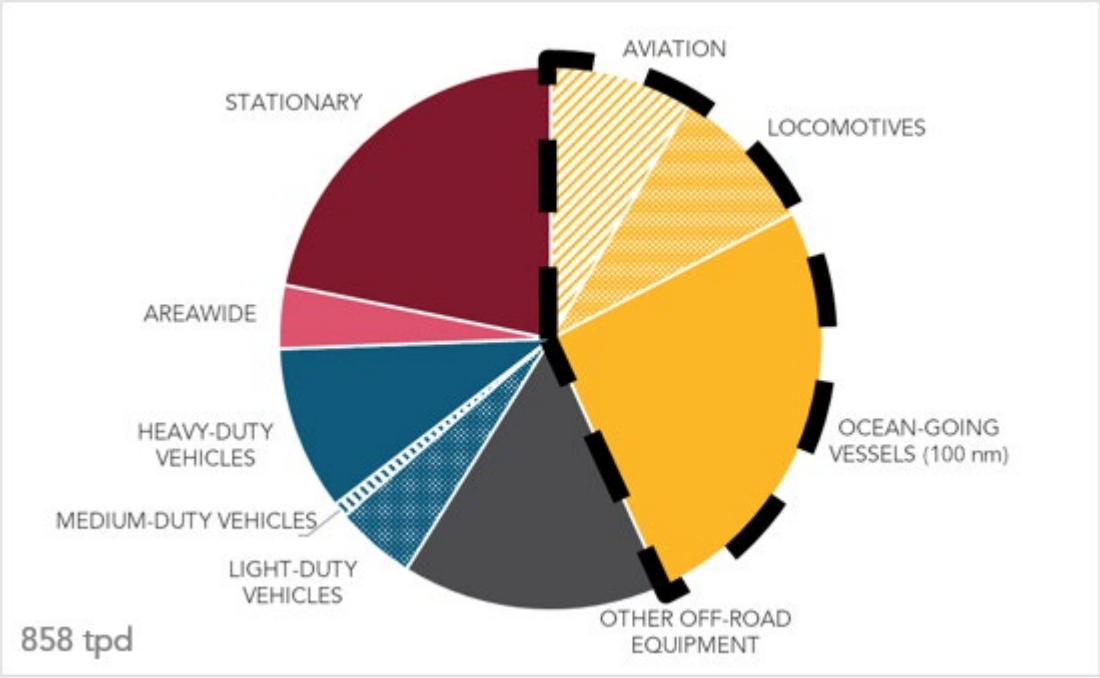
Proposed SIP Commitment

DPR is committed to the development and implementation of a statewide regulation to address both cancer and acute risks to non-occupational bystanders from the use of 1,3-D. While this regulation would not address any mandatory SIP element or other Clean Air Act requirement, it may reduce VOC emissions from the use of this fumigant once it is fully implemented.

Proposed Measures: 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 Clean Air Act, as described below. That said, given that aviation, locomotives, and oceangoing vessels are projected to contribute more than 40 percent of statewide NOx emissions by 2037, as shown in Figure 17, actions by the U.S. EPA and other federal and international entities are needed to reduce emissions from these sources. As shown below and in Figure 18, emissions of both ROG and NOx from these sources are projected to increase from 2018 through 2037 absent additional federal action.

Figure 17 - 2037 Statewide NOx Baseline Emissions Inventory[82]



[82] Source: 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

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. 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 secondary PM2.5.

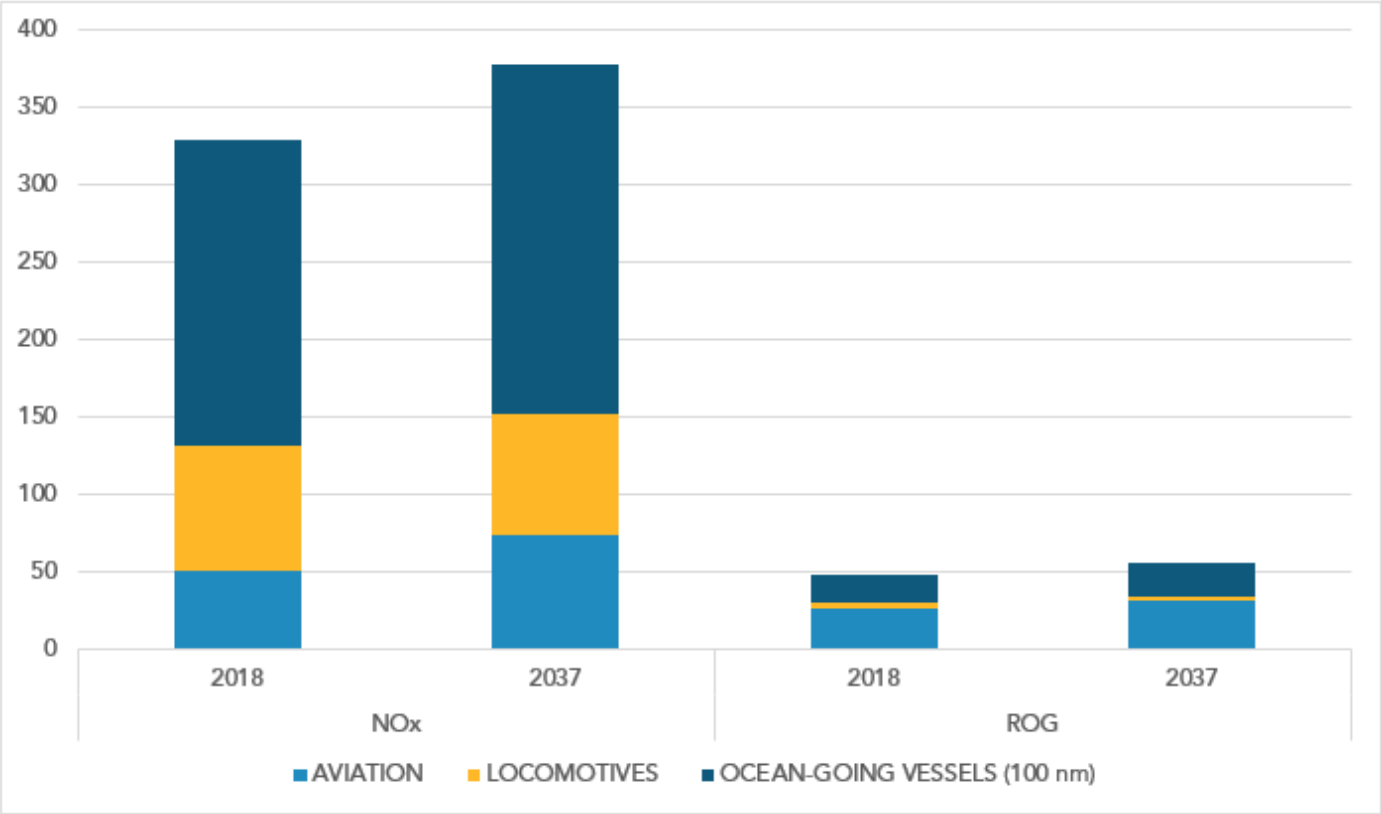
Aviation

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

Ocean-Going Vessels

Ocean-Going Vessels (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. OGVs travel internationally and may be registered by the U.S. Coast Guard (U.S.-flagged), or under the flag of another country (foreign-flagged). Most vessels that visit California ports are foreign-flagged vessels.

Figure 18 - Primarily-Federally Regulated Sources: Statewide Baseline Emissions Inventory[83]



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 may receive a waiver of Clean Air Act preemption for new motor vehicles that differs 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 vehicles than the federal government, 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, transportation refrigeration units, vehicles and equipment used in construction and mining, forklifts, cargo handling equipment, commercial harbor craft, and other

[83] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

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 standards. That said, the 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 will be implemented statewide and provide an opportunity for locomotive operators 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.

Local air districts may also pursue indirect source rules for freight facilities that could result in reductions from this category. CARB staff is considering an indirect source rule suggested control measure to assist air districts.

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 using on-board batteries to support zero-emission rail operation in sensitive areas, as well as cut fuel consumption and GHG emissions. As of March 2022, 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 I railroads: Union Pacific (UP) and BNSF Railway (BNSF). The 1998 Locomotive NO_x Fleet Average Emissions Agreement in the South Coast Air Basin (1998 MOU[84]) mandated a Tier 2-average NOx emission standard throughout the South Coast Air Basin by 2010.

[84]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[85]) 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 emissions 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 operate 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, 2024, a spending account would be established for each locomotive operator.
- The 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 Tier 4 locomotives from 2023-2030, and toward zero-emission locomotives from 2030 and beyond.
- At any time, the spending account funds may be used for zero-emission locomotives, zero-emission railcar movers, zero-emission infrastructure and zero-emission locomotive pilots and demonstration projects.

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

- Beginning January 1, 2030, all locomotives built in or before 2007 would no longer be allowed to operate in California.
- After January 1, 2030, only locomotives less than 23 years may operate in California.
- Starting January 1, 2030 all Passenger, Switch and Industrial locomotives with original engine build dates of 2030 or later must be zero-emission to operate in California.

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

- Starting January 1, 2035 all Line Haul locomotives with an engine build date of 2035 or later must be zero-emission to operate in California.

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

Estimated Emissions Reductions

Emissions reductions for this category were developed using the 2021 line haul locomotive inventory, the 2017 short line inventory, the 2017 passenger locomotive inventory, and the 2022 switcher and industrial and military locomotive inventories. The modeling included a spending account which accumulated funds from the locomotive companies based on the Tier and activity within California, then required spending funds on the cleanest available locomotives. In 2030, operational requirements restrict the use of locomotives age 23 and older, restricting them from operations in California. Zero emission locomotives would be phased in beginning in 2030 for all categories except line haul, with line haul following in 2035. Table 42 shows the estimated emissions benefits for this measure.

Table 42 – In-Use Locomotive Regulation Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
Statewide (2037)	63.2	2.5
South Coast (2037)	10.9	0.4
San Joaquin Valley (2037)	11.2	0.4
Coachella Valley (2037)	3.0	0.1
Eastern Kern County (2032)	1.5	<0.1
Sacramento Metro (2032)	3.2	0.1
Western Mojave (2032)	18.3	0.7
Ventura County (2026)	<0.1	<0.1

Timing

Proposed CARB Board hearing: 2023
Proposed implementation begins: 2024

Proposed SIP Commitment

CARB staff proposes to commit to undertake investigation of a rule designed to achieve the NOx emissions reductions shown in Table 43 for the relevant nonattainment areas in the relevant years. Staff proposes to commit to bring a publicly noticed item before the Board by 2023 that is either a proposed rule, or is a recommendation that the Board direct staff to not to pursue a rule based on an explanation of why such a rule is unlikely to achieve the relevant emissions reductions in the relevant timeframe, and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. If CARB staff

brings a proposed rule to the Board, and the Board adopts it, that rule may provide more or less emissions reductions than the amount shown.

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 the 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 air quality and climate goals and obtain local health exposure reductions. While engine standards do exist at the federal and international level for new type and in-production aircraft engines, 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 emissions 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.

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 (MOUs) with airports to further reduce on-ground emissions. To support emissions reductions on the scale needed, CARB will continue to advocate and coordinate with local, district, State, and federal partners to promulgate measures and regulations to achieve reductions.

Local air districts may also pursue indirect source rules for freight facilities that could result in reductions from this category. CARB staff is considering an indirect source rule suggested control measure to assist air districts.

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.[86]
- 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 new standards and recommended practices. The most recent standards adopted by ICAO are:[87]

[86] 2021_line_haul_locomotive_emission_inventory_final.pdf (ca.gov) *https://ww2.arb.ca.gov/sites/default/files/2021-02/2021_line_haul_locomotive_emission_inventory_final.pdf*

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

  - 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 is required to set emission standards for any air pollutant emitted by aircraft that may reasonably be anticipated to endanger public health or welfare.[88] U.S. EPA is not bound by ICAO standards and can adopt standards that are stricter than those set by ICAO. EPA has historically adopted ICAO standards and has most recently adopted a GHG emission standard and has proposed a PM emission standard for aircraft that are both equivalent to the ICAO standards.
- 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.[89]
- There are certified aircraft engines available that achieve NOx emissions below the CAEP/8 standard and PM emissions below the latest CAEP/11 standard. Engine manufacturers are also currently developing engines that achieve significant reductions beyond the current standards. These new technology advances enable reductions in both NOx and PM emissions and provide a pathway for achieving effective ways to reduce harmful emissions.
- 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, HC, 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 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 on-going reporting would enable better emissions inventory development, technology assessment, and policy development, such as future regulatory and incentive programs.

CARB would continue to assess technology development for the aviation sector. The purpose is to help inform and support CARB planning, regulatory, and voluntary incentive efforts.

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[88] Clean Air Act sec. 231, 42 U.S.C. § 7571.
[89] 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*

Concurrently, CARB would support, track, and explore current, in-development, and future emission reduction technology advancements.

CARB would evaluate federal, State, and local authority in setting operational efficiency practices to achieve emissions 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[90] and reduced power taxiing[91] have the potential to achieve emissions 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 the voluntary use of the cleanest aircraft, engines, and fuels. Incentives to encourage the use of the cleanest aircraft, 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 Proposed 2022 State SIP Strategy, the measure or measures as proposed by staff or adopted by the Board will be subject to full public processes.

Estimated Emissions Reductions

While emissions reductions have not been identified at this time, CARB will quantify any emissions reductions from the proposed measures during the development process.

Timing

CARB is exploring authority, feasibility, and conducting advocacy: 2021-2027

Proposed CARB Board hearing: 2027
Proposed implementation schedule: 2029

Proposed SIP Commitment

CARB staff proposes to commit to engage in a public process and bring to the Board programs and policies or take other actions to implement this measure.

[90] G.S. Koudis *et al.*, "Airport emissions reductions from reduced thrust takeoff operations," *Transportation Research Part D: Transport and Environment*, 52, 15-28 (2017).
[91] 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 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.[92] California has two primary regulations currently in place to reduce emissions from OGVs: 1) the OGV 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.[93,94] 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.[95]

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 are needed to achieve additional emissions reductions – this is discussed further in the Federal Actions portion of this document.

Local air districts may also pursue indirect source rules for freight facilities that could result in reductions from this category. CARB staff is considering an indirect source rule suggested control measure to assist air districts.

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[92] Regulated California Waters is defined as within 24 nautical miles of the California coast.
[93] 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.
[94] 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.
[95] 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

- The 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").[96] 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 account for 20 percent of mobile source NOx emissions in 2037, up from 10 percent in 2017.[97]
- 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, increased purchasing by consumers, 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 beginning on 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+.[98]
- Significant reductions in SOx emissions from OGVs have been achieved through implementation of the OGV Fuel Regulation and North American Emissions Control Area. Reductions in NOx, PM, and GHGs have also been achieved through implementation of the At Berth Regulation, however, additional reductions of these pollutants are needed, particularly from OGVs in transit and anchoring near the 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 are necessary to achieve further reductions from OGVs.

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[96] 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*

[97] 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*

[98] 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*

- 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 are necessary to achieve additional emissions reductions from OGVs given the international nature of sea trade.

Additionally, CARB staff have committed to assessing the potential feasibility of control technologies for use with 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 to the Board 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 AQMD. 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 Proposed 2022 State SIP Strategy, the measure or measures as proposed by staff or adopted by the Board will be subject to full public processes.

Estimated Emissions Reductions

While emissions reductions have not been identified at this time, CARB will quantify any emissions reductions from this measure during the measure development process.

Timing

Proposed CARB advocacy and development of future measures: 2021-2027

Proposed CARB Board hearing: 2027
Proposed implementation schedule: TBD

Proposed SIP Commitment

CARB staff proposes to commit to engage in a public process and bring to the Board programs and policies or take other actions to implement this measure.

Federal Actions Needed

The federal actions for primarily-federally and internationally regulated categories or subcategories include measures to control on-road heavy-duty vehicles, off-road equipment, aviation, locomotives, and oceangoing vessels.

On-Road Heavy-Duty Vehicles

Overview

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. 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.

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. The goal of these proposed measures is to reduce emissions from combustion engine on-road heavy-duty trucks sold outside of California but operating within California.

Background/Regulatory History

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 emissions 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.[99] 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. On March 28, 2022, U.S. EPA proposed the CTP[100], but the proposed rule provides options that are less stringent than previously suggested by U.S. EPA and CARB's Heavy-Duty Omnibus Regulation. 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.

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[99] *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*

[100] U.S. EPA proposed rulemaking on the CTP, *EPA-HQ-OAR-2019-0055-0983_content.pdf*

Additionally, CARB is leading the nation on the development and penetration of on-road heavy-duty ZEVs by adopting the Advanced Clean Trucks Regulation in 2020. The Advanced Clean Trucks regulation requires medium- and heavy-duty manufacturers to sell ZEVs as an increasing portion of their annual sales beginning in 2024. Also, the Proposed 2022 State SIP Strategy proposes the Advanced Clean Fleets Regulation which requires fleets to incorporate ZEVs into their fleet in combination with the Advanced Clean Trucks regulation.

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

Proposed Action

In the 2016 State SIP Strategy, CARB outlined a petition for a federal low-NOx standards that apply to all new heavy-duty trucks sold nationwide starting in 2024 or later. This will 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 emissions 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).

Estimated Emissions Reductions

The estimated emission benefits associated with the On-Road Heavy-Duty Vehicle Low-NOx Engine Standards are calculated with CARB's motor vehicle emissions inventory model, EMFAC2017. The emissions benefits calculation assumes that Federal heavy-duty vehicles with engine model year 2027 and newer will meet the proposed Option 1 standards in U.S. EPA's Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards.[101] Table 43 shows the estimated emissions benefits for this measure.

Table 43 – On-Road Heavy-Duty Vehicle Low-NOx Engine Standards (Federal Action)
Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
South Coast (2037)	3.8	NYQ

Timing

U.S. EPA rulemaking date: TBD; Proposed in 2022
Proposed implementation begins: Proposed for 2027

Proposed SIP Commitment

Although the CTP proposal released in March 2022 provides options that are less stringent, U.S. EPA is moving forward with the federal CTP, and CARB staff proposes to commit to advocate to align the federal CTP with CARB's low-NOx Omnibus regulations to the maximum

[101] 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*

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.

2. On-Road Heavy-Duty Vehicle Zero-Emission Requirements

Proposed Action

CARB would petition and/or advocate to U.S. EPA for federal 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.

Estimated Emissions Reductions

Emissions reductions from this potential federal action have not yet been quantified.

Timing

U.S. EPA rulemaking date:	TBD
Proposed implementation begins:	TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate federal zero-emission on-road heavy-duty vehicle requirements, along with more stringent GHG standards for medium- and heavy-duty vehicles, to achieve the needed NOx emissions reductions for the South Coast in 2037.

Preempted Off-Road Equipment

Overview

Off-road equipment regulated at the federal level also contributes significant ozone precursor emissions in California. The goal of more stringent standards would be to reduce NOx and PM emissions from new, off-road compression-ignition and spark-ignition 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 catalytic reduction (SCR). Included in the CARB measures is a proposed action for Tier 5 standards on State-regulated off-road equipment.

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. 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.

Background/Regulatory History

The off-road category includes spark-ignition engines that mostly operate on gasoline and alternative fuels, as well as compression-ignition engines which operate on diesel fuel. Spark--ignition engines include small off-road engines (SORE) and large spark-ignition engines (LSI). The SORE category includes lawn, garden, and small industrial equipment that are less than or equal to 19 kilowatts (kW). The LSI engine category includes engines greater than 19 kW that are used in forklifts, portable generators, large turf care equipment, airport ground support equipment, and general industrial equipment. Compression--ignition engines are used in off-road equipment including tractors, excavators, bulldozers, graders, and backhoes. As of model year 2020, more than half of all new off-road compression-ignition 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 compression--ignition 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 a national Tier 5 compression-ignition measure would be more stringent than required by current U.S. EPA and European Stage V nonroad regulations and more stringent spark-ignition standard for preempted engines would require the use of best available control technologies for both PM and NOx, while encouraging transitions to zero--emission equipment where feasible.

CARB continues to lead the nation in the development and penetration of ZEVs and equipment including the Proposed 2022 State SIP Strategy proposed Off-Road Zero--Emission Targeted Manufacturer Rule. A national off-road equipment zero-emission standard would provide the market direction manufacturers need to increase the penetration of zero-emission off-road equipment.

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.

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.

1. More Stringent Emission Standards for Preempted Off-Road Engines

Proposed Action

CARB would petition and/or advocate to U.S. EPA to promulgate off-road equipment Tier 5 compression-ignition standards and new spark-ignition 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.

Estimated Emissions Reductions

Similar to non-preempted engines, the estimated emission benefits associated with the Federal Tier 5 measure were calculated using CARB's off-road emissions inventory model, OFFROAD2017,[102] assuming 90 percent NOx reductions and 75 percent PM reductions from the Tier 4 standards for new engines within the 56 kW to 560 kW power categories, and up to 75 percent NOx and PM reductions for new engines less than 56 kW. Engines greater than 560 kW were modeled using a 50 percent reduction for both NOx and PM. For the federal measures, these reductions were applied to construction and agricultural equipment under 175 horsepower, beginning in 2028. Table 44 shows the estimated emissions benefits for this measure.

[102] OFFROAD2017 contains estimates from the 2011 In-use Off-road Inventory.

Table 44 – More Stringent Emission Standards for Preempted Off-Road Engines (Federal Action) Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
South Coast (2037)	1.6	NYQ

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these standards to achieve the needed NOx emissions reductions for the South Coast in 2037.

2. Off-Road Equipment Zero-Emission Standards Where Feasible

Proposed Action

CARB would 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.

Estimated Emissions Reductions

The estimated emission benefits associated with the Federal Off-Road Equipment Zero-Emission Standards Where Feasible measure were calculated using CARB's off-road emissions inventory model, OFFROAD2017,[103] assuming NOx reductions from zero-emission standards for off-road equipment where the technology is feasible. Table 45 shows the estimated emissions benefits for this measure.

Table 45 – Off-Road Equipment Zero-Emission Standards Where Feasible (Federal Action) Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
South Coast (2037)	2.2	NYQ

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these standards to achieve the needed NOx emissions reductions for the South Coast in 2037.

[103] OFFROAD2017 contains estimates from the 2011 In-use Off-road Inventory.

Aviation

Overview

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, additional measures are needed to meet climate and air quality goals and obtain local health exposure reductions. While engine standards and requirements do exist at the federal and international level for aircraft, these standards and requirements 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. To achieve the magnitude of emissions 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.

There are a variety of actions that could be taken by U.S. EPA, FAA, and ICAO to drive reductions in the aviation sector including setting more stringent emissions standards, requiring zero-emission on-ground operation, requiring cleaner fuel and aircraft visits, and setting aircraft emissions caps at California airports. The primary goal for a more stringent aviation engine standard is to reduce emissions from aircraft operating in California. In addition to needing more stringent engine standards, there are other mechanisms by which regulatory entities could require emissions reductions from aircraft in California. This includes cleaner fuel and visit requirements and zero-emission on-ground operation requirements to also reduce emissions from aircrafts operating in California. Finally, an airport aviation emissions cap is a potential additional strategy to reduce emissions from all aircraft activities in California through regulation that is potentially more flexible for regulated entities. 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.

Background/Regulatory History

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.[104] 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 new standards and recommended practices.

The most recent standards adopted by ICAO are:[105]

- CAEP/8: latest NOx standard adopted in 2011;
- CAEP/10: first CO_2 standard adopted in 2017; and

[104] 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
[105] Committee on Aviation Environmental Protection (CAEP) (icao.int)
www.icao.int/ENVIRONMENTAL-PROTECTION/Pages/CAEP.aspx

- CAEP/11: first non-volatile PM mass and number standard adopted in 2019.

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.

U.S. EPA is required to set emission standards for any air pollutant emitted by aircraft that may reasonably be anticipated to endanger public health or welfare.[106] U.S. EPA is not bound by ICAO standards and can adopt standards that are stricter than those set by ICAO. U.S. EPA has historically adopted ICAO standards and has most recently adopted a GHG emission standard and has proposed a PM emission standard for aircraft that are both equivalent to the ICAO standards.

In addition to establishing a new engine standard for aircraft, U.S. EPA could proceed separate from the ICAO to also set cleaner fuel and engine requirements for aircraft visiting California. There is now an opportunity for U.S. EPA to be technology forcing, recognizing the need for tighter standards to help states meet federal air quality mandates.

The on-ground operations at airports present additional emissions reductions opportunities for aviation. Typical aircraft 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 on-board rechargeable batteries instead of the APU as the primary power supply when the main engines are not being used would reduce the usage of the gas turbine APU and hence overall aircraft emissions. Taxiing is another on-ground operation where emissions can be reduced through reduced main engine power during taxiing, improved taxi-time, and the use of new technologies. For example, some airports are employing semi-robotic aircraft tractors during aircraft pushback operations to tow the aircraft with the engines stopped, thus eliminating emissions from the main engines.

U.S. EPA has the authority to regulate aircraft and their operations and reduce the associated emissions. Further, in 1994, U.S. EPA developed a Federal Implementation Plan (FIP) for the South Coast that included strategies U.S. EPA would pursue to support attainment of the 1-hour ozone standard. As an alternative to the strategies identified above, the FIP included an aviation strategy requiring airports to achieve a similar level of NOx and ROG reductions from all airport operations as was required under the stationary cap rules for the South Coast.

1. More Stringent Aviation Engine Standards

Proposed Action

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 a variety of companies to accelerate the development of new aircraft and engine technologies. The goal of the program

[106] Clean Air Act sec. 231, 42 U.S.C. § 7571.

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.[107]

Estimated Emissions Reductions

Emissions reductions from this potential federal action have not yet been quantified.

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these standards to achieve the needed NOx emissions reductions for the South Coast in 2037.

2. Cleaner Fuel and Visit Requirements for Aviation

Proposed Action

CARB would petition and/or advocate to U.S. EPA to require aircraft to use cleaner fuels when traveling through California, and to require visits from cleaner aircraft. Using the aircraft engine certification data manufacturers report to ICAO, CARB staff has identified the Airbus 320-NEO and Airbus 319-100 Series as the cleanest options for NOx emissions among aircraft commonly visiting California, with NOx emissions 40 percent below the weighted-average aircraft visit.

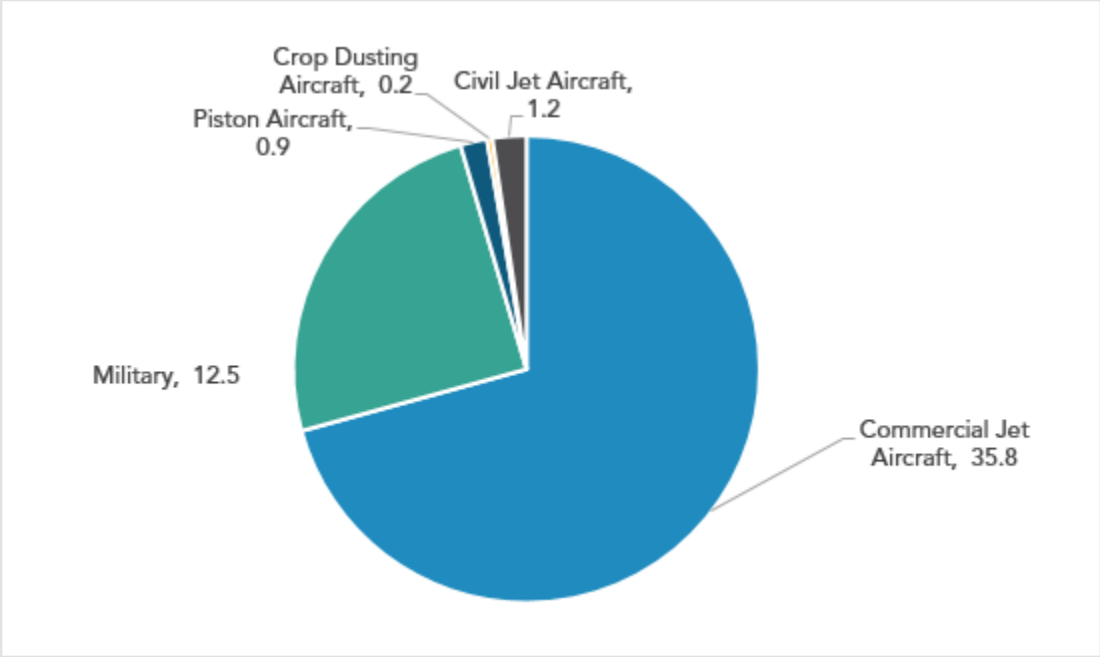
Additionally, a recent study conducted at the Bay Area's three largest airports showed that a jet fuel blend made with 50 percent of Sustainable Aviation Fuels (SAF) reduced PM emissions by 65 percent. Note that this is certified jet fuel being used in an existing and commercially available aircraft, and would not require technology advancement or development, but is simply using the cleanest available option already available.

If the average aircraft visit to California was replaced with the Airbus A320-NEO (or similar) using a SAF blend fuel, the state would achieve a 40 percent NOx reduction, 54 percent PM reduction, and up to a 45 percent reduction in fuel. The table below shows the emissions benefits that could be achieved if this level of reduction is achieved for all commercial aircraft flights in California by 2037. Note that these reductions account for benefits of commercial jet aircraft on take-off, landing, approach, and taxiing only, as flight operations over 3000 feet are not included in the state emission inventory (but are accounted for by U.S. EPA).

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

Commercial jet aircraft make up slightly less than three quarters of the statewide NOx from aircraft in 2022, as shown below in Figure 19.

Figure 19 – Statewide NOx Emissions from Aircraft by Type in 2022[108]



Estimated Emissions Reductions

The emissions reductions were calculated based on the current aviation emissions in CEPAM2022, which are submitted by individual air districts for the airports within their jurisdiction. Reductions were calculated by reviewing the model of aircraft visits to California using FAA data, then replacing all visits with the aircraft that is certified with the lowest NOx emissions. Then a reduction factor for the use of sustainable aviation fuel was applied, simulating replacing all visits with the lowest-NOx aircraft using a 50 percent sustainable aviation fuel blend. Table 46 shows the estimated emissions benefits for this measure.

Table 46 – Cleaner Fuel and Visit Requirements for Aviation (Federal Action) Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
South Coast (2037)	10.2	NYQ

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

[108] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions with adopted CARB and district measures

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these requirements to achieve the needed NOx emissions reductions for the South Coast in 2037.

3. Zero-Emission On-Ground Operation Requirements at Airports

Proposed Action

CARB would petition and/or advocate to U.S. EPA to require zero-emission on-ground operation at California airports.

Estimated Emissions Reductions

Emissions reductions from this potential federal action have not yet been quantified.

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these requirements to achieve the needed NOx emissions reductions for the South Coast in 2037.

4. Airport Aviation Emissions Cap

Proposed Action

In addition to the three proposed aviation actions above, CARB would petition and/or advocate to appropriate agencies, including the U.S. EPA for additional actions to control emissions from aviation, such as requiring an aviation emissions cap at each California airport. This emissions cap would set an emissions level for all aircraft activities related to the airports preventing emissions to increase with airport growth and reduce existing emissions by replacing airport activities with cleaner combustion and zero-emission technologies. These additional reductions could potentially also be achieved through incentivized turnover of aircraft or upgrades to cleaner engines, or other available regulatory mechanisms.

Estimated Emissions Reductions

The emissions reductions were calculated based on the current aviation emissions in CEPAM2022, which are submitted by individual air districts for the airports within their jurisdiction. This emissions cap would set an emissions level for all aircraft activities related to the airports preventing emissions to increase with airport growth and reduce existing emissions by replacing airport activities with cleaner combustion and zero-emission technologies. Table 47 shows the estimated emission benefits for this measure.

Table 47 – Airport Aviation Emissions Cap (Federal Action) Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
South Coast (2037)	9.2	NYQ

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these requirements to achieve the needed NOx emissions reductions for the South Coast in 2037.

Locomotives

Overview

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 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.

Locomotive switchers, or switchers, move railcars and sections of trains in and around railyards and account for about 10 percent of freight diesel use. The 2017 *petition to U.S. EPA* included a proposed standard for zero-emission technology for use in certain overburdened areas and communities near railyards, but zero-emission technology is now feasible for additional locomotive applications and geographical areas.

Further, 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. It is imperative that U.S. EPA remove this regulatory provision in order to ensure emissions reductions as locomotives require updating over time.

Background/Regulatory History

Under the Clean Air Act, U.S. EPA has the sole authority to establish emissions standards for new locomotives. (42 United States Code (U.S.C.) §7547, (a)(5)) By regulation, U.S. EPA has defined "new" locomotives to include both those newly manufactured and those existing locomotives that are remanufactured or rebuilt. U.S. EPA has previously promulgated two sets of national locomotive emission regulations (1998 and 2008). In 1998, U.S. EPA approved national regulations that primarily emphasized NOx reductions through Tier 0, 1, and 2 emission standards. Tier 2 NOx emission standards reduced older uncontrolled locomotive NOx emissions by up to 60 percent, from 13.2 to 5.5 g/bhp-hr.

In 2008, U.S. EPA approved a second set of national locomotive regulations. Older locomotives, upon remanufacture, are required to meet more stringent particulate matter (PM) emission standards, which are about 50 percent cleaner than Tier 0-2 PM emission standards. U.S. EPA refers to the PM locomotive remanufacture emission standards as Tier 0+, Tier 1+, and Tier 2+. The new Tier 3 PM emission standard (0.1 g/bhp-hr), for model years 2012-2014, is the same as the Tier 2+ remanufacture PM emission standard. The 2008 regulations also included new Tier 4 (2015 and later model years) locomotive NOx and PM emission standards. U.S. EPA Tier 4 NOx and PM emission standards further reduced emissions by approximately 90 percent from uncontrolled levels.

In the 2016 State SIP Strategy, CARB included a measure to petition for more stringent national locomotive emission standards and, 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 July 2022, U.S. EPA has taken no action on this petition.

1. More Stringent National Locomotive Emission Standards

Proposed Action

In the 2016 State SIP Strategy, CARB outlined a petition for new national locomotive emission standards for significant additional reductions in criteria and toxic pollutants, and GHG emissions from existing and future locomotives.

This measure describes the emissions levels that CARB staff believes would be achievable with a new generation of national emissions standards for locomotives, including both newly manufactured and remanufactured units. The description focuses on technology that could be employed to reach the lower emission levels to address local, regional, and global air pollution concerns in California, and in other states with high levels of railyard activity or rail traffic

Estimated Emissions Reductions

Emissions reductions from this potential federal action have not yet been quantified.

Timing

U.S. EPA rulemaking date:	TBD
Proposed implementation begins:	TBD

Proposed SIP Commitment

CARB is waiting for U.S. EPA to act on the petition to promulgate both Tier 5 national emission standards for newly manufactured locomotives, and more stringent national requirements for remanufactured locomotives.

2. Zero-Emission Standards for Locomotives

Proposed Action

For this measure, CARB would petition and/or advocate to U.S. EPA to promulgate national zero-emission standards for locomotives to reduce criteria and toxic pollutants, fuel consumption, and GHG emissions.

Estimated Emissions Reductions

Emissions reductions from this potential federal action have not yet been quantified.

Timing

U.S. EPA rulemaking date:	TBD
Proposed implementation begins:	TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these standards achieve the needed NOx emissions reductions for the South Coast in 2037.

3. Address Unlimited Locomotive Remanufacturing

Proposed Action

For this measure, CARB would petition and/or advocate to U.S. EPA to address the regulatory provisions that allows continued remanufacturing of old and polluting locomotives to the same pollution tier standards, and persistent pollution from these sources.

Estimated Emissions Reductions

Emissions reductions from this potential federal action have not yet been quantified.

Timing

U.S. EPA rulemaking date:	TBD
Proposed implementation begins:	TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate a rule to address the regulatory provisions that allow continued remanufacturing of old and polluting locomotives to the same pollution tier standards, and achieve the needed NOx emissions reductions for the South Coast in 2037.

Ocean-Going Vessels

Overview

Emissions from main engines and auxiliary engines of ocean-going vessels (OGVs) during transit, anchorage, and maneuvering must be addressed in order to achieve the NOx reductions needed to meet air quality standards. Currently, very few vessels with Tier 3 main engines visit California ports.

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. 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.

Background/Regulatory History

OGVs and emissions standards are largely regulated on an international level by the 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+.[109]

The 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").[110] 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 SOx emissions.

OGV emissions (up to 100 nautical miles) are projected to contribute 20 percent of mobile source NOx emissions in 2037, up from 10 percent in 2017.[111] Increased emissions are occurring from all modes of OGV operations (in transit, maneuvering, anchoring, and at berth) because of

[109] 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*
[110] 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*
[111] 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*

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.).

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 California coast, 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. For cleaner fuel and vessel engine visit requirements to California, U.S. EPA has authority to set these requirements. 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.

As mentioned earlier, port congestion has led to an abnormally high number of container vessels at anchor, as many as 109 vessels as of October 2021,[112] which use auxiliary engines continuously to provide power for shipboard functions. This has led to emissions increases from ocean-going vessels which can negatively impact air quality, especially in communities near ports. According to CARB estimates, as of October 2021, the increased congestion has resulted in overall containership emissions increases of 20 tpd of NOx and 0.5 tpd of PM in the South Coast relative to average pre-pandemic baseline levels. These dramatic increases in emissions serve as an example of the importance of federal action to control emissions from ocean-going vessels.

1. More Stringent NOx and PM Standards for Ocean-Going Vessels

Proposed Action

Emissions from main engines and auxiliary engines of OGVs during transit, anchorage, and maneuvering must be addressed in order to achieve NOx reductions needed to meet air quality standards in California. 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 5 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

[112] Marine Exchange of Southern California, *https://mxsocal.org/*

adopt more stringent Tier 4 marine standard and establish efficiency requirements for existing vessels.

Estimated Emissions Reductions

The emissions reductions associated with the More Stringent NOx and PM Standards for Ocean-Going Vessels were calculated using the 2021 OGV inventory, and AIS based model developed to calculate and forecast emissions from all vessels that enter within 100 nautical miles of the California shore. The emission benefits were calculated by requiring more stringent Tier 4 marine standard and established efficiency requirements for existing vessels. Table 48 shows the estimated emissions benefits for this measure.

Table 48 – More Stringent NOx and PM Standards for Ocean-Going Vessels

Region	NOx (tpd)	ROG (tpd)
South Coast (2037)	0.8	NYQ

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA and/or IMO that it promulgate more stringent standards to achieve the needed NOx emissions reductions for the South Coast in 2037.

2. Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels

Proposed Action

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. Current Tier 3 vessel manufacturing data suggest that there may not be sufficient Tier 3 vessels to satisfy all vessel visits to the State, 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 retrofit to reduce NOx emissions. Some of the current retrofit technologies for marine engines include exhaust gas recirculation (EGR) and SCR, which both have potential to reduce emissions by up to 80 percent. It is possible that Tier 3 and retrofit strategies may not achieve full potential benefits when operating or maneuvering at lower loads in the vicinity of seaports in Regulated California Waters. Therefore, other strategies such as water-in-fuel emulsion, biofuels, renewable hydrogen and other hydrogen-derived fuels such as ammonia, methanol, batteries and fuel cells are being considered as potential or complementary fuel choices for vessels to achieve maximum emissions reductions. All options need to be considered to achieve the needed emissions reductions. CARB would petition and/or advocate to U.S. EPA to require vessels to use cleaner fuels and visits from cleaner OGVs.

Estimated Emissions Reductions

The emissions reductions associated with the Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels were calculated using the 2021 OGV inventory, and AIS based model developed to calculate and forecast emissions from all vessels that enter within 100 nautical miles of the California shore. The emission benefits were calculated by replacing all visiting vessels with the cleanest options available, a Tier 3 marine engine by 2037. In each year starting in 2028 through 2037, 10 percent of vessels that would not already be naturally turned over to Tier 3 by 2037 would meet Tier 3 standards (or achieve a similar percent reduction in emissions), including their main engines, auxiliary engines, and boilers. Table 49 shows the estimated emissions benefits for this measure.

Table 49 – Cleaner Fuel and Vessel Requirements for Ocean-Going Vessels (Federal Action) Estimated Emissions Reductions

Region	NOx (tpd)	ROG (tpd)
South Coast (2037)	23.7	NYQ

Timing

U.S. EPA rulemaking date: TBD
Proposed implementation begins: TBD

Proposed SIP Commitment

CARB staff proposes to commit to petition and/or advocate to U.S. EPA that it promulgate these requirements to achieve the NOx emissions reductions shown in Table 50 for the South Coast in 2037.

Chapter 6: Incentives

While regulatory mechanisms will achieve most of the necessary emissions reductions, incentives will continue to be critical to achieving near- and long-term air quality goals in California. The rate of natural vehicle fleet turnover will not be sufficient to meet air quality goals and incentives accelerate the deployment of cleaner technologies. Moving forward, a sweeping transformation of the mobile sector will be needed to meet ambient air quality standards, in addition to reducing near-term risk in our most disadvantaged communities, and meeting climate targets. Since release of the 2016 State SIP Strategy, the Legislature has identified and appropriated significant amounts of funding to a variety of CARB's incentive programs. As the State moves forward, it is important to recognize that significant continued public and private investment will be necessary in order to reach the levels of cleaner technology needed in the specified timeframes.

While regulations take considerable time to develop, and lead-time and transition periods are necessary for industry to feasibly comply with those regulations, significant emissions reductions are nonetheless needed from mobile sources in California over the next 5, 10, and 30 years. In recent years, the Board has repeatedly directed staff to pull forward regulatory deadlines where feasible to reduce emissions earlier than previously planned. To the extent possible, CARB will continue to explore areas where it may be possible to achieve emissions reductions earlier than currently scheduled in a developing regulation or by amending an existing regulation.

As part of his 2022-23 State Budget, the Governor has proposed $6.1 billion over five years to accelerate the transition of the transportation sector to ZEVs, with a focus on the communities most impacted by pollution. This builds on the $3.9 billion multi-year commitment to ZEV acceleration in the 2021 Budget Act, for a total investment to $10 billion over six years to decarbonize California's most polluting sector and improve public health. In the May revise, the Governor proposed accelerating almost $2.3 billion of this funding into the current 2021-22 budget year, while maintaining the overall $10 billion investment. The Legislature has approved much of this transformational ZEV package in several budget bills passed in June and signed by the Governor – including agreeing to the overall investment level of $10 billion with plans to finalize some of the detailed, program level appropriations later this session. These substantial allocations specifically dedicated to incentive--based turnover of mobile source vehicles and equipment will achieve emissions reductions from the mobile fleet and from other sources of air pollution statewide. As California has shown for decades, clean technologies and the markets evolving around them are compatible with and contribute to a thriving State economy. With the availability of significant federal and State economic stimulus funds, it is imperative that we use those funds wisely to achieve the maximum benefit possible for all Californians, and this includes reducing mobile source emissions through a transition to zero-emission technologies, and otherwise supporting the green economy.

Incentive programs to promote and accelerate the use of advanced technologies, to enhance transportation options, and to shift transportation systems generally towards lower-pollution modes by reducing vehicle miles travelled as well as reducing emissions from individual vehicles, will be essential to meeting our pre-2030 air quality goals and setting us on the trajectory for future goals like the 70 ppb 8-hour ozone standard. Therefore, strategic use of incentive funding

is essential to achieve earlier penetration of cleaner combustion and zero-emission technologies than would happen through natural turnover, and to support transportation systems improvements. For instance, in its approval of the most recent Funding Plan for Clean Transportation Incentives, CARB's Board called out the continuing need for implementation of the Climate Action Plan for Transportation Infrastructure (CAPTI) and related actions in order to improve the system as a whole. In addition to funding, it is critical that clean transportation is accessible to all Californians, particularly those in low-income and disadvantaged communities who experience a disproportionate share of pollution impacts.

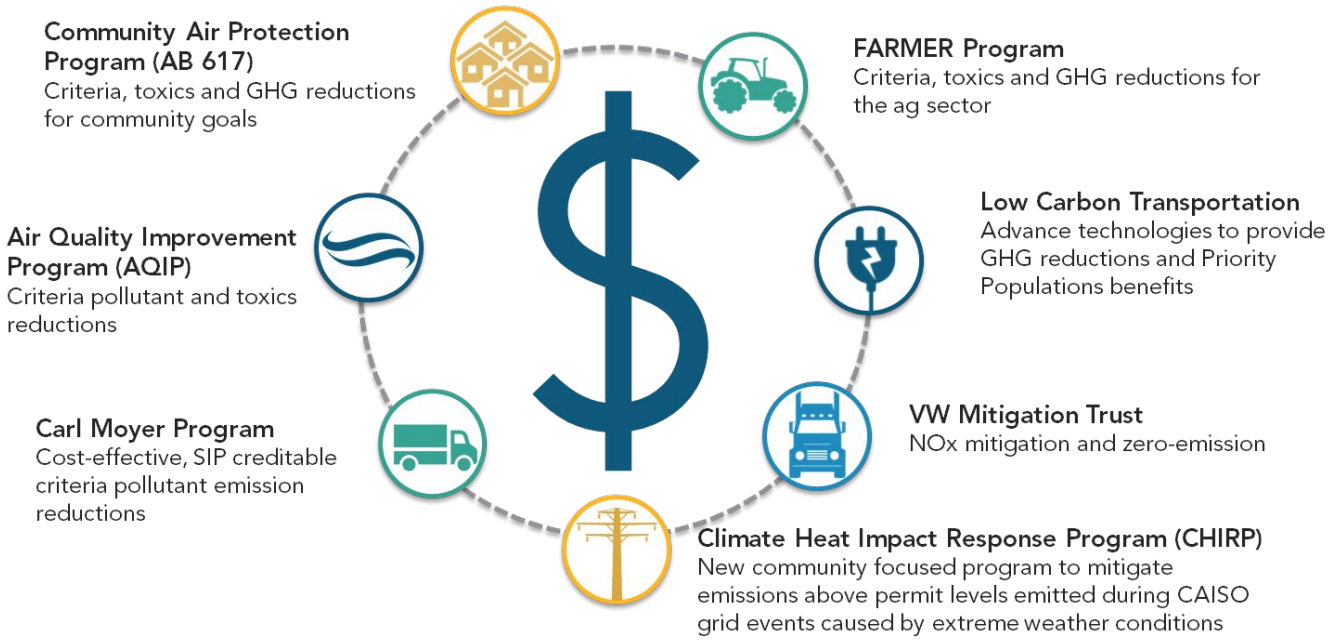
The State, in partnership with the local air districts, has a well-established history of using incentive programs to advance technology development and deployment, and to achieve early emissions reductions. Since 1998, CARB and air districts have been administering incentive funding for cleaner vehicles, starting with the Moyer Program. In recognition of the key role that incentives play in complementing State and local air quality regulations to reduce emissions, the scope and scale of California's air quality incentive programs has since greatly expanded, with many new programs building on the success of the Moyer Program.

Each of CARB's incentive programs has its own statutory requirements, goals, and categories of eligible projects that collectively provide for a diverse and complex incentives portfolio. In total, these programs address multiple goals, including:

- Turning over the legacy fleet to achieve cost-effective early emissions reductions in support of SIP, air toxics, and community air protection goals;
- Accelerating the introduction and deployment of zero-emission technologies to meet federal air quality requirements and mid-century climate change goals;
- Improving access to clean transportation for low-income households, and investing in the disadvantaged and low-income communities most impacted by pollution; and
- Supporting a green economy.

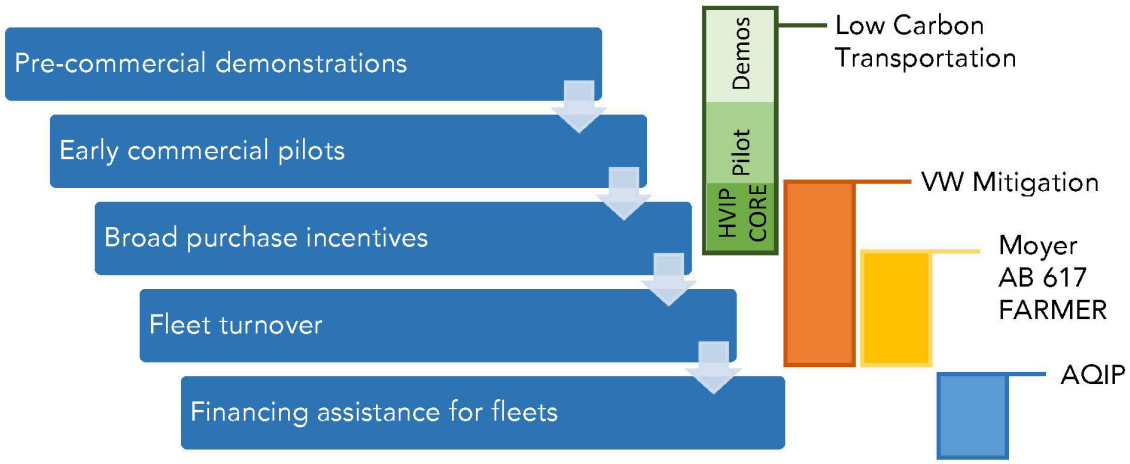
As shown in Figure 19, CARB works each year to prioritize expenditure of available funding between the programs and projects described below to achieve the complementary program goals. This is accomplished with input from the public and interested stakeholders as part of an ongoing public process. The annual Funding Plan for Clean Transportation Incentives is adopted by the Board and is the principal result of this prioritization effort, serving as the blueprint for expending the Clean Transportation Incentives funds appropriated to CARB each year in the State budget. The plan establishes CARB's priorities for the funding cycle, describes the projects CARB intends to fund, and sets funding targets for each project. While the annual Funding Plan for Clean Transportation Incentives includes only programs funded through Low Carbon Transportation Investments and Air Quality Improvement Program (AQIP), funding to the rest of CARB's incentive portfolio is also prioritized on a regular basis to meet the respective program goals.

Figure 20 – CARB's Portfolio of Incentive Programs



As can be seen in Figure 20, CARB's portfolio of incentive programs is used to accelerate all stages of technology commercialization by promoting the purchase of cleaner vehicles and equipment, assisting vehicle and equipment owners with the cost of upgrading their vehicles, and increasing development and deployment of cleaner and advanced zero-emission- technologies. These programs include the Moyer Program, Low Carbon Transportation Investments, AQIP, the Truck Loan Assistance Program, and the Proposition 1B: Goods Movement Emission Reduction (Prop 1B) Program. More recently established programs include the FARMER Program, AB 617 CAPP incentives, and funds available through the Volkswagen (VW) Environmental Mitigation Trust.

Figure 21 - CARB's Programs Fund across all Stages of Technology Commercialization



The Moyer Program, funded by dedicated revenue from the Department of Motor Vehicle smog abatement fee and a fee on the purchase of new tires, provides approximately $94 million in grant funding annually through local air districts for cleaner-than-required engines and equipment. Due to the enactment of *Assembly Bill 1274*,[113] funding for the Moyer Program is expected to increase in future years. The Low Carbon Transportation and AQIP programs provide incentive funding with goals of improving access to clean transportation and mobility and reducing greenhouse gas emissions, criteria pollutants, and air toxics by funding accelerated development and early commercial deployment of the cleanest technologies. AQIP, while a related program, is appropriated from a different funding source, the Air Quality Improvement Fund.

Along with the multitude of grant and rebate opportunities available under the Low Carbon Transportation investments and AQIP, the Truck Loan Assistance Program was created through a one-time appropriation of approximately $35 million in the 2008 State Budget to implement a heavy-duty loan program that assists on-road fleets affected by the Truck and Bus Regulation and the Heavy-Duty Tractor-Trailer Greenhouse Gas Regulation. Since that time, CARB has continued to operate this program with subsequently appropriated AQIP funds of around $28 million annually to provide financing opportunities to small-business truckers who fall below conventional lending criteria and are unable to qualify for traditional financing for cleaner trucks.

In addition to these programs, the Prop 1B Program was created to reduce exposure for populations living near freight corridors and facilities that were being adversely impacted by emissions from goods movement. This program provided incentives to owners of equipment used in freight movement to upgrade to cleaner technologies sooner than required by law or regulation. Voters approved $1 billion in total funding for the air quality element of the Prop 1B Program to complement $2 billion in freight infrastructure funding under the same ballot initiative. While all Prop 1B Program funds have been awarded to the local air districts for implementation, the program framework exists to serve as a mechanism to award clean truck funds through newer funding programs.

In 2015, after a CARB-led investigation, in concert with U.S. EPA, VW admitted to deliberately installing emission defeat devices on nearly 600,000 VW, Audi, and Porsche diesel vehicles sold in the United States, approximately 85,000 of which were sold in California. The VW California settlement agreement includes both a Mitigation Trust to mitigate the excess NOx emissions caused by the company's use of illegal defeat devices in their vehicles, as well as a ZEV Investment Commitment to help grow the State's expanding ZEV program. The Mitigation Trust includes approximately $423 million for California to be used as specified in the settlement agreement. Per the Beneficiary Mitigation Plan approved by CARB in 2018, this funding will be used to replace older heavy-duty trucks, buses, and freight vehicles and equipment with cleaner models, with a focus on zero-emission technologies where available and cleaner combustion everywhere else, as well as to fund light-duty ZEV infrastructure. In addition, there have been mitigation funds established as the result of other settlements from which funding is used to support clean technologies.

[113] O'Donnell, Chapter 633, Statutes of 2017

Since 2017, the Legislature through various budget bills has established a number of new incentive programs that are implemented through CARB. In addition to the planning and monitoring aspects of the aforementioned AB 617 CAPP, the State Legislature provided funding to achieve early emissions reductions in the communities most impacted by air pollution. Despite the fact that there is not a dedicated funding source for the Community Air Protection Incentives, funding appropriated from GGRF by the Legislature has been substantial. Alongside the 2018 funding allocation, the Legislature expanded the possible uses of AB 617 funds to include: Moyer and Proposition 1B eligible projects with a priority on zero-emission projects; zero-emission charging infrastructure; stationary source projects; and additional projects consistent with the CERPs. CARB and air districts partner to run the program, with CARB developing guidelines and the districts administering funds for their regions. In most cases throughout the State, selected communities have identified mobile source emissions as a target for reductions; therefore, it is likely that a significant portion of the AB 617allocated funding will incentivize the accelerated turnover to cleaner vehicles and equipment in and around low--income and disadvantaged communities.

As mentioned, CARB funds a suite of *projects* through the Low Carbon Transportation Program that prioritize equity by providing mobility and advanced technology transportation access to people in low-income and disadvantaged communities. *Clean Cars 4 All* is a program that focuses on providing incentives to lower income California drivers to scrap their older, high -polluting car and replace it with a zero- or near zero-emission replacement. The Financing Assistance for Lower-Income Consumers Program, otherwise known as the Clean Vehicle Assistance Program, and local financing assistance project in the Bay Area, helps lower-income residents finance used or new conventional hybrid electric, plug-in hybrid electric, battery electric, or fuel cell electric vehicles. The *Sustainable Transportation Equity Project* (STEP) is a new pilot that takes a community-based approach to overcoming barriers to clean transportation in disadvantaged and low-income communities throughout California. STEP aims to address community residents' transportation needs, increase residents' access to key destinations (e.g., schools, grocery stores, workplaces, community centers, medical facilities), and reduce greenhouse gas emissions. And finally, the *Clean Mobility Voucher Pilot Program* project supports zero-emission car-sharing, ride-sharing, bike-sharing, and innovative transit services for low-income and disadvantaged communities. All of these projects are specifically designed to benefit members of California's communities most vulnerable to the effects of climate change and poor air quality, and support SB 350 and the State's equity goals.

Since 2017, the Legislature has appropriated $535 million statewide to CARB to reduce agricultural sector emissions through grants, rebates, and other financial incentives for agricultural harvesting equipment, trucks, agricultural pump engines, tractors, and other equipment used in agricultural operations. As of September 30, 2021, $289.7 million has been implemented statewide for eligible vehicle and equipment replacement projects. CARB developed the FARMER Program and approved guidelines that establish the program framework, eligible projects, reporting requirements, and oversight provisions. CARB is directing this funding to air districts to administer for agricultural truck and equipment replacement projects.

Another newer project under the Low Carbon Transportation investments is the Clean Off-Road Equipment Voucher Incentive Project, known as CORE. CORE is designed to accelerate

deployment of cleaner off-road technologies by providing a streamlined way for fleets ready to purchase specific zero-emission equipment to receive funding to offset the higher cost of such technologies. This project is analogous to the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), but specifically targets zero-emission off-road freight equipment that is currently in the early stages of commercial deployment. Born out of a $40 million allocation of Low Carbon Transportation funds in the Fiscal Year 2017-18 CARB Low Carbon Transportation and AQIP Funding Plan, CORE provides vouchers to California purchasers and lessees of zero--emission off-road freight equipment on a first-come, first-serve basis, with increased incentives for equipment located in disadvantaged communities. The 2021-22 State Budget greatly expanded CORE with a $194.95 million allocation. Further, CARB is currently exploring expanding 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-Construction would continue to promote the deployment of zero-emission technology in the off-road sector. The applicability of CORE is currently limited by virtue of budget language direction to freight equipment, but if authorized, CARB could expand the program to include equipment used in construction and other industry applications.

Despite the ongoing pandemic and the resulting health and economic crisis, California has rebounded. Both the 2021-22 and 2022-23 State Budgets represent the State's largest investment thus far to support accelerated zero-emission investment deployment, improve air quality, and support an equitable transition to a cleaner, more sustainable future.

Chapter 7: Infrastructure

ZEV charging and hydrogen fueling infrastructure are critical elements toward meeting California's clean transportation goals including meeting the 70 ppb 8-hour ozone standard. CARB continues to coordinate with other State agencies including the California Energy Commission (CEC) and California Public Utilities Commission (CPUC) to ensure that ZEV fueling and charging infrastructure planning, development, and investments are complemented. To feel confident purchasing a ZEV, drivers and companies need affordable, reliable, and convenient ways to charge or refuel. Private, shared, and public infrastructure are all essential.

ZEV fueling and charging infrastructure development must also address the needs of all Californians, especially given the large-scale transformation that is required to meet California's clean transportation goals. Equity considerations play a significant role, ensuring that all Californians benefit from, and have an opportunity to participate in, this transition. In particular, individual living (e.g. single-family homes, multi-unit dwellings, disadvantaged communities, etc.) and working conditions (e.g. availability of workplace charging) must be considered. Solutions are needed that improve air quality in all communities across the State, especially for those that have historically experienced the greatest environmental challenges in their communities. The location and capacity of ZEV infrastructure plays an important role in these considerations. Equally important considerations include open access (e.g. the availability of multiple payment options, non-proprietary hardware, etc.), charger and station reliability (e.g. high uptime and consistent supply of hydrogen fuel), and availability (e.g. ZEV infrastructure is available as close to 24/7 as local provisions allow).

CEC, as the lead State agency for ZEV infrastructure, is responsible for planning for the State's infrastructure needs to ensure drivers of ZEVs have accessible and convenient access to charging and hydrogen fueling stations. *Chapter 7: Infrastructure* presents CEC's updated projection of infrastructure demands for ZEV focused regulations in the Proposed 2022 State SIP Strategy, investigate key barriers and opportunities for meeting this demand, and highlights CPUC's various utility programs to support transportation electrification. Please note that electrification assessments for off-road sectors are under development and will be quantified in the future.

Infrastructure Demand

Overview of ZEV Infrastructure Analysis

Assembly Bill (AB) 2127, enacted in 2018, requires the CEC to biennially publish a report assessing the charging needs of 5 million ZEVs by 2030.[114] In September 2020, Governor Newsom issued Executive Order (EO) N-79-20,[115] which established expanded ZEV targets and directed the CEC to update its AB 2127 assessment to support them. In July 2021, the CEC released the inaugural *Assembly Bill (AB) 2127 Electric Vehicle Charging Infrastructure*

114 Assembly Bill 2127 (Ting), Statutes of 2018, Chapter 365. *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2127*.

115 Governor Gavin Newsom. Executive Order N-79-20. Issued September 23, 2020. *https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-text.pdf*.

Assessment, which examined the charging needs to support California's plug-in electric vehicle fleet (PEVs) in 2030.[116]

To analyze these expanded ZEV adoption targets, the CEC in the July 2021 release, used the vehicle population scenario from CARB's *2020 Mobile Source Strategy* (2020 MSS).[117] The 2020 MSS illustrated a trajectory needed to achieve the EO N-79-20 target of 100 percent light-duty ZEV sales by 2035, including 8 million light-duty ZEVs and 180,000 medium- and heavy-duty ZEVs by 2030. The inaugural AB 2127 report projected that California would need nearly 1.2 million chargers to support that projected light-duty ZEV population, and 157,000 additional chargers to support the projected population of medium- and heavy-duty ZEVs. These results emphasized the scale of the infrastructure challenge and highlighted the urgency for stakeholders to work together to meet this need over the next decade and beyond. The report also highlighted private investments and innovative solutions to deploy charging infrastructure to support the transition away from combustion vehicles, a significant source of pollution in California communities.

For hydrogen infrastructure, pursuant to Assembly Bill 8 (Perea, 2013),[118] CARB's Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development[119] and the CEC-CARB Joint Agency Staff Report on Assembly Bill 8: Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California[120] evaluate infrastructure deployment relative to FCEV rollout.[121] In support of this work, CARB developed the California Hydrogen Infrastructure Tool (CHIT).[122] CHIT illustrates scenarios regarding the number and locations of hydrogen stations needed to provide adequate coverage and capacity to meet demand. These reports show that station development has been sufficient for aggregate customer need, but that additional station development could be needed for potential longer-term FCEV population growth.

The expected network of 179 hydrogen refueling stations by 2027 will be capable of supporting 245,000 light-duty FCEVs.[123] This is about quadruple the projected fueling demand identified in CARB's *2021 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel*

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116 Alexander, Matt, Noel Crisostomo, Wendell Krell, Jeffrey Lu, and Raja Ramesh. July 2021. Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment: Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030 – Commission Report. California Energy Commission. Publication Number: CEC-600-2021-001-CMR.

117 CARB. 2020. Draft 2020 Mobile Source Strategy. *https://ww2.arb.ca.gov/resources/documents/2020-mobile-source-strategy*

118 Assembly Bill 8 (Perea), Statutes of 2013, Chapter 401. *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB8*

119 CARB. 2021. Annual Hydrogen Evaluation. *https://ww2.arb.ca.gov/resources/documents/annual-hydrogen-evaluation*

120 Baronas, Jean, Gerhard Achtelik, et al. 2020. Joint Agency Staff Report on Assembly Bill 8: 2020 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California. California Energy Commission and California Air Resources Board. Publication Number: CEC-600-2020-008.

121 The CEC will embark in new and expanded hydrogen infrastructure analysis pursuant to Senate Bill 643.

122 CARB. 2017. California Hydrogen Infrastructure Tool. *https://ww2.arb.ca.gov/resources/documents/california-hydrogen-infrastructure-tool-chit*

123 The CEC anticipates reaching 200 stations as the result of funding from the 2021-2022 budget (Senate Bill 170, Skinner, Budget Act of 2021).

Station Network Development. The *Annual Evaluation* report, based on automakers' projected sales, calculated that the FCEV population in California could grow to 61,100 FCEVs by 2027.

The CEC has partnered with National Renewable Energy Laboratory (NREL), Lawrence Berkeley National Laboratory (LBNL), the University of California, Davis (UC Davis), and CARB to develop quantitative analyses tools in support of the charging and hydrogen refueling infrastructure analyses described above. Table 50 summarizes these models and describes various vehicle classes covered, use cases, and local conditions.

Table 50 - Summary of CEC and CARB Charging and Refueling Infrastructure Quantitative Analyses[124]

Models and Analytical Tools	Description
Electric Vehicle Infrastructure Projections (EVI-Pro) 2	Projects charging infrastructure needs to enable electrified intraregional travel for vehicles with a gross vehicle weight rating (GVWR) of 10,000 pounds or less.
Electric Vehicle Infrastructure for Road Trips (EVI-RoadTrip)	Projects charging infrastructure needs to enable all-electric long-distance (>100 mi.) interregional travel for light-duty vehicles.
Widespread Infrastructure for Ride-hailing EV Deployment (WIRED)	Projects charging infrastructure needs to enable electrification of ride-hailing services via transportation network companies.
Medium- and Heavy-Duty Electric Vehicle Infrastructure Load, Operations, and Deployment Tool (HEVI-LOAD)	Projects charging infrastructure needs to enable electrification of on-road MD/HD vehicles with a GVWR of 10,001 pounds and above.
California Hydrogen Infrastructure Tool (CHIT)	Projects hydrogen refueling infrastructure needs to provide the coverage and capacity for hydrogen demand from light-duty FCEVs.

ZEV Population Projections and Infrastructure Analysis Updates

The 2020 MSS builds concepts and presents top-down scenarios that define the technology mixes needed to achieve emissions reduction targets. Built upon the measures and commitments already made in the 2016 State SIP Strategy, the Proposed 2022 State SIP Strategy further expand and translate the concepts in the 2020 MSS into proposed measures. While The inaugural AB 2127 report used CARB's 2020 MSS scenario, this chapter presents infrastructure analyses based on vehicle projections under proposed regulations that have ZEV requirements: ACC II regulation[125], which is a measure in the 2016 State SIP, and ACF

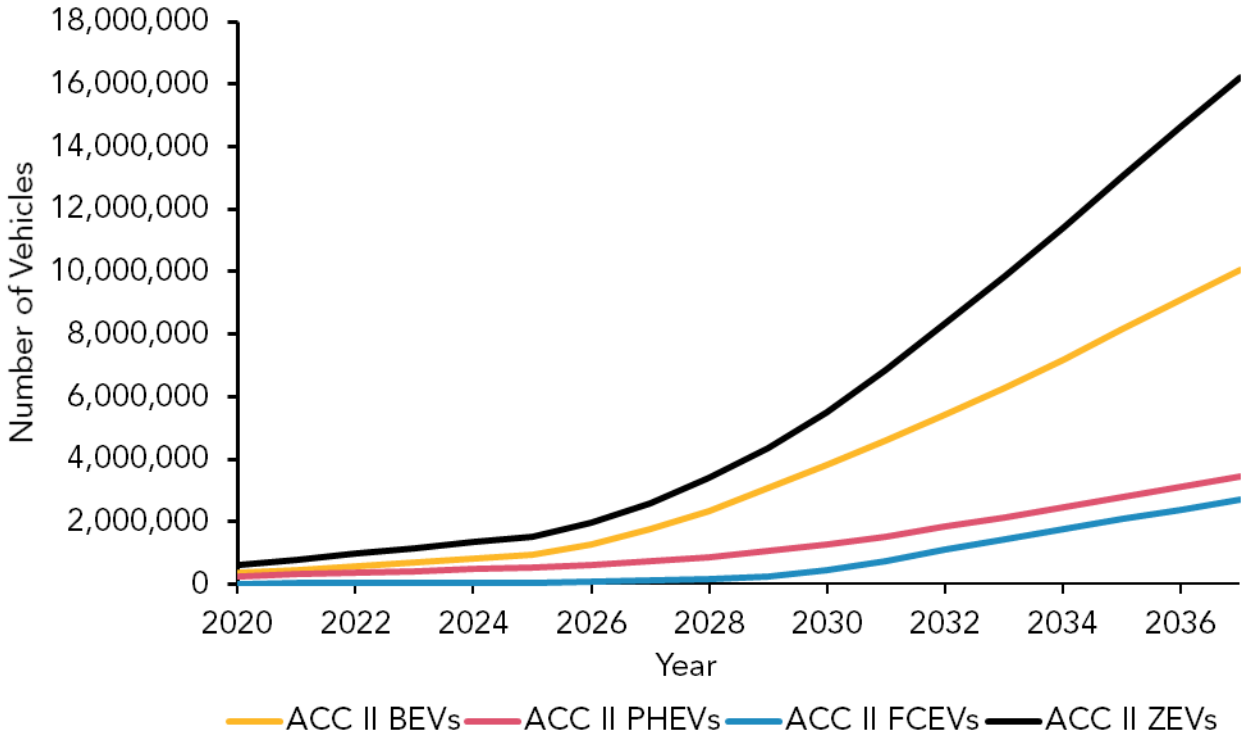
[124] Source: CEC

[125] California Air Resources Board (CARB) (2021). Public Workshop on Advanced Clean Cars II (*https://ww2.arb.ca.gov/sites/default/files/2021-10/accII_october_2021_workshop_presentation_ac.pdf*).

regulation[126], a measure in the Proposed 2022 State SIP Strategy. Note that the vehicle projections are based on EMFAC2017 with MPO activities to align with the emission benefits modeling. Since staff is still developing ACC II and ACF, these projections are preliminary snapshots of the proposals and subject to change.

The vehicle projections based on the proposed ACC II regulation in Figure 22 show about 5.5 million LD ZEVs[127] by 2030 and 13 million by 2035.

Figure 22 - Light-Duty ZEV (<10,000 GVWR) Projections in the Proposed Advanced Clean Cars II Regulation (EMFAC2017 with MPO Activity)[128]



Vehicle projections based on the proposed ACF regulation show MD/HD ZEV population is about 132,000 ZEVs by 2030 and 343,000 ZEVs by 2035. The projections based on the proposed ACF regulation incorporate a significant population of heavy-duty FCEVs (over 20,000 FCEVs by 2030), as these vehicles can support long-haul applications. However, all medium-duty ZEVs are

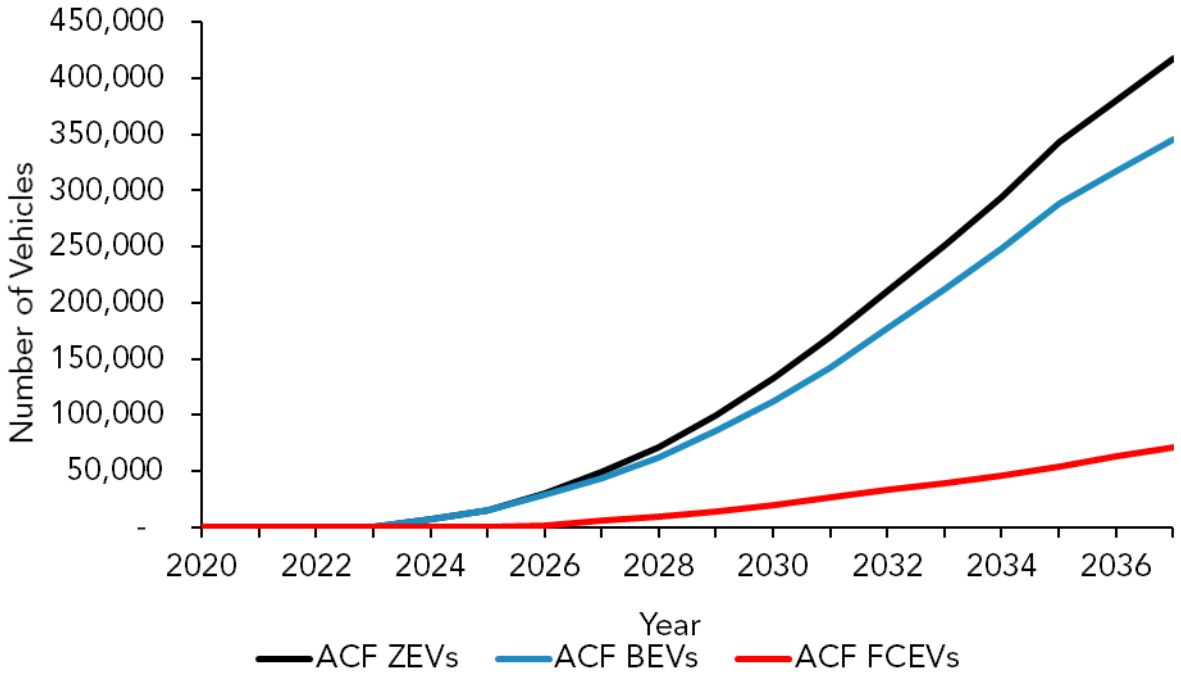
[126] California Air Resources Board (CARB) (2021). Advanced Clean Fleets - Meetings & Events (*https://ww2.arb.ca.gov/sites/default/files/2021-09/210909acfpres_ADA.pdf*)

[127] The CEC's infrastructure analysis divides the light-duty and medium- and heavy-duty vehicle sectors based on whether the vehicles are under or over 10,000 GVWR. This means the CEC's light-duty infrastructure analysis includes vehicle populations from CARB's light-heavy duty truck (LHD1) vehicle classification (GVWR 8,501-10,000 pounds) in the projections based on ACF.

[128] Projections based on the proposed ACC II regulation result in a total of about 5.5 million ZEVs and 13 million ZEVs by 2030 and 2035, respectively. Source: CARB

assumed to be BEVs. Figure 22 illustrates the total MD/HD ZEV populations and the split between FCEVs and BEVs.

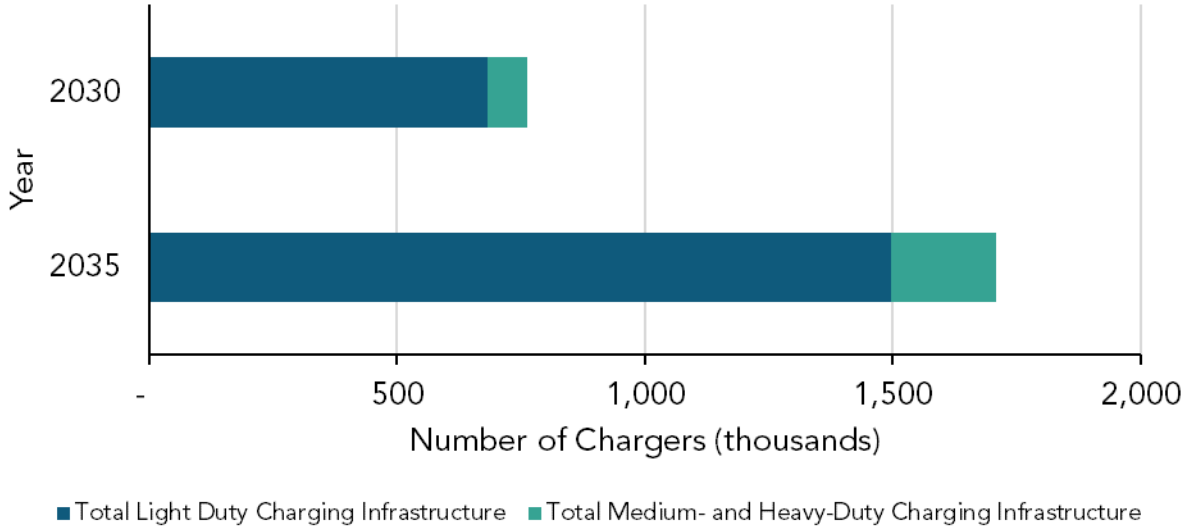
Figure 23 - Medium- and Heavy-Duty ZEV (>10,000 GVWR) Projections in the Proposed Advanced Clean Fleets Regulation (EMFAC2017 with MPO Activity)[129]



In summary, based on the proposed ACC II and ACF regulations and ZEV population projections modeled under EMFAC2017 with MPO activities, the updated EV charging infrastructure analysis to support these vehicle projections estimates a need for a total of 764,000 public and shared private chargers by 2030, and over 1.7 million chargers by 2035 as shown in Figure 24. These totals aggregate the results from all of the EV charging infrastructure models described above in Table 51. The infrastructure results for each individual model, serving varying use cases, are described in more detail in the following sections.

[129] The projections based on the proposed ACF regulation provides BEV and FCEV breakdown, projecting a significant population of heavy-duty FCEVs particularly for long-haul applications. Source: CARB.

Figure 24 - Total Charging Infrastructure Requirements to Support CARB's Vehicle Projections Based on the Proposed ACC II and ACF Regulations[130]



Charging Infrastructure

Intraregional Light-Duty Charging Infrastructure Needs to Enable Local Travel

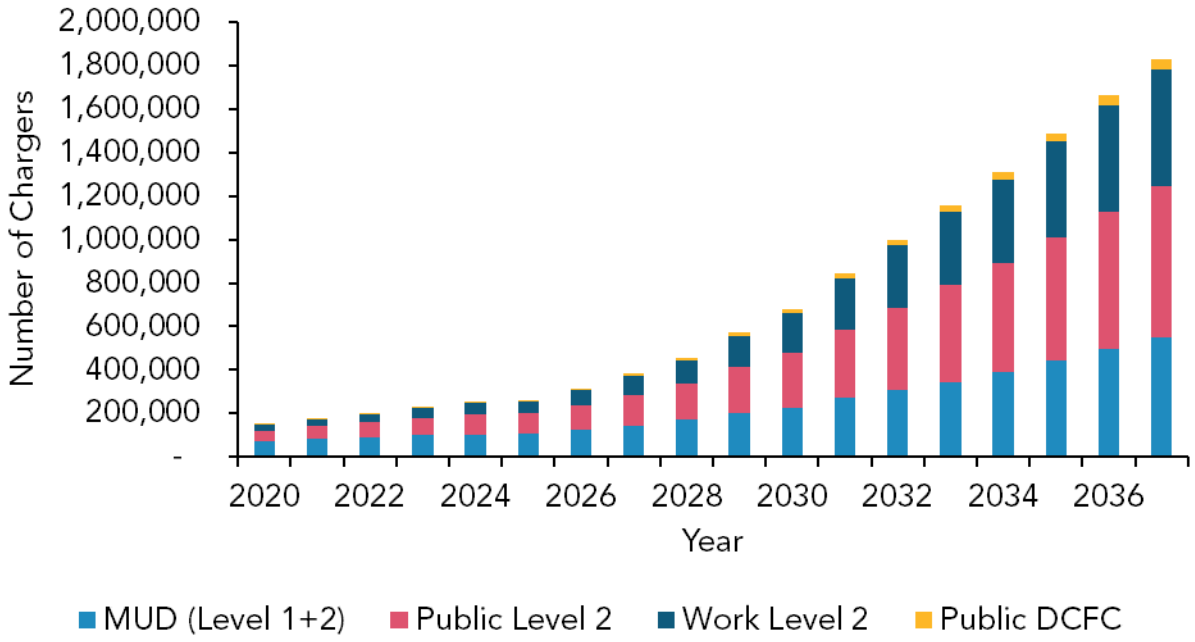
EVI-Pro 2 is a model that calculates the number, locations, and types of chargers required to meet the local travel and charging needs of California's light-duty PEV drivers. Infrastructure results to support the vehicle projections based on the proposed ACC II regulation are provided in Table 51 for years 2030 and 2035. An average of 677,000 and 1.5 million public and shared private L2 and DCFC chargers will be needed by 2030 and 2035, respectively, to serve this use case. Figure 24 shows the total public infrastructure need for each year from 2020 to 2037, reaching over 1.8 million public and shared private chargers by 2037.

[130] Modeling results project an average of 764,000 public and share private chargers will be needed by 2030 to support the light-, medium-, and heavy-duty PEVs projected in CARB's proposed ACC II and ACF regulations. This infrastructure need increases to over 1.7 million total chargers by 2035. Source: CEC, NREL, LBNL, UC Davis.

Table 51 - EVI-Pro 2 Infrastructure Results to Serve 5.5 Million ZEVs in 2030 and 13 Million ZEVs in 2035[131]

Plug Type	2030 Results (1,000 plugs)			2035 Results (1,000 plugs)		
	Low	Average	High	Low	Average	High
Multi-Family Homes (Level 1+2)	181	224	267	359	444	529
Work (Level 2)	183	184.5	186	435	438.5	442
Public (Level 2)	250	252	254	563	567.5	572
All Level 1 and 2	614	660.5	707	1,357	1,450	1,543
Public (DC fast chargers)	16.6	16.8	17	39.5	40	40.5
Total Chargers	630.6	677.3	724	1,396.5	1,490	1,583.5

Figure 25 - Total Average Statewide Public and Share Private Network Requirements for Light-Duty PEVs



Public charging requirements grow rapidly as the light-duty PEV fleet increases from 2020 to 2037. By 2037, need projections are for over 1.8 million chargers. This includes nearly 50,000 DC fast chargers, which is a small contribution to the overall network size but will make up a large portion of the cost and energy delivered.

Source: CEC and NREL

[131] Source: CEC and NREL

Infrastructure requirements for EV charging may go beyond the charger estimates presented here. This could include other types of investments such as distribution system upgrades, and it will be critical to take a comprehensive and holistic approach to EV infrastructure planning.

Interregional Light-Duty Charging Infrastructure Needs to Enable All-Electric Long-Distance Travel

EVI-RoadTrip is a simulation model that determines the number, locations, and power levels of DC fast chargers needed to meet California's BEV drivers' requirements for interregional travel (greater than 100 miles) along major corridors. In practice, both the *intraregional* travel modeled by EVI-Pro 2 and the *interregional* travel modeled by EVI-RoadTrip will use some DC fast chargers. However, the modeling does not yet reflect this synergy and therefore summing them would overestimate the number of needed DC fast chargers.

The projections based on the proposed ACC II regulation estimate about 3.8 million BEVs on the road in 2030 and 8.3 million by 2035. The remaining 1.7 million ZEVs in 2030 and 4.7 million in 2035 are PHEVs and FCEVs. Updated EVI-RoadTrip analysis indicates that these BEV fleet sizes will require an average of about 4,400 DC fast chargers in 2030 and 5,600 in 2035. These chargers will be distributed across an average of about 1,150 and 1,400 stations in 2030 and 2035, respectively (Table 52).

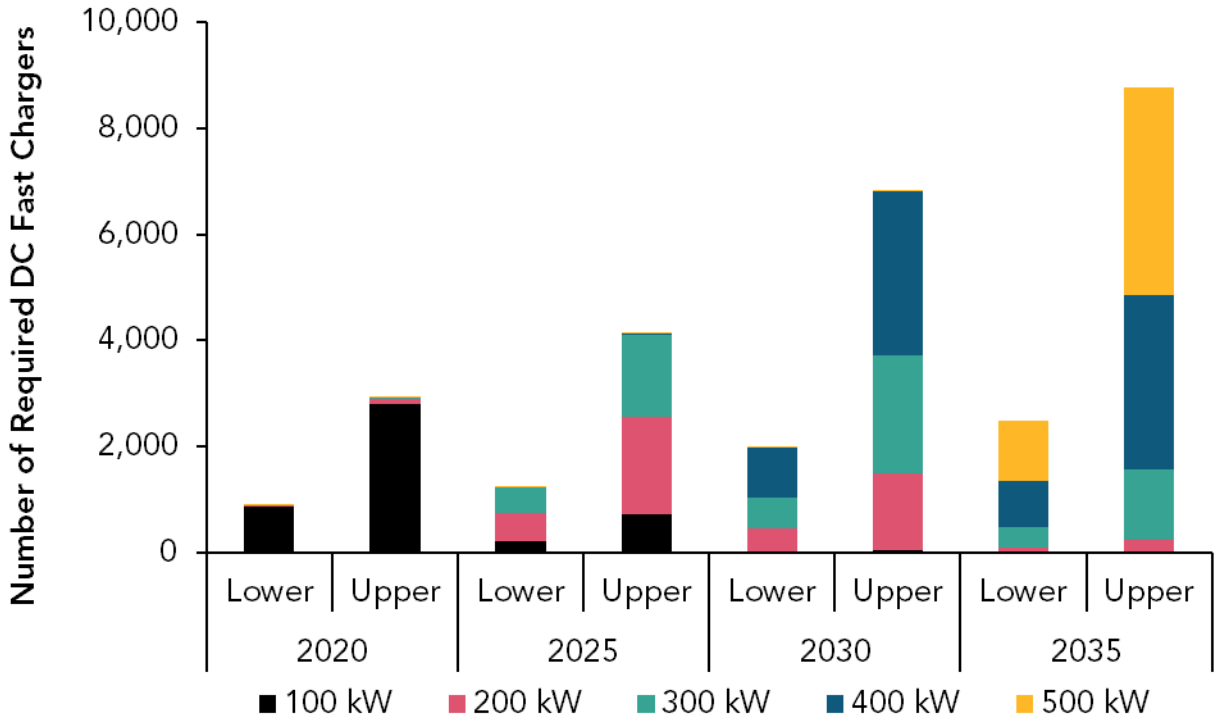
Table 52 - EVI-RoadTrip Infrastructure Results For 3.8 Million BEVs in 2030 and 8.3 Million BEVs in 2035[132]

Result	2030			2035		
	Lower	Average	Upper	Lower	Average	Upper
DC Fast Charge Stations	1,022	1,156	1,290	1,185	1,386	1,587
DC Fast Chargers	1,967	4,390	6,812	2,482	5,628	8,774

Figure 26 shows the lower (assuming 100 percent utilization) and upper (assuming 25 percent utilization) bounds for DC fast charger requirements on five-year intervals from 2020-2035, broken out by power level. This EVI-RoadTrip analysis highlights the need for increasingly higher-powered chargers, which could require future proofing equipment and installations in the near term.

[132] Source: CEC and NREL

Figure 26 - EVI-RoadTrip DC Fast Charger Requirements by Power Level[133]



Light-Duty Charging Infrastructure Needs to Support Electrification of Ride-Hailing Services

The WIRED model assesses the need for charging infrastructure demanded by TNC vehicles in three major California regions: San Diego County, the Greater Los Angeles region, and the San Francisco Bay Area. In the AB 2127 assessment, these infrastructure needs were based on CARB's Draft Clean Miles Standard,[134] which projected 333,000 ZEVs in TNC fleets in California by 2030. Modelers assumed that 80 percent of these ZEVs will operate in these three regions.

These results are tied to the Clean Miles Standard. The AB 2127 assessment found that the three regions together will need more than 2,100 DC fast chargers to serve TNCs by 2030. Figure 27 breaks this total down by region, showing that the Greater Los Angeles region and San Francisco Bay Area have significantly higher demand for charging than San Diego County. Figure 28 shows the growth of TNC charging infrastructure needs over the timeframe of the Clean Miles Standard.

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[133] The power composition of DC fast chargers designed in EVI-RoadTrip evolves over time to favor higher-powered charging, as BEVs are expected to have longer ranges and higher on-board charge power capabilities. Lower and upper bounds on charger counts are shown in five-year intervals from 2020 to 2035. Source: CEC and NREL.
[134] CARB Staff. 2021. Clean Miles Standard. https://ww2.arb.ca.gov/our-work/programs/clean-miles-standard

Figure 27 - DC Fast Chargers Needed to Support TNC PEVs in 2030 by Region[135]

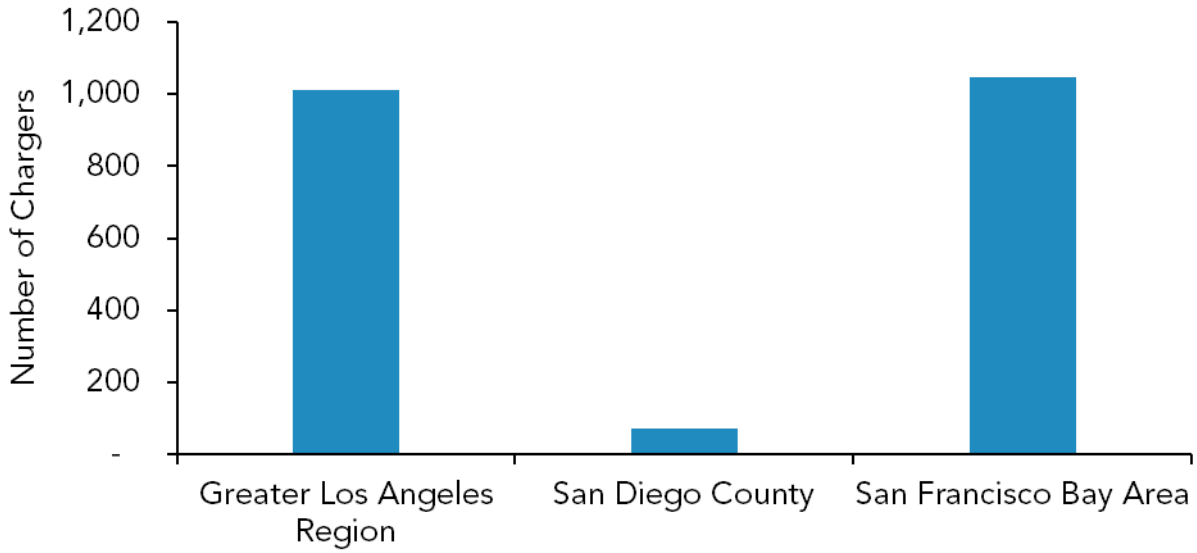
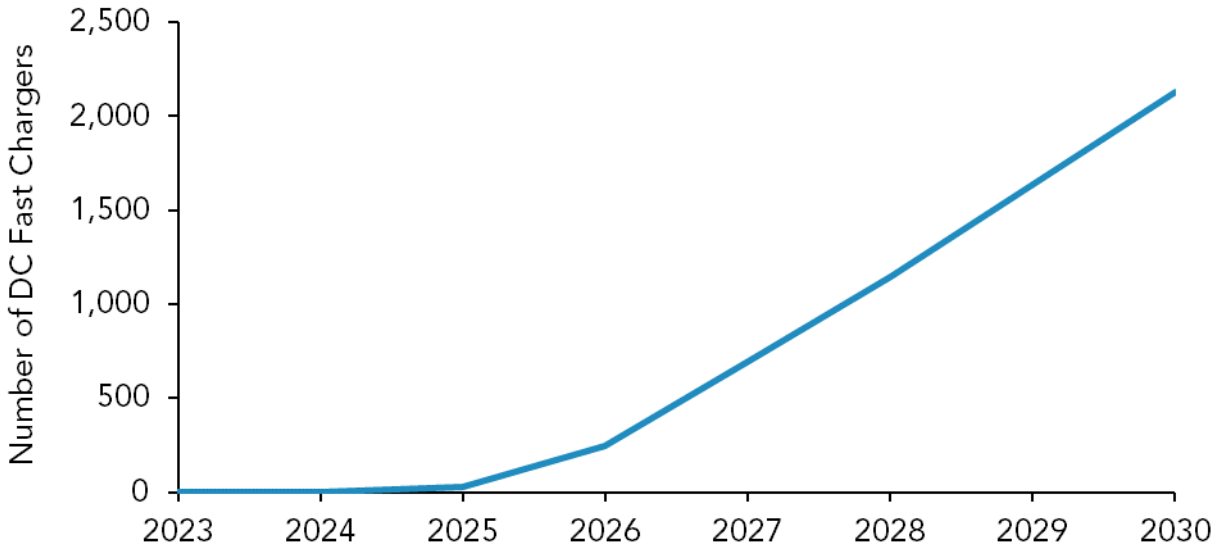


Figure 28 - DC Fast Chargers Needed to Support TNC PEVs (2023–2030)[136]



[135] WIRED models transportation network company infrastructure requirements, illustrating how travel patterns in the different regions affect the resulting network design. Source: UC Davis.

[136] Aggregated DC fast charging infrastructure needs modeled by WIRED in the Greater Los Angeles region, San Diego County, and the San Francisco Bay Area. Source: UC Davis

Medium- and Heavy-Duty Charging Infrastructure Needs to Support On-Road Vehicle Electrification

HEVI-LOAD supports California's transition to MD/HD ZEVs by determining the number, locations, and types of charger deployments and examining suitable power levels for the range of MD/HD vehicle applications. HEVI-LOAD has undergone significant methodological improvements since the July 2021 publication of the inaugural AB 2127 assessment, and this analysis uses the updated version of the model to present the most robust and accurate results currently available. Note that there is a lot of variation in truck fueling behavior, and the modelling exercise described below may not capture this level of detail.

The AB 2127 assessment assumed that MD/HD vehicles in all applications charge at night in a depot using 50 kW DC fast charging, and that when in use, they would opportunistically use 350 kW public charging.

Recent updates incorporate a wide range of power levels for charging. Assumptions for each MD/HD vehicle application include four quartiles of charge capacity based on travel patterns, model specifications, and technological announcements. Each quartile represents a quarter of the vehicles for the respective vehicle classification. Within each quartile, vehicles are able to charge at two power levels, one representing depot charging and the other representing public/opportunistic charging, which are approximately three times depot charging levels. This approach results in 19 specific charging power levels total, which range from 19 kW to 1.6 MW. Table 53 shows the estimated charging infrastructure needed to support about 112,000 MD/HD BEVs in 2030 and 289,000 in 2035. Almost 80,000 chargers are needed in 2030, and this grows to nearly 210,000 chargers by 2035. Charger requirements are grouped by power level for simplicity, and the split between depot and public (opportunistic) chargers is shown in Table 54. By 2030, nearly 90 percent of the MD/HD infrastructure network is projected to be composed of depot chargers, with public chargers mostly restricted to high-power (>500 kW) use cases.

These results also illustrate key tradeoffs between charging energy and time spent charging. In 2030, only 5.5 percent of the total time spent charging for the MD/HD fleet occurs at chargers rated 750 kW or above, yet these charging sessions account for over 21 percent of the total energy needs for these vehicles. Meanwhile, nearly 60 percent of the total time spent charging occurs at chargers rated 75 kW, delivering only 10 percent of their total energy needs. In later years, the share of total time spent charging and total energy delivered shifts to slightly favor high-powered charging, as chargers rated 750 kW or above are the only categories that increase in these two metrics in 2035.

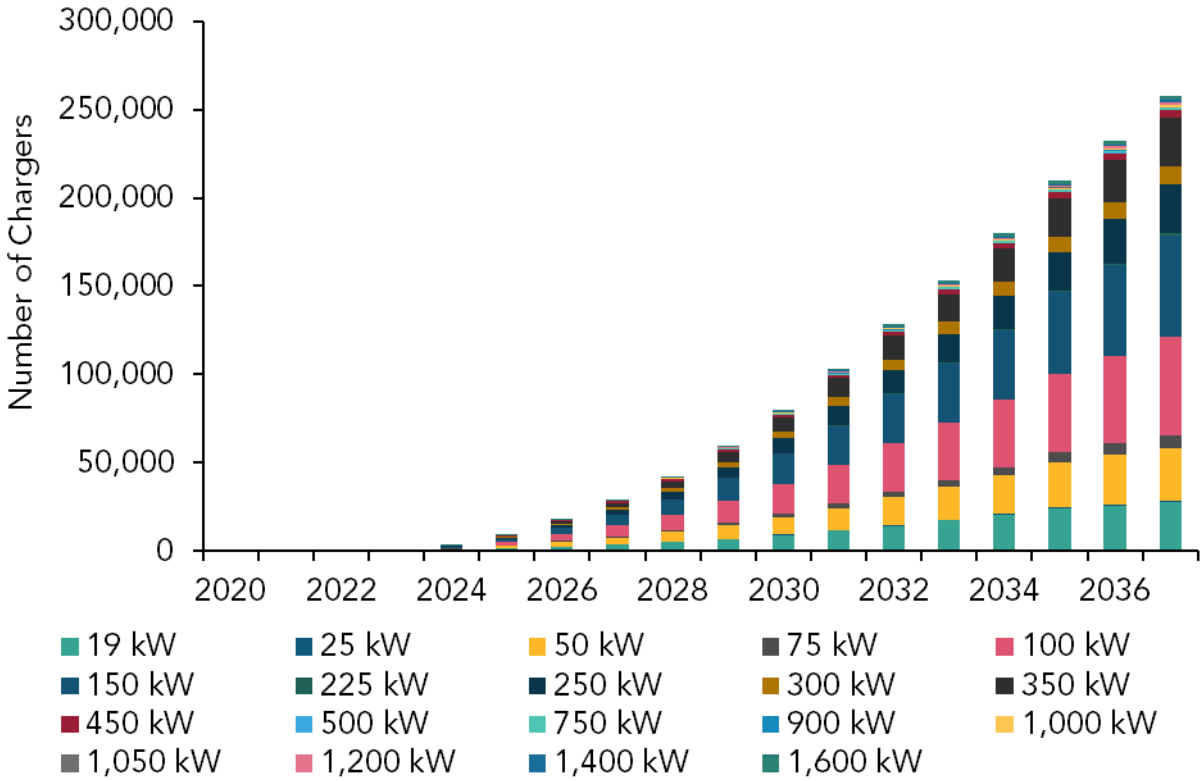
Table 53 - HEVI-LOAD Infrastructure Results for 112,000 BEVs in 2030 and 289,000 BEVs in 2035[137]

Charger Power Level	2030			2035		
	Number Chargers (% Depot / % Public)	Charging Energy (%)	Charging Time (%)	Number Chargers (% Depot / % Public)	Charging Energy (%)	Charging Time (%)
19; 25 kW	9,509 (100 / 0)	2.74	21.69	24,638 (100 / 0)	2.29	19.94
50; 75 kW	12,174 (87 / 13)	7.56	37.45	31,529 (88 / 12)	6.46	36.38
100; 150 kW	33,558 (96 / 4)	29.15	2.42	90,599 (97 / 3)	27.34	2.85
225; 250; 300 kW	12,257 (82 / 18)	20.17	23.71	31,362 (85 / 15)	19.10	24.40
350; 450; 500 kW	9,882 (83 / 17)	18.92	9.20	25,190 (86 / 14)	18.19	10.10
750; 900; 1,000; 1,050 kW	1,112 (0 / 100)	7.77	5.46	2,499 (0 / 100)	8.88	6.25
1,200; 1,400; 1,600 kW	1,498 (0 / 100)	13.69	0.07	3,809 (0 / 100)	17.73	0.09
Total	79,990 (88 / 12)	100	100	209,626 (90 / 10)	100	100

Figure 29 shows the total statewide network requirements to support MD/HD BEVs from 2020 to 2037. By 2037, 346,000 MD/HD BEVs will need about 258,000 chargers of varying power levels. Charging power levels of 19 kW (11 percent of connectors), 50 kW (12 percent), 100 kW (22 percent), 150 kW (22 percent), 250 kW (11 percent), and 350 kW (11 percent) dominate the 2037 network.

[137] Source: CEC and LBNL

Figure 29 - Total Statewide Network Requirements for Medium- and Heavy-Duty BEVs[138]



Hydrogen Infrastructure

Light-Duty Hydrogen Infrastructure Needs to Support On-Road Vehicles

The projections based on the proposed ACC II regulation estimated about 130,000 light-duty FCEVs by 2027 and 2.7 million by 2037. The 179[139] stations expected by 2027 will have the capability to support a theoretical maximum of nearly 245,000 FCEVs assuming each FCEV uses, on average, 0.7 kg of hydrogen per day.

The CEC's Clean Transportation Program plans to help close the gap to 200 stations to achieve Governor Brown's EO B-48-18. Assuming the remaining stations to reach this goal have a nameplate fueling capacity of 1,600 kg (1.6 tonnes) per day, the network of 200 stations could serve a maximum of 290,000 FCEVs. The projected 2.7 million FCEVs would require an additional 1,700 tonnes of fueling capacity per day. In this scenario, California would need an additional 340 – 850 stations by 2037—an assumption based on the expansion of nameplate

[138] HEVI-LOAD analysis shows a continual increase in charger requirements to support MD/HD electrification, reaching more than 250,000 chargers statewide by 2037. This is composed of a wide diversity of power levels ranging from 19 kW to 1.6 MW. Source: CEC and LBNL.
[139] The CEC anticipates reaching 200 stations as the result of funding from the 2021-2022 budget (Senate Bill 170, Skinner, Budget Act of 2021).

capacity seen thus far which suggests that nameplate capacity could grow to an average of 2 to 5 tons per day.

Medium- and Heavy-Duty Hydrogen Infrastructure Needs to Support On-Road Vehicles

As stated earlier, the projections based on ACF include a significant population of heavy-duty FCEVs, reaching about 72,000 vehicles for long-haul applications by 2037. A recent analysis by the California Fuel Cell Partnership estimates 200 hydrogen stations with an average capacity of 8 tons per day would be needed to support 70,000 heavy-duty FCEVs.[140] There are currently seven operational heavy-duty hydrogen fueling stations for fuel cell transit buses and heavy-duty trucks.[141]

Senate Bill (SB) 643 requires the CEC, in consultation with CARB and CPUC, to conduct a statewide assessment of the fuel cell electric vehicle fueling infrastructure and fuel production needs.[142] The infrastructure and fuel production will support the adoption of zero-emission trucks, buses, and off-road vehicles at levels necessary to meet the goals and requirements of Executive Order N-79-20 and the Innovative Clean Transit and other regulations. The CEC will complete the assessment by December 31, 2023 and will update it at least once every three years.

Barriers and Opportunities to Meeting the ZEV Infrastructure Demand

The results presented above illustrate the magnitude of the infrastructure needed to support the state's transition away from polluting internal combustion vehicles to a ZEV transportation system. The cost of this infrastructure is one of the key areas to address to support rapid and widescale deployment. California has made significant, strategic, and important investments to support infrastructure deployment and to transition to greater private investments.

Plug-In Electric Vehicle Infrastructure Costs

The most visible part of a charging station is the electric vehicle supply equipment (EVSE, often referred to as a charger), which is typically a pedestal or wall box and connects to the vehicle to charge it. Except at locations such as single-family homes, EVSE costs rarely make up most of the cost of a charging installation. Other components such as transformers, wiring, conduit, panels, meters, switchgear, breakers, trenching and other construction, permitting and other soft costs, and design play important roles in the cost of charging stations. In addition, charging installations may require utility service upgrades. Ongoing operational costs include electricity, maintenance, and often networking or communications. All of these factors can vary by site and application.

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[140] California Fuel Cell Partnership. July 2021. Fuel Cell Electric Trucks: A Vision for Freight Movement in California – and Beyond. *https://app.greenrope.com/content/Fuel-Cell-Electric-Trucks-Vision-CaFCP.pdf*.
[141] CEC. 2021. California Energy Commission Zero Emission Vehicle and Infrastructure Statistics. Data last updated October 29, 2021. Retrieved October 29, 2021 from *https://www.energy.ca.gov/zevstats*.
142 Senate Bill 643 (Archuleta), Statutes of 2021, Chapter 646.
https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB643.

CALeVIP is the CEC's flagship incentive program for light-duty charging infrastructure. As of September 30, 2021, CALeVIP has launched eleven regional incentive projects totaling $185.7 million in rebate funding (including funding from partner organizations), expected to result in about 16,000 Level 2 connectors and 1,800 DC fast chargers. Data from CALeVIP projects completed through September 30, 2021show that CALeVIP provided an average rebate of $4,153 per Level 2 connector and $67,842 per DC fast charger. CALeVIP leverages additional funds from the project developer and customer. Reported total costs, including private funding, are $9,575 per Level 2 connector and $103,238 per DC fast charger. This represents leveraged funding of 57 percent and 34 percent, respectively.[143]

Assembly Bill 841 (Ting, 2020) mandates that utilities create new rules to design and deploy infrastructure on the utility side of the meter for customers installing EV charging. On October 7, 2021, the CPUC adopted Resolutions implementing the law which direct that customers installing TE charging infrastructure will not bear the costs of in-front-of-the-meter (IFM) infrastructure upgrades.[144] These upgrades include improvements to the distribution system needed to serve the higher electric load created by EV charging. Customers will now benefit from lower costs of electrification and certainty of IFM costs.

Although widespread electrification should result in downward pressure on rates as electric sales increase and fixed costs are spread over a larger number of kilowatt-hours sold, electrification infrastructure costs may contribute to ratepayer pressures, especially in the shorter term. The CPUC has been considering numerous ideas for reducing ratepayer costs for behind-the-meter (BTM) EV infrastructure, including limiting the role of utility ownership of that infrastructure and declining rebates over time as the market matures. Utilities may continue to fund the majority or all of the IFM costs but a variety of actors may pay for the BTM infrastructure including the chargers themselves. These actors include private charging companies, EV customers, state agencies such as the CEC, and the federal government. Although there is almost a million-charger gap between 2030 estimates of chargers needed and the number installed or funded today, [145] it is clear that the utilities will not bear the entire costs of that gap. Utility costs – which in current programs often include both IFM and BTM costs, along with chargers in some cases – are well above $15,000 per light-duty port with medium and heavy-duty charging ports costing several times that much.[146]

Plug-In Electric Vehicle Infrastructure Funding and Revenue

Revenue from electricity sales alone is often not enough for electric vehicle service providers to be profitable at this level of total installation cost for stations with low utilization, although some higher utilization charging stations may be profitable today. Many actors from the private and public sectors are working on strategies to address this challenge, including reducing costs and

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[143] CEC. 2021. California Electric Vehicle Infrastructure Project (CALeVIP) Cost Data. *https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/california-electric-vehicle*.

[144] See Resolution E-5167 (*https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M413/K566/413566906.PDF*) and Resolution E-5168 (*https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M414/K618/414618951.PDF*)

[146] Estimates are preliminary and are based on funds expended in pilots or other small programs.

bringing in additional funding sources and revenue streams. Further, some business models do not rely on electricity sales to be profitable, such as those who sell marketing/advertising services. It is notable that gas stations today rely on on-site services and sales as a revenue stream.

Drivers have installed hundreds of thousands of chargers at single-family homes to take advantage of the convenience and low charging costs home charging offers. Not all EV owners do or will have access to the capital, parking space near electricity, and other requirements for home charging. However, CEC staff expects it to continue to be a popular choice and to primarily be funded by private individuals.

EV charging is and will continue to be offered as part of a package of services to attract drivers. Examples include workplace charging, offered as a perk to employees; charging as an option at commercial parking garages; charging at multifamily housing for renters or owners; and charging funded by auto manufacturers to stimulate sales of their EVs.

Electric utilities have made important investments in charging infrastructure. The CPUC has now authorized over $1.8 billion in funds for utility transportation electrification programs, as detailed below (Table 54):

Table 54 - Authorized Funding for Utility EV Programs[147]

Year	Program Description	Funding
2016	SCE's Charge Ready Pilot	$22M
	SDG&E's Power Your Drive	$45M
	PG&E's EV Charge Network	$130M
2018	SCE's Charge Ready Bridge	$22M
	SB 350 Small IOU Programs	$7.6M
	SB 350 Priority Review Pilots	$42.8M
	SB 350 Standard Review Projects	$615M
2019	PG&E's EV Empower	$4M
	SDG&E's Power Your Drive Fleets Program and V2G School Bus Pilot	$109.13M
	AB 1082/1083 Schools, Parks & Beaches	$54.5M
2020	SCE's Charge Ready 2	$436M
	SB 676 VGI Pilots***	$38.7M
2021	SDG&E's Power Your Drive Extension	$43.5M
	TEF Near-Term Priorities***	$240M

Of the $1.8 billion in authorized funding, $1.48 billion remains available. Approximately half of authorized utility funds support light-duty vehicle electrification with the remainder dedicated to medium and heavy-duty electrification. In recent decisions, the CPUC has required that

[147] Funds authorized for IOU proposals, but no programs/pilots yet approved.

programs spend half of their budgets in disadvantaged or underserved communities.[148] Funds within the utility programs pay for charging infrastructure on the utility side of the meter and, in the case of most programs, on the customer side of the meter. For some programs, EV chargers themselves (EVSE) are also funded. Program budgets also typically include administrative costs, marketing and outreach, and evaluations.

The authorized and program allocated funding[149] will support approximately 55,500 light-duty chargers (of which 13,000 have been energized), 371 DCFC public chargers (of which 14 have been energized), and nearly 300 MD/HD on- and off-road ports. The authorized funding also includes budgets for programs that have not yet been designed which will add to these charger totals. Publicly owned utilities are also investing in EV charging infrastructure. Most notably, Los Angeles Department of Water and Power has been authorized to spend a maximum of $40 million per fiscal year from 2019 to 2029 to reach 10,000 chargers by 2022, 25,000 by 2025, and 28,000 by 2028.

To reduce operating costs like demand charges, some companies, like FreeWire Technologies, install distributed energy resources (including local generation and stationary storage) to limit facility peak demand and enable charging power levels that would otherwise be more costly or potentially require grid upgrades. Where operational requirements allow, smart charging, load management, and other managed charging strategies can help limit instantaneous power demand and minimize long-term charging expenses.[150] The CEC is funding research and demonstration projects in these areas through solicitations under the Electric Program Investment Charge (EPIC)[151] and the Clean Transportation Program.[152] Companies including Powertree Services offer monthly subscriptions and a scheduling and access control system for chargers. This can enable more drivers to share a single charger, reducing the total capital cost to serve the same amount of miles driven.

On the revenue side, one of the most important incentives for EV charging, particularly DC fast chargers, is the CARB Low Carbon Fuel Standard (LCFS) Program.[153] EVSE owners and operators can generate LCFS credits based on the amount of electricity delivered. For example, a standard 6.6 kW Level 2 charger is estimated to yield nearly $1,000 in revenue assuming the charger is used 3.5 hours per weekday and the LCFS credit price is $200 per credit.[154] DC fast chargers can

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[148] See decisions authorizing Southern California Edison's Charge Ready 2, San Diego Gas & Electric's Power Your Drive 2, and TEF Near-Term Priorities.

[149] Roughly $280 million funding is yet to be allocated to programs which may alter these targets.

[150] Santa Clara Valley Transportation Authority. July 9, 2019. "VTA Supports the LACI Feedback for Managed Electrified Fleet Charging Especially for Transit Bus Fleets." *https://efiling.energy.ca.gov/GetDocument.aspx?tn=228926*.

[151] CEC. "GFO-20-304 — Evaluating Bi-Directional Energy Transfers and Distributed Energy Resource Integration for Medium- and Heavy-Duty Fleet Electrification." *https://www.energy.ca.gov/solicitations/2020-09/gfo-20-304-evaluating-bi-directional-energy-transfers-and-distributed-energy*.

[152] CEC. "GFO-20-605 — BESTFIT Innovative Charging Solutions." *https://www.energy.ca.gov/solicitations/2020-08/gfo-20-605-bestfit-innovative-charging-solutions*.

[153] CARB. 2021. Low Carbon Fuel Standard. *https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard*

[154] Center for Sustainable Energy. CALeVIP Low Carbon Fuel Standard Overview. *https://calevip.org/sites/default/files/docs/calevip/Low-Carbon-Fuel-Standard-Overview.pdf*

generate additional capacity credits to mitigate potential low utilization while EV adoption continues to grow. These credits can then be sold to entities who produce or distribute high carbon intensity fuels. Some service providers like Volta earn revenue from advertising shown on large displays on the EVSE. Highland Transportation and other companies targeting fleets will bundle charging into their fleet electrification products, or charging-as-a-service, along with elements such as vehicles and maintenance. In the future, vehicle grid integration (VGI) may provide additional revenue opportunities.

Hydrogen Refueling Infrastructure Costs

By the end of 2023, the Clean Transportation Program plans to have invested a total of $319 million in light-, medium- and heavy-duty hydrogen refueling infrastructure.

Grant recipients will have committed more than $191 million in match funding by the end of the most recent Clean Transportation Program grant agreements. The total reported public and private investment in Clean Transportation Program's hydrogen refueling station projects is nearly $470 million for 179 stations, including 23 privately funded stations.[155] However, this underestimates the total reported investment and the ratio of public to private investment as they do not reflect private investment to cover costs that are not part of CEC agreements and not reported to the CEC.

Cost variations include technological and aesthetic requirements by local jurisdictions such as piping changes, electrical hook ups, easements, and safety requirements. As with EVSE, the site electrical layout (which determines the difficulty of trenching), the electrical capacity of the site and utility distribution system (which, depending on system power, may need expanded capacity or distributed energy resources), and the complexity and time delays involved in permitting, interconnection, and entitlements also contribute to the station cost.

Hydrogen sold at the refueling stations is expected to be a primary revenue source and to attract investment. As with DC fast chargers, a key incentive that improves the business case for hydrogen infrastructure owners is the LCFS Program. Since 2019, the LCFS program has permitted hydrogen station owners to apply for hydrogen refueling infrastructure capacity credits. These capacity credits provide for additional credit generation for not only fuel dispensed, but also fuel available to customers. Additional credits provide a financial incentive to infrastructure owners to build the fueling capacity to support more ZEVs and to reduce carbon intensity of the fuel supply, while at the same time reducing risk of low utilization in the early market.

Scaling Infrastructure Deployment

To achieve California's 2035 ZEV goals and provide access to all Californians, the markets for ZEVs and infrastructure will need to become mutually reinforcing and self-sustaining, and primarily funded by private investment. While projections show PEVs will reach cost parity with internal combustion vehicles in the next few years, there is more uncertainty about the path to self-sufficiency for the infrastructure segments. Continued deployment incentives and

[155] Of the 179 stations, at least 13 are planned to be capable of fueling light-, medium, and heavy-duty vehicles.

innovation-enabling policies are critical to promoting private investment and a sustainable industry. Further, sustained public investment will be necessary to address equity and access concerns where private investment is insufficient or uneven.

The CEC has led on this front through the Clean Transportation Program, which invests up to $100 million annually in a broad portfolio of transportation infrastructure and fuel-related projects throughout the state. Last year, the CEC received a one-time budget allocation of over $1 billion through the state's general fund ZEV package in the Budget Act of 2021 to support infrastructure and manufacturing.[156] Table 55 details funding allocations for the next three fiscal years from the Clean Transportation Program's Investment Plan and the General Fund.[157]

[156] Senate Bill 170 (Skinner), Statutes of 2021, Chapter 240. *https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220SB170*.

[157] Brecht, Patrick. 2021. 2021–2023 Investment Plan Update for the Clean Transportation Program. California Energy Commission. Publication Number: CEC-600-2021-038-LCF

Table 55 - CEC Investment Plan Allocations for FY 2021-2022 and Subsequent Fiscal Years (in Millions)

Category	Funded Activity	2021-2022	2022-2023[148]	2023-2024[149,150]
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Light-Duty Electric Vehicle Charging Infrastructure and eMobility	$30.1	$30.1	$13.8
General Fund Zero-Emission Vehicles and Infrastructure	Light-Duty Electric Vehicle Charging Infrastructure	$240.0	-	-
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure	$30.1	$30.1	$13.8
General Fund Zero-Emission Vehicles and Infrastructure	Medium- and Heavy-Duty Zero-Emission Vehicles and Infrastructure	$208.0	-	-
General Fund Zero-Emission Vehicles and Infrastructure	Drayage	$80.75	$85.0	$80.0
General Fund Zero-Emission Vehicles and Infrastructure	Drayage and Infrastructure Pilot	$25.0	-	-
General Fund Zero-Emission Vehicles and Infrastructure	Transit	$28.5	$30.0	$30.0
General Fund Zero-Emission Vehicles and Infrastructure	School Bus	$19.0	$15.0	$15.0
Clean Transportation Program Zero-Emission Vehicles and Infrastructure	Hydrogen Fueling Infrastructure	$20.0	$20.0	$10.0[151]
General Fund Zero-Emission Vehicles and Infrastructure	Hydrogen Fueling Infrastructure	$27.0	-	-
Clean Transportation Program Alternative Fuel Production and Supply	Zero- and Near Zero-Carbon Fuel Production and Supply	$10.0	$10.0	$5.0
General Fund Manufacturing	ZEV Manufacturing	$118.75	$125.0	-
Clean Transportation Program Related Needs and Opportunities	Workforce Training and Development	$5.0	$5.0	$5.0
Total Clean Transportation Program Fund		$95.2	$95.2	$47.6
Total General Fund		$747[152]	$255[153]	$125[154]

In addition, in January 2022 Governor Newsom's office released their proposed budget for the 2022-23 fiscal year. The budget proposal builds on the previous year's ZEV package, with an additional $6.1 billion for decarbonizing transportation in the state. Combined with the prior year's budget, approximately $10 billion could be directed to decarbonized transportation over six years if these provisions of the proposal are adopted by legislation later this year. The CEC's Clean Transportation program would receive additional funds beyond those shown in Table 55. The proposed budget for Fiscal Year 2022-23 would add funding for investments in a wide array of categories, as shown in Table 56. The Governor's 2022-23 budget proposal also emphasizes the need for equitable deployment of infrastructure and focuses funding on communities with greater need for public assistance in deploying ZEV infrastructure.

Table 56 - ZEV Infrastructure Funding Allocations in Governor Newsom's Proposed FY 2022-23 Budget (in Millions)

ZEV Infrastructure Funding Category	Proposed Funding Amount
Light-Duty ZEV Infrastructure Grants	$600
Equitable At-Home Charging	$300
Drayage	$250
Transit Bus Infrastructure	$140
Commercial Vehicle Infrastructure (includes Trucks, Buses, Agriculture, Construction, and other Sectors)	$500
ZEV Infrastructure at Seaports	$150
Emerging Opportunities	$100

Among other efforts, CEC is expanding continued public support through the block grant incentive model used in CALeVIP. In April 2021, the CEC announced the approval of the multi-million Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles (EnergIIZE Commercial Vehicles) project, a first-of-its-kind project implemented by CALSTART that will fund charging and hydrogen fueling infrastructure for zero-emission trucks, buses, goods movement, and equipment.[158] On the light-duty side, in September 2021 the CEC announced the authorization of two block grant awards for up to $250 million each.[159] One will be implemented by the Center for Sustainable Energy to continue CALeVIP, while the other program will be implemented by CALSTART. These projects will leverage large amounts of funding to rapidly deploy ZEV infrastructure in a streamlined manner and leverage private funds.

Beyond these large-scale projects, the CEC also targets funding through solicitations that address specific opportunities and challenges. For example, the BESTFIT Innovative Charging

[158] CEC. "GFO-20-603 — Block Grant for Medium-Duty and Heavy-Duty Zero-Emission Vehicle Refueling Infrastructure Incentive Projects." *https://www.energy.ca.gov/solicitations/2020-07/gfo-20-603-block-grant-medium-duty-and-heavy-duty-zero-emission-vehicle*.

[159] CEC. "GFO-20-607 — Second Block Grant for Light-Duty Electric Vehicle Charger Incentive Projects." *https://www.energy.ca.gov/solicitations/2021-04/gfo-20-607-second-block-grant-light-duty-electric-vehicle-charger-incentive*.

Solutions solicitation, released in August 2020, aimed to accelerate the commercial deployment of transformative technology solutions for the light-, medium-, and heavy-duty sectors.[160] Other solicitations that have been released or are anticipated to be released in 2021 will fund charging solutions for on-demand transportation services,[161] charging deployments that serve multi-family homes including apartments,[162] and charging installation projects in rural locations.[163] Developing a portfolio of charging solutions will be essential for addressing the wide variety of use cases and local needs throughout California.

The CEC is not the only entity providing funding for EV charging infrastructure. Local governments, utilities, and state agencies are also investing in infrastructure to meet clean air, climate change, and equity goals. As mentioned earlier, in the past decade the electric utilities regulated by the California Public Utilities Commission (CPUC)[164], which serve 78% of the state, have developed dozens of programs aimed at electrifying various segments of the transportation sector and offering specific electric rates for EVs. About 18% of the utility authorized funds have already been spent. Most of the non-pilot programs listed above have multi-year budgets and are only in the first several years of deployment or have not yet been launched, presenting an opportunity for significant scaling in charging infrastructure deployment in coming years.

In addition, in February 2020, the CPUC published a draft proposed overarching transportation electrification policy: the Transportation Electrification Framework (TEF).[165] It contains proposals on determining the appropriate role of utilities in transportation electrification (TE), goals and metrics by which TE programs should be judged, and a process to streamline approval of individual utility programs. Over the next year, the CPUC plans to finalize adoption of the Framework. In July 2021, the chapter of the TEF identifying near-term priorities for investment was adopted.[166] The decision, listed in Table 55 as TEF Near-Term Priorities, authorizes up to $240 million for the IOUs to propose smaller programs through a streamlined process in a number of sectors: grid resiliency, customers without access to home charging, medium and heavy-duty charging, new construction, and panel upgrades for low-income residential

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[160] CEC. "GFO-20-605 — BESTFIT Innovative Charging Solutions." *https://www.energy.ca.gov/solicitations/2020-08/gfo-20-605-bestfit-innovative-charging-solutions*.

[161] CEC. "GFO-21-601 — Charging Access for Reliable On-Demand Transportation Services (CARTS)." *https://www.energy.ca.gov/solicitations/2021-08/gfo-21-601-charging-access-reliable-demand-transportation-services-carts*.

[162] California Energy Commission. Staff Pre-Solicitation Workshop for Light-Duty Electric Vehicle Infrastructure Projects Serving Rural and Multi-Unit Dwelling Residents, June 28, 2021. *https://www.energy.ca.gov/event/workshop/2021-06/staff-pre-solicitation-workshop-light-duty-electric-vehicle-infrastructure*.

[163] Ibid.

[164] Regulated utilities include three large investor-owned utilities (Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric) along with three small or multi-jurisdictional investor-owned utilities (Liberty, PacifiCorp, and Bear Valley).

[165] CPUC's Draft Transportation Electrification Framework (*https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M326/K281/326281940.PDF*)

[166] Decision Setting Near-Term Priorities For Transportation Electrification Investments By The Electrical Corporations (*http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=394347617*)

ratepayers in underserved communities. Programs that fall into these priority areas will not need applications and evidentiary review and may be approved via expedited process.

Another critical factor when scaling up infrastructure deployment is actively preparing for the increasing amount of electric load created by EVs. In June 2021, the CPUC launched a rulemaking to modernize the electric grid for a high distributed energy resources future. This proceeding is focused on preparing the distribution system for increased transportation electrification.[167] In the CPUC's Integrated Resource Planning proceeding, which plans for new generation, the CPUC is increasingly using demand forecasts that predict higher amounts of EV charging.[168] These demand forecasts are also used by the California Independent System Operator to prepare the transmission system for increased load.

In December 2020, the CPUC adopted a decision on vehicle-grid integration (VGI) which created metrics and strategies for advancing VGI and authorized almost $40 million for the utilities to spend piloting VGI technologies and programs.[169] In November 2021, the CPUC adopted a Resolution creating a pathway for alternating current interconnection for vehicle-to-grid integration and allowing some EVs to more easily enable bidirectional mode.[170] The CPUC is continuing to consider streamlining procedures for both EV charging and bidirectional EV interconnections.

In parallel, the CEC is currently developing the EVSE Deployment and Grid Evaluation Tool (EDGE), which will incorporate publicly available electric grid data to aid in regional grid planning. This will act as an "early warning system" to inform charging infrastructure deployment and proactively identify locations where grid upgrades may be required. The CEC is also continuing work on updating the California Vehicle-Grid Integration Roadmap and is investigating pathways to streamline the interconnection of vehicle-to-grid resources that export power and help the grid operate more economically and reliably. Finally, the programs administered by the CEC relevant to EV charging, the Electric Program Investment Charge (EPIC) and the Clean Transportation Program, incorporate flexible and bidirectional EV charging and advance these technologies in the marketplace through targeted demonstrations and other activities.

Future state funding will also continue to support hydrogen refueling infrastructure and meet the state's goals for 100 stations by the end of 2023 and 200 stations by 2025 as called for in AB 8 and EO B-48-18, respectively. To achieve these targets, the CEC is directed to allocate $20 million annually from the Clean Transportation Program, and the recent addition of General Funds will support the 200-station goal.

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[167] See *https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO:RP,57,RIR:P5_PROCEEDING_SELECT:R2106017*

[168] Administrative Law Judge's Ruling Seeking Comments on Proposed Preferred System Plan, pp. 23-28 (*https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M399/K450/399450008.PDF*)

[169] Decision Concerning Implementation of Senate Bill 676 And Vehicle-Grid Integration Strategies (*http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=355794454*)

[170] Resolution E-5165 (*https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M420/K342/420342816.PDF)*

In addition, CEC developed a Statewide ZEV Infrastructure Plan (ZIP).[171] The ZIP supports decision-making by CEC and others by documenting State plans and strategies. It supports public discussions of pathways to success in the State's ZEV goals, especially as embodied in vehicle regulations. The primary principles driving the drafting of the ZIP are that state investments will be directed to increase equity and that state investments will accelerate market development of ZEV infrastructure and the handoff of mainstream charging and fueling infrastructure to the private sector. It presents a high-level view of State infrastructure strategy to ensure sufficient infrastructure deployment and grid-readiness.

The National Electric Vehicle Infrastructure (NEVI) Formula Program is another important piece of the State's infrastructure plan. NEVI was established through the federal Infrastructure Investment and Job's Act, which was signed by President Biden late last year. This program provides funding to advance ZEV infrastructure. California's share of this funding is $384 million over 5 years. CEC and Caltrans recently released the draft California State Electric Vehicle Infrastructure Deployment Plan.[172] Through NEVI, charging infrastructure will be deployed strategically to establish an interconnected network of electric vehicle chargers along key corridors (i.e., Alternative Fuel Corridors) across the state.

Additional Policies to Accelerate Infrastructure Deployment

The list below highlights several other policies and efforts that tackle barriers and support California's increasing infrastructure deployment.

- Properly designed electricity rates are key to encouraging EV adoption and in particular ensuring that charging is less expensive than traditional fossil fuels. Each large investor-owned utility (IOU) offers several EV-specific rates, both for residential and non-residential customers. These rates typically include a steeply differentiated time-of use rate providing a cheap charging time during off-peak periods such as nighttime.[173] Calculations demonstrate that, if customers are able to charge off-peak, most can save significantly on fueling costs over gasoline or diesel.[174] Another significant issue in rate design has been demand charges, which are a portion of commercial and industrial customers' bills that is based on their peak usage for the month, and can be a barrier to electrification. Demand charges can be a large part of the bill for some commercial EV customers because the customers may have a very high peak usage – if several vehicles are charging at once – but relatively low overall electric consumption for the month. Every large IOU now has a commercial EV rate available that significantly reduces or entirely eliminates demand

[171] CEC's Draft Zero-Emission Vehicle Infrastructure Plan (ZIP) (*https://www.energy.ca.gov/publications/2022/draft-zero-emission-vehicle-infrastructure-plan-zip*)
[172] Caltrans and CEC's California's Deployment Plan for the National Electric Vehicle Infrastructure Program (*https://efiling.energy.ca.gov/GetDocument.aspx?tn=243505*)
[173] For more information, visit *https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/electricity-rates-and-cost-of-fueling*
[174] See "When might lower-income drivers benefit from electric vehicles? Quantifying the economic equity implications of electric vehicle adoption (International Council on Clean Transportation)" at *https://theicct.org/publications/EV-equity-feb2021*

charges, and therefore helps promote electrification in the commercial sector. Electrify America (EA) has noted that demand charges are still a huge barrier for LD public DCFC providers and shared some insights in its ZEV Investment Plans (ZIP), as well as its quarterly and annual reports. In the Cycle 3 ZIP Cycle3 report[175], EA noted that several studies[176, 177, 178] showed that demand charges were presenting challenges to station economics. EA also noted in its Cycle 3 ZIP 3 that the rate structure, including demand charges, impacted the cost to provide charging services to consumers and business economic sustainability. To provide some relief from demand charges, EA plans to deploy energy storage and renewable generation at some of its stations.

- State and local building codes require the installation of charger make-ready equipment. The Green Building Standards (CALGreen) Code, Title 24, Part 11[179], requires builders to provide varying levels of infrastructure for electric vehicle charging in newly constructed residential and non-residential buildings thereby avoiding the substantial costs that major retrofits would incur. Beginning in 2023, CALGreen will require that existing multifamily dwellings, hotels, and motels undergoing certain retrofit activities have capacity to support EV charging, and additionally require capacity supporting charging of medium-and-heavy duty vehicles in new warehouses, grocery stores, and retail buildings with off-street loading spaces. Building codes are crucial to ensuring that California meets its ZEVs goals cost-effectively. Building codes are essential to support broad access to ZEV infrastructure and must keep pace as the number of ZEVs continues to grow.
- Streamlined permitting and approval processes will allow for faster and more efficient infrastructure installations timelines. To address this, in 2021 Governor Newsom signed AB 970, which will accelerate the permitting processes by creating provisions for approving a completed EV charging station application after 20 or 40 days. Permitting and application processes for utility actions such as grid upgrades, installations, and interconnections have faced similar challenges. State programs and legislators are addressing ways to improve the ease and speed of charging infrastructure deployments. This will be increasingly critical as megawatt-scale charging sites become more prominent for MD/HD charging. The CEC has also incorporated measures to shorten development time for hydrogen stations. These include requiring applicants to have held preapplication meetings with the authority having jurisdiction, to include benchmarks for developers to

[175] Electrify America (EA) (2021), California ZEV Investment Plan: Cycle 3, available at https://media.electrifyamerica.com/assets/documents/original/685-20210503PublicCaliforniaC3ZEVInvestmentPlanFinalvF.pdf?utm_medium=email&utm_source=govdelivery

[176] Great Plains Institute (2019). Analytical White Paper: Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region. Available at : *https://scripts.betterenergy.org/reports/GPI_DCFC_Analysis_July_2019.pdf*

[177] Rocky Mountain Institute (2019). DCFC Rate Design Study. Available at: https://rmi.org/insight/dcfc-rate-design-study/

[178] National Renewable Energy Laboratory (NREL) (2017).Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges. Available at: *https://www.nrel.gov/docs/fy17osti/68963.pdf*

[179] https://www.dgs.ca.gov/BSC/Rulemaking/2021-Triennial-Code-Adoption-Cycle/Dec-2021-Commission-Mtg

receive approval to build within 18 months of the CEC approving funding for the station, and to open for retail operations within 30 months of the CEC approving the funding.

- Standardization of charging and refueling infrastructure will create a more convenient and efficient infrastructure network for drivers. CARB is proposing a requirement that light-duty vehicles with fast charging capability sold in California be compatible with the CCS connector, beginning with Model Year 2026. The CEC has supported the market shift towards CCS by limiting its funding requirements for the inclusion of CHAdeMO connectors. Currently, projects require only one CHAdeMO connector per site. The lack of connector standardization is even more prevalent among MD/HD vehicles, though the nascency of the market may present opportunities to encourage standardization more aggressively earlier on. The development of the Megawatt Charging System aims to develop a standardized charging system for this sector and has received CEC funding. On the hydrogen side, the CEC has required compliance with international fueling standards to maintain reliable and safe fueling at stations.[180]
- Workforce training and development will be vital to scaling charging infrastructure deployment and has a proposed allocation of $15 million in Clean Transportation Program funding over the next three years. The CEC estimates about 14,100 Californians are employed across 34 ZEV-related manufacturers, and this workforce will need to grow to meet the infrastructure demand over the next decade and beyond.

While the ZEV infrastructure need is significant, it also presents an immense opportunity to transition California to clean transportation, reduce GHG emissions, improve air quality and reduce pollution, and create in-state jobs. The state agencies recognizes the challenges California will face for this multi-billion dollar shift and have moved aggressively to accelerate infrastructure deployment in collaboration with each other and stakeholders. Numerous strategies and mechanisms to scale infrastructure development will contribute to the state's portfolio of solutions to overcome barriers.

[180] Hydrogen refueling standards include SAE International J2600 Compressed Hydrogen Surface Vehicle Fueling Connection Devices, SAE International J2601 Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles, SAE International J2719 Hydrogen Fuel Quality for Fuel Cell Vehicles, and SAE International J2799 Hydrogen Surface Vehicle to Station Communications Hardware and Software.