

Revised

**Proposed 2016 State
Strategy for the State
Implementation Plan**

March 7, 2017

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Preface

Overview

On May 17, 2016, the Air Resources Board (ARB or Board) staff released the Proposed 2016 State Strategy for the State Implementation Plan (State SIP Strategy, hereafter referred to as the ‘strategy’), which describes ARB’s proposed commitment to achieve the mobile source and consumer products reductions needed to meet federal air quality standards over the next 15 years. Statewide, approximately 12 million Californians currently live in communities that exceed the federal standards for ozone and fine particulate matter (PM_{2.5}). Two areas of the State have the most critical air quality challenges – the South Coast and the San Joaquin Valley air basins. Achieving federal air quality standards in these regions, as well as across the State, will provide essential public health protection by reducing hospitalizations for heart and lung related causes, decreasing emergency room visits, and reducing incidences of asthma. Most critically, exposure to PM_{2.5} and ozone is also associated with increased risk of premature mortality, which has been estimated to contribute to 7,500 premature deaths each year in California.

Over the last nine months, ARB staff has continued to work with both the South Coast Air Quality Management District (AQMD) and the San Joaquin Valley Air Pollution Control District on development of the strategy. As part of this process, ARB staff conducted a public workshop in Sacramento and participated in South Coast AQMD workshops and Air Quality Management Plan (AQMP) Advisory Committee meetings to present the strategy, discuss the proposed measures, and solicit public comments. Staff also participated in a San Joaquin Valley ozone plan workshop and held an ARB workshop on December 1, 2016 to discuss emission reduction needs, strategy approaches, and opportunities for early reductions to meet PM_{2.5} standards in the Valley. In addition, the San Joaquin Valley Air District held a workshop on December 7, 2016 to initiate the broader PM_{2.5} State Implementation Plan (SIP) development process. Finally, staff presented the strategy and proposed measures to the Board on September 22, 2016 to receive Board direction, as well as to provide an additional opportunity for public comment.

The revised State SIP Strategy incorporates the most recent air quality modeling and inventory data developed as part of the SIP process, as well as refinements to specific measures in response to stakeholder feedback and continued technology assessments. The technology assessments have defined the next generation of cleaner technologies that are at a suitable stage of commercial and economic viability to support regulatory approaches. At the same time, ARB is funding pilot and demonstration projects to continue to advance cleaner technologies in other sectors. These projects will support identification of future regulatory measures as these technologies mature.

This document, along with the Final Environmental Analysis (EA), and Response to Comments on the Draft EA, will be presented for the Board's consideration at the March 2017 Board hearing, the second of two Board hearings on the proposed State SIP Strategy.

Progress on Implementation

Substantial progress has occurred over the last nine months in further developing various elements of the strategy. Staff has initiated stakeholder discussions and workshops related to a number of measures, including those for Last Mile Delivery, Airport Shuttle Buses, Transport Refrigeration Units, and the Low-NOx Engine Standard for heavy duty trucks. Staff has also continued discussions with the United States Environmental Protection Agency (U.S. EPA) on the importance of federal action for sources that are primarily under federal regulatory control.

Actions related to reducing emissions from heavy-duty trucks are particularly important as they are the largest source of oxides of nitrogen (NOx) emissions in both the South Coast and the San Joaquin Valley. The strategy calls for California action to establish new low-NOx certification requirements, coupled with in-use performance requirements to ensure that the fleet continues to operate as cleanly as possible. The strategy will also provide greater certification flexibility for advanced technologies. If approved, this suite of measures could reduce emissions from today's heavy-duty trucks by up to 90 percent.

Currently, California's optional low-NOx standards are paving the way for more stringent emission standards. For example, a Cummins 8.9 liter natural gas engine has already been certified to the optional 0.02 g/bhp-hr standard, a level 90 percent below the current NOx standard. In October 2016, staff provided a report to the Board describing how ARB will be moving forward on development of the low-NOx strategy. At the same meeting, the Board also approved the Innovative Technology Certification Flexibility Regulation, which is designed to encourage early deployment of the next generation of truck and bus technologies through near-term certification and on-board diagnostics compliance flexibility.

However, because out-of-state trucks account for a large portion of truck activity in the State, federal action to implement national low-NOx engine requirements is essential. To facilitate this effort, ARB staff has been working with U.S. EPA over the past two years to support the development of federal low-NOx requirements. Additionally, the South Coast and San Joaquin Valley air districts, in partnership with other states, recently submitted petitions to U.S. EPA requesting federal action. As a result of this ongoing engagement, in their final rulemaking on the Phase 2 Greenhouse Gas (GHG) Standards in August of 2016¹, U.S. EPA signaled their intent to begin developing more

¹ U.S. EPA Phase 2 Greenhouse Gas Standards available at: <https://www.epa.gov/regulations-emissions-vehicles-and-engines/final-rule-greenhouse-gas-emissions-and-fuel-efficiency>.

stringent federal low-NOx emission requirements, in recognition of the need to pursue a harmonized national strategy in coordination with ARB. Moreover, on December 20, 2016, U.S. EPA responded to the petitions, acknowledging the need for federal action to achieve further NOx reductions from on-road heavy-duty vehicles, and announcing it would initiate the work necessary to begin rulemaking efforts, targeting standards going into effect in the 2024 timeframe.² ARB will continue to call on U.S. EPA to move expeditiously in developing these requirements in recognition of the critical public health benefits it will provide.

ARB has also continued to work with the South Coast on defining funding needs and mechanisms for implementing the State SIP Strategy. Regulatory measures represent a comprehensive and aggressive scope of actions across all sectors and account for approximately 70 percent of the needed reductions, but funding to expand the deployment of these cleaner technologies will also need to play a critical role. Working with ARB, the South Coast has estimated that sustained funding levels of approximately \$1 billion per year through 2031 will be needed to support the necessary scale of technology transformation. The South Coast has recently released a Draft Financial Incentives Funding Action Plan (Funding Action Plan),³ which describes existing sources of funding, new funding opportunities, activities that will be undertaken to pursue each potential funding mechanism, as well as a schedule and reporting process. As part of this effort, the South Coast has identified a broad spectrum of potential funding mechanisms that could meet the region's funding needs. The scope of funding sources reflects the important role that all levels of government must play in bringing healthy air to the South Coast region. The South Coast is also establishing a stakeholder working group to help further develop and implement the Funding Action Plan. ARB will continue to collaborate with the South Coast on the Funding Action Plan, as well as play a key role in implementing State-level efforts that are facilitating the transition to cleaner technologies, such as the California Sustainable Freight Action Plan, the ZEV Action Plan, and the Transformative Climate Communities program.

As part of ongoing implementation of the AQMP, both ARB and the South Coast will also monitor progress in obtaining funding, and progress in quantifying the benefits of reductions from mechanisms such as system efficiencies, advanced transportation systems, and other complementary programs, including the California Sustainable Freight Action Plan and the SB 375 Sustainable Communities and Climate Protection Act target setting process. In addition, ARB staff recently released a discussion draft of the 2030 Target Scoping Plan Update.⁴ The discussion draft outlines a comprehensive suite of actions for meeting the State's 2030 GHG reduction target. Ongoing transformation of the mobile sector to cleaner technologies and fuels is also necessary

² <https://www.epa.gov/regulations-emissions-vehicles-and-engines/petitions-revised-nox-standards-highway-heavy-duty>

³ <http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/draftfinancialincentivefunddec2016.pdf?sfvrsn=6>

⁴ https://www.arb.ca.gov/cc/scopingplan/2030sp_pp_final.pdf

to meet climate goals, and the Scoping Plan draws on the same mobile source measures as those included in the State SIP Strategy.

ARB staff will report back to the Board within one year of adoption of the State SIP Strategy, and yearly thereafter to provide a status report on implementation of the strategy, reductions achieved through the complementary programs discussed above, and progress in implementing the South Coast's Funding Action Plan. Through these Board updates, ARB will identify additional regulatory mechanisms as necessary to achieve needed emission reductions.

Work is also continuing to define the nature of the control strategy and associated emission reductions for meeting PM2.5 standards in the San Joaquin Valley over the next decade. Reductions in directly emitted PM2.5 and NOx from both stationary and mobile sources will be necessary, given the diversity of sources that contribute to elevated PM2.5 levels throughout the year. While current control programs will reduce NOx emissions from mobile sources by approximately 50 percent, and PM2.5 emissions by about 25 percent over the next ten years, continued reductions from the cleaner technologies included in the State SIP Strategy will also be necessary. ARB's initial science-based assessment examining a balanced portfolio of both direct PM2.5 and NOx reductions suggests that NOx emission levels in the range of those necessary to meet the 70 ppb ozone standard would also provide the share of mobile source NOx reductions needed to meet PM2.5 standards. These reductions, however, must be achieved within the earlier timeframes required for PM2.5 attainment. The San Joaquin Valley is also conducting modeling to help define the appropriate control strategy. The revised SIP Strategy therefore includes an initial commitment for 2025 reflecting reductions that will be achieved as new technologies enter the fleet. These reductions will accelerate ozone progress, and serve as a down payment on the reductions needed to meet PM2.5 standards.

At the same time, ARB will continue to work with the San Joaquin Valley and other stakeholders to determine the final emission reduction needs and additional strategies, including funding mechanisms, to accelerate deployment of these technologies. This will also include efforts to reflect the benefits of other transformational efforts underway in the Valley as part of climate programs and the Sustainable Freight Action Plan. A commitment for the additional mobile source reductions needed for attainment will be brought to the Board as part of the comprehensive PM2.5 SIP this fall. Funding efforts and advocacy for federal action will also be coordinated with those of the South Coast, as the need for cleaner technologies are similar and there are strong synergies in the deployment of cleaner cars and trucks in both regions. For example, approximately 20 percent of truck travel that originates in the South Coast subsequently transits through the San Joaquin Valley. Combined investments can therefore benefit both regions and reduce overall funding needs, while providing a strong platform to advocate for the health and economic benefits of meeting clean air standards.

Updates to Proposed Measures

Based on public comments, stakeholder input, and continued assessment of technological readiness, ARB staff has made modifications to a number of measures. These updates include:

- Last Mile Delivery: ARB staff has expanded the scope of approaches being considered as part of this measure. Large delivery companies have reached out to ARB staff to share their interest in pursuing zero-emission vehicles in this sector. While very interested in these technologies, they are concerned that a purchasing requirement may not ensure that manufacturers will support the demand. With the active participation of the delivery industry, staff believes this is an area that zero-emission technology can be put into service in the near-term, paving the way for deployment in additional vocations. ARB staff will be initiating a stakeholder working group as part of the measure development process that includes both delivery companies and manufacturers. Discussions will include consideration of both purchase and manufacturer requirements, ways to use the advanced technology credit provisions U.S. EPA has included in its Phase 2 GHG rule, and the role of incentives.
- Innovative Clean Transit: ARB staff has expanded the scope of this measure and the approaches being considered to address a comprehensive transformation of California's transit systems. Providing clean transit and mobility options must include a long-term transition to zero-emission technologies while continuing to provide transportation options as part of Sustainable Communities Strategies, and ensuring service to people with limited transportation options. Accordingly, the Advanced Clean Transit measure has been expanded and renamed to reflect these broader goals. The new Innovative Clean Transit measure reflects a multi-faceted approach to:
 - Continue to support the near-term deployment of zero-emissions buses where the economics are currently viable, and where transit service can be maintained or expanded.
 - Secure binding commitments from the State's transit providers for a long-term vision for transitioning to zero-emission technologies across all transit options.
 - Partner with transit agencies to pilot innovative approaches, including use of private sector shared economy services, to provide better access to existing transit systems with zero-emissions first and last-mile solutions.
- Innovative Technology Certification Flexibility: This measure was adopted by the Board in October 2016.

- Zero-Emission Airport Shuttle Buses: This measure has been enhanced to reflect consideration of expanding the scope to include emission compliance requirements for other heavy-duty airport vehicles, such as fixed route vehicles entering/exiting the airports, and vehicles operating almost exclusively at the airport facility, such as airport owned operational and maintenance vehicles.
- Small Off-Road Engines: The measure has been strengthened to reflect an increased focus on deploying zero-emission technologies, with use of incentive strategies to accelerate early deployment.
- Low-Emission Diesel Standard: The measure has been updated to provide a specific focus on achieving criteria pollutant reductions. The measure will establish performance requirements for Low-Emission Diesel fuel, and would require that diesel fuel providers decrease criteria pollutant emissions from their diesel products.
- Consumer Products Program: The measure has been updated to propose a range of emission reduction targets, in recognition of potential refinements to growth projections for this category based on the 2013-2015 Consumer and Commercial Products survey. The measure also introduces emission reduction targets for 2023, to be achieved through implementation of regulatory amendments approved by the Board in 2013.

It is important to note that, while the State SIP Strategy includes ARB staff's current assessment of each proposed measure, if the State SIP Strategy is approved, each measure would also be developed through its own subsequent public process. This process will provide additional opportunities for public and stakeholder input, ongoing technology review, and assessments of costs and environmental impacts, all of which will determine the final structure of each measure.

Emissions Inventory Updates

ARB staff has also reviewed and updated the emissions inventory for the off-road federal and international sources category. The line-haul locomotives inventory has been updated to reflect the current age distribution of in-use locomotives, as well as updating the baseline year for the forecasted growth rate. The ocean-going vessel inventory has also been updated to reflect improved data on population, activity, growth, and compliance options for the shore power regulation. These updates have been reflected in both the expected emission benefits from State SIP Strategy measures, as well as the reductions associated with the further deployment of cleaner technologies associated with each sector.

Chapter 1: Introduction

Overview of Strategy

The State SIP Strategy describes ARB staff's proposed strategy to attain health-based federal air quality standards over the next fifteen years as part of nonattainment area SIPs. Under State law, ARB has the responsibility to develop SIP strategies for cars, trucks and other mobile sources, as well as consumer products. Local air districts are primarily responsible for controlling emissions from stationary sources. The upcoming SIPs consist of a combination of State and local air quality planning documents that must show how California will meet federal air quality standards for both ozone and PM2.5. Given recent revisions to air quality standards that have established lower, more health protective levels, substantial reductions from both mobile and stationary sources 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.

Statewide, about 12 million Californians live in communities that exceed the federal ozone and PM2.5 standards. 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 federal ozone standard, and also record some of the nation's highest PM2.5 levels. As a result of ongoing control programs, considerable air quality progress has occurred in both areas. Twenty-five years ago, the federal 8-hour ozone standard of 75 parts per billion (ppb) was violated across the entire South Coast and San Joaquin Valley. Peak ozone levels were more than twice the standard in the South Coast, and 50 percent above the standard in the Valley. Today, significant portions of both regions meet the standard and peak ozone concentrations in the South Coast are within 40 percent of the standard. Moreover, peak levels in the Valley are now within 25 percent of the standard, and the region is on track to meet federal ozone standards based on the ongoing benefits of the current control program.

The South Coast also continues to see steady progress towards meeting the federal annual average PM2.5 standard, with concentrations declining over 50 percent since 2000. Annual PM2.5 levels in the Valley have decreased approximately 20 percent over that same time period, but progress has been interrupted in recent years as a result of weather conditions associated with the drought. The State's largest air quality challenges are therefore meeting ozone standards in the South Coast over the next fifteen years, and PM2.5 standards in the San Joaquin.

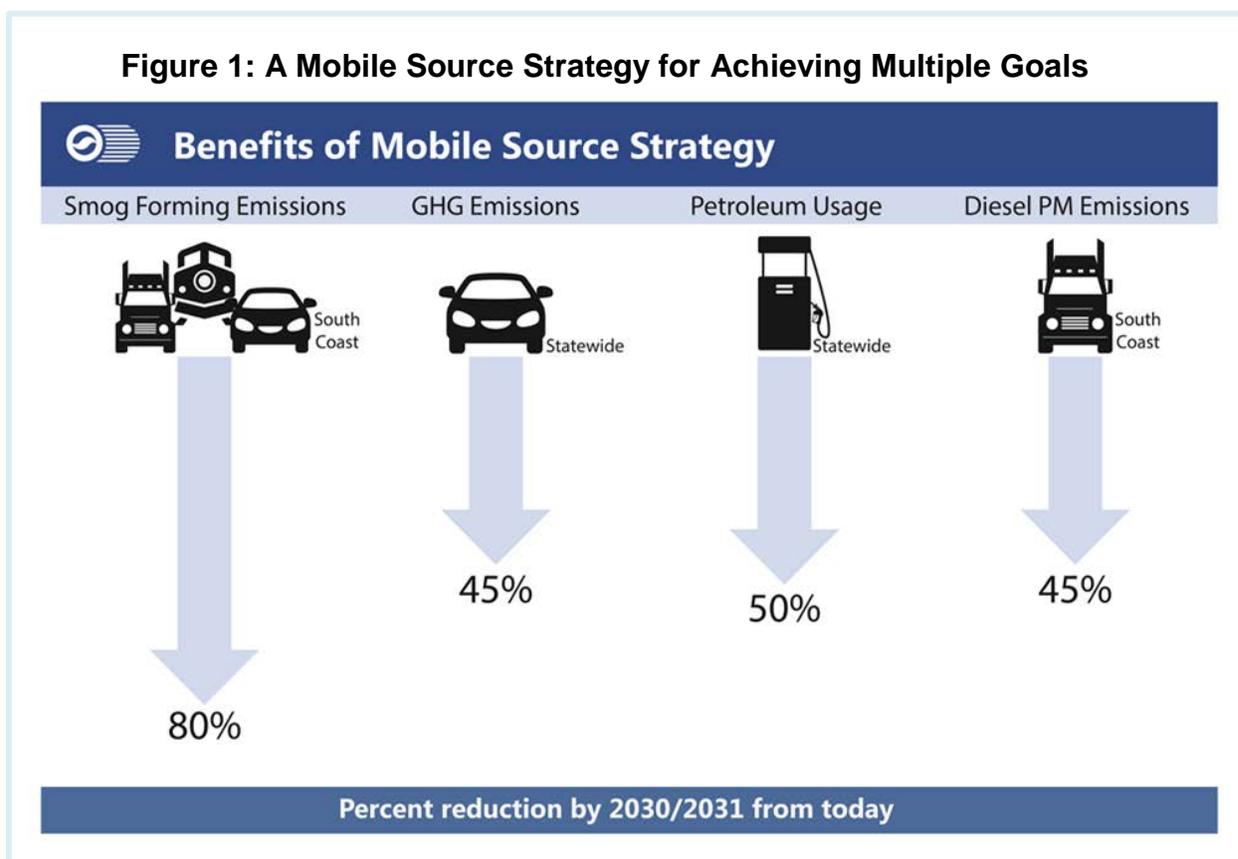
The scope and timing of emission reductions required to meet ozone standards in the South Coast, and PM2.5 standards in the San Joaquin Valley, are thus key drivers for the measures proposed in this strategy. The health and economic impacts of exposure to elevated levels of ozone and PM2.5 in California are considerable; meeting the standards will pay substantial dividends in terms of reducing costs associated with emergency room visits and hospitalization, lost work and school days, and most critically, premature mortality. This year's SIPs are therefore an important step in bringing healthy air to all Californians.

On May 16, 2016, ARB staff released a draft Mobile Source Strategy,⁵ which specifically outlines a coordinated suite of proposed actions to not only meet federal air quality standards, but also to achieve GHG emission reduction targets, reduce petroleum consumption, and decrease health risk from transportation emissions. Mobile sources – cars, trucks, and myriad off-road equipment – and the fossil fuels that power them are the largest contributors to the formation of ozone, PM2.5, toxic diesel particulate matter (diesel PM), and GHG emissions in California. The significant contribution of mobile sources, and the interconnected nature of strategies to meet California's goals, has fostered an integrated planning approach demonstrating the need for a comprehensive transformation to cleaner vehicle technologies, fuels, and energy sources.

The Mobile Source Strategy provides a framework for development of multiple planning efforts that are currently underway. These plans include regional SIPs described in this document, as well as the 2030 Target Scoping Plan Update, California's Sustainable Freight Action Plan, the Short-Lived Climate Pollutant Strategy, and implementation of Senate Bill 375, the Sustainable Communities and Climate Protection Act. Each plan draws from the Mobile Source Strategy by taking measures contained in the strategy to specify roadmaps for meeting climate and air quality targets and incorporate actions and policies necessary to meet individual program goals. The measures included in the State SIP Strategy represent the elements of the Mobile Source Strategy necessary to meet Clean Air Act requirements and to achieve the 80 percent reduction in smog-forming emissions needed for attainment in the South Coast.

⁵ Mobile Source Strategy available at <http://www.arb.ca.gov/planning/sip/2016sip/2016mobsrsrc.htm>

Figure 1: A Mobile Source Strategy for Achieving Multiple Goals



The estimated mobile source emission reduction benefits are shown in Figure 1. This includes an 80 percent reduction of smog-forming emissions and a 45 percent reduction in diesel PM from today's levels in the South Coast. Statewide, the Mobile Source Strategy would also result in a 45 percent reduction in GHG emissions, and a 50 percent reduction in the consumption of petroleum based fuels. These reductions will also accelerate ozone progress in the San Joaquin Valley, and provide a down payment on the mobile source reductions needed to meet PM2.5 standards.

Achieving these complementary goals will provide much needed public health protection for the millions of Californians that still breathe unhealthy air, and reduce exposure to air toxics in disadvantaged communities, especially in light of new information regarding the sensitivity of children to toxic emissions early in life. Meeting California's greenhouse gas emission reduction targets is an essential part of the global action needed to slow global warming and achieve climate stabilization. Finally, actions to meet California's public health and climate goals will reduce our dependence on petroleum and establish a more secure energy future.

Blueprint for Success

ARB's current mobile source control programs have achieved tremendous success in reducing NOx emissions. Ongoing implementation of these programs will result in substantial further reductions through 2031, providing a significant down payment for meeting air quality standards. Nonetheless, significant further reductions will be

required. Technology assessments identified the next generation of technologies and fuels now becoming available that will need to comprise California's transition to a cleaner, more efficient transportation system, and recent developments indicate that this transformation and integration of technology, systems, and fuels has already begun.

Zero-emission vehicle (ZEV) commercialization in the light-duty sector is well underway. New vehicle technologies are being rolled out to the public at an increasing pace. Longer-range battery electric vehicles are coming to market that are cost-competitive with gasoline fueled vehicles, fuel cell vehicles are now for sale, and battery costs are declining at faster rates than projected a few years ago. Autonomous and connected vehicle technologies are being installed on an increasing number of new car models. This technology has the potential to deliver enormous gains in safety, while also reducing traffic congestion and improving fuel efficiency. DC fast charging stations are expanding in California, a growing network of retail hydrogen stations is now available, and California is first in the nation to certify a station for retail hydrogen fuel sales. In the heavy-duty market, zero-emission technologies are commercially available for some uses, and these technologies are increasingly being demonstrated in a range of applications. We are also seeing growing market demand for increasingly clean renewable fuels, with formerly non-regulated entities such as airlines expressing interest in voluntarily opting into the renewable fuels market programs operated by ARB, thereby potentially expanding criteria and greenhouse gas emission reductions benefits from California programs beyond the borders of the State.

Systems are also becoming more efficient and individuals enjoy expanded travel choices. Facilitated in part by sustainable communities strategies, individuals enjoy increased transportation options for personal mobility, with more choices available now than ever before, including car sharing, on-demand mobility services, increased transit options, and increased opportunities that facilitate safe and convenient options to bike or walk. Coordinated regional planning is improving California's land use patterns and transportation policy in a way that reduces transportation-related emissions by reducing growth in vehicle miles travelled. Greater system efficiencies, particularly in the freight sector, also provide opportunities for emission reductions, and may to help mitigate potential growth in freight activity in the State. For example, automated shipping terminals, such as Middle Harbor at the Port of Long Beach and TraPac at the Port of Los Angeles are transforming freight movement in California. ARB is also providing funding for the Green Omni Terminal Demonstration Project at the Port of Los Angeles, a public-private partnership that leverages private investments to demonstrate zero-emission drayage trucks and cargo handling equipment integrated into the full, day-to-day operations of a marine terminal system.⁶ These heavy-duty ZEV demonstration projects also provide public health benefits associated with reduced toxic air contaminant emissions, especially for disadvantaged communities located next to industrial facilities, freight transfer facilities, or along some of the State's businesses trade corridors.

⁶ https://www.portoflosangeles.org/newsroom/2016_releases/news_052616_green_omni.asp

Proposed Actions

The proposed SIP measures identify the regulatory and programmatic approaches necessary to deploy these 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 ARB's commitment to achieve all of the reductions necessary from the mobile sector to meet air quality standards.

For passenger vehicles, the State SIP Strategy includes actions to increase the penetration of plug-in hybrid electric vehicles (PHEVs) and ZEVs, including battery-electric and hydrogen fuel cell electric vehicles. For heavy-duty vehicles, the State SIP Strategy calls for combustion engine technology that is effectively 90 percent cleaner than today's standards. The State SIP Strategy also includes targeted introduction of zero-emission technologies in heavy-duty applications that are suited to early adoption of ZEV technologies. Actions to promote ZEVs in these applications are important to foster further technology development so they become suitable for broader use in the future.

Figures 2 and 3 highlight the reductions that will be achieved for passenger vehicles and trucks. Continued actions to set more stringent standards, coupled with programs to increase the penetration of those technologies into the fleet will reduce NOx emissions from passenger vehicles and trucks by 85 percent from today's levels in the South Coast.

Similar actions are proposed for off-road sources, with a focus on deployment of ZEV technologies in smaller equipment types such as forklifts and airport ground support equipment. A low-emission diesel standard builds upon ARB's existing fuels framework

Figure 2: On-Road Light-Duty Vehicles
NOx Emissions in the South Coast (tpd)

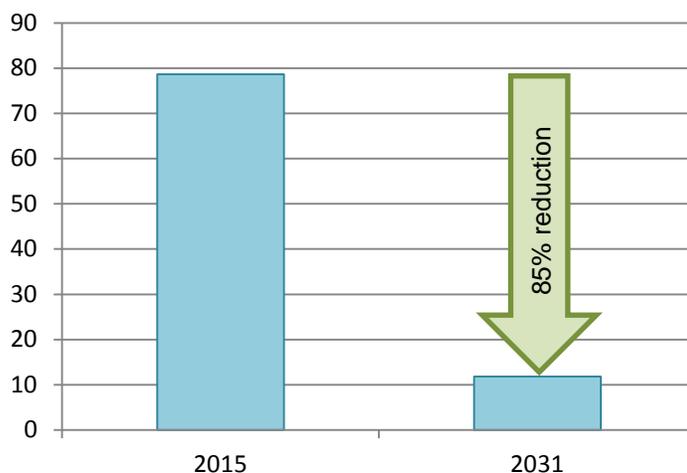
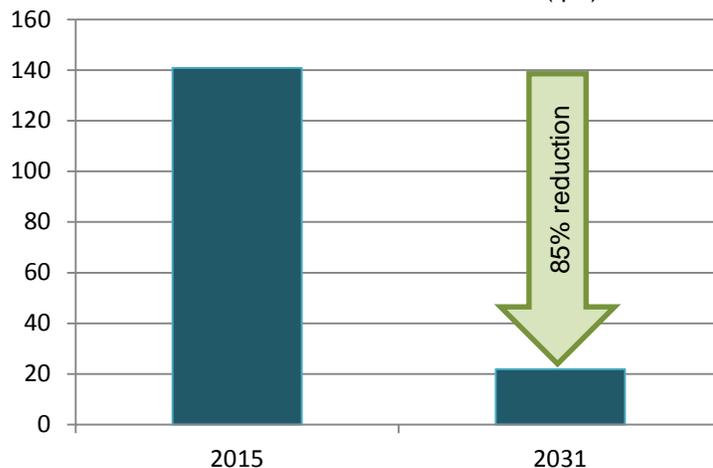


Figure 3: On-Road Heavy-Duty Vehicles
NOx Emissions in the South Coast (tpd)



by requiring that low-emission diesel fuels are used to achieve greater criteria pollutant reductions. Finally, for sources that are primarily under federal jurisdiction, such as interstate trucks, locomotives, and ocean-going vessels, the strategy includes petitions calling for U.S. EPA action to provide the needed emission reductions from these sources by setting more stringent engine standards. Strong federal and international action is critical as these sources represent an increasing portion of emissions in California.

Approximately 70 percent of the reductions needed to meet the ozone standard in the South Coast in 2031 would come from existing or proposed regulatory actions. This includes ongoing implementation of the existing control program, combined with new regulatory measures identified in the State SIP Strategy. The regulatory approach forms the basis of the strategy, and is critical to drive technology development and deployment of the cleanest near-zero and zero-emission technologies into the fleet. The remaining 30 percent of reductions would come from additional efforts to enhance the deployment of these cleaner technologies through new incentive or new regulatory actions. These actions would be implemented through the Further Deployment measures, tailored for each mobile sector, that have been developed to provide further emission reductions from the deployment of cleaner technologies necessary to meet the South Coast's Extreme ozone nonattainment area needs. Additionally, ongoing actions may also provide pathways for emission reductions for SIP needs, including actions to promote efficiency improvements in moving people and freight, and support for the use of advanced transportation technologies, such as intelligent transportation systems and autonomous vehicles. The approaches contained in the Further Deployment measures include:

- Incentive programs to further accelerate technology penetration;
- Identification of additional regulatory approaches based on further technology assessments;
- Increased efficiency in moving people and freight;
- Use of emerging transportation technologies, such as intelligent transportation systems and autonomous and connected vehicles; and
- Further federal actions, including support for demonstration programs, and supporting policies to achieve reductions from sources under federal and international regulatory authority.

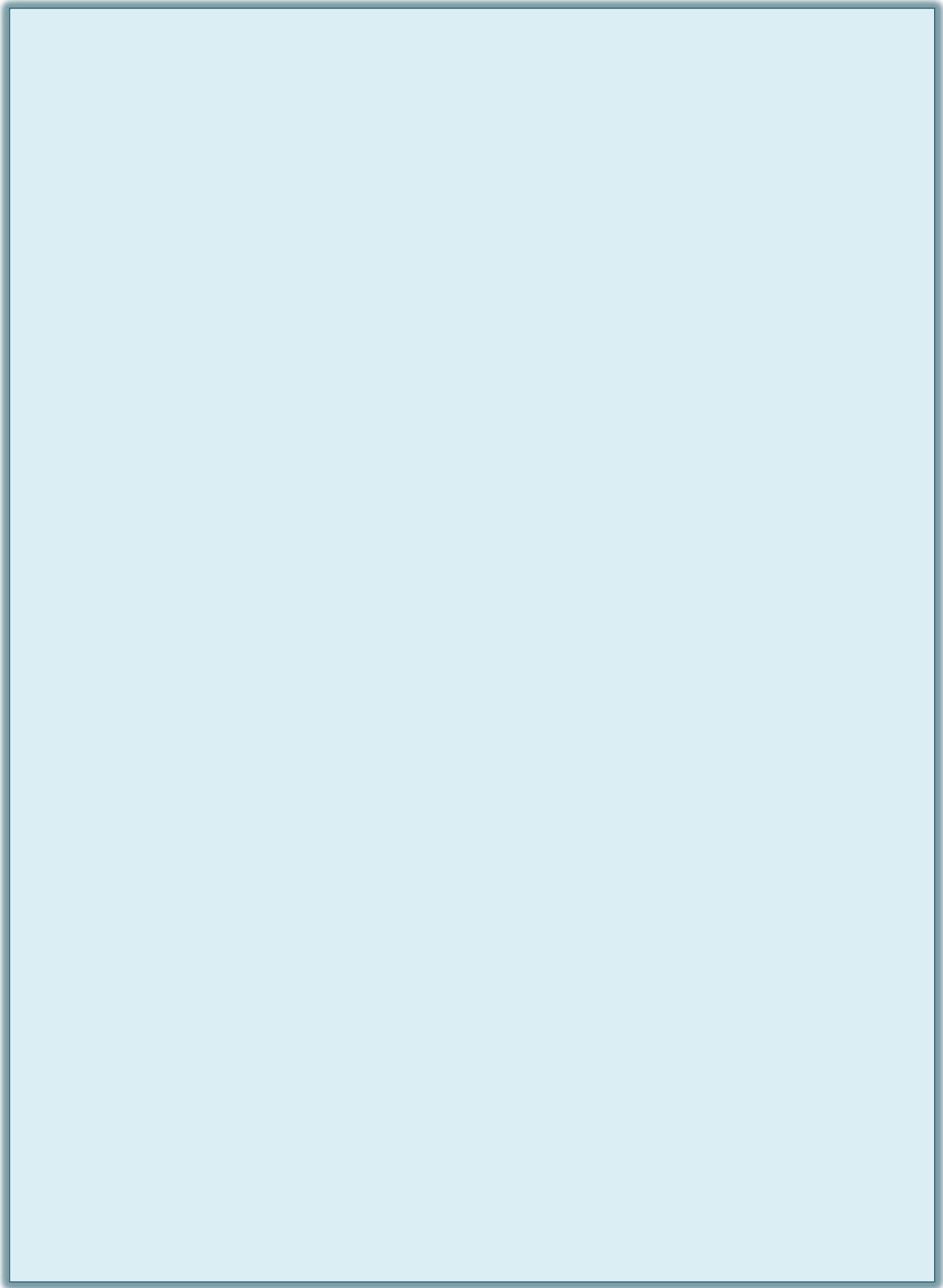
The specific combination of approaches to achieve reductions under these Further Deployment concepts will vary by source sector and the timing of needed reductions. Further details regarding the approach for each sector and identification of technologies is available in the measure descriptions in Chapter 4.

To achieve the emission reductions from the Further Deployment measures included in the State SIP Strategy, the South Coast is also identifying mechanisms under its local authority to achieve emission reductions from mobile sources within the region. These efforts will complement ARB's statewide actions, and will be included in the South Coast's AQMP. Given the need for emission reductions, significant investments to

support incentive programs will be critical to accelerate the penetration of the cleanest technologies in both the South Coast and San Joaquin Valley. ARB staff has been working with South Coast, San Joaquin Valley, and U.S. EPA to identify funding strategies and ensure appropriate mechanisms are in place for an approvable SIP. Finally, The State SIP Strategy contains a measure to address reactive organic gas (ROG) emissions from consumer products, the largest source category of ROG emissions in the State. As part of this measure staff may explore establishing emission limits for currently unregulated categories, and lowering limits for currently regulated categories. To identify categories of consumer products for rulemaking, staff may consider both mass and reactivity of category emissions.

The proposed measures, in combination with ongoing implementation of the current control program, will reduce mobile source NOx emissions 80 percent from today's levels in the South Coast by 2031, as well as reduce ROG emissions by 70 percent, and PM2.5 emissions by over 20 percent. While current control programs provide all of the reductions needed for meeting the 75 ppb ozone standard in the Valley, the measures in the SIP Strategy will enhance progress towards meeting the standard. Overall, these actions will reduce NOx emissions in the Valley from today's levels 60 percent by 2025, increasing to 70 percent by 2031. ARB is also continuing to work with the San Joaquin Valley Air District on development of an integrated strategy for meeting PM2.5 standards over the next decade. The reductions identified above serve as a down payment on the reductions that will be necessary from the mobile sector, coupled with efforts to incentive-based measures to advance the deployment of cleaner technologies.

Implementing the State SIP Strategy will require early and sustained action, and include efforts not only by ARB, but also air districts, the Bureau of Automotive Repair (BAR), U.S. EPA, and other 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 near-zero and zero-emission technologies are able to economically compete with existing technologies. 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. Chapter 2 provides additional background on the emission reductions needed for attainment. Chapter 3 specifies the State's enforceable SIP commitment, and Chapter 4 describes each of the proposed measures.



Public Health Benefits

The health and economic impacts of exposure to elevated levels of ozone and PM2.5 in California are considerable. Meeting the standards will pay substantial dividends in terms of reducing the economic burdens associated with emergency room visits and hospitalization, lost work and school days, and premature mortality.

Inhalation of ozone causes inflammation and irritation of the tissues lining human airways, causing and worsening a variety of symptoms. It can reduce the volume of air that the lungs breathe in and cause shortness of breath. Ozone in sufficient doses increases the permeability of lung cells, rendering them more susceptible to toxins and microorganisms. The occurrence and severity of health effects from ozone exposure vary widely among individuals. Research shows adults and children who spend more time outdoors participating in vigorous physical activities are at greater risk from the harmful health effects of ozone exposure.

With respect to PM2.5, studies have linked daily exposure with hospitalization for heart and lung related causes, as well as an increase in emergency room visits, exacerbation of asthma, and other respiratory diseases, such as chronic obstructive pulmonary disease, increased respiratory symptoms, and increased asthma medication use. Older adults and other individuals with pre-existing chronic heart or lung disease are at greatest risk of experiencing the most serious of the adverse effects related to PM2.5 exposure. Most critically, exposure to PM2.5 and ozone has been estimated to contribute to approximately 7,500 premature deaths in California and millions globally, each year.

The actions contained in the State SIP Strategy will thus deliver broad environmental and public health benefits, as well as support much needed efforts to modernize and upgrade transportation infrastructure, enhance system-wide efficiency and mobility options, and promote clean economic growth in the mobile sector. In addition to the primary criteria emission reduction benefits, implementation of measures in the State SIP Strategy will provide GHG and toxic diesel PM emission reduction benefits.

Diesel PM has a significant impact on California's population. It is estimated that about 70 percent of total known cancer risk related to air toxics in California is attributable to diesel PM. Based on 2012 estimates of Statewide exposure, diesel PM is estimated to increase Statewide cancer risk by 520 cancers per million residents exposed over a lifetime. Annual non-cancer health effects associated with exposure to diesel PM include an estimated 1,400 cases of cardiopulmonary death, approximately 220 cases of cardiovascular or respiratory hospitalization, and approximately 600 respiratory emergency room visits, including for asthma.⁷

⁷ <https://www.arb.ca.gov/research/diesel/diesel-health.htm>

Although progress has been made over the past decade in reducing exposure to diesel exhaust, diesel PM still poses substantial risks to public health and the environment. Reductions in diesel PM will further reduce Statewide cancer risk and non-cancer health effects, especially for residents living near major sources of diesel emissions such as ships, trains, and trucks operating in and around ports, rail yards, and heavily traveled roadways.

Economic and Environmental Analyses

ARB staff has also assessed Statewide costs to affected industries and found the total direct cost of implementing the proposed strategy is approximately \$64 billion over the lifetime of the program (2016 – 2031). These economic impacts encompass the Statewide costs and cost-savings of all proposed measures under State and federal jurisdiction, which includes actions that affect: passenger vehicles; heavy-duty trucks; locomotives; commercial ships; ocean-going vessels; delivery trucks and equipment used in goods movement; construction and mining equipment; engine exhaust and evaporation; fuels; and consumer products. It is important to note that the costs of this strategy also support multiple planning efforts, including California's 2030 Target Scoping Plan Update, the Short-Lived Climate Pollutant Plan, and the California Sustainable Freight Action Plan. As such, investments in cleaner technologies and fuels as proposed in this strategy contribute to achieving multiple goals, in addition to air quality needs, including:

- GHG emission reduction targets being developed through the 2030 Target Scoping Plan Update process;
- Minimizing health risk from exposure to toxic air contaminants (TACs) while improving the efficiency and increasing the competitiveness of California's freight system while transitioning to zero-emission technologies;
- Reducing our petroleum use; and
- Increasing energy efficiency.

The proposed SIP measures are anticipated to deliver broad environmental benefits that include estimated Statewide emission reductions of 168 tons per day (tpd) of NO_x, approximately 85 tpd ROG, 0.6 tpd PM_{2.5}, and 20 million metric tons carbon dioxide equivalent (MMTCO_{2e}) in 2031. The investments made to deploy cleaner technology vehicles, equipment, and fuels will provide significant social and health benefits (including fewer illnesses and reduced medical expenses, and fewer lost work and school days) for the millions of Californians that still breathe unhealthy air, and reducing exposure to air toxics in disadvantaged communities. The actions also provide broad environmental benefits, and meeting California's GHG emission reduction targets is an essential part of the global action needed to slow global warming and achieve climate stabilization. Finally, actions to meet California's public health and climate goals will reduce our dependence on petroleum and establish a more secure energy future. These broad benefits, while potentially significant, are not quantified in this analysis. The total Statewide costs represent costs incurred through 2031 as both near-term provisions and further deployment measures are implemented between 2016 and 2031.

Costs were quantified only for measures where emission reduction benefits have been quantified. The most affected industries are those engaged in the production, distribution, sales, and use of cars and trucks, goods movement, off-road equipment and engines, petroleum production, and consumer products. Further assessment of the socioeconomic impacts of the combined attainment strategies for both mobile and stationary sources will be conducted as part of regional SIPs.⁸ In addition, focused analysis of costs and environmental impacts will be conducted as part of the regulatory development process for each individual measure. Further information on the costs and economic impacts are provided in Appendix A.

To evaluate the potential for significant adverse environmental impacts associated with implementation of the proposed State SIP Strategy, ARB prepared a Draft Environmental Analysis (Draft EA), pursuant to its regulatory program certified by the Secretary of the Natural Resources Agency.⁹ In accordance with the Public Resources Code,¹⁰ public agencies with certified regulatory programs are exempt from certain California Environmental Quality Act (CEQA) requirements, including but not limited to preparing environmental impact reports, negative declarations, and initial studies.¹¹ The resource areas from the CEQA Guidelines Environmental Checklist were used as a framework for assessing the potential for significant impacts.¹² The Draft EA was included as Appendix B to the Draft State SIP Strategy and was released for public review and comment in May 2016.¹³ A docket was opened for a 60-day public review period, from May 17, 2016 through July 18, 2016.

Staff is in the process of summarizing and responding in writing to all comments submitted on the Draft EA in a response to environmental comments document.¹⁴ Clarifications made to the proposed State SIP Strategy as a result of public comments do not require the addition of significant new information to the Draft EA. During the March 2017 Hearing, the Board will consider approval of the Revised Proposed 2016 State Strategy for the State Implementation Plan, the Final EA, staff's responses to environmental comments, and a CEQA Statement of Overriding Considerations. All final CEQA documents will be available at least ten days prior to Board consideration on the State SIP Strategy.

⁸ The Socioeconomic Analysis of the South Coast AQMP is available at: <http://www.aqmd.gov/home/library/clean-air-plans/air-quality-mgt-plan/socioeconomic-analysis>

⁹ 14 CCR 15251(d); 17 CCR 60000–60008

¹⁰ Section 21080.5 of CEQA

¹¹ 14 CCR 15250

¹² 17 CCR 60005(b)

¹³ The Draft EA is available at: <http://www.arb.ca.gov/planning/sip/2016sip/2016sip.htm>

¹⁴ The Comment Log for the Proposed 2016 State SIP Strategy is available at: <https://www.arb.ca.gov/lispub/comm/bccommlog.php?listname=statesip2016>

Next Steps

ARB staff will present the revised State SIP Strategy for Board consideration at the March 2017 Board meeting. The Board will also consider the analysis of potential environmental impacts of the State SIP Strategy, which are analyzed in *Appendix B: The Final Environmental Analysis for the Proposed 2016 State Strategy for the State Implementation Plan*.

The measures included in the State SIP Strategy provide the basis for specific legal commitments in SIPs for individual air districts. The districts' local plans are first considered at the regional level, and, upon local district board approval, and then considered by ARB prior to submittal to U.S. EPA. For each individual air district, ARB considers the regional SIPs and individual SIP commitments prior to submitting the plans to U.S. EPA.

As part of this effort, ARB staff has been working closely with staff of the South Coast and San Joaquin Valley districts. The South Coast District released an initial draft AQMP on June 30, 2016¹⁵, which included local measures for stationary and area sources, and incorporated the ARB commitment to control emissions from mobile sources and consumer products proposed in this document. The South Coast also released a Revised Draft AQMP on October 7, 2016¹⁶ and a Draft Final AQMP in December 2016.¹⁷ The AQMP was approved by the District Board on March 3, 2017. The ARB Board will be considering the South Coast AQMP during its March 2017 Hearing, subsequent to consideration of the State SIP Strategy document. The San Joaquin Valley ozone SIP was adopted by the District Board in May 2016, with approval by ARB in July. ARB and the San Joaquin Valley district are also working together on development of an integrated attainment strategy for meeting multiple PM2.5 standards over the next ten years. As part of that process, ARB staff held a workshop on December 1, 2016 to discuss emission reduction needs, strategy approaches, and opportunities for early reductions. The San Joaquin Valley Air District also held a workshop on December 7, 2016 to initiate the broader PM2.5 SIP development process. This SIP will be considered by the ARB Board in fall 2017.

Moving forward, staff will also continue to initiate actions for the proposed measures, a number of which are slated for Board consideration in 2017. Implementing the State SIP Strategy will require efforts not only by ARB, but also local air districts, U.S. EPA, and international agencies. ARB staff is continuing to collaborate with the South Coast and the San Joaquin Valley on developing comprehensive funding plans to identify overall funding needs, and financing mechanisms. To ensure that SIPs meet Clean Air

¹⁵ The South Coast Draft 2016 AQMP (June 2016) is available at:

<http://www.aqmd.gov/home/library/clean-air-plans/air-quality-mgt-plan/Draft2016AQMP>

¹⁶ The South Coast Revised Draft 2016 AQMP (October 2016) is available at:

<http://www.aqmd.gov/home/library/clean-air-plans/air-quality-mgt-plan>

¹⁷ The South Coast Draft Final 2016 AQMP (December 2016) is available at:

<http://www.aqmd.gov/home/library/clean-air-plans/air-quality-mgt-plan/final-draft-2016-aqmp>

Act requirements, ARB is also working with U.S. EPA to develop the appropriate programmatic structure to credit incentive-based measures. Finally, ongoing coordination is also underway with other State partners to deploy the necessary infrastructure for advanced technologies and fueling systems.

Chapter 2:

Nonattainment Areas and Emission Reduction Needs

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.

Responsibility for developing and implementing a SIP is shared between ARB and local districts, and ARB plays multiple roles in the SIP development and approval process. Under State law, ARB is responsible for controlling emissions from consumer products and mobile sources (except where federal law preempts ARB's authority), developing fuel specifications, and coordinating SIP strategies with BAR and the Department of Pesticide Regulation. Local air districts are primarily responsible for controlling emissions from stationary 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 ARB.

Decades of research programs and technical work conducted by ARB, 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 mobile source controls to attainment, ARB staff works closely with air districts in development of the overall State SIP strategy. As part of this effort, air districts develop a corresponding strategy for stationary sources, and SIPs are first considered at the local level. As the lead air quality agency for the State, ARB must then evaluate SIPs to ensure they meet State law and Clean Air Act requirements, and SIPs are considered and approved by the Board before submittal 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, ARB will be considering SIPs to address the 8-hour ozone standard of 75 ppb and the annual PM_{2.5} standard of 12 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$).

Sixteen areas in California are designated as nonattainment for the 75 ppb 8-hour ozone standard. They include California's large urban regions, as well as a number of 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 2031. Table 1 shows the nonattainment areas, classifications, attainment dates, and 2015 design values. Marginal areas have already met the 75 ppb 8-hour ozone standard and have no further SIP requirements.

Table 1: Ozone Nonattainment Areas

75 ppb 8-hour Standard

Area	Classification	Attainment Date	2015 Design Value
South Coast Air Basin	Extreme	2031	0.102
San Joaquin Valley	Extreme	2031	0.093
West Mojave Desert	Severe	2026	0.090
Coachella Valley	Severe	2026	0.088
Sacramento Metro	Severe	2026	0.081
Ventura County	Serious	2020	0.077
Imperial County	Moderate	2017	0.078
Eastern Kern County	Moderate	2017	0.083
Mariposa County	Moderate	2017	0.075
Western Nevada County	Moderate	2017	0.081
San Diego County	Moderate	2017	0.079
Eastern San Luis Obispo	Marginal	2015	0.073
Calaveras County	Marginal	2015	0.073
Butte County	Marginal	2015	0.074
San Francisco Bay Area	Marginal	2015	0.073
Tuscan Buttes	Marginal	2015	0.074

Four areas in California are designated as nonattainment for the 12 $\mu\text{g}/\text{m}^3$ annual PM_{2.5} standard. These include the South Coast and the San Joaquin Valley, as well as

the border region of Imperial County and the City of Portola in Plumas County. While the PM_{2.5} challenges in the South Coast and the San Joaquin Valley are regional in nature, the Imperial County and Portola nonattainment areas reflect unique local conditions related to cross-border transport and wood smoke impacts, respectively. Separate, tailored control programs will be necessary for these two areas. Unlike ozone, PM_{2.5} SIP planning requirements apply in a step-wise fashion. The process begins with evaluation of the feasibility of meeting the standard by the Moderate area deadline of 2021. If attainment by 2021 is not feasible, U.S. EPA will reclassify the region to Serious, and establish requirements for a SIP submittal that must demonstrate attainment by 2025.

In addition to the most recent air quality standards, the South Coast and San Joaquin Valley must also continue to address progress towards attainment of earlier standards they have not yet achieved, including the 8-hour ozone standard of 80 ppb (with an attainment date of 2023), and the 24-hour PM_{2.5} standard of 35 µg/m³ (with an attainment date of 2019). The South Coast Air Quality Management District is developing a comprehensive AQMP that will address all standards. The San Joaquin Valley Air Pollution Control District is developing ozone and PM_{2.5} SIPs separately. The measures proposed in the State SIP Strategy will also serve as a foundation for SIPs for future, more stringent standards, including the 70 ppb 8-hour ozone standard that U.S. EPA adopted in 2015. This more health protective ozone standard will result in a number of additional nonattainment areas in the more rural regions of California, as well as require further emission reductions in California's existing nonattainment areas. SIPs for this standard will be due in 2021, with attainment dates through 2037. The progression of greater health protection in the federal standards underscores the ongoing need for continuing transformation in the transportation sector.

Emission Reduction Needs

As discussed in Chapter 1, the new reductions that will continue to accrue from implementation of the existing mobile source control program will reduce NO_x emissions in 2031 by over 50 percent from today's levels. These programs will also result in significant reductions in PM_{2.5} emissions. The existing control program will therefore provide the reductions needed to bring almost all areas of the State into attainment of the ozone and PM_{2.5} standards. The key remaining challenges are meeting ozone standards in the South Coast, and PM_{2.5} standards in the San Joaquin Valley. Further reductions in the South Coast will also be necessary to provide for attainment in the Coachella Valley and Mojave Desert regions downwind of the South Coast.

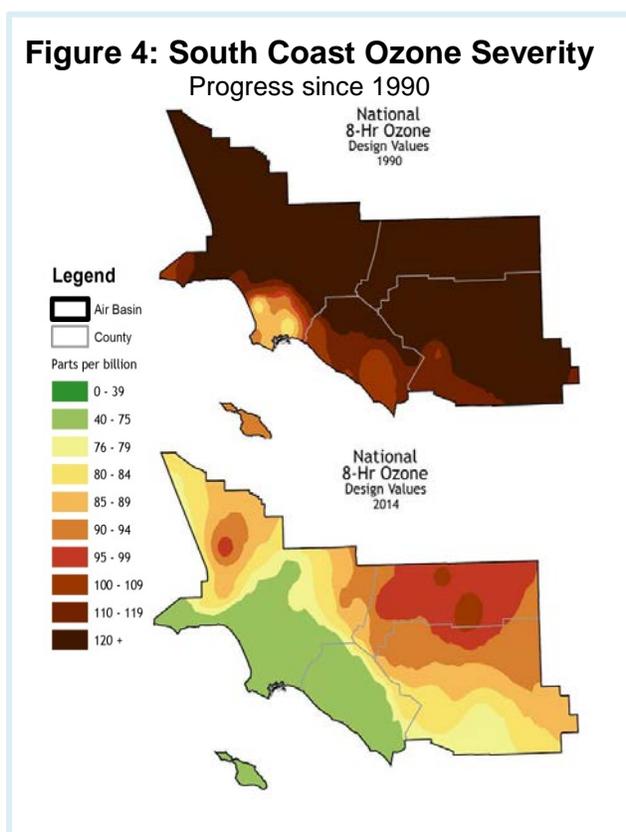
South Coast Emission Reduction Needs

Figure 4 illustrates the ozone air quality progress that has occurred in the South Coast. Twenty-five years ago the entire South Coast region violated the 75 ppb 8-hour ozone standard. Today, ozone concentrations have declined 45 percent, and 40 percent of the population lives in communities that meet the standard.

ARB and the South Coast collaborated on air quality modeling to provide estimates of the reductions needed to attain the ozone and PM_{2.5} standards. PM_{2.5} air quality has also been showing steady improvement. Annual average concentrations have been cut in half since 2001, and the region met the prior 15 µg/m³ annual standard in 2013. Ongoing mobile source reductions to reduce regional PM_{2.5} concentrations, coupled with targeted controls focused on the remaining area of nonattainment in Riverside are expected to bring the entire South Coast region into attainment.

Meeting the ozone standards will therefore 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 standards in 2023 and 2031. While ROG reductions may provide near-term benefits in some portions of the basin, the standards can only be met through significant NO_x reductions. The air quality modeling indicates NO_x emissions will need to decline to approximately 141 tpd in 2023, and 96 tpd in 2031 to provide for attainment in the remaining portions of the region that do not yet meet the standards. Reaching these levels will require an approximate 70 percent reduction from today's levels by 2023, and an overall 80 percent reduction by 2031.

Achieving an 80 percent reduction in NO_x emissions will require comprehensive 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 a decrease of over 75 percent in both mobile and stationary source NO_x 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 control efforts will reduce mobile source NO_x emissions a further 50 percent by 2031.



Achieving the benefits of the current control program will continue to require significant efforts for implementation and enforcement. For example, as part of the Advanced Clean Cars program more stringent passenger vehicle standards will begin phasing in with model year 2017 vehicles. This will require ongoing efforts associated with vehicle certification and in-use surveillance. Outreach and infrastructure development will be needed to continue to grow the market for light-duty ZEVs to meet the ZEV mandate. There are also key implementation deadlines that are yet to occur as part of the Truck and Bus Regulation which require ongoing resources for owner assistance and enforcement. Recognizing these benefits and ensuring effective implementation represents a key element of the overall attainment strategy.

The new actions in the State SIP Strategy are designed to build on these efforts to achieve the 80 percent equal share reduction necessary from the mobile sector. However, the pace of stationary source reductions has slowed since the early 2000's and emissions are projected to decrease at a slower rate than mobile sources. For example, actions included in the State SIP strategy will reduce emissions from light-duty vehicles by over 85 percent. The emissions from almost 12 million light-duty vehicles in the region will therefore become equivalent to current NOx emissions from refineries. Opportunities for achieving further NOx reductions from stationary sources are critical, and the South Coast's AQMP lays out a companion strategy for further reductions from stationary sources.

San Joaquin Valley Emission Reduction Needs

Ozone levels in the San Joaquin Valley have also shown ongoing improvement over the last twenty-five 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 emission reductions. Since 1990, peak ozone concentrations have decreased nearly 20 percent, and the number of days exceeding the standard has dropped over 40 percent. Current control programs will continue the pace of NOx reductions, with a further 60 percent reduction by 2031, resulting in NOx emissions that decline to about 155 tpd by 2023, and about 125 tpd by 2031. Air quality modeling indicates these levels are sufficient to provide for attainment of both the 80 ppb ozone standard in 2023, and the 75 ppb ozone standard in 2031. Additional NOx reductions from measures included in the State SIP Strategy will further enhance ozone progress, as well as provide a foundation for meeting the more health-protective 70 ppb 8-hour ozone standard.

PM2.5 levels in the Valley have also decreased, but meeting PM2.5 standards remains the Valley's greater air quality challenge. Modeling efforts are underway to evaluate the magnitude of reductions needed for attainment of both the annual and 24-hour PM2.5 standards. The PM2.5 attainment strategy for the Valley will need to consider the diversity of sources that contribute to PM2.5, as well as the specific timeframes of meeting both the annual and 24-hour PM2.5 standards over the next ten years. Initial assessments indicate that, given the earlier attainment dates for PM2.5 compared to ozone, accelerating the pace of both NOx and directly emitted PM2.5 reductions will be

necessary. Ongoing mobile source NOx reductions will provide for significant regional improvement, coupled with new reductions from the SIP Strategy, but strategic use of incentive funding will be essential to achieve earlier penetration of cleaner technologies. A similar focus on reductions from sources of directly emitted PM2.5 under local district control will also be critical given their significant contribution to ambient PM2.5 levels in the Valley.

Chapter 3: Proposed SIP Commitment

Overview of Commitment

SIPs must contain enforceable commitments to achieve the level of emissions necessary to meet federal air quality standards, as defined by the attainment demonstration. The State SIP Strategy proposes new SIP measures and quantifies SIP commitments for two areas of the State – the South Coast and the San Joaquin Valley. The State SIP Strategy will also serve as the basis for additional quantified commitments if needed by other federal nonattainment areas. Adoption of the State SIP Strategy by the Board would create a commitment for new emission reductions by the attainment deadlines for each region. The commitment consists of two components:

1. A commitment to bring to the Board or take action on defined new measures; and
2. A commitment to achieve aggregate emission reductions by specific dates.

The total emission reductions and the obligation to propose certain actions would become enforceable upon approval by U.S. EPA of the elements of the State SIP Strategy included in each air district's SIP.

While this proposed State SIP Strategy discusses a range of measures and indicates that ARB will undertake various actions, this State SIP Strategy remains a staff proposal. The proposed commitment is subject to ARB's formal approval process and will not be final until the Board formally takes action on the State SIP Strategy.

Commitment to Act on Defined New Measures

ARB staff proposes to commit to bring to the Board or take action on the list of proposed SIP measures shown in Table 2. For each measure, ARB staff will initiate a rule development process or other appropriate action designed to achieve the emission reduction estimates identified for each measure. This rule development process will 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 therefore provide more or less than the initial emission reduction estimates. In addition, action by the Board may include any action within its discretion. For proposed measures in Table 2 that are not under ARB's regulatory authority, ARB staff proposes to commit to take the appropriate actions as identified in the proposed measure descriptions.

These actions include:

- Petitioning U.S. EPA for federal action on sources under their authority;
- Advocating with federal and international partners for the International Maritime Organization (IMO) to establish more stringent standards for ocean going vessels; and,
- Working with the BAR to conduct an In-Use Performance Assessment.

Commitment to Achieve Emission Reductions

The next two sections describe the emission reduction commitments from the proposed new SIP measures for the South Coast and the San Joaquin Valley, respectively. While the State SIP Strategy includes estimates of the emission reductions from each of the individual new measures, ARB's overall commitment is to achieve the total emission reductions necessary 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 emission reductions, the State is still committed to achieving the total aggregate emission reductions. If actual emission decreases occur that exceed the projections reflected in the current emissions inventory and the State SIP Strategy, ARB 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 emission reductions sufficient for attainment are being achieved through enforceable emission reduction measures.

ARB'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 the implementation of 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 the reductions outlined in the further deployment of cleaner technologies measure for each sector.

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. ARB staff have therefore identified the "Further Deployment of Cleaner Technology" measures as needing U.S. EPA approval under the 182(e)(5) provisions of the Clean Air Act. Measures where federal action is needed are also identified under the Section 182(e)(5) provisions. Section 182(e)(5) measures are noted with an asterisk in Table 2.

Table 2: Proposed New SIP Measures and Schedule

Proposed Measure	Agency	Action	Implementation Begins
On-Road Light-Duty			
Advanced Clean Cars 2	ARB	2020 – 2021	2026
Lower In-Use Emission Performance Assessment	ARB / BAR	n/a	ongoing
Further Deployment of Cleaner Technologies*	ARB / SCAQMD / U.S. EPA	ongoing	2016
On-Road Heavy-Duty			
Lower In-Use Emission Performance Level	ARB	2017 – 2020	2018 +
Low-NOx Engine Standard – California Action	ARB	2019	2023
Low-NOx Engine Standard – Federal Action*	U.S. EPA	2019	2024
Medium and Heavy-Duty GHG Phase 2	ARB / U.S. EPA	2017 – 2019	2018 +
Innovative Clean Transit	ARB	2017	2018
Last Mile Delivery	ARB	2018	2020
Innovative Technology Certification Flexibility	ARB	2016	2017
Zero-Emission Airport Shuttle Buses	ARB	2018	2023
Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles	ARB / SCAQMD	ongoing	2016
Further Deployment of Cleaner Technologies*	ARB / SCAQMD / U.S. EPA	ongoing	2016
Off-Road Federal and International Sources			
More Stringent National Locomotive Emission Standards *	U.S. EPA	2017	2023
Tier 4 Vessel Standards *	ARB / IMO	2016 – 2018	2025
Incentivize Low Emission Efficient Ship Visits	ARB	2018 – 2020	2018 +
At-Berth Regulation Amendments	ARB	2017 – 2018	2023
Further Deployment of Cleaner Technologies*	ARB / SCAQMD / U.S. EPA	ongoing	2016
Off-Road Equipment			
Zero-Emission Off-Road Forklift Regulation Phase 1	ARB	2020	2023
Zero-Emission Off-Road Emission Reduction Assessment	ARB	2025 +	--
Zero-Emission Off-Road Worksite Emission Reduction Assessment	ARB	tbd	--
Zero-Emission Airport Ground Support Equipment	ARB	2018	2023
Small Off-Road Engines	ARB	2018 – 2020	2022
Transport Refrigeration Units Used for Cold Storage	ARB	2018 – 2019	2020 +
Low-Emission Diesel Requirement	ARB	by 2020	2023
Further Deployment of Cleaner Technologies*	ARB / SCAQMD / U.S. EPA	ongoing	2016
Consumer Products			
Consumer Products Program	ARB	2019 – 2021	2020 +

* Request U.S. EPA approval under the provisions of Section 182(e)(5) of the Clean Air Act allowing for reliance on anticipated development of new control techniques or improvement of existing control technologies. Also includes identification of needed funding, infrastructure development, and actions/resources required from other agencies

South Coast Commitment

As discussed in Chapter 2, the current control program is expected to provide sufficient reductions for the entire South Coast region to attain the 12 $\mu\text{g}/\text{m}^3$ annual PM_{2.5} standard by 2025. For ozone, air quality modeling indicates that total NO_x emissions from all sources in the South Coast will need to decrease to approximately 141 tpd in 2023, and 96 tpd in 2031, representing an approximate 70 percent and 80 percent reduction from current levels, respectively. Most of the necessary reductions will come from the existing control program, which is projected to reduce NO_x emissions from all sources by approximately 50 percent by 2031, providing a significant down payment on the emission reductions needed.

Emission Reductions from Current Programs

Ongoing implementation of current control programs is projected to reduce NO_x emissions in the South Coast from today's levels by 153 tpd in 2023 and 184 tpd by 2031. 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.

In the light-duty sector, currently adopted programs reduce NO_x emissions from today's levels almost 80 percent by 2031. Key regulations include ARB's Low Emission Vehicle (LEV) fleet emission standards, which have driven the ongoing clean-up of combustion technology. The Smog Check program has ensured clean in-use performance, and the continued lower in-use performance assessment will do so even more effectively in the future. California's reformulated gasoline standard requires fuel producers to meet increasingly stringent standards, which has reduced NO_x, ROG, and toxic emissions from gasoline. ARB's technology-forcing ZEV regulation continues to drive technology development needed for the long-term transformation of the passenger vehicle fleet.

In the heavy-duty sector, currently adopted programs reduce NO_x emissions by nearly 70 percent by 2031. The Truck and Bus Regulation is one of the most significant rules addressing the legacy heavy-duty truck fleet. Since 2012, it has phased in diesel PM emission controls for nearly all vehicles operating in California, and by 2023 nearly all vehicles will be required to meet 2010 model year engine emissions levels. For municipal and public fleets, the 2005 Fleet Regulation for Public Agencies and Utilities reduces emissions of NO_x and diesel PM from federal, State, county, and city government fleets, as well as those fleets operated by universities, airports, school districts, ports, and special districts such as water, utility, and irrigation districts, by phasing-in requirements for emission control equipment in on-road heavy-duty diesel-fueled fleets. Diesel fuel requirements have further reduced emissions from diesel engines operating in California.

NO_x emissions from off-road equipment are projected to decrease approximately 45 percent by 2031 as a result of ARB programs to establish more stringent engine standards, in-use fleet rules, idling limits, and increasing electrification of smaller

equipment. ARB’s Cleaner In-Use Off-Road Equipment Regulation (Off-Road Regulation) reduces emission from large diesel off-road equipment that remains in use for long periods of time. The Off-Road Regulation accelerates the penetration of the cleanest equipment and will significantly reduce emissions of NOx and toxic diesel PM from the over 150,000 in-use off-road diesel vehicles that operate in California by requiring modernized fleets and exhaust retrofits.

Overall, NOx emissions from sources that are primarily regulated by the federal government, such as ocean going vessels, aircraft, and locomotives, have not kept pace with reductions in other sectors, and are in aggregate projected to remain fairly constant through 2031. While emissions from locomotives continue to decline, emissions from ocean going vessels and aircraft are projected to increase. Although ARB does not have primary regulatory authority over many of these sources, ARB has nonetheless adopted two major regulations to reduce emissions from ocean-going vessels (OGVs), including the OGV Shore Power Regulation, which reduces emissions from diesel auxiliary engines on container ships, passenger ships and refrigerated-cargo ships at-berth at California ports, and the comprehensive OGV Clean Fuel Regulation, which requires vessel operators to use cleaner distillate fuels in their main engines, auxiliary engines, and auxiliary boilers within 24 nautical miles of the California coastline and islands.

Emission Reductions from Proposed New Measures

The new measures contained in the State SIP Strategy commitment reflect a combination of State actions, petitions for federal action, as well as actions that outline a pathway for achieving further deployment of the cleanest technologies in each sector. Together with the emission reductions associated with ongoing implementation of the existing control program, these measures identify all of the reductions needed to achieve a 70 percent reduction in NOx emissions from mobile sources by 2023, and an 80 percent reduction by 2031 in the South Coast. Table 3 summarizes the combined reductions that will accrue through implementation of the current control program, along with proposed new measures identified in the SIP Strategy. Combined, they will reduce NOx emissions 266 tpd by 2023, and 295 tpd by 2031

Table 3: South Coast Mobile Source Emission Reductions
(NOx emission reductions in tpd, from current levels)

	2023		2031	
	Emission Reductions	Percent of Needed Reductions	Emission Reductions	Percent of Needed Reductions
Current Control Programs	153	58%	184	62%
New Proposed Measures	113	42%	111	38%
Total Reductions	266	100%	295	100%

The South Coast NO_x and ROG emission reductions in 2023 and 2031 from each of the proposed new SIP measures are summarized in Table 4. As part of the proposed State SIP Strategy, ARB will provide an enforceable commitment to achieve in aggregate an additional 113 tpd of NO_x reductions by 2023 beyond the current control program, and 111 tpd beyond the current control program by 2031, The proposed new measures in the State SIP Strategy will also provide approximately 50 and 60 tpd of ROG reductions in 2023 and 2031, respectively, which provide supplemental benefits in reducing ozone in portions of the air basin. While Table 4 shows the anticipated emission reductions associated with each measure, the measures as proposed by staff or adopted by the Board may provide more or less reductions than the amount shown.

Table 4: South Coast Expected Emission Reductions from State SIP Measures

All emission reductions in tons per day (tpd)

Proposed Measure	2023		2031	
	NOx	ROG	NOx	ROG
On-Road Light-Duty				
Advanced Clean Cars 2	--	--	0.6	0.4
Lower In-Use Emission Performance Assessment	NYQ	NYQ	NYQ	NYQ
Further Deployment of Cleaner Technologies*	7	16	5	16
Total Category Reductions	7	16	6	16
On-Road Heavy-Duty				
Lower In-Use Emission Performance Level	NYQ	<0.1	NYQ	<0.1
Low-NOx Engine Standard – California Action	--	--	5	--
Low-NOx Engine Standard – Federal Action*	--	--	7	--
Medium and Heavy-Duty GHG Phase 2	NYQ	NYQ	NYQ	NYQ
Innovative Clean Transit	<0.1	<0.1	0.1	<0.1
Last Mile Delivery	<0.1	<0.1	0.4	<0.1
Innovative Technology Certification Flexibility	NYQ	NYQ	NYQ	NYQ
Zero-Emission Airport Shuttle Buses	NYQ	NYQ	NYQ	NYQ
Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles	3	0.4	3	0.4
Further Deployment of Cleaner Technologies*	34	4	11	1
Total Category Reductions	37	4	27	2
Off-Road Federal and International Sources*				
Aircraft				
Further Deployment of Cleaner Technologies*	9	NYQ	13	NYQ
Locomotives				
More Stringent National Locomotive Emission Standards*	<0.1	<0.1	2	<0.1
Further Deployment of Cleaner Technologies*	7	0.3	3	0.3
Ocean-Going Vessels				
Tier 4 Vessel Standards*	--	--	NYQ	NYQ
Incentivize Low Emission Efficient Ship Visits	NYQ	NYQ	NYQ	NYQ
At-Berth Regulation Amendments	0.3	<0.1	1	<0.1
Further Deployment of Cleaner Technologies*	30	NYQ	38	NYQ
Total Off-Road Federal and International Reductions	46	0.3	57	0.3
Off-Road Equipment				
Zero-Emission Off-Road Forklift Regulation Phase 1	--	--	1	0.1
Zero-Emission Off-Road Emission Reduction Assessment	NYQ	NYQ	NYQ	NYQ
Zero-Emission Off-Road Worksite Emission Reduction Assessment	NYQ	NYQ	NYQ	NYQ
Zero-Emission Airport Ground Support Equipment	<0.1	<0.1	<0.1	<0.1
Small Off-Road Engines	0.7	7	2	16
Transport Refrigeration Units Used for Cold Storage	NYQ	NYQ	NYQ	NYQ
Low-Emission Diesel Requirement	0.3	NYQ	1	NYQ
Further Deployment of Cleaner Technologies*	21	21	18	20
Total Off-Road Equipment Reductions	22	28	22	36
Consumer Products				
Consumer Products Program	--	1 – 2	--	4 – 5
Total Consumer Products Reductions	--	1 – 2	--	4 – 5
Aggregate Emission Reductions	113	50 - 51	111	59 - 60

* Request U.S. EPA approval under the provisions of Section 182(e)(5) of the Clean Air Act; "NYQ" denotes emission reductions are Not Yet Quantified; "--" denotes no anticipated reductions

San Joaquin Valley Commitment

Air quality modeling has demonstrated that the substantial reductions from implementation of the existing mobile source control program will provide for attainment of ozone standards in the Valley. These programs will reduce NO_x emissions by 182 tpd between 2015 and 2031, and are sufficient to reach the approximately 160 tpd attainment level for the 80 ppb standard in 2023, and the approximately 130 tpd attainment level for the 75 ppb standard by 2031. The new SIP measures identified in this document provide additional NO_x reductions that go beyond what is needed to meet the Valley's 2031 attainment date, and therefore will enhance air quality progress. As part of the proposed State SIP Strategy, ARB will provide an enforceable commitment to provide an aggregate total of 8 tpd of NO_x reductions from measures under ARB's direct regulatory authority, which, when coupled with strong action at the federal level, will achieve a total of 17 tpd of NO_x emission reductions in 2031. Table 5 shows the anticipated emission reductions associated with each measure. The measures as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Work is also continuing to define the nature of the control strategy and associated emission reductions for meeting PM_{2.5} standards in the San Joaquin Valley over the next decade. As part of this process, ARB staff held a workshop on December 1, 2016 to present a science-based assessment of the sources contributing to PM_{2.5} levels in the Valley, the benefits of current control programs, and an initial evaluation of the scope of further emission reductions needed to meet both annual and 24-hour PM_{2.5} standards over the next 10 years. The San Joaquin Valley Air District also held a workshop on December 7, 2016 to initiate the broader PM_{2.5} SIP development process.

Reductions in directly emitted PM_{2.5} and NO_x from both stationary and mobile sources will be necessary given the diversity of sources that contribute to elevated PM_{2.5} levels throughout the year. While current control programs will reduce NO_x emissions from mobile sources by 50 percent, and PM_{2.5} emissions by nearly 25 percent over the next ten years, continued reductions from the cleaner technologies included in the SIP Strategy will also be important. ARB's initial science-based assessment examining a balanced portfolio of both direct PM_{2.5} and NO_x reductions suggests that NO_x emission levels in the range of those necessary to meet the 70 ppb ozone standard would also provide the share of mobile source NO_x reductions needed to meet PM_{2.5} standards. These reductions, however, must be achieved within the earlier timeframes required for PM_{2.5} attainment. The San Joaquin Valley is also conducting modeling to help define the appropriate control strategy. The revised SIP Strategy therefore includes an initial commitment for 2025 reflecting reductions that will be achieved as new technologies enter the fleet. These reductions will accelerate ozone progress, and serve as a down payment on the reductions needed to meet PM_{2.5} standards.

At the same time, ARB will continue to work with the San Joaquin Valley and other stakeholders to determine the final emission reduction needs and additional strategies, including funding mechanisms, to accelerate deployment of these technologies. This

will also include efforts to reflect the benefits of other transformational efforts underway in the Valley as part of climate programs and the Sustainable Freight Action Plan. A commitment for the additional mobile source reductions needed for attainment will be brought to the Board as part of the comprehensive PM2.5 SIP this fall. Funding efforts and advocacy for federal action will also be coordinated with those of the South Coast, as the need for cleaner technologies are similar and there are strong synergies in the deployment of cleaner cars and trucks in both regions. For example, approximately 20 percent of truck travel that originates in the South Coast subsequently transits through the San Joaquin Valley. Combined investments can therefore benefit both regions and reduce overall funding needs, while providing a strong platform to advocate for the health and economic benefits of meeting clean air standards.

Table 5: San Joaquin Valley Expected Emission Reductions from State SIP Measures

All emission reductions in tons per day (tpd)

Proposed Measure	2025		2031
	NOx	PM2.5	NOx
Advanced Clean Cars 2	--	--	0.2
	--	--	0.2
On-Road Heavy-Duty			
Lower In-Use Emission Performance Level	NYQ	<0.1	NYQ
Low-NOx Engine Standard – California Action	2	--	7
Low-NOx Engine Standard – Federal Action	2	--	8
Innovative Clean Transit	<0.1	<0.1	<0.1
Last Mile Delivery	<0.1	<0.1	0.2
Zero-Emission Airport Shuttle Buses	--	--	<0.1
	4	<0.1	15
Off-Road Federal and International Sources			
More Stringent National Locomotive Emission Standards	0.3	<0.1	1
	0.3	<0.1	1
Zero-Emission Off-Road Forklift Regulation Phase 1	--	<0.1	<0.1
Zero-Emission Airport Ground Support Equipment	<0.1	<0.1	<0.1
Small Off-Road Engines	0.2	<0.1	0.3
Transport Refrigeration Units Used for Cold Storage	NYQ	NYQ	NYQ
Low-Emission Diesel Requirement	1	0.1	0.5
	1	0.1	0.8
	6	0.1	17

"NYQ" denotes emission reductions are Not Yet Quantified

"--" denotes no anticipated reductions

Statewide Emission Reductions

The proposed measures in the State SIP Strategy will also provide broad emission reduction benefits throughout the State, which are summarized in Table 6. Although the existing control program will provide mobile source emission reductions necessary to meet the attainment needs of most areas of the State, the new measures in the State SIP Strategy will provide further reductions to enhance air quality progress and provide a foundation for meeting the more stringent 8-hour ozone standard of 70 ppb. Should additional areas require emission reductions to meet the current ozone and PM2.5 standards, ARB will quantify area and year specific reductions as part of individual attainment plans.

Table 6: Statewide Expected Emission Reductions from State SIP Measures

All emission reductions in tons per day (tpd)

Proposed Measure	2031		
	NOx	ROG	PM2.5
On-Road Light-Duty			
Advanced Clean Cars 2	2	1	<0.1
Lower In-Use Emission Performance Assessment	NYQ	NYQ	NYQ
Further Deployment of Cleaner Technologies*	5	16	0.1
Total Category Reductions	7	17	0.1
On-Road Heavy-Duty			
Lower In-Use Emission Performance Level	NYQ	NYQ	<0.1
Low-NOx Engine Standard – California Action	24	--	--
Low-NOx Engine Standard – Federal Action*	28	--	--
Medium and Heavy-Duty GHG Phase 2	NYQ	NYQ	NYQ
Innovative Clean Transit	0.5	<0.1	<0.1
Last Mile Delivery	1	<0.1	<0.1
Innovative Technology Certification Flexibility	NYQ	NYQ	NYQ
Zero-Emission Airport Shuttle Buses	NYQ	NYQ	NYQ
Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles	3	0.4	--
Further Deployment of Cleaner Technologies*	11	1	--
Total Category Reductions	68	2	<0.1
Off-Road Federal and International Sources*			
More Stringent National Locomotive Emission Standards*	9	0.4	<0.1
Tier 4 Vessel Standards*	NYQ	NYQ	NYQ
Incentivize Low Emission Efficient Ship Visits	NYQ	NYQ	NYQ
At-Berth Regulation Amendments	2	0.1	<0.1
Further Deployment of Cleaner Technologies*	54	0.3	NYQ
Total Category Reductions	65	1	<0.1
Off-Road Equipment			
Zero-Emission Off-Road Forklift Regulation Phase 1	2	0.2	<0.1
Zero-Emission Off-Road Emission Reduction Assessment	NYQ	NYQ	NYQ
Zero-Emission Off-Road Worksite Emission Reduction Assessment	NYQ	NYQ	NYQ
Zero-Emission Airport Ground Support Equipment	<0.1	<0.1	<0.1
Small Off-Road Engines	4	36	<0.1
Transport Refrigeration Units Used for Cold Storage	NYQ	NYQ	NYQ
Low-Emission Diesel Requirement	4	NYQ	0.5
Further Deployment of Cleaner Technologies*	18	20	NYQ
Total Category Reductions	28	56	0.5
Consumer Products			
Consumer Products Program	--	8 - 10	--
Total Category Reductions	--	8 - 10	--
Total Expected Emission Reductions	168	84 – 86	0.6

* Request U.S. EPA approval under the provisions of Section 182(e)(5) of the Clean Air Act for the South Coast
 "NYQ" denotes emission reductions are Not Yet Quantified; "--" denotes no anticipated reductions

Actions to Implement the Further Deployment of Cleaner Technology Measures

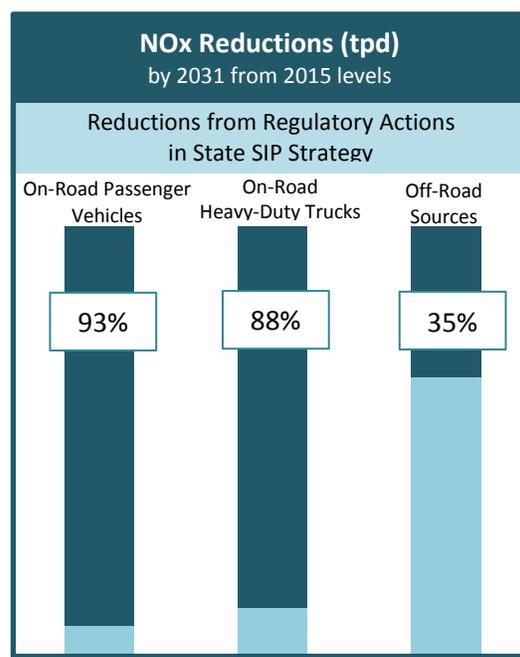
Implementation of the current control program and new regulatory actions to establish requirements for cleaner technologies comprise the core of the overall strategy. Figure 5 illustrates the role of regulatory actions in each sector, as a percentage of the total reductions needed for attainment in the South Coast. The relative proportion of regulatory and incentive reductions varies by the sector, reflecting differences in the maturity of the current control program, authority, and technology development. For example, existing regulations and new proposed regulations for passenger cars provide 93 percent of the overall reductions for the light-duty sector in the SIP Strategy.¹⁸ For trucks, current and proposed regulations provide 88 percent of the overall reductions in the strategy.

Achieving reductions in the off-road sectors remains a greater challenge due to the diverse nature of these sources, regulatory authority that rests outside of ARB in many cases, and the length of time sources such as locomotives, marine vessels, and aircraft remain in the fleet. Nevertheless, the State SIP Strategy includes key regulatory actions to establish the next tier of cleaner combustion for locomotives and marine vessels, and introduction of ZEV technologies for smaller off-road equipment.

Overall, approximately 70 percent of the total reductions in the strategy come from regulations. These regulatory measures represent a comprehensive and aggressive scope of actions across all sectors to establish and deploy requirements for significantly cleaner technologies over the next fifteen years.

The remaining increment of reductions will be achieved through a suite of actions as part of implementation of the further deployment of cleaner technology measures.

Figure 5: NOx Emission Reductions in South Coast



¹⁸ Percentages in Figure 5 represent the relative portion of total emission reductions for each mobile source category that are anticipated to result from regulatory actions (shown in graph in the darker, top portion) in the South Coast. Emission reductions represent reductions by 2031, from today's (i.e. 2015) levels.

These actions reflect the importance of a variety of tools and approaches to achieve emission reductions through a comprehensive transformation of the transportation system. Building from the core regulatory efforts, implementing the complementary actions to support this transformation will include: 1) efforts to enhance the penetration of cleaner technologies through incentive programs and other funding mechanisms; 2) advocacy for further federal actions; 3) further regulatory development as new technologies emerge; 4) quantification of the benefits of increased system efficiencies, utilization of intelligent transportation systems and emerging autonomous and connected vehicle technologies; and 5) other innovative efforts to incentivize the demand for cleaner technologies. The South Coast has also proposed a number of complementary mobile source measures¹⁹ that are designed to help implement the further deployment measures included in the SIP Strategy. These measures play an important role at the local level and include facility oriented measures, as well as incentive based programs for both on-road and off-road sources.

The specific combination of approaches for each further deployment measure will vary by source sector. However ARB and South Coast staff have collaborated to develop an illustrative pathway for each sector outlining the scope of technology required and the suite of implementation tools and recommended actions by both agencies along with continued collaboration with U.S. EPA. Together, these actions provide the mechanisms for achieving the identified emission reductions. Additional discussion of overall approaches is provided below, with individual pathways described as part of the Further Deployment of Cleaner Technologies measure write-ups for each sector contained in Chapter 4.

Identifying and Securing Funding and Other Incentive Mechanisms

Funding to support incentive-based programs and other innovative mechanisms will be an essential element of the further deployment measures. This will be especially important for achieving significant penetration of the cleanest technologies in the South Coast and the San Joaquin Valley over the next five to ten years. The South Coast's Draft Final AQMP identifies several different approaches for quantifying the range of funding necessary to achieve the scale of technology deployment needed between now and 2031. The estimated total funding levels range from approximately \$4 billion to \$14 billion dollars, which translates into \$250 million to approximately \$1 billion per year. This represents the upper limit on funding needs, assuming no other actions are taken to achieve the emission reduction associated with the further deployment measures. Emission reductions achieved through system efficiencies, additional regulatory efforts, and co-benefits from climate program initiatives would reduce the overall funding needed.

Current incentive programs have been an important part of a portfolio to accelerate the penetration of cleaner technologies. Existing State-level incentive programs include the

¹⁹ South Coast AQMD Draft Final 2016 AQMP Mobile Source Measures, December 2016
<http://www.aqmd.gov/home/library/clean-air-plans/air-quality-mgt-plan/final-draft-2016-aqmp>

Carl Moyer Program, Clean Vehicle Rebate Project (CVRP), Enhanced Vehicle Modernization Program (EFMP), Hybrid Truck and Bus Voucher Incentive Program (HVIP), the Low Carbon Transportation investments, and the California Energy Commissions Alternative and Renewable Fuel and Vehicle Technology Program, which helps to fund alternative fuels, advanced technology vehicles, and the needed infrastructure development.²⁰ Local programs include the Carl Moyer Program authorized under AB 923, AB 2766 local government funding, and the South Coast District's Clean Fuels Fund, which is used primarily to commercialize advanced technology vehicles and trucks and alternative fuel infrastructure. The District also receives funding from the U.S. EPA Diesel Emissions Reduction Act (DERA), and Targeted Airshed Grants on a competitive basis, and one time enforcement settlement agreements and mitigation funds. These programs have continued to grow over time as a result of increasing recognition of the role they play in advancing technologies. Today, the District receives approximately \$100 to \$150 million per year through ongoing and one-time funding mechanisms.

However, funding levels beyond what is available through current programs will be needed over the next seven to fifteen years. The South Coast recently released a Draft Financial Incentives Funding Action Plan (Funding Action Plan)²¹ to identify the necessary actions by the State, District, region, federal government, and other partnerships to ensure that sustained levels of funding are secured as early as possible and continue through 2031. The Funding Action Plan describes existing funding programs, new funding opportunities, activities that will be undertaken to pursue each potential funding mechanism, and a schedule and reporting process. As part of this effort, the South Coast is establishing a stakeholder working group to help further develop and implement the Funding Action Plan. ARB will continue to collaborate with the South Coast on the funding plan, as well as play a key role in implementing State-level programs, and coordination with other states regarding national programs.

An initial listing of potential mechanisms is described in the Funding Action Plan. The Funding Action Plan outlines a number of guiding principles in pursuing these potential funding mechanisms. These include: 1) identified funding sources shall not be from a diversion of existing or future funds for purposes other than air quality, 2) where appropriate, priority will be placed on recovering costs from entities that are the emitters of targeted pollutants, 3) ensure that funding secured for the primary purpose of climate change, energy efficiency, or operational efficiencies also provide criteria pollutant benefits to the greatest extent feasible, and 4) funding be disbursed to maximize benefits to residents living in environmental justice and disadvantaged communities, while ensuring the region attains federal air quality standards as early as possible.

²⁰ <http://www.energy.ca.gov/contracts/transportation.html>

²¹ The South Coast Draft Financial Incentives Funding Action Plan (December 2016) is available at: <http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/draftfinancialincentivefunddec2016.pdf?sfvrsn=6>

Examples of funding mechanisms that the South Coast District has identified at the federal, State, and local level include:

Federal

- Creation of national Clean Air Investment and Cleanup Fund
- Expansion of Diesel Emissions Reduction Act (DERA)
- Continued Targeted Airshed Grants
- U.S. Department of Energy Clean Cities Program
- U.S. Department of Transportation Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users Program
- Federal Aviation Administration (FAA) Voluntary Airport Low Emission Program
- National container fee
- VW settlement agreement
- Expansion of federal tax credits

State

- Continuation of existing incentive programs, and other potential new monetary programs, with focus on program design to maximize criteria pollutant and GHG reduction benefits
- Carl Moyer Memorial Air Quality Standards Attainment Program (AB 923)
- The California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program (AB 118) and Low Carbon Transportation Funding (from the Greenhouse Gas Reduction Fund, or GGRF)
- Development of new mechanisms similar to Proposition 1B
- Gasoline/Diesel excise tax add-on
- Crude oil sales tax
- Sales tax breaks for zero-emission vehicles

Local

- Local Motor Vehicle Registration Fees (AB 2766)
- South Coast District's Control of NOx Emissions from Off-Road Diesel Vehicles and California In-Use Off-Road Diesel Fleet Regulation (SCAQMD Rule 2449)
- South Coast District's On-Road Motor Vehicle Mitigation Options Program (SCAQMD Rule 2202)
- Local ballot measures
- Expanded auto registration fee
- Mileage-based user fee
- Property tax / retail sales tax add-on
- Continuation of South Coast District Clean Fuels Program
- Mitigation funds from other local rules and enforcement actions

The broad scope of funding sources reflects the important role that all levels of government must play in bringing healthy air to the South Coast region. Successful

efforts will also require building public/private coalitions to advocate for the needs of the region, along with other areas of the State such as the San Joaquin Valley. These coalitions can include establishment of new partnerships with other national nonattainment areas through the National Association of Clean Air Agencies for pooling and coordinating funds, State collaborations with the California Air Pollution Control Officers Association, and expansion of the District's Strategic Alliance Initiative to implement collaborative efforts to identify and seek federal funding.

Given the \$100 million per year the South Coast currently receives, an expansion of current programs, coupled with a number of the new initiatives identified above, would provide an effective framework for achieving the necessary funding stream. The earlier attainment deadline for meeting the 80 ppb ozone standard by 2023 constitutes the more significant challenge. This will require a greater influx of funding during the early years to support the enhanced deployment of cleaner technologies. However, early investments will reduce the need for funding later in the decade.

While no single funding source or government entity can fulfill the South Coast region's funding needs, in combination the broad spectrum of mechanisms and approaches described above have the potential to provide over \$2.3 billion per year to the South Coast if currently quantified opportunities are realized, exceeding the \$1 billion per year necessary to meet the region's attainment needs. Many of the identified funding sources represent expansion of current successful programs, or mechanisms that have been effectively applied in other situations. For example, a Clean Air Investment Fund could be patterned off of similar efforts used for addressing Superfund cleanup efforts for soil and water contamination. This effort could focus on national and international sources of emissions. Similarly, an additional auto registration fee has been providing funding for numerous incentive programs in the San Joaquin Valley, with a portion of the funds specifically targeted towards programs which benefit disadvantaged communities.

These investments will also help support the comprehensive transformation needed to meet California's climate and risk reduction goals. Targeted funding in disadvantaged communities can provide significant benefits for residents who are disproportionately impacted by multiple emission sources by reducing both criteria pollutants and TACs. A number of incentive programs are also specifically focused on assisting low-income residents with access to cleaner technologies, such as the EFMP Plus Up program. An enhanced focus on investments in these communities will be an important element of the implementation of the funding plan.

Beyond individual funding mechanisms, there are multiple State level programs and legislative mandates that are facilitating the overall transformation to cleaner, more efficient technologies in California. These programs are designed to provide an overall framework to support needed technology development and infrastructure, increase consumer awareness and outreach, and provide for focused investments in individual communities. These efforts also help meet the State's transportation electrification goals under SB 350 through pursuit of transformational programs that can catalyze

widespread transportation electrification. Examples of the State's high level commitment to supporting this transformation include:

- Volkswagen (VW) Settlement Agreement: The proposed VW California settlement agreement includes both a Mitigation Trust to remedy total lifetime excess NOx emissions, as well as a ZEV Investment Commitment which establishes eligible categories for VW investments. The Mitigation Trust includes \$381 million for California, which will be used to provide funding to replace older vehicles and equipment with cleaner models, as well as fund light-duty ZEV infrastructure. The ZEV Investment Commitment includes \$800 million for California to support transportation electrification and the next generation of electric vehicles. Key focus areas will include installing zero-emission vehicle fueling infrastructure (for both electric and hydrogen-powered cars), funding brand-neutral consumer awareness campaigns to increase the zero-emission vehicle market, and investing in projects such as car-sharing programs that will increase access to zero-emission vehicles for all consumers in California. The ZEV Investment Commitment funding also includes a Green City initiative that will demonstrate in a concentration fashion the operation of car sharing services, ZEV/shuttle transit services, and ZEV freight transport projects.
- Transformative Climate Communities: The State of California is proposing to invest \$140 million of cap-and-trade auction proceeds next year in the State's most disadvantaged communities through the Transformative Climate Communities Program, which integrates multiple, cross-cutting approaches to reduce GHG emissions. These revenues – likely \$70 million for Fresno, \$35 million for Los Angeles, and \$35 million in a third location²² – are for broad-based GHG emission reduction projects that provide local economic, environmental, and health benefits to disadvantaged communities.²³
- ZEV Action Plan: In October 2016, the Governor's Office released the 2016 ZEV Action Plan²⁴, which builds on the successful implementation of the 2013 ZEV Action Plan and identifies new actions State agencies will collaboratively take to raise consumer awareness about ZEVs; ensure ZEV accessibility to a broad range of Californians; achieve ZEV commercial availability in targeted heavy-duty applications and in the freight sector; and aid ZEV market growth beyond California.
- Plug-in Electric Vehicle Collaborative: The California Plug-In Electric Vehicle Collaborative is a public/private organization focused on accelerating the adoption of Plug-in Electric Vehicles (PEVs) to meet California's economic, energy and environmental goals. Using the expertise of each member, the PEV Collaborative collaborates on emerging PEV market trends and works to address

²² <http://sgc.ca.gov/Grant-Programs/Transformative-Climate-Communities-Program.html>

²³ <http://sgc.ca.gov/Grant-Programs/TCC-Rulemaking.html>

²⁴ https://www.gov.ca.gov/docs/2016_ZEV_Action_Plan.pdf

challenges and enable strong PEV market growth. The Collaborative's 2010 Strategic Plan, ***Taking Charge***, is designed to facilitate PEV market growth so that, by the end of the decade, hundreds of thousands of PEVs will be sold annually in California, and the market will contribute significantly to California's ongoing economic, energy and environmental policy objectives. Its strategic focus is to solidify California as a technological, manufacturing, economic, and policy leader that benefits from – and shapes – the global PEV market for decades to come.

- **California Fuel Cell Partnership:** The California Fuel Cell Partnership is a collaboration of organizations, including auto manufacturers, energy providers, government agencies and fuel cell technology companies, that work together to promote the commercialization of hydrogen fuel cell vehicles. By working together, the Partnership helps ensure that vehicles, stations, regulations and people are in step with each other as the technology comes to market.
- **California Sustainable Freight Action Plan:** The California Sustainable Freight Action Plan outlines an integrated approach to coordinate State agency priorities and timing on actions to influence freight transportation and energy infrastructure, vehicle and equipment technologies, and facility and operations efficiency, rather than the traditional and separate planning efforts for transportation, environment, and energy. The Action Plan is the beginning of a process, and signals State government's interest in collaborating with stakeholders on defining the actions necessary to make the 2050 Vision for a sustainable freight transport system a reality. The Action plan also includes 2030 targets for guide the State towards meeting this vision, as well as focused pilot projects to achieve near-term progress.

Programs to Support Continued Technology Advancement

ARB, along with other public and private partners, also continue to sponsor research and demonstration programs to further promote advanced technology development. This will occur through ARB's annual research program, grant programs, and other cooperative agreements. For example, ARB, U.S. EPA, the South Coast, and the San Joaquin Valley are partners in a memorandum of understanding that commits to developing and testing new sustainable technologies by aligning resources and evaluating innovative technologies. ARB is funding an examination of the feasibility of various engine configurations and after treatment technologies that enable diesel and natural gas heavy-duty trucks to meet the proposed low-NOx standard of 0.02g/bhp-hr.²⁵ ARB is also funding an analysis of the effectiveness, feasibility, and cost-effectiveness of after treatment controls that reduce NOx and PM emissions from off-road diesel engines less than 37 kW.²⁶

²⁵ <https://www.arb.ca.gov/research/veh-emissions/low-nox/low-nox.htm>

²⁶ https://www.arb.ca.gov/research/single-project.php?row_id=65212

ARB also supports technology demonstrations through various grant programs, including a current award to the South Coast for a \$24 million Statewide demonstration project for zero-emission drayage trucks.²⁷ The South Coast and the California Energy Commission are co-funding a \$2.6 million demonstration project for two Class 8 drayage trucks at the Ports of Long Beach and Los Angeles. ARB has awarded \$9 million to demonstrate two types of zero-emission trucks in the weight classes most commonly used at rail yards and freight transfer yards.²⁸ This project reduces emissions from rail yards and freight facilities in Southern California, while also accelerating ZEV commercialization by providing a model for heavy-duty truck electrification that can be scaled for individual facility needs. Additionally, in partnership with the Port of Los Angeles, ARB has awarded \$14 million for a demonstration project that integrates near-zero and zero-emission vehicles and cargo handling equipment into marine terminal operations.²⁹ This project is expected to reduce NOx, diesel PM and GHG emissions from marine terminals, and leverages private investments to demonstrate the latest generation of advanced technologies. Finally, in October 2016, the Board approved \$60 million under the Low Carbon Transportation program for zero-emission truck and bus pilot deployments to accelerate deployment and drive consumer acceptance at the early stages of commercialization. Seventy-five percent of the funding will be focused in disadvantaged communities. Together, these projects help to accelerate the commercialization of advanced clean technologies, and provide cleaner air for all Californians, especially those who live in disadvantaged communities located next to industrial facilities, freight transfer facilities, or along the State's businesses trade corridors.

Several proposed measures in the State SIP Strategy also focus on deploying zero-emission vehicles and equipment in initial applications that are currently well-suited for broader market deployment such as the Last Mile Delivery measure. Depending upon the success of these applications, and ongoing technology assessment, further regulatory mechanisms for additional applications can be identified. As part of this effort, ARB will also work with federal and international agencies to advocate for more stringent emission standards and efficiency requirements for sources that are not under ARB's regulatory purview.

Other Mechanisms for Emission Reductions

In addition to the technology and funding approaches described above, other technology innovations and policies provide further mechanisms and opportunities for emission reductions as part of the broader transformation of the mobile sector. Additional gains in passenger transportation efficiencies can be achieved through more efficient land use and developing sustainable communities that feature a range of mobility choices. Intelligent transportation systems, and autonomous and connected vehicles and new approaches to personal mobility also represent an opportunity to

²⁷ <https://www.arb.ca.gov/newsrel/newsrelease.php?id=809>

²⁸ <https://www.arb.ca.gov/newsrel/newsrelease.php?id=824>

²⁹ https://www.portoflosangeles.org/newsroom/2016_releases/news_052616_green_omni.asp

fundamentally transform the transportation system and provide synergies for greater use of zero-emission vehicles. Through the California Sustainable Freight Action Plan, ARB and other State agencies are identifying strategies, developed in partnership with stakeholders, to promote greater efficiencies in the freight transport system and approaches to reduce emissions around freight hubs such as rail yards, seaports, airports, and distribution centers. As part of this effort, ARB is initiating a survey to collect information related to the types of emission sources and activities associated with freight hubs. This effort will provide the necessary data for supporting identification of effective mechanisms for reducing emissions. At the same time, ARB is strategically funding innovative demonstration programs that integrate a wide array of intelligent transportation systems and autonomous and connected vehicles with the latest near-zero and zero-emission technologies, powered by renewable fuel sources. Aviation fuels are also being considered as a potential voluntary opt-into the Low Carbon Fuel Standard (LCFS).

Many of these actions will be further defined through companion planning efforts occurring over the next year, including the California Sustainable Freight Action Plan described above, California's 2030 Target Scoping Plan Update, and SB 375, the Sustainable Communities and Climate Protection Act. For example, in 2017 ARB will be considering more stringent per capita GHG reduction targets as part of SB 375. These targets would require development of additional strategies to reduce VMT from light-duty vehicles, thereby reducing both GHG and criteria pollutant emissions. In addition, the 2030 Target Scoping Plan Update identifies a number of measures that would provide criteria pollutant reductions in addition to GHG reductions. As these measures move forward, the reductions can be quantified and incorporated into the SIP.

Additional strategies that target mechanisms for increasing consumer demand for cleaner technologies also offer promise. These strategies could include approaches developed with the goal of expanding the market for green products that are within the budget of more consumers, increasing the frequency in which people can invest in cleaner technologies, including enhanced education and outreach on the benefits of advanced technologies, and providing mechanisms through which consumers can demand the use of greener technologies and supply chains in the products that they buy. Other mechanisms could include dedicated lanes and preferential access to encourage purchase of near-zero and zero-emission technologies.

In addition to connected and autonomous vehicles and truck platooning, new communication and GPS technologies are paving the way to incorporating zero-emission approaches to reducing VMT by integrating flexible, on-demand, technology-based ridesharing, vanpooling and micro-transit into our transit system. These technologies can reduce VMT and expand transit options into areas that do not lend themselves to traditional transit options, and encourage new users in current transit areas. This will allow traditional transit to remain strong in those communities that are dependent on such transit.

Commitment for Monitoring Progress and Ensuring Emission Reductions

As part of ongoing implementation of the AQMP, both ARB and the South Coast commit to monitoring progress in obtaining funding and in quantifying the benefits of reductions from mechanisms such as system efficiencies, advanced transportation systems, and other complementary programs including the California Sustainable Freight Action Plan, the 2030 Target Scoping Plan Update, and the SB 375 target setting process. As noted earlier, ARB's overall commitment is to achieve the aggregate emission reductions necessary to attain the federal air quality standards, reflecting the combined reductions from the existing control strategy and new measures. Based on a continuing assessment of progress, ARB will identify, as necessary, appropriate regulatory mechanisms to achieve any shortfall in reductions. These regulatory mechanisms could include fleet rules to require enhanced deployment of cleaner technologies, expanded purchase requirements for zero-emission technologies, and establishment of more stringent engine standards for additional vehicle and equipment types.

As part of ARB's efforts to implement the further deployment measures, ARB commits to report back to the Board within one year of adoption of the State SIP Strategy, and yearly thereafter. This report will include:

1. The status of partnerships with the South Coast, San Joaquin Valley, U.S. EPA, other government agencies, and the private sector to pursue research, demonstration, and pilot projects for further advancement of near-zero and zero-emission technologies;
2. The status of the Financial Incentives Funding Action Plan, progress in identifying and implementing funding mechanisms, and status of State level incentive programs and allocation of funding to the South Coast and San Joaquin Valley regions;
3. The status of technology assessments, emerging technologies and emission reduction opportunities. ARB staff will also report on implementation of actions identified by the South Coast and San Joaquin Valley as well as actions contained in the California Sustainable Freight Action Plan, the 2030 Target Scoping Plan Update, SB 375, and other complementary efforts and the criteria pollutant benefits that result from these actions; and,
4. Recommendations on the development of further regulatory measures and schedules for their development for inclusion in the SIP.

ARB staff will also provide periodic reports to U.S. EPA on the progress in developing and implementing the further deployment measures. This process will also include coordination with U.S. EPA to develop the programmatic structure for use of incentive-based measures in the SIP to satisfy Clean Air Act requirements. These include: 1) demonstration that the incentive program reductions are quantifiable, enforceable, permanent, and surplus; 2) provisions for an enforceable commitment;

3) technical analyses and supporting documentation; 4) demonstration of funding and legal authority; 5) procedures for public disclosure of information; and 6) provisions to measure and track program results.

At the District level, South Coast staff will assess progress in identifying actions to achieve emission reductions at the local level and report to the Governing Board on a routine basis. If progress is not made in identifying specific actions within one year from adoption of the Final 2016 AQMP, South Coast staff will recommend whether the Governing Board should consider proceeding with the development of rules within its existing legal authority or seek additional authority to adopt and implement measures to cost-effectively reduce mobile source emissions. Such authority includes development of new or expanded clean vehicle fleet rules or indirect source regulations.

Chapter 4:

State SIP Measures

Proposed Measures: On-Road Light-Duty Vehicles

Description of Source Category:

Passenger cars and light trucks (up to 8,500 lbs., otherwise called light-duty vehicles), are a major contributor to NO_x and GHG emissions in California. The State's 39 million residents collectively own about 25 million passenger vehicles and drive more than most other Americans. Over ten million of these vehicles are in the South Coast. The vast majority of these vehicles have internal combustion engines and use gasoline. A small portion is powered by diesel compression ignition engines, and a smaller portion still has electric powertrains. The light-duty vehicle sector is projected to grow to approximately 30 million vehicles Statewide by 2031, and will increasingly rely on electric drive vehicles of varying types (e.g. battery electric, plug-in hybrid, or fuel cell electric vehicles).

Proposed Measures: On-Road Light-Duty Vehicles

Table 7: Summary of On-Road Light-Duty Vehicle Control Measures

Statewide Estimated Emission Reductions (tons per day)		
	2015	2031
NOx Inventory*	209	51
Advanced Clean Cars 2		2
Lower In-Use Emission Performance Assessment		NYQ
Further Deployment of Cleaner Technologies		5
Potential reductions		7
ROG Inventory*	303	128
Advanced Clean Cars 2		1
Lower In-Use Emission Performance Assessment		NYQ
Further Deployment of Cleaner Technologies		16
Potential reductions		17
PM2.5 Inventory*	19	20
Advanced Clean Cars 2		<0.1
Lower In-Use Emission Performance Assessment		NYQ
Further Deployment of Cleaner Technologies		0.1
Potential reductions		0.1

*2031 values reflect anticipated emission reductions from current control programs

"NYQ" denotes emission reductions are Not Yet Quantified; "—" denotes no anticipated reductions

Advanced Clean Cars 2

Overview:

The goal of this proposed measure is to make sure that near-zero and zero-emission technology options continue to be commercially available, with electric driving range improvements to address consumer preferences and to maximize electric vehicle miles traveled (eVMT). ARB would consider expanded California-specific standards for new light-duty vehicles to increase the number of new ZEVs and PHEVs sold in California, and increased stringency of fleet-wide emission standards.

Background / Regulatory History:

Since setting the nation's first motor vehicle exhaust emission standards in 1966 that led to the first pollution controls, California has dramatically tightened emission standards for light-duty vehicles. Through ARB regulations, today's new cars pollute 99 percent less than their predecessors did thirty years ago. In 1970, ARB required auto manufacturers to meet the first standards to control NOx emissions along with hydrocarbon emissions, which together form smog. The simultaneous control of emissions from motor vehicles and fuels led to the use of cleaner-burning gasoline that has removed the emissions equivalent of 3.5 million vehicles from California's roads. Since first adopted in 1990, ARB's LEV I and LEV II, and the ZEV Programs have resulted in the production and sales of hundreds of thousands of ZEVs in California. More recently, there is a focus on reducing GHGs from motor vehicles. Transportation is California's largest source of carbon dioxide, with passenger vehicles and light-duty trucks creating more than 30 percent of total climate change emissions. ARB adopted the first GHG emission standards for new passenger vehicles in the United States, effective with the 2009 model year.

Proposed Actions:

For this proposed measure, ARB staff would develop a regulation based on the technology and market assessments for advanced technology vehicles that would increase the number of new ZEVs and PHEVs sold in California. The regulation may include lowering fleet emissions further beyond the super-ultra-low-emission vehicle (SULEV) standard for the entire light-duty fleet through at least the 2030 model year, and look at ways to improve real world emissions through implementation programs. Additionally, new standards would be considered to further increase the sales of ZEVs and PHEVs in 2026 (and later years) beyond the levels required to ensure future emission reduction, climate, and petroleum targets are met.

Proposed Measures: On-Road Light-Duty Vehicles

Estimated Emission Reductions:

ARB staff used ARB's Vision 2.1³⁰ model to estimate the emission reductions associated with this proposed measure. Baseline projections include emissions from light- and medium-duty passenger car, trucks, and sport utility vehicles. Baseline emissions reflect projected benefits from the LEV III criteria emission vehicle fleet standards, which have increasing stringency for new vehicles through the model year 2025. Emission reductions projected beyond baseline were calculated assuming new vehicles continue to become cleaner through the year 2031. ARB staff assumed a combined passenger vehicle (LDA/LDT2) ZEV/PHEV sales increase from 18 percent to 40 percent between 2025 and 2030, medium-duty trucks (MDV) ZEV/PHEV sales beginning 2026, ramping up to 10 percent by 2030, with 100 percent sales of super-ultra-low-emission vehicles certified to the SULEV 20 exhaust emission standards by 2030 for gasoline light-duty automobiles (LDAs). ARB staff also modeled increased fuel efficiency (at approximately 2.9 percent per year) between 2025 and 2035 for gasoline vehicles.

Timing:

Proposed ARB Board hearing: 2020 – 2021
Proposed implementation schedule: 2026 – 2030

Proposed SIP Commitment:

ARB staff proposes to commit to bring this measure to the Board by 2021. ARB staff will initiate a rule development process designed to achieve the NOx emission reductions shown in Table 4 for the South Coast nonattainment area in 2031 and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

³⁰ Vision Scenario Planning <http://www.arb.ca.gov/planning/vision/vision.htm>

Lower In-Use Emission Performance Assessment

Overview:

The goal of this proposed measure is to ensure that in-use vehicles continue to operate at their cleanest possible level. This joint ARB and BAR assessment is an ongoing further study measure focused on in-use performance and diagnostic inspection procedures.

Description of Source Category:

This evaluation will apply to all On-Board Diagnostic (OBD) II equipped vehicles that are subject to the Smog Check program. OBD II is the second generation of requirements for on-board, self-diagnostic equipment that monitors a vehicle's control components to ensure they are functioning correctly. Light- and medium-duty vehicles are major contributors of air pollutants in the South Coast. While VMT increased more than 50 percent over the last 20 years, vehicle emissions have dropped threefold due to increasingly stringent vehicle emission standards. Yet, the light- and medium-duty vehicle fleet continues to contribute significantly to the NOx emissions in the State. Studies show that the highest emitting 20 percent of the light-duty fleet contribute well over 50 percent of the fleet's total emissions, emphasizing the need to identify and repair these high emitting vehicles.

Background / Regulatory History:

OBD II

California's first OBD regulation required manufacturers to monitor some of the emission control components on vehicles starting with the 1988 model year. In 1989, ARB adopted OBD II, which required 1996 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines to be equipped with second generation OBD systems. OBD systems are designed to identify when a vehicle's emission control systems or other emission-related computer-controlled components are malfunctioning, causing emissions to be elevated above the vehicle manufacturer's specifications. ARB subsequently strengthened OBD II requirements and added OBD II specific enforcement requirements for 2004 and subsequent model year passenger cars, light-duty trucks, and medium-duty vehicles and engines. In 2005, the Board adopted regulations that required OBD systems in heavy-duty engines (HD OBD) beginning in the 2010 model year and that established HD OBD-specific enforcement requirements.

Smog Check

BAR is the State agency charged with administration and implementation of the Smog Check Program. The Smog Check Program is designed to reduce air pollution from California registered light-duty vehicles by requiring periodic inspections for emission control system problems, and by requiring repairs for any problems found. Prior to 2015,

Proposed Measures: On-Road Light-Duty Vehicles

Smog Check stations relied on the BAR-97 Emissions Inspection System (EIS) to test tailpipe emissions with either a Two-Speed Idle (TSI) or Acceleration Simulation Mode (ASM) test depending on the program area. For instance, vehicles registered in urbanized areas or “Enhanced Areas,” received an ASM test, while vehicles in rural areas or “Basic Areas” received a TSI test.

Assembly Bill (AB) 2289 (Eng, Chapter 258, Statutes of 2010) required BAR to implement a new protocol for testing 2000 and newer model-year vehicles. This new test, which relies primarily on the vehicle’s OBD system, provides for a faster and more cost effective inspection compared to tailpipe testing. The BAR-97 EIS utilized OBD test equipment; however, this equipment was outdated and incapable of collecting complete OBD information for all vehicles. To facilitate state-of-the-art OBD-based testing, BAR developed equipment specifications for a new OBD communications device, referred to as the Data Acquisition Device (DAD), which is a component of the new OBD Inspection System (OIS) that replaces the EIS. These changes are aimed at providing for quicker and potentially less costly Smog Check inspections for consumers, and lower Smog Check station operating costs, all while preserving, or even enhancing the emission benefits associated with the Smog Check Program. However, because the OBD inspection procedure does not provide for direct measurement of vehicle emission levels, ARB believes it is prudent to monitor the effectiveness of the new procedure in identifying vehicles in need of emission repairs, and to implement changes necessary to address any issues that are uncovered.

Proposed Actions:

ARB and BAR staff would perform a comprehensive evaluation of California’s in-use performance-focused inspection procedures and, if necessary, make improvements to increase the Smog Check Program’s effectiveness. ARB will conduct a study to further evaluate California’s in-use performance inspection procedures through analysis of the Smog Check database and vehicle sampling obtained through BAR’s Random Roadside Inspection Program. Comparison of test results from the fleet at the time Smog Check inspections take place with the results of roadside inspections conducted at random times in between Smog Check inspections will allow for analysis of Smog Check station performance, repair durability, the real-world performance of OBD II systems in detecting emission-related problems, and other factors that impact the emission benefits provided by the program. Further investigation and analysis of in-use vehicles at the ARB Haagen-Smit Laboratory will be conducted as needed based on the preliminary findings of the roadside data. Results from the study can be used to improve inspection test procedures, address program fraud, improve the effectiveness and durability of emission-related repair work, and to improve the regulations governing the design of in-use performance systems on motor vehicles to the extent necessary.

Estimated Emission Reductions:

As this proposed measure is a study to further evaluate California’s in-use performance and vehicle inspection and maintenance program, anticipated emission reductions are not identified at this time. This measure may provide emission reduction; should the

Proposed Measures: On-Road Light-Duty Vehicles

evaluation identify necessary program improvements, the emission reduction potential and cost effectiveness of such enhancements will be identified at that time.

Timing:

Proposed ARB Board hearing: n/a
Proposed implementation schedule: ongoing

Proposed SIP Commitment:

ARB staff proposes to commit to conduct a study to further evaluate California's in-use performance inspection procedures in order to improve inspection test procedures as necessary, address program fraud, improve the effectiveness and durability of emission-related repair work, and to improve the regulations governing the design of in-use performance systems on motor vehicles.

Further Deployment of Cleaner Technologies: On-Road Light-Duty Vehicles

Overview:

The goals of this proposed measure are to accelerate the penetration of near-zero and zero-emission vehicles, and to promote in-use efficiency gains related to vehicle miles travelled, and through use of autonomous vehicles and advanced transportation systems. This measure is only applicable to the South Coast.

Background / Regulatory History:

ARB's mobile source regulatory program is complemented by additional efforts that reduce emissions. These include incentive programs and implementation of SB 375, the Sustainable Communities and Climate Protection Act. Incentive Programs are intended to accelerate the introduction of advanced technology vehicles, accelerate the turnover of the oldest, highest emitting vehicles, and increase access to clean vehicles and transportation in disadvantaged communities and lower-income households. The three programs established by AB 118 (Núñez, Chapter 750, Statutes of 2007) and reauthorized by AB 8 (Perea, Chapter 401, Statutes of 2013) provide funding for light-duty vehicle incentives. These include ARB's Air Quality Improvement Program (AQIP), California's Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program, and the ARB / BAR's Enhanced Fleet Modernization Program (EFMP). More recently, Cap-and-Trade auction proceeds have greatly expanded the scale of light-duty vehicle incentive funding. Local air district incentive programs complement these Statewide efforts. The State's light-duty incentive strategy includes:

- *ZEV Deployment and Infrastructure:* ARB's Clean Vehicle Rebate Project (CVRP) provides consumer rebates for the purchase of zero-emission and plug-in hybrid passenger vehicles in order to increase the number of ZEVs on California's roadways and help achieve the large scale transformation of the fleet. The Energy Commission's electric vehicle charging and hydrogen fueling infrastructure investments complement ARB's vehicle deployment incentives.
- *Disadvantaged Community Programs:* CVRP is complemented by incentives aimed at increasing access to these clean vehicles in disadvantaged communities and lower-income households. These include car sharing and other mobility improvement programs and financing assistance, among others.
- *Car Scrap:* EFMP provides incentives to lower-income vehicle owners to retire older, higher emitting vehicles. EFMP includes pilot programs run by the South Coast and San Joaquin Valley air districts that provide additional incentives for lower-income vehicle owners who replace their scrapped vehicles with cleaner, more fuel-efficient vehicles, and the EFMP Plus-Up pilot provides

Proposed Measures: On-Road Light-Duty Vehicles

an even greater incentive for ZEV, hybrid, or plug-in hybrid replacement vehicles in underserved communities.

Proposed Actions:

This proposed measure is designed to achieve further emission reductions for South Coast attainment in 2023 and 2031 through a suite of additional actions, including early penetration of near-zero and zero-emission technologies, and emission benefits associated with increased transportation efficiencies, as well as the potential for autonomous vehicles and advanced transportation systems. The emission reductions will be achieved through a combination of actions to be undertaken by both ARB and the South Coast. These actions reflect an initial assessment of a pathway, recognizing that as funding is allocated and advanced technologies further develop, the balance amongst approaches will necessarily adjust.

Scope of Technology Penetration and Mechanisms to Achieve Reductions:

The Advanced Clean Cars regulation brings together a suite of regulations, including the LEV III standards and the ZEV regulation. To achieve the further reductions associated with early penetration of the near-zero and zero vehicle technologies established under the ZEV regulation, ARB and South Coast staff estimate that approximately 500,000 to 600,000 of the oldest passenger cars and trucks would need to be turned over to model year vehicles meeting the currently applicable LEV III emission standard or advanced hybrid or zero-emission technology by 2023. The following mechanisms provide a pathway for achieving this scale of technology deployment:

- Expand and enhance existing incentive and other innovative funding programs for light-duty vehicles in order to accelerate the replacement of older vehicles with vehicles meeting a LEV III or better emissions level. Assuming incentive funding is the primary mechanism to achieve the scope of further technology deployment described above, funding would be required for approximately 70,000 to 85,000 vehicles per year over a seven year period. The incentive funding required for this effort would go beyond the amount currently authorized for existing programs through 2023. This effort could expand upon the current EFMP and EFMP Plus-Up programs, and include increasing the use of these vehicles in underserved communities and by lower-income consumers. Continued incentive funding post-2023 to further accelerate the deployment of zero-emission vehicles would provide additional reductions for 2031.

Determination of the needed resources will be based on assessment of the incremental cost of technologies and the type of funding mechanism employed. Funding needs and mechanisms will be identified working in collaboration with the South Coast and other State agencies over the next several months.

- Continue to support infrastructure investment programs with the California Energy Commission (CEC) to maximize the use of electric vehicles through

Proposed Measures: On-Road Light-Duty Vehicles

expanding charging and hydrogen networks.

- Expand upon consumer awareness and education campaigns for electric vehicles. Awareness in California is currently low and outreach efforts are critical to ensure new car buyers understand ZEVs are available and offer benefits. In addition to ARB's current DriveClean education website, new campaigns are being launched by the PEV Collaborative, electric utilities, and automakers. ARB also supports national efforts by the U.S. DOE and Northeast States for Coordinated Air Use Management (NESCAUM).

Additional mechanisms reflect reductions achieved through reducing growth in VMT as well as through intelligent transportation systems. While these approaches have the greatest potential to provide further reductions post-2023, early advances in these areas could offset some of the reductions required through incentive funding. These additional pathway mechanisms include:

- Reducing growth in passenger vehicle VMT. Local planning jurisdictions are implementing strategies to create more sustainable communities and integrate transportation and land use planning. These efforts to increase mobility choices and focus growth within existing urban boundaries provide a more efficient passenger transportation system that reduces VMT. SB 375, the Sustainable Communities and Climate Protection Act serves as a mechanism for implementation of efforts to reduce growth in passenger vehicle VMT.
- Advances in the development of autonomous and connected vehicles. These changes in how the on-road light-duty sector would operate offer the potential to achieve criteria and GHG emission reductions, but could also reduce VMT and congestion as well as petroleum usage. These concepts are based on emerging technologies and will require significant exploration and demonstration, but also offer synergies in a continued transition to zero-emission vehicle technologies.

Additional mechanisms may be developed to achieve additional reductions from vehicles in this category, including on-road motorcycles.

Timing:

Proposed ARB Board hearing:	n/a
Proposed implementation schedule:	2016 - 2031

Proposed Measures: On-Road Light-Duty Vehicles

Implementation Milestones and Schedule		
Implementation Milestone	Implementation Steps	Schedule
Identify and secure funding for incentive based and other innovative funding programs for accelerated turn-over of near-zero and zero-emission passenger cars and trucks	<i>Phase 1:</i> Identify funding needs and potential sources	2016+ (annually)
	<i>Phase 2:</i> Pursue actions to secure funding	
	<i>Phase 3:</i> Implement funding/incentive programs	
Evaluate potential emission benefits from VMT reductions and autonomous vehicles and quantify and develop mechanisms to provide SIP reductions as appropriate	<i>Phase 1:</i> Evaluation of approaches and potential for emission reductions	2016 - 2023
	<i>Phase 2:</i> Demonstration of systems	2017 – 2026
	<i>Phase 3:</i> Quantification of emission reductions and mechanisms for incorporating into SIP	2023 – 2027
Provide annual reports to Board on status of funding, technology development, and identification of potential further regulatory measures	<i>Phase 1:</i> Evaluate status of funding, technology development, and potential for further regulatory measures	2017+ (annually)
	<i>Phase 2:</i> Develop potential regulatory actions as appropriate	

Proposed SIP Commitment:

ARB commits to bring to the Board programs and policies or take other actions to implement this measure to achieve the NOx emission reductions shown in Table 4 for the South Coast in 2023 and 2031. Further development measures for each source category may provide more or less emission reductions than the amount shown.

Proposed Measures: On-Road Heavy-Duty Vehicles

Description of Source Category:

Heavy-duty trucks over 8,500 pounds are currently the fastest growing transportation sector in the United States, responsible for about 33 percent of total Statewide NOx emissions, approximately 26 percent of total Statewide diesel PM emissions, and a significant source of GHG emissions.

Most of the NOx emissions from heavy-duty engines come from diesel-cycle engines, especially in the higher weight classes. 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.

Proposed Measures: On-Road Heavy-Duty Vehicles

Table 8: Summary of On-Road Heavy-Duty Vehicle Control Measures

Statewide Estimated Emission Reductions (tons per day)		
	2015	2031
NOx Inventory*	506	170
Lower In-Use Emission Performance Level		NYQ
Low-NOx Engine Standard – California Action		24
Low-NOx Engine Standard – Federal Action		28
Medium and Heavy-Duty GHG Phase 2		NYQ
Innovative Clean Transit		0.5
Last Mile Delivery		1
Innovative Technology Certification Flexibility		NYQ
Zero-Emission Airport Shuttle Buses		NYQ
Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles		3
Further Deployment of Cleaner Technologies		11
Potential reductions		68
ROG Inventory*	44	15
Lower In-Use Emission Performance Level		NYQ
Low-NOx Engine Standard – California Action		--
Low-NOx Engine Standard – Federal Action		--
Medium and Heavy-Duty GHG Phase 2		NYQ
Innovative Clean Transit		<0.1
Last Mile Delivery		<0.1
Innovative Technology Certification Flexibility		NYQ
Zero-Emission Airport Shuttle Buses		NYQ
Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles		0.4
Further Deployment of Cleaner Technologies		1
Potential reductions		2
PM2.5 Inventory*	12	6
Lower In-Use Emission Performance Level		<0.1
Low-NOx Engine Standard – California Action		--
Low-NOx Engine Standard – Federal Action		--
Medium and Heavy-Duty GHG Phase 2		NYQ
Innovative Clean Transit		<0.1
Last Mile Delivery		<0.1
Innovative Technology Certification Flexibility		NYQ
Zero-Emission Airport Shuttle Buses		NYQ
Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles		--
Further Deployment of Cleaner Technologies		--
Potential reductions		<0.1

*2031 values reflect anticipated emission reductions from current control programs
 "NYQ" denotes emission reductions are Not Yet Quantified; "--" denotes no anticipated reductions

Lower In-Use Emission Performance Level

Overview:

The goal of this proposed measure is to ensure that in-use heavy-duty vehicles continue to operate at their cleanest possible level. ARB staff would develop and propose new, supplemental actions to address in-use emissions and compliance, and to decrease engine deterioration.

Background / Regulatory History:

Since 1982, both U.S. EPA and ARB have required manufacturers to submit emissions data showing that their engines and vehicles meet applicable emission standards to qualify for a federal "Certificate of Conformity" and/or a California "Executive Order" in order to be sold. The data are generated using specific test procedures for measuring emission levels and assessing durability. The number and types of these tests vary according to the engine/vehicle being tested. The Federal Test Procedure (FTP) is used for regulatory emissions testing of on-road heavy-duty engines. While the FTP was developed to assess emissions performance of an engine under representative operating conditions, it does not assess emissions under all driving conditions, such as high-speed freeway driving and hard accelerations, such as acceleration on an entrance ramp to a freeway.

In the late 1990s, many heavy-duty engine manufacturers were accused of deliberately calibrating their engines to run extremely lean during high-speed freeway driving, which improved fuel economy but increased NO_x emissions. U.S. EPA and ARB deemed this strategy to be a defeat device deliberately designed to delay or deactivate emissions controls, which prompted both agencies to seek remedial action and penalties against the offending manufacturers. As part of a related settlement agreement, all affected parties were directed to work together to further develop the Not To Exceed (NTE) test protocol. The development effort was successful, and the NTE requirement is in effect today.

In addition to complying with the FTP and NTE requirements, compliance with OBD, anti-tampering, fuel tank fill-pipe and openings, crankcase emissions, and other requirements, as applicable, must also be demonstrated as part of the existing certification protocol. Manufacturers must also provide a warranty for the emissions control systems of their certified engines and vehicles for a specified durability period and identify them with emissions control labels. Also, these engines and vehicles are subject to compliance testing and are required to report warranty-related repair rates to both U.S. EPA and ARB.

Additionally, all heavy-duty vehicles in California are subject to in-use inspections in order to control excessive smoke emissions and tampering. These programs are described below:

Proposed Measures: On-Road Heavy-Duty Vehicles

- The Heavy-Duty Vehicle Inspection Program, adopted in 1988, requires heavy-duty vehicles to be inspected for smoke opacity (i.e., excessive smoke), tampering, and engine certification label compliance. Any heavy-duty vehicle operating in California, including vehicles registered in other states and foreign countries, may be inspected. Inspections are performed by ARB inspection teams at border crossings, California Highway Patrol weigh stations, fleet facilities, and randomly selected roadside locations.
- The Periodic Smoke Inspection Program, also adopted in 1988, requires heavy-duty vehicle fleet owners to conduct annual smoke opacity inspections of their vehicles, and have them repaired if excessive smoke emissions are observed. In addition, ARB has the authority to randomly audit these fleets, by reviewing the owners' maintenance and inspection records, and conducting opacity inspections on a representative sample of the vehicles.
- The Emissions Control Label Inspection Program requires all vehicles operating in California be equipped with engines that meet California and/or U.S. EPA emission standards. The engine must have an emissions control label which is legible, displayed as originally installed by the engine manufacturer, and must match the engine serial number stamped on the engine. Owners of applicable vehicles not meeting the emissions control label requirements are subject to a penalty.

Currently, there is no regular, mandatory in-use screening for NO_x or any emissions other than visible smoke.

Proposed Actions:

For this proposed measure, ARB staff would develop new, supplemental actions, in the form of regulatory amendments or new regulations, to address in-use compliance and to decrease engine deterioration. This suite of actions includes:

- Amendments to ARB's existing Periodic Smoke Inspection and Heavy-Duty Vehicle Inspection Programs to revise the current opacity limit and make other program improvements;
- Amendments to warranty and useful life provisions;
- Amendments to the durability demonstration provisions within the certification requirements for heavy-duty engines;
- Amendments to the NTE supplemental test procedures for heavy-duty diesel engines; and
- Adoption of comprehensive heavy-duty vehicle inspection and maintenance program.

Estimated Emission Reductions:

The estimated emission benefits and cost effectiveness associated with each of the identified supplemental actions will be quantified and vetted through ARB's public

Proposed Measures: On-Road Heavy-Duty Vehicles

regulatory process for each of the proposed amendments or new regulatory actions. The regulatory development process for a comprehensive heavy-duty vehicle inspection and maintenance program also includes a research study to assist staff in evaluating potential test methods and program designs, emission benefit potential, and cost effectiveness.

Initial, estimated emission benefits (calculated using ARB’s motor vehicle emissions inventory model, EMFAC2014) are shown below for proposed amendments scheduled to be presented to the Board in September 2017 to reduce the current opacity limit in the Periodic Smoke Inspection and Heavy-Duty Vehicle Inspection Programs. While small, these estimated emission benefits demonstrate ARB’s commitment to evaluate all source categories for potential emission reductions to assist local air districts in meeting the air quality targets in their regional SIPs. ARB staff will reassess and refine the estimated emissions benefits during the formal regulatory process for this amendment package. Based on the initial review of more current data so far, staff expects the emission benefits to be higher than currently estimated using EMFAC2014.

Table 9: Estimated PM2.5 Emission Benefits from Proposed Amendments to the Periodic Smoke Inspection Program and the Heavy-Duty Vehicle Inspection Program

Reductions shown in tons per day (tpd)

Region	2023	2024	2031
Statewide	.065	.067	.070
South Coast	.018	.019	.022
San Joaquin Valley	.014	.015	.017

Timing:

Proposed ARB Board hearing: 2017 – 2020³¹
 Proposed implementation schedule: 2018 – 2024

Proposed SIP Commitment:

ARB staff proposes to commit to bring the above-described elements of this measure that the further study determines are necessary program improvements to the Board between 2017 and 2020. ARB staff will initiate a rule development process designed to achieve the NOx emission reductions shown in Table 4 for the South Coast nonattainment area in 2023 and 2031, and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

³¹ This proposed measure will be implemented via amendment and adoption of multiple regulations. Staff anticipates bringing several of the items to the Board between 2017 and 2020, but some elements may be brought to the Board later.

Low-NOx Engine Standard

Overview:

The goal of this proposed measure is to introduce near-zero emission engine technologies that will substantially lower NOx emissions from on-road heavy-duty vehicles. Coordinating as much as possible with U.S. EPA, ARB will develop a heavy-duty low-NOx engine standard in California, and urge U.S. EPA to develop a similar federal standard.

Background / Regulatory History:

California is the only state with the authority to adopt and enforce emission standards for new motor vehicle engines that differ from the federal emission standards. Since 1990, heavy-duty engine NOx emission standards have become dramatically more stringent, dropping from 6 grams per brake horsepower-hour (g/bhp-hr) in 1990 down to the current 0.2 g/bhp-hr standard, which took effect in 2010. In addition to mandatory NOx standards, there have been several generations of optional lower NOx standards put in place over the past 15 years. From 1998 to 2003, optional NOx standards ranged from 0.5 g/bhp-hr to 2.5 g/bhp-hr, at 0.5 g/bhp-hr increments, which was much lower than the mandatory 4 g/bhp-hr limit. Starting in 2004, engine manufacturers could choose to certify to optional NOx + non-methane hydrocarbon (NMHC) standards ranging from 0.3 g/bhp-hr to 1.8 g/bhp-hr, at 0.3 g/bhp-hr increments, which was significantly below the mandatory 2.4 g/bhp-hr NOx+NMHC standard. Starting in 2015, engine manufacturers could certify to three optional NOx emission standards of 0.1 g/bhp-hr, 0.05 g/bhp-hr, and 0.02 g/bhp-hr (i.e., 50 percent, 75 percent, and 90 percent lower than the current mandatory standard of 0.2 g/bhp-hr). The optional standards allow local air districts and ARB to preferentially provide incentive funding to buyers of cleaner trucks, which encourages the development of cleaner engines.

Proposed Actions:

This proposed measure would establish low-NOx engine standards for new on-road heavy-duty engines used in medium and heavy-duty trucks (for gross vehicle weight rating (GVWR) over 8,500 pounds).

California Action

ARB began development of new heavy-duty low-NOx emission standards in 2016, and Board action is expected in 2019. ARB staff will coordinate as much as possible with U.S. EPA and urge U.S. EPA to develop a similar federal standard.

A California-only low-NOx standard would apply to vehicles with new heavy-duty engines sold in California starting in 2023. However, the dynamics of the heavy-duty market means that this approach would not achieve the full benefit of the emission reductions that could be realized through a federal program. In order to achieve the

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maximum emission reductions from this proposed measure, a federal standard is necessary.

Federal Action

Federal low-NOx standards could 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 emission reductions from a California-only ARB regulation would come mostly from Class 4-6 vehicles (as most Class 7 and 8 vehicles operating in California were originally purchased outside the State).

Due to the preponderance of interstate trucking's contribution to emissions in California, timely federal action to implement a national low-NOx engine standard is critical to provide the emission reductions needed for attainment. The State SIP Strategy thus calls 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. Additionally, U.S. EPA stated they intend to work with CARB to develop such new standards and to address improved warranties and test procedures as well.

Estimated Emission Reductions:

ARB staff used ARB's Vision 2.1 model to estimate the emission reductions associated with this proposed measure. Both the Federal and California-only low-NOx standards were assumed to provide 90 percent overall NOx emission reductions from the current engine and emission control technologies. This reduction, in part, reflects assumptions on decreasing engine deterioration due to Lower In-Use Emission Performance Level Measure. For Federal low-NOx standards, NOx reductions were applied to all heavy-duty trucks starting in model year 2024, regardless of vocation and registration.

In addition to trucks coming from out-of-state, many California heavy-duty truck owners also purchase used trucks from out-of-state. Therefore, a California-only low-NOx standard would only impact a fraction of the heavy-duty activity and emissions in California. Staff assumed an aggregated fraction to estimate emission reduction based on survival rates derived from multiple years of EMFAC baseline data.

Timing:

U.S. EPA Rulemaking:	2019
ARB Rulemaking:	2019
Proposed ARB Board hearing:	2019

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Proposed implementation schedule: California regulation implementation would be starting in 2023; If U.S. EPA establishes a federal low-NO_x standard, implementation nationwide could occur no earlier than 2024. If U.S. EPA adopts standards, ARB would harmonize as much as possible.

Proposed SIP Commitment:

ARB proposes to commit to bring this measure to the Board by 2019. ARB staff will pursue a rule development process designed to achieve the NO_x emission reductions shown in Table 4 for the South Coast nonattainment area in 2031, and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Medium and Heavy-Duty GHG Phase 2

Overview:

The goal of this proposed measure is to advance fuel efficiency improvements and achieve greater GHG emission reductions through the introduction of the next generation of integrated engine, powertrain, vehicle, and trailer technologies designed to reduce climate emissions and fuel use. This new round of medium- and heavy-duty vehicle and engine GHG emission standards, known as Phase 2, will build upon the Phase 1 standards adopted federally in 2011 and in California in 2013.

Background / Regulatory History:

The California Global Warming Solutions Act of 2006, AB 32, established requirements for a comprehensive program of regulatory and market mechanisms to reduce GHG emissions in California. AB 32 also required ARB to develop and approve a Scoping Plan that describes California's approach to reducing GHG emissions to 1990 levels by 2020. The Scoping Plan was first approved by the Board in 2008 and updated for the first time in 2014.

The Tractor-Trailer GHG Regulation was an early action measure from the 2008 Scoping Plan. First approved by the Board in late 2008 and later amended in 2010, this regulation required improved aerodynamics and tires for 53-foot and longer long-haul tractors and trailers operating on California's roads.

The Phase 1 GHG standards, based on off-the-shelf technologies and applicable to 2014 and later model year medium- and heavy-duty engines and vehicles, were adopted by U.S. EPA in 2011 and by the Board in 2013. The Phase 1 standards took effect with the 2014 model year and are projected to reduce CO₂ by about 12.5 percent by 2035.

Proposed Actions:

U.S. EPA finalized the federal Phase 2 standards for medium- and heavy-duty vehicles in August 2016.³² The new standards, which push technology improvements beyond what is currently in widespread commercial use, are expected to take effect with model year 2021 for all new class 2b-8 medium- and heavy-duty trucks sold in the nation and in model year 2018 for new trailers, and to be fully phased in by model year 2027. This measure establishes Phase 2 GHG standards for all new class 2b-8 medium- and heavy-duty trucks starting in 2021, and for certain classes of new trailers, starting in 2018. At the federal level, GHG emission reduction requirements would apply to certain box-type trailers for the first time.

Following an informational update to the Board in 2016, ARB staff plans to present a California Phase 2 proposal for the Board's consideration in 2017. Staff plans to

³² <https://www.epa.gov/newsreleases/heavydutyaug162016>

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propose a California Phase 2 regulation that harmonizes with the federal Phase 2 regulation in structure, timing, and stringency. However, there will be minor differences to facilitate enforcement, align with existing California programs, and provide incentives for manufacturers to bring advanced technologies to the market.

In addition, ARB is funding research into further aerodynamic improvements for trailers and vocational vehicles, and depending on the outcome of that research, may in 2019 propose regulations with additional requirements for trailer and vocational vehicle aerodynamics beyond what Phase 2 requires. For example, staff may amend the Tractor-Trailer GHG to include requirements for trailer categories not included in the federal Phase 2 program in order to further reduce GHG emissions in California. In California, GHG emission reduction requirements for certain 53-foot and longer box-type trailers have been in place since 2008 under ARB's Tractor-Trailer GHG Regulation. Amendments to this regulation could potentially include GHG emission reduction requirements for flatbed, tanker, container, and curtain side trailers, thus providing additional GHG reductions in California. California is the only state with the authority to adopt and enforce emission standards for new motor vehicles and engines that differ from the federal emission standards.

Estimated Emission Reductions:

While criteria emission reductions have not been identified at this time, emission reductions for the measure will be identified as part of the rule development process. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than as proposed by staff.

Timing:

Proposed ARB Board hearing: 2017 - 2019

Proposed implementation schedule: Implementation will begin with model year 2021 for all new heavy-duty trucks class 2b-8 sold in the nation and model year 2018 for new trailers, and will be fully implemented by model year 2027.

Proposed SIP Commitment:

ARB staff proposes to commit to bring the California Phase 2 proposal to the Board by 2017. ARB staff also proposes to commit to bring the amendments to the Tractor-Trailer GHG regulation to the Board by 2019. Emission reductions for the measure will be identified as part of the rule development process. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than as proposed by staff.

Innovative Clean Transit

Overview:

Development of a modern, multi-modal, clean transit system is critical to meeting the state's criteria, toxics, and climate emissions and petroleum reduction goals. Access to public transit is especially important for people in disadvantaged communities who may have limited mobility choices. The proposal will support the transition to a suite of cleaner transit options to support these goals. The measure will consider a variety of mechanisms to support access to innovative transit and mobility options that together will achieve emission reductions or other benefits in disadvantaged communities, maintain or expand service, while deploying advanced, clean technologies. These approaches are intended to: 1) support the long-term transition to zero-emission technologies as soon as they become viable economic options for transit agencies; 2) provide transit options to support regional sustainable communities strategies; and 3) support service for people with limited transportation options. Experience from using advanced technology in buses and other modes of transit will also expand the market for the same technologies in other heavy-duty vehicle applications.

Description of Source Category:

There are about 200 transit agencies in California that provide a variety of transit services including bus, passenger rail and other transportation options. This includes approximately 11,000 buses that are currently fueled primarily by diesel and natural gas, with zero-emission options growing rapidly as an alternative technology.

Background / Regulatory History:

Adopted by ARB in 2000, the Fleet Rule for Transit Agencies required reductions in diesel PM and NOx emissions from urban buses and transit fleet vehicles, and required future zero-emission bus purchases. Urban bus fleets were required to select either the diesel path or the alternative-fuel path. Transit agencies on the diesel path needed to demonstrate zero-emission buses, and to meet the zero-emission bus purchase requirements sooner, while agencies on the alternative-fuel path had to ensure that 85 percent of urban bus purchases were alternative fueled without a demonstration requirement.

The Transit Fleet Rule was amended in 2004, and again in 2006. The 2006 amendments temporarily postponed the zero-emission bus purchase requirement (until 2011 and 2012, depending on the compliance path) and expanded the initial demonstration with a subsequent advanced technology demonstration phase.

In 2009, ARB staff provided a technology update to the Board on the commercial readiness of zero-emission buses. At that time, the extended demonstration was behind schedule due to delays in funding and vehicle production. ARB staff recommended a postponement of the purchase requirements, and proposed to establish technology performance metrics that could be used to assess commercial

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readiness of zero-emission buses. The Board, through Resolution 09-49, directed ARB staff to delay the purchase requirement, research and develop commercial readiness metrics to be used as criteria to initiate the zero-emission bus purchase requirement, and to conduct a technology assessment on the readiness of zero-emission bus technologies.

Proposed Actions:

ARB would develop and propose a variety of approaches and mechanisms to support the transition to a suite of innovative clean transit options. ARB staff have convened a technical workgroup and a transit agency subcommittee to inform key data collection and analysis, and to help develop and refine potential approaches. These approaches may include: 1) securing binding commitments from the state's transit providers for a long-term vision for transitioning to zero-emission buses and other technologies. Progress towards this zero-emissions goal would be tracked through emissions related metrics such as aggregate emissions per fleet or per capita for the individual transit agencies; 2) continuing to support to the maximum extent possible the near-term deployment of zero-emission buses into service where transit agency commitments exist, or new actions where the economics become viable and transit service can be maintained, expanded, or enhanced; and 3) working with transit agencies to pilot innovative approaches, including the use private sector shared vehicle services, to enhance access to existing transit systems with zero-emission first and last-mile solutions. These zero-emissions technologies exist today and can serve as an immediate step towards the deployment of a modern, long-term zero-emission transit system.

These approaches would provide flexibility to transit fleets that support timely implementation of advanced technologies in ways that are synergistic with their operations, and recognize factors such as early actions to reduce emissions, utilization of alternative modes of zero-emission transportation (e.g., light-rail, shared vehicle services), and improved efficiencies of the transit system.

Estimated Emission Reductions:

ARB staff used ARB's Vision 2.1 model to estimate the emission reductions associated with this proposed measure. As a bounding exercise to estimate the potential emissions benefits, ARB staff modelled 20 percent of the new urban buses purchased by transit agencies beginning in 2018 will be zero-emission buses with the penetration of zero-emission technology ramped up to 100 percent of new sales in 2030. The emission reductions themselves may come from a combination of new purchase requirements, incentives, or alternative performance standards. ARB staff also assumed any new natural gas buses, starting in 2018, and diesel buses, starting in 2020, would meet the optional heavy-duty low-NOx standard. The low-NOx standard was assumed to provide 90 percent overall NOx emission reductions from the current engine and emission control technologies.

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Timing:

Proposed ARB Board hearing: 2017
Proposed implementation schedule: 2018-2040

Proposed SIP Commitment:

ARB staff proposes to bring the Innovative Clean Transit proposal to the Board in 2017. ARB staff will initiate a process designed to develop actions to achieve the NO_x emission reductions shown in Table 4 for the South Coast in 2023 and 2031 and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Last Mile Delivery

Overview:

The goal of this proposed measure is to achieve NOx and GHG emission reductions through advanced clean technology, and to increase the penetration of the first wave of zero-emission heavy-duty technology into applications that are well suited to its use. Last mile delivery fleets are well suited for introducing zero-emission technology because they operate in urban centers, have stop and go driving cycles and are centrally maintained and fueled. Experience gained from demonstrating the viability of advanced technologies in these fleets will benefit the market and enable the same technologies to be used in other heavy-duty vehicle applications.

Description of Source Category:

The source category includes Classes 3-7 heavy-duty delivery trucks operated within California that are used in last mile freight delivery applications. Most of the last mile delivery trucks are within vehicle classes 3-6 (10,000 -26,000 lbs.) and some are in the vehicle class 7 (26,001-33,000 lbs.) Last mile delivery trucks are predominately used in urban areas to deliver freight from warehouses and distribution centers to its final point of sale or use (last mile delivery). Their duty cycle is favorable for accelerated penetration of zero-emission technology because they typically operate at low average driving speeds with frequent stop-and-go drive cycles, and are centrally maintained and fueled at an urban distribution center.

Background / Regulatory History:

The Last Mile Delivery is a newly proposed measure to support the SIP, Sustainable Freight Action Plan, SB 350, AB 32, and the Diesel Risk Reduction Plan. This proposed measure would be developed in partnership with affected stakeholders to identify the most effective strategy to influence advanced technologies such as low-NOx engines and zero-emission trucks, primarily for class 3-7 last mile delivery trucks in California. Although there have not been previous regulations specific to last mile delivery trucks, ARB has controlled these sources through other regulations such as the Truck and Bus Regulation. All privately and federally owned diesel trucks with a GVWR of 14,000 pounds and greater (Class 4 and above) that operate in California are subject to the requirements of the Truck and Bus Regulation, which include meeting PM filter requirements and upgrading to 2010 or newer model year engines.

Proposed Actions:

ARB would develop and propose a regulation that would result in the use of low-NOx engines and the deployment of increasing numbers of zero-emission trucks where best suited, primarily for class 3-7 last mile delivery trucks in California. This proposed measure will begin in 2020, with a small scale deployment initially, and ramping up to a higher percentage of new vehicles sales. The initial ramp up of zero-emission trucks

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will consider the ability of the new technology to meet the operational needs of the users. ARB staff is evaluating options for purchase requirements.

Estimated Emission Reductions:

ARB staff used ARB's Vision 2.1 model to estimate conservative emission reductions associated with this proposed measure. The benefits were estimated assuming that zero-emission vehicles comprise 2.5 percent of new Class 3-7 trucks sales in local fleets starting 2020. The penetration rate increases to 10 percent in 2025, and is assumed to remain flat through 2030.

Timing:

Proposed ARB Board hearing:	2018
Proposed implementation schedule:	2020-2050

Proposed SIP Commitment:

ARB staff proposes to commit to bring this measure to the Board in 2018. ARB staff will initiate a rule development process designed to achieve the NO_x emission reductions shown in Table 4 for the South Coast nonattainment area in 2023 and 2031 and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Innovative Technology Certification Flexibility

Overview:

The goal of this proposed measure is to encourage early deployment of the next generation of truck and bus technologies through defined, near-term ARB certification and OBD compliance flexibility for medium- and heavy-duty vehicles. This regulation is intended to balance the need to provide key, promising technologies with a predictable, and practical ARB-certification pathway, while preserving ARB's overarching objective to ensure expected emission benefits of advanced truck and bus technologies are achieved in-use. This regulation would provide the greatest flexibility for potentially transformational engine and vehicle technologies, such as robust hybrids and heavy-duty engines meeting the current optional low-NOx standard.

The deployment of robust hybrids (including those with zero-emission capability) is expected to both yield near-term emission benefits and facilitate the battery innovation needed to expand the application of zero-emission technology. By enabling early deployment of electric drivelines, low-NOx engines, and other key truck and bus technologies, this regulation would also help lay the foundation for the future technology-advancing regulation(s) needed to meet air quality and climate goals.

Background / Regulatory History:

In December 2013, ARB adopted Optional Reduced Emission Standards for Heavy-Duty Engine to further reduce emissions from the heavy-duty vehicle sector. These optional low-NOx emission standards set targets of 0.10, 0.05, and 0.02 g/bhp-hr NOx, which are 50 percent, 75 percent, and 90 percent, respectively, below the current 2010 emission standard. As of November 1, 2015, only one heavy-duty engine has been certified to an optional low-NOx standard – a Cummins ISL 8.9 liter alternative-fueled engine meeting the 0.02 g/bhp-hr NOx standard.

California law requires new motor vehicles and engines to be certified by ARB for emission compliance before they are legal for sale, use, or registration in California. Light- and medium- duty vehicle emissions are typically evaluated on a *chassis dynamometer* as part of the vehicle certification process. Heavy-duty vehicles (greater than 14,000 lbs.) are not required to be ARB-certified as a complete vehicle; instead, an engine must be ARB-certified for use in a heavy-duty vehicle.³³ Heavy-duty engine emissions are certified using an engine dynamometer, in part due to challenges in chassis testing heavier vehicles, and the impracticality of chassis certifying the diversity of potential truck and bus configurations in which a heavy-duty engine could be installed. However, dynamometer testing of heavy-duty engines does not quantify the potential emission impact of innovative non-engine technologies, such as hybrid drivelines.

³³ Hybrid heavy-duty vehicles have the option for complete full vehicle certification, utilizing ARB's Heavy-Duty Hybrid-Electric Vehicles Certification Procedures (December, 2013)

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ARB certification requirements mandate that manufacturers demonstrate that their new engines or vehicles comply with applicable exhaust and evaporative emission standards over their useful life, and comply with other requirements, such as labeling and emissions warranty requirements.

OBD is an important emission control program that is critical for California to achieve its air quality goals. OBD consists mostly of added software in the relevant powertrain control modules that monitor critical components of the engine and aftertreatment. The OBD system monitors virtually every component that can cause an emission increase, including but not limited to all emission controls and all electronic components (such as sensors and actuators) that affect emissions or are used to monitor other emission controls. To function properly, OBD monitors must run with a specified minimum frequency in-use. The OBD system alerts the driver if something is wrong via the dashboard “check engine” (or malfunction indicator) light, and stores information pinpointing the likely root cause of a potential malfunction to assist repair technicians.

Light- and medium-duty vehicles have met OBD requirements beginning in 1996. Heavy-duty gasoline and diesel engine OBD requirements phased-in with the 2013 model year, while alternative fuel heavy-duty engines must begin OBD compliance in the 2018 model year due in part to their limited production volumes.

Proposed Actions:

ARB’s existing medium- and heavy-duty vehicle certification and OBD requirements provide a critical and effective mechanism for ensuring a vehicle’s expected emission benefits are achieved in-use. However, ARB’s engine and vehicle approval paradigm, geared towards traditional technologies, may deter some manufacturers from developing promising new truck and bus technologies that are uncertain to achieve market acceptance.

Hybrid truck and bus technology, in particular plug-in technology, has potential to achieve near-term emission benefits and provide a technology bridge to zero-emission solutions. Hybrid truck and bus technology can support battery innovation in higher demand zero-emission applications, and help build supply chains for zero-emission components like controllers, motors, and electricity converters. Plug-in hybrids with a robust electric drive can also foster fleet acceptance of zero-emission technology and drivetrains. However, California demand for hybrid trucks and the number of manufacturers offering hybrid truck technology in California has declined significantly in recent years. Part of this decline in hybrid truck manufacturers may be attributed to reduced demand from initial large, early adopter fleets, as well as challenges meeting California heavy-duty OBD requirements.

Initial Innovative Technology Regulation concepts discussed with stakeholders would provide tiered ARB certification and OBD requirements for an innovative heavy-duty engine or vehicle technology, providing targeted flexibility at market launch and early technology deployment stages, and reverting back to full ARB approval requirements

Proposed Measures: On-Road Heavy-Duty Vehicles

once the technology achieves a market foothold. Initial draft flexibility provisions for hybrid trucks are geared towards encouraging manufacturers to enter the market, and address OBD compliance challenges encountered by what are typically non-vertically integrated engine, driveline and vehicle manufacturers. Hybrid flexibility provisions discussed with stakeholders thus far are structured to preferentially encourage hybrids capable of achieving at least 35 miles of zero-emission range. Initial Innovative Technology Regulation concepts for low-NOx engines are geared towards encouraging manufacturers to accelerate development and market launch of a diversity of alternative-fuel and diesel low-NOx engine families.

Estimated Emission Reductions:

As this measure is a modification to a test procedure that is intended to enable key technology-advancing heavy-duty vehicle regulations and incentive programs identified in this SIP, it does not have associated emission reductions.

Timing:

Proposed ARB Board hearing:	2016
Proposed implementation schedule:	2017 – 2027

Proposed SIP Commitment:

In October 2016, ARB staff brought this measure to the Board for its consideration. At the October 2016 Board Hearing, the Proposed Innovative Technology Regulation (IRT) was adopted.

Zero-Emission Airport Shuttle Buses

Overview:

The goal of this proposed measure is to achieve NO_x and GHG emission reductions goals through advanced clean technology, and to increase the penetration of the first wave of zero-emission heavy-duty technology into applications that are well suited to its use.

Description of Source Category:

Airport shuttle buses include buses that transport passengers to and from car parking lots and airport terminals as well as those that transport passengers to airport car rental facilities. The emissions in this source category are expected to increase with the projected increase in passenger aviation activities.

Background / Regulatory History:

Diesel airport shuttle buses with a GVWR greater than 14,000 pounds that are owned or operated by a municipality are regulated under California's Diesel Particulate Matter Control Measure for Municipality or Utility On-Road Heavy-Duty Diesel Fueled Vehicles (Public Agency and Utility Regulation). This regulation requires a municipality or utility that owns, leases or operates on-road diesel fueled vehicles with engine model year 1960 or newer and GVWR greater than 14,000 pounds to reduce its engine's PM_{2.5} emissions to 0.01 g/bhp-hr. This can be done by repowering, retrofitting, or retiring the vehicle. Implementation of the rule started in 2007, with a compliance schedule based on the engine model year. Airport shuttle buses owned by a municipality that are less than 14,000 pounds GVWR are not subject to the Public Agency and Utility Regulation.

Private contractors that operate diesel airport shuttles are regulated under the Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen and Other Criteria Pollutants from In-Use Heavy-Duty Diesel-Fueled Vehicles (Truck and Bus Regulation). The regulation requires airport shuttle buses with engines older than 2010 to eventually be replaced with engines that meet the 2010 emission standard of 0.2 g/bhp-hr NO_x and 0.01 g/bhp-hr PM_{2.5}. As a result, by 2023, nearly all shuttle buses should be compliant with this regulation. However, similar to the Public Agency and Utility Regulation, this regulation does not apply to shuttle buses with GVWR less than 14,000 pounds. Diesel and alternative-fueled shuttles less than 14,000 GVWR are subject to new engine emission standards of 0.20 g/bhp-hr NO_x and 0.01 g/bhp-hr PM.

There are additional regulatory requirements for airport shuttle fleets that operate in the South Coast District's jurisdiction, as specified in Rule 1194. This rule requires public and private fleets of 15 or more vehicles that provide passenger pickup services at commercial airports to acquire cleaner burning (certified to ARB's ultra-low emission vehicle, super-ultra-low emission vehicle, or zero-emission vehicle emission standards) or alternative-fueled vehicles when procuring their vehicles. Non-diesel airport shuttles are not subject to ARB in-use fleet regulations.

Proposed Measures: On-Road Heavy-Duty Vehicles

Proposed Actions:

ARB would develop and propose a regulation or other measures to deploy zero-emission airport shuttles in order to further support market development of zero-emission technologies in the heavy-duty sector. Airport passenger shuttles that frequent the airport such as rental car and parking lot shuttles typically operate fixed short routes coupled with stop-and-go operation and low average speeds. As seen in past zero-emission bus demonstrations, vehicles that operate on fixed routes, have stop-and-go operation, and maintain low average speeds are ideal candidates for zero-emission electric technologies.

The current successes of zero-emission transit buses can reasonably be translated to airport shuttle buses due to the similarities between these two vehicle types. A near-term strategy to encourage airports to begin purchasing zero-emission shuttle buses would introduce these buses into the marketplace, which may result in entire zero-emission shuttle bus fleets in the future. Like transit buses, the inclusion of zero-emission airport shuttles would serve as a stepping stone to encourage broader deployment of zero-emission technologies in the on-road sector. Initially, incentive funding could be used to help defer the higher incremental cost of zero-emission airport shuttles as compared to traditionally-fueled shuttles. As the capital costs for zero-emission technologies decrease over time, implementation of the near-term strategy could occur either by regulation or a memorandum of understanding, or a combination thereof.

ARB will also consider the feasibility of expanding the scope of this measure to include emission compliance requirements for other heavy-duty airport vehicles, such as fixed route vehicles entering/exiting the airports and vehicles operating almost exclusively at the airport facility, such as airport owned operational and maintenance vehicles.

Estimated Emission Reductions:

While emission reductions have not been identified at this time, ARB will quantify any emission reductions from this measure during the rule development process. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than as proposed by staff.

Timing:

Proposed ARB Board hearing:	2018
Proposed implementation schedule:	2023

Proposed SIP Commitment:

ARB staff proposes to commit to bring this measure to the Board in 2018.

Incentive Funding to Achieve Further Emission Reductions from On-Road Heavy-Duty Vehicles

Overview:

The goal of this proposed measure is to provide incentive funding to accelerate the penetration of near-zero and zero-emission engines beyond the rate of natural turnover achieved through implementation of the other proposed measures identified for on-road heavy-duty vehicles. This measure is specifically for the South Coast.

Background / Regulatory History:

Several State and local incentive funding pools have been used historically -- and remain available -- to fund the accelerated turnover of on-road heavy-duty vehicles. Since 1998, the Carl Moyer Program (Moyer Program) has provided funding for replacement, new purchase, repower and retrofit of trucks in the South Coast. Beginning in 2008, the Goods Movement Emission Reduction Program funded by Proposition 1B has funded cleaner trucks for the region's transportation corridors; the final increment of funds will implement projects in South Coast through 2018.

ARB's Air Quality Improvement Program (AQIP) has funded the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) since 2010, and continued South Coast participation is expected. ARB has also administered a Truck Loan Assistance Program since 2009. Beyond these Statewide programs, the District receives local funds to improve air quality through vehicle registration fees authorized by AB 923, AB 2766, and Senate Bill 1928. The South Coast AB 2766 Motor Vehicle Subvention Program, funded by a motor vehicle registration fee surcharge, incentivizes emission reduction from mobile sources and is used to drive early introduction of clean air technology such as cleaner vehicle engines, and accelerated vehicle retirement and repair programs. The South Coast's Clean Fuels Program funds the development, demonstration, and accelerated deployment of clean fuels and transportation technologies.

Additionally, funding could also be provided through programs including Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007), which authorized the California Energy Commission (CEC)'s Alternative and Renewable Fuel and Vehicle Technology Program. This program has an annual program budget of approximately \$100 million to support projects including improved heavy-duty vehicle technologies, retrofitting on-road heavy-duty vehicle fleets, and expanding infrastructure. The Low Carbon Transportation Program provides mobile source incentives to reduce GHG emissions, criteria pollutants, and air toxics through the development of advanced technology and clean transportation. Low Carbon Transportation investments are supported by California Cap-and-Trade auction proceeds. A voluntary incentive program administered by ARB, the Low Carbon Transportation Investment program funds clean vehicle and equipment projects. The Enhanced Fleet Modernization Program (EMP) and EMP Plus-up programs augment the State's existing vehicle retirement program,

Proposed Measures: On-Road Heavy-Duty Vehicles

with approximately \$30 million available annually to provide funds for car scrapping, provided the vehicles meet certain eligibility requirements.

At the Federal level, U.S. EPA's DERA program funds projects that reduce diesel emissions from on-road heavy-duty engines, including school buses, Class 5 – 8 heavy-duty interstate vehicles, locomotive engines, marine engines, and non-road engines, equipment or vehicles used in construction, cargo handling equipment, and off-road equipment used in agricultural, mineral, or energy production industries.

Proposed Actions:

This proposed measure would use existing incentive and other innovative funding programs to help increase the penetration of near-zero and zero-emission heavy-duty trucks. Funding mechanisms would target technologies that meet or exceed an optional low-NOx standard through 2023, when implementation of a new federal low-NOx standard will begin and part of the current round of Moyer Program funding ends.

Implementation will require commitment of at least \$28 million of the current State and South Coast District incentive funds described above to truck replacement projects in the 2015 to 2020 timeframe. In addition, pending annual appropriation by the Legislature and approval by the Board, ARB's Low Carbon Transportation and AQIP funds can be apportioned from 2015 through 2020, with approximately \$7 million per year allocated for low-NOx trucks using renewable fuels in South Coast. These funds could be used to target applications that are well-suited for ZEV applications, such as ZEV drayage.

It is important to note that funds under the control of the South Coast District may also be used for other applications, including off-road vehicles. Identifying the most effective use of funds in order to maximize emission reductions will depend on the incremental cost of technologies, cost effectiveness, and the type of financing mechanism employed. Accordingly, the use of these funds to maximize emission reductions for 2023 may be further refined.

Timing:

Proposed ARB Board hearing:	2016 and annually thereafter
Proposed implementation schedule:	2016 – 2023

Proposed SIP Commitment:

ARB staff proposes to commit to bring to the Board by 2018 a prospective incentive-based emission reduction measure designed to achieve the NOx emission reductions shown in Table 4 for the South Coast in 2023 and 2031, for inclusion in the California SIP as a mechanism to allow California to receive SIP credit for reductions achieved through these incentive programs. These measures will meet U.S. EPA integrity requirements and will include a mechanism for tracking and backstopping reductions. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Further Deployment of Cleaner Technologies: On-Road Heavy-Duty Vehicles

Overview:

The goal of this proposed measure is to identify concepts that will further reduce NOx emissions. These concepts will include additional incentive funding and developing technologies to accelerate the penetration of near-zero and zero equipment beyond the rate of natural turnover achieved through implementation of the other proposed measures identified for on-road heavy-duty vehicles. This measure is specifically for the South Coast.

Background / Regulatory History:

A number of existing measures will achieve NOx reductions from heavy-duty trucks, and could be expanded to provide additional reductions. In addition, new technologies, along with regulations, could potentially provide additional NOx reductions.

Incentives:

Several State and local incentive funding pools have been used historically -- and remain available -- to fund the accelerated turnover of on-road heavy-duty vehicles in the South Coast. Since 1998, the Carl Moyer Program has provided funding for replacement, new purchase, repower and retrofit of trucks in the basin. Beginning in 2008 the Goods Movement Emission Reduction Program funded by Proposition 1B has funded cleaner trucks for the region's transportation corridors. The Air Quality Improvement Program has funded the HVIP since 2010. In addition, new Low Carbon Transportation incentives funded by the GGRF are available for zero-emission and cleaner combustion truck projects that achieve GHG benefits, and these projects may often provide criteria pollutant reduction co-benefits. However, to achieve additional reductions in this category, new sources of funding will be pursued.

Advanced Technologies Such as Connected and Autonomous Vehicles/Systems:

Advanced technologies are expected to be introduced into the market and could replace or supplement the need to solely rely on additional funding pools. Examples of these strategies include autonomous and connected vehicle systems, greater fleet and system operational efficiencies, and improvements in transportation logistics. Some of these strategies are currently in the early stages of development and are expected to bring not only emission reductions, but cost savings to the industry once deployed. Many of these technologies will ultimately bring cost saving to the freight movement sector. It is likely that this deployment can be accelerated if necessary using by incentive funding and regulations.

Proposed Actions:

This proposed measure is designed to achieve further emission reductions for South Coast attainment in 2023 and 2031 through a suite of additional actions, including early penetration of near-zero and zero-emission technologies, emission benefits associated with increased operational efficiency strategies, and the potential for new driver assist

Proposed Measures: On-Road Heavy-Duty Vehicles

and intelligent transportation systems. The emission reductions will be achieved through a combination of industry actions, motivated by both ARB and the South Coast. These actions reflect an initial assessment of a pathway, recognizing that as funding is allocated and advanced technologies further develop, the balance amongst approaches will necessarily adjust.

Scope of Technology Penetration and Mechanisms to Achieve Reductions:

Under current ARB regulations, nearly all heavy-duty trucks operating in the South Coast must meet today's 2010 engine standards by 2023, with the exception of very low mileage fleets and public fleets regulated under earlier fleet rule requirements. A key component of the mobile source strategy for heavy-duty vehicles is the adoption of a more stringent engine performance standard reflecting technology that is effectively 90 percent cleaner than today's standards. To achieve the further reductions associated with early penetration of these cleaner heavy-duty technologies, ARB and South Coast staff estimate that by 2023, approximately 100,000 to 150,000 trucks would need to have engine technologies equivalent to emissions represented by a 0.02 g/bhp-hr low-NO_x standard. The following mechanisms provide a pathway for achieving this scale of technology deployment:

- Identify and develop regulatory mechanisms that encourage the development of near-zero and zero-emission heavy-duty truck deployment. Similar actions have been done previously in the South Coast, including local regulations and the San Pedro Bay Ports Clean Truck Program. The South Coast will include local measures in its AQMP to address the accelerated deployment of heavy-duty vehicles.
- Expand and enhance existing incentive and other innovative funding programs for heavy-duty vehicles to increase the emphasis on and support for purchase of near-zero and zero-emission equipment. Funding mechanisms would target technologies that meet either lower NO_x standards, or are hybrid/zero-emission technologies. If incentive funding is the primary mechanism to achieve the scope of further technology deployment described above, funding would be required for approximately 15,000 to 20,000 trucks per year over a seven year period, depending upon the availability of zero-emission vehicles and engines certified to ARB's optional low-NO_x standards of 0.05 g/bhp-hr and 0.02 g/bhp-hr, or other advanced hybrid/zero-emission technologies. The incentive funding required for this effort would go beyond the amount currently authorized for existing programs through 2023. Continued incentive funding post-2023 to further accelerate the deployment of trucks meeting or exceeding a 0.02 g/bhp-hr standard would provide additional reductions for 2031.

Determination of the needed resources will be based on assessment of the incremental cost of technologies, cost effectiveness, and the type of financing mechanism employed. Funding needs and mechanisms will be identified working

Proposed Measures: On-Road Heavy-Duty Vehicles

in collaboration with the District and other State agencies over the next several months.

Additional mechanisms for achieving the needed emission reductions reflect actions by ARB and others to continue increasing the penetration of zero-emission technologies, intelligent transportation systems, and other operational efficiencies. While these approaches have the greatest potential to provide further reductions post 2023, early advances in these areas could offset some of the reductions required through incentive funding or regulations. These additional pathway mechanisms include:

- Several individual proposed measures focus on deploying zero-emission vehicles in heavier applications that are currently well-suited for broad market development, such as transit buses, airport shuttles, and last mile delivery. Depending upon the success of these applications, and ongoing technology assessment, regulatory mechanisms to require zero-emission vehicles in additional applications may be feasible. The greatest opportunities exist for fleets that are captive to the South Coast, and drive shorter distances. This technology assessment is already underway.
- Advances in the development of autonomous and connected vehicle systems, particularly if based on zero-emission technologies, as well as greater operational efficiencies, and improvements in transportation logistics. These changes in how the heavy-duty truck sector would operate offer the potential to achieve criteria, toxic, and GHG emission reductions, but also reduce VMT and congestion as well as petroleum usage. These concepts are based on emerging technologies, and will require significant exploration and demonstration prior to becoming concepts with quantified emission reductions. To promote initial demonstration of these concepts, the FY 16/17 Low Carbon Transportation Funding Plan will include eligibility for demonstration projects related to intelligent transportation systems and connected vehicles.

Timing:

Proposed ARB Board hearing: n/a
Proposed implementation schedule: 2016 – 2031

Proposed Measures: On-Road Heavy-Duty Vehicles

Implementation Milestones and Schedule		
Implementation Milestone	Implementation Steps	Schedule
Identify and secure funding for incentive based and other innovative funding programs for accelerated deployment of near-zero and zero-emission heavy-duty vehicles	<i>Phase 1:</i> Identify funding needs and potential sources	2016 + (annually)
	<i>Phase 2:</i> Pursue actions to secure funding	
	<i>Phase 3:</i> Implement funding/incentive programs	
Develop regulatory strategies for deployment of zero-emission technologies in additional heavy-duty vehicle applications as appropriate	<i>Phase 1:</i> Evaluation of technology and prototype demonstrations. Regulatory strategies brought to ARB Board for approval.	2016 – 2023
	<i>Phase 2:</i> Development of regulatory strategies	2020 - 2023
	<i>Phase 3:</i> Measure implementation	2025 – 2031
Evaluate potential for emission benefits from operational efficiencies and intelligent transportation systems and quantify and develop mechanisms to provide SIP reductions as appropriate	<i>Phase 1:</i> Evaluation of approaches and potential for emission reductions	2016 – 2023
	<i>Phase 2:</i> Demonstration of systems	2020 – 2024
	<i>Phase 3:</i> Quantification of emission reductions and mechanisms for incorporating into SIP	2024 – 2027
Provide annual reports to Board on status of funding, technology development, and identification of potential further regulatory measures	<i>Phase 1:</i> Evaluate status of funding, technology development, and potential for further regulatory measures	2017+ (annually)
	<i>Phase 2:</i> Develop potential regulatory actions as appropriate	

Proposed SIP Commitment:

ARB commits to bring to the Board programs and policies or take other actions to implement this measure to achieve the NOx emission reductions shown in Table 4 for the South Coast in 2023 and 2031. Further development measures for each source category may provide more or less emission reductions than the amount shown.

Proposed Measures: Off-Road Federal and International Sources

Description of Source Categories:

Locomotives

Union Pacific Railroad (UP) and BNSF Railway (BNSF) 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 ARB staff 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 ARB has identified as a toxic air contaminant), NO_x, and GHGs. These emissions often occur in or near densely populated areas and neighborhoods, exposing residents to unhealthy levels of toxic diesel PM, plus regional ozone and fine particulates that form in the atmosphere.

Ocean-Going Vessels

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

Proposed Measures: Off-Road Federal and International Sources

Table 10: Summary of Off-Road Federal and International Sources Control Measures

Statewide Estimated Emission Reductions		
(tons per day)		
	2015	2031
NOx Inventory*	336	420
More Stringent National Locomotive Emission Standards		9
Tier 4 Vessel Standards		NYQ
Incentivize Low Emission Efficient Ship Visits		NYQ
At-Berth Regulation Amendments		2
Further Deployment of Cleaner Technologies		54
Potential reductions		65
ROG Inventory*	44	56
More Stringent National Locomotive Emission Standards		0.4
Tier 4 Vessel Standards		NYQ
Incentivize Low Emission Efficient Ship Visits		NYQ
At-Berth Regulation Amendments		0.1
Further Deployment of Cleaner Technologies		0.3
Potential reductions		0.8
PM2.5 Inventory*	12	14
More Stringent National Locomotive Emission Standards		<0.1
Tier 4 Vessel Standards		NYQ
Incentivize Low Emission Efficient Ship Visits		NYQ
At-Berth Regulation Amendments		<0.1
Further Deployment of Cleaner Technologies		NYQ
Potential reductions		<0.1

*2031 values reflect anticipated emission reductions from current control programs

"NYQ" denotes emission reductions are Not Yet Quantified; "—" denotes no anticipated reductions

More Stringent National Locomotive Emission Standards

Overview:

The goal of this proposed measure is to reduce emissions from locomotives in order to meet air quality, localized health risk, and climate change goals. Under the proposed measure, ARB will petition U.S. EPA to promulgate by 2020 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.

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 NO_x reductions through Tier 0, 1, and 2 emission standards. Tier 2 NO_x emission standards reduced older uncontrolled locomotive NO_x 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 NO_x and PM emission standards. U.S. EPA Tier 4 NO_x and PM emission standards further reduced emissions by approximately 90 percent from uncontrolled levels.

Proposed Actions:

ARB would petition U.S. EPA for new national locomotive emission standards for significant additional reductions in criteria and toxic pollutants, and GHG emissions from existing and future locomotives. ARB staff estimates that U.S. EPA could require manufacturers to implement the new locomotive emission regulations by as early as 2023 for remanufactures and 2025 for newly manufactured locomotives.

This measure describes the emissions levels that ARB 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

Proposed Measures: Off-Road Federal and International Sources

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.

As documented in the Final Technology Assessment for Freight Locomotives,³⁴ ARB staff believes the most technologically feasible advanced technology for near-term deployment is the installation of a compact aftertreatment system (e.g., combination of selective catalytic reduction (SCR) and diesel oxidation catalyst (DOC) onto new and remanufactured diesel-electric freight interstate line haul locomotives. Newly manufactured locomotives can also be augmented with on-board batteries to provide an additional 10-25 percent reduction in diesel fuel consumption and GHG emissions to achieve the Tier 5 emission levels shown in the table below. For purposes of this document, ARB staff assumes a 15 percent reduction in fuel use for locomotives equipped with this battery technology. On-board batteries could also provide zero-emission track mile capabilities in and around railyards to further reduce diesel PM and the associated health risks.

A new federal standard could also facilitate development and deployment of zero-emission track mile locomotives and zero-emission locomotives by building incentives for those technologies into the regulatory structure.

The compact SCR and DOC aftertreatment system could also be retrofitted to existing Tier 4 locomotives to be able to achieve a Tier 4+ emissions standard, when Tier 4 locomotives are scheduled for remanufacture (every 7 to 10 years). Based on the typical remanufacture schedule, all Tier 4 locomotives could potentially be retrofitted with aftertreatment between 2025 and 2037. Existing locomotives originally manufactured to meet Tier 2 or Tier 3 standards could also be upgraded with the same compact aftertreatment system upon remanufacture to achieve emissions equal to Tier 4 levels. The potential amended emission standards for locomotives and locomotive engines are shown in the table below.

³⁴ Final Technology Assessment for Freight Locomotives available at: <https://www.arb.ca.gov/msprog/tech/report.htm>

Proposed Measures: Off-Road Federal and International Sources

Potential Amended Emission Standards for Locomotives and Locomotive Engines

Tier Level	Year of Manufacture	NOx		PM		GHG		HC		Proposed Effective Date
		Standard (g/bhp-hr) ²	Percent Control ¹	Standard (g/bhp-hr) ²	Percent Control ¹	Standard (g/bhp-hr) ²	Percent Control ¹	Standard (g/bhp-hr)	Percent Control ¹	
2++	2005-2011	1.3	90	0.03	95	NA	0	0.14	85	2023
3+	2012-2014	1.3	90	0.03	95	NA	0	0.14	85	2023
4+	2015-2024	0.3	99	<0.01	99	NA	0	0.05	95	2023
5	2025	0.2	99+	<0.01	99	NA	10-25%	0.02	98	2025
		With capability for zero-emission operation in designated areas.								

1. Compared with uncontrolled baseline, reflects percent control over line haul baseline for illustrative purposes; ARB staff assumed older pre-Tier 0 line haul and switch locomotives would be able to emit up to the Tier 0 PM emission standards, based on American Association of Railroads in-use emission testing (required to comply with U.S. EPA in-use emission testing requirements) for older switch locomotives with EMD 645 engines.
2. ARB, Draft Technology Assessment: Freight Locomotives, 2016.

Estimated Emission Reductions:

ARB staff used ARB’s Vision 2.1 model to estimate the emission reductions associated with this proposed measure.

Newly manufactured locomotives:

The Tier 5 emissions standard was modeled as a new tier of locomotives to be introduced in 2025. Tier 5 is defined by the same emission standards as Tier 4 for all pollutants except NOx, PM, HC, and GHG, which would be at the levels shown in the table above. This was represented in the model by increasing the Tier 5 locomotive activity in the total tier distribution by ~3.0 percent per year.

Remanufactured locomotives:

The locomotive fleet meeting the remanufacture emissions levels was modeled by assuming approximately 8 percent of the Tier 4 activity every year in the baseline will be operated by Tier 4+ locomotives.

Proposed Measures: Off-Road Federal and International Sources

Timing:

ARB petition to U.S. EPA	2017
U.S. EPA rulemaking date:	2020
Proposed implementation schedule:	2023 for remanufactured locomotives 2025 for newly manufactured locomotives

Proposed SIP Commitment:

ARB staff proposes to commit to petition U.S. EPA in 2017 to promulgate these standards by 2020 to achieve the NOx emission reductions shown in Table 4 for the South Coast in 2023 and 2031, and as shown in Table 5 for the San Joaquin Valley in 2025 and 2031. U.S. EPA's action may provide more or less reductions than the amount shown.

Tier 4 Vessel Standards

Overview:

The goal of this proposed measure is to reduce emissions from OGVs. ARB would advocate with international partners for the IMO to establish new Tier 4 NO_x and PM standards, plus efficiency targets for existing vessels, and new vessel categories not covered by IMO efficiency standards.

Background/Regulatory History:

The IMO, under Annex VI (“Regulations for the Prevention of Air Pollution from Ships”), specifies new engine NO_x standards and sets fuel sulfur limits. Tier 2 IMO NO_x standards have applied to new vessels since 2011, and in 2016, Tier 3 NO_x standards will apply within NO_x Emission Control Areas (ECAs) such as the North American ECA. However, the Tier 3 NO_x limits are relatively high compared to the standards that apply to landside diesel engines. Annex VI regulations also do not limit PM exhaust emissions from new engines. The fuel sulfur limit in the North American ECA is 0.1 percent sulfur, the same as the ARB regulation discussed below. However, there are some differences between the regulations. The California regulation specifies the use of cleaner “distillate” grades of fuel, rather than just a sulfur limit, and the federal ECA provides exemptions for many vessels that are not exempted by the California rule.

The IMO also established amendments to Annex VI in 2011 that set in place efficiency standards for new ships. Beginning in 2013, the regulations establish energy efficiency design index (EEDI) standards that become progressively more stringent over time. The EEDI requires a minimum energy efficiency level per capacity mile (e.g., ton-mile) for different ship types and size segments. The categories of ships covered include oil and gas tankers, bulk carriers, general cargo ships, refrigerated cargo carriers and container ships. Together, these vessel categories account for over 70 percent of the carbon dioxide emissions from the new-build fleet. The regulations do not cover passenger vessels, mixed-use vessels, other specialty vessels, and vessels below 400 gross tons. For vessel types not covered, EEDI formulas are expected to be developed in the future.

The IMO also requires operators of both new and existing vessels to develop and maintain a Ship Energy Efficiency Management Plan (SEEMP). The SEEMP, a complement to the EEDI, provides a mechanism to improve the energy efficiency of a ship. A vessel’s SEEMP document is expected to change over time, and many companies already use a similar plan to reduce fuel costs. The SEEMP regulations only require that ships have plan, but an approval of the plan, and tracking of the vessel’s progress by the flag state administration is not required.

California regulations include the Ocean-going Vessel Fuel Regulation and the At-Berth (Shore-power) Regulation. The OGV Fuel Regulation was designed to reduce diesel

Proposed Measures: Off-Road Federal and International Sources

PM, NO_x, and SO_x emissions. This regulation was implemented in 2009, and required that vessels use lower sulfur distillate fuels. The current fuel sulfur limit of 0.1 percent was implemented in 2014, a year before the ECA set this same sulfur standard. The At-Berth Regulation was designed to limit emissions of diesel PM, NO_x, and GHG from vessels at dockside. The regulation requires that vessels turn off their auxiliary diesel engines and plug in to shore-based grid electrical power, or utilize alternative technologies to achieve comparable emission reductions.

California has the authority to regulate marine vessels, including foreign-flagged vessels, when they visit our ports, to the extent such regulation is not preempted by federal law. The California OGV Fuel Regulation was adopted as two essentially identical regulations under our authority to regulate both TACs and criteria pollutants.

Proposed Actions:

Under this Action, ARB would work with U.S. EPA, U.S. Coast Guard, and international partners to urge the IMO to adopt more stringent emission standards for new ocean-going vessels and efficiency requirements for existing vessels. Specifically, ARB would advocate for a Tier 4 NO_x standard for new marine engines on ocean-going vessels and vessel efficiency requirements for the existing in-use fleet.

Additional regulations are necessary because the existing IMO marine engine regulations do not include a PM standard, and the Tier III 2016 NO_x standard is higher than the NO_x standards for other diesel equipment categories. In addition, the IMO efficiency standards for existing vessels only require that vessels have a “Ship Energy Efficiency Management Plan.” These regulations do not require approval of the plan, tracking of the vessel’s progress, or actual improvement in energy efficiency.

Estimated Emission Reductions:

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

Timing:

ARB advocacy:	2016 - 2018
IMO action, ratification, and implementation:	2020 - 2025 ³⁵

Proposed SIP Commitment:

ARB staff proposes to commit to advocate with international partners for the IMO to establish new Tier 4 NO_x and PM standards, and more comprehensive efficiency standards for existing vessels. The measure as proposed may provide more or less emission reductions than the amount shown.

³⁵ Anticipated implementation beginning in 2025

Incentivize Low Emission Efficient Ship Visits

Overview:

The goal of this proposed measure is to achieve early implementation of clean vessel technologies such as liquefied natural gas, Tier 3 standards or better, and incentivize vessels with those technologies in California service. ARB staff would work with California seaports, ocean carriers, and other stakeholders to develop the criteria and to identify the best way to incentivize introduction of Low Emission Efficient Ships into the existing fleet of vessels that visit California seaports.

Background/Regulatory History:

In addition to the traditional regulations outlined in the previous proposed measure, Port authorities in California have developed a number of measures for OGVs which are typically implemented through incentive programs or lease agreements.

The Ports of Los Angeles and Long Beach (San Pedro Bay Ports) have the most comprehensive program. The San Pedro Bay Ports Clean Air Action Plan (CAAP) is designed to reduce the emissions from a variety of port sources, including OGVs. The plan includes reductions from Port ordinances, regulations, green lease agreements, environmental mitigation requirements, and voluntary and incentive efforts such as the "Green Ship Incentive Program" and "Vessel Speed Reduction Incentive Program" (VSR). In addition, the Ports of Los Angeles, Long Beach, Oakland, San Diego, San Francisco, and Hueneme have installed shoreside infrastructure for vessels to plug in at berth, and some have provisions in leases to require use of the infrastructure beyond the requirements of ARB's Statewide At-Berth regulation. Prior to the implementation of a Statewide clean fuel regulation for OGVs, the San Pedro Bay Ports also developed a clean fuel incentive program which covered the cost differential between dirty heavy fuel oil and cleaner burning low sulfur distillate fuel.

The Port of Los Angeles' Voluntary Environmental Ship Index Program (ESI) rewards vessel operators for reducing NO_x, SO_x, and CO₂ from OGVs. When an operator goes beyond what is required for compliance by bringing their newest and cleanest vessels to the Port and demonstrating technologies onboard their vessels, they are rewarded with incentives via lower dockage fees. It also encourages use of cleaner technology and practices in advance of regulations.

Proposed Actions:

Numerous technologies are available that can reduce emissions from ships and improve the efficiency of a vessel. Incentive programs can be leveraged to encourage vessel owners and operators to implement technologies that exceed current regulatory requirements. Under this proposed measure, ARB staff would work with California seaports and other stakeholders to develop criteria for a Low Emission Efficient Ship, targeting NO_x, diesel PM, GHG, and sulfur oxide emissions. ARB would also pursue

Proposed Measures: Off-Road Federal and International Sources

partnerships with other jurisdictions and ports along the Pacific shipping corridor to develop a “green lane” concept with multiple small incentives for cleaner vessels that add up to sufficient financial benefit to change the decisions of vessel operators about which vessels are deployed on which routes. Incentives to encourage visits from ships meeting the criteria would involve identification of funding sources and implementation mechanisms such as development of new programs, enhancement of existing programs such as the Port of Long Beach Green Flag program and the Port of Los Angeles Environmental Ship Index Incentive Program, or incorporation into existing Statewide incentive programs.

Estimated Emission Reductions:

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

Timing:

Proposed ARB action date: 2018 – 2020
Proposed implementation schedule: 2018 +

Proposed SIP Commitment:

ARB staff proposes to commit to develop criteria for a Low Emission Efficient Ship and incentives for using these ships at California ports by 2020.

At-Berth Regulation Amendments

Overview:

The goal of this proposed measure is to further reduce emissions from ships that visit California ports. ARB staff would develop and propose amendments to the current At-Berth Regulation and look for additional reductions from additional vessel fleets, types, and operations.

Description of Source Category:

Ocean-going vessels are large vessels designed for deep water navigation. This category includes vessels such as container ships, tankers, bulk carriers, refrigerated cargo vessels, passenger cruise ships, and “roll-on, roll-off” ships used to transport automobiles. These vessels make about 9,000 visits to California ports annually, and are mostly foreign-flagged vessels engaged in international trade.

Most ocean-going vessels are propelled by a single very large diesel engine (main engine), and also typically have several diesel-powered generator sets (auxiliary engines) providing electrical power to the ship, as well as diesel powered boilers to produce steam for heating or other uses. Passenger cruise ships use a different engine configuration that is referred to as “diesel-electric.” These vessels use large diesel generator sets to provide electrical power for both propulsion and ship-board electricity. For the purpose of the regulation, these engines are treated as auxiliary engines.

Emissions from ocean-going vessels occur while vessels transit to and from California ports, during maneuvering operations into and out of berth, and while anchored offshore, or berthed at dock (hoteling). During transiting, the main and auxiliary engines are operating, while the boiler on many vessels may not be operating or may be used at partial load, since the heat from the main engine exhaust may be sufficient to produce ship steam. During maneuvering, main and auxiliary engines, as well as the boiler, would typically be operating. At berth or anchorage, only the auxiliary engines and boiler would typically be operating, while the main engine would be turned off.

Background/Regulatory History:

In December 2007, ARB approved the Airborne Toxic Control Measure (ACTM) for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port Regulation (At-Berth Regulation). ARB has broad authority to regulate ocean-going vessel emissions, including the emissions from diesel auxiliary engines on ocean-going vessels docked at California ports.

The At-Berth Regulation was designed to reduce emissions from diesel auxiliary engines on container ships, passenger ships, and refrigerated cargo ships while at berth at California’s major seaports, and is limited to fleets of 25 or more vessels (five or more for passenger ships). The At-Berth regulation also requires that vessels turn off their

Proposed Measures: Off-Road Federal and International Sources

auxiliary diesel engines and plug in to shore-based grid electrical power, or utilize alternative technologies to achieve comparable emission reductions.

ARB staff has begun developing proposed amendments to the Regulation. These amendments will be designed to address current implementation issues while preserving the intended air quality benefits, and to expand the scope of the Regulation to achieve additional emission reductions.

Proposed Actions:

ARB would evaluate how the Regulation can be amended to achieve further emission reductions by including smaller fleets, additional vessel types (including roll-on/roll-off vehicle carriers, bulk cargo carriers, and tankers), and additional operations. In addition, there are two companies with portable emissions capture and control systems that have successfully demonstrated performance and may now be used for compliance with the Regulation on certain container vessels. If one or both systems prove to be feasible and cost-effective on additional vessel types, the technology could help support an ARB staff proposal to expand the scope of the Regulation to include additional vessel types and/or smaller fleets.

Estimated Emission Reductions:

ARB staff used ARB's Vision 2.1 model to estimate the emission reductions associated with this proposed measure. The amendments would require additional vessels to reduce emissions, with the primary compliance options likely to be the use of shore power or the emissions capture and control systems. For this calculation, staff assumed that additional vessels (i.e., auto carriers, bulk cargo, general cargo, roll-on roll-off carriers, and tankers) would connect to shore power rather than run auxiliary engines. For modeling purposes, the amendments were limited to the ports that are currently offering shore power and implementation was assumed to start in 2022 at 10 percent fleet compliance and to increase to 50 percent fleet compliance by 2032. This compliance rate was converted into the number of ships impacted, and then multiplied by the average time spent at berth. As the current regulation allows between 3 to 5 hours of auxiliary engine operation for each affected visit, four hours was used as the average time spent at berth using auxiliary engines. The results from above were then combined to find the total hours of auxiliary engine use at berth that would be reduced by the amendments.

Timing:

Proposed ARB Board hearing:	2017 - 2018
Proposed implementation schedule:	2023 - 2031

Proposed SIP Commitment:

ARB staff proposes to commit to bring this measure to the Board in 2017 - 2018. ARB staff will initiate a rule development process designed to achieve the NOx emission

Proposed Measures: Off-Road Federal and International Sources

reductions shown in Table 4 for the South Coast nonattainment area in 2023 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Further Deployment of Cleaner Technologies: Off-Road Federal and International Sources

Overview:

The goals of this proposed measure are to increase the penetration of cleaner ocean-going vessel, locomotive, and aircraft technologies, and to promote efficiency improvements at the equipment, sector, and systems levels. This measure is specifically for the South Coast.

Background/Regulatory History:

This category includes a variety of sources that travel both nationally and internationally, including ocean going vessels, locomotives, and aircraft. Under current requirements, new locomotive engines must meet a Tier 4 engine emission standard. Beginning in 2016, new ocean going vessels must meet a Tier 3 standard if the vessel will be calling at marine ports located in an Emissions Control Area such as the North American Emission Control Area. Finally, new certificated aircraft engines must meet Tier 8 (CAEP/8) standards.

Proposed Actions:

This proposed measure is designed to achieve further emission reductions for South Coast attainment in 2023 and 2031 through a suite of additional actions, including early penetration of cleaner technologies and emission benefits associated with increased efficiencies.

While more stringent engine standards have been established for new equipment, existing equipment tends to remain in operation for a long period of time. In addition, these sources are primarily regulated by the federal government and international organizations. As a result, emissions from these categories have not decreased at the same pace as those for other mobile sources. By 2023, ocean going vessel NO_x emissions in the South Coast are projected to grow to 37 tpd. Locomotive emissions are projected at 15 tpd, and aircraft emissions will grow to 17 tpd. Achieving the magnitude of emission reductions necessary from this category is therefore more difficult, and will require strong action at the federal and international level, coupled with State and local advocacy and action to facilitate these efforts.

ARB and South Coast staff have estimated a scope of technology development and penetration as one example pathway of what would be necessary by 2023 and 2031 to achieve equal share reductions from this sector. Achieving equal share reductions would represent a significant expansion of cleaner technology deployment. The time frame to accomplish this is short, the development of cleaner technologies lags behind those for other sectors, and the scope of State and local authority is limited. These issues will need to be considered as the proposed measures are further developed for this SIP. For 2023, this would require: 1) all locomotives operating in the South Coast meeting the Tier 4 standard; 2) all aircraft meeting today's Tier 8 emission levels; and

Proposed Measures: Off-Road Federal and International Sources

3) ocean going vessels achieving emission levels significantly cleaner than today's requirements. An equal share pathway for this sector post-2023 would require deployment of locomotives meeting a more stringent Tier 5 standard. More stringent Tier 4 ocean going vessel standards would also be necessary. Finally, operational efficiency strategies would be needed to provide an additional mechanism for further reductions as a complement to deployment of cleaner technologies.

A series of actions that would be taken at the State and local level to achieve further reductions are outlined below:

- Expand and enhance existing incentive and innovative funding programs to increase the emphasis on and support for deployment of cleaner technologies in these sectors. Air quality incentives and transit funding programs, for example, will be effective in transforming the passenger rail system in the South Coast, with nearly all Metrolink trains expected to reach a Tier 4 level by 2023.

The incentive funding required will go well beyond the amount currently authorized under existing programs through 2023. Funding needs and mechanisms will be identified working in collaboration with the District over the next several months.

- Partner with airports to incentivize cleaner aircraft to come to California airports, along with partnerships with international engine manufacturers to encourage production of cleaner, more efficient engines.
- Seek continued funding for and partnerships with federal agencies such as the U.S. Department of Energy, U.S. EPA, FAA, U.S. Maritime Administration, and Federal Railroad Administration for new technology and fuel demonstration projects. This would include efforts on development of hybrid, battery and fuel cell technologies for locomotives, the FAA's CLEEN program, and retrofit technologies for in-use vessels and boilers.
- Encourage efficiency improvements, including industry based initiatives (like the San Pedro Bay Ports' Supply Chain Optimization effort to increase port competitiveness), as well as concepts being developed as part of the California Sustainable Freight Action Plan. These improvements may include approaches such as reducing unproductive moves, use of marine vessel sharing agreements that result in maximum use of cargo space, and increased reliance on logistics planning and operations software.

Timing:

Proposed implementation schedule: 2016 – 2031

Proposed Measures: Off-Road Federal and International Sources

Implementation Milestones and Schedule		
Implementation Milestone	Implementation Steps	Schedule
Identify and secure incentives, including funding, for accelerated deployment of cleaner ocean going vessels, locomotives, and aircraft in California service	<i>Phase 1:</i> Identify incentives, including funding needs and potential sources	2016 + (annually)
	<i>Phase 2:</i> Pursue actions to secure funding	
	<i>Phase 3:</i> Implement funding/incentive programs	
Work with federal and international agencies to advocate for increased stringency of emission standards and efficiency requirements, demonstration of new technologies, and incentives to attract the cleanest technologies to California	<i>Ongoing</i>	2016 - 2031
Evaluate, quantify and encourage efficiency improvements with the potential to result in lower emissions per unit of cargo transported, including changes in cargo and equipment activity that are typically reflected in SIP emission inventories	<i>Phase 1:</i> Retrospective and prospective evaluation of approaches with potential for lower systemwide emissions per unit of cargo transported	2016 – 2023
	<i>Phase 2:</i> Demonstration of system efficiency improvements and support for expanded private and public efforts	2018 – 2027
	<i>Phase 3:</i> Ongoing quantification of the effect of efficiency improvements on freight activity and emissions for incorporation into SIP	2020 – 2031
Provide annual reports to Board on status of funding, technology development, and identification of potential further regulatory measures	<i>Phase 1:</i> Evaluate status of funding, technology development, and potential for further regulatory measures	2017+ (annually)
	<i>Phase 2:</i> Develop potential regulatory actions as appropriate	

Proposed Measures: Off-Road Federal and International Sources

Proposed SIP Commitment:

ARB commits to bring to the Board programs and policies or take other actions to implement this measure to achieve the NO_x emission reductions shown in Table 4 for the South Coast nonattainment area in 2023 and 2031. Further development measures for each source category may provide more or less emission reductions than the amount shown.

Proposed Measures: Off-Road Equipment

Description of Source Category:

The Off-Road Equipment category includes lawn and garden equipment, transport refrigeration units, vehicles and equipment used in construction and mining, forklifts, cargo handling equipment, commercial harbor craft, and other industrial equipment. Given the diversity of equipment and duty cycles that comprises this category, each measure includes a more detailed description of the specific source.

Proposed Measures: Off-Road Equipment

Table 11: Summary of Off-Road Equipment Control Measures

Statewide Estimated Emission Reductions (tons per day)		
	2015	2031
NOx Inventory*	351	193
Zero-Emission Off-Road Forklift Regulation Phase 1		2
Zero-Emission Off-Road Emission Reduction Assessment		NYQ
Zero-Emission Off-Road Worksite Emission Reduction Assessment		NYQ
Zero-Emission Airport Ground Support Equipment		<0.1
Small Off-Road Engines		4
Transport Refrigeration Units Used for Cold Storage		NYQ
Low-Emission Diesel Requirement		4
Further Deployment of Cleaner Technologies		18
Potential reductions		28
ROG Inventory*	304	200
Zero-Emission Off-Road Forklift Regulation Phase 1		0.2
Zero-Emission Off-Road Emission Reduction Assessment		NYQ
Zero-Emission Off-Road Worksite Emission Reduction Assessment		NYQ
Zero-Emission Airport Ground Support Equipment		<0.1
Small Off-Road Engines		36
Transport Refrigeration Units Used for Cold Storage		NYQ
Low-Emission Diesel Requirement		NYQ
Further Deployment of Cleaner Technologies		20
Potential reductions		56
PM2.5 Inventory*	20	10
Zero-Emission Off-Road Forklift Regulation Phase 1		<0.1
Zero-Emission Off-Road Emission Reduction Assessment		NYQ
Zero-Emission Off-Road Worksite Emission Reduction Assessment		NYQ
Zero-Emission Airport Ground Support Equipment		<0.1
Small Off-Road Engines		<0.1
Transport Refrigeration Units Used for Cold Storage		NYQ
Low-Emission Diesel Requirement		0.5
Further Deployment of Cleaner Technologies		NYQ
Potential reductions		0.5

*2031 values reflect anticipated emission reductions from current control programs
 "NYQ" denotes emission reductions are Not Yet Quantified; "—" denotes no anticipated reductions

Zero-Emission Off-Road Forklift Regulation Phase 1

Overview:

The goal of this proposed measure is to accelerate the deployment of zero-emission technologies in off-road equipment types that are already primed for the technologies that exist today and facilitate further technology development and infrastructure expansion by demonstrating its viability. ARB would develop a regulation that focuses on forklifts with lift capacities equal to or less than 8,000 pounds.

Description of Source Category:

Forklifts operate in many different industry sectors but are most prevalent in manufacturing and at locations such as warehouses, distribution centers, and ports. There are approximately 100,000 forklifts operating in California, most of which are battery-electric, propane, diesel, or gasoline-fueled. Although battery-electric forklifts offer reduced maintenance requirements, lifetime cost savings, and cleaner tailpipe emissions, electric forklift usage has not changed significantly relative to internal combustion forklift usage over the past 20 years. While the equipment population of this source category has seen limited growth, without ARB actions, the transition to zero-emission may remain very gradual.

Background/Regulatory History:

Manufacturers of forklift engines are subject to new engine standards for both diesel and Large Spark Ignition (LSI) engines. Off-road diesel engines were first subject to engine standards and durability requirements in 1996 while the most recent Tier 4 Final emission standards were phased in starting in 2013. Tier 4 emission standards are based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction. LSI engines have been subject to new engine standards that include both criteria pollutant and durability requirements since 2001 with the cleanest requirements phased-in starting in 2010.

Forklift fleets can be subject to either the LSI fleet regulation, if fueled by gasoline or propane, or the off-road diesel fleet regulation. Both regulations require fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. The off-road diesel regulation was adopted by the Board in 2007 with implementation beginning in 2010. It is applicable to all diesel-fueled, self-propelled off-road equipment with at least 25 HP. Forklifts are included in the fleet average along with other equipment. The LSI fleet regulation was originally adopted in 2007 with requirements beginning in 2009. While the LSI fleet regulation applies to forklifts, tow tractors, sweeper/scrubbers, and airport ground support equipment, it maintains a separate fleet average requirement specifically for forklifts. The LSI fleet regulation requires fleets with four or more LSI forklifts to meet fleet average emission standards.

The Clean Air Act preempts states, including California, from adopting requirements for new off-road engines less than 175 HP used in farm or construction equipment.

Proposed Measures: Off-Road Equipment

California may adopt emission standards for in-use off-road engines pursuant to Section 209(e)(2), but must receive authorization from U.S. EPA before it may enforce the adopted standards.

Proposed Actions:

ARB staff would develop and propose a regulation to increase penetration of ZEVs in off-road applications, with specific focus on forklifts with lift capacities equal to or less than 8,000 pounds, for which zero-emission technologies have already gained appreciable customer acceptance and market penetration. This regulation would send a market signal to technology manufacturers and investors that zero-emission technologies will be strongly supported moving forward. This proposed measure would advance ZEV commercialization by increasing the penetration of zero-emission technologies. Experience gained from demonstrating the viability of advanced technologies in heavier-duty applications will spur market development and enable the technologies to be transferred to larger, higher power-demand off-road equipment types, such as high lift-capacity forklifts and other equipment types in the construction, industrial, and mining sectors. The regulation could also include requirements that result in the deployment of zero-emission technologies in heavier equipment fleets that remain at a particular location for extended periods of time or other similar provisions that would spur further technology innovation.

Estimated Emission Reductions:

ARB staff used ARB's Vision 2.1 model to estimate the emission reductions associated with this proposed measure. This measure requires electrification of diesel and LSI forklifts with horsepower ratings less than 65 HP in the industrial and airport ground support sectors. Electrification would be accomplished through incentives as well as natural and accelerated turnover. To model the emission reductions, ARB staff reviewed the reporting data and found that approximately 73 percent of forklifts in California were in medium or large fleets and would be subject to the regulation. Additionally, it was assumed that 90 percent of qualifying forklifts (overall 65.7 percent of the total) could reasonably be targeted for electrification by 2035 with a proposed starting year of 2028. A linear penetration of replaced equipment from 2028 to 2035 was applied to the emissions data from the official in-use off-road model.

Timing:

Proposed ARB Board hearing:	2020
Proposed implementation schedule:	2023 - 2035

Staff Proposed Commitment:

ARB staff proposes to commit to bring this measure to the Board by 2020. ARB staff will initiate a rule development process designed to achieve the NOx emission reductions as shown in Table 4 for the South Coast nonattainment area in 2031 and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The

Proposed Measures: Off-Road Equipment

measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Zero-Emission Off-Road Emission Reduction Assessment

Overview:

The goal of this proposed measure is to expand the use of zero-emission technology in non-freight, off-road applications. This further-study proposed measure would be a follow-up to off-road measures implemented in the 2023+ timeframe, such as the Zero-Emission Off-Road Forklift Regulation Phase 1, and through it ARB would identify opportunities to further expand the use of near-zero and zero-emission technologies in off-road applications.

Description of Source Category:

Equipment in these sectors is typically high power and utilizes diesel powertrains. While it is expected that these sectors will be heavily reliant on diesel for the foreseeable future, diesel-electric and hybrid powertrains significantly reduce fuel consumption and are in the early stages of commercialization. As battery technology develops, it may open up opportunities to apply these advanced technologies to more applications as well as develop all-electric versions of equipment. While new engine and fleet standards continue to reduce emissions from heavy-duty off-road equipment, it is important that ARB continue to look for ways to continue to apply advanced technology to further increase the sustainability of the off-road sector.

Background/Regulatory History:

Fleets with diesel equipment are subject to the off-road diesel fleet regulation. This regulation requires fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. The off-road diesel regulation was adopted by the Board in 2007 with implementation beginning in 2010. It is applicable to all diesel-fueled, self-propelled off-road equipment with at least 25 HP, excluding equipment used at seaports and railyards. Manufacturers of diesel engines are subject to new engine standards. Off-road diesel engines were first subject to engine standards and durability requirements in 1996 while the most recent Tier 4 Final emission standards were phased in starting in 2013. Tier 4 emission standards are based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction.

Proposed Actions:

ARB staff would conduct an assessment and provide the Board with an informational update regarding the status of ZEVs in off-road applications, once the Phase I Forklift Regulation is in place. The update would be the result of a technology assessment, and would identify opportunities to further expand their use. The focus of this proposed measure is on transferring near-zero and zero-emission technologies to heavier pieces of off-road equipment, such as high lift-capacity forklifts or other equipment in the construction, industrial, and mining sectors, with the intent of expanding their application as technology matures and infrastructure grows. This evaluation would focus primarily

Proposed Measures: Off-Road Equipment

on the scalability and transferability of zero-emission technologies from smaller applications to larger, higher power-demand equipment types and would be used to inform the development of the Phase 2 regulation. The information obtained from this technology review would be used to inform the development of Phase 2 of the Zero-Emission Off-Road Regulation. The Zero-Emission Off-Road Phase 2 Regulation would build upon the Phase 1 regulation and focus primarily on larger, higher power-demand equipment types, such as large forklifts, construction equipment, etc. The scope and timeframe of the Phase 2 regulation would depend upon advancements in technology and information obtained through the Zero-Emission Off-Road Emission Reduction Assessment.

Estimated Emission Reductions:

As this proposed measure is a study to further evaluate the status of ZEVs in off-road applications and to identify opportunities to further expand their use, anticipated emission reductions are not identified at this time. This measure may provide emission reduction; should the evaluation identify necessary program improvements, the emission reduction potential and cost effectiveness of such enhancements will be identified at that time.

Timing:

Proposed ARB Board hearing:	2025+
Proposed implementation schedule:	--

Staff Proposed Commitment:

ARB staff proposes to commit to bring this technology review and assessment to the Board by 2025, in order to identify opportunities to further expand the use of near-zero and zero-emission technologies in off-road applications. The intent of this evaluation is to expand the application of near-zero and zero-emission technologies as technology matures and infrastructure grows, with a primary focus on the scalability and transferability of zero-emission technologies from smaller applications to larger, higher power-demand equipment types.

Zero-Emission Off-Road Worksite Emission Reduction Assessment

Overview:

The goal of this proposed measure is to advance ZEV commercialization by increasing the penetration of zero-emission technologies. Through this emission reduction assessment and technology review, ARB would analyze developing worksite integration and efficiency technologies, such as connected vehicle, automation, and fleet management technologies in off-road sectors. ARB would also encourage deployment via incentives or by providing credit in the off-road rule.

Description of Source Category:

This assessment will focus on technologies and strategies that increase worksite efficiency, such as automation, connected vehicles, and fleet management. These technologies are already being applied to the construction industry in a variety of equipment types, including graders, excavators, and tractors. Examples include grading assisted technologies that can use on-board sensors and GPS to accurately grade to a desired depth and slope thus reducing the number of passes needed. Fleet management technologies allow a fleet manager to monitor parameters such as fuel usage and productivity to optimize equipment utilization on the job site. Technologies such as these have the potential to achieve significant fuel-savings if applied across the industry and could yield emission reductions beyond what is achieved through engine and fleet regulations.

Background/Regulatory History:

Currently, there is no regulatory program that considers worksite efficiency technologies. One of the goals of the assessment will be to consider potential metrics in order to compare fuel efficiency, work productivity, and emission reductions and develop ways to award either regulatory credits or credits or incentives for usage of these technologies.

Fleets with diesel equipment are subject to the off-road diesel fleet regulation. This regulation requires fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards. The off-road diesel regulation was adopted by the Board in 2007 with implementation beginning in 2010. It is applicable to all diesel-fueled, self-propelled off-road equipment with at least 25 HP. Manufacturers of diesel engines are subject to new engine standards. Off-road diesel engines were first subject to engine standards and durability requirements in 1996 while the most recent Tier 4 Final emission standards were phased in starting in 2013. Tier 4 emission standards are based on the use of advanced after-treatment technologies such as diesel particulate filters and selective catalytic reduction.

Proposed Actions:

Staff would conduct an assessment and provide the Board an informational update regarding the technologies and/or strategies that increase worksite efficiency, such as

Proposed Measures: Off-Road Equipment

connected vehicles, automation, and fleet management technologies. While there is not yet a consensus on how to quantify the benefits of such technologies, advanced machine control and worksite integration technologies that are commercially available today reportedly hold the potential for fuel savings of up to 30 percent or more, depending on worksite conditions. Some of these products are available today from new equipment manufacturers, as well as aftermarket suppliers, and can be adapted or retrofitted to much of the existing legacy fleet. The scalability of these systems is wide-ranging, and such systems can be applied to a single piece of off-road equipment on a small project, or to many vehicles at the largest, most complex worksites. While there is significant promise in these types of technologies, more work has to be done to ensure the development of a robust worksite efficiency program that is cost-effective and achieves emission reductions that are real and quantifiable. This proposed measure would evaluate business return on investment, sustainability of the system, and ancillary benefits such as improved safety and work consistency. There would also be potential testing comparing fuel efficiency, work productivity, and emission reductions via portable emission measurement system (PEMS).

Estimated Emission Reductions:

As this proposed measure is an assessment of the technologies and/or strategies to increase worksite efficiency, anticipated emission reductions are not identified at this time. This measure may provide emission reduction; should the evaluation identify necessary program improvements, the emission reduction potential and cost effectiveness of such enhancements will be identified at that time.

Timing:

Proposed ARB Board hearing:	tbd
Proposed implementation schedule:	--

Staff Proposed Commitment:

ARB staff proposes to commit to bring this technology review and assessment to the Board, with a focus on the technologies and/or strategies that increase worksite efficiency in off-road sectors, such as connected vehicles, automation, and fleet management technologies. This assessment would analyze developing worksite integration and efficiency technologies for their potential to yield further emission reductions.

Zero-Emission Airport Ground Support Equipment

Overview:

The goal of this proposed measure is to increase the penetration of the first wave of zero-emission heavy-duty technology in applications that are well suited to its use, and to facilitate further technology development and infrastructure expansion. ARB staff would develop a regulation to accelerate the transition of diesel and LSI Airport Ground Support Equipment (GSE) to zero-emission technology.

Description of Source Category:

Airport GSE are used in airport operations and perform a wide variety of functions including providing power to aircraft, transporting cargo, baggage, and passengers to and from aircraft, and providing aircraft maintenance and fueling. The most common equipment types include belt loaders, baggage tugs, cargo tractors, cargo loaders, forklifts, and aircraft tugs. GSE are fueled by gasoline, liquefied petroleum gas (LPG), compressed natural gas (CNG) and diesel fuel. Battery-electric GSE are the most common zero-emission alternative technology equipment commercially available today. The current California population estimate of internal combustion powered GSE is greater than 10,000. This includes approximately 4,000 compression ignition engine powered equipment and approximately 6,000 large spark-ignited engine powered equipment. Aircraft activity is expected to increase significantly by 2050. This increase will likely necessitate an increase in GSE population as well.

Background/Regulatory History:

California has adopted regulations limiting emissions from new engines used in GSE as well as emissions from existing GSE in-use.

Engines used in newly manufactured GSE operating on gasoline, LPG, and CNG are required to meet California's new engine emission standards for LSI. The LSI engine standard for engines greater than 1.0 liter (typical for GSE) is 0.6 g/bhp-hr of hydrocarbons (HC) and NO_x. Engines meeting this standard are 70 percent cleaner than LSI engines produced as recent as 2009. Additionally, fleets operating LSI GSE must meet the in-use LSI engine fleet requirements. Adopted in 2006, the LSI fleet rule requires GSE fleets to maintain an average emission level of no more than 2.5 g/bhp-hr HC+NO_x, starting January 1, 2013.

Diesel engines in newly manufactured GSE must meet the Tier 4 emission standards applicable to off-road compression-ignition engines. These standards vary by horsepower and are more than 90 percent cleaner than the emissions levels of engines produced twenty years ago. Additionally, in 2007, California adopted the In-Use Off-Road Diesel-Fueled Fleets regulation which requires fleets operating in-use diesel equipment to meet an annual fleet average emissions target that decreases over time. For example, for equipment over 175 and under 750 HP, the final 2023 NO_x fleet average target is 1.5 g/bhp-hr, which is equivalent to the interim Tier 4 NO_x standard for

Proposed Measures: Off-Road Equipment

newly produced engines. Fleets that do not meet the required annual fleet average must meet the best available control technology (BACT) requirements that require turnover, repower or retrofit of a specific percent of a fleet's total HP. These requirements are currently being phased-in.

Lastly, non-mobile GSE such as portable air-start units, ground power units and air conditioners may be subject to the Portable Diesel-Engines Air Toxic Control Measure (ATCM). The ATCM reduces PM emissions by requiring engine replacement in a schedule based on a fleet's weighted PM emission average.

Proposed Actions:

ARB would develop and propose a regulation to transition diesel and LSI GSE to zero-emission technology. The current commercial availability of several GSE equipment types indicates the feasibility of this transition. Battery-electric GSE are the most common type of zero-emission GSE, and are available for several high-population equipment types. Many large air carriers which operate diesel GSE have already begun moving towards electric equipment. The added introduction of zero-emission GSE will act as a catalyst to further zero-emission equipment penetration in the off-road equipment sector and other heavier duty-cycle and longer range applications.

A conservative strategy would rely on incentives and natural turnover, along with current in-use requirements, to replace equipment in which electric replacements are readily available, such as belt loaders, baggage tractors and cargo tractors. A more aggressive turnover and implementation strategy could utilize a memorandum of understanding, regulation, or a combination thereof, along with incentives for demonstration, to ensure 60 percent of existing diesel equipment in these categories would be replaced with zero-emission equipment by 2032, along with 50 percent of narrow body aircraft tugs and 30 percent existing wide-body aircraft tugs. Incentive funds would be targeted to demonstrating the feasibility of zero-emission technologies in the high-power equipment applications (e.g., wide-body aircraft tugs).

Estimated Emission Reductions:

ARB staff used ARB's Vision 2.1 model to estimate the emission reductions associated with this proposed measure. This proposed measure requires electrification of certain diesel airport ground support equipment (belt loaders, baggage tugs, and cargo tractors) through incentives and natural turnover. To model emission reductions, ARB staff used the turnover inherent in the official in-use off-road model, and assumed all new vehicles of the applicable types would be electric starting in 2023. For modeling purposes, new electric GSE vehicles would replace older vehicles using the natural turnover rate for this sector, which is the historical rate that equipment has been replaced, with no acceleration of purchasing habits.

Timing:

Proposed ARB Board hearing:	2018
Proposed implementation schedule:	2023

Proposed Measures: Off-Road Equipment

Staff Proposed Commitment:

ARB staff proposes to commit to bring this measure to the Board in 2018. ARB staff will initiate a rule development process designed to achieve the NO_x emission reductions shown in Table 4 for the South Coast in 2023 and 2031, and as shown in Table 5 for the San Joaquin Valley in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than as proposed by staff.

Small Off-Road Engines

Overview:

The goal of this proposed measure is to reduce emissions from Small Off-Road Engines (SORE) and to increase the penetration of zero-emission technology. Small off-road engines that are subject to ARB regulations are used in residential and commercial lawn and garden equipment, and other utility applications. ARB staff will promote increased use of zero-emission equipment, propose tighter exhaust and evaporative emission standards, and enhance enforcement of current emission standards for SORE.

Description of Source Category:

SORE are spark-ignited engines rated at or below 19 kilowatts. They are used in applications such as lawn and garden, industrial, construction and mining, logging, airport ground support, commercial utility, and farm equipment, golf carts, and specialty vehicles. It is estimated that there are approximately 16.5 million pieces of SORE equipment in California in 2016. In the absence of tighter emission standards for SORE, emissions of the ozone precursors ROG and NO_x are expected to increase beginning in the late-2020s.

Background/Regulatory History:

The Board first approved regulations to control exhaust emissions from SORE in December 1990. ARB adopted amendments to the 1990 regulations to further control exhaust emissions in 1998 and 2003. These regulations were implemented through three tiers of progressively more stringent exhaust emission standards that were phased in between 1995 and 2008. Evaporative emissions from SORE were uncontrolled prior to the adoption of standards by the Board in 2003, which were implemented from 2006-2013. As a result of these regulations, the sum of exhaust and evaporative ROG emissions from SORE in the South Coast have been reduced by 55 percent in 2016, compared to 1990 levels, and NO_x emissions from SORE in the South Coast have been reduced by 2 percent in 2016, compared to 1990 levels.

Proposed Actions:

ARB will develop and propose regulations to reduce emissions from small off-road engines through tightened exhaust and evaporative emission standards. High failure rates have been observed in evaporative emissions testing of SORE, preventing previously-claimed emission reductions from being realized. Exhaust and evaporative emissions from SORE would be reduced through enhanced enforcement of the current emission standards, adoption of tighter exhaust and evaporative emission standards, and increased use of zero-emission equipment. Strategies will be developed for transitioning to zero-emission technologies, including an initial focus on incentives for use of zero-emission equipment, coupled with increasingly stringent emission standards for criteria pollutants and GHGs.

Proposed Measures: Off-Road Equipment

Estimated Emission Reductions:

ARB staff estimated the emission reductions associated with this proposed measure by applying NOx and hydrocarbon emission factor reductions by model year, beginning in 2022 with a reduction of 25 to 60 percent, and increasing in stringency to 2030 with reductions of approximately 90 percent. The reductions apply to exhaust and evaporative emissions (though each has its own reduction factor), and manufacturers are assumed to meet the required reductions with improved engine design and by increasing sales of battery or electric powered equipment to replace spark-ignited engines.

Timing:

ARB enhanced enforcement:	2016
Proposed ARB Board hearing:	2018 – 2020;
Proposed implementation schedule:	2022 – 2030

Staff Proposed Commitment:

ARB staff brought to the Board for its consideration the enhanced enforcement components of this measure in November 2016, which were adopted by the Board.

ARB staff proposes to bring to the Board by 2018-2020 regulations to achieve the emission reductions described in this measure. ARB staff will initiate a rule development process designed to achieve the NOx emission reductions shown in Table 4 for the South Coast nonattainment area in 2023 and 2031, and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Transport Refrigeration Units Used for Cold Storage

Overview:

The goal of this proposed measure is to advance near-zero and zero-emission technology commercialization by increasing the early penetration of hybrid electric and electric standby-equipped Transport Refrigeration Units (TRU) used for cold storage, and supporting the needed infrastructure developments. ARB would develop a regulation to reduce NO_x, PM, and GHG emissions by reducing the amount of time TRUs operate using internal combustion engines while refrigerated trucks, trailers, and shipping containers are parked (stationary) at certain California facilities and other locations.

Description of Source Category:

TRUs are refrigeration systems powered by an internal combustion engine (inside the unit housing), designed to control the environment of temperature-sensitive products that are transported in refrigerated trucks, trailers, railcars, and shipping containers. Examples of the products hauled are food, beverages, pharmaceuticals, flowers, medical products, industrial chemicals, and explosives. TRUs may be capable of both cooling and heating. TRUs operate in large numbers at distribution centers, food manufacturing facilities, packing houses, truck stops, and intermodal facilities. They deliver perishable goods to retail outlets, such as grocery stores, restaurants, cafeterias, convenience stores, etc. The growth rate of TRUs is tied to population, since food is the main product type that is hauled.

Background/Regulatory History:

The Board identified diesel PM as a TAC and in October 2000, ARB published a "*Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-fueled Engines and Vehicles.*" In the Diesel Risk Reduction Plan, ARB identified TRU PM emissions associated with refrigerated warehouse distribution centers as creating potential cancer risks and included TRU engines in the plan to reduce diesel PM emissions 85 percent by 2020.

ARB adopted its ATCM for In-Use Diesel-Fueled TRUs and TRU Generator Sets in 2004. This regulation requires TRU diesel engines to meet in-use diesel PM emission standards by the end of the seventh year after manufacture. Implementation of the TRU ATCM began in 2009. The TRU ATCM was amended in 2010 and 2011.

Proposed Actions:

The initial concepts of the proposed regulation would limit the amount of stationary operating time that a transport refrigeration system powered by an internal combustion engine can operate at certain facilities. The time limit would decrease on a phased compliance schedule. Compliance options include the use of commercially available

Proposed Measures: Off-Road Equipment

hybrid electric TRUs, TRUs equipped with electric standby motors, and cryogenic transport refrigeration systems. Hybrid electric and electric standby-equipped TRUs would plug into electric power plugs while stationary and use diesel engine power while on the road. Facilities may be required to provide the necessary electric infrastructure to support this action. ARB is currently offering funding through the Proposition 1B Goods Movement Emission Reduction Program to support both purchase of TRUs that can plug in and the stationary electric infrastructure. Cryogenic transport refrigerators use liquid nitrogen and liquid carbon dioxide to provide cooling. Development and use of zero-emission technologies, such as all-electric plug-in / advanced battery transport refrigeration systems would be encouraged, as well as adequately-sized cold storage facilities, and more efficient inbound delivery appointment and outbound dispatch scheduling.

Estimated Emission Reductions:

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

Timing:

Proposed ARB Board hearing:	2018 – 2019
Proposed implementation schedule:	2020+

Proposed SIP Commitment:

ARB staff proposes to commit to bring this measure to the Board in 2018 - 2019. Emission reductions for the measure will be identified as part of the rule development process. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than as proposed by staff.

Low-Emission Diesel Requirement

Overview:

The goal of this proposed measure is to reduce emissions from the portion of the heavy-duty fleet that will continue to operate on internal combustion engines in order to reduce emissions as quickly as possible. This proposed measure would establish performance requirements for Low-Emission Diesel, and would require that diesel fuel providers decrease criteria pollutant emissions from their diesel products until 2031.

Description of Source Category:

The total diesel sales in California in 2012 were about 3.3 billion gallons.³⁶ Based on the California Energy Commission analysis, it is expected that the total diesel demand may remain more or less the same or slightly decline by 2030.³⁷ The use of low-emission diesel in on-road vehicles and off-road equipment will reduce tailpipe NOx and PM emissions, in addition to other criteria pollutants. Some studies carried out to date on hydrotreated vegetable oil have reported NOx emission reductions of 6 percent to 25 percent and PM emission reductions of 28 percent to 46 percent, depending on the types of fuels, drive cycles tested, and diesel engines used. The absolute amounts of NOx and PM reductions will be determined during a subsequent rulemaking process.

ARB has a long history of achieving emission reductions via setting fuel standards. Cleaner fuel has an immediate impact in reducing emissions from the mobile source sector and has had a significant impact in reducing reactive organic compounds and sulfur oxide emissions. More recently, ARB developed the LCFS to reduce the carbon intensity of transportation fuels, which will reduce our dependence on petroleum, and incentivizes increased production and use of renewable, low-carbon fuels.

California's stringent air quality programs treat motor vehicles and their fuels holistically (as a system, rather than as separate components). As a result, ARB's fuels programs achieve significant reductions in criteria and toxic air pollution from motor vehicles used in California. Relative to federal gasoline, ARB's reformulated gasoline program reduces NOx emissions by 15 percent and TACs by 50 percent. Similarly, ARB's ultralow sulfur diesel program reduces emissions significantly relative to federal diesel, about 7 percent reduction in NOx and 25 percent in diesel PM. Further, in combination with other State and federal GHG-reduction programs (California's Advanced Clean Cars and Pavley Vehicle Standards programs; the U.S. EPA's Renewable Fuel Standard 2 and Corporate Average Fuel Economy programs), implementation of the recently re-adopted

³⁶ California Energy Commission. Retrieved from http://energyalmanac.ca.gov/gasoline/piira_retail_survey.html

³⁷ Gene Strecker, 2015. Overview of Preliminary Transportation Energy Demand Forecast. Retrieved from http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-10/TN205135_20150623T151914_Overview_of_Preliminary_Transportation_Energy_Demand_Forecast.ppt.

Proposed Measures: Off-Road Equipment

LCFS and adopted new Alternative Diesel Fuel (ADF) regulations is anticipated to result in environmental benefits that include an estimated reduction in GHG emissions of more than 60 MMTCO_{2e} from transportation fuels used in California from 2016 through 2020. On its own, the LCFS is estimated to reduce transportation-related GHG emissions by 35 MMTCO_{2e} during those years.

In 2015, Governor Brown set a goal to reduce petroleum use by up to 50 percent by 2030. One of the opportunities to help meet this goal is for fuel providers to sell diesel with incrementally higher blends of advanced renewable diesel replacement fuels. As the mobile sector will continue operating on internal combustion engines for some time, it is critical that the fuels consumed in these vehicles contribute to the emission reductions needed to meet our 2031 air quality and 2030 climate and petroleum reduction goals. The Vision scenarios illustrate that, since diesel vehicles will comprise a large portion of the fleet still operating with combustion engines, a low-emission diesel standard would reduce NO_x and diesel PM. Furthermore, a low-emission diesel fuel standard could be designated to provide the flexibility to target the most cost-effective emission reductions, for example by requiring emission reductions sooner in the South Coast than in the rest of the State.

Proposed Actions:

ARB would bring to the Board a proposed low-emission diesel measure that would require diesel fuel providers to steadily decrease criteria pollutant emissions from their diesel products. Due to the magnitude of needed NO_x reductions in the South Coast and the large volumes of low-emission diesel needed for full Statewide implementation, the proposed measure could be phased-in with a gradual implementation strategy that starts in the South Coast, and subsequently expands Statewide.

This standard is flexible and enables multiple fuel types to meet this standard. The Low-Emission Diesel standard would achieve a reduction in NO_x and PM emission relative to current conventional diesel. The amount of NO_x and PM emission reductions required would be determined in a subsequent rulemaking. This standard is anticipated to both increase consumption of low-emission diesel fuels, and to reduce emissions from conventional fuels. This proposed measure would provide NO_x benefits predominately from legacy (pre-2010) on-road heavy-duty vehicles, off-road engines, stationary engines, portable engines, marine vessels and locomotives, as well as NO_x and diesel PM benefits in potentially all model year off-road engines, stationary engines, portable engines, marine vessels and locomotives. Interstate vehicles, even those registered out-of-state but operating on ARB diesel blended with low-emission diesel, are also anticipated to provide emission reduction benefits.

This standard would complement existing ARB programs that incentivize increased use of renewable fuels as substitutes for conventional fuels, and will focus on more completely transitioning the fuel mix to a cleaner mix of diesel substitute fuels. Potential diesel substitutes that may be considered include: renewable hydrocarbon diesel; NO_x mitigated biodiesel; natural gas; gas to liquid diesel; and further refined conventional

Proposed Measures: Off-Road Equipment

diesel. The proposed measure is anticipated to diversify the fuel pool, as it will incentivize increased production of low-emission diesel fuels. This proposed measure would provide reductions in criteria pollutants from on- and off-road diesel products sold in the State through 2031.

Estimated Emission Reductions:

To calculate the emission reductions for this requirement, ARB staff used ARB's official emissions inventory coupled with the reductions associated with the aforementioned measures. Under this requirement, off-road NOx and PM2.5 emissions from non-SCR diesel engines using CARB diesel would be reduced by 2 percent to 4.5 percent and 6 to 8 percent, respectively. For modeling purposes, the emissions associated with ocean-going vessels were excluded, and the total emissions associated with locomotives were reduced by 50 percent (in-state fuel), while the rest of the off-road inventory emissions were reduced to include only those emissions associated with non-SCR engines. The total emissions were then calculated (locomotive and the rest of the off-road inventory) and this number was reduced by the sum of the measure reductions, and multiplied by 3.25 percent or 7.25 percent (average NOx or PM2.5 reductions, respectively) to determine the total reductions in NOx and PM2.5 for this requirement.

Timing:

Proposed ARB Board hearing: by 2020
Proposed implementation schedule: 2023 – 2031

Proposed SIP Commitment:

ARB staff proposes to commit to bring this measure to the Board by 2020. ARB staff will initiate a rule development process designed to achieve the NOx emission reductions shown in Table 4 for the South Coast nonattainment area in 2031, and as shown in Table 5 for the San Joaquin Valley nonattainment area in 2025 and 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

Further Deployment of Cleaner Technologies: Off-Road Equipment

Overview:

The goals of this proposed measure are to accelerate the penetration of near-zero and zero equipment and to promote in-use efficiency gains through use of connected and autonomous vehicles, and worksite efficiencies. This measure is specifically for the South Coast.

Background/Regulatory History:

Incentive Funding

Several State and local incentive funding pools have been used historically – and remain available – to fund the accelerated turnover of off-road heavy-duty vehicles in the South Coast. Since 1998 the Carl Moyer Program has provided funding for replacement, new purchase, repower and retrofit of engines in the South Coast. However, to achieve additional reductions in this category, new sources of funding will be pursued.

Low Emission Technologies and Efficiency Improvements

In addition to developing new funding sources, alternative strategies may exist to replace or supplement additional funding pools. While new engine and fleet standards continue to reduce emissions from heavy-duty off-road equipment, it is important that ARB continue to look for ways to apply advanced technology to further increase the sustainability of the off-road sector such as automation, connected vehicles, and fleet management. These technologies are already being applied to the construction industry in a variety of equipment types, including graders, excavators, and tractors. Examples include grading assisted technologies that can use on-board sensors and GPS to accurately grade to a desired depth and slope thus reducing the number of passes needed. Fleet management technologies allow a fleet manager to monitor parameters such as fuel usage and productivity to optimize equipment utilization on the job site. Technologies such as these have the potential to achieve significant fuel-savings if applied across the industry and will yield emission reductions beyond what is achieved through engine and fleet regulations.

Proposed Actions:

This proposed measure is designed to achieve further emission reductions through a suite of additional actions, including early penetration of near-zero and zero-emission technologies, and emission benefits associated with the potential for worksite integration and efficiency, as well as connected and autonomous vehicle technologies. These emission reductions will be achieved through a combination of actions to be undertaken by both ARB and the District.

Proposed Measures: Off-Road Equipment

Scope of Technology Penetration and Mechanisms to Achieve Reductions:

Under current requirements, most new equipment is required to meet Tier 4 emission standards, and many smaller engines are converting to use of zero-emission technologies. To achieve the further reductions associated with early penetration of the cleanest technologies across each sector, ARB and South Coast staff estimated the scope of penetration that would be required by 2023. This would include:

1) electrification of small engine forklifts less than 65 HP; 2) cleaner near-zero and zero-emission technologies for TRUs; 3) electrification of ground support equipment such as baggage tugs, belt loaders, cargo tractors, and aircraft tugs; 4) electrification of certain types of lawn and garden equipment such as mowers, leaf blowers, and edgers; and 5) replacement of construction, mining, and industrial equipment with engines that are below Tier 4 with Tier 4 final equipment.

The following mechanisms provide a pathway for achieving this scale of technology deployment: Identify and develop mechanisms to incentivize deployment of construction and mining equipment meeting Tier 4 final standards such as the South Coast's SOON program for the clean-up of off-road diesel equipment. Such programs have allowed affected fleets to meet requirements through public funding assistance. This could achieve further reductions from the approximately 7,000 pieces of equipment that would still have engines that are Tier 2 and below in 2023. The South Coast will include local measures to address certain types of heavy-duty equipment in their AQMP.

- Develop requirements for cleaner near-zero and zero-emission technologies for TRUs. Emission reductions associated with Transport Refrigeration Units Used for Cold Storage measure have not yet been quantified. This proposed measure reflects concepts to limit the amount of stationary operating time that a TRU powered by an internal combustion engine could operate at certain facilities. Development and use of zero-emission technologies would be encouraged. This proposed measure will need to motivate distribution and other facilities to install the infrastructure needed to support near-zero and zero-emissions technologies, encourage the development and demonstration of near-zero and zero-emission technologies, and cause refrigerated fleets to evaluate and invest in near-zero and zero-emission technologies.
- Expand and enhance existing incentive and other innovative funding programs for off-road equipment to increase the emphasis on and support for zero-emission capable equipment. Assuming incentive funding is the primary mechanism to achieve early deployment of zero-emission capable technologies for forklifts, airport ground support equipment, and TRUs by 2023, funding would be required for at least 4,000 pieces of equipment per year over a seven year period. This early deployment through enhanced incentive funding would provide a down payment towards meeting requirements that would be established through the subsequent regulatory mechanisms identified for these categories. The population of lawn and garden equipment in the South Coast is very large; thus funding programs

Proposed Measures: Off-Road Equipment

would target the types of lawn and garden equipment with the greatest emissions, such as mowers, leaf blowers, and edgers. Use of zero-emission technologies would also provide near-source risk reduction for operators of the equipment. The incentive funding required for these efforts would go beyond the amount currently authorized through 2023.

Determination of the needed resources will be based on assessment of the incremental cost of technologies, cost effectiveness, and the type of financing mechanism employed. Funding needs and mechanisms will be identified working in collaboration with the District and other State agencies over the next several months.

Additional mechanisms reflect continued penetration of near-zero and zero-emission technologies, as well as reductions achieved through worksite efficiencies. Reductions from other equipment types within this category will also be considered, including motorcycles, watercraft, aftermarket parts, and additional enforcement initiatives. While these approaches have the greatest potential to provide further reductions post 2023, early advances in these areas could offset some of the reductions required through incentive funding. These additional pathway mechanisms include:

- Further advanced technology deployment. Based on on-going technology assessment, regulatory mechanisms to expand zero-emission technologies into heavier pieces of off-road equipment such as high lift-capacity forklifts and other equipment in the construction, mining, and industrial sectors may be feasible. The greatest opportunities exist for engines that have a duty cycle to accommodate battery electric or fuel cell electric technologies.
- Advances in the development of autonomous systems, particularly if based on zero-emission technologies, as well as greater worksite integration, efficiency and fleet management technologies. These changes in how the off-road equipment sector would operate offer the potential to achieve criteria, toxic, and GHG emission reductions as well as reduce petroleum usage. These concepts are based on emerging technologies, and will require exploration and demonstration prior to quantifying emission reductions.

Timing:

Proposed implementation schedule: 2016 – 2031

Proposed Measures: Off-Road Equipment

Implementation Milestones and Schedule:		
Implementation Milestones	Implementation Steps	Schedule
Identify and secure funding for incentive based and other innovative funding programs for accelerated deployment of near-zero and zero-emission off-road equipment	<i>Phase 1:</i> Identify funding needs and potential sources	} 2016 + (annually)
	<i>Phase 2:</i> Pursue actions to secure funding	
	<i>Phase 3:</i> Implement funding/incentive programs	
Develop regulatory strategies for deployment of zero-emission technologies in off-road equipment applications as appropriate	<i>Phase 1:</i> Evaluation of technology and prototype demonstrations	2016 – 2023
	<i>Phase 2:</i> Development of regulatory strategies	2022 – 2025
	<i>Phase 3:</i> Measure implementation	2027 – 2031
Evaluate potential for emission benefits from operational efficiencies, and intelligent transportation systems and quantify and develop mechanisms to provide SIP reductions as appropriate	<i>Phase 1:</i> Evaluation of approaches and potential for emission reductions	2016 – 2023
	<i>Phase 2:</i> Demonstration of systems	2020 – 2025
	<i>Phase 3:</i> Quantification of emission reductions and mechanisms for incorporating into SIP	2025 – 2031
Provide annual reports to Board on status of funding, technology development, and identification of potential further regulatory measures	<i>Phase 1:</i> Evaluate status of funding, technology development, and potential for further regulatory measures	} 2017+ (annually)
	<i>Phase 2:</i> Develop potential regulatory actions as appropriate	

Proposed SIP Commitment:

ARB commits to bring to the Board programs and policies or take other actions to implement this measure to achieve the NOx emission reductions shown in Table 4 for the South Coast nonattainment area in 2023 and 2031. Further development measures for each source category may provide more or less emission 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 the fourth largest category Statewide. The magnitude of emissions from this sector indicates that additional approaches to reduce emissions from this sector remain important, even though the average photochemical reactivity of ROG emissions from the consumer product sector has decreased.

Table 12: Summary of Consumer Products Program

Statewide Estimated Emission Reductions (tons per day)		
	2015	2031
NOx Inventory	--	--
Consumer Products Program		--
Potential reductions		--
ROG Inventory*	204	231
Consumer Products Program		8 – 10
Potential reductions		8 – 10
PM2.5 Inventory	--	--
Consumer Products Program		--
Potential reductions		--

*2031 value reflects anticipated emission reductions from the current control program
 "NYQ" denotes emission reductions are Not Yet Quantified; "--" denotes no anticipated reductions

Consumer Products Program

Overview:

Current regulations have been effective in substantially reducing emissions of ROG from consumer products. The goal of this proposed measure would be to maintain this success in light of population growth. Staff would evaluate the 2013-2015 data reported to the Consumer Products Program to identify strategies to maintain emission reductions from consumer products. The proposed measure may involve establishing new ROG limits for categories currently unregulated and/or lowering ROG limits for categories already regulated. To identify categories of consumer products for rulemaking, staff may consider both mass and reactivity of category emissions.

Background/Regulatory History:

Consumer products are a source of ROG emissions and have been regulated since 1989. These products are widely used by consumers throughout the State.

As part of the State's effort to reduce air pollutants, in 1988 the Legislature added section 41712 to the California Clean Air Act (Act) in the Health and Safety Code. Along with subsequent amendments, this section requires ARB to adopt regulations to achieve the maximum feasible reduction in ROG emissions from consumer products. Prior to adopting regulations, the Board must determine that adequate data exist to establish that the regulations are necessary to attain State and federal ambient air quality standards. Commercial and technological feasibility of the regulations must also be demonstrated. The Act further stipulates that regulations adopted must not eliminate any product form, and that recommendations from health professionals must be considered when developing ROG control measures for health benefit products.

For almost 30 years, the Board has taken actions pertaining to the regulation of consumer products. Three regulations have set ROG limits for 129 consumer product categories. The most recent amendments to these three regulations were approved for adoption on September 26, 2013. The regulations will cumulatively reduce ROG emissions by about 50 percent. By 2020, limits on the use of ingredients with higher GWP values will provide reductions of approximately 0.23 million metric tons of carbon dioxide equivalents per year.

Aerosol coating products are regulated under a reactivity-based regulation. This regulation limits the ozone formation potential of all aerosol coating product emissions. Tables of Maximum Incremental Reactivity have also been adopted to implement the Aerosol Coating Products Regulation.

Exposure to TACs has also been reduced by prohibiting use of certain chlorinated compounds in 83 categories of consumer products. Total emissions of TACs have been reduced by over 13 tpd. Furthermore, when setting ROG limits, ARB has applied California Environmental Quality Act provisions requiring that environmental impacts of

Proposed Measures: Consumer Products

proposed regulations be evaluated. Consequently, use of alkylphenol ethoxylate surfactants has also been prohibited in several categories of consumer products.

In addition, a voluntary program regulation, the Alternative Control Plan was adopted to provide compliance flexibility to companies.

Despite the progress with emission reductions, population growth in the years ahead is expected to increase emissions from consumer products after 2023 even as new and revised limits become effective in 2017.

In order to ensure the ROG emission reductions are based on the state-of-science, ARB staff periodically conducts mandatory Consumer and Commercial Surveys (Survey) to assess the volume of sales of consumer products sold in California and the ingredients within those products. Over the past 25 years ARB has conducted at least seven of these data collection efforts. ARB staff is currently conducting a Survey on consumer products sold into California during the years 2013 to 2015. ARB staff expects to use this data to assess future regulatory directions for the Consumer Products Program. Staff will conduct a Survey for Aerosol Coatings in 2018 to determine emissions and reformulation trends.

Proposed Actions:

Approaches being considered include evaluating categories with higher mass and reactivity, investigating concepts for expanding manufacturer compliance options, 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 ensure that no negative impacts occur either through the use of TACs or other chemicals that may have other negative environmental impacts.

Estimated Emission Reductions:

In the South Coast, emissions of ROG from consumer products are projected to grow from an estimated 90 tpd in 2023 to 94 tpd in 2031. Staff will use the Survey data, along with other technical information, to propose control strategies to mitigate projected ROG emission increases in the South Coast.

Timing:

Proposed ARB Board hearing:	2019 – 2021
Proposed implementation schedule:	2020 – 2023

Proposed Commitment:

ARB staff proposes to commit to bring this measure to the Board by 2021. ARB staff will initiate a rule development process designed to achieve the reductions shown for the South Coast nonattainment area in 2031. The measure as proposed by staff to the Board or adopted by the Board may provide more or less reductions than the amount shown.

California Environmental Protection Agency

 **Air Resources Board**

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