Eastern Kern
Air Pollution Control District

2023 OZONE ATTAINMENT PLAN
FOR THE 2008 & 2015, 8-HOUR OZONE
NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Draft
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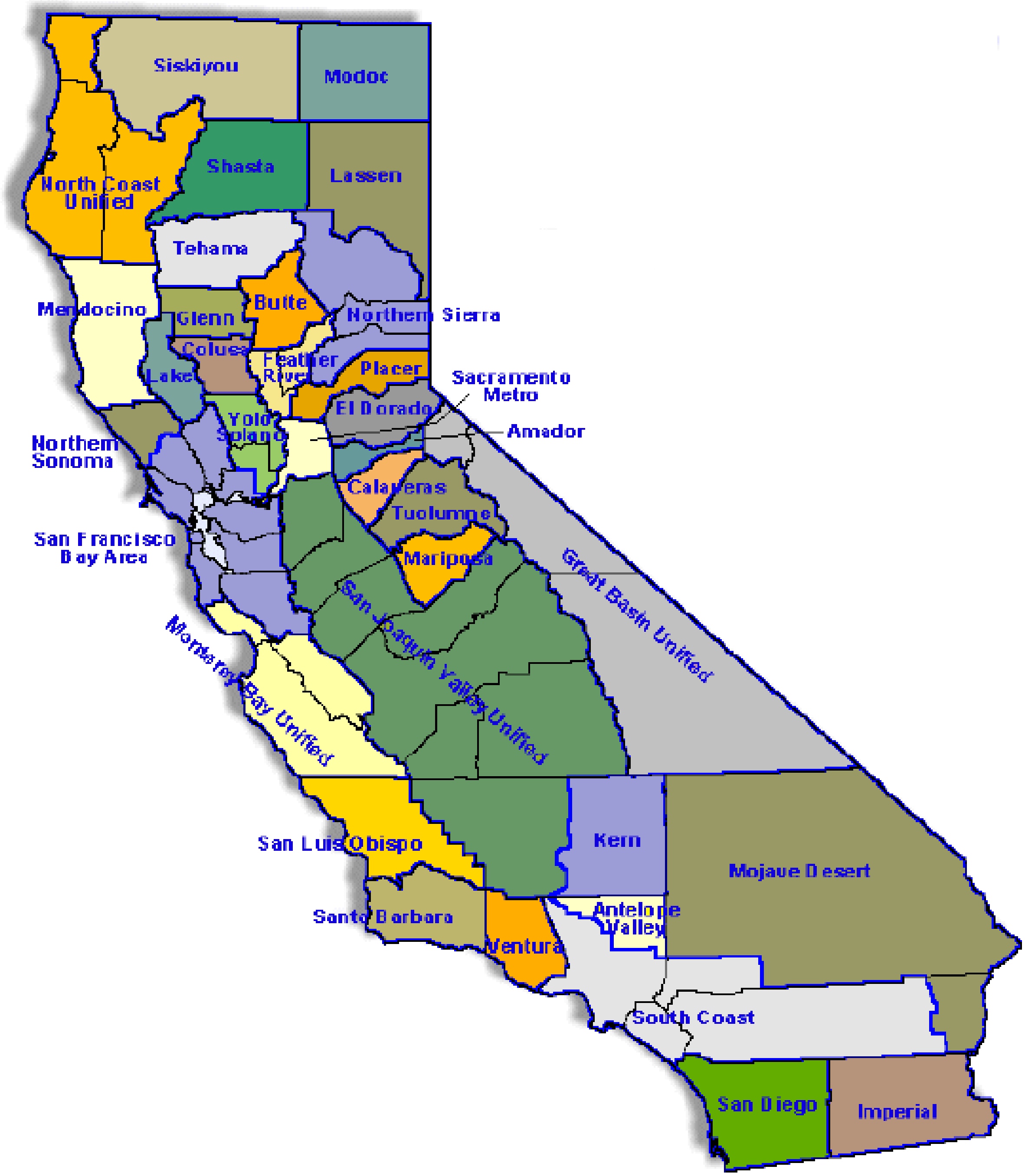

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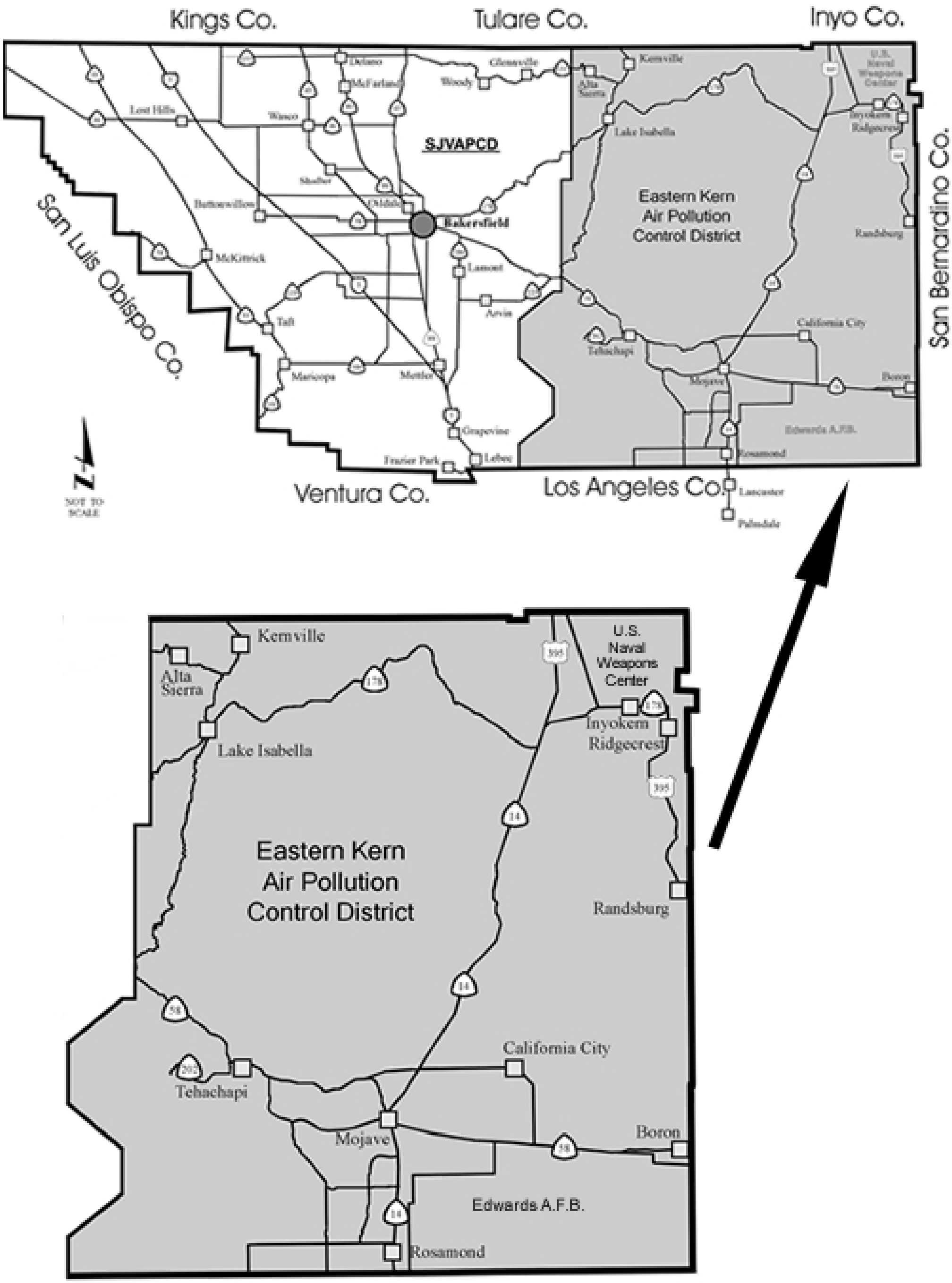

EXECUTIVE SUMMARY

This attainment plan is intended to satisfy both the 2008, 8-hour Ozone ($O_{3)}$ National Ambient Air Quality Standards (NAAQS) of 75 parts per billion (ppb) and 2015, 8-hour O_3 NAAQS (70 ppb). Each standard has a different attainment date but share many of the same elements, required emissions reductions, strategies, and plan requirements.

In 2012, a portion of Eastern Kern was classified "Marginal" nonattainment pursuant to the 2008, 8-hour O_3 NAAQS of 75 ppb. Although the Indian Wells Valley planning area met the 2008, O_3 NAAQS, the remainder of the District failed to meet the standard by the applicable attainment date and was reclassified as "Moderate" nonattainment, effective June 3, 2016. As a result, the District was required to submit a SIP revision for the nonattainment area by January 1, 2017, which showed compliance with statutory and regulatory conditions applicable to the Moderate classification.

The District, in partnership with the California Air Resources Board (CARB), conducted photochemical modeling along with supplemental analyses to determine whether the District could attain the 2008, O_3 NAAQS by the Moderate deadline. Modeling indicated the District would not meet the 75 ppb standard by the Moderate deadline but could attain it by 2020, which was the attainment date for "Serious" nonattainment areas. Pursuant to CAA §181(b)(3) "Voluntary Reclassification", the District provided CARB with documentation to formally request that the Environmental Protection Agency (EPA) reclassify the District's nonattainment area from "Moderate" to "Serious" pursuant to the 2008, O_3 NAAQS, and revise the attainment date to July 15, 2021. EPA approved the District's request and reclassified the nonattainment area to Serious nonattainment. Although modeling showed attainment would be achieved, the District failed to attain the 2008, O_3 NAAQS in 2020.

In response, on May 15, 2021, the District requested CARB submit documentation to EPA to reclassify the District's nonattainment area from Serious to Severe pursuant to the 2008, O_3 NAAQS. On June 25, 2021, EPA approved/conditionally approved, all elements of the 2017, Eastern Kern Ozone SIP, except they deferred action on the Serious area attainment and reasonably available control measures (RACM) demonstrations. On July 7, 2021, EPA reclassified the District's nonattainment area to Severe nonattainment pursuant to the 2008, O_3 NAAQS, and now required to attain by July 2027.

Additionally, modeling indicated the District would not attain the 2015, O_3 NAAQS (70 ppb) by the Serious nonattainment date of 2027, but could attain it by 2033, (attainment date for Severe). Pursuant to CAA §181(b)(3) "Voluntary Reclassification", the District is petitioning CARB in this attainment plan to formally submit a request to EPA asking for the voluntary reclassification from "Serious" to "Severe" pursuant to the 2015, O_3 NAAQS. This will extend the attainment deadline to August 27, 2033.

The District anticipates EPA will approve the request to be reclassified as Severe nonattainment (70 ppb), therefore this Ozone attainment plan addresses all required plan elements, emissions reductions, and control measures necessary to demonstrate attainment of the 2015, O_3 NAAQS by 2033.

I. INTRODUCTION

A. Ozone

Stratospheric ozone occurs naturally and is beneficial in the upper atmosphere, shielding the earth from harmful ultraviolet radiation from the sun. However, ground-level (tropospheric) ozone (O_3) is a colorless gas with a pungent, irritating odor and is a highly reactive harmful air pollutant that can damage living tissues and man-made materials upon contact.

O_3 is not directly emitted from sources, but formed in the air by reactions of O_3 precursor emissions—volatile organic compounds (VOC) and oxides of nitrogen (NOx)—in the presence of sunlight and heat. Accordingly, peak O_3 levels occur during the sunnier, warmer times of the year, typically April through October.

Health effects of O_3 are focused on the respiratory tract. When inhaled, O_3 can irritate and inflame the lining of the lungs, much like sunburn damage on skin. Potential health impacts include aggravated asthma, reduced lung capacity, and increased susceptibility to respiratory illnesses like pneumonia and bronchitis. Individuals with respiratory problems are most vulnerable to O_3, but outdoor activities on "high" O_3 days can even affect people that are normally healthy.

B. Background

The Federal Clean Air Act (CAA) of 1970 required the United States Environmental Protection Agency (EPA) to develop health-based National Ambient Air Quality Standards (NAAQS) for several categories of air pollutants, including O_3). EPA periodically reviews the NAAQS and associated scientific basis in determining appropriate revisions. Accordingly, EPA establishes new standards following advances in scientific understanding of the pollutant and its potential health effects.

Section 110 (a)(1) of the Federal Clean Air Act Amendments (FCAAA) of 1977 required EPA to divide the United States into "Planning Areas" and designate these areas "attainment", "nonattainment", or "unclassified" within 3 years of adopting the NAAQS.

FCAAA of 1990 gave states the primary responsibility for achieving the NAAQS. The principal mechanism for complying with the FCAAA was developing and adopting a State Implementation Plan (SIP). A SIP outlines programs, actions, and commitments a state will carry out to implement its responsibilities under the FCAAA. The EPA must approve all SIPs before they can be implemented by state and local governments. Once approved by the EPA, a SIP becomes a legally binding document under both state and federal law, and may be enforced by either government.

In 1990, EPA viewed all of Kern County as one "Planning Area" even though it was divided between two air basins. Unfortunately, there was not an O_3 monitoring station located in Eastern Kern County at that time and the only data available was from the San Joaquin Valley portion of Kern County. Consequently, all of Kern County was classified as Serious Nonattainment, with respect to the 1990 FCAAA. The statutory attainment date became November of 1999.

C. Kern County Split

In 1992, Kern County was split between two air districts. The San Joaquin Valley portion of Kern County became part of the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) and the Eastern Kern, high-desert portion of the County remained the Kern County Air Pollution Control District (KCAPCD)[1]. Even though the District is located in the Mojave Desert air basin, EPA continued to consider it part of the San Joaquin Valley Federal Ozone Planning Area. In November 2001, upon the District's request, EPA formally agreed to consider the District as a separate O_3 planning area.

D. 1994, Attainment Plan

The District's 1994 O_3 Attainment Demonstration (Attainment Plan) was approved by EPA on September 25, 1996 (62 Fed. Reg. 1150, January 8, 1997). The Attainment Plan was presented in two parts: (I Transport Analysis) and (II Attainment Demonstration).

Part I showed District overwhelmingly impacted by O_3 transport from both the San Joaquin Valley Air Basin and the South Coast Air Basin. Eastern Kern air pollutant emission sources, by themselves, do not cause NAAQS or California Ambient Air Quality Standards (CAAQS) exceedances.

Part II showed District would attain O_3 NAAQS but not CAAQS by 1999. This, in fact occurred. O_3 data collected from 1999-2002 at the District's O_3 monitor located in Mojave showed attainment.

E. 1997, Ozone NAAQS

A "new" 8-hour O_3 NAAQS of 0.08 ppm was established in 1997. The 8-hour averaging time was selected to address the impacts of exposure to longer periods of elevated O_3. The 0.08 ppm O_3 standard is attained when: Each monitor in a region shows a three-year O_3 concentration average, of the annual fourth-highest daily 8-hour average, no greater than 0.084 ppm (based on the rounding convention dictated in federal regulation)[2]. Three years of O_3 concentrations are averaged due to the impacts of year-to-year variations in meteorology on O_3 formation.

[1] In 2010 KCAPCD appropriately changed its name to Eastern Kern Air Pollution Control District.

[2] Appendix I to 40 CFR 50, "Interpretation of the Eight-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone."

By 2011, the Design Value (DV)[3] of the District's O_3 nonattainment area dropped from 0.098 ppm (2003 level) to 0.080 ppm. On December 3, 2012, EPA announced they found that the Eastern Kern nonattainment area attained the 1997, 8-hour O_3 NAAQS.[4] With this finding, effective January 3, 2013, the entire District was deemed to have "clean data" with respect to the 1997 standard.

F. Indian Well Valley Attainment Area

In 2004, at request of the California Air Resources Board (CARB), EPA divided the District into two O_3 planning areas: The Indian Wells Valley (IWV), which attained the 1997, 8-hour O_3 NAAQS of 0.08 ppm, and the remainder of Eastern Kern County (Nonattainment Area).

Figure 3: Indian Wells Valley Attainment Area

[3]The three year average of the fourth highest 8-hour ozone value for the target year and the two preceding years is the design value for that year. To determine attainment that design value is compared to the Ozone NAAQS.

[4] 77 Federal Register 71551-71555; December 3, 2012

G. 2008, Ozone NAAQS

In 2008, EPA adopted a more stringent 8-hour O_3 NAAQS of 75 ppb[5]. Although the District showed a significant reduction in O_3 levels by attaining the 1997, O_3 NAAQS, and the IWV[6] planning area already met the 75 ppb standard, the remainder of the District had a DV[7] higher than 75 ppb. On May 21, 2012, EPA classified a portion of the District as "Marginal" nonattainment pursuant to the 2008, O_3 NAAQS.

CARB, in partnership with the District, conducted photochemical modeling along with supplemental analyses to determine anticipated attainment of the 2008, O_3 NAAQS. Air monitoring data and modeling revealed the District would not attain the 75 ppb standard by the Marginal (July 15, 2015) or Moderate (July 15, 2018) deadlines. However, modeling indicated the District could attain the 2008, O_3 NAAQS by the Serious deadline of July 15, 2021. Therefore, on July 27, 2017, the District adopted an attainment plan designed to address all required elements of Serious nonattainment pursuant to the 75 ppb O_3 NAAQS. The adopted O_3 plan identified emission control measures and associated emission reductions necessary to demonstrate attainment by 2021. Unfortunately, the District did not achieve attainment of the 75 ppb standard by July 15, 2021, and was reclassified to "Severe" nonattainment (now required to attain by July 2027).

H. 2015, Ozone NAAQS

On October 1, 2015, EPA revised the federal 8-Hour O_3 NAAQS, lowering it from 75 ppb to 70 ppb[8] (2015, 8-Hour O_3 NAAQS). CARB performed analysis to determine appropriate designation recommendations throughout the State using the criteria outlined in EPA's guidance memorandum[9]. One of the first steps of determining attainment is to compare the O_3 DV to the level of the standard. The DV reflects a three-year average of the fourth highest 8-hour average concentration at each monitoring site. If the DV is 71 ppb or greater, it violates the 2015, standard. These three-year average DVs are updated once the monitoring data from each calendar year are reviewed and certified.

Based on O_3 air quality monitoring data from years 2013-2015, nineteen areas did not meet the 70 ppb standard. Sixteen of these areas are also currently designated nonattainment for the 2008 (75 ppb) standard. CARB recommended the boundaries of these sixteen nonattainment areas remain the same for both O_3 NAAQS (70 and 75 ppb).

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[5] 73 FR 16436; 40 CFR 50.15, "National Primary & Secondary Ambient Air Quality Standards for Ozone."

[6] The Indian Wells Valley portion of Eastern Kern Air Pollution Control District was found attainment/unclassified for the 2008 Ozone NAAQS by EPA in 2011.

[7] Attainment is achieved when: "3-year average" of "annual 4th highest daily maximum" 8-hour average O_3 concentration, called "Design Value", is no greater than 75 ppb at each EPA-approved O_3 air monitor in the District. The "3-year & 4th highest" are statistical values that provide stability to the standard, moderating the influence of extreme meteorological conditions (over which an area has no control).

[8] 80 Federal Register 26594; October 26, 2015

[9] February 25, 2016, Area Designations for the 2015 Ozone National Ambient Air Quality Standards, Memorandum from Janet G. McCabe, Acting Assistant Administrator, Office of Air and Radiation to Regional Administrators, Regions 1-10.

II. 2015, OZONE NAAQS RECLASSIFICATION

Nonattainment areas are classified as Marginal, Moderate, Serious, Severe, or Extreme, depending on the magnitude of the area's O_3 DV and EPA's guidance. On June 4, 2018, the EPA classified the District's nonattainment area as "Moderate" pursuant to the 2015, O_3 NAAQS[10]. However, photochemical modeling conducted by CARB indicated the District would not attain the 70 ppb standard by the Moderate deadline of August 2024. Modeling also showed the District would need more time to achieve the necessary emissions reductions in order to achieve attainment.

CAA §181(b)(3) "Voluntary Reclassification" states: "The Administrator shall grant the request of any State to reclassify a nonattainment area in that State in accordance with Table 1 of subsection (a) to a higher classification." The request for EPA to reclassify a nonattainment area to a higher classification will extend the attainment deadline. Even though more stringent requirements are imposed with each higher attainment classification, reclassification is an appropriate approach for areas that must rely on long-term strategies required for accomplishing the emission reductions needed for achieving attainment.

On May 6, 2021, the District sent a letter to CARB requesting they formally submit a request to EPA for the voluntary reclassification of the District's nonattainment area from "Moderate" to "Serious" pursuant to the 2015, O_3 NAAQS. This reclassification would modify the attainment deadline from August 3, 2024 to August 3, 2027, which was believed to allow adequate time for achieving attainment.

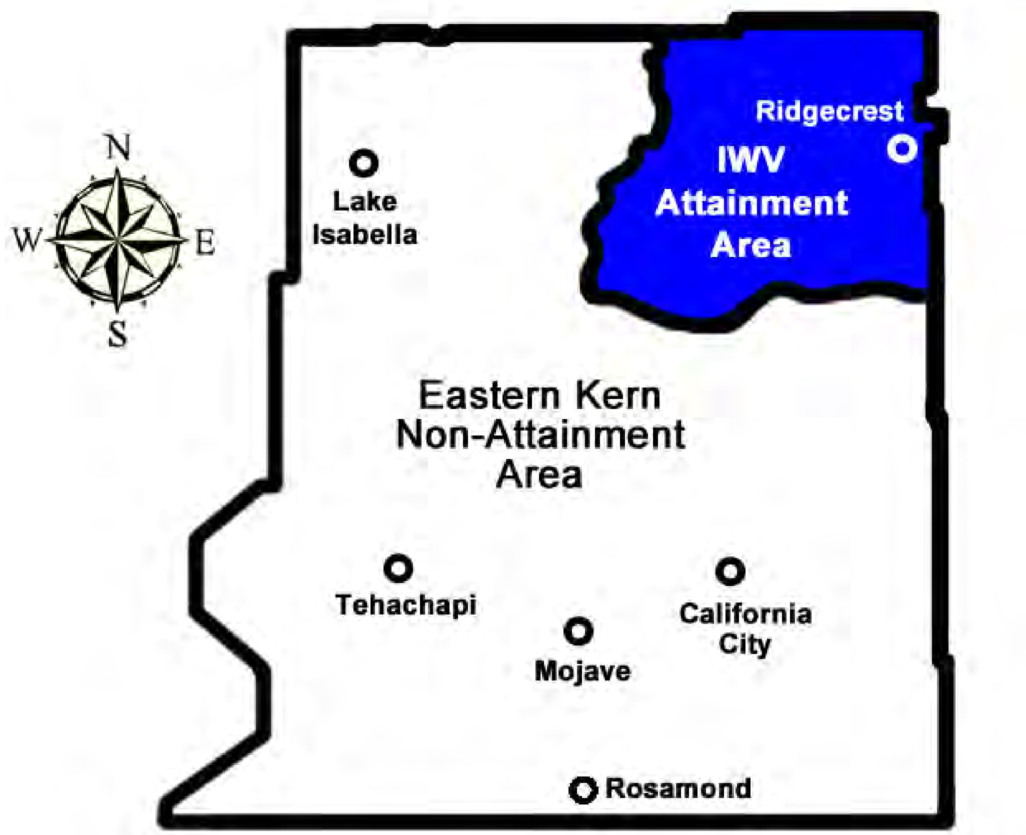
On October 28, 2021, EPA granted the District's request and reclassified the District as Serious nonattainment[11]. Unfortunately, CARB's photochemical modeling conducted to show attainment with the 2008, O_3 NAAQS also showed that the District would not attain the 2015, O_3 NAAQS by August 3, 2027. However, the additional modeling showed that attainment could be achieved by 2033, which is the deadline for the Severe classification.

A. Voluntary Reclassification Request

The District requests that CARB formally submit a request to the EPA for the voluntary reclassification of the District's nonattainment area from Serious to Severe nonattainment pursuant to the 2015, O_3 NAAQS. This request is made in accordance with CAA §181(b)(3)(a), Table 1 "Voluntary Reclassification" of the CAA. This reclassification will revise the attainment deadline from August 3, 2027, to August 3, 2033. District Staff is aware that there will be additional planning requirements; however, staff believes this proactive approach is the best method for achieving attainment. Additionally, the Weight of Evidence included in this attainment plan provides data showing attainment will achieve by 2033.

[10] 83 Federal Register 25776; June 4, 2018
[11] 86 Federal Register 59648-59651; October 28, 2021

Figure 4: Eastern Kern Nonattainment Area



III. REQUIREMENTS FOR OZONE NONATTAINMENT AREA

In 2015, EPA promulgated an "implementation" rule for the 2008, O_3 NAAQS (2015 Implementation Rule)[12], designed to assist states with plan development. Under the Implementation Rule, affected regions are required to address planning and emission control requirements in their implementation plan.

All nonattainment areas, including the District, are subject to the general planning and emission control requirements of Subpart 2 (Title I, Part D) of the CAA, which consist of the following:

1 **Emission Inventory:** CAA §182(a)(1): Is a comprehensive tabulation of air pollutants organized by emission source category. This Ozone Attainment Plan includes updated inventories of O_3 precursor emissions (VOC and NOx) for the 2008 and 2015 planning years, the 2017 base year, the year from which future-year inventories are projected, and 2026 (75ppb) and 2032 (70ppb) attainment years. Additionally, all inventory years in this Attainment Plan are derived from the 2017 base year inventory.

[12] Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; Final Rule. 80 Fed. Reg. 44. Pp. 12264-12319. (March 6, 2015), (to be codified at 40 CFR Parts 50, 51, 52, et al.) https://www.gpo.gov/fdsys/pkg/FR-2015-03-06/pdf/2015-04012.pdf

2 **Major Source Emission Statements:** CAA §182(a)(3)(B):States whether the District's existing emission statement reporting rule (Rule 108.2) is sufficient and remained adequate for the purposed of the 2008, 8-hour O_3 NAAQS for major sources.

3 **New Source Review (NSR):** CAA §182(a)(2): Requires the District to address emissions form new sources and major modifications to existing sources.

A. Emissions Inventory

An emissions inventory is one of the fundamental building blocks in the development of a SIP. In simple terms, an emissions inventory is a systematic listing of the sources of air pollution along with the amount of pollution emitted from each source or category over a given time period. An emissions inventory is required by the CAA and *Ozone SIP Requirements Rule*, also called the *Ozone Implementation Rule*[13].

Specifically, emissions inventories are required for areas that exceed the NAAQS. These areas are designated as nonattainment based on monitored exceedances of these standards. These nonattainment areas must develop an emissions inventory as the basis of a SIP that demonstrates how they will attain the standards by specified dates. The following sections of this attainment plan describes the emissions inventory included in the District's 2015, O_3 SIP (70 ppb). Showing attainment of the 70 ppb standard will also demonstrate attainment of the 75 ppb standard as the 70 ppb standard is the more restrictive of the two.

B. Emissions Inventory Overview

Emissions inventories are estimates of the amount and type of pollutants emitted into the atmosphere by facilities, mobile sources, and area-wide sources. They are fundamental components of an air quality plan and serve critical functions such as:

1). The primary input to air quality modeling used in attainment demonstrations;
2). The emissions data used for developing control strategies; and
3). A means to track progress in meeting the emission reduction commitments.

CARB and the District have developed a comprehensive current emissions inventory consistent with the requirements set forth in CAA §182(a)-(f)[14]. CARB and District staff conducted a thorough review of the inventory to ensure that the emission estimates reflect accurate emissions reports for point sources and that estimates for mobile and area wide sources are based on the most recent approved models and methodologies.

[13] Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements; (40 CFR part 51 Subpart AA; see also https://www.epa.gov/ground-level-ozone-pollution/implementation-2008-national-ambient-air-quality-standards-naaqs-ozone)

[14] §182(a)-(f) of the Act. https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart2-sec7511a.htm

CARB also reviewed the growth profiles for point and area wide source categories and updated them as necessary to ensure that the emission projections are based on data that reflect historical trends, current conditions, and recent economic and demographic forecasts.

EPA regulations require that the emissions inventory for an O_3 SIP contain emissions data for the two precursors to O_3 formation: NOx and VOC[15]. The inventory included in this plan substitutes VOC with reactive organic gases (ROG), which, in general, represent a slightly broader group of compounds than those in EPA's list of VOCs.

C. Inventory Base Year

40 CFR 51.1315(a) requires that the inventory year be selected consistent with the baseline year for the reasonable further progress (RFP) plan as required by 40 CFR 51.1310(b)[16], which states that the base year emissions inventory shall be the emissions inventory for the most recent calendar year of which a complete triennial inventory is required to be submitted to EPA under the provisions of subpart A of 40 CFR part 51, Air Emissions Reporting Requirements, 40 CFR 51.1– 50. States may also use an alternative baseline emissions inventory provided that the year selected corresponds with the year of the effective date of designation as nonattainment for that NAAQS[17].

CARB selected the base year 2017 because it is the most recent triennial inventory year conducted for the National Emissions Inventory (NEI) pursuant to the Air Emissions Reporting Requirements (AERR) rule.

D. Forecasted Inventories

In addition to base year emissions, emissions projections are needed for a variety of reasons, including re-designation maintenance plans, the attainment projected inventory for a nonattainment area (NAA), and air quality modeling for attainment plans[18].

For stationary and area sources, forecasted inventories are a projection of the base year inventory that reflects expected growth trends for each source category and emissions reductions due to adopted control measures. CARB develops emission forecasts by applying growth and control profiles to the base year inventory. The stationary and area source emissions inventory for the Eastern Kern 70 ppb O_3 SIP is modeled by the California Emission Projection Analysis Model (CEPAM), 2019 Emission Projections, Version 1.04 (CEPAM2019v1.04).

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[15] §182(a)(1) of the Act. https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart2-sec7511a.htm
[16] 40 CFR 51.1315(a). https://www.govinfo.gov/content/pkg/CFR-2021-title40-vol2/pdf/CFR-2021-title40-vol2-sec51-1315.pdf.
[17] 40 CFR 51.1310(b). https://www.govinfo.gov/content/pkg/CFR-2020-title40-vol2/pdf/CFR-2020-title40-vol2-sec51-1310.pdf.
[18] 40 CFR 51.114. https://www.govinfo.gov/content/pkg/CFR-2000-title40-vol2/pdf/CFR-2000-title40-vol2-sec51-114.pdf.

Growth profiles for point and area-wide sources are derived from surrogates, such as economic activity, fuel usage, population, and housing units that best reflect the expected growth trends for each specific source category. Growth projections were obtained primarily from government entities with expertise in developing forecasts for specific sectors, or, in some cases, from econometric models. Control profiles, which account for emission reductions resulting from adopted rules and regulations, are derived from data provided by the regulatory agencies responsible for the affected emission categories.

Projections for on-road mobile source emissions are generated by CARB's EMFAC2017 model, which predicts activity rates and vehicle fleet turnover by vehicle model year, along with activity inputs from the metropolitan planning organization (MPO). Off-road mobile sources are forecasted with category-specific model or, where not available, CARB's OFFROAD2007.

CEPAM integrates the emission projections derived from these mobile source models to develop a comprehensive forecasted emission inventory. As with stationary sources, the mobile source models include control algorithms that account for adopted regulatory actions.

E. Temporal Resolution

40 CFR 51.1315(c) requires emissions values included in the base year inventory to be actual O_3 season day emissions as defined by 40 CFR 51.1300(q)[19]. Since O_3 concentrations tend to be highest during the summer months, the emissions inventory used in the SIP is based on the summer season (May through October).

F. Geographic Resolution

The inventory presented in this plan includes emissions for the District NAA, which consists of the Eastern Kern County, excluding the IWV. Since the NAA is split into a region not defined by county, air basin, or district boundaries, the District identified the facilities that fall in the portion of NAA, on-road emissions were estimated by EMFAC2017, and the area and off-road source emissions in the NAA were estimated using category-specific factors based on the spatial distribution of population and other activity parameters within the nonattainment region. These fractions were developed by CARB and the District. The special split allocation method of each subcategory is shown in Table 1.

[19] 40 CFR 51.1315(c). https://www.govinfo.gov/content/pkg/CFR-2021-title40-vol2/pdf/CFR-2021-title40-vol2-sec51-1315.pdf.

Table 1: Subcategory Allocation Method for NAA

Subcategory	Allocation Method
MANUFACTURING AND INDUSTRIAL	HUMAN POPULATION
FOOD AND AGRICULTURAL PROCESSING	HUMAN POPULATION
SERVICE AND COMMERCIAL	HUMAN POPULATION
SEWAGE TREATMENT	HUMAN POPULATION
LANDFILLS	HUMAN POPULATION
LAUNDERING	HUMAN POPULATION
DEGREASING	HUMAN POPULATION
COATINGS AND RELATED PROCESS SOLVENTS	HUMAN POPULATION
ADHESIVES AND SEALANTS	HUMAN POPULATION
PETROLEUM MARKETING	HUMAN POPULATION
MINERAL PROCESSES	HUMAN POPULATION
METAL PROCESSES	HUMAN POPULATION
CONSUMER PRODUCTS	HUMAN POPULATION
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	HUMAN POPULATION
PESTICIDES/FERTILIZERS	LAND AREA
ASPHALT PAVING / ROOFING	HUMAN POPULATION
RESIDENTIAL FUEL COMBUSTION	HUMAN POPULATION
FARMING OPERATIONS	LAND AREA
FIRES	HUMAN POPULATION
MANAGED BURNING AND DISPOSAL	LAND AREA
COOKING	HUMAN POPULATION
LIGHT DUTY PASSENGER (LDA)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
LIGHT DUTY TRUCKS - 1 (LDT1)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
LIGHT DUTY TRUCKS - 2 (LDT2)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
MEDIUM DUTY TRUCKS (MDV)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
LIGHT HEAVY DUTY GAS TRUCKS - 1 (LHDV1)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
LIGHT HEAVY DUTY GAS TRUCKS - 2 (LHDV2)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
MEDIUM HEAVY DUTY GAS TRUCKS (MHDV)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDV1)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDV2)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDV)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
HEAVY HEAVY DUTY DIESEL TRUCKS (HHDV)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
MOTORCYCLES (MCY)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
SCHOOL BUSES - DIESEL (SBD)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
OTHER BUSES - GAS (OBG)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
OTHER BUSES - MOTOR COACH - DIESEL (OBC)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
ALL OTHER BUSES - DIESEL (OBD)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
MOTOR HOMES (MH)	EMFAC2017 run for Kern--MD air basin (excludes IWV)
AIRCRAFT	DISTRICT FRACTION ESTIMATE
TRAINS	DISTRICT FRACTION ESTIMATE
RECREATIONAL BOATS	HUMAN POPULATION
OFF-ROAD RECREATIONAL VEHICLES	HUMAN POPULATION
OFF-ROAD EQUIPMENT	HUMAN POPULATION
FARM EQUIPMENT	LAND AREA
FUEL STORAGE AND HANDLING	HUMAN POPULATION

G. Quality Assurance and Quality Control

CARB has established a quality assurance and quality control (QA/QC) process to ensure the integrity and accuracy of the emission inventories used in the development of air quality plans. QA/QC occurs at the various stages of SIP emission inventory development. Base year emissions are assembled and maintained in the California Emission Inventory Development and Reporting System (CEIDARS). CARB inventory staff works with air districts, which are responsible for developing and reporting point source emission estimates, to verify these data are accurate. The locations of point sources, including stacks, are checked to ensure they are valid.

Area-wide source emissions estimates are developed by both CARB and District staff, and the methodologies are reviewed by both agencies before their inclusion in the emissions inventory. Mobile categories are verified with CARB mobile source staff for consistency with the on-road and off-road emission models. Additionally, CEIDARS is designed with automatic system checks to prevent errors, such as double counting of emission sources. At the final stage, CEPAM is thoroughly reviewed to validate the accuracy of growth and control application, and the output emissions are compared against prior approved versions of CEPAM to identify data anomalies.

H. Emission Inventory Components

A summary of the components that make up the District's 70 ppb O_3 SIP emissions inventory is presented in the following sections. These include mobile (on- and off-road) sources, stationary point sources, and area-wide sources. Natural sources are not included.

I. Mobile Source Emissions

CARB develops the emission inventory for the mobile sources using various modeling methods. These models account for the effects of various adopted regulations, technology types, fleet turnover, and seasonal conditions on emissions. Mobile sources in the emission inventory are composed of both on-road and off-road sources, described in the sections below.

J. On-Road Mobile Source Emissions

Emissions from on-road mobile sources, which include passenger vehicles, buses, and trucks, were estimated using outputs from CARB's EMFAC2017 model. The on-road emissions were calculated by applying EMFAC2017 emission factors to the transportation activity data provided by the local MPO.

EMFAC2017 includes data on California's car and truck fleets and travel activity. Light-duty motor vehicle fleet age, vehicle type, and vehicle population were updated based on 2016 DMV data. The model also reflects the emissions benefits of CARB's recent rulemakings such as the Pavley Standards and Advanced Clean Cars Program and includes the emissions benefits of CARB's Truck and Bus Rule and previously adopted rules for other on-road diesel fleets.

EMFAC2017 utilizes a socio-econometric regression modeling approach to forecast new vehicle sales and to estimate future fleet mix. Light-duty passenger vehicle population includes 2016 DMV registration data along with updates to mileage accrual using Smog Check data. Updates to heavy-duty trucks include model year specific emission factors based on new test data, and population estimates using DMV data for in-state trucks and International Registration Plan (IRP) data for out-of-state trucks.

Additional information and documentation on the EMFAC2017 model is available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation

1. EMFAC2017 SAFE Vehicles Rules Off-Model Adjustment Removal

On September 27, 2019, EPA and National Highway Traffic Safety Administration (NHTSA) published the "Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program" (SAFE-1)[20]. SAFE-1 revoked California's authority to set its own greenhouse gas emissions standards and set zero-emission vehicle mandates in California. On April 28, 2021, EPA reconsidered the 2019 SAFE-1 by finding that the actions taken as a part of SAFE-1 were decided in error and are now entirely rescinded[21]. Therefore, any previously applied off-model adjustments as a result of SAFE-1 were removed in this inventory, resulting in a minor reduction in emissions.

2. EMFAC2017 ACT Off-Model Adjustment

The Advanced Clean Trucks (ACT) regulation was approved on June 25, 2020 and has two main components, a manufacturers zero-emission vehicle (ZEV) sales requirement and a one-time reporting requirement for large entities and fleets. The first component requires manufacturers to sell ZEVs as a percentage of annual truck and bus sales in California for vehicle model years 2024 and newer.

The ACT regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors in order to reflect the regulation. Adjustment factors were based on calculations in EMFAC2021, which models a percentage of California-certified ZEV sales for each EMFAC category and model year. More information on inventory modelling methods can be found in the ACT Initial Statement of Reasons (ISOR) Appendix B.

[20] 84 FR 51310. https://www.govinfo.gov/content/pkg/FR-2019-09-27/pdf/2019-20672.pdf.
[21] 87 FR 14332. https://www.govinfo.gov/content/pkg/FR-2022-03-14/pdf/2022-05227.pdf.

These adjustment factors were calculated based on emission estimates using EMFAC2021 under two scenarios:

1). Controlled scenario -estimated emissions with adopted regulations (EMFAC2021 default) and

2). Uncontrolled scenario - estimated emissions without accounting for the benefits of adopted regulations, including ACT and other regulations Heavy-Duty Omnibus, Opacity, and ICT (described below).

These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of the ACT regulation. The ACT off-model adjustment factors were only applied to the medium-and heavy-duty truck sectors.

Additional information on ACT is available at: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks

Additional information on EMFAC2021 technical details is available at: https://ww2.arb.ca.gov/sites/default/files/202108/emfac2021_technical_documentation_april2021.pdf

3. EMFAC2017 Heavy-Duty Omnibus Off-Model Adjustment

On August 27, 2020, CARB adopted the Heavy-Duty (HD) Omnibus regulation, which would establish NOx engine emission standards 90 percent lower than today's technology. The Omnibus Regulation will dramatically reduce NOx emissions by comprehensively overhauling exhaust emission standards, test procedures, and other emissions-related requirements for California-certified heavy-duty engines with engine model years 2024 and newer. The HD Omnibus regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources.

Therefore, CARB developed off-model adjustment factors based on EMFAC2021 (described above) in order to reflect the regulation. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of the HD Omnibus regulation. The adjustment factors reflect the impact of all components of the HD Omnibus regulation on in-use (i.e. real-world) NOx emissions and deterioration-related emissions. More details on the inventory analysis for this regulation can be found in Appendix E of the HD Omnibus staff report. The HD Omnibus off-model adjustment factors were only applied to on-road heavy-duty vehicles.

Additional information on the HD Omnibus regulation is available at: https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox

4. EMFAC2017 Innovative Clean Transit Off-Model Adjustment

The Innovative Clean Transit (ICT) regulation was adopted by CARB in 2019 and targets reductions in transit fleets by requiring transit agencies to gradually transition their buses to zero-emission technologies. ICT has helped to advance heavy-duty ZEV deployment, with buses acting as a beachhead in the heavy-duty sector. Based on the size of the transit agencies, they are categorized as small and large agencies. Starting calendar year 2023, large agencies follow the phase-in schedule to have a certain percentage of their new purchases as zero emission buses (ZEB). For the small agencies, the start calendar year will be 2025. By 2030, all the agencies need to have 100% of their new purchases as ZEB.

The ICT regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on EMFAC2021 (described above) in order to reflect the regulation. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of ICT. More details on the inventory analysis for this regulation can be found in Appendix L of the ICT staff report. The ICT off-model adjustment factors were only applied to the urban buses (UBUS) category.

Additional information on the ICT regulation is available at:
https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit/ict-regulation

5. EMFAC2017 Heavy-Duty Inspection and Maintenance Off-Model Adjustment

The Innovative Clean Transit (ICT) regulation was adopted by CARB in 2019 and targets reductions in transit fleets by requiring transit agencies to gradually transition their buses to zero-emission technologies. ICT has helped to advance heavy-duty ZEV deployment, with buses acting as a beachhead in the heavy-duty sector. Based on the size of the transit agencies, they are categorized as small and large agencies. Starting calendar year 2023, large agencies follow the phase-in schedule to have a certain percentage of their new purchases as zero emission buses (ZEB). For the small agencies, the start calendar year will be 2025. By 2030, all the agencies need to have 100% of their new purchases as ZEB.

The ICT regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on EMFAC2021 (described above) in order to reflect the regulation. These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of ICT.

More details on the inventory analysis for this regulation can be found in Appendix M of the ICT staff report. The ICT off-model adjustment factors were only applied to the urban buses (UBUS) category.

Additional information on the ICT regulation is available at: https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit/ict-regulation

6. EMFAC2017 Heavy-Duty Inspection and Maintenance Off-Model Adjustment

Dec. 9th, 2021, CARB adopted Heavy-Duty Inspection and Maintenance (HD I/M) program, which controls emissions effectively from non-gasoline on-road heavy-duty vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds. Starting from calendar year 2023, the program drastically reduces NOx and PM 2.5 emissions by enforcing periodic testing and inspections for heavy-duty trucks operating in California.

The Heavy-Duty Inspection and Maintenance (HD I/M) regulation impacts some of the underlying assumptions in CARB's EMFAC2017 model, which was used to assess emissions from on-road mobile sources. Therefore, CARB developed off-model adjustment factors based on off-model analysis with EMFAC2021 in order to reflect the regulation. More information on this analysis is provided in Appendix E of the HD I/M staff report. Since this regulation was adopted after the release of EMFAC2021, these adjustment factors were calculated based on emission estimates under two scenarios:

1). EMFAC2021 with HD I/M analysis incorporated and

2). EMFAC2021 default, which does not include HD I/M.

These adjustments, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2017 model by the CEPAM external adjustment module to account for the impact of HD I/M. These off-model adjustment factors were applied to all diesel heavy-duty diesel categories.

K. Off-Road Mobile Source Emissions

Emissions from off-road sources are estimated using a suite of category-specific models or, where a new model was not available, the OFFROAD2007 model. Many of the newer models are developed to support recent regulations, including in-use off-road equipment, ocean-going vessels, and others. The sections below summarize the updates made by CARB to specific off-road categories.

1. Recreational Marine Vessels

Pleasure craft or recreational marine vessel (RMV) is a broad category of marine vessel that includes gasoline-powered spark-ignition marine watercraft (SIMW) and diesel-powered marine watercraft. It includes outboards, sterndrives, personal watercraft, jet boats, and sailboats with auxiliary engines. This emissions inventory was last updated in 2014 to support the evaporative control measures. The population, activity, and emission factors were revised using new surveys, DMV registration information, and emissions testing.

Staff used economic data from a 2014 UCLA Economic Forecast to estimate the near-term annual sales of RMV(2014 to 2019). To forecast long-term annual sales (2020 and later), staff used an estimate of California's annual population growth as a surrogate.

Additional information is available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

2. Recreational Vehicles

Off-highway recreational vehicles include off-highway motorcycles (OHMC), all-terrain vehicles (ATV), off-road sport vehicles, off-road utility vehicles, sand cars, golf carts, and snowmobiles. A new model was developed in 2018 to update emissions from recreational vehicles. Input factors such as population, activity, and emission factors were re-assessed using new surveys, DMV registration information, and emissions testing. OHMC population growth is determined from two factors: incoming population as estimated by future annual sales and the scrapped vehicle population as estimated by the survival rate.

Additional information is available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

3. Fuel Storage and Handling

Emissions from portable fuel containers (gas cans) were estimated based on past surveys and CARB in-house testing. This inventory uses a composite growth rate that depends on occupied household (or business units), percent of households (or businesses) with gas cans, and average number of gas cans per household (or business) units.

Additional information is available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-offroad

4. Small Off-Road Engines (SORE)

Small off-road engines (SORE) are spark-ignition engines rated at or below 19 kilowatts (i.e., 25 horsepower). Typical engines in this category are used in lawn and garden equipment as well as other outdoor power equipment and cover a broad range of equipment. The majority of this equipment belongs to the Lawn & Garden (e.g., lawnmower, leaf blower, trimmer) and Light Commercial (e.g., compressor, pressure washer, generator) categories of CARB's SORE emissions inventory model.

The newly developed, stand-alone SORE2020 Model reflects the recovering California economy from the 2008 economic recession and incorporates emission results from CARB's recent in-house testing as well as CARB's most recent Certification Database. CARB also has conducted an extensive survey of SORE operating within California through the Social Science Research Center (SSRC) at the California State University, Fullerton (CSUF). Data collected through this survey provides the most up-to-date information regarding the population and activity of SORE equipment in California. The final SORE emissions included the adopted SORE rule in December 2021 as well as the 15-day changes after the Board hearing which allowed the pressure washers (greater than 5 hp) extra time for meeting the regulation. The SORE annual sales were forecasted using historic growth of the number of California households (DOF household forecasts, 2000 – 2008 and 2009 - 2018).

Additional information on SORE baseline emissions (without the adopted rule and 15-day changes) is available at: https://ww2.arb.ca.gov/sites/default/files/2020-09/SORE2020_Technical_Documentation_2020_09_09_Final_Cleaned_ADA.pdf

5. Locomotives

All locomotive inventories were updated in 2020 and include line haul (large national companies), switchers (used in railyards), passenger, and Class 3 locomotives (smaller regional companies). Data for each sector was supplied by rail operations, including Union Pacific and Burlington Northern Santa Fe Railway (BNSF) for line haul and switcher operations. Data for other categories was supplied by the locomotive owners. Emission factors for all categories were based on EPA emission factors for locomotives. The inventory reflects the 2005 memorandum of understanding (MOU) with Union Pacific and BNSF. Growth rates were primarily developed from the FAF.

More information is available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

6. Military and Industry Locomotives

This new category includes military and Industrial (M&I) locomotive emission inventory and relies on the annual fuel consumption and engine information collected from 2011 to 2018. The M&I locomotive data was supplied by 39 private companies, 4 military rail groups, with a total of 85 locomotives. The subject locomotives typically consist of smaller, older switchers and medium horsepower (MHP, 2,301 to 3,999 hp) locomotives operating within the boundaries of a granary, plant, or industrial facility.

The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

7. Diesel Agricultural Equipment

The agricultural equipment inventory covers all off-road vehicles used on farms or first processing facilities (of all fuel types). It was updated in 2021 using a 2019 survey of California farmers and rental facilities, and the 2017 U.S. Department of Agriculture (USDA) agricultural census. Emission factors are based on the 2017 off-road diesel emission factor update. The inventory reflects incentive programs for agricultural equipment that were implemented earlier than August 2019. Agricultural growth rates were developed using historical data from the County Agricultural Commissioners' reports.

Additional information is available at: https://ww2.arb.ca.gov/sites/default/files/2021-08/AG2021_Technical_Documentation_0.pdf

8. In-Use Off-Road Equipment

This category covers off-road diesel vehicles over 25 horsepower in construction, mining, industrial, and oiling drilling categories. The inventory was updated in 2022 based on the DOORS registration program. Activity was updated based on a 2021 survey of registered equipment owners, and emission factors were based on the 2017 off-road diesel emission factor update. The inventory reflects the In-Use Off-Road Equipment Regulations, as amended in 2011.

The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

9. Transportation Refrigeration Units - Diesel

The Transportation Refrigeration Units (TRU) inventory was updated in 2020 based on the TRU reporting program at CARB. The activity was developed based on 2010 surveys of facilities served by TRUs and 2017 to 2019 telematics data purchased from TRU manufacturers. Emission factors were developed specifically for TRUs based on TRU engine certification data reported to EPA as of 2018. The inventory reflects the TRU ATCM and 2021 amendments. Forecasting was based on IBISWorld reports forecast for related industries, and turnover forecasting was based on the past 20 years equipment population trends.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/barcu/board/rulemaking/tru2021/apph.pdf

10. Portable Equipment

Portable equipment inventory includes non-mobile diesel, such as generators, pumps, air compressors, chippers, and other miscellaneous equipment over 50 horsepower. This inventory was developed in 2017 based on CARB's registration program, 2017 survey of registered owners for activity and fuel, and the 2017 off-road diesel emission factor update. The inventory also reflects the Portable ATCM and 2017 amendments.

Because registration in PERP is voluntary, the PERP registration data was used as the basis for equipment population, with an adjustment factor used to represent the remaining portable equipment in the state. Estimates of future emissions beyond the base year were made by adjusting base year estimates for population growth, activity growth, and the purchases of new equipment (i.e. natural and accelerated turnover).

Additional information is available at:
https://ww3.arb.ca.gov/msei/ordiesel/perp2017report.pdf

11. Large Spark Ignition/Forklifts

The large spark ignition (LSI) inventory includes gasoline and propane forklifts, sweeper/scrubbers, and tow tractors. The inventory was updated in 2020 based on the LSI/forklift registration in the DOORS reporting system at CARB, and the sales data was provided by the Industrial Truck Association (ITA). Activity was based on a survey of equipment owners in the DOORS system, and emission factors were based on EPA's latest guidance for gasoline and propane engines. The inventory reflects the LSI regulation requirements and 2016 amendments.

The updated methodology is currently in the process of being posted online. When it is completed, the methodology will be available at:
https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/road-documentation/msei-documentation-road

12. Forestry Equipment

The new 2021 forestry diesel equipment emissions inventory was developed to replace the previous emissions inventory for diesel forestry equipment based on OFFROAD2007. This inventory includes equipment used in forestry and in milling. This includes foresting operations, such as feller/bunchers and dragline operations, equipment used to build roads to reach forested areas, and forklifts or loaders used in milling operations. The inventory was based on a 2019 survey of forestry operations and mills (for calendar year 2017), as well as the 2019 California Department of Tax and Fee Administration data on the annual timber harvest, with emission factors from the 2017 off-road diesel emission factor update. This sector does not include any emission reduction measures or strategies. The model projects forestry equipment population and emissions in future years by predicting the retirement and purchasing habits of forestry equipment. The model attempts to predict a business as usual (BAU) behavior based on the 2017 survey data.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/2021-10/2021_Forestry_Inventory_Technical_Document_FINAL_09302021.pdf

L. Stationary Point Sources

The stationary source inventory is composed of point sources and area-wide sources. The data elements in the inventory are consistent with the data elements required by the AERR. The inventory reflects actual emissions from industrial point sources reported to the District by the facility operators through calendar year 2017.

Stationary point sources also include smaller point sources, such as gasoline dispensing facilities and laundering, that are not inventoried individually, but are estimated as a group and reported as a single source category. Emissions from these sources are estimated using various models and methodologies. Estimation methods include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations. Emissions for these categories are estimated by both CARB and the District.

Estimates for the categories below were developed by CARB and has been reviewed by CARB staff to reflect the most up-to-date information.

1. Stationary Nonagricultural Diesel Engines

This category includes emissions from backup and prime generators and pumps, air compressors, and other miscellaneous stationary diesel engines that are widely used throughout the industrial, service, institutional, and commercial sectors. The emission estimates, including emission forecasts, are based on a 2003 CARB methodology derived from the OFFROAD2007 model.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbfuelcombother.htm

2. Agricultural Diesel Irrigation Pumps

This category includes emissions from the operation of diesel-fueled stationary and mobile agricultural irrigation pumps. Emission estimates are based on a 2003 CARB methodology using statewide population and include replacements due to the Carl Moyer Program. Emissions are grown based on projected acreage for irrigated farmland from the California Department of Conservation's Farmland Mapping and Monitoring Program (FMMP), 2008.

Additional information on this category is available at:
https://ww3.arb.ca.gov/ei/areasrc/fullpdf/full1-1.pdf

3. Laundering

This category includes emissions from perchloroethylene (perc) dry cleaning establishments. Emission estimates are based on a 2002 CARB methodology that used nationwide perc consumption rates allocated to the county level based on population and an emission factor of 10.125 pounds per gallon used. Emissions were grown based on the California Department of Finance (DOF) population forecasts, 2020.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbcleanlaund.htm

4. Degreasing

This category includes emissions from solvents in degreasing operations in the manufacturing and maintenance industries. Emissions estimates are based on a 2000 CARB methodology using survey and industry data, activity factors, emission factors and a user's fraction. Emissions were grown based on CARB's Real Disposable Personal Income (REMI) industry-specific economic output, version 2.4.5.

Additional information on this methodology is available at:
https://ww3.arb.ca.gov/ei/areasrc/arbcleandegreas.htm

5. Coatings and Thinners

This category includes emissions from coatings and related process solvents. Auto refinishing emissions estimates are based on a CARB methodology using production data and a composite emission factor derived from a 2002 survey. These estimates were grown based on CARB's on-road mobile sources model (EMFAC2017). Estimates for industrial coatings emissions are based on a 1990 CARB methodology using production and survey data, and emission factors derived from surveys.

Estimates for thinning and cleaning solvents are based on a 1991 CARB methodology, census data and a default emission factor developed by CARB. These estimates were grown based on REMI county economic forecasts, version 2.4.5.

Additional information on these methodologies is available at: https://ww3.arb.ca.gov/ei/areasrc/arbcleancoatreproc.htm

6. Adhesives and Sealants

This category includes emissions from solvent-based and water-based solvents contained in adhesives and sealants. Emissions are estimated based on a 1990 CARB methodology using production data and default emission factors. Estimates were grown based on REMI county economic forecasts, version 2.4.5.

Additional information on this methodology is available at: https://ww2.arb.ca.gov/carb-cleaning-and-surface-coating-methodologies-adhesives-and-sealants

7. Gasoline Dispensing Facilities

This category uses a 2015 CARB methodology to estimate emissions from fuel transfer and storage operations at gasoline dispensing facilities (GDFs). The methodology addresses emissions from underground storage tanks, vapor displacement during vehicle refueling, customer spillage, and hose permeation. The updated methodology uses emission factors developed by CARB staff that reflect more current in-use test data and also accounts for the emission reduction benefits of onboard refueling vapor recovery (ORVR) systems. The emission estimates are based on 2012 statewide gasoline sales data from the California Board of Equalization that were apportioned to the county level using fuel consumption estimates from EMFAC 2014. Emissions were grown based on EMFAC2017.

Additional information on this category is available at: https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

8. Gasoline Cargo Tank

This category uses a 2002 CARB methodology to estimate emissions from gasoline cargo tanks. These emissions do not include the emissions from loading and unloading of gasoline cargo tank product; they are included in the gasoline terminal inventory and gasoline service station inventory. Pressure-related fugitive emissions are volatile organic vapors leaking from three points: fittings, valves, and other connecting points in the vapor collection system on a cargo tank. 1997 total gasoline sales were obtained from the California Department of Transportation.

The emission factors are derived from the data in the report, "Emissions from Gasoline Cargo Tanks, First Edition," published by the Air and Waste Management Association in 2002.

The initial emission estimates for 1997, were grown to 2012 using a growth parameter developed by Pechan based on gasoline and oil expenditures data. Emissions were grown according to fuel consumption from CARB's EMFAC 2017 mobile sources emission factors model.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/arb-petroleum-production-and-marketing-methodologies-petroleum-marketing

9. Oil and Gas Production

The oil and natural gas production inventory is estimated by a 2015 CARB methodology. This category is related to fugitive emissions from production-related fuel consumption, fugitive losses (sumps, pits, pumps, compressors, well heads, separators, valves and fittings), vapor recovery and flares, tank and truck working and breathing losses, wastewater treatment, tertiary production, and wet and dry gas stripping. Emissions were calculated using EPA's Oil and Natural Gas Tool v1.4 with default emissions factors from ENVIRON Int'l Corp's 2012 report, "2011 Oil and Gas Emission Inventory Enhancement Project for CenSARA States," and activity data taken from California's Division of Oil, Gas, and Geothermal Resources (DOGGR) (which was renamed to Geologic Energy Management Division (CalGEM) in 2020).

CARB also incorporated data from the 2007 Oil and Gas Industry Survey (e.g., typical component counts) and feedback from individual air districts (e.g., minimum controls required to operate in a certain district, with associated control factors) to improve these parameters and further adjust the tool's output. Emissions were grown to 2017 based on CalGEM historical statewide production. Growth in future years an assumed 2.9% annual decline, which reflects the statewide CalGEM trend from 2000 through 2016.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/resources/documents/oil-and-gas-industry-survey
https://ww3.arb.ca.gov/ei/areasrc/oilandgaseifinalreport.pdf

M. Area-Wide Sources

Area-wide sources include categories where emissions take place over a wide geographic area, such as consumer products. Emissions from these sources are estimated using various models and methodologies. Estimation methods include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations. Emissions for these categories are estimated by both CARB and the District.

Estimates for the categories below were developed by CARB and has been reviewed by CARB staff to reflect the most up-to-date information:

1. Consumer Products and Aerosol Coatings

The Consumer Product emission estimates utilized sales and formulation data from the CARB's mandatory survey of all consumer products sold in California for calendar years 2013 through 2015 (2015 Consumer Product Survey). The aerosol coatings estimates utilized sales and formulation data from a survey conducted by CARB in 2010. Based on the survey data, CARB staff determined the total product sales and total VOC emissions for the various product categories. Growth for personal care products are based on real disposable personal income projections per REMI version 2.4.5. No growth is assumed for aerosol coatings. Growth for all other consumer products are based on DOF population projections, 2020.

Additional information on CARB's consumer products surveys is available at: https://ww2.arb.ca.gov/our-work/programs/consumer-products-program/consumer-commercial-product-surveys

2. Architectural Coatings

Architectural coatings are coatings applied to stationary structures and their accessories. They include house paints, stains, industrial maintenance coatings, traffic coatings, and many other products. Industrial maintenance coatings are high performance architectural coatings formulated for application to substrates, including floors, exposed to extreme environmental conditions (e.g., immersion in water, chronic exposure to corrosive agents, frequent exposure to temperatures above 121°C, repeated heavy abrasion). The architectural coatings category reflects emission estimates based on a 2014 comprehensive CARB survey for the 2013 calendar year. The emission estimates include benefits of the 2007 CARB Suggested Control Measures. These emissions are grown based on DOF households forecast, 2020.

Additional information about CARB's architectural coatings program is available at: https://ww2.arb.ca.gov/carb-solvent-evaporation-methodologies-architectural-coatings-and-cleaningthinning-solvents

3. Pesticides

The California Department of Pesticide Regulation (DPR) develops month-specific emission estimates for agricultural and structural pesticides. Each calendar year, DPR updates the inventory based on the Pesticides Use Report, which provides updated information from 1990 through the 2018 calendar year. Agricultural pesticide emission forecasts for years 2019 and beyond are based on the average of the most recent five years. Growth for agricultural pesticides is based on CARB projections of farmland acres per FMMP, 2016. Growth for structural pesticides is based on DOF households growth projections, 2020.

Additional information about CARB's pesticides program is available at: https://ww2.arb.ca.gov/carb-solvent-evaporation-methodologies-agricultural-and-non-agricultural-pesticides

4. Residential Wood Combustion

Residential Wood Combustion estimates are based off a 2011 CARB methodology. It reflects survey data on types of wood burning devices and wood consumption rates, updates to the 2002 EPA National Emission Inventory (NEI) emission factors, and improved calculation approaches.

CARB assumes no growth for this category based on the relatively stagnant residential wood fuel use over the past decade (according to the American Community Survey and US Energy Information Administration).

Additional information on this methodology is available at: https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

5. Residential Natural Gas Combustion

CARB staff updated the methodology to reflect 2017 fuel use from the California Energy Consumption Database. The emissions estimates reflect the most recent emissions factors from EPA's AP-42 for residential natural gas combustion. Growth is based on California Energy Commission (CEC) projections for natural gas consumption, 2019.

Additional information on this methodology is available at: https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

6. Residential Distillate Oil and Liquefied Petroleum Gas

The residential distillate oil/liquefied petroleum gas (LPG) category includes emissions occurring in the residential sector. Distillate oil for heating is generally used in older homes and remote areas where natural gas lines are not available.

Activity is based on the number of housing units, population, and LPG and distillate oil capacities. The 1991 Fuels Report Working Paper published by the CEC was used to determine energy demand by fuel type in terms of the number of houses heated by a specific fuel in a particular area. Heating degree days (HDD) are used to estimate how many heating days are likely to occur in a particular area.

This category uses emission factors from EPA's AP-42. The emissions were initially calculated in 1993 then grown to 2012 using housing unit data from the DOF, 2013. Emissions were grown from 2012 to 2017 using a 'no growth' profile developed by Pechan (2012). Emissions post-2017 were grown based on EIA – SEDS, and no growth was assumed.

Additional information on this methodology is available at: https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-residential-fuel-combustion

7. Farming Operations

CARB staff updated the non-cattle Livestock Husbandry methodology to reflect livestock population data based on the USDA's 2017 Census of Agriculture. Cattle emissions are primarily based on the 2012 Census of Agriculture. A seasonal adjustment was added to account for the suppression of dust emissions in months in which rainfall occurs. Growth profiles are based on CARB's projections of Census of Agriculture's historical livestock population trends, 2012. No growth is assumed for dairy and feedlots.

Additional information on CARB's methodology is available at: https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-farming-operations

8. Fires

Emissions from structural and automobile fires were estimated based on a 1999 CARB methodology using the number of fires and the associated emission factors. Estimates for structural fires are calculated using the amount of the structure that is burned, the amount and content of the material burned, and emission factors derived from test data. Estimates for automobile fires are calculated using the weight of the car and components and composite emission factors derived from AP-42 emission factors. Structural fire growth is based on DOF households forecasts, 2020, and automobile fire growth is based on DOF population forecasts, 2020.

Additional information on this methodology is available at: https://ww2.arb.ca.gov/carb-miscellaneous-process-methodologies-fires

9. Managed Burning & Disposal – Agricultural Burning

The Agricultural Burning Managed Burning and Disposal category includes the open burning of weed abatement (such as ditch and canal bank burning). CARB updated the emissions inventory to reflect burn data reported by air district staff for 2017. Emissions are calculated using crop specific emission factors and fuel loadings. Temporal profiles reflect monthly burn activity. No growth is assumed for burning associated with weed abatement.

Additional information on this methodology is available at: https://ww2.arb.ca.gov/district-miscellaneous-process-methodologies-managed-burning-and-disposal

N. Point and Area-wide Source Emissions Forecasting

Emission forecasts (2018 and subsequent years) are based on growth profiles that in many cases incorporate historical trends up to the base year or beyond. The growth surrogates used to forecast the emissions from these categories are presented in Table 2. The emissions inventory also reflects emission reductions from point and area-wide sources subject to District rules and CARB regulations. Table 3 lists the rules and regulations included in the inventory.

Table 2: Growth Surrogates for Point and Area-wide Sources

Source Category	Subcategory	Growth Surrogate
Electric Utilities	Other Fuels	Energy Information Administration (EIA) Annual Energy Outlook, 2019
Cogeneration	All	CEC forecast, 2019
Oil and Gas Production (Combustion)	All	DOGGR statewide total oil production. Assumed 2.9% annual decline reflecting CalGEM historical trend, 2000 through 2016
Petroleum Refining (Combustion)	All	No growth assumption
Manufacturing and Industrial	Natural Gas	CEC forecast, 2019
	Other Fuels	EIA forecast, 2018
Food and Agricultural Processing	Ag Irrigation I. C. Engines	FMMP irrigated farmland acreage, 2008
Service and Commercial	Natural Gas	CEC forecast, 2019
	Other Fuels	EIA forecast, 2018
Other (Fuel Combustion)	Diesel	Modeled estimate, 2003
	Other Fuels	EIA forecast, 2018
Waste Disposal	All	DOF population forecast, 2020
Laundering	Dry Cleaning	DOF population forecast, 2020
Degreasing	All	CARB/REMI economic forecast, version 2.4.5
Coatings & Thinners	Auto Refinishing	Vehicles from CARB EMFAC2017 model
	Others	REMI economic forecast, version 2.4.5
Adhesives & Sealants	All	REMI economic forecast, version 2.4.5
Oil and Gas Production	All	Assumed 2.9% annual decline reflecting CalGEM historical trend, 2000 through 2016
Petroleum Refining	All	No growth assumption

Table 2: Continued

Source Category	Subcategory	Growth Surrogate
Petroleum Marketing	Natural Gas Transmission	CEC forecast, 2019
	Gas Dispensing Facilities and Cargo Tanks	Fuel use from CARB EMFAC2017 model
	Other Point Sources	REMI economic forecast, version 2.4.5
Chemical	All	REMI economic forecast, version 2.4.5
Mineral Processes	All	REMI version 2.4.5; EIA forecast, 2018
Metal Processes	All	REMI economic forecast, version 2.4.5
Other Industrial Processes	All	REMI economic forecast, version 2.4.5
Consumer Products	Personal Care Products	Real Disposable Personal Income per REMI, version 2.4.5
	Other Consumer Products	DOF population forecast, 2020
	Aerosol Coatings	No growth
Architectural Coatings & Related Process Solvents	All	DOF households forecast, 2020
Pesticides & Fertilizers	Agricultural Pesticides	CARB projection of farmland acres per FMMP, 2016
	Structural Pesticides	DOF households forecast, 2020
Asphalt Paving & Roofing	All	DOF construction jobs forecast, 2020; CARB projection
Residential Fuel Combustion	Natural Gas	CEC forecast, 2019
	Other Fuels	EIA – SEDS – No growth
Farming Operations	Dairy / Feedlots	No growth
	Other Livestock	CARB projection of livestock population per Census of Agriculture, 2012
Fires	Structural	DOF households forecast, 2020
	Automobile	DOF population forecast, 2020
Managed Burning and Disposal	Agricultural Burning, Weed Abatement	FMMP farmland acreage projection, 2016
Cooking	All	DOF population forecast, 2020

Table 3: District and CARB Control Rules and Regulations Included in the Inventory

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
CARB	ARCH_SCM	Architectural Coatings 2000 SCM	Architectural coatings
CARB	AC_SCM2007	Architectural Coatings 2007 SCM	Architectural coatings
CARB	ARB_R003 & ARB_R003_A	Consumer Product Regulations & Amendments	Consumer products
CARB	ARB_R007	Aerosol Coating Regulations	Aerosol coatings
CARB	GDF_HOSREG	Gasoline Dispensing Facility Hose Emission Regulation	Petroleum marketing
CARB	ORVR	Fueling Emissions from ORVR Vehicles	Petroleum marketing
CARB	AG_IC_ENG	Agricultural IC Engine Emission Scalers	Agricultural irrigation internal combustion engines
CARB	NONAGICENG	Non-Agricultural IC Engine Emission Scalers	Non-agricultural internal combustion reciprocating engines

O. External Adjustments

External adjustments were made in CEPAM to account for military growth and other unaccounted regulatory factors. The external adjustments reflected in the CEPAM2019v1.04 Eastern Kern SIP inventory are listed below in Table 4.

Table 4: External Adjustment IDs and Descriptions

Adjustment ID	Adjustment Description
HD_I/M	HD I/M Regulation adopted by CARB Dec 2021
NonAg_ICE	Update non-ag internal comb. engines to reflect 2003 ATCM and 2010 rule amend
TRUCK_REGS	Advanced clean trucks Omnibus Low NOx_Opacity ICT_UBUS adjustments

IV. CHALLENGES

A. Meteorology

High temperatures and low relative humidity play a big role in O_3 formation. Meteorological data from several ambient air monitoring stations[22] and airports[23] located in Kern, Los Angeles, and San Bernardino Counties along with data obtained from CARB were analyzed during the summer months (peak O_3 season). Temperatures in the District can be in excess of 95° Fahrenheit for sixty to seventy days per year between June and September with almost no precipitation. Relative humidity is also very low with average humidity below 10 percent in the hottest part of the day.

[22] Ambient air monitoring data was collected at air monitoring stations in Mojave (Eastern Kern APCD), Bakersfield, Edison, Oildale, and Arvin (SJVAPCD); Lancaster (SCAQMD), and Barstow and Trona (MDAQMD)

[23] Meteorological data was obtained from the following airports: Mojave Airport, Edwards Air Force Base, Meadows Field, Naval Air Weapons Station, Lancaster, Ontario, San Bernardino, and Daggett.

The combination of a hot dry climate, mixed with little to no cloud cover, produces an intense solar radiation that contributes to photochemical O_3 formation. June through September is considered peak O_3 season, with O_3 concentrations gradually rising from the beginning of the year toward the summer where levels peak by August when temperatures are usually the hottest, then gradually declining during the fall and winter.

B. Geography

The District is located on the western edge of the Mojave Desert and comprised of unique geography, topography, and meteorology, which create a challenging environment for attaining the O_3 NAAQS. The District is separated from populated valleys and coastal areas to the west and south by several mountain ranges. O_3 and its precursor emissions (NOx and VOC) are transported from these valleys and coastal areas are the major factor affecting O_3 exceedances in the District.

The surrounding mountain ranges contain a limited number of passes that serve as transport corridors. Passes include: Tehachapi Pass, connecting the western Mojave Desert to the southern San Joaquin Valley, and Soledad Pass and Cajon Pass connecting to the South Coast Air Basin. The District is primarily influenced by transport through the Tehachapi Pass corridor with some potential influence through Soledad Pass. Soledad Pass and Cajon Pass mainly influence air quality in the eastern portion of the Mojave Desert due to prevailing wind directions.

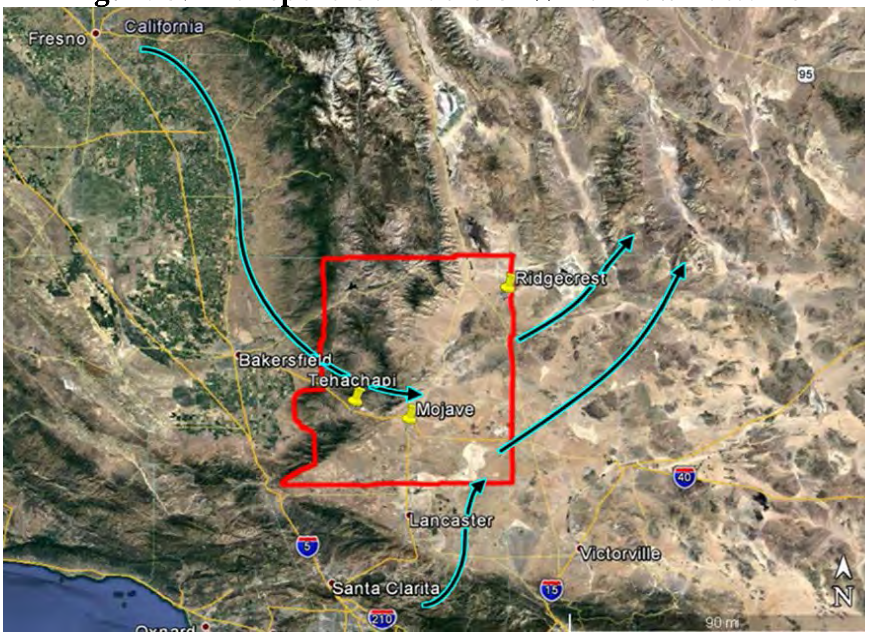
C. Pollutant Transport

It is common for air pollutants to transport between air basins. The District's air quality is overwhelmingly impacted from O_3 and its precursor emissions being transported from SJVAPCD and SCAQMD (both designated Extreme Nonattainment). Transport can take place from the surface up to several thousand feet elevation. Transport occurs when winds are of sufficient in magnitude, direction, and duration. Atmospheric chemistry also determines how transported pollutants may affect downwind O_3 concentrations.

Analysis of Eastern Kern's wind data shows O_3 and its precursors transport to the District when: Prevailing wind originates from consistently high O_3 concentration areas, and wind is persistent with high enough velocity to move emissions from upwind areas. Data also demonstrated elevated O_3 concentrations in the District coinciding with high upwind O_3 levels being transported. Figure 5 illustrates District transport corridors and wind flow patterns[24] from surrounding air basins.

[24] Reference from California Surface Wind Climatology published by Aerometric Projects and Laboratory Branch (Meteorology Section) from ARB from June to September. https://www.arb.ca.gov/research/apr/reports/l013.pdf

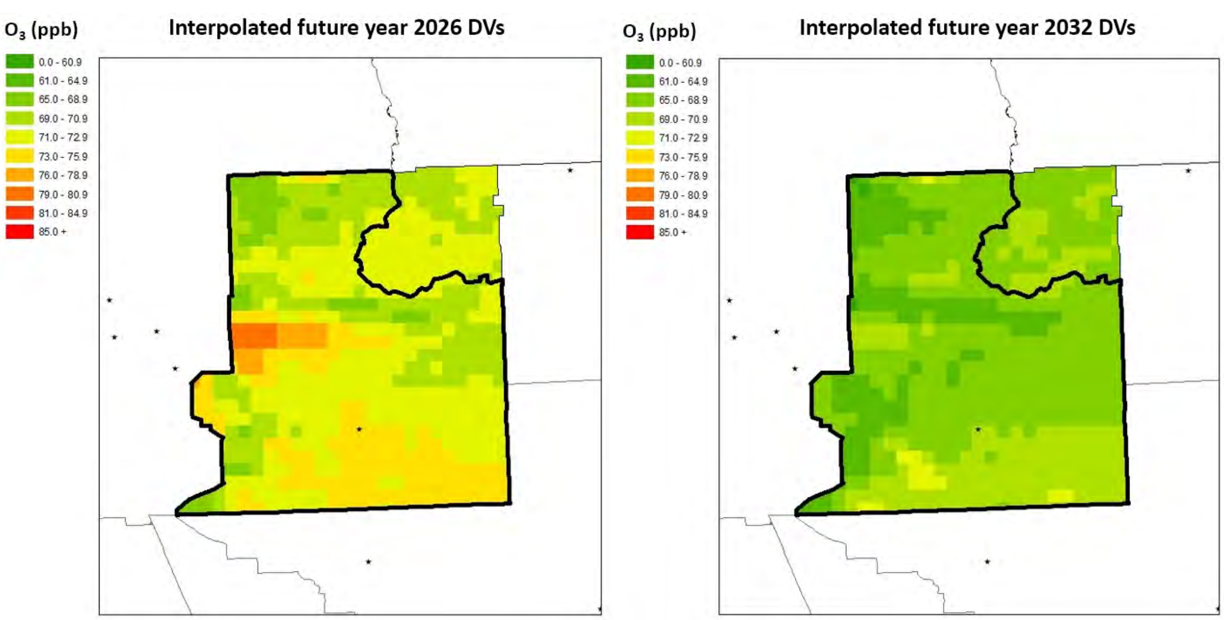
Figure 5: Transport Corridors & Wind Flow Patterns



D. Ozone Trends

Although SJVAPCD and SCAQMD have been improving their local air quality and reducing O_3 and its precursor emissions, neither district have attained the 2008, or 2015 O_3 NAAQS. Concurrently, the District has been steadily improving its air quality since of attaining the 1997, 8-Hour O_3 NAAQS (80 ppb). Figure 6 compares the District's interpolated DVs for future years 2026 and 2032, along with the areas of the District being impacted by O_3 transport emissions. Appendix M, Section G contains CARB's unmonitored area analysis of the District's nonattainment area.

Figure 6: O_3 Transport and Future DVs for 2026 and 2032



V. DEVELOPMENT OF OZONE EMISSION INVENTORIES

Emission inputs for air quality modeling (commonly and interchangeably referred to as "modeling inventories" or "gridded inventories") have been developed by CARB and staff from multiple air districts. These inventories support multiple SIPs across California to address nonattainment of the federal O_3 standards. CARB maintains an electronic database of emissions and other useful information to generate aggregate emission estimates at the county, air basin, and district level, Criteria Pollutant Emission Inventory Data in CEIDARS. CEIDARS provides a foundation for the development of a more refined (hourly, grid cell-specific) set of emission inputs that are required by air quality models. The CEIDARS base year inventory is a primary input to the state's CEPAM emission forecasting system. CEPAM produces the projected emissions that are then processed to serve as the emission input for air quality models. Appendix B of this Attainment Plan describes the methods used to prepare the base and future year emissions inventory estimates. Please see Appendix B for complete details.

VI. TRANSPORTATION CONFORMITY BUDGETS

CAA §176(c) establishes transportation conformity requirements, which are intended to ensure transportation activities do not interfere with air quality progress. The CAA requires transportation plans, programs, and projects that obtain federal funds or approvals, be consistent with, or conform to the applicable SIP before being approved by a Metropolitan Planning Organization (MPO). Conformity to the SIP means that proposed transportation activities must not:

1). Cause or contribute to any new violation of any standard,

2). Increase the frequency or severity of any existing violation of any standard in any area, or

3). Delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

SIP analyzes of a region's total emissions inventory (all applicable sources) is necessary to demonstrate RFP, attainment, or maintenance of the NAAQS. The emissions inventory for on-road and transit vehicles in the RFP, becomes the "motor vehicle emissions budget[25]". The motor vehicle emissions budget is the mechanism for ensuring transportation planning activities conform to the SIP. Budgets are set for each criteria pollutant or precursor for each RFP milestone year including the attainment year.

[25] Federal transportation conformity regulations are found in 40 CFR Parts 51 and 93 – Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved under Titles 23 or 49 of the United States Code.

A. Requirements for Demonstrating Conformity

Kern COG[26] prepares a long-range regional transportation plan (RTP) at least every four years and a short-range funding program, or regional transportation improvement program (RTIP) every two years[27]. Before adopting the RTP/RTIP, Kern COG prepares a regional emissions analysis using the proposed plan and program as specified in the federal conformity regulation and compares those emissions to the emission budgets in the SIP. The MPO may determine the RTP/RTIP conforms if the emissions from the proposed actions are less than the emissions budgets in the SIP. The conformity determination also signifies that the MPO has met other transportation conformity requirements such as interagency consultation and financial constraint.

B. Motor Vehicle Emissions Budget (MVEB)

CARB has prepared the motor vehicle emissions budget (MVEB) [28] for the 75 ppb 8-hr O_3 NAAQS and the 70 ppb 8-hr O_3 NAAQS. The MVEB is the maximum allowable emissions from motor vehicles within an air basin and is used for determining whether transportation plans and projects conform to the applicable SIP.

The MVEBs are set for each criteria pollutant or its precursors for each milestone year and the attainment year of the SIP. Subsequent transportation plans and programs produced by transportation planning agencies must demonstrate that the emissions from the proposed plan, program, or project do not exceed the MVEBs established in the applicable SIP.

The MVEBs established in this SIP apply as a "ceiling" or limit on transportation emissions for Kern COG for the years in which they are defined, and for all subsequent years until another year for which a different budget is specified, or until a SIP revision modifies the budget. For the 75 ppb 8-hr O_3 NAAQS, the milestone year and the attainment year of the SIP (also referred to as the plan analysis years) are 2023 and 2026. For the 70 ppb 8-hr O_3 NAAQS, the milestone years and the attainment year of the SIP are 2023, 2026, 2029, and 2032.

C. Methodology

The MVEB for the 75 ppb and 70 ppb O_3 standards are established based on guidance from EPA on the motor vehicle emission categories and precursors that must be considered in transportation conformity determinations as found in the transportation conformity regulation and final rules as described below.

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[26] The MPO in Kern County

[27] Content of the RTP and RTIP are specified in federal transportation law found at Titles 23 and 49 of the federal code of regulations and applicable sections of state transportation planning law.

[28] Federal transportation conformity regulations are found in 40 CFR Part 51, subpart T – Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C. of the Federal Transit Laws. Part 93, subpart A of this chapter was revised by the EPA in the August 15, 1997 Federal Register.

The MVEB must be clearly identified and precisely quantified, and consistent with applicable CAA requirements for reasonable further progress and attainment toward meeting NAAQS. Further, it should be consistent with the emission inventory and control measures in the SIP.

The District's O_3 SIP establishes the MVEB for the O_3 precursor emissions ROG and NOx using emission rates from California's motor vehicle emission model, EMFAC2017 (V.1.0.3) [29], using activity data (vehicle miles traveled [VMT] and speed distributions) from Kern COG's 2019 Federal State Transportation Improvement Program (FSTIP) amendment[30]. Appendix C contains the complete VMT Emissions Offset Demonstration.

On August 15, 2019, EPA approved EMFAC2017 for use in SIPs, and to demonstrate transportation conformity[31]. The EMFAC model estimates emissions from two combustion processes (start and running) and four evaporative processes (hot soak, running loss, diurnal, and resting loss). In addition, the emissions output from the EMFAC2017 model was adjusted to account for the impacts of recently adopted regulations and regulations currently under development that are not reflected in the EMFAC2017 model using off-model adjustments[32]. The regulations incorporated in this way are the Heavy-Duty Warranty Phase 1, Innovative Clean Transit (ICT), Amendments to the Heavy-Duty Vehicle Inspection Program (HDVIP), Periodic Smoke Inspection Program (PSIP), Advanced Clean Trucks (ACT), Heavy-Duty (HD) Omnibus, Advanced Clean Cars II (ACC II), and Advanced Clean Fleets (ACF).

The MVEBs for this SIP were developed to be consistent with the on-road emissions inventory and attainment demonstration using the following method:

1) Used the EMFAC2017 model to produce an initial/preliminary calculation of the on-road motor vehicle emissions totals (average summer day) for the appropriate pollutants (ROG and NOx) using 2019 FSTIP activity data.

2) Applied the off-model adjustments to account for recently adopted regulations.

3) Subtracted expected emission reductions from ACC II and ACF to be consistent with the on-road control measures in the California State Implementation Plan Strategy for 70 ppb 8-hr O_3 standard[33].

4) Rounded the totals for both ROG and NOx to the nearest tenth ton.

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[29] More information on data sources can be found in the EMFAC technical support documentation at: *https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation*
[30] 2019 Federal Statewide Transportation Improvement Program (FSTIP) (ca.gov)
[31] EPA approval of EMFAC2017 can be found at 84 FR 41717 *https://www.federalregister.gov/d/2019-17476*
[32] Off-Model Adjustment Factors to Account for Recently Adopted Regulations in EMFAC2017 Model *https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory*
[33] 2022 State Strategy for the State Implementation Plan *https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy*

The MVEB in Table 5 was established according to the methodology outlined above and in consultation with the Kern COG, CARB, EPA, Federal Highway Administration (FHWA), and Federal Transit Administration (FTA). The MVEB is consistent with the emission inventories and control measures in the O_3 SIP. These budgets will be effective once EPA determines it is adequate.

The emissions budgets presented in Table 5 represent the on-road motor vehicle emission levels projected for 2023, 2026, 2029, and 2032, as determined using the CARB, EMFAC2017 model, recently adopted regulations, and regulations currently under development using off-model adjustments for both ROG and NOx emissions. Years 2023 and 2026 are used for the 2008, O_3 NAAQS, while all four years are used for the 2015, O_3 NAAQS. The final MVEB is rounded upwards to the nearest tenth.

Table 5: Motor Vehicle Emissions Budgets for 2023, 2026, 2029, 2032

Eastern Kern Totals (Tons/Day)	2023		2026		2029		2032	
	ROG	NOx	ROG	NOx	ROG	NOx	ROG	NOx
Vehicular Exhaust	0.78	2.38	0.69	2.28	0.62	2.23	0.56	2.22
Reductions from recently adopted regulations using off-model adjustments[a]	0.0000	0.0553	0.0005	0.9081	0.0019	1.1033	0.0041	1.2244
Reductions from developing regulations using off-model adjustments[b]	-	-	-	-	-	-	0.0280	0.1650
Total[c]	0.78	2.33	0.69	1.37	0.62	1.12	0.53	0.83
Motor Vehicle Emission Budget[d]	**0.8**	**2.4**	**0.7**	**1.4**	**0.7**	**1.2**	**0.6**	**0.9**

a This reflects the adjustment factor for Heavy-Duty Vehicle Warranty Phase 1, ICT, HDVIP/PSIP, ACT, and HD Omnibus regulations.
b This reflects the on-road commitments for ACCII and ACF from the draft 2022 State SIP Strategy.
c Values from EMFAC2017 v1.03 may not add up due to rounding.
d Motor vehicle emission budgets calculated are rounded up to the nearest tenth of a tpd. Source::EMFAC2017v1.03

VII. MOBILE SOURCE REGULATIONS & EMISSION REDUCTION PROGRAMS

Given the severity of California's air quality challenges and the need for ongoing emission reductions, CARB has implemented the most stringent mobile source emissions control program in the nation. CARB's comprehensive program relies on four fundamental approaches:

1). Stringent emissions standards that minimize emissions from new vehicles and equipment;
2). In-use programs that target the existing fleet and require the use of the cleanest vehicles and emissions control technologies;
3). Cleaner fuels that minimize emissions during combustion; and,
4). Incentive programs that remove older, dirtier vehicles and equipment and pay for early adoption of the cleanest available technologies.

This multi-faceted approach has spurred the development of increasingly cleaner technologies and fuels and achieved significant emission reductions across all mobile source sectors that go far beyond national programs or programs in other states. These efforts extend back to the first mobile source regulations adopted in the 1960s, and pre date the CAA Amendments of 1970, which established the basic national framework for controlling air pollution.

In recognition of the pioneering nature of CARB's efforts, the CAA provides California unique authority to regulate mobile sources more stringently than the federal government by providing a waiver of preemption for its new vehicle emission standards under Section 209(b). This waiver provision preserves a pivotal role for California in the control of emissions from new motor vehicles, recognizing that California serves as a laboratory for setting motor vehicle emission standards. Since then, the CARB has consistently sought and obtained waivers and authorizations for its new motor vehicle regulations. CARB's history of progressively strengthening standards as technology advances, coupled with the waiver process requirements, ensures that California's regulations remain the most stringent in the nation.

In 1998, CARB identified diesel particulate matter as a toxic air contaminant. Since then, CARB adopted numerous regulations aimed at reducing exposure to diesel particulate matter while concurrently providing reductions in oxides of nitrogen (NOx) from freight transport sources like heavy-duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Phased implementation of these regulations will continue to produce emission reduction benefits through 2032 and beyond, as the regulated fleets are retrofitted, and as older and dirtier portions of the fleets are replaced with newer and cleaner models at an accelerated pace.

Further, CARB and District staff work closely on identifying and distributing incentive funds to accelerate cleanup of engines. Key incentive programs include the Carl Moyer Program; the Goods Movement Program; the Lower-Emission School Bus Program; and the Air Quality Improvement Program (AQIP). These incentive-based programs work in tandem with regulations to accelerate deployment of cleaner technology.

A. Light-Duty Vehicles, Emissions Standards, and Clean Fuels

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. Figure 7 illustrates the trend in NOx emissions from light-duty vehicles and key programs contributing to those reductions. As a result of these efforts, light-duty vehicle emissions in the District's O_3 nonattainment area have been reduced significantly since 1990 and will continue to decrease due to the benefits of CARB's longstanding light-duty mobile source programs. Key light-duty programs include Advanced Clean Cars, On-Board Diagnostics, Reformulated Gasoline, Incentive Programs, and the Smog Check Program.

Figure 7: Key Programs to Reduce Light-Duty NOx Emissions

B. Heavy-Duty Trucks, Emissions Standards, and Clean Fuels

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. Most recently in 2015, engine manufacturers can 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 CARB to preferentially provide incentive funding to buyers of cleaner trucks, to encourage the development of cleaner engines.

Figure 8 illustrates the trend in NOx emissions from heavy-duty vehicles and key programs contributing to those reductions. As a result of these efforts, heavy-duty vehicle emissions in the District's O_3 nonattainment area have been reduced significantly since 1990 and will continue to decrease due to the benefits of CARB's longstanding heavy-duty mobile source programs. Key programs include Heavy-Duty Engine Standards, Clean Diesel Fuel, Truck and Bus Regulation and Incentive Programs.

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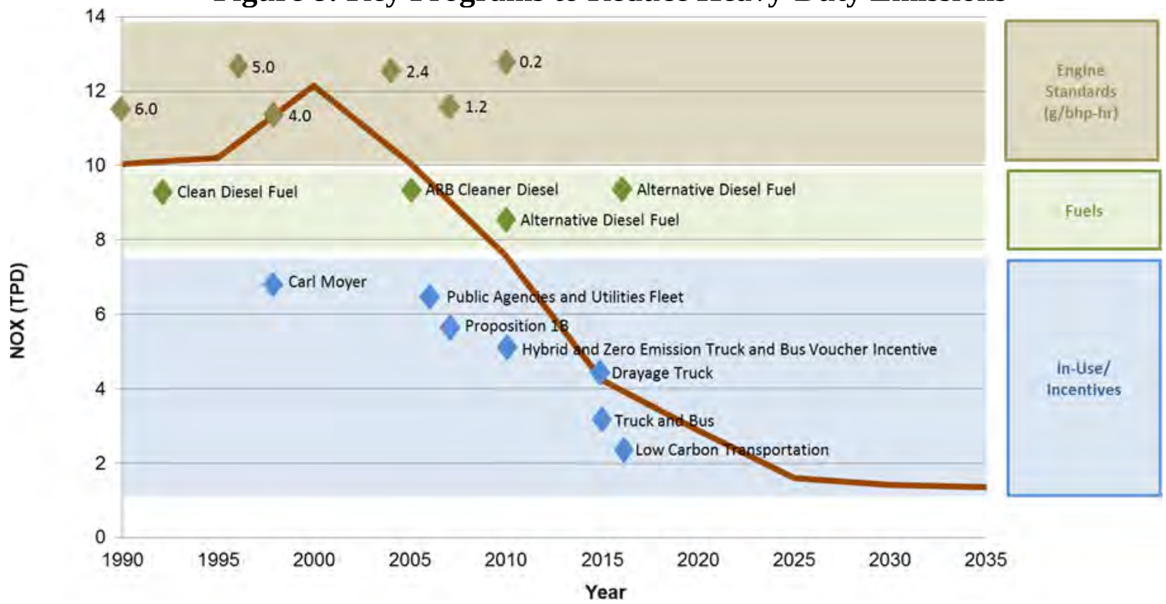
Figure 8: Key Programs to Reduce Heavy-Duty Emissions



C. Off-Road Sources, Emissions Standards, and Clean Fuels

Off-road sources encompass equipment powered by an engine that does not operate on the road. Sources vary from ships to lawn and garden equipment and for example, include sources like locomotives, aircraft, tractors, harbor craft, off-road recreational vehicles, construction equipment, forklifts, and cargo handling equipment.

Figure 9 illustrates the trend in NOx emissions from off-road equipment and key programs contributing to those reductions. As a result of these efforts, off-road emissions in the District O_3 nonattainment area have been reduced since 1990 and will continue to decrease due to the benefits of CARB's and EPA's longstanding programs. Key programs include Off-Road Engine Standards, Locomotive Engine Standards, Clean Diesel Fuel, Cleaner In-Use Off-Road Regulation and In-Use LSI Fleet Regulation.

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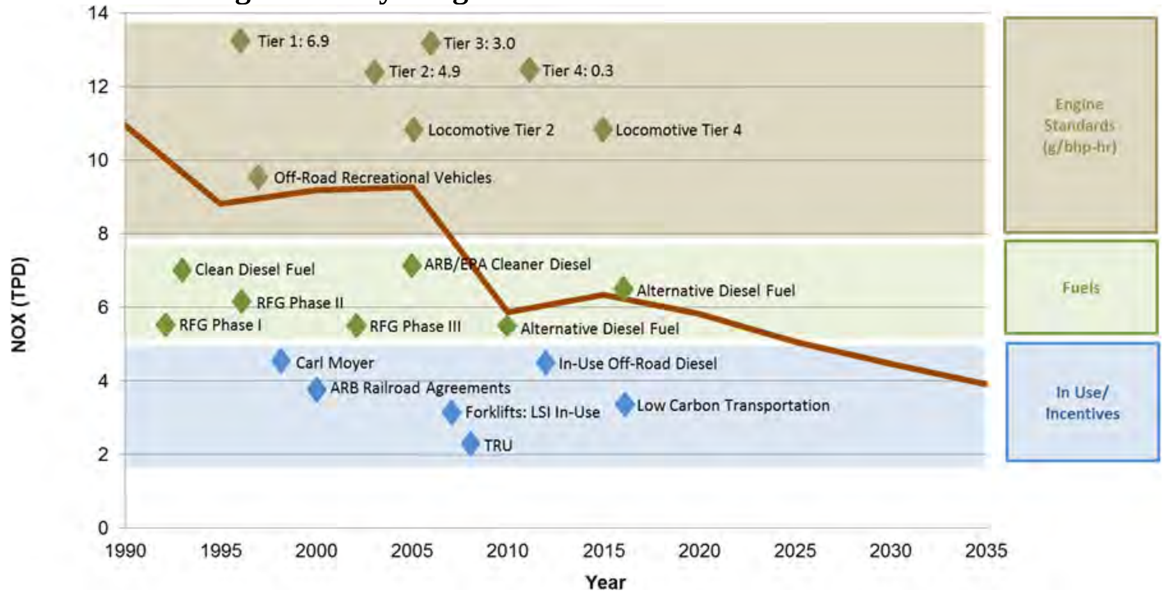
Figure 9: Key Programs to Reduce Off-Road Emissions



Appendix H of this Attainment Plan includes an extensive and detailed list of CARB's mobile source programs designed to reduce vehicle related emissions.

VIII. CARB COMMITMENTS FOR EASTERN KERN

A. CARB Commitments

SIPs may contain enforceable commitments to achieve the level of emissions necessary to meet NAAQS, as defined in the attainment demonstration. The 2022 State SIP Strategy lists new SIP measures and quantifies potential emissions reduction SIP commitments for the District based on the measures identified and quantified to date. CARB's Board adoption of the 2022 State SIP Strategy and control measure schedule formed the basis of the commitments for emission reductions by the attainment deadlines for each region that will be proposed for CARB's Board consideration, alongside the respective nonattainment area's SIP. The commitments consist of two key components:

1). A commitment to bring an item to the CARB Board for defined new measures or take other specified actions within CARB's authority; and

2). A commitment to achieve aggregate emission reductions by specific dates.

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

Commitment to Act on Measures

On September 22, 2022, the CARB Board adopted the 2022 State SIP Strategy list of measures and corresponding schedule. For each SIP measure from the 2022 State SIP Strategy shown in Table 6, CARB commits to address each measure as described in this document. For each measure committed to, CARB staff would undertake the actions detailed for each measure. In the instance of measures that involve the development of a rule under CARB's regulatory authority, CARB commits to bring a publicly noticed item before the CARB Board that is either a proposed rule or a recommendation that the CARB Board direct staff not to pursue a rule covering that subject matter at that time. That recommendation would be based on an explanation of why such a rule is unlikely to achieve the relevant emission reductions in the relevant timeframe and would include a demonstration that the overall aggregate commitment will be achieved despite that rule not being pursued. This public process and CARB hearing would provide additional opportunity for public and stakeholder input, ongoing technology review, and assessments of costs and environmental impacts.

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

Table 6: CARB Measures and Schedule

Measure	Agency	Action	Implementation Begins
On-Road Heavy-Duty			
Advanced Clean Fleets Regulation	CARB	2023	2024
Zero-Emissions Trucks Measure	CARB	2028	2030
On-Road Light-Duty			
On-Road Motorcycle New Emissions Standards	CARB	2022	2025
Clean Miles Standard	CARB	2021	2023
Off-Road Equipment			
Tier 5 Off-Road Vehicles and Equipment	CARB	2025	2029
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	CARB	2022	2024
Transport Refrigeration Unit Regulation Part 2	CARB	2026	2028
Cargo Handling Equipment Amendments	CARB	2025	2026
Off-Road Zero-Emission Targeted Manufacturer Rule	CARB	2027	2031
Clean Off-Road Fleet Recognition Program	CARB	2025	2027
Spark-Ignition Marine Engine Standards	CARB	2029	2031
Other			
Consumer Products Standards	CARB	2027	2028
Zero-Emission Standard for Space and Water Heaters	CARB	2025	2030
Enhanced Regional Emission Analysis in State Implementation Plans	CARB	2025	2023
Federally & Internationally Regulated Sources – CARB Measures			
In-Use Locomotive Regulation	CARB	2023	2024
Future Measures for Aviation Emission Reductions	CARB	2027	2029

Commitment to Achieve Emission Reductions

The following section describes the estimated emission reductions and commitment from the SIP measures identified and quantified to date for the District. The aggregate commitment of emissions reductions from State sources to be proposed for CARB Board consideration will be found in CARB's staff report for the Eastern Kern County 8-hour 70 ppb O_3 SIP when it is brought to the CARB Board. While the 2022 State SIP Strategy includes estimates of the emission reductions from each of the individual new measures, CARB's overall commitment is to achieve the total emission reductions necessary from State-regulated sources to attain the federal air quality standards, reflecting the combined reductions from the existing control strategy and new measures. Therefore, if a particular measure does not get its expected emission reductions, the State's overall commitment to achieving the total aggregate emission reductions still exists.

If actual emission decreases occur that exceed the projections reflected in the current emission inventory and the 2022 State SIP Strategy, CARB will submit an updated emissions inventory to EPA as part of a SIP revision. The SIP revision would outline the changes that have occurred, and provide tracking to demonstrate that aggregate emission reductions sufficient for attainment are being achieved through enforceable emission reduction measures. CARB's emission reduction commitments may be achieved through a combination of actions including but not limited to the implementation of control measures; the expenditure of local, State, or federal incentive funds; or through other enforceable measures.

Air quality modeling indicates that NOx emissions reductions are needed in areas upwind and within the District by 2032, in order to achieve attainment. A significant fraction of the needed reductions will come from the existing control program. In addition, although most of the 2016 State SIP Strategy measure commitments have been adopted, there is one (Zero Emission Forklift) that the CARB Board will be acting upon over the next year, and two that were recently adopted but are not yet accounted for in the baseline emissions inventory (Advanced Clean Cars II, Transport Refrigeration Unit Part 1), as outlined in Table 7. Action will be taken on the remaining measure in the coming year (2023).

Table 7: Reductions from Remaining 2016 State SIP Strategy Measures

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

*Numbers may not add up due to rounding.

Table 8 shows that, collectively, emissions reductions from CARB's current control program, reductions from the 2016 State SIP Strategy measures still to be adopted, and reductions estimated from the measures in the 2022 State SIP Strategy provide the emissions reductions needed from State sources to support attainment of the 70 ppb 8-hour O_3 NAAQS. The measures listed in Table 9 reflect CARB commitments for State actions and the estimated emissions reductions for the District.

Table 8: NOx Emission Reductions from CARB Programs

CARB Programs in Eastern Kern County	2032 NOx Emission Reductions (tpd)
Current Mobile Source Control Program[34].	3.1
Potential CARB Emissions Reductions Commitments	1.8
2016 State SIP Strategy Measures (Not yet in baseline inventory)	<0.1
2022 State SIP Strategy Measures	1.8
Total Reductions	4.9

*Numbers may not add up due to rounding.

Table 9: Expected Emissions Reductions from the 2022 State SIP Strategy Measures

Measure	2032 NOx (tpd)	2032 ROG (tpd)
On-Road Heavy-Duty		
Advanced Clean Fleets Regulation	0.1	<0.1
Zero-Emissions Trucks Measure	NYQ[35]	NYQ
Total On-Road Heavy-Duty Reductions	0.1	<0.1
Road Light-Duty		
On-Road Motorcycle New Emissions Standards	<0.1	<0.1
Clean Miles Standard	<0.1	<0.1
Total On-Road Light-Duty Reductions	<0.1	<0.1
Off-Road Equipment		
Tier 5 Off-Road Vehicles and Equipment	<0.1	NYQ
Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation	<0.1	<0.1
Transport Refrigeration Unit Regulation Part 2	0.1	<0.1
Cargo Handling Equipment Amendments	<0.1	<0.1
Off-Road Zero-Emission Targeted Manufacturer Rule	NYQ	NYQ
Clean Off-Road Fleet Recognition Program	NYQ	NYQ
Spark-Ignition Marine Engine Standards	<0.1	<0.1
Total Off-Road Equipment Reductions	0.2	<0.1
Other		
Consumer Products Standards	-	NYQ
Zero-Emission Standard for Space and Water Heaters	NYQ	NYQ
Enhanced Regional Emission Analysis in State Implementation Plans	NYQ	NYQ
Total Other	NYQ	NYQ
Primarily-Federally and Internationally Regulated Sources – CARB Measures		
In-Use Locomotive Regulation	1.5	<0.1
Future Measures for Aviation Emission Reductions	NYQ	NYQ
Total Primarily-Federally and Internationally Regulated Sources – CARB Measures Reductions	1.5	<0.1
Aggregate Emissions Reductions	1.8	0.1

*Numbers may not add up due to rounding.

[34]Source: CARB 2019 CEPAM v1.04; represents the current baseline emissions out to 100 nautical miles
[35] Not yet quantified

As a part of the aggregate emission reduction commitment for the District, CARB staff will propose to commit to emissions reductions specifically from on-road mobile sources that will be used for transportation conformity. CARB continues to have an aggregate emission reduction commitment, which is a sum of emissions reductions from on- and off-road mobile sources, consumer products, and other State regulated sources as outlined above. The on-road mobile source commitment will provide the enforceability needed to support the use of motor vehicle emissions budgets that factor in reductions from the on-road mobile source measures in the 2022 State SIP Strategy. The proposed on-road mobile source commitment in Table 10 is a subset of emissions reductions from the aggregate emission reduction commitment and is not additive to the aggregate emission reduction commitment.

Table 10: Emissions Reductions from On-Road Mobile Source Measures

On-Road Mobile Source Reductions	2032 NOx (tpd)	2032 ROG (tpd)
Eastern Kern County	0.2	0.03

B. CARB Measures

Advanced Clean Fleets Regulation

This measure accelerates zero-emission vehicle adoption in the medium- and heavy-duty sectors by setting zero-emission requirements for fleets and 100 percent ZEV sales requirement in California for manufacturers of Class 2b through 8 vehicles. The Advanced Clean Fleets Regulation will focus on strategies to ensure that the cleanest vehicles are deployed by government, business, and other entities in California to meet their transportation needs. The requirements would be phased-in on varying schedules for different fleets including public, drayage trucks, and high priority private and federal fleets. Public fleets would be required to phase-in purchase requirement starting at 50 percent of new purchases in 2024 and 100 percent starting in 2027. All drayage trucks operating at seaports and intermodal railyards would be required to be zero-emission by 2035. Drayage trucks will also have new registration and reporting requirements, starting in 2023. High priority private and federal fleets would be required to phase-in zero-emission vehicles as a percentage of the total fleet. The fleet requirements are based on zero-emission suitability and are phased-in by vehicle body type. The Advanced Clean Fleets Regulation would also include a requirement that 100 percent of Class 2b and above vehicle manufacturer sales in California are zero emissions starting in 2040.

Zero-Emission Trucks Measure

This measure would increase the number of ZEVs and require cleaner engines to achieve emissions reductions from fleets that are not affected by the proposed Advanced Clean Fleets measure. This would include potential zero-emissions zone concepts around warehouses and sensitive communities if CARB is given new authority to enact indirect source rules in combination with strategies to upgrade older trucks to newer and cleaner engines. This would be a transitional strategy to achieve zero emissions medium- and heavy-duty vehicles everywhere feasible by 2045.

C. On-Road Light-Duty

On-Road Motorcycles New Emissions Standards

This measure would reduce emissions from new, on-road motorcycles by adopting more stringent exhaust and evaporative emissions standards along with limited on board diagnostics requirements and zero-emissions sales thresholds with an associated credit program to help accelerate the development of zero emissions motorcycles. The new exhaust emissions standards include substantial harmonization with the more stringent European motorcycle emissions standards already in place. The new evaporative emissions standards are based on more aggressive CARB off highway recreational vehicle emissions standards that exist today. This measure also proposes significant zero-emission motorcycle sales thresholds beginning in 2028 and increasing gradually through 2035.

Clean Miles Standard

The Clean Miles Standard was adopted by CARB on May 20, 2021. The primary goals of this measure are to reduce GHG emissions from ride-hailing services offered by transportation network companies (TNCs) and promote electrification of the fleet by setting an electric vehicle mile target, while achieving criteria pollutant co-benefits. TNCs would be required to achieve zero grams CO2 emissions per passenger mile traveled and 90 percent electric VMT by 2030.

D. Off-Road Equipment

Tier 5 Off-Road Vehicles and Equipment

This measure would reduce NOx and PM emissions from new off road compression-ignition (CI) engines by adopting more stringent exhaust standards for all power categories, including those that do not currently utilize exhaust aftertreatment such as diesel particulate filters and selective catalytic reduction. This measure would be more stringent than required by current EPA and European Stage V non-road regulations and would require the use of best available control technologies.

For this measure, CARB staff would develop and propose standards for new off-road CI engines including the following: aftertreatment-based PM standards for engines less than 19 kilowatt (kW) (25 horsepower [hp]), after treatment-based NOx standards for engines greater than or equal to 19 kW (25 hp) and less than 56 kW (75 hp), and more stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp). Other possible elements include enhancing in-use compliance, proposing more representative useful life periods, and developing a low load test cycle. It is expected that this comprehensive off road Tier 5 regulation would rely heavily on technologies manufacturers are developing to meet the recently approved low NOx standards and enhanced in-use requirements for on-road heavy-duty engines.

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

Amendments to the In-Use Off-Road Diesel-Fueled Fleets Regulation were approved by CARB on November 17, 2022. This measure will further reduce emissions from the in-use off-road diesel equipment sector by adopting more stringent requirements to the In-Use Off-Road Diesel-Fueled Fleets Regulation. These amendments create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure.

The amendments include an operational backstop to the current In-Use Off Road Diesel-Fueled Fleets Regulation for most Tier 0, 1, and 2 engines between 2024 and 2032. This will allow a 12-year phase out of these oldest engines. Along with the operational backstop, adding vehicle provisions in the current regulation will be extended to phase in a limitation on the adding of Tier 3 and Tier 4i vehicles to fleets. The amendments also include proposed new requirements for most fleets to use renewable diesel, proposed requirements for prime contractors and public works awarding bodies to increase the enforceability of the regulation, and optional flexibility provisions for fleet adoption of zero-emission vehicles.

Transport Refrigeration Unit Regulation Part 2 (Non-Truck TRUs)

This measure is the second part of a two-part rulemaking to transition diesel-powered transport refrigeration units (TRUs) to zero-emission technologies. This measure would require zero-emission equipment for non-truck TRUs (trailer TRUs, domestic shipping container TRUs, railcar TRUs, TRU generator sets, and direct-drive refrigeration units).

Cargo Handling Equipment Amendments

This measure would start transitioning Cargo Handling Equipment (CHE) to full zero emission in 2026, with over 90 percent penetration of ZE equipment by 2036. Based on the current state of zero-emission CHE technological developments, the transition to zero-emission would most likely be achieved largely through the electrification of CHE. This assumption about aggressive electrification is supported by the fact that currently some electric RTG cranes, electric forklifts, and electric yard tractors are already commercially available. Other technologies are in early production or demonstration phases.

Off-Road Zero-Emission Targeted Manufacturer Rule

The Off-Road Zero-Emission Targeted Manufacturer Rule would accelerate the development and production of zero-emission off-road equipment and powertrains. Existing zero-emission regulations and regulations currently under development target a variety of sectors (e.g., forklifts, cargo-handling equipment, off road fleets, Small Off Road Engines (SORE), etc.). However, as technology advancements occur, more sectors including wheel loaders, excavators, and bulldozers could be accelerated. Fully addressing control of emissions from new farm and construction equipment under 175 horsepower that are preempted, will require partnership on needed Federal zero emission standards for off-road equipment.

This measure would require manufacturers of off-road equipment and/or engines to produce for sale zero-emission equipment and/or powertrains as a percentage of their annual statewide sales volume. Sales/production mandate levels would be developed based on the projected feasibility of zero-emission technology to enter and grow in the various off-road equipment types currently operating in California. This measure is expected to increase the availability of zero-emission options in the off-road sector and support other potential measures that promote and/or require the purchase and use of such options. A targeted manufacturer regulation will need to take into account parameters such as the number of equipment and engine manufacturers producing off-road equipment for sale in California, along with sales volumes, to ensure that such an effort is cost effective and technologically feasible.

Clean Off-Road Fleet Recognition Program

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

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

Spark-Ignition Marine Engine Standards

For this measure, CARB will develop and propose catalyst-based standards for outboard and personal watercraft engines less than or equal to 40 kW in power that will gradually reduce emission standards to approximately 70 percent below current levels. For outboard and personal watercraft engines under 40 kW, more stringent exhaust standards will be developed and proposed based on the incorporation of electronic fuel injection that will gradually reduce emission standards 40 percent below current levels. This measure would require a 5.0 g/kW-hr HC+NOx standard for outboard engines and personal watercraft engines at or above 40 kW in power and a 10.0 g/kW-hr HC+NOx standard for engines less than 40 kW.

In addition to requiring more stringent exhaust standards, CARB is considering actions consistent with Executive Order N-79-20 that would require a percentage of outboard and personal watercraft vessels to be propelled by zero-emission technologies for certain applications. Outboard engines less than 19 kW, which are typically not operated aggressively or for extended periods, could potentially be phased-out and gradually replaced with zero-emission technologies. Some personal watercraft applications could also potentially be replaced with zero-emission technologies.

E. Other Categories

Consumer Products Standards

This measure will further reduce VOC and equivalent VOC emissions from consumer products to expedite attainment of the O_3 NAAQS. As with previous rulemakings, emission reductions will be achieved by setting regulatory standards applicable to the content of consumer products. To meet emission reduction targets for the measure, CARB staff will evaluate categories with relatively high contributions to O_3 formation, whether currently regulated or unregulated. Staff will consider the merits of proposing VOC content standards as well as reactivity limits. Staff developing proposed amendments to the Consumer Products Regulation will also consider investigating concepts for expanding manufacturer compliance options, market-based approaches, and reviewing existing exemptions. Staff will work with stakeholders to explore mechanisms that would encourage the development, distribution, and sale of cleaner, very low, or zero-emitting products. In undertaking these efforts, staff will prioritize strategies that achieve the maximum feasible reductions in O_3 forming, toxic air contaminant, and GHG emissions. This measure complements a parallel measure in CARB's Climate Change Scoping Plan Update, approved by the CARB Board in December 2022, to phase down use of HFC 152a and other GHGs in consumer products.

Zero-Emission Standard for Space and Water Heaters

For this measure, CARB would develop and propose zero GHG emission standards for space and water heaters sold in California; CARB could also work with air districts to further tighten district rules to drive zero-emission technologies. This measure would not mandate retrofits in existing buildings, but some buildings would require retrofits to be able to use the new technology that this measure would require. Beginning in 2030, 100 percent of sales of new space and water heaters (for either new construction or replacement of burned-out equipment in existing buildings) would need to meet zero-emission standards. It is expected that this regulation would rely heavily on heat pump technologies currently being sold to electrify new and existing homes.

<u>Enhanced Regional Emissions Analysis in SIPs</u>

The primary goal of this measure is to reduce criteria pollutant and GHG emissions that come from on-road mobile sources through reductions in VMT. In addition, lowering VMT will help alleviate traffic congestion, improve public health, reduce consumption of fossil fuels, and reduce infrastructure costs. CARB is exploring three options to reduce ROG and NOx emissions through reductions in VMT. First, CARB will consider whether and how to change the process for developing MVEB by evaluating the existing MVEB development process to meet NAAQS. In addition, CARB will assess and improve the RACM analysis in the SIP by providing a comprehensive list of Transportation Control Measures (TCMs) and emission quantification methodology. Finally, CARB will consider updating the guidelines for the California Motor Vehicle Registration Fee (MV Fees) Program and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program to fund a broader range of transportation and air quality projects that advance new approaches and technologies in reducing air pollution.

F. CARB Measures for Federally & Internationally Regulated Sources

In addition to reducing emissions from the above sources, it is critical to achieve emissions reductions from sources that are primarily regulated at the federal and international level. It is imperative that the federal government and other relevant regulatory entities act decisively to reduce emissions from these primarily-federally and internationally regulated sources of air pollution. CARB and the air districts in California have taken actions to petition federal agencies for action and reduce emissions using programmatic mechanisms within our respective authorities. CARB continues to explore additional actions, many of which may require a waiver or authorization under the CAA, as described below.

<u>In-Use Locomotive Regulation</u>

This measure would use mechanisms available under CARB's regulatory authority to accelerate the adoption of advanced, cleaner technologies, and include zero emission technologies, for locomotive operations. The In-Use Locomotive Regulation would apply to all locomotives operating in the State of California with engines that have a total rated power of greater than 1,006 horsepower, excluding locomotive engines used in training of mechanics, equipment designed to operate on roads and rails, and military locomotives. The measure reduces emissions by increasing use of cleaner diesel locomotives and zero emission locomotives through a spending account, in-use operational requirements, and by an idling limit. By July 1, 2024, a spending account would be established for each locomotive operator. Funds in the account would only be used toward Tier 4 or cleaner locomotives until 2030, and at any time toward zero emission locomotives, zero-emission pilot or demonstration projects, or zero-emission infrastructure.

For the in-use operational requirements, beginning January 1, 2030, only locomotives built after January 1, 2007 may operate in California. Each year after January 1, 2030, only locomotives less than 23 years old may operate in California. Additionally, under the in-use operational requirements, starting January 1, 2030, all switch, industrial, and passenger locomotives operating in California with an original engine build date 2030 or newer will be required to be zero emission. Starting January 1, 2035, all freight-line haul locomotives operating in California with an original engine build date 2035 or newer must be zero emission. Locomotives equipped with automatic engine stop/start systems are to idle no more than 30 minutes unless an exemption applies. Locomotive operators would also be required to report locomotive engine emissions levels and activity on an annual basis.

Future Measures for Aviation Emissions Reductions

Future measures for aviation would reduce emissions from airport and aircraft related activities. The identified emission sources for the aviation sector are main aircraft engines, auxiliary power units (APU), and airport ground transportation. Emission reductions can be achieved by pursuing incentive and regulatory measures.

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

CARB would similarly work with EPA, Air Districts, airports, and industry stakeholders in a collaborative effort to develop regulations, voluntary measures, and incentive programs. CARB would evaluate the incentive amounts that would be required to encourage aircrafts to voluntarily use cleaner engines and fuels. Incentives to encourage the use of cleaner engines and fuels for aircraft in California would involve identification of funding sources and implementation mechanisms such as development of new programs.

IX. STATE SIP STRATEGY

The 2022, State Strategy for the State Implementation Plan (2022, State SIP Strategy) is a Statewide planning document that identifies the strategies and controls under State authority that are needed to reduce emissions to reduce ground-level O_3. These measures are needed across the State of California for areas to meet the federal 70 ppb 8-hour O_3 NAAQS. More specifically, the document describes the State's proposed commitments to develop control measures and reduce emissions from State-regulated sources as needed to support attainment by the required attainment dates; these State measures and commitments will be incorporated into regional SIPs for the 70 ppb O_3 standard for each nonattainment area. CARB's 2022, State SIP Strategy is located in Appendix J of this attainment plan.

X. BANKED EMISSION REDUCTION CREDITS

CAA §182(d)(2) requires that, for purposes of satisfying the offset requirements pursuant to this part, the ratio of total emission reductions of VOCs to total increased emissions of such air pollutant shall be at least 1.3 to 1, except that if the State plan requires all existing major sources in the nonattainment area to use Best Available Control Technology (BACT) (as defined in section 7479(3) of this title) for the control of VOCs, the ratio shall be at least 1.2 to 1.

The District's federally mandated New Source Review (NSR) rules 210.1, New and Modified Stationary Source Review (NSR) and 210.1A, Major New and Modified Stationary Source Review (MNSR) require new and modified major stationary sources that increase emissions in amounts exceeding specified thresholds to provide emission reduction offsets to mitigate their emissions growth. Offsets represent either on-site emission reductions, or the use of banked emission reduction credits (ERCs), which are voluntary, surplus emission reductions previously achieved and registered with the District for future use as offsets.

There should be no net effect on emissions inventories from future construction or modifications at major stationary sources due to offset requirements. For example, a new emissions unit at a major source producing "new" emissions are canceled out by reductions of other emissions units already in the inventory.

To ensure construction or modification of major sources has no net effect on emission inventories used for demonstrating attainment, banked ERCs, which otherwise would not be included as emissions in the baseline and subsequent inventories, must be added back into the inventories, pursuant to federal requirements[36]. Accordingly, Table 11 presents currently (as of 2022) banked ERCs in the District's credit bank that have been added to the emissions inventory.

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[36] 70 Federal Register 71676; November 29, 2005.

Table 11: Banked ERC Summary

Company Name	Certificate Number	NOx	VOC	Cumulative Totals	
		(TPY)	(TPY)	NOx	VOC
Edwards Air Force Base	0126002/501		3.44		3.44
Edwards Air Force Base	0127029/501		1.74		5.18
Edwards Air Force Base	0134004/401	0.23		0.23	5.18
Edwards Air Force Base	0134023/401	0.38		0.61	5.18
Edwards Air Force Base	0134023/501		0.01	0.61	5.19
Edwards Air Force Base	0134062/401	0.07		0.68	5.19
Edwards Air Force Base	0146004/501		0.09	0.68	5.28
Edwards Air Force Base	0147012/401	0.02		0.70	5.28
MSS Properties	2052001/401	3.57		4.27	5.28
MSS Properties	2052001/501		1.84	4.27	7.12
National Cement Company	1128003/401	9.41		13.68	7.12
National Cement Company	1128001/501		1.98	13.68	9.10
Naval Air Weapons Station	9001005/501		5.59	13.68	14.69
Naval Air Weapons Station	9001016/401	5.62		19.30	14.69
Naval Air Weapons Station	9001349/401	0.19		19.49	14.69
U.S. Borax, Inc.	1004005/401	1.76		21.25	14.69
U.S. Borax, Inc.	1004077/401	21.25		42.50	14.69
TOTALS (tons per year):				**42.50**	**14.69**
TOTALS (tons per day):				**0.12**	**0.04**

The amount of NOx and VOCs emission in the Banked ERC Summary table was not incorporated in the O_3 modeling emission inventory or the attainment demonstration. The amount of the ERCs banked is relatively small (0.12 tpd NOx and 0.04 tpd VOCs). The sensitivity analysis in the attainment demonstration concluded that an extra tpd of NOx emission would lead to an increase of 0.0426 ppb of O_3 design value for the attainment years, while the impact from extra VOC emission is negligible (Appendix M, Table 16). Thus, the banked ERCs would lead to an increase of 0.005 ppb in attainment year O_3 design values and would not affect the attainment status.

XI. EMISSION STATEMENT CERTIFICATION

Pursuant to CAA §182(a)(3)(B)[37] subsection (i), states must have an Emissions Statement program (i.e., rule) in place by 1993, that requires stationary sources to annually report and certify accuracy of their NOx and VOC emissions. Subsection (ii) has waiver provisions for stationary sources emitting less than 25 tpy of NOx or VOC. District Rule 108.2 (Emission Statement Requirements), was adopted July 13, 1992, last amended August 4, 2022, addresses Emissions Statement requirements. The District is currently awaiting EPA's approval of the 8/4/2022, revision and inclusion into the SIP. EPA promulgated the previous (5/2/1996), revision of Rule 108.2 into the SIP May 26, 2004[38].

[37] 70 Federal Register 71676; November 29, 2005.
[38] CAA §182(a)(3)(B) details Emissions Statement requirements for O3 nonattainment areas classified as marginal and above.

District staff reviewed Rule 108.2 for adequacy, pursuant to CAA requirements and subsequent EPA guidance. Staff amended Rule 108.2 August 4, 2022, to meet CAA §182(a)(3)(B) requirements set forth in the implementation rule as shown in Table 12. The District certifies Rule 108.2 is adequate for the purposes of implementing the 2008 and 2015, 8-hour O_3 NAAQS.

Table 12: CAA §182(a)(3)(B) Requirements and Provisions of District Rule 108.2

CAA §182(a)(3)(B)	District Rule 108.2
CAA §182(a)(3)(B)(i)	
Within 2 years after November 15, 1990, the State must submit revision to SIP to require that the owner or operator of each stationary source of NOx or VOC to provide the State with a statement, in such form as the Administrator may prescribe (or accept an equivalent alternative developed by the State), for classes or categories of sources, showing the actual emissions of NOx or VOC from that source.	Rule 108.2 was adopted in July 1992 and amended in May 1996. EPA promulgated Rule 108.2 into the SIP on May 26, 2004. Amended August 4, 2022, awaiting EPA approval.
Requires the owner/operator of stationary sources of NOx or VOC to provide the State with statements showing the actual NOx and VOC emissions.	The owner or operator of any source operation emitting or with the potential to emit NOx or VOC shall provide the District with a written statement, in such form as prescribed, showing actual emissions of NOx and VOC from such source.
Submittal of the first statement was required to be submitted within three years after November 15, 1990. Submittal of subsequent statements is required at least every year thereafter.	The first statement shall cover 1992 emissions and shall be submitted to the district by June 1993. Statements shall be submitted annually thereafter.
Statements shall contain a certification that the information contained in the statement in accurate to the best knowledge of the individual certifying the statement.	The statement shall also contain a certification by a responsible official of the company that information contained in the statement is accurate to the best knowledge of the individual certifying the statement.
CAA §182(a)(3)(B)(ii)	
The State may elect to waive the application of clause (i) to any class or category of stationary sources which emit less than 25 tons per year of VOC or NOx if the State provides an inventory of emissions from such class or category of source, based on the use of the emission factors established by the Administrator or other methods acceptable to the Administrator.	The Control Officer may waive this requirement to any class or category of stationary sources emitting less than 25 tons per year of oxides of nitrogen or reactive organic gases if the district provides CARB with an emission inventory of sources emitting greater than 10 tons per year of nitrogen oxides or reactive organic gases based on the use of emission factors acceptable to the CARB.

XII. NEW SOURCE REVIEW

Pursuant to CAA §182(c)(10), the District is required to have an New Source Review (NSR) rule designed to address emissions from new and modified major stationary sources of NOx or VOC. District Rule 210.1, New and Modified Stationary Source Review (NMSR), last amended May 4, 2000, was initially adopted in 1974 when the District's jurisdiction included the San Joaquin portion of Kern County and was classified as Serious nonattainment. Therefore, the applicability thresholds for NOx and VOCs in Rule 210.1 is 50 tpy with an offset ratio of 1.2-to-1 (as mandated in the CAA for areas classified as "Serious" nonattainment). Although this satisfies the requirements of the District's 2015, O_3 NAAQS, it does not meet the requirements of District's 2008, O_3 NAAQS classification of Severe nonattainment; which has NOx and VOCs applicability thresholds of 25 tpy with an offset ratio of 1.3-to-1. In an effort to meet the requirements of Severe nonattainment, the District adopted Rule 210.1A, Major New and Modified Stationary Source Review (MNSR) on August 8, 2022. Rule 210.1A has a NOx and VOC threshold of 25 tpy and an offset ratio of 1.3-to-1.

The District certifies the currently adopted version of Rule 210.1 (NSR), and 210.1A (MNSR) are sufficient for the purposes of the 2008, and 2015, O_3 NAAQS, and fulfills the requirements of a Severe nonattainment area (which would also include Serious). Although the key regulatory components of Rule 210.1 currently satisfy the NOx and VOC applicability threshold and offset ratio for Serious nonattainment, the District plans to amend Rule 210.1 in the near future to include components for Severe and Extreme nonattainment along with any new or revised definitions, and any new EPA requirement.

XIII. ATTAINMENT PLAN REQUIREMENTS

EPA's Implementation Rule for the O_3 NAAQS requires additional planning and emission control demonstrations necessary for Severe nonattainment areas (which includes Serious) in order to comply with the CAA. These conditions go beyond the general requirements listed in Section III of this plan and include the following:

1). **Reasonably Available Control Measures (RACM):** CAA §172(c) requires the District to verify that all RACM including stationary, transportation, and mobile) are being implemented as expeditiously as practicable.

2). **Reasonable Further Progress (RFP):** CAA §182(b)(1) requires the District to provide RFP to show steady progress in emission reduction between the baseline planning (2008), base year (2018), and attainment year (2026, 75 ppb and 2032, 70 ppb).

3). **Attainment Demonstration:** CAA §182(c)(2)(A) requires the District to develop photochemical air quality simulation modeling that demonstrates attainment of 2008 8-hour O_3 NAAQS as expeditiously as practicable.

4). **Contingency Measures:** CAA §179(c)(9) requires the District to implement contingency measures in the event of failure to achieve RFP milestones or to attain 8-hour O_3 NAAQS by the attainment deadline.

XIV. REASONABLE AVAILABLE CONTROL MEASURES DEMONSTRATION

To fulfill the CAA control measure requirements for O_3 nonattainment areas, an assessment of control measures in the SIP must be performed. For O_3 nonattainment areas, the control measures must be shown to be RACM. CARB is responsible for measures to reduce emissions from mobile sources needed to attain the national ambient air quality standards (standards). This chapter will discuss how California's mobile source measures meet RACM.

Given the severity of California's air quality challenges, CARB has implemented the most stringent mobile source emissions control program in the nation. CARB's comprehensive strategy to reduce emissions from mobile sources includes stringent emissions standards for new vehicles, in-use programs to reduce emissions from existing vehicle and equipment fleets, cleaner fuels that minimize emissions, and incentive programs to accelerate the penetration of the cleanest vehicles beyond that achieved by regulations alone. Taken together, California's mobile program meets RACM requirements in the context of O_3 nonattainment.

A. RACM Requirements

EPA has interpreted RACM to be those emission control measures that are technologically and economically feasible and when considered in aggregate, would advance the attainment date by at least one year. Section 172(c)(1) of the Act requires SIPs to provide for the implementation of RACM as expeditiously as practicable. Given the severity of California's air quality challenges, CARB has implemented the most stringent mobile source emissions control program in the nation. CARB's comprehensive strategy to reduce emissions from mobile sources includes stringent emissions standards for new vehicles, in-use programs to reduce emissions from existing vehicle and equipment fleets, cleaner fuels that minimize emissions, and incentive programs to accelerate the penetration of the cleanest vehicles beyond that achieved by regulations alone. Taken together, California's mobile source program meets RACM requirements in the context of O_3 nonattainment.

To ensure the State continues to meet RACM requirements and achieve its emissions reductions goals in the future, California continues to develop new programs and regulations to strengthen its overall mobile source program and to achieve new emissions reductions from mobile sources.

B. RACM for Mobile Sources

1. Waiver and Authorizations

While section 209 of the Act preempts other states from adopting emission standards and other emission-related requirements for new motor vehicles and engines that differ from the federal standards set by EPA, the Act provides California with the ability to seek a waiver or authorization from the federal preemption clause in order to enact emission standards and other emission-related requirements for new motor vehicles and engines, as well as new and in-use off-road vehicles and engines[39] – provided California standards are at least as protective as applicable federal standards.

Over the years, California has received waivers and authorizations for over 100 regulations. The most recent California standards and regulations that have received waivers and authorizations are: the Advanced Clean Cars (ACC) regulations for light duty vehicles including ZEV and the Low-Emission Vehicle III (LEV III) regulations); the On-Board Diagnostics (OBD) regulation; the Heavy-Duty Idling, Malfunction and Diagnostics System Regulation; the In-Use Off-Road Diesel Fleets Regulation; the Large Spark Ignition (LSI) Fleet Regulation; and the Mobile Cargo Handling Equipment (CHE) regulation. Further, CARB has recently submitted waiver requests for: *Advanced Clean Transit (ACT) regulation; the Zero-Emission Airport Shuttle Buses Regulation; the Zero Emission Powertrain Certification Regulation, and the Heavy-Duty Omnibus Regulation*. Other authorizations include the Off Highway Recreational Vehicles and PERP.

Additionally, CARB obtained an authorization from EPA to enforce adopted emission standards for off-road engines used in yard trucks and two-engine sweepers. CARB adopted the off-road emission standards as part of its “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 bulk of the regulation applies to in use heavy-duty diesel on-road motor vehicles with a gross vehicle weight rating in excess of 14,000 pounds, which are not subject to preemption under section 209(a) of the Act and do not require a waiver under section 209(b).

The waiver and authorizations California has received are integral to the success and stringent emission requirements that characterize CARB’s mobile source program. Due to California’s unique waiver authority under the Act, no other state or nonattainment area has the authority to promulgate mobile source emission standards at levels that are more stringent than the federal standards. Other states can elect to match either the federal standards or the more stringent California standards. As such, no state or nonattainment area has a more stringent suite of mobile source emission control programs than California, implying a de-facto level of control that at least meets, if not exceeds, RACM.

[39] Locomotives and engines less than 175 horsepower (hp) used in farm and construction equipment are exempt from California’s waiver authority.

2. CARB's Mobile Source Controls

CARB's current mobile source control program, along with efforts at the local and federal level, have been tremendously successful in reducing emissions of air pollutants, resulting in significantly cleaner vehicles and equipment in operation.

CARB developed its 2022 State Strategy for the SIP (2022 State SIP Strategy) through a multi-step measure development process, including extensive public consultation, to develop and evaluate potential strategies for mobile source categories under CARB's regulatory authority that could contribute to expeditious attainment of the 70 ppb 8-hour O_3 NAAQS, as well as supporting attainment for other national and State air quality standards. This effort builds on the measures and commitments already made in the 2016 State SIP Strategy, and expands on the scenarios and concepts included in the 2020 Mobile Source Strategy, CARB's multi pollutant planning effort that identifies the pathways forward to achieve the State's many air quality, climate, and community risk reduction goals. The Board adopted the 2022 State SIP Strategy in September 2022.

With the 2022 State SIP Strategy, CARB is exploring and proposing an unprecedented variety of new measures to reduce emissions from the sources under our authority using all mechanisms available. The measures included in the 2022 State SIP Strategy encompass actions to establish requirements for cleaner technologies (both zero-emissions and near zero-emissions), deploy these technologies into the fleet, and to accelerate the deployment of cleaner technologies through incentives.

3. Light- and Medium-Duty Vehicles

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 CARB regulations, today's new cars pollute 99 percent less than their predecessors did thirty years ago. In 1970, CARB 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.

Light- and medium-duty vehicles are currently regulated under California's ACC program, which includes the LEV III and ZEV programs. The ACC program combines the control of smog, soot-causing pollutants, and greenhouse gas emissions into a single coordinated package of requirements for model years 2015 through 2025. Since first adopted in 1990, CARB'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. Advanced Clean Cars II (ACC II), a measure in the 2016 State SIP Strategy, is a significant effort critical to meeting air quality standards and will be finalized this year. ACC II, which was recently adopted by the CARB Board in

August 2022, has the goal of cutting emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035.

For passenger vehicles, the 2022 State SIP Strategy includes actions to increase the penetration of ZEVs by targeting ride-hailing services offered by transportation network companies through the Clean Miles Standard regulation in order to reduce GHG and criteria pollutant emissions, and promote electrification of the fleet. For motorcycles, the 2022 State SIP Strategy proposes more stringent exhaust and evaporative emissions standards along with zero-emissions sales thresholds. The primary goal of the On-Road Motorcycle New Emissions Standard measure is to reduce emissions from new, on-road motorcycles by adopting more stringent exhaust and evaporative emissions standards along with zero emissions sales thresholds.

CARB is also active in implementing in-use programs for owners of older dirtier vehicles to retire them early. The “car scrap” programs, like Clean Cars 4 All and Clean Vehicle Rebate Project provide monetary incentives to replace old vehicles with zero emission vehicles. Other California programs and goals such as the 2012 Governor’s Executive Order to put 1.5 million zero emission vehicles on the road by 2025 and will produce substantial and cost effective emission reductions from the light-duty vehicle sector.

Taken together, California’s emission standards, fuel specifications, and incentive programs for on-road light- and medium-duty vehicles represent all measures that are technologically and economically feasible within California. There are no additional measures that, when considered in aggregate, would advance the attainment date by at least one year.

4. Heavy-Duty Vehicles

California’s heavy-duty vehicle emissions control program includes requirements for increasingly stringent new engine emission standards and addresses vehicle idling, certification procedures, on-board diagnostics, emissions control device verification, and in use measures to ensure that emissions from the existing vehicle fleet remain adequately controlled. Taken together, the on-road heavy-duty vehicle program is designed to achieve an on-road heavy-duty diesel fleet with 2010 engines emitting 98 percent less NOx and PM2.5 than trucks sold in 1986.

Other significant in-use control measures CARB has in place include: the On-Road Heavy Duty Diesel Vehicle (In Use) Regulation; the Drayage (Port or Rail Yard) Regulation; the Public Agency and Utilities Regulation; the Solid Waste Collection Vehicle Regulation; the Heavy-Duty (Tractor-Trailer) Greenhouse Gas (GHG) Regulation, the Airborne Toxic Control Measures (ATCM) to Limit Diesel Fueled Commercial Motor Vehicle Idling; the Heavy-Duty Diesel Vehicle Inspection Program; the Periodic Smoke Inspection Program (PSIP); the, Fleet Rule for Transit Agencies; the Lower-Emission School Bus Program; and Heavy-Duty Truck Idling Requirements.

In 2013, California recognized the heavy-duty engines could be cleaner and established optional low-NOx standards for heavy-duty diesel engines (Optional Reduced Emissions Standards for Heavy-Duty Engines regulation), with the most aggressive standard being 0.02 g/bhp-hr, 90 percent below the 2010 federal standard. Further, in 2021, CARB adopted the Heavy-Duty Engine and Vehicle Omnibus Regulation (Omnibus Regulation) which made the 0.02 g/bhp-hr a mandatory standard, and comprehensively overhauled how NOx emissions from new heavy-duty engines are regulated in California. The Omnibus Regulation also includes in-use standards that significantly reduce tailpipe NOx emissions during most vehicle operating modes, and revisions to the emissions warranty, useful life, emissions warranty and reporting information and corrective action procedures, and durability demonstration procedures.

To further control emissions from the in-use fleet, CARB adopted in 2021 the Heavy Duty Inspection and Maintenance Regulation, which requires periodic demonstration that vehicles' emissions control systems are properly functioning in order to legally operate within the State. This regulation is designed to achieve criteria emissions reductions by ensuring that malfunctioning emissions control systems are timely repaired.

In June 2020, CARB adopted the ACT regulation, a first of its kind regulation requiring medium- and heavy-duty manufacturers to produce ZEVs as an increasing portion of their sales beginning in 2024. This regulation is expected to result in roughly 100,000 ZEVs by 2030 and nearly 300,000 ZEVs by 2035. Most recently in the ongoing efforts to go beyond federal standards and achieve further reductions, the 2022 State SIP Strategy includes the complementary Advanced Clean Fleets measure. Through this program, CARB is developing a medium and heavy-duty zero-emission fleet regulation with the goal of achieving a zero-emission truck and bus California fleet by 2045 everywhere feasible, and significantly earlier for certain market segments such as last mile delivery and drayage applications.

The 2022 State SIP Strategy also includes the Zero-Emissions Trucks Measure, which would accelerate the number of zero-emission heavy-duty vehicles beyond existing measures and the Advanced Clean Fleets measure. The Zero-Emissions Trucks Measure was developed in response to comments from the public related to turning over heavy-duty trucks at the end of their useful life. The Zero-Emissions Trucks Measure targets the replacement of older trucks in order to increase the number of heavy-duty ZEVs as soon as possible and reduces emissions from fleets not affected by the Advanced Clean Fleets measure. CARB is exploring new methods to replace older trucks, including market signal tools that would burden low-income truckers, provide flexibility and target reductions in the areas that need it most.

In addition, CARB’s significant investment in incentive programs provides an additional mechanism to achieve maximum emission reductions from this source sector. California has a variety of programs to incentivize clean heavy-duty vehicles that include the Carl Moyer Air Quality Standards Attainment Program, the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project, the Truck Loan Program, and AB 617 Community Air Protection Funds.

Taken together, California's emission standards, fuel specifications, and incentive programs for on-road heavy-duty vehicles represent all measures that are technologically and economically feasible within California. There are no additional measures that, when considered in aggregate, would advance the attainment date by at least one year.

5. Off-Road Vehicles and Engines

California regulations for off-road equipment include not only increasingly stringent emission standards for new off road diesel engines, but also in-use requirements and idling restrictions. CARB has programs in place to control emissions from various new off-road vehicles and equipment. CARB also has in-use programs for off-road vehicles and equipment, including the In-Use Off-Road Diesel Fueled Fleets Regulation (Off-Road Regulation) and Large Spark-Ignition Engine Fleet Requirements Regulation, as well as incentive programs including the Clean Off-Road Equipment (CORE) Voucher Incentive Project. CARB adopted amendments to the small off-road engine regulations in December 2021, the Transport Refrigeration Unit Part 1 regulatory action in February 2022, and will be proposing the Zero Emission Off-Road Forklift regulation in the next year.

The Off-Road Regulation, adopted in 2010, is an extensive program designed to accelerate the penetration of the cleanest equipment into California's fleets, and impose idling limits on off-road diesel vehicles. The program goes beyond emission standards for new engines through comprehensive in-use requirements for legacy fleets. CARB is also including in the 2022 State SIP Strategy a measure for amendments to the existing Off-Road Regulation. These amendments would create additional requirements to the currently regulated fleets by targeting the oldest and dirtiest equipment that is allowed to operate indefinitely under the current regulation's structure, potentially through an operational ban on the oldest and dirtiest equipment and limitations on vehicles added to a fleet.

The LSI Engine Fleet Requirements Regulation applies to operators of forklifts, sweeper/scrubbers, industrial tow tractors, and airport ground support equipment (GSE). The 2006 LSI rulemaking and 2010 amendments required operators of in-use fleets to achieve specific hydrocarbon + NOx fleet average emission level standards that became more stringent over time. CARB adopted amendments to the small off-road engine (SORE) regulations in December 2021 that will accelerate the transition of SORE equipment to Zero Emission Equipment (ZEE). Deployment of ZEE is key to meeting the expected emission reductions in the 2016 State SIP Strategy.

As discussed in the 2016 State SIP Strategy, CARB is also developing new requirements to transition diesel-powered transport refrigeration units (TRUs) to zero-emission technology in two phases. CARB adopted the Part 1 amendments to the existing TRU ATCM in February 2022, which requires the transition of diesel-powered truck TRUs to zero-emission. As discussed in the 2022 State SIP Strategy, CARB plans to develop a subsequent Part 2 regulation to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets, for future Board consideration.

Additionally, the 2022 State SIP Strategy includes the Tier 5 Off-Road New Compression-Ignition Engine Standards measure to reduce NOx and PM emissions from new, off-road compression-ignition engines by adopting more stringent exhaust standards for all power categories. Compression-ignition engines are used in a wide range of off-road equipment including tractors, excavators, bulldozers, graders, and backhoes. The standards considered for this measure would be more stringent than required by current EPA and European Stage V non-road regulations and would require the use of BACT for both PM and NOx.

CARB is also developing a measure, as described in the 2022 State SIP Strategy, to accelerate the development and production of zero-emission off-road equipment and powertrains through the Off-Road Zero-Emission Targeted Manufacturer Rule. Existing zero-emission regulations and regulations currently under development target a variety of sectors (e.g., forklifts, cargo handling equipment, off-road fleets, small off road engines, etc.) however, as technology advancements occur, more sectors, including wheel loaders, excavators, and bulldozers could be accelerated through this measure.

Further, CARB implements a number of incentive programs and projects to advance the turnover of off-road equipment to cleaner technologies. The Moyer Program has provided funding towards on- and off-road equipment for decades. The CORE is a newer project that is intended to accelerate deployment of advanced technology in the off-road sector and targets commercial-ready products that have not yet achieved a significant market foothold. For engines and equipment used in agricultural processes, CARB has the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) program to support fleet turnover to cleaner engines.

Taken together, California's comprehensive suite of emission standards, fuel specifications, and incentive programs for off-road vehicles and engines represent all measures that are technologically and economically feasible within California. There are no additional measures, that, when considered in aggregate, would advance the attainment date by at least one year.

6. Fuels

As mentioned earlier, cleaner burning fuels also play an important role in reducing emissions from motor vehicles and engines in these source categories. CARB has adopted standards to ensure that the fuels sold in California are the cleanest in the nation. These programs include the California Reformulated Gasoline program (CaRFG), which controls emissions from gasoline, and the Ultra-Low Sulfur Diesel requirements (2006), which provide the nation's cleanest diesel fuel specifications and help to ensure that diesel fuels burn as cleanly as possible and work synergistically with cleaner-operating heavy-duty trucks equipped with advanced emission control systems that debuted in 2007, and the Low Carbon Fuel Standard. These fuel standards, in combination with engine technology requirements, ensure that California's transportation system achieves the most effective emission reductions possible.

Taken together, California's emission standards, fuel specifications, and incentive programs for other mobile sources and fuels represent all measures that are technologically and economically feasible within California. There are no additional measures that, when considered in aggregate, would advance the attainment date by at least one year.

7. Mobile Source Summary

California's long history of comprehensive and innovative emissions control has resulted in the most stringent mobile source control program in the nation. EPA has previously acknowledged the strength of the program through the waiver process, and in their approvals of CARB's regulations and District plans.

While EPA deferred action on the RACM elements included in the 2017 Eastern Kern O_3 SIP plan for the 75 ppb 8-hour O_3 NAAQS[40], it did find that the State's current control program and measure commitments from the 2016 State SIP Strategy met RACM requirements in its 2019 approval of the San Joaquin Valley's 2016 O_3 Plan for the same O_3 standard:

"There are no additional reasonably available control measures that would advance attainment of the 2008 ozone standards in the San Joaquin Valley… therefore, the 2016 Ozone Plan provides for the implementation of all RACM as required by [the] CAA. [41]"

In addition to declarations that the mobile source control program meets RACM requirements, EPA has also provided past determinations that CARB's mobile source control programs meet the more rigorous BACM requirements. As BACM requirements are considered a more stringent threshold to meet than RACM, EPA has stated that a determination that the control program has meet BACM requirements also constitutes a conclusion that it meets RACM requirements[42].

[40] 86 FR 33528 *https://www.federalregister.gov/documents/2021/06/25/2021-13608/approval-of-air-quality-implementation-plans-california-eastern-kern-8-hour-ozone-nonattainment-area*
[41] 84 FR 3302 *https://www.federalregister.gov/documents/2019/02/12/2019-01686/clean-air-plans-2008-8-hour-ozone-nonattainment-area-requirements-san-joaquin-valley-california*
[42] "We interpret the BACM requirement as generally subsuming the RACM requirement (i.e., if we determine that the measures are indeed the ''best available,'' we have necessarily concluded that they are ''reasonably

EPA has acknowledged CARB's mobile source control program as meeting BACM in and in their 2019 approval of the South Coast's PM2.5 Serious Area Plan[43]. In their 2018 proposal for that approval, EPA noted that,

"With respect to mobile sources, we recognize that CARB's current program addresses the full range of mobile sources in the South Coast through regulatory programs for both new and in-use vehicles… Overall, we believe that the program developed and administered by CARB and SCAG provide for the implementation of BACM for PM2.5 and PM2.5 precursors in the South Coast nonattainment area. [44]*"*

In in their 2020 approval of the San Joaquin Valley's PM2.5 Serious Area 2018 Plan[45], EPA further found that CARB's mobile source control program met the more stringent level of Most Stringent Measures (MSM). In their 2020 proposal for that plan, EPA found that,

"CARB's programs constitute the most stringent emission control programs currently available for the mobile source and fuels categories, taking into account economic and technological feasibility. [46]*"*

CARB has continued to substantially enhance and accelerate reductions from our mobile source control programs through the implementation of more stringent engine emissions standards, in-use requirements, incentive funding, and other policies and initiatives as described in the preceding sections. The CARB process for developing CARB's control measures includes an extensive public process and is consistent with EPA's RACM guidance. Through this process, CARB found that with the current mobile source control program and new measures included in the 2022 State SIP Strategy, there are no additional reasonable available control measures that would advance attainment of the 70 ppb 8-hour O_3 NAAQS in the nonattainment area. There are no reasonable regulatory control measures excluded from use in this plan; therefore, there are no emissions reductions associated with unused regulatory control measures. As a result, California's mobile source control programs fully meet the requirements for RACM.

C. RACM for Stationary Sources

Sections 182(b)(2) and 182(f) of the FCAAA (42 U.S.C. §7511(a)) require O3 nonattainment areas to implement Reasonably Available Control Technology (RACT) emission standards for "major sources" of VOCs and NOx (O3 precursors). RACT is also required for sources of air pollution that are subject to Control Techniques

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[43] 84 FR 3305 *https://www.federalregister.gov/documents/2019/02/12/2019-01922/approval-and-promulgation-of-implementation-plans-california-south-coast-serious-area-plan-for-the*
[44] 83 FR 49872 *https://www.federalregister.gov/documents/2018/10/03/2018-21560/approval-and-promulgation-of-implementation-plans-california-south-coast-serious-area-plan-for-the*
[45] 85 FR 44192 *https://www.federalregister.gov/documents/2020/07/22/2020-14471/clean-air-plans-2006-fine-particulate-matter-nonattainment-area-requirements-san-joaquin-valley*
[46] 85 FR 17382 *https://www.federalregister.gov/documents/2020/03/27/2020-05914/clean-air-plans-2006-fine-particulate-matter-nonattainment-area-requirements-san-joaquin-valley*

Guidelines (CTGs) issued by EPA14. RACT is defined as the lowest emissions limitation that a particular source is capable of meeting by the application of air pollution control technology that is reasonably available considering technological and economic feasibility (44 FR 53762; September 17, 1979) [47].

RACT requirements are included in the CAA to assure that significant source categories of O_3 precursor emissions are controlled to a "reasonable" extent, but not necessarily to the more stringent Best Available Control Technology (BACT) or Maximum Achievable Control Technology (MACT) levels expected for new or modified major stationary sources.

Pursuant to the 75 ppb 8-hour O_3 NAAQS, the District's stationary source NOx and VOC prohibitory rules were fully addressed in the District's 2017 Reasonable Available Control Technology State Implementation Plan (RACT SIP). The RACT SIP evaluated District O_3 precursor control measures to determine compliance with federal RACT requirements for stationary sources covered by Control Technique Guidelines (CTGs). The RACT SIP revealed deficiencies in the following three District rules designed to regulate NOx at major stationary sources:
425 (Cogeneration Gas Turbine Engines);
425.2 (Boilers, Steam Generators, and Process Heaters); and
425.3 (Portland Cement Kilns).

The District committed to amending the three deficient rules in the 2017 O_3 Attainment Plan. [48] The District amended all three Rules in 2018 to adequately correct their deficiencies and fulfill RACT requirements. The Board adoption dates are as follows Rule 425 amended January 11, 2018, Rules 425.2 and 425.3 amended March 8, 2018.

Pursuant to the 70 ppb 8-hour O_3 NAAQS, the District's stationary source NOx and VOC prohibitory rules were fully addressed in the District's 2020 RACT SIP. The RACT SIP evaluated District O_3 precursor control measures to determine compliance with federal RACT requirements for stationary sources covered by CTGs. All rules applicable to CTG source categories were determined to meet or exceed CTG requirements.
The District's 2017 RACT SIP is located in Appendix N and the 2020 RACT SIP is located in Appendix O of this attainment plan.

D. RACM for Consumer Products

Consumer products are defined as chemically formulated products used by household and institutional consumers. For thirty years, CARB has taken actions pertaining to the regulation of consumer products. Three regulations have set VOC limits for 129 consumer product categories. These regulations, referred to as the Consumer Product

[47] RACT requirements are included in the Clean Air Act to ensure that significant source categories at major sources of ozone precursor emissions are controlled to a "reasonable" extent, but not necessarily to the more stringent best available control technology (BACT) or maximum achievable control technology (MACT) levels expected for new or modified major stationary sources.
[48] 2017 Ozone Attainment Plan For 2008 Federal 75 ppb 8-Hour Ozone Standard Adopted – July 27, 2017

Program, have been amended frequently, and progressively stringent VOC limits and reactivity limits have been established. These are Regulation for Reducing VOC Emissions from Antiperspirants and Deodorants; Regulation for Reducing Emissions from Consumer Products; and Regulation for Reducing the Ozone Formed from Aerosol Coating Product Emissions, and the Tables of Maximum Incremental Reactivity Values. Additionally, a voluntary regulation, the Alternative Control Plan has been adopted to provide compliance flexibility to companies. The program's most recent rulemaking occurred in 2021 with amendments to Consumer Products Regulation and Method 310.

EPA also regulates consumer products. EPA's consumer products regulation was promulgated in 1998 however; federal consumer products VOC limits have not been revised since their adoption. EPA also promulgated reactivity limits for aerosol coatings. As with the general consumer products, California's requirements for aerosol coatings are more stringent than the EPA's requirements. Other jurisdictions, such as the Ozone Transport Commission states, have established VOC limits for consumer products that are modeled after the California program. However, the VOC limits typically lag those applicable in California.

In summary, California's Consumer Products Program, with the most stringent VOC requirements applicable to consumer products, meets RACM. There are no additional reasonable available control measures that, when considered in aggregate, would advance attainment of the 70 ppb 8-hour O_3 NAAQS in the nonattainment area. There are no reasonable regulatory control measures excluded from use in this plan; therefore, there are no emissions reductions associated with unused regulatory control measures. As a result, California's consumer product control program fully meets the requirements for RACM.

XV. REASONABLE FURTHER PROGRESS (RFP)

CAA §172(c)(2) and §182(c)(2) require nonattainment areas to provide for Reasonable Further Progress (RFP). RFP is defined in CAA §171(1) as " such annual incremental reductions in emissions of the relevant air pollutant as are required…for the purpose of ensuring attainment of the applicable national ambient air quality standard by the applicable date." This requirement to demonstrate steady progress in emission reductions between the baseline year and attainment date ensures that areas will begin lowering air pollution in a timely manner and not delay implementation of control programs until immediately before the attainment deadline.

There are two separate RFP requirements for O_3 nonattainment areas depending upon their classification. For O_3 nonattainment areas classified as Moderate or above, there is a one-time requirement for a 15% reduction in ROG emissions over the first six years of the planning period (§182(b)(1)). For O_3 nonattainment areas classified as Serious or higher, §182(c)(2)(B) of the Act has an additional requirement to demonstrate 3% per year cumulative reduction of O_3 precursors averaged over each consecutive three-year period until attainment.

In 1997, EPA approved a 15% ROG-only rate of progress demonstration for the District's O_3 nonattainment area for the 1-hour O_3 standard covering the entire nonattainment area for the 75 ppb 8-hour O_3 standard[49]. As such, the requirement under section 182(b)(1) of the Act in the first 6 years of the attainment planning period has been met for the O_3 nonattainment area.

For the §182(c)(2)(B) RFP requirement for Serious and higher areas, EPA guidance allows for NOx substitution to demonstrate the annual 3% reductions of O_3 precursors if it can be demonstrated that substitution of NOx emission reductions (for ROG reductions) yields equivalent O_3 reductions[50]. Additional EPA guidance states that certain conditions are needed to use NOx substitution in an RFP demonstration[51]. First, an equivalency demonstration must show that cumulative RFP emission reductions are consistent with the NOx and ROG emission reductions determined in the O_3 attainment demonstration. Second, the reductions in NOx and ROG emissions should be consistent with the continuous RFP emission reduction requirement. The guidance states "Any combination of VOC (ROG) and NOx emission reductions which totals 3% per year and meet other SIP consistency requirements described in this document are allowed."

Photochemical modeling included in the attainment demonstration shows that NOx reductions are critical for the District to reach attainment and yields more O_3 reductions compared to the same percentage of ROG reductions. See Appendix B for more information.

The current SIP submittal address two 8-hour O_3 standards (75 ppb and the 70 ppb). For the 75 ppb 8-hour standard, the District is required to demonstrate RFP from the base-year of 2011, to the remaining future milestone year of 2023, and the attainment year of 2026. For the 70 ppb 8-hour O_3 standard, the District must demonstrate RFP in all milestone years until attainment, which are 2023, 2026, 2029, and the attainment year of 2032. The base-year for the 70 ppb RFP demonstration is 2017.

The District's 8-hour O_3 RFP demonstrations were developed using CARB's CEPAM2019v1.04 Emission Projections (see Appendix M). In order to demonstrate consistency between the RFP demonstration and the motor vehicle emissions budgets (MVEB), a line item adjustment is made in the RFP demonstration to account for the differences in the on-road mobile source emissions projections in the CEPAM inventory and the MVEB which is rounded up to the nearest tenth of a ton, see Section VI.B.

Another line item adjustment to the RFP demonstration is made to account for banked ERCs. ERCs are voluntary, surplus, emission reductions that are registered and banked with air districts. ERCs are generated from equipment shutdown or voluntary controls and can be used as offsets for new or modified projects. EPA policy requires that ERCs are treated as emissions in the air and therefore included in each future year in the RFP demonstration. More information regarding banked ERCs can be found in Section X.

[49] 62 FR 1150 https://www.gpo.gov/fdsys/pkg/FR-1997-01-08/pdf/97-144.pdf
[50] *P1001E8Z.PDF (epa.gov)*
[51]www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19931201_oaqps_nox_substitution_guidance.pdf

Table 13 demonstrates that the cumulative ROG and NOx emission reductions meet the 75 ppb standard RFP targets in the 2023, milestone year and the attainment year of 2026. In accordance with EPA guidance for implementation of the 75 ppb 8-hour O_3 NAAQS attainment plans, *Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements*, the emissions reductions in the RFP demonstration occur inside the nonattainment area, and are achieved through existing control regulations starting from the baseline year of 2011[52]. The District meets RFP requirements for the 75 ppb 8-hour O_3 NAAQS.

Table 13: RFP Demonstration for the 75 ppb Ozone SIP

Year	**2017**	**2023**	**2026**
ROG emissions	**8.81**	**7.13**	**6.97**
Emission Reduction Credits		0.04	0.04
MVEB Rounding Margin		0.02	0.01
ROG Emissions + ERCs + MVEB Rounding Margin		7.18	7.03
Required %Change Since 2017		36%	45%
Target ROG Level		5.64	4.84
Shortfall (-)/ Surplus (+) in ROG		-1.55	-2.18
Shortfall (-)/ Surplus (+) in ROG, %		-18%	-25%
Year	**2011**	**2023**	**2026**
NOx emissions	26.29	18.74	17.75
Emission Reduction Credits		0.12	0.12
MVEB Rounding Margin		0.07	0.01
NOx Emissions + ERCs + MVEB Rounding Margin		18.94	17.89
Change in NOx since 2017		7.35	8.40
Change in NOx since 2017, %		28%	32%
NOx reductions since 2017 used for ROG substitution in this milestone year, %		18%	25%
NOx reductions since 2017 surplus after meeting ROG substitution needs in this milestone year, %		10%	7%
RFP shortfall (-), if any		0%	0%
RFP Met:		**YES**	**YES**

Note: Numbers may not add up due to rounding

Table 14 demonstrates that the cumulative ROG and NOx emission reductions only meets the 70 ppb standard RFP targets in the milestone years of 2023, and 2026, but not the out year of 2029, or the attainment year of 2032. In accordance with EPA guidance for implementation of the 70 ppb 8-hour O_3 standard attainment plans, *Implementation of the 2015 National Ambient Air Quality Standards for Ozone: Nonattainment Area State Implementation Plan Requirements,* the emissions reductions in the RFP demonstration

[52] 80 FR 12264 http://www.gpo.gov/fdsys/pkg/FR-2015-03-06/pdf/2015-04012.pdf

occur inside the nonattainment area, are achieved through existing control regulations, and start from the baseline year of 2017[53].

However, the CAA provides an alternative for meeting RFP requirements if the area cannot demonstrate reductions of 3 percent per year. CAA §182(c)(2)(B)(ii) allows nonattainment areas to demonstrate RFP if they include in their SIP "all measures that can feasibly be implemented in the area, in light of technological achievability" and "measures that are achieved in practice by sources in the same source category in nonattainment areas of the next higher classification."

An analysis of the sources and measures in the District and in the two Extreme nonattainment areas is provided in Section XV.B, demonstrating the nonattainment area meets RFP requirements for the 70 ppb 8-hour O_3 NAAQS.

Table 14: RFP Demonstration for the 70 ppb Ozone SIP

Year	**2017**	**2023**	**2026**	**2029**	**2032**
ROG emissions	**7.86**	**7.13**	**6.97**	**6.83**	**6.76**
Emission Reduction Credits		0.04	0.04	0.04	0.04
MVEB Rounding Margin		0.02	0.01	0.08	0.07
ROG Emissions + ERCs + MVEB Rounding Margin		7.18	7.03	6.96	6.85
Required % change since 2017		18%	27%	36%	45%
Target ROG Level		6.45	5.74	5.03	4.32
Shortfall (-)/ Surplus (+) in ROG		-0.74	-1.29	-1.92	-2.52
Shortfall (-)/ Surplus (+) in ROG, %		-9%	-16%	-24%	-32%
Year	**2017**	**2023**	**2026**	**2029**	**2032**
NOx emissions	21.56	18.74	17.75	17.50	17.48
Emission Reduction Credits		0.12	0.12	0.12	0.12
MVEB Rounding Margin		0.07	0.01	0.06	0.00
NOx Emissions + ERCs + MVEB Rounding Margin		18.94	17.89	17.68	17.60
Change in NOx since 2017		2.62	3.67	3.88	3.96
Change in NOx since 2017, %		12%	17%	18%	18%
NOx reductions since 2017 used for ROG substitution in this milestone year, %		9%	16%	18%	18%
NOx reductions since 2017 surplus after meeting ROG substitution needs in this milestone year, %		3%	1%	0%	0%
RFP shortfall (-), if any		0%	0%	-6%	-14%
RFP Met:		**YES**	**YES**	**NO**	**NO**

Note: Numbers may not add up due to rounding

In order to be most conservative, 0.00 values are used when the corresponding MVEB was lower than comparable emissions in CEPAM due to updated adjustment factors used in the MVEB at the direction of EPA

[53] 83 FR 629988 https://www.govinfo.gov/content/pkg/FR-2018-12-06/pdf/2018-25424.pdf

Additionally, the CAA provides an alternative for meeting RFP requirements if the nonattainment area cannot demonstrate reductions of 3% per year. CAA §182(c)(2)(B)(ii) of the CAA allows the nonattainment area to demonstrate RFP if the SIP includes "all measures that can feasibly be implemented in the area, in light of technological achievability" and "measures that are achieved in practice by sources in the same source category in nonattainment areas of the next higher classification."

An analysis of the source categories and District control measures compared to the two Extreme nonattainment areas that demonstrates the nonattainment area meets RFP requirements for the 70 ppb 8-hour O_3 NAAQS is provided in Section XIII.B.

A. Amended NOx & VOC Rules

As shown in Table 14, the District's existing NOx and VOC rules were not going to achieve the required 3% annual reductions needed to meet RFP for the 70 ppb standard. Therefore, the District evaluated current rules to determine where any additional reductions could be achieved. The District identified the following three VOC rules that could be made more stringent: 410 (Organic Solvents), 410.8 (Aerospace Coating Operations), and 432 (Polyester Resin Operations).

Rules 410, 410.8, and 432, were originally listed in a CARB approved commitment letter as VOC rules to be included in the contingency provisions of the attainment plan. However, due to the projected RFP shortfall, the District amended all three VOC rules in 2022. The combined VOC emissions reductions from amending these three rules are estimated to be 0.2 tpd. Reductions are as follows: 410 (0.183 tpd), 410.8 (0.014 tpd), and 432 (0.003 tpd). Although these reductions are a step toward achieving attainment, they do not provide enough emissions reductions needed to meet RFP.

B. Pathway to Meeting RFP

CAA §182 (c)(2)(B)(ii) includes a provision that allows O_3 nonattainment areas that cannot meet the 3% annual emission reduction requirement of the RFP a pathway to an approvable RFP demonstration. The state must demonstrate that the SIP includes measures that are achieved in practice, by sources in the same source category in the nonattainment area, meet requirements of the next higher classification (Extreme).

In order for EPA to approve an RFP that does not meet the minimum 3% annual reduction requirement, the District must document and demonstrate that its NOx and VOC rules are at least as stringent as the two Extreme California air districts. The following sections detail CARB's required analysis to show RFP for three source types: (1) Major Stationary Source, (2) Non-major Point Source and Area Source, and (3) Other Sources.

1. Major Stationary Source

The main goal of this section is (1) to create an analysis that includes all the major stationary sources and (2) to make the case that the emission reduction measures adopted by these sources match those being achieved in practice in NAAs of the next higher classification. For severe areas, this requires comparison to the two extreme nonattainment areas, South Coast (SCAQMD) and San Joaquin Valley (SJVAPCD). The District may follow the steps below to draft the analysis.

a. Identify the major stationary sources with an emission threshold consistent with that of the next higher classification

  i. Produce a new list of major stationary sources based on the major source threshold of the next higher classification (10 tpy for Extreme) for both ROG and NOx.

  ii. Group the sources according to their source categories

  iii. Determine if these sources are operating in the extreme areas using CARB's CEIDARS facility search tool or other sources.

b. Assess the stringency of the District controls compared to the extreme controls for each source identified.

  i. For each source category document that the adopted and projected rules and measures are no less stringent than those in practice in the extreme areas.

  ii. Each rule involved in this part of the analysis should be listed with key specifications for clear comparison.

  iii. If some rules in South Coast and San Joaquin Valley are found more stringent and the controls are in practice, the District will need to commit to amending the applicable rules.

c. Ensure District rules are still RACT since the RACT SIP submittal

  i. Reassess source category in other areas regardless of classification and demonstrate that more stringent controls do not exist in practice anywhere.

  ii. Document consent decrees that will require controls.

2. Non-major Point Sources and Area Sources

The District should also document controls on non-major point sources and area sources of NOx or ROG emissions that are regulated by the District.

a. Investigate current and future rules that apply to these sources and compare to those in NAAs of the next higher classification.

b. Identify the largest contributing source categories.

c. Compare the rules in place to those adopted in NAAs of the next higher classification.

d. For those categories with less stringent rules or no rules, consider adopting similar rules in the NAAs of the next higher classification.

e. List all the rules that are relevant to this section's analysis.

3. Other sources

The District should identify sources that are not regulated by the district, evaluate, and document.

C. Sources Over 10 tpy

The District evaluated all permitted stationary sources (that are not currently over the major source threshold) to determine if any would exceed the major source threshold of the next higher classification (10 tpy for Extreme) for both VOC and NOx. The District determined that Innovative Coatings Technology Corporations located in Mojave is the only source currently above 10 tpy of VOCs.

D. NOx & VOC Rule Comparison to Extreme Nonattainment Area

In order to satisfy CAA §182 (c)(2)(B)(ii), the District compared all currently adopted NOx and VOC rules to the NOx and VOC rules of the two Extreme nonattainment air districts, SCAQMD and SJVAPCD. Table 15 demonstrates that the SIP includes control measures applicable to all NOx and VOC emissions sources located within the District's nonattainment area, and that the measures meet or exceed the requirements of the next higher classification (Extreme). Table 15 shows that the District is achieving all that could be expected in practice. Additionally, the Model Attainment Demonstration in Section XVII, shows that attainment will be achieved by 2023 even without meeting the 3% reductions for 2029 or 2032. The District believes that it has shown that all NOx and VOC emission reductions strategies have been employed and that the RFP requirement should be satisfied.

Table 15: NOx & VOC Rule Comparison to Extreme Districts

Category	EKAPCD Rule	SJVAPCD Rule	SCAQMD Rule	Difference
Organic Solvents	410	4661	442	EK More Stringent
Amended	9/1/22	9/20/07	12/15/00	
Architectural Coatings	410.1A	4601	1113	SJV & SC Have a few lower limits
Amended	1/1/11	4/16/20	2/5/16	
Organic Solvent Degreasing Operations	410.3	4662	1122	Equivalent
Amended	5/7/98	9/20/07	5/1/09	
Metal, Plastic, and Pleasure Craft Parts and Products Coating Operations	410.4	4603	1107	Equivalent
Amended	3/13/14	9/17/09	2/7/20	
Motor Vehicle and Mobile Equipment Refinishing Operations	410.4A	4612	1151	Equivalent
Amended	3/13/14	10/21/10	9/5/14	
Cutback, Slow Cure, and Emulsified Asphalt, Paving and Maintenance Operations	410.5	4641	1108 & 1108.1	Equivalent
Amended	3/7/96	12/17/92	2/1/85 11/4/83	
Graphic Arts	410.7	4607	1130	SJV & SC Have a few lower limits
Amended	3/7/96	12/18/08	5/2/14	
Aerospace Assembly and Coating Operations	410.8	4605	1124	EK More Stringent
Amended	11/3/22	6/16/11	9/21/01	
Wood Products Surface Coating Operations	410.9	4606	1136	Equivalent to SJV More Stringent than SC
Amended	3/13/14	10/16/08	6/14/96	
Storage of Organic Liquids	411	4623	463	Equivalent
Amended	3/7/96	5/19/05	11/4/11	
Gasoline Transfer into Stationary Storage Containers, Delivery Vessels, and Bulk Plants	412	4621	461	Equivalent
Amended	1/13/22	12/19/13	1/7/22	

Table 15: Continued

Category	EKAPCD Rule	SJVAPCD Rule	SCAQMD Rule	Difference
Transfer of Gasoline to Vehicle Fuel Tanks	412.1	4622	461	Equivalent
Amended	1/13/22	12/19/13	1/7/22	
Organic Liquid Loading	413	4624	462	Equivalent
Amended	3/7/96	12/20/07	5/14/99	
Wastewater Separators	414	4625	464	Equivalent
Amended	3/7/96	12/15/11	12/7/90	
Valves, Pressure Relief Valves, Flanges, Threaded Connections and Process Drains at Petroleum Refineries and Chemical Plants	414.1	4409	466.1 & 467	Equivalent
Amended	3/7/96	4/20/05	3/16/84 3/5/82	
Soil Decontamination (VOCs) -	414.2	4651	1166	Equivalent
Amended	5/6/99	9/20/07	5/11/01	
Pump and Compressor Seals at Petroleum Refineries and Chemical Plants	414.5	4455	466	Equivalent
Amended	3/7/96	4/20/05	10/7/83	
Residential Water Heaters (NOx)	424	4902	1121	SJV & SC Have a few lower limits
Amended	4/19/93	3/19/09	9/3/04	
Stationary Gas Turbines (NOx)	425	4703	1134	Equivalent To SJV SC Has lower limits
Amended	1/11/18	9/20/07	2/4/22	
Hot Mix Asphalt Paving Plants (NOx)	425.1	N/A	471 Rescinded	No Rules to Compare
Amended	10/13/94		9/7/79	
Boilers, Steam Generators, and Process Heaters (NOx)	425.2	4305	1146	Equivalent To SJV SC Has a few lower limits
Amended	3/8/18	8/21/03	12/4/20	
Portland Cement Kilns (NOx)	425.3	N/A	1112	EK More Stringent
Amended	3/8/18		6/6/86	
Stationary Piston Engines (NOx)	427	4701	1110.1 Rescinded	ATCM Supersedes
Amended	11/1/01	8/21/03	6/3/05	
Polyester Resin Operations	432	4684	1162	EK More Stringent
Amended	9/1/22	8/18/11	7/8/05	

Table 15 shows that almost all of the District's NOx and VOC rules are equivalent to, or more stringent than the NOx and VOC rules of the two Extreme nonattainment air districts. Two source category rules were identified (Graphic Arts and Residential Hot Water Heaters) in the Extreme districts that have slightly more restrictive VOC limits. However, amending these two rules would still not achieve RFP because the emissions reductions would be negligible. Furthermore, amending these two rules to include more stringent controls or purchasing new equipment would not achieve an annual 3 percent reduction and the associated costs would not outweigh the insignificant reductions.

XVI. WEIGHT OF EVIDENCE

Photochemical modeling is a required element of the SIP to ensure that existing and proposed control strategies provide the reductions needed to meet the federal standards by the relevant attainment deadlines. To address the uncertainties inherent to photochemical modeling assessments, EPA guidance, *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze*, recommends that supplemental analyses accompany all modeled attainment demonstrations.

To complement regional photochemical modeling analyses included in the District's O_3 SIP, Appendix L contains the Weight of Evidence (WOE) demonstration, which includes detailed analyses of ambient O_3 data and trends, transport impacts, precursor emission trends and reductions, population exposure trends, and a discussion of conditions that contribute to exceedances of the federal standards. All analysis methods have inherent strengths and weaknesses; therefore, examining an air quality problem in a variety of ways helps offset the limitations and uncertainties associated with any one approach.

The impact of emissions generated in the upwind South Coast and San Joaquin Valley Air Basins, which are both classified as Extreme O_3 nonattainment areas, have a significant impact on air quality in the District. O_3 air quality data, along with photochemical modeling results show that while the District has made progress, the magnitude of emission reductions in the upwind area that are necessary to provide for attainment for the 2015, 8-hour O_3 NAAQS will not occur by the 2026. However, data shows that the District should achieve attainment by 2032 (the Severe nonattainment date).

As shown in Table 16, the most recent DV for the site is 10 percent above the level of the 2015 standard (70 ppb) and 2.7 percent above the level of the 2008 standard (75 ppb). The WOE provides the documentation to support the District's reclassification to Severe nonattainment pursuant to the 2015, 8-hour O_3 NAAQS, with an attainment deadline of 2032.

Table 16: O_3 Design Values at the Western Mojave Monitoring Site

Site Name	AQS ID	2019 Design Value (ppb)*	2020 Design Value (ppb)*	% Above Standard in 2020
Mojave-923 Poole Street	060290011	78	77	10%**
Mojave-923 Poole Street	060290011	78	77	2.7%***

* with 2018 and 2020 wildfire days (as identified in the wildfire section of this document) removed.
** above 070 ppb standard.
*** above 75 ppb standard.

XVII. MODEL ATTAINMENT DEMONSTRATION

Photochemical modeling plays a crucial role in the SIP process to demonstrate attainment of air quality standards based on estimated future emissions and for the development of emissions targets necessary for attainment. As previously stated, the District's nonattainment area is classified as Severe nonattainment pursuant to the 2008, O_3 NAAQS (75 ppb) and will be reclassified to Severe for the 2015 O_3 NAAQS (70 ppb), which means it must demonstrate attainment of the 2008 standard by 2026, and the 2015 standard by 2032. Consistent with EPA's guidance for model attainment demonstrations (EPA, 2018), photochemical modeling was used to estimate the 2026, and 2032, DVs at the Mojave-923 Poole Street monitoring site located within the District's nonattainment area, to show attainment of the 75 ppb and 70 ppb O_3 NAAQS.

The findings of District's model attainment demonstration are summarized below. Additional information and a detailed description of the procedures employed in this modeling are available in Appendix B.

EPA's modeling guidance[54] outlines the approach for utilizing regional chemical transport models (CTMs) to predict future attainment of the 2008 (75 ppb) and 2015 (70 ppb) 8-hour O_3 NAAQS. The model attainment demonstration requires that CTMs be used in a relative sense, where the relative change in O_3 to a given set of emission reductions (i.e., predicted change in future anthropogenic emissions) is modeled, and then used to predict how current/present-day O_3 levels would change under the future emissions scenario.

The starting point for the attainment demonstration is the observational based DV, which is used to determine compliance with the O_3 standards. The DV for a specific monitor and year represents the three-year average of the annual 4th highest 8-hour O_3 mixing ratio observed at the monitor. The EPA recommends using an average of three DVs to better account for the year-to-year variability in O_3 levels due to meteorology. This average DV is called a weighted DV (in the context of this SIP document, the weighted DV will also be referred to as the reference year DV or DV_R).

[54] EPA. 2018. Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze. 11 29. *https://www.epa.gov/scram/sip-modeling-guidance-documents*.

Since 2018, represents the reference year for projecting DVs to the future, site-specific DVs should be calculated for the three-year periods ending in 2018, 2019, and 2020, and then these three DVs are averaged. However, 2020, was an atypical year with large societal changes in response to the COVID19 pandemic and is not suitable for use in the DV_R calculation. To remove the impact from 2020, observations, an alternative methodology was used for calculating the average DVs by excluding year 2020. In this method, the 8-hour O_3 DV for 2020, was replaced by the two-year average of the 4^{th} highest 8-hour O_3 concentrations from 2018, and 2019.

These reference DVs serve as the anchor point for estimating future year projected DVs. The years 2026, and 2032, are the future years modeled in this attainment demonstration because those are the years that must demonstrate attainment.

Projecting the reference DVs to the future requires the following three photochemical model simulations:

1. Base Year Simulation

The base year simulation for 2018, is used to assess model performance (i.e., to ensure that the model is reasonably able to reproduce the observed O_3 mixing ratios). Since this simulation will be used to assess model performance, it is essential to include as much day-specific detail as possible in the emissions inventory, including, but not limited to hourly adjustments to the motor vehicle and biogenic inventories based on local meteorological conditions, known wildfire and agricultural burning events, and any exceptional events such as refinery fires.

2. Reference Year Simulation

The reference year simulation was identical to the base year simulation, except that certain emissions events which are either random and/or cannot be projected to the future are removed from the emissions inventory. For 2018, the only difference between the base and reference year simulations was that wildfires were excluded from the reference year simulation.

3. Future Year Simulation

The future year simulation (2026 or 2032) was identical to the reference year simulation, except that the projected future year anthropogenic emission levels were used rather than the reference year emission levels. All other model inputs (e.g., meteorology, chemical boundary conditions, biogenic emissions, and calendar for day-of-week specifications in the inventory) are the same as those used in the reference year simulation.

Table 17 summarizes the District’s 2018, 2026, and 2032, anthropogenic emissions. Overall, anthropogenic NOx emissions in CEPAM2019v1.04 were projected to decrease by ~13.6% (from 20.5 tpd to 17.8 tpd) and 15% (20.5 tpd to 17.5 tpd) respectively in 2026 and 2032 when compared to 2018, levels with bulk of the reductions coming from on-road mobile sources. In contrast, anthropogenic ROG was projected to decrease by ~9.5% (from 7.7 tpd to 7.0 tpd) and 12% (from 7.7 tpd to 6.8 tpd) respectively in 2026 ,and 2032, when compared to the 2018, levels with the bulk of those reductions coming from all mobile sources including on-road and other mobile sources. CEPAM2019v1.04 emissions for 2026, and 2032, reflect emission reductions from CARB's Heavy-Duty Vehicle Inspection and Maintenance (HD I/M) Program.

The right two columns in Table 17 show the 2032, emissions after further incorporating CARB commitments from the State SIP Strategy, which are estimated at ~1.8 and 0.3 tpd additional reductions to the 2032, NO_x and ROG emission levels, respectively. Details on these rules/adjustments can be found in Appendix B.

Table 17. Summer Planning Emissions for 2018, 2026 and 2037 (tons/day)

	CEPAM2019v1.04						**With CARB Commitments**	
Source Category	**2018 NOx (tpd)**	**2018 ROG (tpd)**	**2026 NOx (tpd)**	**2026 ROG (tpd)**	**2032 NOx (tpd)**	**2032 ROG (tpd)**	**2032 NOx (tpd)**	**2032 ROG (tpd)**
Stationary	12.8	1.4	12.3	1.5	12.4	1.6	12.4	1.6
Area	0.1	1.2	0.1	1.2	0.1	1.3	0.1	1.3
On-road Mobile	3.7	1.2	1.4	0.7	1.0	0.6	0.8	0.5
Other Mobile	4.0	3.9	3.9	3.6	3.9	3.4	2.3	3.2
Total	20.5	7.7	17.8	7.0	17.5	6.8	15.7	6.5

Emission Inventory of O_3 Precursors in the District (2008-2021) are located in Appendix A
* Note: Rounding errors may result in emissions totals that do not exactly match the sum of the individual categories.

As part of the model attainment demonstration, the fractional changes in O_3 mixing ratios between the model reference year and model future years were calculated at the Mojave-923 Poole Street monitor following EPA modeling guidance and procedures outlined in Appendix B. These ratios, called "relative response factors" or RRFs, are calculated based on the ratio of modeled future year O_3 to the corresponding modeled reference year O_3.

$$\text{RRF} = \frac{\frac{1}{N}\sum_{d=1}^{N}(MDA8\ O_3)_{future}^{d}}{\frac{1}{N}\sum_{d=1}^{N}(MDA8\ O_3)_{reference}^{d}}$$

The RRFs and the 2026, and 2032, future O_3 DVs for the Mojave-923 Poole Street site are summarized in Table 18 and Table 19. The projected O_3 DV (at the site) in 2026, is 74 ppb and in 2032, is 69 ppb. Therefore, the attainment demonstration modeling predicts that the District will attain the 2008, 75 ppb 8-hour O_3 NAAQS by 2026, and the 2015, 70 ppb 8- O_3 NAAQS by 2032, with the commitments outlined in the SIP.

Table 18. Key parameters related to the future year 2026, O_3 DV calculation

Site	RRF	2018 Average DV (ppb)	2026 DV (ppb)	2026 Truncated DV (ppb)
Mojave-923 Poole St.	0.8979	82.7	74.3	74

Table 19. Key parameters related to the future year 2032, O_3 DV calculation

Site	RRF	2018 Average DV (ppb)	2032 DV (ppb)	2032 Truncated DV (ppb)
Mojave-923 Poole St.	0.8400	82.7	69.5	69

XVIII. CONTINGENCY MEASURES

Contingency measures are required by the CAA to be implemented should an area fail to make reasonable further progress or attain the NAAQS by the required date. Over the last few years, multiple court decisions in the 9th circuit and nation-wide have effectively disallowed the SIP-approved approach which CARB and the districts have historically used to meet contingency measure requirements. CARB and the District continue to strive to meet the requirements, but EPA has not yet released comprehensive and updated guidance encompassing the full scope of contingency measure requirements, in light of the results of the varying court decisions. Guidance is needed for CARB, the District, and other air agencies across California and the U.S., to ensure that any resources devoted to creating, adopting, and implementing a measure will result in one that meets the requirements and be approved into the SIP.

Additionally, California faces the most difficult air quality challenges in the nation and, accordingly, leads the country with the most stringent air pollution control programs. Historically, EPA guidance required contingency measures to achieve approximately one year's worth of emission reductions. CARB and District control programs are advanced, and primarily-federally regulated sources contribute over half of the emissions. Thus, opportunities for a triggered contingency measure that can be implemented by the State and result in one year's worth of emission reductions in the required time frame are not readily available. Further, if any measure that could achieve this level of emission reductions existed, it would be adopted to improve air quality and support attainment of NAAQS, and would not be withheld for contingency purposes. Even with recent court decisions, EPA has the opportunity to justify a revised approach for contingency measures recognizing the maturity of control programs or allow states to provide a reasoned justification for achieving less than the required amount. California continues to work towards meeting contingency measure requirements, but EPA must issue guidance to provide clarity and direction for states to move forward and pursue contingency measures that will meet the requirements.

CAA §172(c)(9) requires nonattainment areas to implement contingency measures if they fail to make RFP or fail to attain air quality standards by the required attainment date. The CAA is silent though on the specific level of emission reductions that must flow from contingency measures. In the absence of specific requirements for the amount of emission reductions required, in 1992, EPA conveyed that the contingency measures should, at a minimum, ensure that an appropriate level of emissions reduction progress continues to be made if attainment of RFP is not achieved and additional planning by the State is needed[55]. Further, EPA O_3 guidance states that "contingency measures should represent one year's worth of progress amounting to reductions of 3 percent of the baseline emissions inventory for the nonattainment area". EPA, though, has accepted contingency measures that equal less than a year's worth of progress when the circumstances fit under "EPA's long-standing recommendation that states should consider 'the potential nature and extent of any attainment shortfall for the area' and that contingency measures 'should represent a portion of the actual emissions reductions necessary to bring about attainment in the area[56].'"

Historically, EPA allowed contingency measure requirements to be met via excess emission reductions from ongoing implementation of adopted emission reduction programs, a method that CARB has used for a contingency measure and EPA has approved in the past. In 2016, in *Bahr v. U.S. Environmental Protection Agency*[57] *(Bahr)*, the 9th Circuit Court of Appeals determined EPA erred in approving a contingency measure that relied on an already-implemented measure for a nonattainment area in Arizona, thereby rejecting EPA's longstanding interpretation of section 172(c)(9). EPA staff interpreted this decision to mean that contingency measures must include a future action triggered by a failure to attain or failure to make RFP. This decision was applicable to the states covered by the 9th Circuit Court. In the rest of the country, EPA was still approving contingency measures using their pre-Bahr stance. In January 2021, in *Sierra Club v. Environmental Protection Agency*[58], the United States Court of Appeals for the D.C. Circuit, ruled that already implemented measures do not qualify as contingency measures for the rest of the country (Sierra Club).

Additionally, CAA §182(c)(9) requires that the plan provide for the implementation of specific measures to be undertaken if the nonattainment area fails to meet any applicable milestone. Such measures shall be included in the plan revision as contingency measures to take effect without further action by the State or the Administrator upon a failure by the State to meet the applicable milestone.

A. CARB's Opportunities for Contingency Measures

Much has changed since EPA's 1992 guidance on contingency measures. Control programs across the country have matured as have the health-based standards. O_3 standards have strengthened in 2008 and 2015 with attainment dates out to 2037. California has the only two extreme areas in the country. Control measures identified for these areas must be implemented for meeting the standard and not held in reserve.

[55] 57 Federal Register 13510, 13512 (April 16, 1992)
[56] 78 Fed.Reg. 37741, 37750 (Jun. 24, 2013), approval finalized with 78 Fed.Reg. 64402 (Oct. 29, 2013).
[57] *Bahr v. U.S. Environmental Protection Agency*, (9th Cir. 2016) 836 F.3d 1218.
[58] *Sierra Club v. Environmental Protection Agency*, (D.C. Cir. 2021) 985 F.3d 1055.

To address contingency measure requirements given the courts' decisions and current EPA guidance, CARB and local air districts would need to develop a measure or measures that, when triggered by a failure to attain or failure to meet RFP, will achieve one year's worth of emissions reductions for the given nonattainment area, or approximately 3 percent of total baseline emissions.

Given CARB's wide array of mobile source control programs, the relatively limited portion of emissions primarily regulated by the local air district, and the fact that primarily-federally regulated sources are expected to account for approximately 49 percent of statewide NOx emissions by 2026[59] and 54 percent of statewide NOx emissions by 2032[60], finding a single triggered measure that will achieve the required reductions would be nearly impossible. That said, even discounting the amount to reflect the proportion that is primarily-federally regulated, approximately 1.3 percent of total baseline emissions would still be needed. Even targeting a lower percentage, additional control measures that can be identified by CARB are scarce or nonexistent that would achieve the require emissions reductions needed for a contingency measure.

Adding to the difficulty of identifying available control measures, not only does the suite of contingency measures need to achieve a large amount of reductions, but they will also need to achieve these reductions in the year following the year in which the failure to attain or meet RFP has been identified. Control measures achieving the level of reductions required may take years to implement and will likely not result in immediate reductions. In the 2022 State SIP Strategy, CARB's three largest NOx reduction measures, In-Use Locomotive Regulation, Zero -Emission Standards for Space and Water Heaters and Advanced Clean Fleets, rely on accelerated turnover of older engines/trucks. Buildup of infrastructure and equipment options limits the availability to have significant emission reductions in a short amount of time. Unless EPA changes its historic stance or finds a reasoned justification for requiring less than the stated amount, adopting a single triggered measure that can be implemented and achieve the necessary reductions in the time frame required is scarce in California and may not be possible.

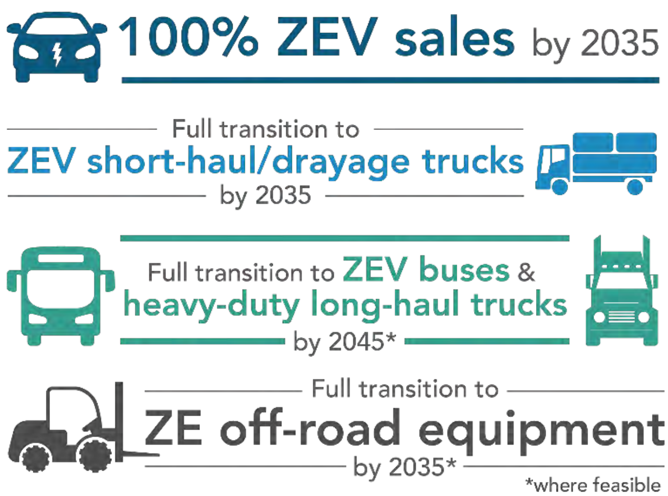
CARB has over 50 years of experience reducing emissions from mobile and other sources of pollution under State authority. The RACM for State Sources analysis illustrates the reach of CARB's current programs and regulations, many of which set the standard nationally for other states to follow. Few sources CARB has primary regulatory authority over remain without a control measure, and all control measures that are in place support the attainment of the NAAQS. This causes a lack of additional control measures available that could achieve the reductions necessary for a contingency measure.

[59] Source: CARB 2019 CEPAM v1.03; based on 2026 emissions totals.
[60] Source: CARB 2019 CEPAM v1.03; based on 2026 emissions totals.

Due to the unique air quality challenges California faces, should such additional measures exist, CARB would pursue those measures to support expeditious attainment of the NAAQS and would not reserve such measures for contingency purposes. Nonetheless, CARB continues to explore options for potential statewide contingency measures utilizing its authorities in anticipation of EPA's written guidance. CARB anticipates that EPA's guidance will allow an assessment of viability of such a statewide measure.

A central issue in considering a statewide contingency measure under CARB's authority is that CARB is already fully committed to the "drive to zero" effort. In 2020, Governor Newsom signed Executive Order N-79-20 (Figure 10) that established a first-in-the-nation goal for 100 percent of California sales of new passenger cars and trucks to be zero emission by 2035. The Governor's order set a goal to transition 100 percent of the drayage truck fleet to zero-emission by 2035, all off-road equipment where feasible to zero-emission by 2035 and the remainder of the medium and heavy-duty vehicles to zero-emission where feasible by 2045.

Figure 10: Governor Newson Executive Order N-79-20



CARB has committed to achieving these goals. Thus, CARB's programs not only go beyond emissions standards and programs set at the federal level, but many include zero-emissions requirements or otherwise, through incentives and voluntary programs, drive mobile sources to zero-emissions, as listed in Table 20. CARB is also exploring and developing a variety of new measures to drive more source categories to zero-emissions and reduce emissions even further, as detailed in the 2022 State Strategy for the State Implementation Plan. With most source categories being driven to zero-emissions, opportunities for which a triggered measure that could reduce emissions by the amount required for contingency measures are scarce.

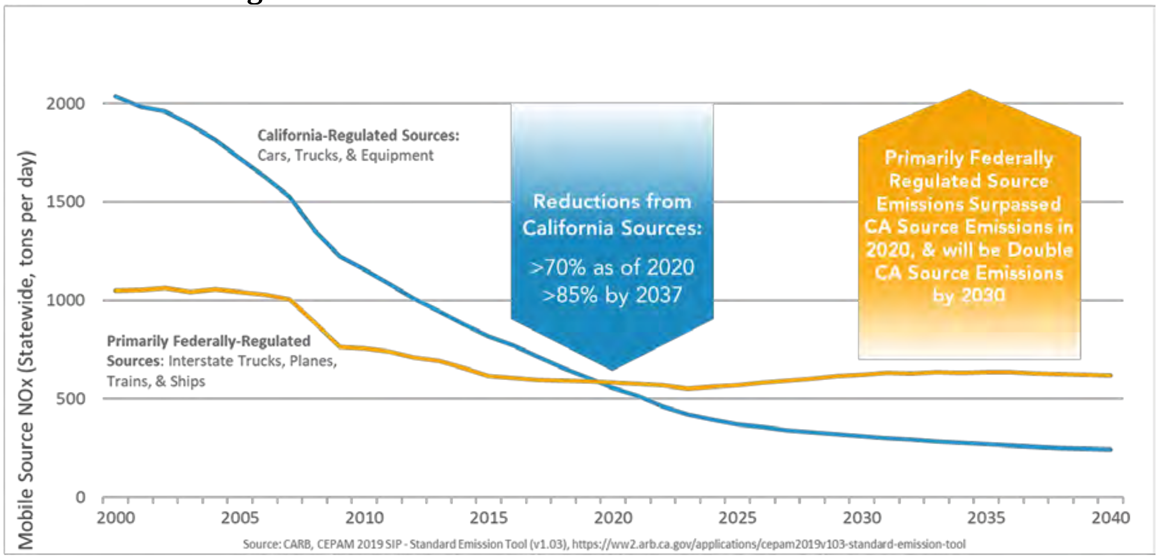
Table 20. CARB Programs with a Zero-Emissions Component

Emission Source	Regulatory Programs
Light-Duty Passenger Vehicles and Light-Duty Trucks	• Advanced Clean Cars Program (I and II*), including the Zero Emission Vehicle Regulation • Clean Miles Standard *
Motorcycles	• On-Road Motorcycle Regulation*
Medium Duty-Trucks	• Advanced Clean Cars Program (I and II*), including the Zero Emission Vehicle Regulation • Zero-Emission Powertrain Certification Regulation • Advanced Clean Trucks Regulation • Advanced Clean Fleets Regulation*
Heavy-Duty Trucks	• Zero-Emission Powertrain Certification Regulation • Advanced Clean Trucks Regulation • Advanced Clean Fleets Regulation*
Heavy-Duty Urban Buses	• Innovative Clean Transit • Advanced Clean Fleets Regulation*
Other Buses, Other Buses – Motor Coach	• Zero-Emission Airport Shuttle Regulation • Advanced Clean Fleets Regulation*
Commercial Harbor Craft	• Commercial Harbor Craft Regulation
Recreational Boats	• Spark-Ignition Marine Engine Standards*
Transport Refrigeration Units	• Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (Parts I and II*)
Industrial Equipment	• Zero-Emission Forklifts* • Off-Road Zero-Emission Targeted Manufacturer Rule*
Construction and Mining	• Off-Road Zero-Emission Targeted Manufacturer Rule*
Airport Ground Support Equipment	• Zero-Emission Forklifts*
Port Operations and Rail Operations	• Cargo Handling Equipment Regulation • Off-Road Zero-Emission Targeted Manufacturer Rule*
Lawn and Garden	• Small Off-Road Engine Regulation • Off-Road Zero-Emission Targeted Manufacturer Rule*
Ocean-Going Vessels	• At Berth Regulation
Locomotives	• In-Use Locomotive Regulation*

*Indicates program or regulation is in development

There are few sources remaining without a control measure implemented by CARB, and those that do remain are primarily-federally regulated sources. This includes interstate trucks, ships, locomotives, aircraft, and certain categories of off-road equipment, constituting a large source of potential emissions reductions. Since these are primarily regulated at the federal and, in some cases, international level, options to implement a contingency measure with reductions approximately equivalent to one year’s worth of emission reductions are limited.

Figure 11: Statewide Mobile Source NOx Reductions



CARB includes a zero-emission component in most of their regulations, both those already adopted and those that are in development, and the vast majority of the regulations are statewide. Beyond the wide array of sources CARB has been regulating over the last few decades, and especially considering those they are driving to zero-emission, there are few sources of emissions left for CARB to implement additional controls upon under its authorities. The few source categories that do not have control measures are primarily regulated federally and internationally.
CARB and local air districts will need to implement contingency measures that, when triggered, would achieve one year's worth of emissions reductions, or at least the relevant portion equivalent to the contribution of sources primarily regulated at the State and local level, unless a reasoned rationale for achieving less emission reductions can be provided. Considering the air quality, challenges California and local air districts face, CARB would need to implement the measure to support expeditious attainment of the NAAQS as the CAA requires rather than withhold it for contingency measure purposes. Should there be a measure achieving the required emission reductions, the measure would likely take more than one year to reduce the necessary emissions.

CARB fully intends to meet the contingency requirement as required by the CAA, but written EPA guidance that addresses the dilemma California faces is needed to provide direction and clarity for CARB and local air districts to develop and adopt approvable contingency measures. CARB continues to explore potential contingency measures while awaiting EPA's written guidance. Further, since it has been about 30 years, since EPA developed the guidance, this may be the time for EPA to update the guidance by formally changing its historic stance on the amount of reductions required to meet the contingency measure requirement and allowing states with mature control programs to demonstrate that contingency measure opportunities are scarce.

B. District's Opportunities for Contingency Measures

Over the past decades, the District has drafted, adopted, and implemented generations of emissions control measures for stationary and area sources under its jurisdiction. These control measures, coupled with stringent regulations on mobile sources from CARB, represent some of the nation's toughest air pollution emissions controls. The District's current rules and regulations reflect technologies and methods that are far beyond any minimum required control levels.

District Rules 410 (Organic Solvents), 410.8 (Aerospace Coating Operations), and 432 (Polyester Resin Operations) were identified as the only three rules that could be made more stringent if the District failed to attain the NAAQS. All three rules were listed in a CARB approved commitment letter[61] as rules to be included in the contingency provisions of the attainment plan. However, due to the projected RFP shortfall, the District amended all three rules in 2022 and therefore left without rules that contained contingency triggers and provisions. Additionally, if the District identified any rule, or combination of rules that could be amended to produce O_3 reductions significant enough to achieve RFP, the amendment would have already occurred in order to meet RFP. If this were the case, the District would still be without a contingency rule.

Although the District is challenged in providing contingency provisions within its SIP rules, this should not interfere with the approvability of the attainment plan. As shown in Table 13, the District will make RFP for all applicable dates of the 75 ppb 8-hour O_3 NAAQS. Additionally, RFP will be achieved in 2023 and 2026 pursuant to the 70 ppb 8-hour O_3 NAAQS (shown in Table 14) however, there is a mitigated shortfall in 2029 and 2032. As described in Section XV.B. CAA §182 (c)(2)(B)(ii) includes a provision that allows O_3 nonattainment areas that cannot achieve RFP a pathway to an approvable RFP demonstration by meet requirements of the next higher classification (Extreme). Table 15 shows that the District has NOx and VOC rules applicable to all applicable source categories, and that those rules are equivalent to, or more stringent than the NOx and VOC rules of the two Extreme nonattainment air districts, with exception to only two minor source categories (Graphic Arts and Residential Hot Water Heaters), that if amended would only provide negligible reductions. Amending these two rules would not achieve an annual 3 percent reduction and the associated costs would not outweigh such minor reductions.

Although RFP for the 70 ppb 8-hour O_3 NAAQS is not being achieved in 2029 and 2032, modeling and the attainment demonstration show that, the District will attain the 70 ppb standard by 2032. As detailed throughout this attainment plan, attainment will be achieved through a combination of mobile source regulations, the State SIP Strategy, reductions in transport emissions, and CARB's commitments for Eastern Kern.

[61] Eastern Kern Air Pollution Control District Commitment to Adopt Rule Amendments as Contingency Measures for the 2008 8-Hour Ozone Standard (March 13, 2020).

In an effort to satisfy CAA §182(c)(9) and provide a contingency measure in this attainment plan, the District will commit to removing the small container exemption from Section IV.B. of District Rule 410.1A, Architectural Coating Controls. Removing this exemption from the rule will provide unquantifiable VOC reductions but will satisfy the CAA requirement of providing a contingency measure in the plan.

C. CAA 185 Fees

CAA §185 requires that: Each implementation plan revision required under section 7511a(d) and (e) of this title (relating to the attainment plan for Severe and Extreme O_3 nonattainment areas) shall provide that, if the area to which such plan revision applies has failed to attain the O_3 NAAQS by the applicable attainment date, each major stationary source of VOCs located in the area shall, except as otherwise provided under subsection (c) of this section, pay a fee to the State as a penalty for such failure, computed in accordance with subsection (b) of this section, for each calendar year beginning after the attainment date, until the area is re-designated as an attainment area for O_3.

CAA §185(e) allows the following exemptions for certain small areas: For areas with a total population under 200,000 which fail to attain the standard by the applicable attainment date, no sanction under this section or under any other provision of this chapter shall apply if the area can demonstrate, consistent with guidance issued by the Administrator, that attainment in the area is prevented because of O_3 or O_3 precursors transported from other areas. The prohibition applies only in cases in which the area has met all requirements and implemented all measures applicable to the area under this chapter.

D. CAA 185 Fee Rule

In the event the District fails to attain the 75 ppb or 70 ppb 8-hour O_3 NAAQS by each standard's milestone attainment date for Severe nonattainment, the District will evaluate the applicability of adopting a 185 Fee Rule. As stated within this attainment plan, O_3 and O_3 precursor emissions transported from other areas is a major contributing facture to the District not attaining the NAAQS. Additionally, the population in the District's nonattainment area is currently well below 200,000 and anticipated to continue growing at a very slow rate.

If attainment is not achieved by either 8-hour O_3 NAAQS milestone date, and the District can demonstrate that attainment was prevented by O_3 or O_3 precursor emissions transported from other areas, and the nonattainment area has a population under 200,000, then District will be exempt from adopting and implementing a 185 fee rule. However, If the District fails to attain either 8-hour O_3 NAAQS by the milestone date, and it cannot be demonstrated that attainment was prevented by O_3 or O_3 precursor emissions transported from other areas, and the nonattainment area has a population over 200,000, then the District will adopt and implement a 185 fee rule pursuant to the requirements of CAA §185 and consistent with guidance issued by the EPA.

XIX. CONCLUSION

Pursuant to CAA requirements and EPA guidance, CARB and the District conducted extensive analyses to determine whether timely attainment of the 75 ppb and 70 ppb 8-hour O_3 NAAQS as a "Severe" nonattainment area is likely. The results of the modeling provide strong evidence that the District will continue to achieve the O_3 reductions needed to meet both 8-hour O_3 NAAQS by each milestone date (2026, and 2032). Attainment will be achieved through a combination of the District's emission control measures, CARB's Commitments for Eastern Kern, along with implementation of CARB's Mobile Source Regulations, Emission Reduction Programs, and the State SIP Commitment, which are all detailed within this Attainment Plan.

CARB provides substantial emissions reduction planning methods and strategies in their 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy). The State SIP Strategy is a Statewide planning document that identifies the strategies and controls under State authority that are needed to reduce emissions to reduce ground-level O_3 (smog).

Control programs already adopted by CARB and upcoming measures that were included in the 2016 State SIP Strategy, as well as District and EPA programs, provided a significant down payment on reducing the NOx emissions needed to meet the 70 ppb O_3 standard and improve air quality throughout the State. These measures will achieve almost a 36 percent reduction in total NOx emissions by 2037, as relative to 2018, with especially significant reductions in emissions from light-, medium-, and heavy-duty on-road vehicles.

Although the 2016 State SIP Strategy has achieved significant reductions, additional measures are needed across the State of California for areas to meet the 70 ppb 8-hour O_3 NAAQS. More specifically, the 2022 State SIP Strategy describes the State's proposed commitments to develop additional control measures and greater emissions reductions from State-regulated sources, as needed to support attainment by 2032. The State measures and commitments detailed within the document will be incorporated into regional SIPs for the 70 parts ppb 8-hour O_3 NAAQS for the nonattainment area.

The 2022 State SIP Strategy also identifies all of the proposed measures, associated emissions reductions, and other elements needed to support attainment of the 70 ppb O_3 standard. Additionally, the State SIP Strategy allows CARB to explore and propose an unprecedented variety of new measures to reduce emissions from the sources under their authority, which will use all mechanisms available. This level of action is needed to ensure federal air quality standards are attained and to deliver on CARB's commitments to protect public health, particularly in light of the growing body of evidence on the adverse impacts of air pollution. The State SIP Strategy is located in Appendix J of this attainment plan.

APPENDIX A
Emission Inventory of Ozone Precursors in the District
For 2008, 2012, 2014, 2017, 2020 and 2021 (tons per day)

SOURCE CATEGORY	2008		2012		2014		2017		2020		2021	
	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOX
ELECTRIC UTILITIES	0	0	0	0	0	0	0	0.005	0	0.005	0	0.005
COGENERATION	0.035	0.479	0.031	0.432	0.038	0.452	0.046	0.424	0.045	0.415	0.045	0.415
MANUFACTURING AND INDUSTRIAL	0.041	1.702	0.032	1.244	0.035	1.342	0.026	1.465	0.026	1.448	0.026	1.448
FOOD AND AGRICULTURAL PROCESSING	0.003	0.041	0.002	0.025	0.001	0.024	0.001	0.01	0.001	0.009	0.001	0.008
SERVICE AND COMMERCIAL	0.032	0.312	0.068	0.574	0.034	0.452	0.239	0.449	0.252	0.479	0.254	0.484
OTHER (FUEL COMBUSTION)	0	0	0	0	0	0	0.007	0.179	0.007	0.182	0.007	0.183
SEWAGE TREATMENT	0	0	0	0	0	0	0.005	0	0.005	0	0.005	0
LANDFILLS	0.0379	0	0.035	0	0.036	0	0.04	0.002	0.041	0.002	0.041	0.002
OTHER (WASTE DISPOSAL)	0	0	0	0	0	0	0	0	0	0	0	0
LAUNDERING	0	0	0	0	0	0	0.004	0	0.004	0	0.004	0
DEGREASING	0.934	0	0.419	0	0.506	0	0.468	0	0.461	0	0.470	0
COATINGS AND RELATED PROCESS SOLVENTS	0.131	0	0.115	0	0.116	0	0.158	0.009	0.167	0.009	0.169	0.01
PRINTING	0	0	0	0	0	0	0	0	0	0	0	0
ADHESIVES AND SEALENTS	0.045	0	0.039	0	0.041	0	0.042	0	0.041	0	0042	0
OTHER (CLEANING AND SURFACE COATINGS)	0.003	0	0.012	0	0.017	0	0.001	0	0.001	0	0.001	0
OIL AND GAS PRODUCTION	0	0	0	0	0	0	0	0.001	0	0.001	0	0.001
PETROLEUM REFINING	0.004	0	0	0	0	0	0.002	0	0.002	0	0.002	0
PETROLEUM MARKETING	0.127	0	0.115	0	0.09	0	0.145	0	0.134	0	0.132	0
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0	0	0.003	0	0	0	0	0	0	0	0	0
CHEMICAL	0	0	0	0	0	0	0	0	0	0	0	0
FOOD AND AGRICULTURE	0	0	0	0	0	0	0	0	0	0	0	0
MINERAL PROCESSES	0.098	13.828	0.092	10.896	0.206	8.293	0.163	10.162	0.153	9.398	0.161	10.09
METAL PROCESSES	0	0.009	0	0.009	0	0.008	0	0.009	0	0.010	0	0.01
WOOD AND PAPER	0	0	0	0	0	0	0	0	0	0	0	0
OTHER (INDUSTRIAL PROCESSES)	0.006	0.002	0	0.001	0	0.001	0.024	0.005	0.025	0.005	0.025	0.005
STATIONARY SUBTOTAL	**1.498**	**16.372**	**0.963**	**13.181**	**1.121**	**10.572**	**1.4**	**12.719**	**1.392**	**11.962**	**1.415**	**12.662**

SOURCE CATEGORY	2008		2012		2014		2017		2020		2021	
	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
CONSUMER PRODUCTS	0.652	0	0.648	0	0.649	0	0.656	0	0.728	0	0.691	0
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.212	0	0.17	0	0.173	0	0.177	0	0.181	0	0.183	0
PESTICIDES/FERTILIZERS	0.044	0	0.123	0	0.109	0	0.067	0	0.072	0	0.072	0
ASPHALT PAVING/ROOFING	0.071	0	0.069	0	0.073	0	0.063	0	0.069	0	0.071	0
RESIDENTIAL FUEL COMBUSTION	0.025	0.130	0.027	0.126	0.034	0.108	0.023	0.116	0.023	0.122	0.023	0.122
FARMING OPERATIONS	0.109	0	0.104	0	0.1	0	0.094	0	0.089	0	0.087	0
CONSTRUCTION AND DEMOLITION	0	0	0	0	0	0	0	0	0	0	0	0
PAVED ROAD DUST	0	0	0	0	0	0	0	0	0	0	0	0
UNPAVED ROAD DUST	0	0	0	0	0	0	0	0	0	0	0	0
FUGITIVE WINDBLOWN DUST	0	0	0	0	0	0	0	0	0	0	0	0
FIRES	0.002	0	0.002	0	0.002	0.001	0.002	0.001	0.002	0.001	0.002	0.001
MANAGED BURNING AND DISPOSAL	0	0	0.002	0.001	0.006	0.001	0.002	0.001	0.005	0.001	0.005	0.001
COOKING	0.006	0	0.006	0	0.006	0	0.007	0.001	0.007	0	0.007	0
OTHER (MISCELLANEOUS PROCESSES)	0	0	0	0	0	0	0	0	0	0	0	0
AREA-WIDE SUBTOTAL	**1.123**	**0.131**	**1.151**	**0.127**	**1.152**	**0.11**	**1.09**	**0.118**	**1.176**	**0.124**	**1.142**	**0.124**
LIGHT DUTY PASSENGER (LDA)	0.729	0.560	0.505	0.364	0.414	0.286	0.297	0.195	0.00	0.132	0.204	0.118
LIGHT DUTY TRUCKS – 1 (LDT1)	0.212	0.129	0.145	0.088	0.103	0.063	0.082	0.046	0.06	0.03	0.055	0.027
LIGHT DUTY TRUCKS – 2 (LDT2)	0.437	0.517	0.335	0.342	0.296	0.276	0.236	0.198	0.186	0.131	0.175	0.115
MEDIUM DUTY TRUCKS (MDV)	0.236	0.296	0.207	0.218	0.204	0.192	0.182	0.147	0.146	0.101	0.136	0.088
LIGHT HEAVY DUTY GAS TRUCKS – 1 (LHDGT1)	0.111	0.095	0.094	0.070	0.108	0.066	0.087	0.054	0.064	0.039	0.06	0.036
LIGHT HEAVY DUTY GAS TRUCKS – 2 (LHDGT2)	0.007	0.007	0.006	0.006	0.006	0.005	0.005	0.005	0.004	0.004	0.004	0.003
MEDIUM HEAVY DUTY GAS TRUCKS (MHDGT)	0.025	0.026	0.013	0.016	0.009	0.013	0.005	0.007	0.003	0.005	0.003	0.005
HEAVY HEAVY DUTY GAS TRUCKS (HHDGT)	0.007	0.012	0.005	0.010	0.001	0.001	0	0	0	0	0	0
LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDDT1)	0.024	0.639	0.023	0.517	0.022	0.022	0.018	0.398	0.018	0.305	0.017	0.278
LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDDT2)	0.006	0.155	0.006	0.127	0.006	0.110	0.006	0.098	0.006	0.077	0.005	0.071
MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDDT)	0.056	0.519	0.030	0.292	0.029	0.287	0.021	0.226	0.013	0.173	0.01	0.153
HEAVY HEAVY DUTY DIESEL TRUCKS (HHDDT)	0.551	6.337	0.332	4.107	0.209	3.276	0.121	2.451	0.082	2.068	0.07	1.936

SOURCE CATEGORY	2008		2012		2014		2017		2020		2021	
	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx	VOC	NOx
MOTORCYCLES (MCY)	0.232	0.06	0.211	0.053	0.21	0.052	0.196	0.050	0.177	0.044	0.172	0.042
HEAVY DUTY DIESEL URBAN BUSES (UBD)	0	0.006	0	0.001	0	0.001	0	0	0	0	0	0
HEAVY DUTY GAS URBAN BUSES (UBG)	0	0	0	0	0	0	0	0	0	0	0	0
SCHOOL BUSES – GAS (SBG)	0.001	0.002	0.001	0.001	0	0	0	0	0	0	0	0
SCHOOL BUSES – DIESEL (SBD)	0.003	0.034	0.002	0.031	0.001	0.03	0	0.028	0	0.025	0	0.024
OTHER BUSES – GAS (OBG)	0.002	0.006	0.002	0.005	0.001	0.005	0.001	0.003	0.001	0.002	0.001	0.002
OTHER BUSES – MOTOR COACH – DIESEL (OBC)	0.001	0.016	0.001	0.012	0.001	0.010	0	0.008	0	0.006	0	0.005
ALL OTHER BUSES – DIESEL (OBD)	0.002	0.019	0.002	0.013	0.001	0.005	0	0.003	0	0.002	0	0.002
MOTOR HOMES (MH)	0.009	0.033	0.006	0.026	0.004	0.022	0.003	0.019	0.002	0.015	0.002	0.014
ON-ROAD SUBTOTAL	**2.653**	**9.466**	**1.927**	**6.3**	**1.622**	**5.167**	**1.264**	**3.938**	**0.982**	**3.159**	**0.915**	**2.918**
AIRCRAFT	2.481	1.278	2.502	1.282	2.512	1.284	2.525	1.286	2.536	1.289	2.541	1.289
TRAINS	0.224	3.174	0.153	2.454	0.121	2.284	0.079	1.677	0.085	1.874	0.085	1.903
RECREATIONAL BOATS	1.108	0.157	0.936	0.142	0.894	0.139	0.774	0.132	0.671	0.127	0.64	0.126
OFF-ROAD RECREATIONAL VEHICLES	0.056	0.001	0.046	0.001	0.042	0.001	0.039	0.001	0.037	0.001	0.036	0.001
OFF-ROAD EQUIPMENT	0.782	0.761	0.558	0.3647	0.504	0.654	0.461	0.654	0.439	0.552	0.432	0.518
OFF-ROAD EQUIPMENT (PERP)	0.018	0.213	0.014	0.177	0.012	0.154	0.011	0.136	0.009	0.01	0.009	0.098
FARM EQUIPMENT	0.247	1.324	0.208	1.104	0.187	1.014	0.159	0.899	0.027	0.0131	0.025	0.0127
FUEL STORAGE AND HANDLING	0.094	0	0.073	0	0.067	0	0.06	0	0.055	0	0.054	0
OFF-ROAD SUBTOTAL	**5.01**	**6.907**	**4.49**	**5.806**	**4.338**	**5.53**	**4.109**	**4.786**	**3.859**	**3.955**	**3.823**	**3.947**
TOTAL	**10.284**	**32.876**	**8.531**	**25.414**	**8.233**	**21.379**	**7.863**	**21.561**	**7.409**	**19.2**	**7.295**	**19.651**

Source: CARB CEPAM emissions inventory, CEPAM2019v1.04 with approved external emission adjustment factors.

Projected Emission Inventory for Future Years
2018, 2026, 2032

SOURCE CATEGORY	2018		2026		2032	
	VOC	NOx	VOC	NOx	VOC	NOx
ELECTRIC UTILITIES	0	0.005	0	0.005	0	0.005
COGENERATION	0.045	0.416	0.045	0.415	0.047	0.432
MANUFACTURING AND INDUSTRIAL	0.026	1.455	0.026	1.45	0.027	1.465
FOOD AND AGRICULTURAL PROCESSING	0.001	0.01	0	0.007	0	0.005
SERVICE AND COMMERCIAL	0.242	0.46	0.263	0.499	0.268	0.509
OTHER (FUEL COMBUSTION)	0.007	0.179	0.007	0.175	0.007	0.174
SEWAGE TREATMENT	0.005	0	0.005	0	0.006	0
LANDFILLS	0.041	0.002	0.044	0.002	0.047	0.002
OTHER (WASTE DISPOSAL)	0	0	0	0	0	0
LAUNDERING	0.004	0	0.005	0	0.005	0
DEGREASING	0.477	0	0.52	0	0.569	0
COATINGS AND RELATED PROCESS SOLVENTS	0.159	0.009	0.184	0.01	0.196	0.011
PRINTING	0	0	0	0	0	0
ADHESIVES AND SEALENTS	0.042	0	0.042	0	0.042	0
OTHER (CLEANING AND SURFACE COATINGS)	0.001	0	0.001	0	0.001	0
OIL AND GAS PRODUCTION	0	0.001	0	0.001	0	0.001
PETROLEUM REFINING	0.002	0	0.002	0	0.002	0
PETROLEUM MARKETING	0.141	0	0.125	0	0.119	0
OTHER (PETROLEUM PRODUCTION AND MARKETING)	0	0	0	0	0	0
CHEMICAL	0.018	0	0.017	0	0.018	0
FOOD AND AGRICULTURE	0	0	0	0	0	0
MINERAL PROCESSES	0.164	10.216	0.157	9.759	0.158	9.777
METAL PROCESSES	0	0.009	0	0.012	0	0.012
WOOD AND PAPER	0	0	0	0	0	0
OTHER (INDUSTRIAL PROCESSES)	0.025	0.005	0.026	0.005	0.027	0.005
STATIONARY SUBTOTAL	**1.411**	**12.766**	**1.481**	**12.34**	**1.55**	**12.399**

SOURCE CATEGORY	2018		2026		2032	
	VOC	NOx	VOC	NOx	VOC	NOx
CONSUMER PRODUCTS	0.665	0	0.727	0	0.802	0
ARCHITECTURAL COATINGS AND RELATED PROCESS SOLVENTS	0.179	0	0.192	0	0.205	0
PESTICIDES/FERTILIZERS	0.05	0	0.07	0	0.069	0
ASPHALT PAVING/ROOFING	0.067	0	0.076	0	0.081	0
RESIDENTIAL FUEL COMBUSTION	0.023	0.116	0.023	0.123	0.024	0.127
FARMING OPERATIONS	0.092	0	0.081	0	0.075	0
CONSTRUCTION AND DEMOLITION	0	0	0	0	0	0
PAVED ROAD DUST	0	0	0	0	0	0
UNPAVED ROAD DUST	0	0	0	0	0	0
FUGITIVE WINDBLOWN DUST	0	0	0	0	0	0
FIRES	0.002	0	0.003	0.001	0.003	0.001
MANAGED BURNING AND DISPOSAL	0.119	0.007	0.005	0.001	0.005	0.001
COOKING	0.007	0	0.007	0	0.008	0
OTHER (MISCELLANEOUS PROCESSES)	0	0	0	0	0	0
AREA-WIDE SUBTOTAL	**1.203**	**0.124**	**1.185**	**0.125**	**1.271**	**0.129**
LIGHT DUTY PASSENGER (LDA)	0.264	0.169	0.152	0.079	0.124	0.066
LIGHT DUTY TRUCKS – 1 (LDT1)	0.073	0.039	0.04	0.016	0.027	0.01
LIGHT DUTY TRUCKS – 2 (LDT2)	0.217	0.172	0.134	0.065	0.1	0.04
MEDIUM DUTY TRUCKS (MDV)	0.169	0.13	0.099	0.045	0.077	0.027
LIGHT HEAVY DUTY GAS TRUCKS – 1 (LHDGT1)	0.0775	0.048	0.043	0.022	0.031	0.013
LIGHT HEAVY DUTY GAS TRUCKS – 2 (LHDGT2)	0.078	0.004	0.043	0.002	0.031	0.002
MEDIUM HEAVY DUTY GAS TRUCKS (MHDGT)	0.004	0.208	0.002	0.073	0.001	0.055
HEAVY HEAVY DUTY GAS TRUCKS (HHDGT)	0	0.208	0	0.073	0	0.055
LIGHT HEAVY DUTY DIESEL TRUCKS - 1 (LHDDT1)	0.078	0.365	0.043	0.162	0.031	0.075
LIGHT HEAVY DUTY DIESEL TRUCKS - 2 (LHDDT2)	0.006	0.091	0.004	0.043	0.003	0.024
MEDIUM HEAVY DUTY DIESEL TRUCKS (MHDDT)	0.018	0.208	0.001	0.073	0.001	0.055
HEAVY HEAVY DUTY DIESEL TRUCKS (HHDDT)	0.106	2.32	0.046	0.805	0.049	0.641

SOURCE CATEGORY	2018		2026		2032	
	VOC	NOx	VOC	NOx	VOC	NOx
MOTORCYCLES (MCY)	0.189	0.048	0.148	0.036	0.131	0.033
HEAVY DUTY DIESEL URBAN BUSES (UBD)	0	0	0	0	0	0
HEAVY DUTY GAS URBAN BUSES (UBG)	0	0	0	0	0	0
SCHOOL BUSES – GAS (SBG)	0	0	0	0	0	0
SCHOOL BUSES – DIESEL (SBD)	0	0.027	0	0.018	0	0.014
OTHER BUSES – GAS (OBG)	0.001	0.003	0.001	0.001	0.001	0.001
OTHER BUSES – MOTOR COACH – DIESEL (OBC)	0	0.008	0	0.002	0	0.001
ALL OTHER BUSES – DIESEL (OBD)	0	0.003	0	0.002	0	0.003
MOTOR HOMES (MH)	0.002	0.017	0.001	0.01	0	0.007
ON-ROAD SUBTOTAL	**1.153**	**3.661**	**0.686**	**1.385**	**0.556**	**1.014**
AIRCRAFT	0	1.287	0	1.294	0	1.299
TRAINS	0.085	1.82	0.085	2.024	0.086	2.158
RECREATIONAL BOATS	0.738	0.131	0.513	0.119	0.403	0.115
OFF-ROAD RECREATIONAL VEHICLES	0.038	0.001	0.031	0.001	0.023	0.001
OFF-ROAD EQUIPMENT	0.448	0.616	0.354	0.394	0.219	0.312
OFF-ROAD EQUIPMENT (PERP)	0.011	0.126	0.007	0.059	0.007	0.05
FARM EQUIPMENT	0.031	0.015	0.017	0.01	0.01	0.007
FUEL STORAGE AND HANDLING	0.058	0	0.05	0	0.048	0
OFF-ROAD SUBTOTAL	**3.938**	**3.996**	**3.62**	**3.902**	**3.386**	**3.941**
TOTAL	**7.705**	**20.547**	**6.972**	**17.752**	**6.763**	**17.483**

Source: CARB CEPAM emissions inventory, CEPAM2019v1.04 with approved external emission adjustment factors.

APPENDIX B
Modeling Emission Inventory for the Ozone State Implementation Plan

Modeling Emission Inventory for the Ozone State Implementation Plan
August 2022

CALIFORNIA
AIR RESOURCES BOARD

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I. Acronyms

APCD – Air Pollution Control District

AQMD – Air Quality Management District

Caltrans – California Department of Transportation

CalVAD – California Vehicle Activity Database

CARB – California Air Resources Board

CCAQS – Central California Air Quality Studies

CCOS – Central California Ozone Study

CEIDARS – California Emission Inventory Development and Reporting System

CEMS – Continuous emissions monitoring system

CEPAM – California Emission Projection Analysis Model

CMAQ – Community Multi-Scale Air Quality

CRPAQS – California Regional PM10/PM25 Air Quality Study

EIC – Emission Inventory Code

EICSUM – EIC SUMmary category, the first three digits of EIC

ERG – Eastern Research Group

HD – Heavy Duty

I&M – Inspection and Maintenance

MPO – Metropolitan Planning Organization

NLCD – National Land Cover Database

NOx – Oxides of Nitrogen

OGV – Ocean Going Vessel

PM – Particulate Matter

PM10 – Particulate Matter 10 micrometers in diameter and smaller

PM2.5 – Particulate Matter 2.5 micrometers in diameter and smaller

ROG – Reactive Organic Gases

RRF – Relative Response Factor

RTPA – Regional Transportation Planning Agencies

RWC – Residential Wood Combustion

SAPRC – Statewide Air Pollution Research Center

SCC – Source Classification Code

SIP – State Implementation Plan

SIPIWG – State Implementation Plan Inventory Working Group

SJV – San Joaquin Valley

SMOKE – Sparse Matrix Operator Kernel Emissions

SSS – State SIP Strategy

TOG – Total Organic Gases

II. Development of Ozone Emissions Inventories

Emission inputs for air quality modeling (commonly and interchangeably referred to as "modeling inventories" or "gridded inventories") have been developed by the California Air Resources Board (CARB) and staff from multiple air districts. These inventories support multiple State Implementation Plans (SIP)s across California to address nonattainment of the federal ozone (O3) standards. CARB maintains an electronic database of emissions and other useful information to generate aggregate emission estimates at the county, air basin, and district level, *Criteria Pollutant Emission Inventory Data*. This database is called the California Emission Inventory Development and Reporting System (CEIDARS). CEIDARS provides a foundation for the development of a more refined (hourly, grid cell-specific) set of emission inputs that are required by air quality models. The CEIDARS base year inventory is a primary input to the state's emission forecasting system, known as the California Emission Projection Analysis Model (CEPAM). CEPAM produces the projected emissions that are then processed to serve as the emission input for air quality models. The following sections of this document describe the methods used to prepare the base and future year emissions inventory estimates.

A. Inventory Coordination

Most of this inventory was developed in direct coordination with staff at the regional Air Pollution Control Districts across the state. In July of 2019 CARB convened the SIP Inventory Working Group (SIPIWG) to provide an opportunity and means for interested parties (CARB, districts, etc.) to discuss issues pertaining to the development and review of base year, future year, planning and gridded inventories to be used in SIP modeling. The group met every four to six weeks since convening into early 2020. Group participants included staff from Bay Area, Butte, Eastern Kern, El Dorado, Feather River, Imperial, Northern Sierra, Placer, Sacramento, San Diego, San Joaquin Valley, San Luis Obispo, South Coast, Ventura, and Yolo-Solano air districts.

Additionally, CARB established the SIPIWG Spatial Surrogate Sub-committee, which focuses on improving input data to spatially disaggregate emissions at a more refined level needed for air quality modeling. Local air districts that participate include San Joaquin Valley, San Diego, Bay Area, Imperial, South Coast, Ventura, and Sacramento.

A great deal of work preceded this modeling effort through the Central California Air Quality Studies (CCAQS). CCAQS consisted of two studies: 1) the Central California Ozone Study (CCOS); and 2) the California Regional PM10 (particulate matter 10µm in diameter and smaller) /PM2.5 (particulate matter 2.5µm in diameter and smaller) Air Quality Study (CRPAQS).

B. Background

California's emission inventory is an estimate of the amounts and types of pollutants emitted from thousands of industrial facilities, millions of motor vehicles, and myriad emission sources such as consumer products and fireplaces. The development and maintenance of the emission inventory involves several agencies. This multi-agency effort includes: CARB, 35 local air pollution control and air quality management districts (Districts), regional transportation planning agencies (RTPAs), and the California Department of Transportation (Caltrans). CARB is responsible for the compilation of the final statewide emission inventory, and for maintaining this information in CEIDARS. In addition to the statewide emission inventory, emissions from northern Mexico and western United States (Nevada, Arizona, Oregon, Idaho, and Utah) are also incorporated in the final emission inventory used for modeling. The final emission inventory reflects the best information available at the time.

The basic principle for estimating county-wide regulatory emissions is to multiply an estimated, per-unit emission factor by an estimate of typical usage or activity. For example, on-road motor vehicle emission factors are estimated for a specific vehicle type and applied to all applicable vehicles. The estimates are based on dynamometer tests of a small sample for a vehicle type. The activity for any given vehicle type is based on an estimate of typical driving patterns, number of vehicle starts, and typical miles driven. Assumptions are also made regarding typical usage: it is assumed that all vehicles of a certain vehicle type are driven under similar conditions in each region of the state.

Developing emission estimates for stationary sources involves the use of per unit emission factors and activity levels. Under ideal conditions, facility-specific emission factors are determined from emission tests for a particular process at a facility. A continuous emission monitoring system (CEMS) can also be used to determine a gas or particulate matter concentration or emission rate (U.S. EPA, 2016). More commonly, a generic emission factor is developed by averaging the results of emission tests from similar processes at several different facilities. This generic factor is then used to estimate emissions from similar types of processes when a facility-specific emission factor is not available. Activity levels from stationary sources can be derived from the amount of product produced, solvent used, or fuel used.

The district-reported and CARB-estimated emissions totals are stored in the CEIDARS database for any given pollutant. Both criteria pollutants and their precursors are stored in this complex database. These are typically annual average emissions for each county, air basin, and district. Modeling inventories for reactive organic gases (ROG) are estimated from total organic gases (TOG). Similarly, the modeling inventories for PM10 and PM2.5 are estimated from total particulate matter (PM). Details about chemical and size resolved speciation of emissions for modeling can be found in Section

III.E. Additional information on CARB emission inventories can be found at *CARB Emission Inventory Activities*.

C. Inventory Years

The emission inventory scenarios used for air quality modeling must be consistent with U.S. EPA's Modeling Guidance (U.S. EPA, 2014). Since changes in the emissions inventory can affect the calculation of the relative response factors (RRFs) used to project air quality to future years, the terms used in the preparation of the emission inventory scenarios must be clearly defined. In this document, the following inventory definitions will be used.

1. Base Case Modeling Inventory (2018)

Base case modeling is intended to evaluate model performance and demonstrate confidence in the modeling system used for the modeled attainment test. The base case modeling inventory is not used as part of the modeled attainment test itself. Model performance is assessed relative to how well model-simulated concentrations match actual measured concentrations. The modeling inputs are developed to represent (as best as possible) actual, day-specific conditions. Emissions for certain sectors are based on day-specific activities, meteorology, and emission adjustments. Actual district-reported point source emissions were gathered for the year 2017 and forecasted to 2018. The year 2018 was selected to coincide with the year selected for baseline design values (described below). The U.S. EPA modeling guidance states that once the model has been shown to perform adequately, the use of day-specific emissions is no longer needed. In preparation for SIP development, both CARB and the local air districts began a comprehensive review and update of the emission inventory resulting in a comprehensive emissions inventory for 2018.

2. Reference Year Modeling Inventory (2018)

The reference year inventory is intended to be a representation of emission patterns occurring through the baseline design value period and the emission patterns expected in the future year. U.S. EPA modeling guidance describes the reference year modeling inventory as "a common starting point" that represents average or "typical" conditions that are consistent with the baseline design value period. U.S. EPA guidance also states "using a 'typical' or average reference year inventory provides an appropriate platform for comparisons between baseline and future years." The 2018 reference year inventory represents typical average conditions and emission patterns through the 2018 design value period. This reference emissions inventory is not developed to capture all day-specific emission characteristics; however, this reference inventory does include meteorological effects for 2018 (e.g., temperature, relative humidity, and solar insolation), as well as certain day-specific emission activities, such as agricultural and prescribed burning.

3. Future Year Modeling Inventory (2026 and 2032)

Future year modeling inventories, along with the reference year modeling inventory, are used in the model-derived RRF calculation. Projected inventory year 2026 was chosen to address the modeled attainment year for the 8-hour 2008 ozone standard of 75 ppb. Projected inventory year 2032 was chosen to address the modeled attainment year for the 8 hour 2015 ozone standard of 70 ppb.

These inventories maintain the “typical,” average patterns of the 2018 reference year modeling inventory. Some sectors of the 2026 and 2032 inventories include temporal variations that were driven by temperature, relative humidity, and solar insolation effects from reference year (2018) meteorology. Future year point and area source emissions are projected from the 2017 baseline emissions. Future year on-road emission inventories are used as projected by EMFAC.

D. Spatial Extent of Emission Inventories

The emissions model-ready files that are prepared for use as an input for the air quality model conform to the definition and extent of the grids shown in Figure 1. Figure 2 illustrates an enlarged image of the Eastern Kern Nonattainment area in Central California (highlighted in yellow) in the statewide 4 km modeling grid.

Figure 1. Spatial coverage of emissions grid with nonattainment area highlighted in yellow

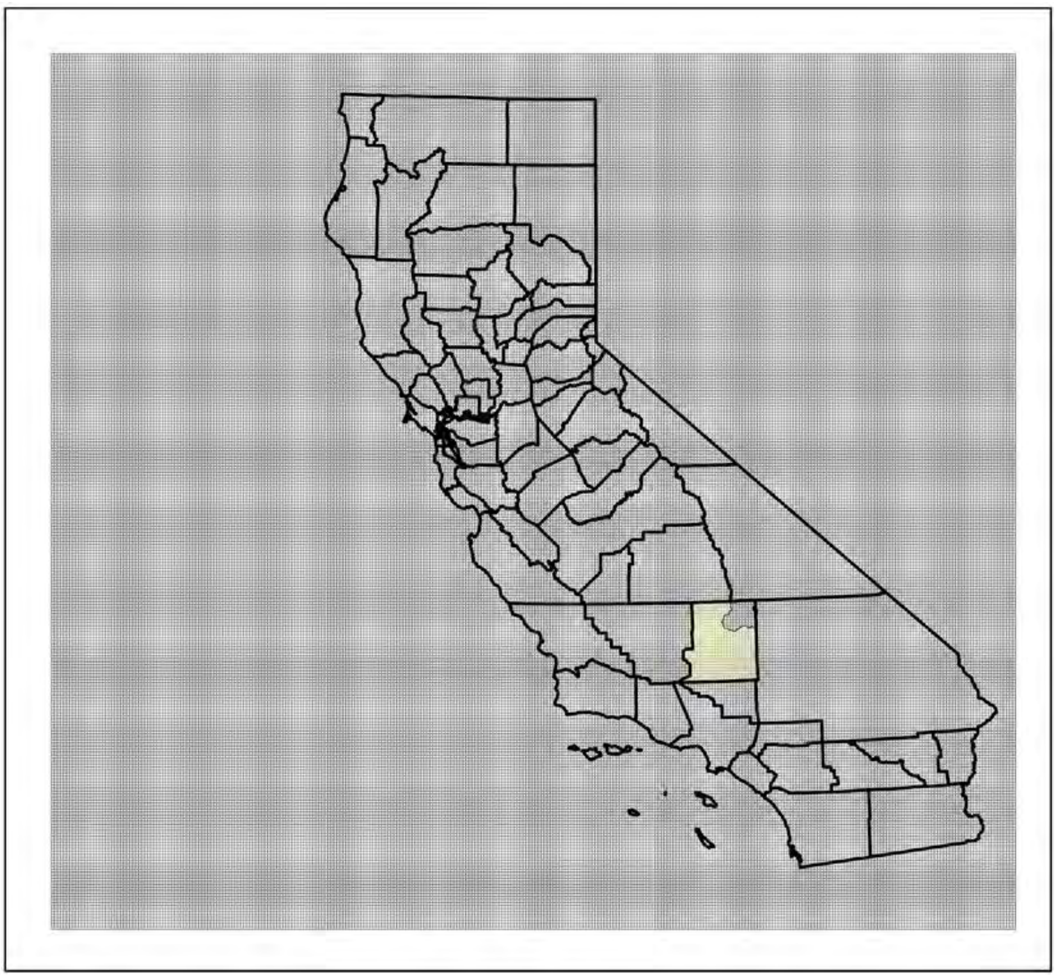


Figure 2: Eastern Kern Nonattainment area highlighted in Central California with statewide 4 km grid overlayed

The domain uses a Lambert projection and assumes a spherical Earth. The emissions inventory grid uses a Lambert Conical Projection with two parallels. The parallels are at 30° and 60° N latitude, with a central meridian at 120.5° W longitude. The coordinate system origin is offset to 37° N latitude. The emissions inventory is developed for the gridded statewide domain on a spatial resolution of 4 km x 4 km. The state modeling domain extends entirely over California and 100 nautical miles west over the Pacific Ocean. The specifications for the statewide modeling domain are summarized in Table 1.

Table 1: Modeling domain parameters

Parameter	Statewide domain
Map Projection	Lambert Conformal Conic
Datum	None (Clarke 1866 spheroid)
1st Standard Parallel	30.0° N
2nd Standard Parallel	60.0° N
Central Meridian	-120.5° W
Latitude of projection origin	37.0° N
Coordinate system Units	Meters
Semi-major axis	6370 km
Semi-minor axis	6370 km
Grid size	4 km x 4 km
Number of cells	291 x 321 cells
Lambert origin	(-684,000 m, -564,000 m)
Geographic center	-120.5° Lat and 37.0° Lon

III. Estimation of Base Year Modeling Inventory

As mentioned in Section I.C.1, base case modeling is intended to demonstrate confidence in the modeling system used for the modeled attainment test. The following sections describe the temporal and spatial distribution of emissions and how each of the sectors within the modeling inventories are prepared.

A. Terminology

The terms “point sources” and “area sources” are often confused. Traditionally, these terms have had different meanings to the developers of planning emissions inventories and the developers of modeling emissions inventories. Table 2 summarizes the difference in the terms as both sets of terms are used in this document. In modeling terminology, “point sources” traditionally refer to elevated emission sources that exit from a stack and have an associated plume rise. The current inventory includes emissions sources reported by the Air Pollution Control District (APCD). Those sources associated with a facility are treated as either elevated sources or non-elevated. The emissions processor calculates plume rise for elevated sources; non-elevated sources are treated as ground-level sources. Examples of non-elevated emissions sources include landfills and composting facilities. “Area sources” refers collectively to area-wide sources, stationary-aggregated sources, and other mobile sources (including aircraft, trains, ships, and all off-road vehicles and equipment). That is, “area sources” are low-level sources from a modeling perspective.

Table 2: Inventory terms for emission source types

Modeling Term	Emission Inventory Term	Examples
Point	Stationary – Point Facilities	Stacks at Individual Facilities
Area	Off-road Mobile	Construction Equipment, Farm Equipment, Trains, Recreational Boats
Area	Area-wide	Residential Fuel Combustion, Livestock Waste, Consumer Products, Architectural Coatings
Area	Stationary - Aggregated	Industrial Fuel Use
On-road Motor Vehicles	On-road Mobile	Cars and Trucks
Biogenic	Biogenic	Trees

The following sections describe in more detail the temporal, spatial, and chemical disaggregation of the emissions inventory for point sources and area sources.

B. Emissions Inventory

Modeling emissions are based on the CEPAM inventories for the base year and future year. Since the modeling inventory was processed in parallel to the application of updates to CEPAM the modeling inventory was patched from CEPAM 2019 v1.03 for the following source sectors:

- Off-Road SORE rule as adopted by the Board December 2021
- Cargo Handling Equipment (CHE)
- Construction “In Use” Equipment
- Large Spark Ignition (LSI) Forklifts
- Forestry Equipment
- Industrial/Military Rail
- Additional adjustments for GSE in South Coast

The resulting modeling inventory matches totals from CEPAM 2019 v1.04.

C. Temporal Distribution of Emissions

The emissions are temporally resolved by month, week, day, and hour to more accurately gauge model performance and ultimately better assess the influence of control measures on attainment. This section covers the temporal distributions of the point, area, and off-road mobile sources. The temporal distribution of the emissions from on-road, biogenic, and ocean-going vessel (OGV) sources are discussed in Sections IV.B, IV.C, and IV.E. The temporal distribution of residential wood combustion (RWC) and agricultural ammonia sectors are described in Section IV.F.4 and Section IV.F.5, respectively.

Temporal data are stored in CARB's emission inventory database. Each local air district assigns temporal data for all processes at each facility in their district to represent when emissions at each process occur. For example, emissions from degreasing may operate differently than a boiler. CARB or district staff also assign temporal data for each area source category by county/air basin/district.

1. Monthly Variation

Emissions are adjusted temporally to represent variations by month. Some emission sources operate the same throughout a year. For example, a process heater at a refinery or a line-haul locomotive likely operates the same month-to-month. Other emission categories, such as a tomato processing plant or use of recreational boats, vary significantly by season. CARB's emission inventory database stores the relative monthly fractional activity for each process, the sum of which is 100. Using an example of emission sources that typically operate the same over each season, emissions from refinery heaters and line-haul locomotives would have a monthly fraction (throughput) of 8.33 for each month (calculated as 100/12 = 8.33). This is considered a flat monthly profile. To apply monthly variations to create a gridded inventory, the annual average day's emissions (yearly emissions divided by 365) is multiplied by the typical monthly throughput. For example, a typical monthly throughput of 15 in July for recreational boats results in emissions about 1.8 times higher (15 / 8.33 = 1.8) than a day in a month with a flat monthly profile.

2. Weekly Variation

Emissions are adjusted temporally to represent variations by day of the week. Some operations are the same over a week, such as a utility boiler or a landfill. Many businesses operate only 5 days per week. Other emissions sources are similar on weekdays, but may operate differently on weekend days, such as architectural coatings or off-road motorcycles. To accommodate variations in days of the week, each process or emission category is assigned a days-per-week code or DPWK. Table 3 shows the current DPWK codes.

Table 3: Day of week variation factors

Code	WEEKLY CYCLE CODE DESCRIPTION	M	T	W	TH	F	S	S
1	One day per week	1	1	1	1	1	0	0
2	Two days per week	1	1	1	1	1	0	0

Code	WEEKLY CYCLE CODE DESCRIPTION	M	T	W	TH	F	S	S
3	Three days per week	1	1	1	1	1	0	0
4	Four days per week	1	1	1	1	1	0	0
5	Five days per week - Uniform activity on weekdays, none on Saturday and Sunday	1	1	1	1	1	0	0
6	Six days per week - Uniform activity on weekdays, none on Saturday and Sunday	1	1	1	1	1	1	0
7	Seven days per week – Uniform activity every day of the week	1	1	1	1	1	1	1
20	Uniform activity on Saturday and Sunday, no activity the remainder of the week	0	0	0	0	0	1	1
21	Uniform activity on Saturday and Sunday, half as much activity on weekdays	5	5	5	5	5	10	10
22	Uniform activity on weekdays, reduced activity on weekends	10	10	10	10	10	7	4
23	Uniform activity on weekdays, reduced activity on weekends	10	10	10	10	10	8	8
24	Uniform activity on weekdays; half as much activity on Saturday. Little activity on Sunday	10	10	10	10	10	5	1
25	Uniform activity on weekdays, one third as much on Saturday, little on Sunday	10	10	10	10	10	3	1
26	Uniform activity on weekdays, little activity on Saturday, no activity on Sunday	10	10	10	10	10	3	0
27	Uniform activity on weekdays, half as much activity on weekends	10	10	10	10	10	5	5
28	Uniform activity on weekdays, five times as much activity on weekends	2	2	2	2	2	10	10
29	Uniform activity on Monday through Thursday, increased activity on Friday, Saturday, and Sunday	8	8	8	8	10	10	10

3. Daily Variation

Emissions are adjusted temporally to represent variations by hour of day. Many emission sources occur 24 hours per day, such as livestock waste or a sewage treatment plant whereas many businesses operate 8 hours per day. Other emissions sources vary significantly over a day, such as residential space heating or pesticide application. Each process or emission category is assigned an hours-per-day (HPDY) code. Table 4 displays the daily variation factors or current HPDY codes. Code 33 is no longer used for residential fuel combustion in favor of day specific adjustments see Section IV.F.4. Additional temporal profiles are shown in Section IX.

Table 4: Daily variation factors

Code	CODE DESCRIPTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	1 HOUR PER DAY	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	3 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
4	4 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
5	5 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
6	6 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
7	7 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
8	8 HOURS PER DAY - UNIFORM ACTIVITY FROM 8 A.M. TO 4 P.M. (NORMAL WORKING SHIFT)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
9	9 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
10	10 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
11	11 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
12	12 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
13	13 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
14	14 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
15	15 HOURS PER DAY	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Code	CODE DESCRIPTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
16	16 HOURS PER DAY - UNIFORM ACTIVITY FROM 8 A.M. TO MIDNIGHT (2 WORKING SHIFTS)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
17	17 HOURS PER DAY	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
18	18 HOURS PER DAY	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	19 HOURS PER DAY	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
20	20 HOURS PER DAY	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
21	21 HOURS PER DAY	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
22	22 HOURS PER DAY	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
23	23 HOURS PER DAY	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
24	24 HOURS PER DAY - UNIFORM ACTIVITY DURING THE DAY	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
31	MAJOR ACTIVITY 5-9 P.M., AVERAGE DURING DAY, MINIMAL IN EARLY A.M.(GAS STATIONS)	3	1	1	1	1	1	1	5	5	5	5	5	5	5	5	5	5	10	10	10	10	7	7	3
33	MAX ACTIVITY 7-9 A.M. & 7-11 P.M.,AVERAGE DURING DAY, LOW AT NIGHT (RESIDENTIAL FUEL COMBUSTION)	2	2	2	2	2	2	2	10	10	6	6	5	5	5	5	5	5	5	5	10	10	10	10	2
34	ACTIVITY 1 TO 9 A.M.; NO ACTIVITY REMAINDER OF DAY (i.e. ORCHARD HEATERS)	0	8	8	8	8	10	10	10	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	MAX ACTIVITY 7 A.M. TO 1 A.M., REMAINDER IS LOW (i.e. COMMERCIAL AIRCRAFT)	10	1	1	1	1	1	1	8	8	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10

Code	CODE DESCRIPTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
37	ACTIVITY DURING DAYLIGHT HOURS; LESS CHANCE IN EARLY MORNING AND LATE EVENING	0	0	0	0	0	1	3	6	9	10	10	10	10	10	10	10	10	9	6	3	1	0	0	0
38	ACTIVITY DURING MEAL TIME HOURS (i.e. RESIDENTIAL COOKING)	0	0	0	0	0	2	6	6	2	2	1	2	4	4	2	1	1	3	10	8	7	6	1	0
50	PEAK ACTIVITY AT 7 A.M. & 4 P.M.; AVERAGE DURING DAY (ON-ROAD MOTOR VEHICLES)	1	1	1	1	1	1	6	10	6	5	5	5	5	5	5	6	10	8	6	4	1	1	1	1
51	ACTIVITY FROM 6 A.M. TO 12 P.M. (PETROLEUM DRY CLEANING)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
52	MAJOR ACTIVITY FROM 6 A.M.-12 P.M., LESS FROM 12-7 P.M. (PESTICIDES)	0	0	0	0	0	1	6	10	10	10	10	10	6	3	3	3	3	4	4	0	0	0	0	0
53	ACTIVITY FROM 7 A.M. TO 12 P.M. (AGRICULTURAL AIRCRAFT)	0	0	0	0	0	0	0	2	2	2	2	2	1	0	0	0	0	0	0	0	0	0	0	0
54	UNIFORM ACTIVITY FROM 7 A.M. TO 9 P.M. (DAYTIME BIOGENICS)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
55	UNIFORM ACTIVITY FROM 9 P.M. TO 7 A.M. (NIGHTIME BIOGENICS)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
56	MAX ACTIVITY 8 A.M. TO 5 P.M, MINIMAL AT NIGHT & EARLY MORNING(CAN&COIL/METAL PARTS COATINGS)	0	0	0	0	1	1	2	3	10	10	10	10	10	10	10	10	9	1	1	1	1	1	1	1
57	MAX ACTIVITY 7 A.M. TO 2 P.M., MINIMAL AT EVENING AND MORNING HOURS (CONSTRUCTION EQUIPMENT ON HOT DAYS)	0	0	0	0	0	1	6	10	10	10	10	10	10	9	8	4	2	1	1	0	0	0	0	0

Code	CODE DESCRIPTION	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
58	MAX ACTIVITY 7 A.M. TO NOON.;REDUCED ACTIVITY NOON TO 6 P.M. (AUTO REFINISHING)	0	0	0	0	0	0	0	10	10	10	10	10	8	8	8	8	8	8	0	0	0	0	0	0
59	MAXIMUM ACTIVITY FROM 7:00 AM TO 3:00 PM; REDUCED ACTIVITY FROM 3:00 TO 6:00 PM.(CONSTRUCTION EQUIPMENT ON NORMAL DAYS)	0	0	0	0	0	0	2	10	10	10	10	10	10	10	10	7	3	1	1	0	0	0	0	0
60	MAXIMUM ACTIVITY FROM NOON TO 7:00 PM; REDUCED ACTIVITY EVENING AND MORNING HOURS (RECREATIONAL BOAT EXHAUST)	0	0	0	0	0	0	0	2	4	6	7	9	10	10	10	10	10	10	10	7	5	3	1	0
81	MAX ACTIVITY 9 AM TO 3 PM; HALF THE ACTIVITY REMAINING HOURS (WASTE FROM DAIRY CATTLE)	7	6	6	5	4	4	4	5	7	8	9	10	10	10	7	3	3	3	4	4	5	6	7	7
82	ACTIVITY FROM 10 AM TO 9 PM RISING TO PEAK AT 3; NO ACTIVITY REMAINDER OF DAY (WASTE FROM POULTRY)	0	0	0	0	0	0	0	0	0	3	3	7	7	7	10	10	7	3	3	3	3	0	0	0
83	ACTIVITY FROM 9 AM TO 12 AM RISING TO PEAK AT 3; MINIMUM ACTIVITY REMAINDER OF DAY (WASTE FROM SWINE)	0	0	0	0	0	0	0	1	1	2	4	6	8	8	9	10	8	4	3	3	2	1	1	1
84	MAJOR ACTIVITY FROM 11AM TO 6PM; REDUCED OTHER HOURS (EVAP-COASTAL COUNTIES)	7	7	6	6	6	6	6	7	8	8	9	9	10	10	10	10	9	9	8	8	7	7	7	7
85	MAJOR ACTIVITY FROM 11AM TO 6PM; REDUCED OTHER HOURS (EVAP-NON-COASTAL COUNTIES)	5	5	5	5	4	4	5	5	6	7	8	9	9	10	10	10	9	9	8	7	6	6	6	5

D. Spatial Allocation

Once the base case, reference, or future year inventories are developed, the next step of modeling inventory development is to spatially allocate the emissions. Air quality models attempt to replicate the physical (e.g., transport) and chemical processes that occur in the atmosphere within a modeling domain. Therefore, it is important that the physical location of emissions be specified as accurately as possible. Ideally, the actual location of all emissions would be known exactly. However, some categories of emissions would be virtually impossible to determine—for example, the actual amount and location of consumer products (e.g., deodorant) used every day. To the extent possible, the spatial allocation of emissions in a modeling inventory approximates as closely as possible the actual location of emissions.

Spatial allocation is typically accomplished by using spatial surrogates. These spatial surrogates are processed into spatial allocation factors to geographically distribute county-wide area source emissions to individual grid cells. Spatial surrogates are developed based on demographic, land cover, and other data that exhibit patterns geographically. Sonoma Technology, Inc. (STI) (Funk, et al., 2001) under CCOS contract, originally developed many of the spatial surrogates by creating a base year (2000) and various future year surrogate inventories. STI updated the underlying spatial data and developed new surrogates (Reid, et al., 2006), completing the project in 2008. CARB and districts have since continued to update and improve many of the spatial surrogates, adding new ones as more data become available.

Four basic types of data are used to develop the spatial allocation factors: land use and land cover, satellite imagery, facility location, and demographic and socioeconomic data. Land use and land cover data are associated with specific land uses, such as agricultural harvesting or recreational boats. Facility locations are used for sources such as gas stations and dry cleaners. Demographic and socioeconomic data, such as population and housing, are associated with residential, industrial, and commercial activities (e.g., residential fuel combustion). To develop spatial allocation factors of high quality and resolution, local socioeconomic and demographic data were used when available for developing base case, baseline, and future year inventories. These data were available from local Metropolitan Planning Organizations (MPO)s or Regional Transportation Planning Agency (RTPA), where they are used as inputs for travel demand models. In rural regions for which local data were not available, data from Caltrans' Statewide Transportation Model were used.

The current snapshot used for the Eastern Kern O_3 SIP emission inventory is defined as snapshot October 1st, 2021 (SNP20211001_SORE) with improvements to SORE categories. Detailed methodology for each surrogate can be found in the spatial surrogate methodology document (AMSS, Spatial Surrogate Methodology Document SNP2021-10-01, 2021). This working snapshot includes all previous updates noted in surrogate snapshot 2020-10-01 (AMSS, 2020), as well as recent improvements outlined below. A summary of the primary spatial surrogates by EICSUM is provided in Section X.

- Improvements to small off-road equipment (SORE) surrogates
    - Creation of SNOW-level allocation factors for single family housing and commercial activity related to locations that will only occur with snowfall (snowblowers, etc.).

  - Creation of forest roads spatial surrogate (191) based on the integration of NLCD forest data with the TIGER road network
- Updated to 2016 National Land Cover Database
- Improvements to the Dunn and Bradstreet based surrogates with integration of Digital Maps Products 2017 Parcel data
- Updates to ocean going vessel surrogates based on 2018 Automatic Identification System (AIS)
- Improvement to construction surrogates
  - Creation of a 90:10 ratio split of on-road to offroad construction surrogate
- Improvements to agriculture surrogates
  - Updated input data for Farm Road VMT and inclusion of California Department of Pesticide Regulation (CDPR) data
  - Updated input data to our poultry related surrogate from California Water Board, Southern California Association of Governments (SCAG), and San Diego Association of Governments (SANDAG)
- Creation of a Water bodies and Land mask to remove anomalies caused by AIS satellite bias.

1. Spatial Allocation of Area Sources

Area-wide emissions are modeled using a top-down approach where emission totals are estimated for a large geographic area of interest (GAI). Each area source category is assigned a primary spatial surrogate that is used to allocate emissions to a grid cell in CARB’s 4 km statewide modeling domain. Examples of surrogates include population, land use, and other data with known geographic distributions for allocating emissions to grid cells, as described above.

2. Spatial Allocation of Point Sources

Each point source is allocated to grid cells using the latitude and longitude reported for each stack. If there are no stack latitude and longitude, the facility coordinates are used. There are two types of point sources: elevated and non-elevated sources. Stationary point sources with stacks are regarded as elevated sources. Those without physical stacks that provide only latitude/longitude, such as airports or landfills, are considered non-elevated. Emissions are allocated vertically for elevated sources using the SMOKE (Sparse Matrix Operator Kernel Emissions) modeling system's in-line plume rise calculation within the CMAQ (Community Multi-scale Air Quality) photochemical model. SMOKE will select the sources that will receive the CMAQ in-line plume rise treatment, and group together sources with nearly identical stack parameters to reduce the number of calculations performed by the CMAQ in-line plume rise module. SMOKE will then output the emissions by grouped sources and the accompanying stack/facility coordinates and stack parameters for CMAQ's in-line plume rise module to handle the vertical allocation of the elevated sources.

3. Spatial Allocation of Wildfires, Prescribed Burns, and Wildland Fire Use

Emissions from wildfires, prescribed burns, and wildland fires are event- and location-based. A fire event can last a few hours or span multiple days. Each fire is spatially allocated to grid cells using the final extent of each fire event while the temporal distribution also reflects the actual duration of the fire. The spatial information to allocate the fire emissions comes from a statewide interagency fire perimeters geodatabase maintained by the Fire and Resource Assessment Program (FRAP) of the

California Department of Forestry and Fire Protection (CALFIRE). More details on the methodology and estimation of the wildfire emissions can be found in Section III.F.1.

4. Spatial Allocation of Ocean-going Vessels (OGV)

CARB OGV emissions consist of four activity types: hoteling, maneuvering, anchorage and transit. Since hoteling is stationary in port areas, it was treated as a point source. The remaining activity types are regarded as area sources. Individual berths were identified from a combination of AIS telemetry data, satellite and aerial photography, and detailed port maps where available. The centroids of grid cells on the Statewide domain containing berth locations were then associated with hoteling emissions for each GAI. Transit, spatial surrogates were constructed based on the National Waterway Network and AIS data from 2017. Maneuvering spatial surrogates were drawn to connect the transit lanes with the berth locations for each port. Anchorage locations were determined based on raster data from the National Oceanic and Atmospheric Administration (NOAA) which reflects anchorage locations codified in the Federal Register.

5. Spatial Allocation of On-road Motor Vehicles

The spatial allocation of on-road motor vehicles is based on data from the latest travel demand models provided by local Metropolitan Planning Organizations (MPOs). These model outputs are combined into a statewide transportation network using the Integrated Transportation Network (ITN). For areas without a regional travel demand model, data from the California Department of Transportation (Caltrans) California Statewide Travel Demand Model (CSTDM). For more details, see Section III.B.3.

E. Speciation Profiles

CARB’s emission inventory lists the amounts of pollutants discharged into the atmosphere by source in a certain geographical area during a given time period. It currently contains estimates for CO, NH3, NOx, SOx, total organic gases (TOG) and particulate matter (PM). CO and NH3 each are single species; NOx emissions are composed of NO, NO2 and HONO; and SOx emissions are composed of SO2 and SO3. TOG and PM potentially contain over hundreds of different chemical species, and speciation is the process of disaggregating these inventory pollutants into individual chemical species components or groups of species. CARB maintains and updates such speciation profiles for organic gases (OG) and PM for a variety of source categories.

Photochemical models simulate the physical and chemical processes in the lower atmosphere and include all emissions of the important classes of chemicals involved in photochemistry as well as less reactive compounds that are of concern from a health or visibility standpoint. TOG includes all organic compounds that can become airborne (through evaporation, sublimation, as aerosols, etc.), excluding CO, CO2, carbonic acid, metallic carbides or carbonates, and ammonium carbonate. TOG emissions reported in the CARB’s emission inventory are the basis for deriving the reactive organic gas (ROG) emission components, which are also reported in the inventory. ROG is defined as TOG minus CARB’s exempt compounds (e.g., methane, ethane, various chlorinated fluorocarbons, acetone, perchloroethylene, volatile methyl siloxanes, etc.). ROG is nearly identical to U.S. EPA’s Volatile Organic Compounds (VOC), which is based on EPA’s exempt list. For all practical purposes, use of the terms ROG and VOC are interchangeable.

Modeling Emission Inventory

The OG speciation profiles are applied to estimate the amounts of various organic compounds that make up TOG emissions. A speciation profile contains a list of organic compounds and the weight fraction that each compound comprises of the TOG emissions from a particular source type. In addition to the chemical name for each chemical constituent, the file also shows the 5-digit CARB internal identification chemical code. The speciation profiles are applied to TOG to develop both the photochemical model inputs and the emission inventory for ROG. It should be noted that districts are allowed to report their own reactive fraction of TOG that is used to calculate ROG rather than use the information from the assigned OG speciation profiles. These district-reported fractions are not used in developing modeling inventories because the information needed to calculate the amount of each organic compound is not available.

The PM emissions are size-fractionated by using PM size distribution profiles, which contain the total weight fraction for PM2.5 and PM10 out of total PM. The fine and coarse PM chemical compositions are characterized by applying the PM chemical speciation profiles for each source type, which contain the weight fractions of each chemical species for PM2.5, PM10, and total PM. PM chemical speciation profiles may also vary for different PM size fractions even for the same emission source. PM size profiles and speciation profiles are typically generated based on source testing data. In most previous source testing studies aimed at determining PM chemical composition, filter-based sampling techniques were used to collect PM samples for chemical analyses.

The most current OG profiles and PM profiles are available for download from *CARB's speciation profile web page*. Based on these original profiles, a model-ready speciation file, gspro, was generated for a specific chemical mechanism (for example, SAPRC07T) to separate aggregated inventory pollutant emission totals into emissions of model species required by the air quality model.

Each process or product category is keyed to one of the OG profiles and one of the PM profiles. Also available for download from CARB's web site (see link in previous paragraph) is a cross-reference file that indicates which OG profile and PM profile are assigned to each category in the inventory. The inventory source categories are represented by an 8-digit source classification code (SCC) for point sources, or a 14-digit emission inventory code (EIC) for area and mobile sources. Some of the OG profiles and PM profiles related to motor vehicles, ocean going vessels, and fuel evaporative sources vary by the inventory year of interest, due to changes in fuel composition, vehicle fleet composition, and emissions control devices such as diesel particulate filters (DPFs). Details can be found in CARB's references of speciation profile development available on the *Consolidated List for Speciation Profiles site*. Mapping of each category to OG and PM profiles is summarized in rogpm and gsref files.

Research studies are conducted regularly to improve CARB's speciation profiles. These profiles support ozone and PM modeling studies and can also be used for regional toxics modeling. Speciation profiles need to be as complete and accurate as possible. CARB has an ongoing effort to update speciation profiles as data become available through testing of emission sources or surveys of product formulations. New speciation data generally undergo technical and peer review; updates to the profiles are coordinated with end users of the data. The recent additions to CARB's speciation profiles include:

- OG profiles
    - Off-road recreational vehicle exhaust and evaporation

  - Biomass burning
  - Consumer products
  - Architectural coating
  - Gasoline fuel and headspace vapor
  - Gasoline vehicle hot soak and diurnal evaporation
  - Gasoline vehicle start and running exhaust
  - Silage
  - Aircraft exhaust
  - Compressed Natural Gas (CNG) bus running exhaust
- PM profiles
  - Tire burning
  - Gasoline vehicle exhaust
  - On-road diesel exhaust
  - Off-road diesel exhaust
  - Ocean going vessel exhaust
  - Aircraft exhaust
  - Concrete batching
  - Commercial cooking
  - Residential fuel combustion-natural gas
  - Coating/painting
  - Cotton ginning
  - Stationary combustion
  - OGV auxiliary boiler combustion
  - Compressed Natural Gas (CNG) vehicle running exhaust

IV. Methodology for Developing Base Case, Baseline, and Future Projected Emissions Inventories

As mentioned in Section II.C, the base case and reference inventories include temperature, humidity, and solar insolation effects for some emission categories; development of these data is described in Sections IV.F. Sections IV.A through IV.H detail how the base case and reference inventories were created for different sectors of the inventory such as point, area, on-road motor vehicles, biogenic, OGV, other day-specific sources, Northern Mexico, and Western States.

A. Estimation of Gridded Area and Point sources

Emissions inventories that are temporally, chemically, and spatially resolved are needed as inputs for the photochemical air quality model. Point sources and area sources (area-wide, off-road mobile, and aggregated stationary) are processed into emissions inventories for photochemical modeling using the SMOKE modeling system (https://www.cmascenter.org/smoke/). The current SIP modeling uses SMOKE v4.8 (referred as Official SMOKE hereafter) following in-house testing of this version of the software.

Inputs for SMOKE are annual emissions totals from CEPAM and information for allocating to temporal, chemical, and spatial resolutions. Temporal inputs for SMOKE are screened for missing or invalid temporal codes as discussed in Section V.A. Temporal allocation of emissions using SMOKE involves the disaggregation of annual emissions totals into monthly, day-of-week, and hour-of-day emissions totals. The temporal codes from Table 3 and Table 4 are reformatted into an input-ready format as explained in the SMOKE user's manual. Chemical speciation profiles, as described in Section III.E, and emissions source cross-reference files used as inputs for SMOKE are developed by CARB staff. SMOKE uses the files for the chemical speciation of NOx, SOx, TOG, and PM to produce the species needed by photochemical air quality models.

Emissions for area sources are allocated to grid cells defined by the modeling grid domain in Section I.D. Emissions are spatially disaggregated using spatial surrogates as described in Section II.C. These spatial surrogates are converted to a SMOKE-ready format as described in the SMOKE user's manual. Emissions for point sources are allocated to grid cells by SMOKE using the latitude and longitude coordinates reported for each stack.

B. Estimation of On-road Motor Vehicle Emissions

1. General Methodology

The EMFAC2017 with Metropolitan Planning Organizations specific activity version 10 (MPOv10) emissions are processed into on-road emissions inventories using ESTA developed by CARB. The ESTA model applies spatial and temporal surrogates to emissions to create top-down emission inventory files.

More information on ESTA is available at the following *GitHub repository for Emissions Spatial and Temporal Allocator*.

2. Activity Data Updates

Link-based and Traffic Analysis Zone (TAZ)-based travel activity from travel demand models provided by different MPOs, Caltrans and other California RTPAs. Parameters such as vehicle mix and VMT are compared between the default EMFAC and Caltrans databases prior to spatial allocation to ensure values lie within reasonable limits.

3. Spatial Adjustment

CARB works with local Metropolitan Planning Organizations (MPOs) to obtain the latest available output from regional travel demand models. The output link networks from these models are combined into a statewide link network using the Integrated Transportation Network (ITN) framework (CARB, 2021). For regions where no local travel demand model data are available, data from the Caltrans California Statewide Travel Demand Model (CSTDM) are used (Caltrans, 2020). Data are quality assured by checking network/link volume, vehicle miles traveled (VMT), and spatial rendering. Overlapping networks are checked for duplicate links to avoid overallocation in these regions. Model output years vary between all regional data sources for ITN. The networks are normalized into modeling years used for air quality modeling using county level growth factors from EMFAC. Table 6 contains the data vintages used in the current working version of the statewide ITN.

Spatial allocation of on-road activity surrogates is split into two vehicle groups, light-duty and heavy-duty. Some major MPOs and Caltrans provide vehicle classification splits in their model link outputs. When possible, this information is incorporated into the ITN. However, when no vehicle splits are provided by the regional models the total network volumes must be used for both light-duty and heavy-duty spatial distribution. Travel demand model output provides network volume information organized by peak and off-peak time periods. This peak period volume information is disaggregated to create 24 hourly surrogates for an average modeling day.

The link networks are processed through the spatial allocator tool to create gridded surrogates weighted by VMT.

Table 5: Network information for data sources used in current version of ITN

Network	Counties in Network	Data Vintage
Association of Monterey Bay Area Governments (AMBAG)	Monterey, San Benito, Santa Cruz	2018 RTDM
Butte County Association of Governments (BCAG)	Butte	2020 RTP/SCS
California Statewide Travel Demand Model (CSTDM)	Statewide	Version 3.0
Fresno Council of Governments (FCOG)	Fresno	2019 RTP/SCS
Kings County Association of Governments (KCAG)	Kings	2018 RTP/SCS
Kern Council of Governments (KCOG)	Kern	2018 RTP/SCS
Merced County Association of Governments (MCAG)	Merced	2018 RTP/SCS
Madera County Transportation Commission (MCTC)	Madera	2018 RTP/SCS
Metropolitan Transportation Commission (MTC)	Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, Sonoma	2017 RTP/SCS
Sacramento Area Council of Governments (SACOG)	El Dorado, Placer, Sacramento, Solano, Sutter, Yolo, Yuba	2020 MTP/SCS
San Diego Association of Governments (SANDAG)	San Diego	2018 RTP/SCS

Network	Counties in Network	Data Vintage
Santa Barbara County Association of Governments (SBCAG)	Santa Barbara	2017 FSTIP
Southern California Association of Governments (SCAG)	Imperial, Los Angeles, Orange, Riverside, San Bernardino, Ventura	2020 RTP/SCS
San Joaquin Council of Governments (SJCOG)	San Joaquin	2018 RTP/SCS
San Luis Obispo Council of Governments (SLOCOG)	San Luis Obispo	2019 RTP
Shasta Regional Transportation Agency (SRTA)	Shasta	2018 RTP
Stanislaus Council of Governments (StanCOG)	Stanislaus	2018 RTP
Tulare County Association of Governments (TCAG)	Tulare	2018 RTP
Tahoe Metropolitan Planning Organization (TMPO)	El Dorado, Placer	2015 FSTIP

Evaporative surrogates were created using registration data from the California Department of Motor Vehicles (DMV). Vehicle registration was provided by census block group for the entire state. Registration data were split into five vehicle types and two fuel types. Table 7 shows the vehicle type categories used for the evaporative emission surrogates. Registration counts were totaled over a three-year period (2015-2018) and assigned to the corresponding census block group polygons. Data from the NASA Nighttime Lights (Mills, 2013) dataset was used to clip the census block group into areas with active population.

Table 6: Registration Data Vehicle Type Classes.

Vehicle Class Group Name	Description
MC	Motorcycles
MH_BUS	Motorhomes and Buses
P	Passenger Vehicles
T1_T4	Light-Heavy Duty Trucks
T5_T7	Heavy-Heavy Duty Trucks

4. Temporal Adjustment (Day-of-week adjustments for EMFAC daily totals)

EMFAC2017 produces average day-of-week (DOW) estimates that represent Tuesday, Wednesday, and Thursday. To more accurately represent daily emissions, DOW adjustments are made to all emissions estimated on a Friday, Saturday, Sunday or Monday. The DOW adjustment factors were developed using CalVAD data. The California Vehicle Activity Database (CalVAD), developed by UC Irvine for CARB, is a system that fuses available data sources to produce a “best estimate” of vehicle activity by class. The latest activity from the CalVAD database was released in 2012. There are no expected upcoming updates. The CalVAD data set includes actual daily measurements of VMT on the road network for 43 of the 58 counties in California. However, there are seven counties that can’t be used because the total vehicle miles traveled are less than the sum of the heavy heavy-duty truck vehicle miles traveled and trucks excluding heavy heavy-duty vehicle miles traveled. Furthermore, two more counties that have high vehicle miles traveled on Sunday are also excluded. Therefore, only 34 of these counties had useful data. To fill the missing 24 counties’ data to cover all of California, a county which is nearby and similar in geography is selected to represent each of the missing counties. The CalVAD fractions were developed for three categories of vehicles: passenger cars (LD), light- and medium-duty trucks (LM), and heavy-heavy duty trucks (HHDT). Table 87 also shows the corresponding assignment to each vehicle type. Furthermore, the CalVAD fractions are scaled so that a typical workday (Tuesday, Wednesday, or Thursday) gets a scaling factor of 1.0. All other days of the week receive a scaling factor where their VMT is related back to the typical workday. This means there are a total of five weekday scaling factors. Lastly, the CalVAD data were used to create a typical holiday, because the traffic patterns for holidays are quite different than a typical weekday. Thus, in the end, there are six daily fractions for each of the three vehicle classes, for all 58 counties. The DOW factors and vehicle type can be found in Section VII.

Heavy-heavy duty vehicle fractions were updated using 2018 Performance Measurement System (PeMS) data. Truck volumes were pulled for each county. Day of year specific fractions were calculated relative to an average weekday for each county. Fractions were manually reviewed by staff to check data integrity. Counties without data or poor data quality were screened out and replaced with an older version of fractions from CalVAD.

Table 7: Vehicle classification and type of adjustment

Vehicle Class	Vehicle type	Type of adjustment
1	LDA	LD
2	LDT1	LD
3	LDT2	LD
4	MDV	LD
5	LHDT1	LM

Vehicle Class	Vehicle type	Type of adjustment
6	LHDT2	LM
7	T6	LM
8	T7 HHDT	HHDT
9	Other Bus	LM
10	School Bus	Unadjusted on weekdays, zeroed on weekends
11	Urban Bus	LD
12	Motorhomes	LD
13	Motorcycles	LD

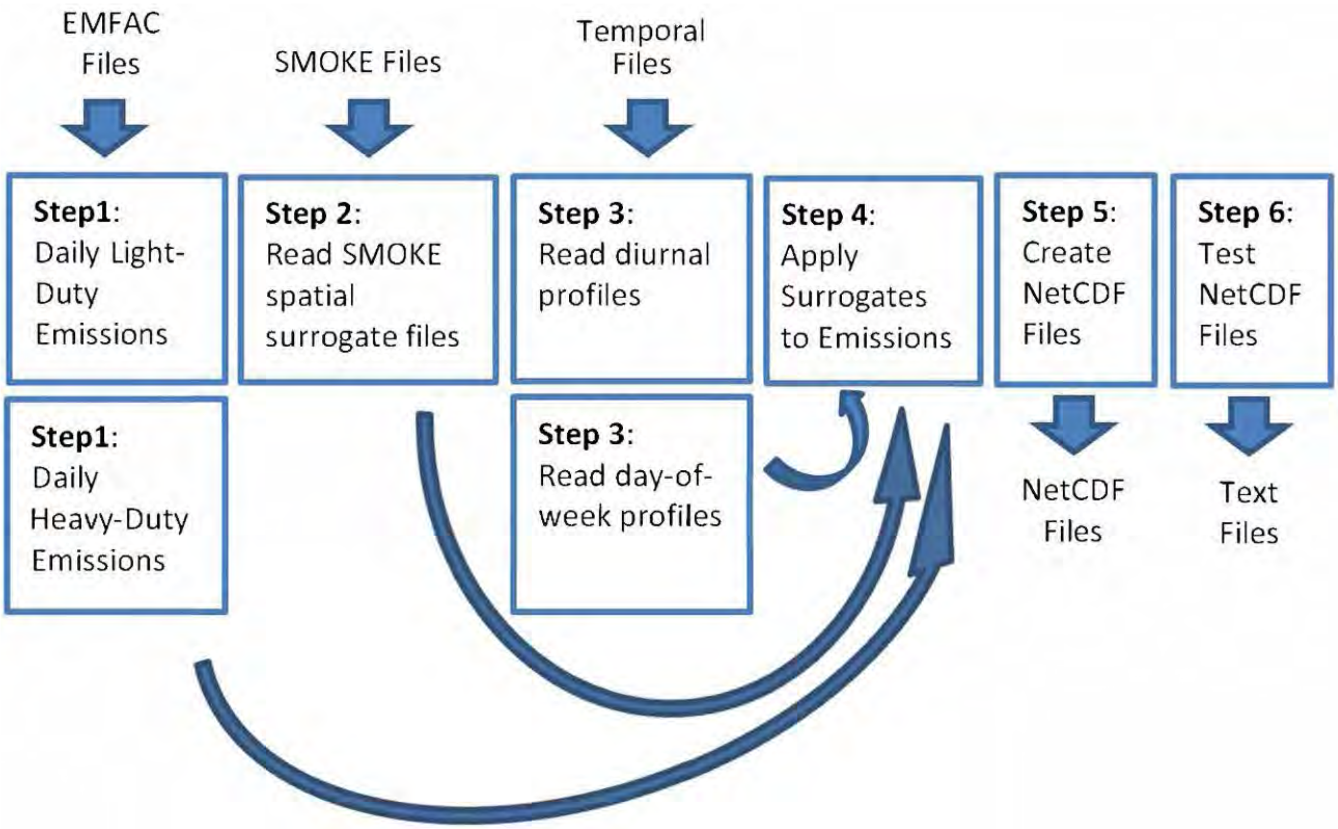
5. Temporal Adjustment (Hour-of-day profiles for EMFAC daily totals)

EMFAC produces emission estimates for an average weekday and lacks the day-of-week hour-of-day temporal variations that are known to occur on specific days of the week. To rectify this, the CalVAD data were used to develop hour-of-day profiles for Friday through Monday, a typical weekday and a typical holiday. Heavy-heavy duty hourly vehicle fractions were updated using 2018 Performance Measurement System (PeMS) data from Caltrans in counties where data were available. The hour-of-day profiles for passenger cars (LD), light- and medium-duty trucks (LM), and heavy heavy-duty trucks (HH) can be found in Appendix B: Hour-of-day Profiles by Vehicle Type and County.

6. Summary of On-road Emissions Processing Steps

The six steps to process on-road emissions for regional air quality modeling with CMAQ are represented below in Figure 3. Step 1 reads daily emissions input data from EMFAC. Step 2 reads SMOKE-ready spatial surrogates files. Step 3 reads day of week and diurnal temporal activity profiles from CALVAD. Step 4 applies both the spatial surrogates and temporal allocations to the daily emissions from EMFAC. Step 5 creates the gridded, hourly NETCDF files for each day of the year being modeled. Lastly, step 6 produces text files for use in quality assurance and quality checks of the emissions data.

Figure 3: Workflow for spatial and temporal allocation of on-road emissions



7. Adjustment to the Future Year On-road Emissions

The future year on-road mobile source emissions were adjusted to incorporate emission reduction programs for heavy duty vehicles. The reductions applied to the inventory reflect the Low NOx Standard (CARB, Heavy-Duty Low NOx, 2020), Advanced Clean Truck (ACT) (CARB, Advanced Clean Trucks, 2020), and Heavy Duty Inspection and Maintenance Regulation (CARB, Heavy-Duty Inspection and Maintenance Regulation, 2021) for both future years. The State SIP Strategy was applied only for 2032 (CARB, 2022 State Strategy for the State Implementation Plan, 2022). The combined factors for 2026 and 2032 are shown in Table 8.

Table 8: NOx Reductions (TPD) by Air Basin for 2026 and 2032

Region	2026 Reductions (Tpd)	2032 Reductions (Tpd)
Eastern Kern	0.99	1.555
San Joaquin Valley	16.99	28.29
Total Statewide reductions	65.8	123.12

C. Estimation of Gridded Biogenic Emissions

Biogenic emissions were generated using the MEGAN3.0 biogenics emissions model (https://bai.ess.uci.edu/megan/versions). MEGAN3.0 incorporates a new pre-processor (MEGAN-EFP) for estimating biogenic emission factors based on available landcover and emissions data. The MEGAN3.0 default datasets for plant growth form, ecotype, and emissions were utilized. Leaf Area Index (LAI) for non-urban grid cells was based on the 8-day 500-m resolution MODIS Terra/AQUA combined product (MCD15A2H) for 2018 (https://earthdata.nasa.gov/). The LAI data was converted to LAIv, which represents the LAI for the vegetated fraction within each grid cell, by dividing the gridded MODIS LAI values by the Maximum Green Vegetation Fraction (MGVF) for each grid cell (https://archive.USGS.gov/archive/sites/landcover.USGS.gov/green_veg.html). The MODIS LAI product does not provide information on LAI in urban regions, so urban LAIv was estimated from the US Forest Service's Forest Inventory and Analysis (FIA) urban tree plot data, processed through the i-Tree v6 software (https://www.itreetools.org/tools/i-tree-eco). Hourly meteorology was provided by 4-km WRF simulations for 2018, and all stress factor adjustments were turned off.

D. Aircraft Emissions

Aircraft emissions were generated using the Gridded Aircraft Trajectory Emissions Model (GATE) developed by CARB (AQPSD CARB, 2019). The GATE model distributes aircraft emissions in three dimensions. The GATE model takes annual aircraft emissions during landing, taxiing, and take-off, and converts this data into gridded, hourly emissions as follows:

- Read aircraft emissions from an annual inventory
- Split the emissions into hourly components
- Split any county-wide emissions into individual runways
- Geometrically model the 3D flight paths at each runway
- Intersect the above 3D paths with the 3D modeling grid
- Distribute the hourly aircraft emissions into the 3D grid

More information on GATE is available at the following *GitHub repository for GATE*.

E. Estimation of Ocean-going Vessel (OGV) Emissions

Annual emissions are provided through CEPAM for commercial and military OGV. The Mobile Source Analysis Branch compiled port activity data for 2016 reported for Long Beach, Port of Los Angeles, Bay Area, and San Diego. The activity data consisted of daily visits by vessel types for the full calendar year. This data was used to derive monthly and weekly temporal profiles for OGV sources. No activity data was available to create temporal profiles for the military sector; default SMOKE temporal profiles were assumed.

After applying the port activity factors mentioned above, emissions were separated by at-berth and everything else. At-berth emissions are processed through SMOKE and plume rise is calculated for every day of the year (Kwok, 2015). For transit, maneuvering, and anchorage, emissions are distributed evenly in two vertical layers (2 and 3) (Kwok, 2015).

F. Estimation of Other Day-specific Sources

Day-specific data were used for preparing base case inventories when data were available. CARB and district staff were able to gather hourly/daily emission information for 1) wildfires and prescribed burns, 2) paved and unpaved road dust, and 3) agricultural burns in six districts (more details highlighted below).

For the reference and future year inventories, day-specific emissions for wildfires, prescribed burns, and wildland fires use (WFU) are left out of the inventory. All other day-specific data are included in both reference and future year modeling inventories.

1. Wildfires and Prescribed Burns

Day-specific, base case estimates of emissions from wildfires and prescribed fires were developed in a two-part process. The first part consisted of estimating micro-scale, fire-specific emissions (i.e. at the fire polygon scale, which can be at a smaller spatial scale than the grid cells used in air quality modeling). The second part consisted of several steps of post-processing fire polygon emission estimates into gridded, hourly emission estimates that were formatted for use in air quality modeling.

Fire event-specific emissions were estimated using a combination of geospatial databases and a federal wildland fire emission model (Clinton, 2006). A series of pre-processing steps were performed using GIS to develop fuel loading and fuel moisture inputs to the First Order Fire Effects (FOFEM) fire emission model (Lutes, et al., 2012). Polygons from a statewide interagency fire perimeters geodatabase (Fire17_1.zip, downloaded May 8, 2018) maintained by the Fire and Resource Assessment Program (FRAP) of the California Department of Forestry and Fire Protection (CALFIRE) provided georeferenced information on the location, size (area), spatial shape, and timing of wildfires and prescribed burns. Under interagency Memorandums of Understanding, federal, state, and local agencies report California wildfire and prescribed burning activity data to FRAP. Using GIS software, fire polygons were overlaid upon a vegetation fuels raster dataset called the Fuel Characteristic Classification System (FCCS) (Ottmar, et al., 2007). The FCCS maps vegetation fuels at a 30-meter spatial resolution, and is maintained and distributed by LANDFIRE.GOV, a state and federal consortium of wildland fire and natural resource management agencies. With spatial overlay of fire polygons upon the FCCS raster, fuel model codes were retrieved and component areas within each fire footprint tabulated. For each fuel code, loadings (tons/acre) for fuel categories were retrieved from a FOFEM look-up table. Fuel categories included dead woody fuel size classes, overstory live tree crown, understory trees, shrubs, herbaceous vegetation, litter, and duff. Fuel moisture values for each fire were estimated by overlaying fire polygons on year- and month-specific 1 km spatial resolution fuel moisture raster files generated from the national Wildland Fire Assessment System (WFAS.net) and retrieving moisture values from fire polygon centroids. Fire event-specific fuel loads and fuel moisture values were compiled and formatted to a batch input file and run through FOFEM.

A series of post-processing steps were performed on the FOFEM batch output to include emission estimates (pounds/acre) for three supplemental pollutant species (NH_3, TNMHC, and N_2O) in addition to the seven species native to FOFEM (CO, CO_2, PM2.5, PM10, CH_4, NO_x, and SO_2), and to calculate total emissions (tons) by pollutant species for each fire. Emission estimates for NH_3, TNMHC, and N_2O were based on mass ratios to emitted CO and CO_2 (Gong, 2003).

Fire polygon emissions were apportioned to CMAQ model grid cells using area fractions, developed using GIS software, by intersecting fire polygons to the grid domain.

Another set of post-processing steps were applied to allocate fire polygon emissions by date and hour of the day. Fire polygon emissions were allocated evenly between fire start and end dates, taken from the fire perimeters geodatabase. Daily emissions were then allocated to hour of day and to the model grid cells by using a script developed by CARB. A stack file and a 2-D hourly emissions file are generated for each day that has fire emissions. The stack file includes the fire locations, stack parameters and the number of acres burned for a fire in one day. The 2-D hourly emissions file includes the emissions for each specie and the heat flux (BTU/hr). CMAQ's in-line plume rise module will handle the vertical allocation of the fire emissions.

2. Paved and Unpaved Road Dust

Statewide emissions of total particulate matter from both paved and unpaved road dust are also a part of the CEPAM inventory. However, the sectors that have been embedded in any CEPAM version are already pre-adjusted. The unadjusted emissions are what is required before making any adjustment. Therefore, the unadjusted paved road dust is based upon CEPAM SIP2019v1.02-v1.01, while the unadjusted unpaved road dust uses an older CEPAM version with 20161130 snapshot. To adjust for precipitation, daily precipitation data for 2018 were used, provided by an in-house database maintained by CARB staff that stores meteorological data collected from outside sources. The specific data sources for these data include Remote Automated Weather Stations (RAWS), Atmospheric Infrared Sounder (AIRS), California Irrigation Management Information System (CIMIS) networks, and Federal Aviation Administration (FAA). FAA data provide precipitation data collected from airports in California.

When the precipitation reaches or exceeds 0.01 inches (measured anywhere within a county or county/air basin boundary on a particular day), the uncontrolled emissions are reduced on that day only: 25% for paved road dust, and total removal for the unpaved. The reductions can be achieved by running SMOKE with control matrices.

3. Agricultural Burning

Agricultural burn 2018 data processed were reported by air districts. The tons burned provided by the air districts were converted to acres using fuel loading data. With date of the burns, the location of the burns (latitude and longitude coordinates), crop type, and burn duration, the agricultural burn data were processed and then projected onto a statewide grid for each hour of a specific day.

4. Residential Wood Combustion Curtailment

Emissions were reduced to reflect residential wood curtailment (RWC) in San Joaquin Valley APCD and Sacramento Metropolitan AQMD.

A pre-SMOKE utility program called GenTpro is used to generate county-specific temporal profiles based on average temperature by grid cell (UNC Chapel Hill - The Institute for the Environment, 2016). Emissions for any given county are only allocated whenever the daily average temperature by grid cell is below 50 °F based on WRF simulated meteorology.

San Joaquin Valley APCD provided areas of curtailment, which are used to mask the spatial surrogates for woodstoves and fireplaces. The masked surrogates were used to apply day-specific curtailment. The corresponding complimentary surrogates were also constructed by subtracting the masked surrogates from the original spatial surrogates. These complimentary surrogates apply to areas without curtailment. For winter months (January, February, November, December) SJVAPCD provided no-burn days by county, from which day-specific CNTLMAT curtailment files were constructed. With these settings, processing of winter months using SMOKE is enabled by merging the outputs of two separate runs. The first run is for the portion with masked surrogates with curtailment via CNTLMAT, and the second run is for the portion that includes complimentary surrogates without curtailment. For non-winter months, SMOKE is only run once with the original spatial surrogates without any curtailment. When curtailment is applied to any county in SJV, wood burning emissions are reduced by 51%.

Areas under Sacramento Metropolitan AQMD (SACAQMD) have their RWC emissions reduced by 70% (i.e. 30% remaining) whenever no-burn days are designated. Curtailment is applied to the full spatial surrogates without exceptions.

5. Estimation of Agricultural Ammonia Emissions

Ammonia emissions from fertilizers/pesticides and livestock are separated from the aggregated area source inventory as they are affected by local meteorology. For fertilizers/pesticides, emissions vary by hour based on WRF’s two-meter temperature and ten-meter wind speed. For livestock, WRF’s ground temperature and aerodynamic resistance drive hourly variations in emissions. Through GenTpro these meteorological factors are averaged by county before creating year-long hourly profiles for each of the respective sectors. All algorithms are described in the SMOKE Manual 4. (UNC Chapel Hill - The Institute for the Environment, 2016), while the results of CARB in-house tests were summarized in an internal report (Kwok, Meteorology-adjusted Temporal Profiles for Agricultural and Residential Wood Combustion Sectors Using Smoke Gentpro Utility Program, 2016). In general, higher temperature and/or wind speeds favor ammonia emissions. Monthly surrogates based upon the frequency of pesticides applications were also applied to fertilizer NH3. The sector also has emissions reported by a few individual facilities whose latitudes/longitudes are known.

Thus, the facility-reported livestock were represented as point sources. Another hourly GenTpro file was created just for them. To preserve the spatial distribution, emissions were apportioned to those individual facilities by GAI. SMOKE runs with these spatio-temporal allocations covered criteria pollutants NH3, PM and TOG.

G. Northern Mexico Emissions

Transboundary flow of pollutants between California and Mexico must be considered and accounted for in air quality simulations of Southern California. Affected areas in California include the border regions of San Diego, Imperial and given the right meteorological conditions, more northern counties such as Riverside, Orange, and Los Angeles. As a result, emissions within the five municipal districts of Mexico’s State of Baja California and one municipal district in Sonora must be included when running regional air quality models on the California Statewide Domain.

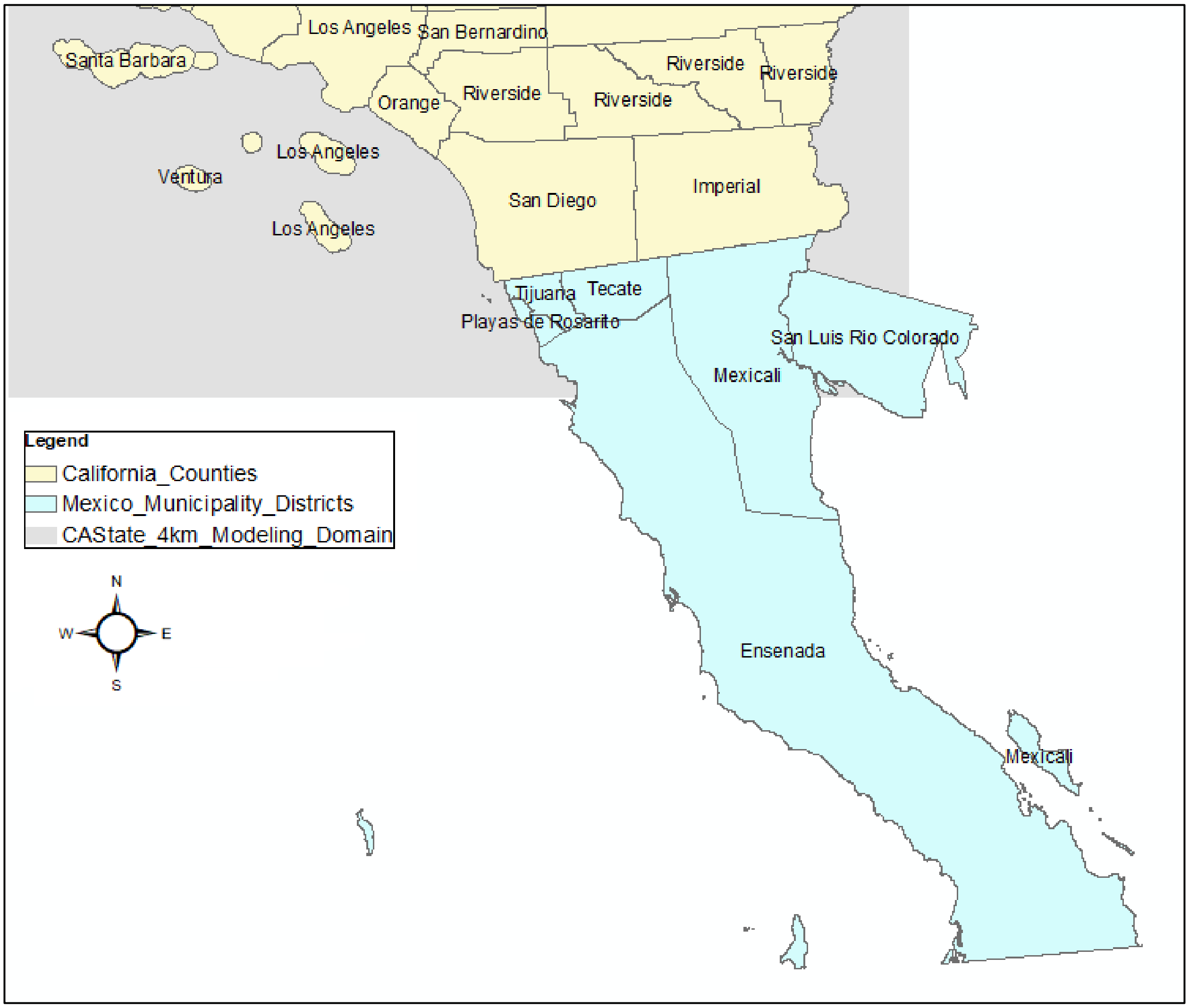
Modeling Emission Inventory

CARB's Mexico emissions inventory for area, point and non-road emission sources have been processed using an updated inventory developed by Eastern Research Group Inc. (ERG). This inventory is based on the 2014 Mexico National Emissions Inventory (MNEI) with additional improvements made by ground truthing agricultural burning, brick kilns and improving methods to calculate idling mobile emissions at the border entries (ERG, 2019). Base year 2017 emission estimates were developed by projecting the 2014 emissions to 2017. Future year 2037 emissions estimates were developed by interpolating 2014, 2020 and 2025 emission estimates to 2037.

For mobile sources, the U.S. EPA on-road emissions model SMOKE-MOVES (Sparse Matrix Operator Kernel Emissions – Motor Vehicle Emission Simulator) Mexico was used to produce an on-road emissions inventory. The on-road sector is reflective of true 2017 emissions. Future year 2037 emission estimates used the U.S. EPA on-road emissions model SMOKE-MOVES Mexico for future year 2028. SMOKE-MOVES is more comprehensive than the data provided for the on-road sector in the 2014 MNEI, and after discussions with U.S. EPA it was suggested to use SMOKE-MOVES over the 2014 MNEI estimates.

Modeling Emission Inventory

Figure 4: Outline of Mexico municipalities included in California air quality simulations. The grey box outlines the boundaries of the CAState_4km modeling domain



Under contract to CARB, ERG recently completed an update to the spatial distribution of Mexico's area, non-road and on-road emissions (ERG, 2019). These updates include additional spatial surrogates such as the location of brick kilns, bakeries, ports, airports etc. for the state of Baja California. In addition, the project supports large improvements on emission estimates at two major border crossings (ERG, 2019). These updates have been included in the base and future year inventories and the surrogates used are listed in Table 11.

EPA's National Emission Inventory (NEI) has been used by ARB as a foundation for identifying spatial surrogates that will aid in allocating emissions in the northern part of Mexico. While searching for improved surrogates, different online databases were investigated to find shapefiles relevant to established source sectors. The updated population surrogate was pulled from Instituto Nacional de Estadística y Geografía (INEGI) using information from Mexico's 2010 Population and Housing Census. INEGI provides spatial information about Mexico such as resources, population, and land use. The population surrogate was also used to update the following residential heating sources: wood, distillate oil, coal, and LP gas. The total road miles surrogate that is used to spatially allocate on-road emissions was also updated using data provided by INEGI's dataset containing information on urban and rural roads and highways. Agriculture and forests spatial surrogates were updated using the same dataset from Comisión Nacional Forestal (CONAFOR). Using satellite images taken by the MODIS sensor (Moderate Resolution Imaging Spectroradiometer), the resulting vector data set from CONAFOR was produced to characterize Mexico's land. The border crossings surrogate was updated using statistics from the U.S. Bureau of Transportation, which provided points of entry along California and Mexico's border. Once the shapefiles were collected, they were converted to the standard projection used in CARB's modelling. These EPA-based surrogates are used within the state of Sonora, which was not covered in the ERG contract, and as secondary spatial allocation for the state of Baja CA. Table 12 lists the EPA-based Mexico surrogates dated as of May 2018.

Table 9: List indicating ERG developed spatial surrogates for the state of Baja California

Spatial Surrogate ID	Description	Year
100	Mexicali Agriculture	2014
110	Mexicali Agburn	2014
111	Mexicali Agburn Asparagus	2014
112	Mexicali Agburn Bermuda	2014
113	Mexicali Agburn Wheat	2014
120	Airports	2014
130	Autoshop	2014
140	Bakeries	2014
150	Border Crossing	2014
160	Brick Kilns	2014
170	Charbroiling	2014
180	Feedlots	2014
190	Gas Stations	2014
200	Graphic Arts	2014
210	Hospitals	2014

Spatial Surrogate ID	Description	Year
220	Landfills	2014
230	Total Population	2014
231	Rural Population	2014
232	Urban Population	2014
240	Ports	2014
250	Railroads	2014
260	Wastewater	2014
270	Windblown Dust	2014

Table 10: List of EPA's Mexico surrogates as of May 2018

#	Surrogate	Year	Shapefile	Weight field
10	Population	2010	north_mexico_population.shp	population
12	Housing	2010	north_mexico_population.shp	population
14	Residential Heating Wood	2010	north_mexico_population.shp	population
16	Residential Heating Distillate Oil	2010	north_mexico_population.shp	population
18	Residential Heating Coal	2010	north_mexico_population.shp	population
20	Residential Heating LP Gas	2010	north_mexico_population.shp	population
22	Total Road Miles	2011	MEX_roads.shp	WEIGHT
24	Total Railroad Miles	2000	mexico_rr_MM5.shp	LENGTH
26	Total Agriculture	2015	MEX_agriculture.shp	WEIGHT
28	Forest Land	2015	MEX_Forests.shp	WEIGHT
30	Land Area	2000	REPMEX_ES_HEAT1_MM5.shp	P001

#	Surrogate	Year	Shapefile	Weight field
32	Commercial Land	1999	com_ind_viv_MM5.shp	A500_2000
34	Industrial Land	1999	com_ind_viv_MM5.shp	A505_2000
36	Commercial Plus Industrial	1999	com_ind_viv_MM5.shp	A510_2000
38	Commercial plus Industrial Land	1999	com_ind_viv_MM5.shp	A515_2000
40	Residential Commercial Industrial Institutional	1999	com_ind_viv_MM5.shp	a535_2000
42	Personal Repair	1999	REP_CRUCES_MM5.shp	a545_1999
44	Airports Area	1999	mexico_air_MM5.shp	WEIGHT
46	Marine Ports	1999	mexico_ports_MM5.shp	VALUE
48	Brick Kilns	1999	BOSQUE_LAD_MM5.shp	LAD_2000
50	Mobile Sources Border Crossing	2014	Border_Crossing_Years_MM5.shp	Y20**

H. Western States Emissions

In addition to transboundary flow from Mexico into California cities, pollutants can travel between various bordering states such as Nevada, Arizona, Oregon, Idaho, and Utah. The current statewide modeling domain includes grid cells that cover these regions and therefore emission estimates from the four major source sectors (area, point, non-road and on-road) need to be included for a complete California State modeling domain inventory. As CARB or California air districts are not responsible for the development of emission estimates in those geographic regions, the national emission inventory developed by the U.S. EPA was used.

CARB's Western US emissions inventory has been developed using the U.S. Environmental Protection Agency (EPA) 2011 National Emissions Inventory (NEI) platform version 3 with future year projections for 2017and 2028[1].

Base year 2017 emissions were developed with "2011v3 NEI 2017ek_cb6v2_v6_11g" which are 2017 projections from the 2011 national emissions inventory version three, while the future year 2026 and 2032 emissions were processed from "2011v3 NEI 2028el_cb6v2_v6_11g" 2028 projections based on the 2011 National Emissions Inventory version three. Spatial and temporal allocations were applied

1 All inventory and ancillary files for spatial and temporal allocation are available for download at: ftp://newftp.epa.gov/air/emismod/2011/v3platform/ (U.S. EPA, 2018).

using the U.S. EPA ancillary files however, all spatial surrogates were processed through the spatial allocator tool with the California statewide map projection applied.

I. Application of Control Measure Reduction Factors

Future year onroad vehicle emissions were adjusted to reflect statewide reduction commitments for CARB's Low NOx, ACT, and HD I&M for 2026 and 2032. SSS adjustments for onroad were applied to the 2032 projected inventory. The onroad adjustments are summarized in Section B.7.

V. Quality Assurance of Modeling Inventories

As mentioned in Section II.C.1., base case modeling is intended to demonstrate confidence in the modeling system. Quality assurance of the data is necessary to detect outliers and potential problems with emission estimates. The most important quality assurance checks of the modeling emissions inventory are summarized in the following sections.

A. Area and Point Sources

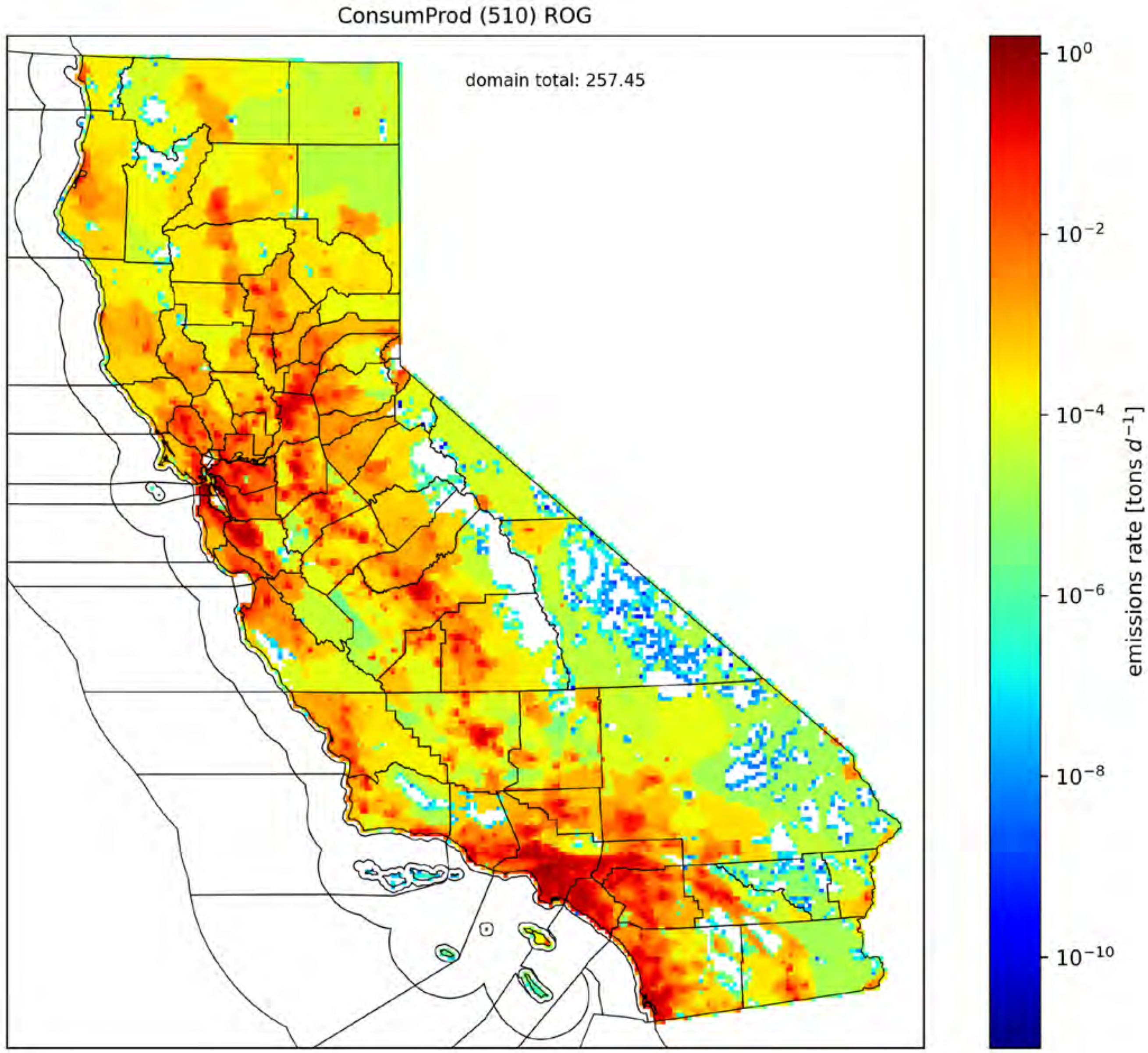
All SMOKE inputs are subject to extensive quality assurance procedures performed by CARB staff. Annual and forecasted emissions are carefully reviewed prior to running SMOKE. CARB and district staff review data used to calculate emissions along with other ancillary data, such as temporal profiles and the location of facilities and assignment of SCC to each process. Growth and control information are reviewed and updated as needed.

We also compare annual average emissions from CEPAM with planning inventory totals to ensure data integrity. The planning and modeling inventories start with the same annual average emissions. The planning inventory is developed for an average summer day and an average winter day, whereas the modeling inventory processes daily emissions. Both inventory types use the same temporal data described in Section II.B. The summer planning inventory uses the monthly throughputs from May through October. Similarly, the winter planning inventory uses the monthly throughputs from November through April. The modeling inventory produces emissions for every day of the year.

Annual, gridded emissions totals are plotted on the statewide modeling domain and visually inspected to check the spatial allocation of emissions. Spatial plots by source category like the one shown in Figure 5 are carefully screened for proper spatial distribution of emissions.

Modeling Emission Inventory

Figure 5: Example of an ROG spatial plot by source category (Consumer Products)



Before air quality model-ready emissions files are generated by SMOKE, the run configurations and parameters set within the SMOKE environment are checked for consistency for both the reference and future years.

To aid in the quality assurance process, SMOKE is configured to generate inventory reports of temporally, chemically, and spatially-resolved emissions inventories. CARB staff utilize the SMOKE reports by checking emissions totals by source category and region. Staff also create and analyze time series plots, and compare aggregate emissions totals with the pre-SMOKE emissions totals obtained from CEPAM.

Checks for missing or invalid temporal assignments are conducted to ensure accurate temporal allocation of emissions. Special attention is paid to checking monthly throughputs and appropriate monthly temporal distribution of emissions for each source category. In addition, checks for time-invariant temporal assignments are done for certain source categories and suitable alternate temporal assignments are determined and applied.

Further improvements to temporal profiles used in the allocation of area source emissions are performed using suitable alternate temporal assignments determined by CARB staff. Select sources from manufacturing and industrial, degreasing, petroleum marketing, mineral processes, consumer products, residential fuel combustion, farming operations, aircraft, off-road equipment, and commercial harbor craft sectors are among the source categories included in the application of adjustments to temporal allocation.

B. On-road Emissions

There are several processes to conduct quality assurance of the on-road mobile source modeling inventory at various stages of the inventory processing. The specific steps taken are described below.

- Plot MPO provided data spatially to find any missing or incomplete links.
- Compare spatial distribution of VMT between on and off-peak periods for each MPO.
- Generate time series plots for the on-road emissions files to check the diurnal pattern.
- Compare the daily total emissions for the on-road emissions files and the EMFAC 2017 emissions files for each county to ensure that the emissions are the same.
- Generate the spatial plot for the on-road emissions files to check if there were any missing emissions.

C. Aircraft Emissions

There are two steps to conduct quality assurance of the aircraft emissions.

- Compare the daily total emissions for the aircraft emissions files and the raw emissions files for each county to ensure that the emissions are the same.
- Generate the spatial plot for the aircraft emissions files to check if there were any missing emissions.

D. Day-specific Sources

1. Wildfires

GIS records for 413 wildfires, 166 prescribed wildland burn events, and 28 wildland fires use reported for 2018 were downloaded from *The California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP)* and imported to a geodatabase. Data fields included wildfire or burn project name, burned area, and start and end dates. A series of geoprocessing steps were used to map and overlay wildfire and prescribed burn footprint polygons on the statewide vegetation fuels (FCCS) and moisture raster datasets, to retrieve associated fuel loadings and moisture values for use as input to FOFEM. Wildfire and prescribed burn footprint polygons were also overlaid on the statewide 4-km modeling grid to assign grid cell IDs to each wildfire and prescribed burn. Emission estimates for each wildfire and prescribed burn event were generated by FOFEM and summarized in an Access database. To check the location of the fires and the daily total emissions, a script is used to make a netCDF file from the stack file and the 2-D hourly emissions file for each day. The spatial plot and the daily total emissions from processing the netCDF file are then compared to the raw fire emissions data to check for accuracy.

2. Agricultural Burning

Checks were done to verify the quality of the agricultural burn data. The day-specific emissions from agricultural burning were compared to the emissions from CEPAM for each county to check for agreement between the planning and modeling inventories. Time series plots were reviewed for each county to see that days when burning occurred matched the days provided by the local air district. For each county, a few individual fires were calculated by hand starting from the raw data through all the steps to the final model-ready emissions files to make sure the calculations were done correctly. Spatial plots were made to verify the location of each burn.

E. Additional Quality Assurance

In addition to the quality assurance described above, comparisons are made between annual average inventories from CEPAM and modeling inventories. The modeling inventory shows emissions by month and subsequently calculates the annual average for comparison with CEPAM emissions. Annual average inventories and modeling inventories can be different, but differences should be well understood. For example, modeling inventories are adjusted to reflect different days of the week for on-road motor vehicles as detailed in Section III.B; since weekend travel is generally less than weekday travel, modeling inventory emissions are usually lower when compared to annual average inventories from CEPAM. Figure 6 is an example of a QA report that summarizes NOx emissions by category for EIC3 10 through 499 for the San Joaquin Valley air basin. The report compares the monthly and annual processed emissions totals against CEPAM. Please note that this report is only an example since emissions have been updated from what is displayed here.

Figure 6: Comparison of inventories report

2018 Ozone SIP, Base Year 2018 -- CEPAM 2019 Ozone SIP Ver 1.03 With Off-Road Patch (CEPAM2022v1.01) And Zero Out 430-995-7000-0000 NOx in E. Kern BYr:2018 MYr:2018

Basin:*MD* County:*15* Spec:*NOx*

EIC	Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	RF3064_19v1.02	RF3084_19v1.03	RF3108_19v1.04	RF3089_22v1.01
10	Electric Utilities	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
20	Cogeneration	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.48	0.42	0.42	0.39
30	Oil And Gas Production (Combustion)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40	Petroleum Refining (Combustion)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50	Manufacturing And Industrial	0.99	1.10	1.30	1.50	1.71	1.71	1.70	1.71	1.70	1.71	1.50	1.19	1.49	1.54	1.49	1.49	1.37
52	Food And Agricultural Processing	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.03
60	Service And Commercial	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.49	0.20
99	Other (Fuel Combustion)	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.18	0.18	0.18	0.15
110	Sewage Treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
120	Landfills	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
130	Incinerators	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
140	Soil Remediation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
199	Other (Waste Disposal)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
210	Laundering	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
220	Degreasing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
230	Coatings And Related Process Solvents	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
240	Printing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
250	Adhesives And Sealants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
299	Other (Cleaning And Surface Coatings)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
310	Oil And Gas Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	Petroleum Refining	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
330	Petroleum Marketing	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
399	Other (Petroleum Production And Marketing)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
410	Chemical	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
420	Food And Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
430	Mineral Processes	10.51	8.37	10.51	10.72	7.95	10.81	11.23	11.31	9.44	10.55	9.70	9.53	10.06	17.37	17.28	10.06	18.09
440	Metal Processes	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
450	Wood And Paper	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
460	Glass And Related Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
470	Electronics	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
499	Other (Industrial Processes)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

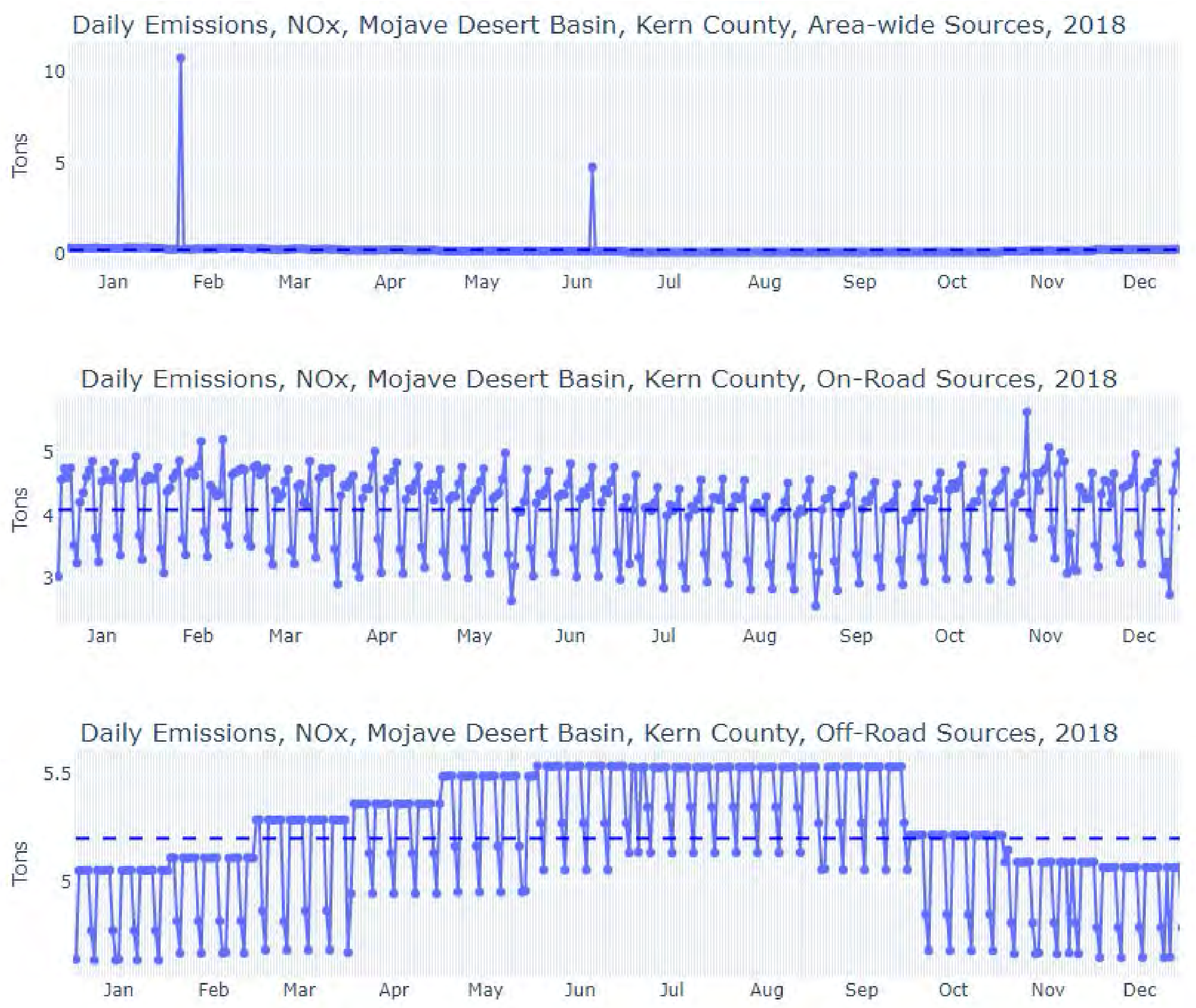
Notes:

- CEPAM refers to annual average emissions from 2019 SIP Baseline Emission Inventory Tool with external adjustments: *CEPAM External Adjustment Reporting Tool*
- Monthly gridded emissions come from GeoVAST mo-yr/avg tabular summary - gid 657

Staff also review how modeling emissions vary over a year. Figure 7 provides an example of a modeling inventory time series plot for San Luis Obispo County for area-wide sources, on-road sources and off-road sources. Again, this figure is only an example.

Modeling Emission Inventory

Figure 7: Daily variation of NOx emissions for sources in Eastern Kern County in 2018



F. Model-ready Files Quality Assurance

Prior to developing the modeling inventory emissions files used in the photochemical models, the same model-ready emissions files developed for the individual source categories (e.g., on-road, area, point, day-specific sources) are checked for quality assurance. Extensive quality assurance procedures are already performed by CARB staff on the intermediate emissions files (e.g., SMOKE-generated reports); however, further checks are needed to ensure data integrity is preserved when the model-ready emissions files are generated from those intermediate emissions files. Figure 8 shows the share of area, on-road, and point sources contribution to annual NOx emissions are shown for San Joaquin Valley Nonattainment area in 2018. These same sources are shown as a daily timeseries for San Joaquin Valley Nonattainment area in Figure 9. These figures are only examples and do not reflect the inventory totals used for SIP attainment modeling.

Figure 8: Annual processed emissions example for 2018 Eastern Kern Nonattainment Area NOx for area, on-road, and point sources

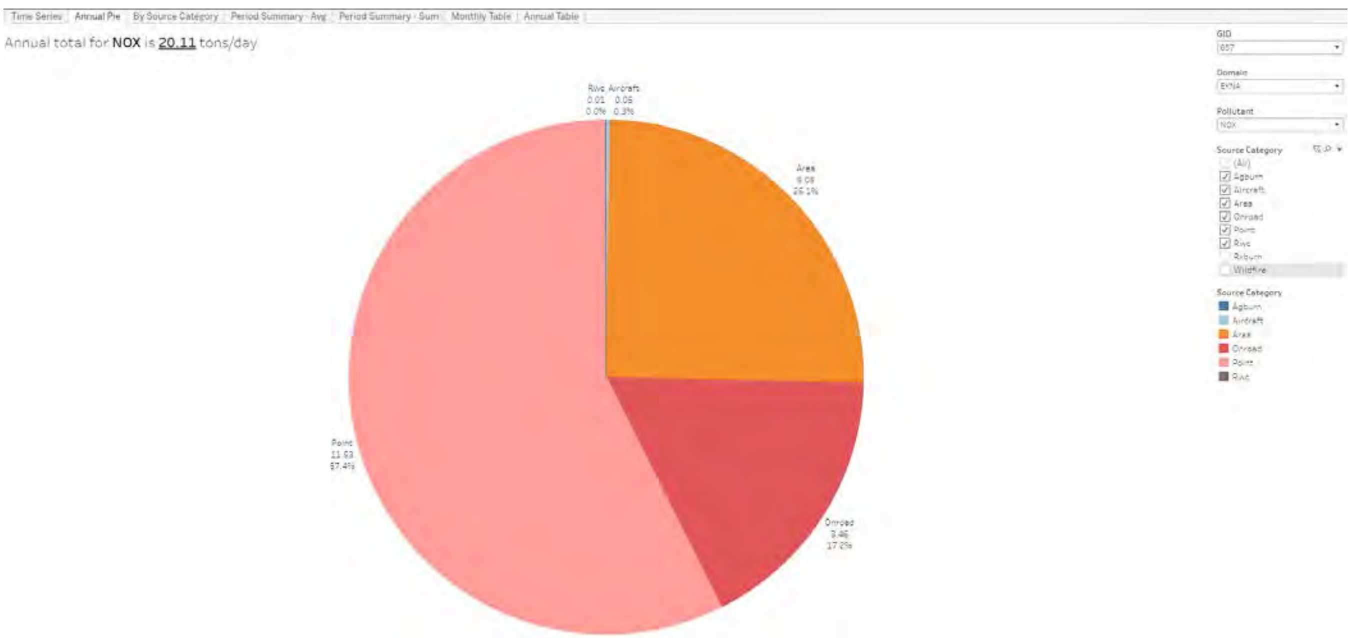
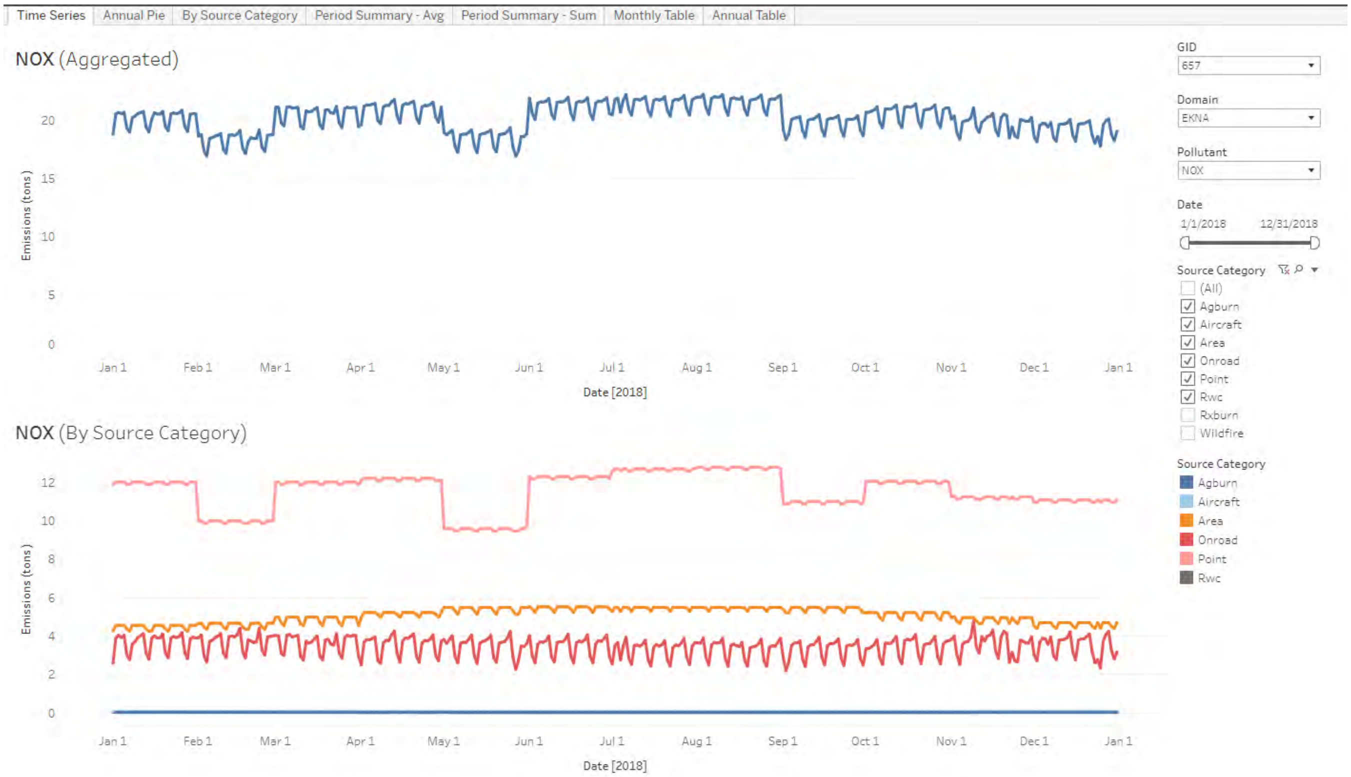


Figure 9: Example timeseries plot for daily 2018 NOx emissions from area, on-road, and point sources for Eastern Kern Nonattainment Area



Comparisons of the totals for both the intermediate and model-ready emissions files are made. Emissions totals are aggregated spatially, temporally, and chemically to single-layer, statewide, daily values by inventory pollutant. Spatial plots are also generated for both the intermediate and model-ready emissions files using the same graphical utilities and aggregated to the same spatial, temporal, and chemical resolution to allow equal comparison of emissions. Any discrepancies in the emissions totals are reconciled before proceeding with the development of the model-ready inventory emissions files.

Before combining the model-ready emissions files of the individual source category inventories into a single model-ready inventory, they are checked for completeness. Most sources should have emissions for every day in the modeling period. Exceptions to this apply to sources like fires since burning (natural or planned) does not occur every day. It is important that during these checks source inventories with missing files are identified and resolved. Once all constituent source inventories are complete, they are used to develop the model-ready inventory used in photochemical modeling. When the modeling inventory files are generated, log files are also generated documenting the constituents of each daily model-ready emissions file as an additional means of verifying that each daily model-ready inventory is complete.

VI. References

U.S. EPA. (2018). *CHIEF Modeling Emissions 2011NEIv3*. Retrieved 2019, from ftp://newftp.epa.gov/air/emismod/2011/v3platform/

AMSS. (2020). *Spatial Surrogate Methodology Document SNP2020-10-01.* Sacramento: INTERNAL DRAFT CARB.

AMSS. (2021). *Spatial Surrogate Methodology Document SNP2021-10-01.* Sacramento: INTERNAL DRAFT CARB.

Baek, B. a. (2015). *Final Summary Report: Development of SMOKE version 4.0. Under contract ITS:12-764.* Sacramento, CA.

Caltrans. (2020). *Statewide Modeling*. Retrieved from https://dot.ca.gov/programs/transportation-planning/multi-modal-system-planning/statewide-modeling

CARB. (2017). *Modeling Emission Inventory for the 8-hour Ozone State Implementation Plan in the Imperial Non-Attainment Area.*

CARB. (2018). *Modeling Emissions Inventory for the PM2.5 State Implementation Plan in the San Joaquin Valley.*

CARB. (2019e, November 20). *EMFAC Off-Model Adjustment Factors to Account for the SAFE Vehicle Rule Part One.* Retrieved December 10, 2019, from https://ww3.arb.ca.gov/msei/emfac_off_model_adjustment_factors_final_draft.pdf

CARB. (2020, 02 07). *Advanced Clean Trucks*. Retrieved from https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks

CARB. (2020, February 07). *Heavy-Duty Low NOx.* Retrieved from https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox

CARB. (2021). *Heavy-Duty Inspection and Maintenance Regulation*. Retrieved from https://ww2.arb.ca.gov/rulemaking/2021/hdim2021

Modeling Emission Inventory

CARB. (2021). *Report on Updates to the California Integrated Transportation Network (ITN).* INTERNAL DRAFT.

CARB. (2022). *2022 State Strategy for the State Implementation Plan*. Retrieved from https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy

Clinton, N. G. (2006). Quantification of pollutants emitted from very large wildland fires in Southern California. *Atmospheric Environment*, Volume 40, pp. 3686-3695.

ERG. (2014). *Develop Mexico Future Year Emissions.* Sacramento, CA. Retrieved from ftp://newftp.epa.gov/air/emismod/2011/v2platform/2011emissions/Mexico_Emissions_WA%204-09_final_report_121814.pdf

ERG. (2019). *2014 Norther Baja California Emissions Inventory Project.*

Funk, t., Stiefer, P., & Chinkin, L. (2001). *Development of gridded spatial allocation factors for the state of California.* San Joaquin Valley wide Air Pollution Study Agency and Environmental Protencion Agency- Air Resources Board. Sacramento: STI.

Gong, P. C. (2003). *Extension and input refinement to the ARB wildland fire emissions estimation model Final report, contract number 00-729.* Sacramento, CA: Air Resources Board.

Kwok, R. (2015). *Modeling Plume Rise of Ocean-going Vessel Emissions.* Sacramento: INTERNAL DRAFT CARB.

Kwok, R. (2016). *Meteorology-adjusted Temporal Profiles for Agricultural and Residential Wood Combustion Sectors Using Smoke Gentpro Utility Program.* Sacramento: INTERNAL DRAFT CARB.

Mills, S. W. (2013). VIIRS day/night band (DNB) stray light characterization and correction. *SPIE Proceedings* , Vol. 8866.

Modeling Emission Inventory

Reid, S., Penfold, B., & Chinkin, L. (2006). *Emission inventory for the Central California Ozone Study (CCOS) review of spatial variations of area, non-road mobile, and point sources of emissions.* Sonoma Technology Inc. Petaluma, CA: STI.

U.S. EPA. (2014). *Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and RegionalHaze.* United States Environmental Protection Agency, Research Triangle Park. North Carollina: U.S. EPA. Retrieved July 10, 2015, from http://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf

U.S. EPA. (2016). *https://www3.epa.gov/ttn/emc/cem.html*. Retrieved August 16, 2016, from https://www3.epa.gov/ttn/emc/cem.html

U.S. EPA and NHTSA. (2019). The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program. *Federal Register, 84*, 51310-51363.

UNC Chapel Hill - The Institute for the Environment. (2016, September 30). *SMOKE v4.0 User's Manual.* Retrieved 02 07, 2020, from https://www.cmascenter.org/smoke/documentation/4.0/manual_smokev40.pdf

APPENDIX C
VMT EMISSIONS OFFSET DEMONSTRATION

A. INTRODUCTION

Within two years after the adoption of a national ambient air quality standard (standard), the Clean Air Act (CAA) requires states to submit enforceable transportation control strategies (TCSs) and transportation control measures (TCMs) to offset any growth in volatile organic compounds (VOC) emissions due to increases in vehicle miles traveled (VMT) and the number of vehicle trips from the base year to the attainment year of the state implementation plan (SIP). The Eastern Kern Air Pollution Control District has voluntarily reclassified the Eastern Kern ozone nonattainment area from serious to severe for the 75 parts per billion (ppb) and 70 ppb 8-hour ozone standards. Accordingly, the California Air Resources Board (CARB) analyzed the change in VOC emissions related to growth in VMT and whether additional TCSs and TCMs are needed for the Eastern Kern nonattainment area to meet the ozone standards for the severe classification, as required by Section 182(d)(1)(A) and in accordance with U.S. EPA's August 2012 guidance entitled "Implementing Clean Air Act Section 182(d)(1)(A): Transportation Control Measures and Transportation Control Strategies to Offset Growth in Emissions Due to Growth in Vehicle Miles Traveled" ("2012 guidance").[1]

Table A-1 U.S. EPA GUIDANCE ON VMT OFFSET REQUIREMENT

In its 2012 guidance, U.S. EPA indicated that improvements in vehicle technology, motor vehicle fuels, and other transportation strategies could be used to offset emission increases from VMT. The guidance also set forth a methodology for demonstrating whether any increase in VOC emissions from VMT growth is adequately offset by existing TCSs and TCMs. If the projected attainment year emissions, assuming no new control measures and no VMT growth, are less than the projected actual attainment year emissions, including new control measures and VMT growth, then no additional TCMs or TCSs are required. The guidance recommends that the base year used in the VMT offset demonstration be the base year used in the attainment demonstration for the 75 ppb and 70 ppb 8-hour ozone standards.

Table A-2 TRANSPORTATION CONTROL STRATEGIES AND TRANSPORTATION CONTROL MEASURES

Generally, TCSs consist of strategies such as motor vehicle emission standards, inspection and maintenance programs, alternative fuel programs, and other technology-based measures. On the other hand, TCMs are strategies that reduce emissions or concentration of air pollutants by reducing the number of vehicle trips or VMT or improving traffic flow. The CAA §182(d)(1)(A) differentiates between TCSs and TCMs in more detail, both of which can be used as options to offset increased emissions from growth in VMT per the provisions of CAA §182(d)(1)(A) and U.S. EPA's 2012 guidance. Since 1990, when this requirement was established, California has adopted a substantial number of enforceable TCSs—more than enough to meet the requirement to offset increased emissions from VMT growth. Attachment A-1 provides a list of

[1] U.S. Environmental Protection Agency [EPA]: Office of Transportation and Air Quality. (2012, August). *Implementing Clean Air Act Section 182(d)(1)(A): Transportation Control Measures and Transportation Control Strategies to Offset Growth in Emissions Due to Growth in Vehicle Miles Traveled* (EPA-420-B-12-053). Retrieved from *http://www.epa.gov/otaq/stateresources/policy/general/420b12053.pdf*

the State's mobile source TCSs that CARB has adopted since 1990 and for which the benefits are included in this analysis.

In contrast, TCMs are generally adopted at the regional scale as part of a regional transportation plan (RTP). For the Eastern Kern nonattainment area, the Kern Council of Governments (KCOG) is designated under federal law as a metropolitan planning organization (MPO) and under State law as a regional transportation planning agency and a council of governments and is therefore responsible for adopting TCMs. On August 16, 2018, KCOG adopted the 2019 federal state transportation improvement program (FSTIP), which contains their adopted TCMs.

Table A-3 Methodology

The following calculations are based on U.S. EPA's 2012 guidance. For the 75-ppb 8-hour ozone standard for the severe area, 2011 and 2026 are the base and attainment years, respectively. For the 70-ppb 8-hour ozone standard for the severe area, 2017 and 2032 are the base and attainment years, respectively.

This analysis uses California's motor vehicle emissions model, EMission FACtor (EMFAC).[2] On August 15, 2019, U.S. EPA approved EMFAC2017 for use in SIPs and to demonstrate transportation conformity.[3] The EMFAC model estimates the emissions from two combustion processes – running exhaust and start exhaust – and from four evaporative processes – hot soak, running losses, diurnal, and resting losses. Emissions from running exhaust, start exhaust, hot soak, and running losses are a function of how much a vehicle is driven. Therefore, emissions from these processes are directly related to vehicle starts and VMT. These processes are included in calculating the emissions levels used in the VMT offset demonstration. Emissions from resting loss and diurnal loss processes are not related to VMT, trips, or vehicle starts and are not included in the analysis because these emissions occur whether or not vehicle travel occurs on a given day.

To calculate on-road emission inventories in the Eastern Kern ozone nonattainment area, EMFAC combines VMT and speed distributions from the 2019 FSTIP. The number of vehicle starts per day is based on household travel surveys, and vehicle population data are from the California Department of Motor Vehicles with corresponding emission rates from EMFAC to calculate emissions. The number of vehicle trips per day is based on data provided by KCOG's 2019 FSTIP amendment.

Table A-4 Analysis of Eastern Kern 75 ppb Standard

Following a two-step process with appropriate calculations, CARB staff compared target-year VOC emissions under three different VMT and emission control scenarios.

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[2] More information on data sources can be found in the EMFAC technical support documentation at: *https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation*

[3] 84 FR 41717 *https://www.federalregister.gov/d/2019-17476*

Table A-5 ***Step 1. Provide the emissions levels for the 2011 base year.***

Table 1 shows the Eastern Kern VOC emissions for the calendar year 2011 from the EMFAC2017 model.

Table 1: Eastern Kern Base Year (2011) VMT and Emissions

Description	VMT (miles/day)	VOC (tons/day)
2011 Vehicle-Miles Traveled and On-Road Emissions	3,082,742	1.8

Table A-6 ***Step 2. Calculate three emission levels in the 2026 attainment year.***

(1) Calculate emissions levels with the motor vehicle control program frozen at 2011 levels and with projected VMT in the attainment year. This would represent the emissions in the attainment year if TCSs and TCMs were not implemented after 2011.

(2) Calculate emissions levels with the motor vehicle control program frozen at 2011 levels and assuming VMT does not increase from 2011 levels.

(3) Calculate an emissions level that represents emissions of projected VMT in the attainment year with full implementation of all TCSs and TCMs since 2011.

Table A-7 ***Calculation 1. Calculate the emissions in the attainment year assuming growth in VMT and no new control measures since the base year.***

To perform this calculation, CARB staff identified the on-road motor vehicle control programs adopted since 2011 and adjusted the EMFAC2017 output to reflect the VOC emission levels in 2026 without the benefits of the post-2011 control programs. As a result, the projected VOC emissions are 0.6 tons per day for 2026. In comparison, in the base year of 2011, VOC emissions were 1.8 tons per day.

Table A-8 ***Calculation 2. Calculate the emissions with no growth in VMT.***

EMFAC2017 allows the user to input different VMT values. CARB ran EMFAC2017 for the calendar year 2026 with the 2011 VMT level of 3,082,742 miles per day without the benefits of the post-2011 control programs. The VOC emissions associated with the 2011 VMT level are 0.5 tons per day for 2026.

Table A-9 ***Calculation 3. Calculate emissions reductions with full implementation of TCSs and TCMs.***

CARB calculated the VOC emission levels for 2026, assuming the benefits of the post-2011 motor vehicle control program and the projected VMT levels in 2026 are calculated using EMFAC2017. The projected VOC emissions levels are 0.5 tons per day for 2026.

VOC emissions for the calculations described above are provided in Tables 2 and 3.

Table 2: Eastern Kern VOC Emissions Calculations for the 2026 Attainment Year (75-ppb Severe Plan)

Calculation Number	Description	VMT year	Vehicle Control Program year	VMT (miles/day)	VOC (tons/day)
1	Emissions with motor vehicle control program frozen at 2011 levels (VMT at 2026 projected levels)	2026	2011	3,887,618	0.6
2	Emissions with motor vehicle control program frozen at 2011 levels (VMT at 2011 levels)	2011	2011	3,082,742	0.5
3	Emissions with a full motor vehicle control program in place (VMT at 2026 projected levels)	2026	2026	3,887,618	0.5

As provided in the 2012 U.S. EPA guidance, to determine compliance with CAA §182(d)(1)(A), Calculation 3 emissions levels should be less than or equal to the Calculation 2 emissions levels:

VOC: 0.5 ≈ 0.5 tons per day for the 75-ppb Severe Plan

Since the estimated attainment year emissions are approximately equal to the VMT Offset ceiling (calculation 2), additional TCMs and TCSs will not be needed.

Table A-10 Analysis of Eastern Kern 70 ppb Standard

Following a two-step process with appropriate calculations, CARB staff compared target-year VOC emissions under three different VMT and emission control scenarios.

Table A-11 *Step 1. Provide the emissions levels for the 2017 base year.*

Table 1 shows the Eastern Kern VOC emissions for the calendar year 2017 from the EMFAC2017 model.

Table 3: Eastern Kern Base Year (2017) VMT and Emissions

Description	VMT (miles/day)	VOC (tons/day)
2017 Vehicle-Miles Traveled and On-Road Emissions	3,427,424	1.0

Table A-12 ***Step 2. Calculate three emission levels in the 2032 attainment year.***

(1) Calculate emissions levels with the motor vehicle control program frozen at 2017 levels and with projected VMT in the attainment year. This would represent the emissions in the attainment year if TCSs and TCMs were not implemented after 2017.

(2) Calculate emissions levels with the motor vehicle control program frozen at 2017 levels and assuming VMT does not increase from 2017 levels.

(3) Calculate an emissions level that represents emissions with full implementation of all TCSs and TCMs since 2017.

Table A-13 ***Calculation 1. Calculate the emissions in the attainment year assuming growth in VMT and no new control measures since the base year.***

To perform this calculation, CARB staff identified the on-road motor vehicle control programs adopted since 2017 and adjusted the EMFAC2017 output to reflect the VOC emission levels in 2032 without the benefits of the post-2017 control programs. As a result, the projected VOC emissions are 0.5 tons per day for 2032. In comparison, in the base year of 2017, VOC emissions were 1.0 tons per day.

Table A-14 ***Calculation 2. Calculate the emissions with no growth in VMT.***

EMFAC2017 allows the user to input different VMT values. CARB ran EMFAC2017 for the calendar year 2032 with the 2017 VMT level of 3,427,424 miles per day without the benefits of the post-2017 control programs. The VOC emissions associated with the 2017 VMT level are 0.4 tons per day for 2032.

Table A-15 ***Calculation 3. Calculate emissions reductions with full implementation of TCSs and TCMs.***

CARB calculated the VOC emission levels for 2037, assuming the benefits of the post-2017 motor vehicle control program and the projected VMT levels in 2032 are calculated using EMFAC2017. The projected VOC emissions levels are 0.4 tons per day for 2032.

VOC emissions for the sets of calculations described above are provided in Tables 2 and 3.

Table 4: Eastern Kern VOC Emissions Calculations for the 2032 Attainment Year (70-ppb Severe Plan)

Calculation Number	Description	VMT year	Vehicle Control Program year	VMT (miles/day)	VOC (tons/day)
1	Emissions with motor vehicle control program frozen at 2017 levels (VMT at 2032 projected levels)	2032	2017	4,328,636	0.5
2	Emissions with motor vehicle control program frozen at 2017 levels (VMT at 2017 levels)	2017	2017	3,427,424	0.4
3	Emissions with a full motor vehicle control program in place (VMT at 2032 projected levels)	2032	2032	4,328,636	0.4

As provided in the 2012 U.S. EPA guidance, to determine compliance with CAA §182(d)(1)(A), Calculation 3 emissions levels should be less than or equal to the Calculation 2 emissions levels:

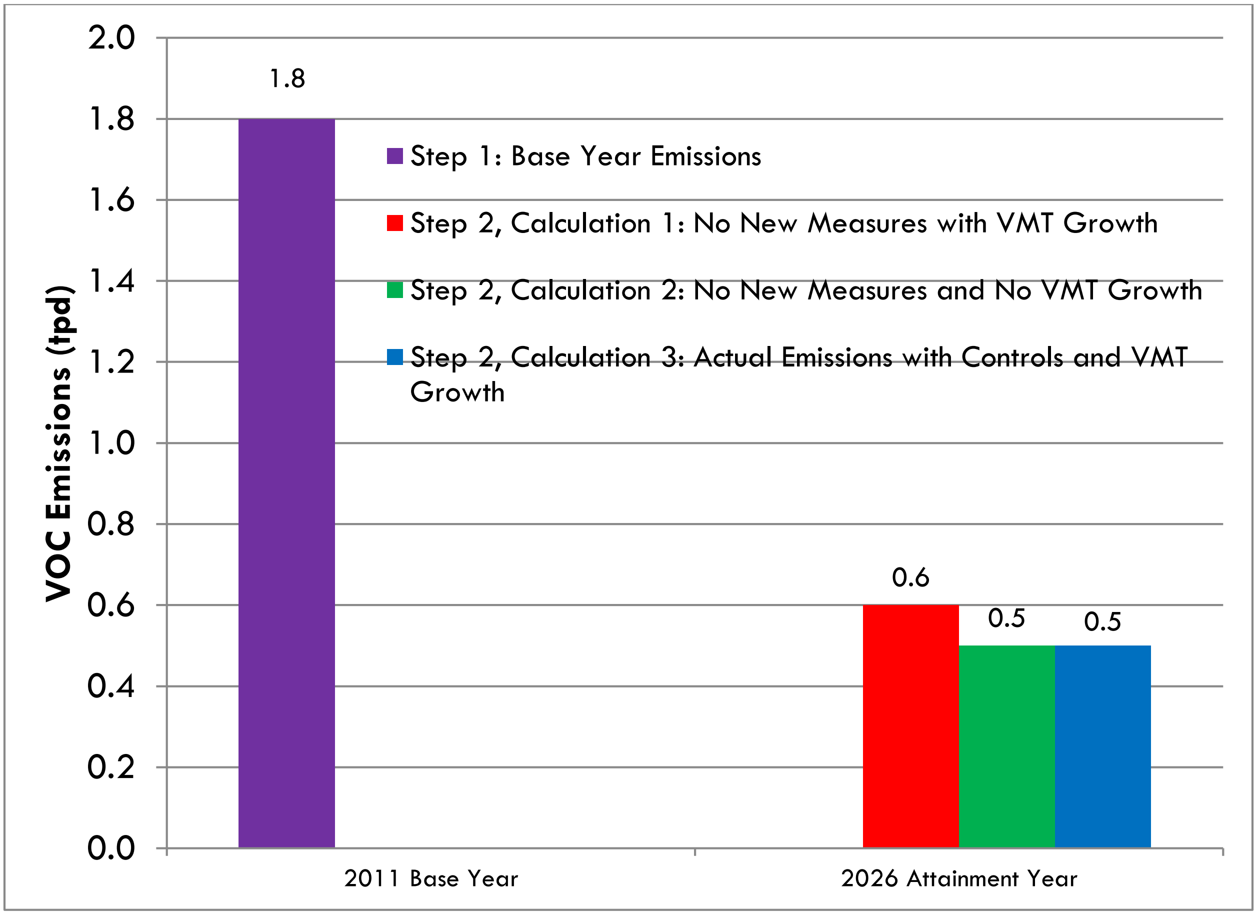
VOC: 0.4 ≈ 0.4 tons per day for the 70-ppb Severe Plan

Since the estimated attainment year emissions are approximately equal to the VMT Offset ceiling (calculation 2), additional TCMs and TCSs will not be needed.

Table A-16SUMMARY

To further illustrate the demonstration, Figures 1 and 2 graphically display the emissions benefits of the motor vehicle control programs in offsetting VOC emissions resulting from VMT increases in Eastern Kern County. For the 75 ppb 8-hour ozone Severe nonattainment standard (Figure 1), the left-most bar (in purple) shows the emissions in the base year, 2011. The three bars on the right show the emission levels in the attainment year 2026. The red bar on the right represents the emissions if there are no further motor vehicle controls after the base year (2011 level) and with projected VMT increases (2026 level). The green bar represents the emissions if VMT does not increase from the base-year (2011 levels) and there are no new TCSs or TCMs after the base year. Finally, the blue bar represents the emission levels with all the existing motor vehicle control programs in place with projected VMT increases.

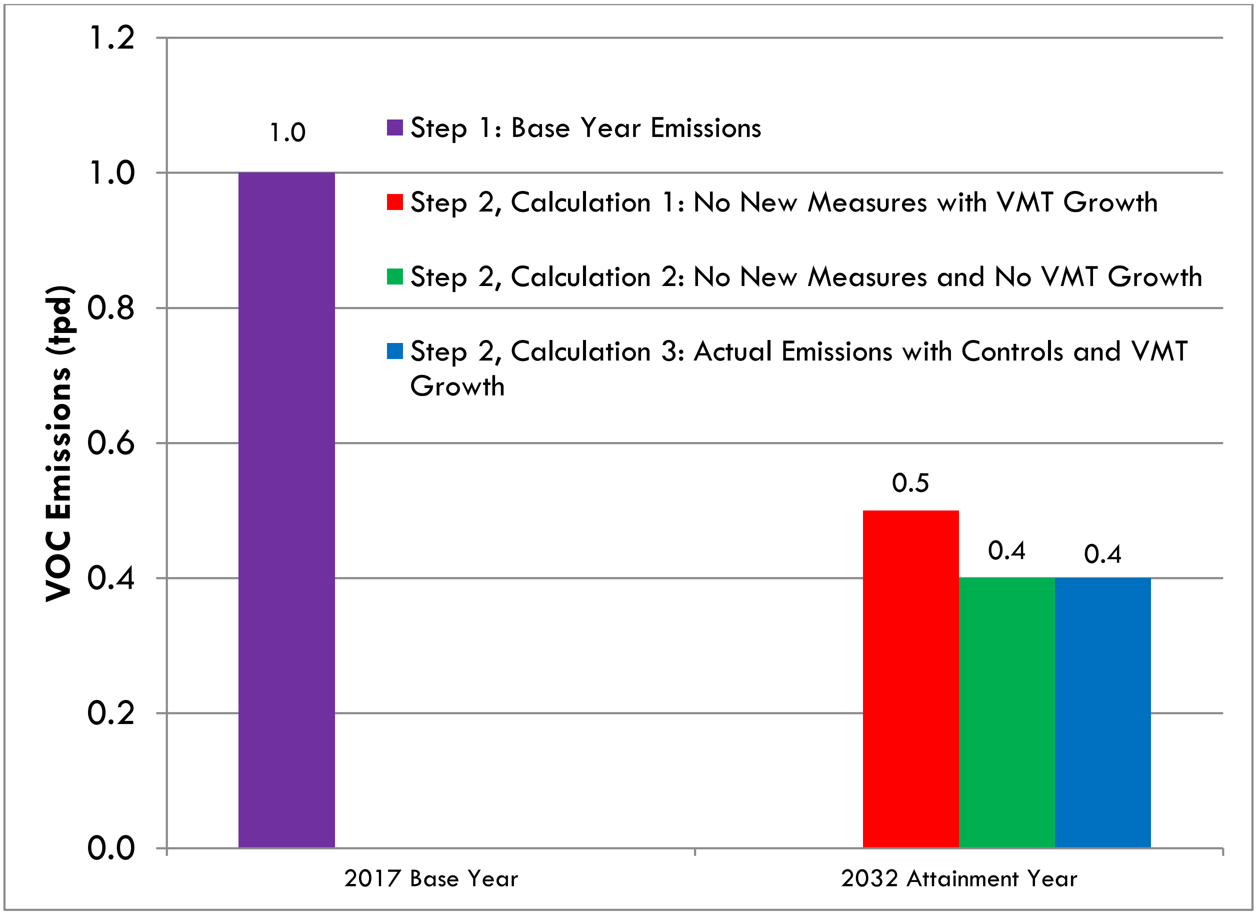
Figure 1 Eastern Kern VMT Offset Demonstration for the 75 ppb Standard*



* Does not include resting or diurnal loss emissions

For the 70 ppb 8-hour ozone severe nonattainment standard (Figure 2), the left-most bar (in purple) shows the emissions in the base year. The three bars on the right show the emission levels in the attainment year 2032. The red bar on the right represents the emissions if there are no further motor vehicle controls after the base year (2017 level) and with projected VMT increases (2032 level). The green bar represents the emissions if VMT does not increase from the base-year (2017 levels) and there are no new TCSs or TCMs after the base year. Finally, the blue bar represents the emission levels with all the existing motor vehicle control programs in place with projected VMT increases.

Figure 2 Eastern Kern VMT Offset Demonstration for the 70 ppb Standard*



* Does not include resting or diurnal loss emissions

Table A-17 CONCLUSION

The previous sections provide an analysis to demonstrate compliance with CAA §182(d)(1)(A). Based on the 2012 U.S. EPA guidance, since emissions with the existing control measures and VMT are less than or equal to emissions with no new measures and no VMT growth, and hence no additional TCSs and TCMs will be needed to offset the growth in emissions.

Attachment A-1

Table A-18 STATE OF CALIFORNIA MOTOR VEHICLE CONTROL PROGRAM (1990-PRESENT)

Table A-1 Transportation Control Strategies Adopted by the California Air Resources Board since 1990		
Measure	**Hearing Date**	**Category**
California Reformulated Gasoline (CalRFG), Phase I. T 13, CCR, 2251.5	9/27/1990	Fuels

Table A-1 Transportation Control Strategies Adopted by the California Air Resources Board since 1990		
Measure	**Hearing Date**	**Category**
California Reformulated Gasoline, Phase II. T 13, CCR, 2250, 2255.1, 2252, 2260 - 2272, 2295	11/21/1991	Fuels
Wintertime Gasoline Program. T 13, CCR, 2258, 2298, 2251.5, 2296	11/21/1991	Fuels
Wintertime Oxygenate Program. T 13, CCR, 2258, 2251.5, 2263(b), 2267, 2298, 2259, 2283, 2293.5	9/9/1993	Fuels
Diesel Fuel Certification Test Methods. T 13, CCR, 1956.8(b), 1960.1(k), 2281(c), 2282(b), (c) and (g)	10/24/1996	Fuels
Diesel Fuel Test Methods. T 13, CCR, 1956.8(b), 1960.1(k), 2281(c), 2282(b), (c) and (g)	10/24/1996	Fuels
1997 Amendments to Onboard Diagnostics, Phase II, Technical Status. T 13, CCR, 1968.1, 2030, 2031	12/12/1996	On-Road
Low Emission Vehicles Standards (LEV 2) and Compliance Assurance Program (CAP 2000). T 13, CCR,1961 & 1962 (both new); 1900, 1960.1, 1965, 1968.1, 1976, 1978, 2037, 2038, 2062, 2101, 2106, 2107, 2110, 2112, 2114, 2119, 2130, 2137-2140, 2143-2148	11/5/1998	On-Road
Exhaust Standards for (On-Road) Motorcycles. T 13, CCR, 1900, 1958, 1965	12/10/1998	On-Road
Light-and Medium Duty Low Emission Vehicle Alignment with Federal Standards. Exhaust Emission Standards for Heavy Duty Gas Engines. T 13, CCR, 1956.8 &1961	12/7/2000	On-Road
Heavy Duty Diesel Engine Standards for 2007 and Later. T 13, CCR, 1956.8 and incorporated test procedures	10/25/2001	On-Road
Low Emission Vehicle Regulations. T 13, CCR, 1960.1,1960.5, 1961, 1962 and incorporate test procedures and guidelines	11/15/2001	On-Road

Table A-1 Transportation Control Strategies Adopted by the California Air Resources Board since 1990		
Measure	**Hearing Date**	**Category**
2003 Amendments to On-Board Diagnostic II Review Amendments. T 13, CCR, 1968.1, 1968.2, 1968.5	4/25/2002	On-Road
CaRFG Phase 3 Amendments. T 13, CCR, 2261, 2262, 2262.4, 2262.5, 2262.6, 2262.9, 2266.5, 2269, 2271, 2272, 2265, and 2296	7/25/2002	Fuels
Adoption of Minor Amendments to the Low-Emission Vehicle Regulations. T 13, CCR, 1961, 1965, 1978, and the incorporate test procedures	12/12/2002	On-Road
Incorporation of Federal Exhaust Emission Standards for 2008 and Later Model-Year Heavy Duty Gasoline Engines and the Adoption of Minor Amendments to the Low-Emission Vehicle Regulations. T 13, CCR, 1956.8 and documents incorporated by reference	12/12/2002	On-Road
CaRFG Phase 3 Amendments (specifications for De Minimis Levels of Oxygenates and MTBE Phase Out Issues). T 13, CCR, 2261, 2262.6, 2263, 2266.5, 2272, 2273, 2260, 2273.5	12/12/2002	Fuels
Specifications for Motor Vehicle Diesel Fuel. T 13 & T17, CCR, 1961, 2281, 2282, 2701, 2284, 2285, 93114, and incorporated test procedures	7/24/2003	Fuels
California Reformulated Gasoline, Phase 3. T 13, CCR, 2260, 2262, 2262.4, 2262.5, 2262.6, 2262.9, 2263, 2265 (and the incorporated “California Procedures”), and 2266.5	11/18/2004	Fuels
On-Board Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines (HD OBD). T 13, CCR, 1971.1	7/21/2005	On-Road

Table A-1 Transportation Control Strategies Adopted by the California Air Resources Board since 1990		
Measure	**Hearing Date**	**Category**
Requirements to Reduce Idling Emissions from New and In-Use Trucks, Beginning in 2008. T 13, CCR, 1956.8, 2404, 2424, 2425, and 2485 and the incorporated document	10/20/2005	On-Road
Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yard. T 13, CCR, 2479	12/8/2005	On-road and Off-road
Evaporative and Exhaust Emission Test Procedures. T 13, CCR, 1961, 1976, 1978	6/22/2006	On-road
Heavy-Duty In-Use Compliance Regulation. T 13, CCR, 1956.1, 1956.8, and documents incorporated by reference	9/28/2006	On-Road
2007 Amendments to On-Board Diagnostic II. T 13, CCR, 1968.2, 1968.5, 2035, 2037 and 2038	9/28/2006	On-Road
Phase 3 Reformulated Gasoline (Ethanol Permeation) T 13, CCR, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2270, 2271, and 2273	6/14/2007	Fuels
2007 Amendments to Heavy-Duty In-Use Compliance Regulation. T 13, CCR, 1956.1, 1956.8, and documents incorporated by reference	12/6/2007	On-Road
Port Truck Modernization T 13, CCR, 2027	12/6/2007	On-Road
Cleaner In-Use Heavy-Duty Trucks (Truck and Bus Reg) T 13, CCR, 2025	12/11/2008	On-Road
2010 Amendments to On-Board Diagnostic II. T 13, CCR, 1968.2, 1968.5, 2035, 2037 and 2038	5/28/2009	On-Road
Plug-In Hybrid Electric Vehicle Test Procedure Amendments. T 13, CCR, 2032, 1900, 1962, 1962.1	5/28/2009	On-Road
2010 Amendments to On-Board Diagnostic System Requirements for Heavy-Duty Engines (HD OBD). T 13, CCR, 1971.1 and 1971.5	5/28/2009	On-Road
Truck and Bus Regulation 2010. T13, CCR, 2025	12/16/2010	On-Road

Table A-1 Transportation Control Strategies Adopted by the California Air Resources Board since 1990		
Measure	**Hearing Date**	**Category**
2011 Amendments to Heavy-Duty In-Use Compliance Regulation. T 13, CCR, 1956.1, 1956.8, and documents incorporated by reference	6/23/2011	On-Road
Amendments to Mobile Cargo Handling Equipment at Ports and Intermodal Rail Yard. T 13, CCR, 2479	9/22/2011	On-Road
Advanced Clean Cars T 13, CCR, 1900, 1956, 1960, 1961, 1962, 1965, 1968, 1976, 1978, 2037, 2038, 2062, 2112, 2139, 2140, 2145, 2147, 2235, 2300, 2302, 2303, 2304, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, and 2318	1/26/2012	On-Road
Zero Emission Vehicle Standards for 2009 through 2017 models. T 13, CCR, 1962.1, 1962.3	1/26/2012	On-Road
2012 Amendments to On-Board Diagnostic II. T 13, CCR, 1968.2, 1968.5, 2035, 2037 and 2038	1/26/2012	On-Road
Emergency Regulatory Amendments to the Tractor-Trailer Greenhouse Gas Regulation T 17, CCR, 95307	2/29/2012	On-Road
2013 Amendments to On-Board Diagnostics (OBD I and II) Regulations T 13, CCR, 1968.2, 1971.1	8/23/2012	On-Road
2013 Amendments to Heavy Duty On Board Diagnostic Requirements	8/23/2012	On-Road
Low Emission Vehicle III Greenhouse Gas and Zero Emission Vehicle Regulation Amendments for Federal Compliance Option T 13, CCR, 1900, 1956.8, 1960.1, 1961, 1961.2, 1961.3, 1962.1, 1962.2, 1976	11/15/2012	On-Road

Table A-1 Transportation Control Strategies Adopted by the California Air Resources Board since 1990		
Measure	**Hearing Date**	**Category**
Heavy-Duty Greenhouse Gas Phase 1: On-Road Heavy Duty Greenhouse Gas Emissions Rule, Tractor-Trailer Rule, Commercial Motor Vehicle Idling Rule, Optional Emission Standards, Heavy-Duty Hybrid-Electric Vehicle Certification Procedure T 13, CCR, 1900, 1956.	12/12/2013	On-Road
Heavy-Duty Hybrid-Electric Vehicle Certification Procedure T 13, CCR, 1900, 1956.8, 2036, 2037, 2112, 2139, 2140, 2147, 2485, T 17, CCR, 95300, 95301, 95302, 95303, 95305, 95660, 95661, 95662, 95663, 95664	12/12/2013	On-Road
Amendments to Low Emission Vehicle III Criteria Pollutant Requirements for Light- and Medium-Duty Vehicles the Hybrid Electric Vehicle Test Procedures, and the Heavy-Duty Otto-Cycle and Heavy-Duty Diesel Test Procedures T 13, CCR, 1900, 1956.8, 1961.2, 1962.2, 1965, 1976, 1978	10/23/2014	On-Road
2014 Amendments to Zero Emission Vehicle Regulation T 13, CCR, 1962.1, 1962.2	10/23/2014/5/21/2015	On-Road

APPENDIX D
Day-of-Week Redistribution Factors
By Vehicle Type and County

Redistribution Factors

Factors shown in Table 1 represent the "day-of-week" factors for each county for a broad vehicle class: LD is Light-Duty and LM is Light- and Medium-Duty Trucks. Factors shown in Table 2 represent the day-specific factors for each county for the Heavy Heavy-Duty Trucks.

Table 1: Day-of-week adjustment by vehicle class and county

County	Day of Week	LD	LM
Fresno	Sunday	0.850	0.443
Fresno	Monday	1.015	0.934
Fresno	Tues/Wed/Thurs	1.000	1.000
Fresno	Friday	1.155	1.026
Fresno	Saturday	0.945	0.563
Fresno	Holiday	0.800	0.775
Kern	Sunday	1.113	0.630
Kern	Monday	1.061	0.942
Kern	Tues/Wed/Thurs	1.000	1.000
Kern	Friday	1.253	1.044
Kern	Saturday	1.099	0.734
Kern	Holiday	0.986	0.910
Kings	Sunday	0.662	0.358
Kings	Monday	0.961	0.909
Kings	Tues/Wed/Thurs	1.000	1.000
Kings	Friday	1.044	0.982
Kings	Saturday	0.806	0.521
Kings	Holiday	0.669	0.666
Madera	Sunday	1.015	0.478
Madera	Monday	1.022	0.942
Madera	Tues/Wed/Thurs	1.000	1.000
Madera	Friday	1.175	1.022
Madera	Saturday	1.103	0.602
Madera	Holiday	0.871	0.834
Merced	Sunday	1.002	0.593
Merced	Monday	1.009	0.958
Merced	Tues/Wed/Thurs	1.000	1.000
Merced	Friday	1.185	1.103
Merced	Saturday	1.055	0.713
Merced	Holiday	0.977	0.897
San Joaquin	Sunday	0.933	0.500
San Joaquin	Monday	0.984	0.918
San Joaquin	Tues/Wed/Thurs	1.000	1.000
San Joaquin	Friday	1.128	1.086

Redistribution Factors

County	Day of Week	LD	LM
San Joaquin	Saturday	1.035	0.657
San Joaquin	Holiday	0.907	0.770
Stanislaus	Sunday	1.002	0.593
Stanislaus	Monday	1.009	0.958
Stanislaus	Tues/Wed/Thurs	1.000	1.000
Stanislaus	Friday	1.185	1.103
Stanislaus	Saturday	1.055	0.713
Stanislaus	Holiday	0.977	0.897
Tulare	Sunday	1.029	0.429
Tulare	Monday	1.052	0.936
Tulare	Tues/Wed/Thurs	1.000	1.000
Tulare	Friday	1.099	1.020
Tulare	Saturday	0.993	0.670
Tulare	Holiday	0.942	0.585

Table 2: Daily adjustment for Heavy Heavy-Duty Trucks (HH) by county

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
1/1/2018	0.565	0.497	0.469	0.832	0.436	0.405	0.797	0.448
1/2/2018	1.048	0.994	0.993	1.000	0.720	0.784	1.000	0.868
1/3/2018	1.084	1.051	1.073	1.000	0.718	0.822	1.000	0.923
1/4/2018	1.044	1.034	0.992	1.000	0.772	0.829	1.000	0.893
1/5/2018	1.054	1.041	1.101	0.961	0.808	0.833	0.970	0.930
1/6/2018	0.811	0.760	0.864	0.476	0.582	0.571	0.477	0.656
1/7/2018	0.722	0.663	0.700	0.400	0.504	0.473	0.421	0.555
1/8/2018	0.933	0.906	0.999	0.902	0.620	0.697	0.904	0.780
1/9/2018	0.931	0.954	0.880	1.000	0.639	0.746	1.000	0.745
1/10/2018	0.998	1.030	0.947	1.000	0.662	0.811	1.000	0.782
1/11/2018	1.026	1.083	1.059	1.000	0.714	0.818	1.000	0.832
1/12/2018	1.072	1.052	1.036	0.961	0.803	0.820	0.970	0.827
1/13/2018	0.805	0.748	0.847	0.476	0.529	0.556	0.477	0.575
1/14/2018	0.707	0.641	0.710	0.400	0.455	0.452	0.421	0.517
1/15/2018	1.015	1.052	1.053	0.832	0.676	0.756	0.797	0.864
1/16/2018	1.070	1.080	1.122	1.000	0.699	0.803	1.000	0.864
1/17/2018	1.041	1.033	0.968	1.000	0.693	0.800	1.000	0.861
1/18/2018	1.046	1.033	0.964	1.000	0.706	0.785	1.000	0.862
1/19/2018	1.047	1.014	0.970	0.961	0.762	0.812	0.970	0.858
1/20/2018	0.787	0.706	0.706	0.476	0.585	0.579	0.477	0.615
1/21/2018	0.720	0.640	0.679	0.400	0.518	0.469	0.421	0.514

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
1/22/2018	1.020	0.977	0.907	0.902	0.756	0.770	0.904	0.849
1/23/2018	1.051	1.017	1.027	1.000	0.767	0.822	1.000	0.879
1/24/2018	1.006	0.986	0.904	1.000	0.743	0.808	1.000	0.890
1/25/2018	1.037	1.015	0.921	1.000	0.746	0.807	1.000	0.919
1/26/2018	1.081	1.009	0.943	0.961	0.822	0.840	0.970	0.953
1/27/2018	0.797	0.729	0.762	0.476	0.588	0.584	0.477	0.670
1/28/2018	0.733	0.644	0.696	0.400	0.528	0.484	0.421	0.536
1/29/2018	1.022	0.982	0.906	0.902	0.702	0.804	0.904	0.890
1/30/2018	0.988	1.008	1.061	1.000	0.724	0.818	1.000	0.924
1/31/2018	1.011	0.999	1.035	1.000	0.746	0.837	1.000	0.912
2/1/2018	1.038	1.013	1.035	1.000	0.794	0.850	1.000	0.940
2/2/2018	1.027	0.994	1.003	0.961	0.769	0.860	0.970	0.922
2/3/2018	0.816	0.701	0.706	0.476	0.598	0.607	0.477	0.666
2/4/2018	0.701	0.602	0.754	0.400	0.525	0.485	0.421	0.517
2/5/2018	1.013	0.964	0.963	0.902	0.795	0.846	0.904	0.907
2/6/2018	1.023	0.977	0.974	1.000	0.800	0.881	1.000	0.923
2/7/2018	1.016	1.008	0.971	1.000	0.778	0.881	1.000	0.937
2/8/2018	1.044	1.034	0.847	1.000	0.796	0.896	1.000	0.956
2/9/2018	1.073	1.043	0.824	0.961	0.849	0.922	0.970	0.978
2/10/2018	0.831	0.762	0.822	0.476	0.637	0.620	0.477	0.711
2/11/2018	0.741	0.657	0.702	0.400	0.557	0.505	0.421	0.553
2/12/2018	1.020	1.018	0.934	0.902	0.801	0.857	0.904	0.948
2/13/2018	1.041	1.030	0.935	1.000	0.795	0.890	1.000	0.953
2/14/2018	1.018	1.011	1.017	1.000	0.825	0.884	1.000	0.888
2/15/2018	1.061	1.056	1.094	1.000	0.869	0.903	1.000	0.919
2/16/2018	1.114	1.076	1.025	0.961	0.954	0.904	0.970	0.932
2/17/2018	0.847	0.756	0.842	0.476	0.698	0.602	0.477	0.678
2/18/2018	0.746	0.666	0.692	0.400	0.596	0.500	0.421	0.549
2/19/2018	0.972	0.948	0.984	0.832	0.844	0.764	0.797	0.908
2/20/2018	1.045	0.868	0.997	1.000	0.877	0.883	1.000	0.966
2/21/2018	1.014	0.845	0.980	1.000	0.874	0.850	1.000	0.948
2/22/2018	1.052	0.879	1.020	1.000	0.857	0.905	1.000	0.928
2/23/2018	1.087	1.064	1.061	0.961	0.925	0.954	0.970	0.946
2/24/2018	0.837	0.753	0.801	0.476	0.682	0.609	0.477	0.715
2/25/2018	0.771	0.693	0.724	0.400	0.620	0.542	0.421	0.551
2/26/2018	1.022	0.998	0.930	0.902	0.816	0.866	0.904	0.920
2/27/2018	1.031	1.000	0.933	1.000	0.907	0.946	1.000	0.932
2/28/2018	1.050	1.026	0.973	1.000	0.940	0.957	1.000	0.966
3/1/2018	0.999	1.065	0.928	1.000	0.876	0.882	1.000	0.946

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
3/2/2018	1.013	0.988	0.895	0.961	0.925	0.898	0.970	0.918
3/3/2018	0.800	0.732	0.661	0.476	0.684	0.584	0.477	0.671
3/4/2018	0.773	0.697	0.723	0.400	0.601	0.528	0.421	0.624
3/5/2018	1.068	1.029	0.984	0.902	0.903	0.912	0.904	0.974
3/6/2018	1.027	1.041	0.947	1.000	0.919	0.923	1.000	0.956
3/7/2018	1.032	1.001	1.008	1.000	0.945	0.933	1.000	0.998
3/8/2018	1.042	1.061	0.936	1.000	0.930	0.938	1.000	1.020
3/9/2018	1.083	1.041	0.942	0.961	1.012	0.951	0.970	1.021
3/10/2018	0.825	0.732	0.798	0.476	0.712	0.623	0.477	0.716
3/11/2018	0.757	0.689	0.720	0.400	0.631	0.536	0.421	0.594
3/12/2018	1.046	1.032	1.000	0.902	0.942	0.888	0.904	0.980
3/13/2018	1.045	0.992	0.900	1.000	0.888	0.896	1.000	1.010
3/14/2018	0.874	0.940	0.948	1.000	0.934	0.900	1.000	1.006
3/15/2018	0.940	0.983	0.987	1.000	0.981	0.896	1.000	1.066
3/16/2018	0.938	0.970	1.001	0.961	1.008	0.895	0.970	1.028
3/17/2018	0.679	0.656	0.709	0.476	0.714	0.614	0.477	0.688
3/18/2018	0.599	0.619	0.706	0.400	0.665	0.543	0.421	0.494
3/19/2018	0.863	0.961	0.917	0.902	0.954	0.902	0.904	0.825
3/20/2018	0.818	0.990	0.910	1.000	0.919	0.898	1.000	0.840
3/21/2018	0.782	0.933	0.904	1.000	0.900	0.912	1.000	0.774
3/22/2018	0.879	0.928	0.898	1.000	0.898	0.895	1.000	0.876
3/23/2018	0.953	1.056	0.717	0.961	0.956	0.960	0.970	0.999
3/24/2018	0.712	0.749	0.483	0.476	0.721	0.643	0.477	0.748
3/25/2018	0.618	0.644	0.438	0.400	0.660	0.559	0.421	0.581
3/26/2018	0.948	0.991	0.643	0.902	0.986	0.943	0.904	1.005
3/27/2018	0.963	1.060	1.005	1.000	0.990	0.979	1.000	1.038
3/28/2018	0.998	1.074	1.021	1.000	0.954	0.992	1.000	1.074
3/29/2018	1.041	1.118	1.109	1.000	0.991	0.995	1.000	1.088
3/30/2018	1.023	1.059	1.103	0.961	0.976	0.960	0.970	1.036
3/31/2018	0.684	0.721	0.735	0.832	0.762	0.644	0.797	0.677
4/1/2018	0.570	0.577	0.647	0.400	0.631	0.525	0.421	0.493
4/2/2018	0.988	0.982	1.044	0.902	1.010	0.949	0.904	0.975
4/3/2018	1.028	1.035	1.007	1.000	0.923	0.997	1.000	0.999
4/4/2018	1.027	1.032	1.038	1.000	0.969	0.997	1.000	0.996
4/5/2018	1.044	1.064	1.103	1.000	0.980	0.978	1.000	1.027
4/6/2018	1.053	1.034	1.057	0.961	0.994	0.890	0.970	1.015
4/7/2018	0.704	0.699	0.766	0.476	0.729	0.612	0.477	0.654
4/8/2018	0.626	0.600	0.674	0.400	0.646	0.528	0.421	0.546
4/9/2018	0.953	0.942	0.906	0.902	0.942	0.924	0.904	0.955

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
4/10/2018	1.007	1.007	0.941	1.000	0.926	0.976	1.000	0.980
4/11/2018	1.005	1.022	0.793	1.000	0.964	0.970	1.000	0.995
4/12/2018	1.046	1.055	0.752	1.000	0.980	0.997	1.000	1.021
4/13/2018	1.071	1.063	1.005	0.961	1.016	0.992	0.970	1.025
4/14/2018	0.724	0.753	0.734	0.476	0.743	0.667	0.477	0.667
4/15/2018	0.619	0.612	0.665	0.400	0.615	0.547	0.421	0.515
4/16/2018	0.960	0.947	0.891	0.902	0.932	0.925	0.904	0.910
4/17/2018	1.004	0.997	0.897	1.000	0.957	0.991	1.000	0.945
4/18/2018	0.984	1.002	0.943	1.000	0.971	1.004	1.000	0.979
4/19/2018	1.076	1.044	1.035	1.000	0.998	1.012	1.000	1.006
4/20/2018	1.054	1.061	1.009	0.961	1.029	1.004	0.970	1.043
4/21/2018	0.716	0.730	0.710	0.476	0.726	0.668	0.477	0.686
4/22/2018	0.619	0.636	0.680	0.400	0.658	0.561	0.421	0.534
4/23/2018	0.982	0.971	0.963	0.902	0.991	0.951	0.904	0.920
4/24/2018	0.969	1.020	0.941	1.000	0.963	0.987	1.000	1.007
4/25/2018	0.993	1.005	0.949	1.000	0.968	0.999	1.000	0.990
4/26/2018	1.067	1.057	1.027	1.000	0.995	0.998	1.000	1.036
4/27/2018	1.090	1.058	1.057	0.961	1.076	1.027	0.970	1.043
4/28/2018	0.744	0.735	0.731	0.476	0.777	0.676	0.477	0.704
4/29/2018	0.657	0.640	0.690	0.400	0.694	0.570	0.421	0.569
4/30/2018	0.995	0.981	0.956	0.902	0.953	0.978	0.904	0.986
5/1/2018	1.033	1.003	0.936	1.000	0.936	0.986	1.000	0.999
5/2/2018	0.937	0.941	0.938	1.000	0.984	1.000	1.000	1.006
5/3/2018	1.039	1.045	1.009	1.000	1.026	0.996	1.000	1.028
5/4/2018	1.103	1.057	1.030	0.961	1.061	1.019	0.970	1.050
5/5/2018	0.696	0.736	0.693	0.476	0.762	0.660	0.477	0.680
5/6/2018	0.603	0.625	0.643	0.400	0.675	0.558	0.421	0.555
5/7/2018	0.967	0.970	0.916	0.902	0.953	0.961	0.904	0.964
5/8/2018	0.982	0.998	0.940	1.000	0.985	0.995	1.000	0.989
5/9/2018	0.985	1.010	0.964	1.000	0.988	1.008	1.000	1.000
5/10/2018	1.071	1.075	1.040	1.000	1.021	1.011	1.000	1.033
5/11/2018	1.082	1.077	1.057	0.961	1.045	1.024	0.970	1.050
5/12/2018	0.751	0.743	0.723	0.476	0.807	0.681	0.477	0.654
5/13/2018	0.621	0.616	0.649	0.400	0.695	0.561	0.421	0.510
5/14/2018	0.999	0.978	0.948	0.902	1.012	0.983	0.904	0.899
5/15/2018	1.031	1.015	0.975	1.000	1.002	1.003	1.000	0.901
5/16/2018	1.033	1.014	0.963	1.000	0.966	1.019	1.000	0.904
5/17/2018	1.078	1.066	1.035	1.000	1.017	1.011	1.000	0.945
5/18/2018	1.118	1.091	1.075	0.961	1.069	1.022	0.970	0.957

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
5/19/2018	0.752	0.743	0.746	0.476	0.762	0.693	0.477	0.635
5/20/2018	0.675	0.659	0.702	0.400	0.688	0.566	0.421	0.519
5/21/2018	1.006	0.984	0.960	0.902	0.988	0.985	0.904	0.877
5/22/2018	1.031	1.010	0.982	1.000	0.991	1.031	1.000	0.884
5/23/2018	1.043	1.037	1.003	1.000	0.975	1.027	1.000	0.968
5/24/2018	1.105	1.108	1.089	1.000	1.015	1.035	1.000	0.946
5/25/2018	1.121	1.147	1.124	0.961	1.077	1.025	0.970	0.966
5/26/2018	0.755	0.717	0.763	0.476	0.787	0.664	0.477	0.682
5/27/2018	0.540	0.505	0.532	0.400	0.595	0.512	0.421	0.467
5/28/2018	0.677	0.664	0.704	0.832	0.715	0.597	0.797	0.597
5/29/2018	1.028	0.941	0.985	1.000	1.005	0.995	1.000	0.923
5/30/2018	1.045	0.929	0.980	1.000	0.995	1.018	1.000	0.964
5/31/2018	1.064	0.954	1.027	1.000	0.943	1.026	1.000	1.065
6/1/2018	1.085	1.056	1.065	0.961	0.968	1.057	0.970	1.080
6/2/2018	0.742	0.764	0.736	0.476	0.724	0.714	0.477	0.734
6/3/2018	0.644	0.633	0.691	0.400	0.664	0.563	0.421	0.578
6/4/2018	0.934	0.969	0.965	0.902	0.967	0.969	0.904	0.987
6/5/2018	0.962	1.018	0.984	1.000	0.923	1.003	1.000	1.008
6/6/2018	0.997	1.004	0.995	1.000	0.923	1.029	1.000	1.037
6/7/2018	1.048	1.038	1.055	1.000	0.929	1.048	1.000	1.066
6/8/2018	1.069	1.069	1.080	0.961	0.959	1.025	0.970	1.067
6/9/2018	0.740	0.745	0.760	0.476	0.737	0.706	0.477	0.737
6/10/2018	0.650	0.645	0.713	0.400	0.661	0.592	0.421	0.585
6/11/2018	0.968	0.995	0.961	0.902	0.920	0.993	0.904	1.018
6/12/2018	0.999	1.026	1.015	1.000	0.907	0.977	1.000	1.043
6/13/2018	1.009	1.021	1.021	1.000	1.018	1.032	1.000	1.033
6/14/2018	1.069	1.077	1.116	1.000	1.041	1.059	1.000	1.062
6/15/2018	1.048	1.124	1.132	0.961	1.087	1.060	0.970	1.073
6/16/2018	0.752	0.778	0.781	0.476	0.818	0.727	0.477	0.733
6/17/2018	0.626	0.626	0.652	0.400	0.703	0.589	0.421	0.567
6/18/2018	0.938	0.997	0.982	0.902	1.003	1.017	0.904	1.009
6/19/2018	0.962	1.045	1.021	1.000	1.005	1.060	1.000	1.050
6/20/2018	0.943	1.030	1.027	1.000	0.959	1.052	1.000	1.028
6/21/2018	0.972	1.070	1.118	1.000	1.006	1.084	1.000	1.063
6/22/2018	0.989	1.100	1.137	0.961	1.087	1.051	0.970	1.088
6/23/2018	0.697	0.769	0.809	0.476	0.805	0.694	0.477	0.734
6/24/2018	0.620	0.654	0.711	0.400	0.698	0.576	0.421	0.559
6/25/2018	0.894	0.994	1.014	0.902	1.044	1.035	0.904	0.975
6/26/2018	0.964	1.064	1.047	1.000	1.052	1.070	1.000	1.010

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
6/27/2018	0.948	1.029	1.055	1.000	1.040	1.079	1.000	0.997
6/28/2018	0.992	1.086	1.098	1.000	1.099	1.079	1.000	1.033
6/29/2018	1.051	1.118	1.140	0.961	1.185	1.044	0.970	1.039
6/30/2018	0.765	0.762	0.814	0.476	0.814	0.730	0.477	0.706
7/1/2018	0.622	0.638	0.725	0.400	0.741	0.608	0.421	0.555
7/2/2018	0.918	0.973	1.020	0.902	1.087	1.038	0.904	0.941
7/3/2018	0.960	1.020	1.082	1.000	1.076	1.049	1.000	0.993
7/4/2018	0.667	0.671	0.779	0.832	0.683	0.658	0.797	0.619
7/5/2018	0.945	0.920	1.002	1.000	1.001	1.001	1.000	0.930
7/6/2018	1.027	1.038	1.108	0.961	1.148	1.069	0.970	1.007
7/7/2018	0.710	0.741	0.816	0.476	0.815	0.713	0.477	0.705
7/8/2018	0.599	0.620	0.715	0.400	0.743	0.571	0.421	0.559
7/9/2018	0.923	0.953	0.997	0.902	1.120	1.013	0.904	0.950
7/10/2018	0.934	1.002	1.035	1.000	1.123	1.043	1.000	1.006
7/11/2018	0.914	0.988	1.003	1.000	1.110	1.050	1.000	1.000
7/12/2018	0.972	1.043	1.104	1.000	1.159	1.056	1.000	1.038
7/13/2018	1.021	1.068	1.155	0.961	1.190	1.061	0.970	1.046
7/14/2018	0.730	0.750	0.839	0.476	0.870	0.713	0.477	0.720
7/15/2018	0.664	0.626	0.747	0.400	0.754	0.608	0.421	0.567
7/16/2018	0.935	0.959	1.018	0.902	1.144	1.029	0.904	0.979
7/17/2018	0.937	1.010	1.049	1.000	1.156	1.074	1.000	1.026
7/18/2018	0.964	0.991	1.044	1.000	1.140	1.060	1.000	0.996
7/19/2018	0.999	1.031	1.084	1.000	1.185	1.061	1.000	1.027
7/20/2018	1.035	1.059	1.153	0.961	1.198	1.066	0.970	1.054
7/21/2018	0.755	0.748	0.836	0.476	0.866	0.732	0.477	0.721
7/22/2018	0.698	0.626	0.751	0.400	0.708	0.614	0.421	0.570
7/23/2018	0.957	0.961	1.028	0.902	1.148	1.027	0.904	0.968
7/24/2018	0.949	1.014	1.061	1.000	1.142	1.053	1.000	1.008
7/25/2018	0.970	0.981	1.081	1.000	1.131	1.041	1.000	1.021
7/26/2018	1.015	1.023	0.769	1.000	1.209	1.047	1.000	1.043
7/27/2018	1.051	1.066	0.759	0.961	1.194	1.068	0.970	1.058
7/28/2018	0.755	0.769	0.547	0.476	0.867	0.734	0.477	0.714
7/29/2018	0.662	0.633	0.472	0.400	0.770	0.623	0.421	0.562
7/30/2018	0.933	0.973	0.702	0.902	1.171	1.026	0.904	0.990
7/31/2018	0.947	1.046	0.731	1.000	1.149	1.078	1.000	1.010
8/1/2018	0.945	1.035	1.087	1.000	1.125	1.078	1.000	1.013
8/2/2018	0.969	1.018	1.119	1.000	1.191	1.066	1.000	1.048
8/3/2018	1.020	1.052	1.158	0.961	1.192	1.070	0.970	1.077
8/4/2018	0.743	0.745	0.807	0.476	0.883	0.732	0.477	0.748

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
8/5/2018	0.630	0.606	0.713	0.400	0.768	0.614	0.421	0.571
8/6/2018	0.915	0.952	1.055	0.902	1.165	1.038	0.904	1.005
8/7/2018	0.928	1.017	1.075	1.000	1.168	1.080	1.000	1.025
8/8/2018	0.939	1.007	1.077	1.000	1.136	1.071	1.000	1.023
8/9/2018	0.974	1.029	1.114	1.000	1.206	1.064	1.000	1.015
8/10/2018	1.016	1.055	1.128	0.961	1.211	1.070	0.970	1.048
8/11/2018	0.730	0.738	0.819	0.476	0.897	0.740	0.477	0.738
8/12/2018	0.615	0.604	0.707	0.400	0.774	0.604	0.421	0.565
8/13/2018	0.937	0.968	1.049	0.902	1.156	1.026	0.904	0.989
8/14/2018	0.943	1.001	1.080	1.000	1.148	1.066	1.000	1.040
8/15/2018	0.935	0.987	1.056	1.000	1.126	1.089	1.000	1.010
8/16/2018	0.999	0.988	1.090	1.000	1.158	1.079	1.000	1.036
8/17/2018	1.032	1.007	1.130	0.961	1.197	1.084	0.970	1.056
8/18/2018	0.757	0.729	0.804	0.476	0.853	0.754	0.477	0.735
8/19/2018	0.650	0.589	0.715	0.400	0.719	0.622	0.421	0.579
8/20/2018	0.939	0.931	1.007	0.902	1.149	1.064	0.904	0.999
8/21/2018	0.989	0.954	1.037	1.000	1.103	1.108	1.000	1.019
8/22/2018	0.974	0.963	1.031	1.000	1.097	1.078	1.000	1.023
8/23/2018	1.000	1.009	1.097	1.000	1.115	1.109	1.000	1.053
8/24/2018	1.138	1.041	1.150	0.961	1.203	1.059	0.970	1.060
8/25/2018	0.785	0.694	0.889	0.476	0.871	0.706	0.477	0.671
8/26/2018	0.546	0.587	0.713	0.400	0.713	0.588	0.421	0.521
8/27/2018	0.852	0.919	0.966	0.902	1.103	1.011	0.904	0.955
8/28/2018	0.932	0.961	0.997	1.000	1.135	1.068	1.000	1.021
8/29/2018	0.921	0.949	1.012	1.000	1.127	1.101	1.000	1.009
8/30/2018	0.968	1.012	1.093	1.000	1.185	1.107	1.000	1.052
8/31/2018	1.040	1.056	1.156	0.961	1.232	1.090	0.970	1.094
9/1/2018	0.718	0.756	0.817	0.476	0.906	0.706	0.477	0.789
9/2/2018	0.503	0.489	0.551	0.400	0.644	0.550	0.421	0.485
9/3/2018	0.648	0.648	0.731	0.832	0.816	0.654	0.797	0.682
9/4/2018	0.952	0.977	1.023	1.000	1.110	1.032	1.000	1.007
9/5/2018	0.997	1.032	1.063	1.000	1.118	1.080	1.000	1.053
9/6/2018	1.022	1.032	1.121	1.000	1.111	1.089	1.000	1.053
9/7/2018	1.022	0.996	1.136	0.961	1.117	1.064	0.970	1.007
9/8/2018	0.692	0.714	0.803	0.476	0.876	0.751	0.477	0.759
9/9/2018	0.592	0.563	0.714	0.400	0.701	0.598	0.421	0.584
9/10/2018	0.912	0.910	0.961	0.902	1.117	1.032	0.904	0.989
9/11/2018	0.943	0.941	0.986	1.000	1.105	1.094	1.000	1.029
9/12/2018	0.943	0.949	0.982	1.000	1.084	1.094	1.000	1.019

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
9/13/2018	0.981	1.012	1.059	1.000	1.083	1.097	1.000	1.041
9/14/2018	1.047	1.017	1.108	0.961	1.130	1.113	0.970	1.057
9/15/2018	0.711	0.732	0.816	0.476	0.809	0.752	0.477	0.788
9/16/2018	0.617	0.594	0.739	0.400	0.650	0.608	0.421	0.608
9/17/2018	0.900	0.918	0.995	0.902	1.040	1.064	0.904	1.029
9/18/2018	0.934	0.963	1.003	1.000	1.078	1.100	1.000	1.060
9/19/2018	0.937	0.971	1.012	1.000	1.104	1.101	1.000	1.062
9/20/2018	0.978	1.017	1.071	1.000	1.095	1.098	1.000	1.090
9/21/2018	1.019	1.016	1.101	0.961	1.157	1.099	0.970	1.096
9/22/2018	0.724	0.733	0.837	0.476	0.839	0.750	0.477	0.779
9/23/2018	0.597	0.594	0.714	0.400	0.732	0.611	0.421	0.598
9/24/2018	0.903	0.933	0.990	0.902	1.121	1.064	0.904	1.019
9/25/2018	0.916	0.941	0.982	1.000	1.086	1.100	1.000	1.037
9/26/2018	0.921	0.934	0.993	1.000	1.085	1.089	1.000	1.036
9/27/2018	0.967	0.971	1.039	1.000	1.129	1.056	1.000	1.068
9/28/2018	1.016	1.011	1.106	0.961	1.138	1.127	0.970	1.117
9/29/2018	0.706	0.713	0.786	0.476	0.820	0.762	0.477	0.775
9/30/2018	0.598	0.604	0.742	0.400	0.744	0.627	0.421	0.599
10/1/2018	0.845	0.908	0.969	0.902	1.087	0.996	0.904	1.025
10/2/2018	0.863	0.925	0.958	1.000	1.086	1.088	1.000	1.028
10/3/2018	0.836	0.947	0.885	1.000	1.064	1.061	1.000	1.016
10/4/2018	0.826	0.984	1.025	1.000	1.076	1.068	1.000	1.039
10/5/2018	1.011	1.012	1.076	0.961	1.157	1.089	0.970	1.108
10/6/2018	0.717	0.723	0.757	0.476	0.833	0.727	0.477	0.787
10/7/2018	0.616	0.589	0.685	0.400	0.727	0.590	0.421	0.593
10/8/2018	0.961	0.950	0.959	0.902	1.034	1.000	0.904	1.025
10/9/2018	1.011	0.954	0.961	1.000	0.859	0.966	1.000	1.033
10/10/2018	0.990	0.956	0.959	1.000	1.085	1.082	1.000	0.998
10/11/2018	1.009	1.012	1.007	1.000	1.130	1.081	1.000	1.004
10/12/2018	1.079	1.043	1.078	0.961	1.177	1.088	0.970	1.082
10/13/2018	0.716	0.710	0.758	0.476	0.854	0.740	0.477	0.757
10/14/2018	0.638	0.601	0.703	0.400	0.736	0.602	0.421	0.591
10/15/2018	0.958	0.916	0.961	0.902	1.141	1.045	0.904	1.014
10/16/2018	0.948	0.956	0.977	1.000	1.118	1.080	1.000	1.029
10/17/2018	0.966	0.953	0.993	1.000	1.097	1.086	1.000	1.038
10/18/2018	1.013	1.001	1.055	1.000	1.127	1.067	1.000	1.067
10/19/2018	1.041	1.013	1.083	0.961	1.181	1.049	0.970	1.074
10/20/2018	0.705	0.730	0.759	0.476	0.837	0.745	0.477	0.759
10/21/2018	0.620	0.601	0.692	0.400	0.728	0.616	0.421	0.615

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
10/22/2018	0.950	0.922	0.964	0.902	1.082	1.018	0.904	0.998
10/23/2018	0.949	0.950	0.956	1.000	1.093	1.066	1.000	1.026
10/24/2018	0.975	0.948	0.981	1.000	1.129	1.071	1.000	1.029
10/25/2018	1.032	1.010	1.058	1.000	1.161	1.085	1.000	1.052
10/26/2018	1.014	1.021	1.113	0.961	1.207	1.081	0.970	1.146
10/27/2018	0.731	0.715	0.754	0.476	0.843	0.719	0.477	0.796
10/28/2018	0.616	0.602	0.675	0.400	0.721	0.594	0.421	0.611
10/29/2018	0.958	0.935	0.945	0.902	1.111	1.043	0.904	1.044
10/30/2018	0.987	0.963	0.954	1.000	1.109	1.073	1.000	1.069
10/31/2018	0.956	0.936	0.950	1.000	1.054	1.026	1.000	1.050
11/1/2018	0.988	0.981	1.031	1.000	1.074	1.023	1.000	1.089
11/2/2018	1.041	1.008	1.039	0.961	1.152	1.050	0.970	1.119
11/3/2018	0.734	0.722	0.731	0.476	0.793	0.696	0.477	0.803
11/4/2018	0.586	0.567	0.667	0.400	0.666	0.569	0.421	0.588
11/5/2018	0.952	0.928	0.957	0.902	1.062	1.019	0.904	1.042
11/6/2018	0.969	0.957	0.986	1.000	1.005	1.051	1.000	1.070
11/7/2018	0.976	0.960	0.975	1.000	1.027	1.072	1.000	1.070
11/8/2018	1.015	1.011	1.045	1.000	1.094	1.086	1.000	1.103
11/9/2018	1.307	1.215	1.119	0.961	1.153	1.100	0.970	1.201
11/10/2018	0.940	0.827	0.777	0.476	0.825	0.720	0.477	0.839
11/11/2018	0.796	0.726	0.749	0.400	0.707	0.586	0.421	0.185
11/12/2018	1.072	1.010	1.125	0.832	1.092	1.013	0.797	0.567
11/13/2018	0.915	0.876	0.979	1.000	1.051	1.074	1.000	0.902
11/14/2018	0.956	0.987	0.994	1.000	1.015	1.065	1.000	1.004
11/15/2018	1.034	1.021	1.062	1.000	1.123	1.060	1.000	1.111
11/16/2018	1.117	1.068	1.139	0.961	1.167	1.051	0.970	1.142
11/17/2018	0.770	0.787	0.835	0.476	0.842	0.703	0.477	0.827
11/18/2018	0.643	0.655	0.754	0.400	0.717	0.595	0.421	0.646
11/19/2018	1.016	1.011	1.032	0.902	1.084	1.040	0.904	1.081
11/20/2018	1.142	1.130	1.245	1.000	1.106	1.081	1.000	1.162
11/21/2018	1.039	1.115	1.023	1.000	1.041	0.980	1.000	1.124
11/22/2018	0.542	0.548	0.595	0.832	0.615	0.503	0.797	0.571
11/23/2018	0.647	0.649	0.639	0.961	0.763	0.651	0.970	0.783
11/24/2018	0.610	0.616	0.599	0.476	0.747	0.626	0.477	0.691
11/25/2018	0.577	0.602	0.591	0.400	0.747	0.573	0.421	0.614
11/26/2018	1.010	0.948	1.048	0.902	1.151	1.016	0.904	1.050
11/27/2018	0.990	0.933	0.988	1.000	1.093	1.015	1.000	1.072
11/28/2018	0.914	0.926	0.910	1.000	0.987	0.995	1.000	1.012
11/29/2018	0.931	0.926	0.938	1.000	0.991	0.959	1.000	0.998

Redistribution Factors

Date	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
11/30/2018	0.999	0.953	0.987	0.961	1.101	1.032	0.970	1.061
12/1/2018	0.682	0.688	0.706	0.476	0.736	0.666	0.477	0.753
12/2/2018	0.603	0.582	0.695	0.400	0.659	0.565	0.421	0.579
12/3/2018	0.923	0.887	0.898	0.902	1.058	1.006	0.904	1.013
12/4/2018	1.093	0.954	0.947	1.000	1.075	1.017	1.000	1.081
12/5/2018	1.108	0.965	0.910	1.000	1.027	1.000	1.000	1.061
12/6/2018	1.119	0.851	0.884	1.000	1.004	1.033	1.000	1.047
12/7/2018	1.198	0.951	0.984	0.961	1.056	1.034	0.970	1.073
12/8/2018	0.874	0.689	0.735	0.476	0.755	0.687	0.477	0.747
12/9/2018	0.752	0.633	0.688	0.400	0.673	0.575	0.421	0.596
12/10/2018	1.090	0.957	0.900	0.902	1.024	0.994	0.904	1.026
12/11/2018	1.114	0.968	0.959	1.000	1.006	1.029	1.000	1.047
12/12/2018	1.115	0.978	0.960	1.000	1.042	1.023	1.000	1.067
12/13/2018	1.175	0.993	1.004	1.000	1.070	1.029	1.000	1.096
12/14/2018	1.206	1.021	1.039	0.961	1.146	1.027	0.970	1.124
12/15/2018	0.908	0.751	0.801	0.476	0.789	0.691	0.477	0.787
12/16/2018	0.760	0.624	0.702	0.400	0.674	0.560	0.421	0.598
12/17/2018	1.083	0.979	0.923	0.902	1.041	0.971	0.904	1.011
12/18/2018	1.137	0.996	1.002	1.000	1.066	1.046	1.000	1.072
12/19/2018	1.157	0.996	1.028	1.000	1.123	1.040	1.000	1.075
12/20/2018	1.223	1.041	1.053	1.000	1.157	1.051	1.000	1.080
12/21/2018	1.234	1.039	1.082	0.961	1.195	1.032	0.970	1.083
12/22/2018	0.899	0.783	0.764	0.476	0.859	0.676	0.477	0.804
12/23/2018	0.716	0.568	0.559	0.400	0.664	0.545	0.421	0.559
12/24/2018	0.683	0.555	0.471	0.902	0.644	0.598	0.904	0.593
12/25/2018	0.515	0.391	0.382	0.832	0.469	0.398	0.797	0.335
12/26/2018	1.046	0.912	0.868	1.000	1.062	0.886	1.000	0.993
12/27/2018	1.195	1.047	1.083	1.000	1.151	0.982	1.000	1.077
12/28/2018	1.160	0.991	1.018	0.961	1.141	0.974	0.970	1.056
12/29/2018	0.870	0.744	0.706	0.476	0.832	0.662	0.477	0.770
12/30/2018	0.725	0.618	0.604	0.400	0.688	0.516	0.421	0.558
12/31/2018	0.796	0.660	0.594	0.902	0.785	0.675	0.904	0.728

APPENDIX E
Hour-of-Day Profiles By
Vehicle Type and County

Profiles By Vehicle

The factors shown in the tables below represent the differently hourly profiles for different days of the week for each county for a broad vehicle class: LD is Light-Duty, LM is Light- and Medium-Duty Trucks and HH is Heavy Heavy-Duty Trucks. Hourly profiles for LD and LM by day of week are shown in Table 1 and Table 2. An excerpt of the day-specific hourly profiles for July 1st through July 8th for HH are shown in Table 3.

Table 1: Hour-of-Day Profiles for LD and LM Vehicle Types in Fresno, Kern, Kings, and Madera Counties

Day of Week	Hour	Fresno LD	Fresno LM	Kern LD	Kern LM	Kings LD	Kings LM	Madera LD	Madera LM
Sunday	0	0.015	0.033	0.014	0.028	0.016	0.031	0.014	0.037
Sunday	1	0.010	0.030	0.010	0.024	0.010	0.025	0.008	0.032
Sunday	2	0.008	0.027	0.007	0.022	0.007	0.026	0.005	0.028
Sunday	3	0.005	0.025	0.006	0.020	0.005	0.022	0.004	0.026
Sunday	4	0.006	0.024	0.007	0.021	0.004	0.020	0.004	0.026
Sunday	5	0.010	0.026	0.012	0.024	0.008	0.023	0.009	0.027
Sunday	6	0.017	0.029	0.016	0.027	0.018	0.029	0.016	0.030
Sunday	7	0.022	0.032	0.024	0.032	0.023	0.030	0.022	0.033
Sunday	8	0.032	0.038	0.032	0.039	0.034	0.040	0.033	0.039
Sunday	9	0.044	0.046	0.042	0.045	0.048	0.049	0.046	0.047
Sunday	10	0.055	0.052	0.051	0.051	0.059	0.057	0.056	0.052
Sunday	11	0.063	0.057	0.059	0.056	0.071	0.064	0.065	0.057
Sunday	12	0.071	0.062	0.066	0.060	0.084	0.077	0.071	0.059
Sunday	13	0.076	0.064	0.071	0.063	0.083	0.077	0.073	0.059
Sunday	14	0.077	0.063	0.075	0.065	0.080	0.072	0.076	0.059
Sunday	15	0.077	0.061	0.078	0.064	0.076	0.065	0.076	0.058
Sunday	16	0.075	0.059	0.077	0.063	0.074	0.062	0.077	0.058
Sunday	17	0.073	0.056	0.074	0.060	0.068	0.056	0.074	0.055
Sunday	18	0.066	0.050	0.069	0.055	0.059	0.044	0.068	0.048
Sunday	19	0.057	0.044	0.061	0.049	0.050	0.037	0.060	0.043
Sunday	20	0.050	0.038	0.053	0.042	0.043	0.032	0.052	0.039
Sunday	21	0.040	0.033	0.042	0.035	0.036	0.028	0.042	0.034
Sunday	22	0.030	0.028	0.032	0.030	0.028	0.022	0.030	0.028
Sunday	23	0.020	0.023	0.021	0.025	0.015	0.015	0.018	0.023
Monday	0	0.009	0.019	0.013	0.022	0.005	0.013	0.007	0.021
Monday	1	0.005	0.018	0.009	0.019	0.002	0.012	0.003	0.020
Monday	2	0.004	0.018	0.008	0.019	0.001	0.013	0.002	0.020
Monday	3	0.005	0.020	0.011	0.022	0.001	0.012	0.004	0.023
Monday	4	0.011	0.023	0.021	0.029	0.003	0.015	0.012	0.028
Monday	5	0.024	0.034	0.040	0.041	0.012	0.021	0.029	0.039
Monday	6	0.044	0.047	0.047	0.046	0.034	0.040	0.050	0.051
Monday	7	0.069	0.064	0.056	0.054	0.070	0.071	0.072	0.063

Profiles By Vehicle

Day of Week	Hour	Fresno LD	Fresno LM	Kern LD	Kern LM	Kings LD	Kings LM	Madera LD	Madera LM
Monday	8	0.063	0.062	0.050	0.052	0.073	0.071	0.063	0.059
Monday	9	0.055	0.056	0.049	0.052	0.061	0.063	0.058	0.056
Monday	10	0.055	0.056	0.052	0.053	0.058	0.062	0.057	0.057
Monday	11	0.057	0.059	0.057	0.056	0.059	0.063	0.059	0.059
Monday	12	0.061	0.061	0.061	0.059	0.062	0.064	0.060	0.062
Monday	13	0.063	0.062	0.064	0.060	0.064	0.067	0.061	0.061
Monday	14	0.069	0.065	0.068	0.063	0.073	0.071	0.066	0.062
Monday	15	0.074	0.068	0.074	0.067	0.078	0.072	0.071	0.064
Monday	16	0.079	0.068	0.073	0.065	0.086	0.073	0.075	0.062
Monday	17	0.076	0.062	0.067	0.058	0.087	0.070	0.074	0.058
Monday	18	0.053	0.043	0.050	0.044	0.056	0.046	0.052	0.041
Monday	19	0.037	0.030	0.037	0.034	0.037	0.028	0.037	0.030
Monday	20	0.030	0.023	0.032	0.028	0.029	0.021	0.030	0.022
Monday	21	0.024	0.018	0.026	0.023	0.023	0.015	0.025	0.017
Monday	22	0.018	0.013	0.021	0.018	0.016	0.010	0.019	0.014
Monday	23	0.012	0.010	0.014	0.015	0.009	0.007	0.012	0.011
T/W/T	0	0.007	0.018	0.010	0.021	0.004	0.013	0.005	0.020
T/W/T	1	0.004	0.017	0.007	0.019	0.002	0.011	0.002	0.019
T/W/T	2	0.003	0.017	0.006	0.020	0.001	0.011	0.001	0.019
T/W/T	3	0.004	0.019	0.009	0.022	0.001	0.011	0.003	0.021
T/W/T	4	0.010	0.023	0.019	0.029	0.003	0.014	0.010	0.027
T/W/T	5	0.024	0.032	0.039	0.041	0.012	0.021	0.027	0.037
T/W/T	6	0.044	0.047	0.048	0.046	0.035	0.040	0.050	0.050
T/W/T	7	0.070	0.064	0.058	0.053	0.069	0.066	0.074	0.063
T/W/T	8	0.065	0.063	0.052	0.052	0.073	0.071	0.065	0.059
T/W/T	9	0.055	0.057	0.049	0.050	0.060	0.062	0.057	0.057
T/W/T	10	0.054	0.056	0.050	0.051	0.057	0.061	0.055	0.057
T/W/T	11	0.055	0.058	0.054	0.054	0.058	0.063	0.056	0.058
T/W/T	12	0.058	0.060	0.059	0.056	0.060	0.064	0.057	0.059
T/W/T	13	0.061	0.062	0.062	0.058	0.061	0.065	0.059	0.060
T/W/T	14	0.068	0.065	0.068	0.062	0.071	0.070	0.065	0.063
T/W/T	15	0.074	0.067	0.075	0.067	0.077	0.072	0.071	0.064
T/W/T	16	0.080	0.067	0.075	0.066	0.086	0.073	0.078	0.064
T/W/T	17	0.078	0.063	0.070	0.060	0.087	0.072	0.078	0.061
T/W/T	18	0.055	0.045	0.052	0.046	0.059	0.051	0.055	0.043
T/W/T	19	0.039	0.032	0.039	0.036	0.039	0.032	0.039	0.031
T/W/T	20	0.032	0.024	0.033	0.030	0.032	0.023	0.033	0.024
T/W/T	21	0.027	0.019	0.029	0.025	0.026	0.017	0.028	0.019
T/W/T	22	0.020	0.014	0.023	0.020	0.018	0.011	0.021	0.014

Profiles By Vehicle

Day of Week	Hour	Fresno LD	Fresno LM	Kern LD	Kern LM	Kings LD	Kings LM	Madera LD	Madera LM
T/W/T	23	0.013	0.010	0.015	0.017	0.010	0.007	0.013	0.011
Friday	0	0.007	0.019	0.009	0.021	0.006	0.014	0.006	0.020
Friday	1	0.004	0.018	0.007	0.019	0.002	0.012	0.002	0.019
Friday	2	0.003	0.017	0.006	0.019	0.001	0.011	0.002	0.019
Friday	3	0.004	0.019	0.008	0.021	0.001	0.012	0.003	0.021
Friday	4	0.009	0.023	0.015	0.027	0.002	0.015	0.009	0.027
Friday	5	0.020	0.032	0.031	0.037	0.011	0.021	0.022	0.036
Friday	6	0.037	0.044	0.039	0.043	0.031	0.039	0.039	0.047
Friday	7	0.059	0.060	0.048	0.050	0.063	0.064	0.059	0.058
Friday	8	0.057	0.059	0.045	0.050	0.067	0.069	0.054	0.058
Friday	9	0.052	0.056	0.045	0.049	0.057	0.062	0.051	0.056
Friday	10	0.053	0.057	0.049	0.053	0.057	0.063	0.052	0.057
Friday	11	0.056	0.059	0.054	0.055	0.059	0.065	0.054	0.059
Friday	12	0.059	0.061	0.058	0.057	0.061	0.065	0.056	0.060
Friday	13	0.062	0.063	0.063	0.060	0.062	0.066	0.059	0.062
Friday	14	0.068	0.066	0.068	0.063	0.070	0.069	0.065	0.063
Friday	15	0.073	0.067	0.072	0.067	0.073	0.069	0.071	0.064
Friday	16	0.077	0.067	0.073	0.064	0.079	0.073	0.077	0.062
Friday	17	0.074	0.061	0.070	0.059	0.078	0.065	0.076	0.057
Friday	18	0.060	0.047	0.060	0.048	0.061	0.050	0.063	0.046
Friday	19	0.046	0.034	0.049	0.039	0.045	0.034	0.050	0.035
Friday	20	0.038	0.026	0.042	0.032	0.036	0.023	0.042	0.026
Friday	21	0.034	0.020	0.037	0.027	0.031	0.017	0.037	0.021
Friday	22	0.028	0.015	0.031	0.023	0.028	0.013	0.030	0.015
Friday	23	0.020	0.011	0.021	0.018	0.017	0.008	0.021	0.012
Saturday	0	0.015	0.028	0.016	0.028	0.013	0.022	0.012	0.031
Saturday	1	0.010	0.025	0.011	0.023	0.008	0.019	0.008	0.027
Saturday	2	0.008	0.024	0.009	0.022	0.005	0.017	0.006	0.025
Saturday	3	0.007	0.023	0.009	0.021	0.003	0.016	0.005	0.024
Saturday	4	0.009	0.024	0.014	0.025	0.004	0.016	0.008	0.027
Saturday	5	0.016	0.029	0.027	0.034	0.010	0.022	0.017	0.032
Saturday	6	0.026	0.036	0.034	0.038	0.023	0.031	0.026	0.039
Saturday	7	0.036	0.043	0.042	0.045	0.036	0.041	0.036	0.045
Saturday	8	0.045	0.050	0.050	0.052	0.045	0.049	0.047	0.052
Saturday	9	0.053	0.055	0.056	0.056	0.053	0.054	0.055	0.057
Saturday	10	0.060	0.061	0.060	0.057	0.061	0.063	0.062	0.062
Saturday	11	0.066	0.064	0.063	0.059	0.067	0.072	0.067	0.063
Saturday	12	0.069	0.065	0.065	0.061	0.071	0.072	0.068	0.062
Saturday	13	0.069	0.063	0.066	0.061	0.071	0.069	0.068	0.059

Profiles By Vehicle

Day of Week	Hour	Fresno LD	Fresno LM	Kern LD	Kern LM	Kings LD	Kings LM	Madera LD	Madera LM
Saturday	14	0.070	0.063	0.067	0.060	0.071	0.070	0.068	0.059
Saturday	15	0.069	0.060	0.067	0.060	0.070	0.067	0.068	0.056
Saturday	16	0.067	0.057	0.064	0.056	0.070	0.061	0.068	0.054
Saturday	17	0.063	0.051	0.058	0.052	0.066	0.056	0.064	0.050
Saturday	18	0.056	0.044	0.051	0.046	0.059	0.048	0.057	0.042
Saturday	19	0.047	0.036	0.044	0.037	0.049	0.036	0.049	0.034
Saturday	20	0.041	0.031	0.039	0.033	0.043	0.032	0.043	0.030
Saturday	21	0.038	0.027	0.035	0.029	0.040	0.027	0.039	0.027
Saturday	22	0.034	0.024	0.030	0.024	0.037	0.024	0.035	0.024
Saturday	23	0.024	0.019	0.023	0.020	0.024	0.017	0.025	0.020
Holiday	0	0.013	0.023	0.015	0.023	0.011	0.017	0.011	0.023
Holiday	1	0.007	0.022	0.009	0.021	0.006	0.018	0.005	0.024
Holiday	2	0.006	0.022	0.007	0.020	0.002	0.018	0.004	0.022
Holiday	3	0.005	0.022	0.008	0.021	0.001	0.019	0.004	0.024
Holiday	4	0.008	0.025	0.013	0.024	0.003	0.015	0.007	0.026
Holiday	5	0.016	0.030	0.027	0.032	0.010	0.021	0.016	0.033
Holiday	6	0.028	0.039	0.033	0.037	0.026	0.034	0.027	0.040
Holiday	7	0.040	0.046	0.039	0.043	0.043	0.046	0.037	0.045
Holiday	8	0.045	0.049	0.043	0.047	0.050	0.052	0.043	0.051
Holiday	9	0.049	0.052	0.050	0.050	0.051	0.052	0.051	0.053
Holiday	10	0.057	0.058	0.055	0.055	0.060	0.067	0.059	0.060
Holiday	11	0.065	0.062	0.064	0.060	0.067	0.070	0.067	0.064
Holiday	12	0.070	0.067	0.068	0.061	0.073	0.078	0.071	0.066
Holiday	13	0.071	0.067	0.071	0.066	0.075	0.072	0.071	0.067
Holiday	14	0.074	0.066	0.073	0.064	0.076	0.070	0.072	0.064
Holiday	15	0.076	0.067	0.075	0.067	0.072	0.073	0.075	0.062
Holiday	16	0.076	0.064	0.072	0.064	0.075	0.066	0.076	0.060
Holiday	17	0.072	0.058	0.066	0.059	0.071	0.059	0.072	0.056
Holiday	18	0.058	0.046	0.056	0.046	0.059	0.046	0.060	0.044
Holiday	19	0.047	0.035	0.047	0.042	0.047	0.032	0.050	0.035
Holiday	20	0.039	0.028	0.039	0.033	0.040	0.029	0.043	0.029
Holiday	21	0.032	0.022	0.031	0.027	0.034	0.024	0.035	0.022
Holiday	22	0.026	0.017	0.025	0.021	0.030	0.015	0.028	0.018
Holiday	23	0.018	0.013	0.016	0.018	0.018	0.009	0.017	0.014

Profiles By Vehicle

Table 2: Hour-of-day profiles for LD and LM vehicle types in counties Merced, San Joaquin, Stanislaus, and Tulare

Day of Week	Hour	Merced LD	Merced LM	San Joaquin LD	San Joaquin LM	Stanislaus LD	Stanislaus LM	Tulare LD	Tulare LM
Sunday	0	0.014	0.025	0.016	0.024	0.014	0.025	0.022	0.015
Sunday	1	0.009	0.019	0.010	0.017	0.009	0.019	0.024	0.015
Sunday	2	0.007	0.016	0.007	0.015	0.007	0.016	0.023	0.011
Sunday	3	0.005	0.015	0.006	0.014	0.005	0.015	0.023	0.009
Sunday	4	0.006	0.016	0.008	0.015	0.006	0.016	0.024	0.010
Sunday	5	0.010	0.019	0.011	0.018	0.010	0.019	0.026	0.018
Sunday	6	0.015	0.023	0.017	0.022	0.015	0.023	0.030	0.031
Sunday	7	0.021	0.029	0.023	0.027	0.021	0.029	0.034	0.035
Sunday	8	0.031	0.038	0.032	0.036	0.031	0.038	0.035	0.042
Sunday	9	0.043	0.050	0.045	0.048	0.043	0.050	0.040	0.057
Sunday	10	0.055	0.060	0.056	0.059	0.055	0.060	0.044	0.066
Sunday	11	0.063	0.065	0.063	0.067	0.063	0.065	0.047	0.070
Sunday	12	0.070	0.070	0.068	0.071	0.070	0.070	0.051	0.076
Sunday	13	0.075	0.071	0.071	0.074	0.075	0.071	0.054	0.073
Sunday	14	0.077	0.069	0.073	0.073	0.077	0.069	0.056	0.071
Sunday	15	0.078	0.070	0.073	0.071	0.078	0.070	0.059	0.071
Sunday	16	0.077	0.067	0.073	0.068	0.077	0.067	0.060	0.066
Sunday	17	0.075	0.062	0.072	0.063	0.075	0.062	0.061	0.063
Sunday	18	0.068	0.055	0.067	0.055	0.068	0.055	0.060	0.052
Sunday	19	0.061	0.047	0.061	0.047	0.061	0.047	0.059	0.050
Sunday	20	0.051	0.039	0.054	0.040	0.051	0.039	0.055	0.037
Sunday	21	0.041	0.031	0.044	0.031	0.041	0.031	0.048	0.029
Sunday	22	0.029	0.024	0.031	0.024	0.029	0.024	0.038	0.018
Sunday	23	0.019	0.019	0.019	0.019	0.019	0.019	0.028	0.014
Monday	0	0.011	0.017	0.010	0.012	0.011	0.017	0.022	0.004
Monday	1	0.007	0.015	0.006	0.010	0.007	0.015	0.023	0.004
Monday	2	0.006	0.015	0.006	0.010	0.006	0.015	0.023	0.004
Monday	3	0.009	0.018	0.011	0.015	0.009	0.018	0.024	0.006
Monday	4	0.018	0.027	0.029	0.028	0.018	0.027	0.027	0.015
Monday	5	0.030	0.039	0.043	0.043	0.030	0.039	0.035	0.035
Monday	6	0.044	0.051	0.053	0.052	0.044	0.051	0.040	0.056
Monday	7	0.058	0.058	0.061	0.059	0.058	0.058	0.044	0.063
Monday	8	0.053	0.058	0.055	0.057	0.053	0.058	0.046	0.071
Monday	9	0.051	0.059	0.051	0.056	0.051	0.059	0.046	0.066
Monday	10	0.054	0.062	0.051	0.058	0.054	0.062	0.049	0.070
Monday	11	0.057	0.064	0.052	0.060	0.057	0.064	0.051	0.070
Monday	12	0.060	0.064	0.054	0.061	0.060	0.064	0.056	0.072

Profiles By Vehicle

Day of Week	Hour	Merced LD	Merced LM	San Joaquin LD	San Joaquin LM	Stanislaus LD	Stanislaus LM	Tulare LD	Tulare LM
Monday	13	0.061	0.064	0.056	0.063	0.061	0.064	0.055	0.073
Monday	14	0.067	0.066	0.063	0.068	0.067	0.066	0.058	0.073
Monday	15	0.072	0.065	0.069	0.072	0.072	0.065	0.061	0.077
Monday	16	0.075	0.063	0.072	0.071	0.075	0.063	0.061	0.073
Monday	17	0.074	0.055	0.070	0.065	0.074	0.055	0.059	0.059
Monday	18	0.055	0.042	0.055	0.045	0.055	0.042	0.050	0.037
Monday	19	0.042	0.031	0.041	0.031	0.042	0.031	0.045	0.024
Monday	20	0.034	0.023	0.033	0.023	0.034	0.023	0.040	0.017
Monday	21	0.027	0.018	0.027	0.017	0.027	0.018	0.035	0.013
Monday	22	0.020	0.014	0.021	0.013	0.020	0.014	0.029	0.010
Monday	23	0.014	0.011	0.014	0.010	0.014	0.011	0.022	0.006
T/W/T	0	0.008	0.016	0.009	0.011	0.008	0.016	0.021	0.004
T/W/T	1	0.005	0.014	0.006	0.010	0.005	0.014	0.021	0.004
T/W/T	2	0.005	0.014	0.005	0.010	0.005	0.014	0.022	0.004
T/W/T	3	0.008	0.018	0.010	0.014	0.008	0.018	0.024	0.005
T/W/T	4	0.017	0.026	0.027	0.026	0.017	0.026	0.028	0.014
T/W/T	5	0.030	0.039	0.043	0.041	0.030	0.039	0.035	0.033
T/W/T	6	0.044	0.050	0.054	0.051	0.044	0.050	0.041	0.056
T/W/T	7	0.059	0.059	0.062	0.059	0.059	0.059	0.044	0.067
T/W/T	8	0.055	0.058	0.056	0.057	0.055	0.058	0.046	0.071
T/W/T	9	0.051	0.059	0.051	0.055	0.051	0.059	0.047	0.067
T/W/T	10	0.052	0.060	0.049	0.056	0.052	0.060	0.049	0.069
T/W/T	11	0.054	0.061	0.050	0.058	0.054	0.061	0.052	0.071
T/W/T	12	0.057	0.062	0.052	0.059	0.057	0.062	0.054	0.069
T/W/T	13	0.060	0.063	0.055	0.062	0.060	0.063	0.056	0.072
T/W/T	14	0.066	0.065	0.062	0.068	0.066	0.065	0.059	0.074
T/W/T	15	0.073	0.066	0.069	0.074	0.073	0.066	0.061	0.080
T/W/T	16	0.077	0.064	0.072	0.074	0.077	0.064	0.060	0.072
T/W/T	17	0.076	0.057	0.070	0.067	0.076	0.057	0.057	0.059
T/W/T	18	0.058	0.044	0.056	0.048	0.058	0.044	0.051	0.037
T/W/T	19	0.044	0.032	0.043	0.033	0.044	0.032	0.045	0.025
T/W/T	20	0.036	0.025	0.034	0.025	0.036	0.025	0.041	0.019
T/W/T	21	0.028	0.019	0.028	0.019	0.028	0.019	0.035	0.014
T/W/T	22	0.021	0.014	0.021	0.014	0.021	0.014	0.029	0.010
T/W/T	23	0.015	0.012	0.015	0.010	0.015	0.012	0.022	0.006
Friday	0	0.008	0.016	0.008	0.012	0.008	0.016	0.020	0.004
Friday	1	0.006	0.014	0.006	0.010	0.006	0.014	0.021	0.003
Friday	2	0.005	0.014	0.005	0.010	0.005	0.014	0.023	0.004
Friday	3	0.008	0.017	0.009	0.013	0.008	0.017	0.022	0.005

Profiles By Vehicle

Day of Week	Hour	Merced LD	Merced LM	San Joaquin LD	San Joaquin LM	Stanislaus LD	Stanislaus LM	Tulare LD	Tulare LM
Friday	4	0.014	0.024	0.022	0.023	0.014	0.024	0.027	0.013
Friday	5	0.024	0.035	0.036	0.036	0.024	0.035	0.034	0.032
Friday	6	0.036	0.045	0.046	0.045	0.036	0.045	0.038	0.051
Friday	7	0.049	0.053	0.053	0.052	0.049	0.053	0.042	0.062
Friday	8	0.047	0.054	0.049	0.051	0.047	0.054	0.046	0.070
Friday	9	0.047	0.056	0.046	0.052	0.047	0.056	0.047	0.066
Friday	10	0.051	0.060	0.048	0.055	0.051	0.060	0.050	0.070
Friday	11	0.054	0.062	0.050	0.058	0.054	0.062	0.052	0.071
Friday	12	0.057	0.063	0.054	0.061	0.057	0.063	0.054	0.070
Friday	13	0.061	0.065	0.058	0.065	0.061	0.065	0.056	0.072
Friday	14	0.068	0.067	0.065	0.070	0.068	0.067	0.058	0.074
Friday	15	0.074	0.067	0.069	0.075	0.074	0.067	0.059	0.075
Friday	16	0.076	0.064	0.071	0.073	0.076	0.064	0.059	0.070
Friday	17	0.075	0.058	0.069	0.069	0.075	0.058	0.055	0.057
Friday	18	0.064	0.048	0.061	0.052	0.064	0.048	0.053	0.041
Friday	19	0.052	0.037	0.050	0.038	0.052	0.037	0.045	0.027
Friday	20	0.043	0.029	0.042	0.029	0.043	0.029	0.042	0.020
Friday	21	0.035	0.022	0.035	0.022	0.035	0.022	0.039	0.017
Friday	22	0.027	0.016	0.028	0.017	0.027	0.016	0.032	0.014
Friday	23	0.020	0.012	0.020	0.012	0.020	0.012	0.026	0.011
Saturday	0	0.015	0.026	0.014	0.021	0.015	0.026	0.025	0.010
Saturday	1	0.010	0.020	0.009	0.016	0.010	0.020	0.025	0.007
Saturday	2	0.008	0.018	0.007	0.014	0.008	0.018	0.026	0.007
Saturday	3	0.008	0.019	0.007	0.015	0.008	0.019	0.027	0.009
Saturday	4	0.011	0.021	0.011	0.018	0.011	0.021	0.029	0.014
Saturday	5	0.017	0.028	0.018	0.025	0.017	0.028	0.036	0.033
Saturday	6	0.025	0.036	0.027	0.033	0.025	0.036	0.042	0.056
Saturday	7	0.034	0.044	0.036	0.042	0.034	0.044	0.041	0.055
Saturday	8	0.044	0.053	0.045	0.050	0.044	0.053	0.043	0.057
Saturday	9	0.054	0.061	0.054	0.059	0.054	0.061	0.045	0.061
Saturday	10	0.062	0.068	0.061	0.067	0.062	0.068	0.048	0.066
Saturday	11	0.067	0.071	0.065	0.071	0.067	0.071	0.050	0.067
Saturday	12	0.069	0.070	0.067	0.072	0.069	0.070	0.052	0.068
Saturday	13	0.070	0.067	0.067	0.070	0.070	0.067	0.053	0.067
Saturday	14	0.070	0.064	0.067	0.068	0.070	0.064	0.055	0.070
Saturday	15	0.069	0.061	0.067	0.065	0.069	0.061	0.058	0.077
Saturday	16	0.068	0.057	0.066	0.061	0.068	0.057	0.057	0.066
Saturday	17	0.064	0.051	0.063	0.055	0.064	0.051	0.054	0.053
Saturday	18	0.056	0.042	0.057	0.045	0.056	0.042	0.052	0.040

Profiles By Vehicle

Day of Week	Hour	Merced LD	Merced LM	San Joaquin LD	San Joaquin LM	Stanislaus LD	Stanislaus LM	Tulare LD	Tulare LM
Saturday	19	0.048	0.034	0.049	0.036	0.048	0.034	0.046	0.034
Saturday	20	0.041	0.029	0.043	0.030	0.041	0.029	0.042	0.027
Saturday	21	0.037	0.024	0.040	0.026	0.037	0.024	0.038	0.023
Saturday	22	0.031	0.020	0.035	0.023	0.031	0.020	0.032	0.019
Saturday	23	0.023	0.016	0.025	0.017	0.023	0.016	0.025	0.014
Holiday	0	0.013	0.020	0.012	0.015	0.013	0.020	0.024	0.008
Holiday	1	0.009	0.017	0.008	0.013	0.009	0.017	0.024	0.007
Holiday	2	0.007	0.015	0.006	0.012	0.007	0.015	0.023	0.006
Holiday	3	0.007	0.016	0.008	0.014	0.007	0.016	0.023	0.007
Holiday	4	0.011	0.020	0.015	0.020	0.011	0.020	0.027	0.016
Holiday	5	0.019	0.028	0.023	0.028	0.019	0.028	0.033	0.030
Holiday	6	0.027	0.035	0.031	0.035	0.027	0.035	0.035	0.045
Holiday	7	0.035	0.042	0.036	0.040	0.035	0.042	0.040	0.052
Holiday	8	0.040	0.048	0.041	0.045	0.040	0.048	0.043	0.065
Holiday	9	0.048	0.055	0.047	0.051	0.048	0.055	0.045	0.061
Holiday	10	0.059	0.064	0.055	0.061	0.059	0.064	0.050	0.075
Holiday	11	0.065	0.070	0.063	0.069	0.065	0.070	0.049	0.076
Holiday	12	0.069	0.072	0.066	0.072	0.069	0.072	0.058	0.075
Holiday	13	0.071	0.071	0.068	0.074	0.071	0.071	0.052	0.069
Holiday	14	0.072	0.069	0.070	0.073	0.072	0.069	0.055	0.069
Holiday	15	0.073	0.068	0.071	0.072	0.073	0.068	0.062	0.070
Holiday	16	0.073	0.065	0.071	0.068	0.073	0.065	0.065	0.074
Holiday	17	0.070	0.057	0.068	0.061	0.070	0.057	0.053	0.057
Holiday	18	0.060	0.046	0.060	0.050	0.060	0.046	0.051	0.040
Holiday	19	0.050	0.036	0.051	0.040	0.050	0.036	0.047	0.031
Holiday	20	0.042	0.029	0.044	0.031	0.042	0.029	0.046	0.027
Holiday	21	0.034	0.023	0.037	0.025	0.034	0.023	0.040	0.019
Holiday	22	0.027	0.017	0.029	0.019	0.027	0.017	0.034	0.014
Holiday	23	0.018	0.014	0.020	0.013	0.018	0.014	0.024	0.011

Profiles By Vehicle

Table 3: Hour-of-day profiles (Sunday July 1 to Saturday July 8) for Heavy Heavy-Duty vehicles by county

Day of Week	Hour	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
Sunday	0	0.021	0.019	0.020	0.044	0.023	0.022	0.037	0.021
Sunday	1	0.016	0.016	0.016	0.040	0.018	0.018	0.032	0.018
Sunday	2	0.012	0.014	0.016	0.037	0.014	0.015	0.029	0.016
Sunday	3	0.014	0.012	0.014	0.035	0.011	0.015	0.028	0.013
Sunday	4	0.014	0.013	0.014	0.034	0.015	0.017	0.028	0.017
Sunday	5	0.019	0.019	0.017	0.034	0.021	0.023	0.029	0.023
Sunday	6	0.026	0.026	0.027	0.036	0.028	0.030	0.031	0.030
Sunday	7	0.033	0.034	0.036	0.036	0.037	0.036	0.035	0.035
Sunday	8	0.041	0.043	0.042	0.040	0.046	0.043	0.040	0.042
Sunday	9	0.049	0.048	0.050	0.044	0.053	0.052	0.047	0.052
Sunday	10	0.055	0.054	0.050	0.046	0.057	0.059	0.051	0.058
Sunday	11	0.055	0.057	0.052	0.048	0.062	0.061	0.054	0.060
Sunday	12	0.061	0.056	0.055	0.049	0.059	0.063	0.055	0.059
Sunday	13	0.061	0.061	0.055	0.049	0.060	0.061	0.056	0.060
Sunday	14	0.061	0.061	0.052	0.048	0.059	0.062	0.055	0.059
Sunday	15	0.062	0.059	0.056	0.047	0.059	0.060	0.053	0.065
Sunday	16	0.064	0.058	0.063	0.047	0.056	0.057	0.052	0.054
Sunday	17	0.060	0.061	0.067	0.046	0.054	0.056	0.049	0.052
Sunday	18	0.058	0.062	0.059	0.043	0.054	0.052	0.046	0.056
Sunday	19	0.055	0.058	0.058	0.041	0.050	0.051	0.042	0.054
Sunday	20	0.048	0.052	0.058	0.040	0.048	0.045	0.040	0.047
Sunday	21	0.044	0.045	0.045	0.039	0.045	0.041	0.038	0.042
Sunday	22	0.039	0.039	0.040	0.038	0.040	0.034	0.036	0.036
Sunday	23	0.032	0.030	0.039	0.037	0.031	0.028	0.037	0.029
Monday	0	0.019	0.017	0.023	0.024	0.016	0.014	0.023	0.017
Monday	1	0.016	0.015	0.020	0.024	0.014	0.012	0.022	0.014
Monday	2	0.015	0.017	0.020	0.024	0.015	0.014	0.022	0.016
Monday	3	0.018	0.020	0.020	0.026	0.019	0.023	0.025	0.019
Monday	4	0.021	0.026	0.024	0.029	0.028	0.032	0.032	0.025
Monday	5	0.030	0.033	0.027	0.036	0.040	0.041	0.039	0.034
Monday	6	0.041	0.039	0.034	0.044	0.046	0.047	0.045	0.042
Monday	7	0.048	0.042	0.046	0.051	0.050	0.053	0.050	0.051
Monday	8	0.050	0.042	0.041	0.049	0.051	0.055	0.051	0.050
Monday	9	0.048	0.046	0.045	0.049	0.054	0.060	0.053	0.051
Monday	10	0.053	0.050	0.047	0.051	0.059	0.062	0.056	0.054
Monday	11	0.056	0.051	0.050	0.053	0.063	0.065	0.057	0.057
Monday	12	0.059	0.054	0.055	0.055	0.060	0.065	0.058	0.058
Monday	13	0.061	0.063	0.055	0.054	0.061	0.061	0.058	0.058

Profiles By Vehicle

Day of Week	Hour	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
Monday	14	0.065	0.065	0.063	0.057	0.059	0.059	0.058	0.061
Monday	15	0.065	0.063	0.066	0.058	0.058	0.057	0.057	0.060
Monday	16	0.062	0.063	0.065	0.057	0.055	0.052	0.055	0.060
Monday	17	0.059	0.058	0.059	0.055	0.051	0.049	0.051	0.056
Monday	18	0.051	0.051	0.052	0.047	0.045	0.043	0.042	0.048
Monday	19	0.043	0.046	0.044	0.039	0.041	0.037	0.036	0.042
Monday	20	0.038	0.042	0.041	0.034	0.035	0.030	0.031	0.038
Monday	21	0.032	0.037	0.039	0.031	0.030	0.027	0.028	0.035
Monday	22	0.028	0.033	0.036	0.027	0.028	0.023	0.027	0.030
Monday	23	0.024	0.027	0.028	0.024	0.023	0.020	0.025	0.023
Tuesday	0	0.019	0.023	0.022	0.027	0.017	0.016	0.025	0.019
Tuesday	1	0.017	0.020	0.025	0.026	0.016	0.014	0.024	0.020
Tuesday	2	0.016	0.020	0.024	0.026	0.014	0.016	0.025	0.019
Tuesday	3	0.018	0.023	0.023	0.028	0.019	0.024	0.028	0.023
Tuesday	4	0.021	0.030	0.023	0.032	0.029	0.032	0.034	0.028
Tuesday	5	0.031	0.037	0.028	0.039	0.040	0.042	0.042	0.037
Tuesday	6	0.042	0.042	0.037	0.047	0.048	0.050	0.047	0.044
Tuesday	7	0.050	0.047	0.045	0.054	0.050	0.054	0.052	0.052
Tuesday	8	0.052	0.046	0.052	0.052	0.052	0.055	0.052	0.052
Tuesday	9	0.052	0.048	0.054	0.051	0.056	0.057	0.054	0.053
Tuesday	10	0.054	0.050	0.053	0.052	0.059	0.060	0.056	0.055
Tuesday	11	0.056	0.054	0.052	0.052	0.059	0.059	0.057	0.055
Tuesday	12	0.058	0.056	0.054	0.053	0.057	0.062	0.057	0.058
Tuesday	13	0.060	0.058	0.056	0.054	0.058	0.065	0.056	0.057
Tuesday	14	0.062	0.060	0.059	0.055	0.061	0.060	0.056	0.060
Tuesday	15	0.063	0.057	0.059	0.056	0.058	0.053	0.055	0.061
Tuesday	16	0.059	0.057	0.055	0.055	0.052	0.049	0.053	0.055
Tuesday	17	0.054	0.053	0.054	0.053	0.051	0.045	0.049	0.051
Tuesday	18	0.048	0.046	0.049	0.044	0.044	0.043	0.041	0.045
Tuesday	19	0.041	0.041	0.041	0.036	0.040	0.037	0.034	0.039
Tuesday	20	0.038	0.039	0.040	0.032	0.036	0.033	0.030	0.035
Tuesday	21	0.034	0.034	0.037	0.028	0.031	0.028	0.026	0.031
Tuesday	22	0.029	0.032	0.032	0.025	0.028	0.026	0.025	0.028
Tuesday	23	0.025	0.027	0.027	0.023	0.023	0.020	0.023	0.023
Holiday	0	0.030	0.032	0.033	0.028	0.030	0.025	0.027	0.030
Holiday	1	0.024	0.028	0.030	0.028	0.024	0.020	0.025	0.025
Holiday	2	0.024	0.024	0.028	0.027	0.020	0.019	0.024	0.022
Holiday	3	0.023	0.025	0.024	0.026	0.022	0.023	0.026	0.023
Holiday	4	0.024	0.029	0.025	0.031	0.028	0.029	0.029	0.028

Profiles By Vehicle

Day of Week	Hour	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
Holiday	5	0.031	0.037	0.029	0.035	0.036	0.038	0.033	0.037
Holiday	6	0.041	0.042	0.040	0.039	0.043	0.046	0.038	0.045
Holiday	7	0.046	0.051	0.048	0.042	0.048	0.052	0.042	0.050
Holiday	8	0.051	0.055	0.057	0.045	0.053	0.052	0.046	0.054
Holiday	9	0.056	0.056	0.056	0.048	0.058	0.056	0.050	0.058
Holiday	10	0.062	0.057	0.059	0.053	0.061	0.060	0.055	0.062
Holiday	11	0.062	0.059	0.059	0.055	0.061	0.062	0.060	0.062
Holiday	12	0.059	0.060	0.060	0.056	0.061	0.063	0.061	0.058
Holiday	13	0.059	0.056	0.055	0.058	0.058	0.060	0.061	0.058
Holiday	14	0.060	0.054	0.058	0.058	0.058	0.056	0.059	0.056
Holiday	15	0.057	0.051	0.057	0.055	0.050	0.052	0.058	0.051
Holiday	16	0.053	0.049	0.052	0.054	0.048	0.046	0.055	0.048
Holiday	17	0.047	0.045	0.046	0.053	0.043	0.042	0.050	0.043
Holiday	18	0.041	0.042	0.042	0.046	0.040	0.039	0.044	0.040
Holiday	19	0.037	0.036	0.036	0.040	0.037	0.037	0.039	0.036
Holiday	20	0.033	0.030	0.031	0.037	0.033	0.034	0.034	0.033
Holiday	21	0.029	0.029	0.027	0.032	0.030	0.030	0.030	0.026
Holiday	22	0.030	0.030	0.026	0.030	0.030	0.032	0.028	0.029
Holiday	23	0.022	0.025	0.020	0.026	0.025	0.025	0.026	0.025
Thursday	0	0.015	0.016	0.013	0.027	0.014	0.013	0.025	0.015
Thursday	1	0.012	0.014	0.012	0.026	0.011	0.011	0.024	0.013
Thursday	2	0.012	0.013	0.014	0.026	0.011	0.012	0.025	0.013
Thursday	3	0.014	0.016	0.014	0.028	0.017	0.021	0.028	0.015
Thursday	4	0.017	0.022	0.016	0.032	0.026	0.030	0.034	0.022
Thursday	5	0.027	0.032	0.022	0.039	0.037	0.039	0.042	0.032
Thursday	6	0.038	0.037	0.035	0.047	0.045	0.048	0.047	0.041
Thursday	7	0.048	0.042	0.041	0.054	0.050	0.053	0.052	0.048
Thursday	8	0.050	0.046	0.045	0.052	0.052	0.057	0.052	0.051
Thursday	9	0.052	0.046	0.049	0.051	0.055	0.060	0.054	0.054
Thursday	10	0.055	0.050	0.055	0.052	0.059	0.061	0.056	0.056
Thursday	11	0.060	0.054	0.053	0.052	0.061	0.066	0.057	0.058
Thursday	12	0.060	0.059	0.055	0.053	0.062	0.066	0.057	0.059
Thursday	13	0.062	0.060	0.066	0.054	0.066	0.064	0.056	0.060
Thursday	14	0.066	0.063	0.066	0.055	0.064	0.061	0.056	0.065
Thursday	15	0.069	0.064	0.066	0.056	0.061	0.056	0.055	0.065
Thursday	16	0.066	0.059	0.067	0.055	0.057	0.052	0.053	0.061
Thursday	17	0.059	0.055	0.060	0.053	0.054	0.048	0.049	0.055
Thursday	18	0.050	0.048	0.050	0.044	0.043	0.042	0.041	0.047
Thursday	19	0.042	0.044	0.047	0.036	0.039	0.037	0.034	0.041

Profiles By Vehicle

Day of Week	Hour	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
Thursday	20	0.036	0.045	0.042	0.032	0.035	0.031	0.030	0.035
Thursday	21	0.032	0.044	0.038	0.028	0.031	0.028	0.026	0.034
Thursday	22	0.032	0.041	0.036	0.025	0.028	0.023	0.025	0.033
Thursday	23	0.029	0.029	0.036	0.023	0.024	0.020	0.023	0.026
Friday	0	0.021	0.022	0.025	0.029	0.021	0.015	0.027	0.019
Friday	1	0.019	0.021	0.024	0.029	0.018	0.015	0.025	0.016
Friday	2	0.017	0.021	0.023	0.029	0.017	0.016	0.026	0.018
Friday	3	0.018	0.023	0.021	0.030	0.020	0.024	0.029	0.020
Friday	4	0.021	0.029	0.023	0.034	0.030	0.033	0.035	0.026
Friday	5	0.030	0.036	0.029	0.040	0.038	0.042	0.042	0.036
Friday	6	0.040	0.041	0.037	0.048	0.046	0.048	0.047	0.043
Friday	7	0.048	0.046	0.047	0.054	0.048	0.054	0.052	0.049
Friday	8	0.049	0.047	0.049	0.054	0.051	0.054	0.053	0.052
Friday	9	0.053	0.047	0.052	0.054	0.054	0.058	0.055	0.054
Friday	10	0.054	0.050	0.049	0.054	0.055	0.062	0.058	0.059
Friday	11	0.055	0.052	0.047	0.054	0.061	0.062	0.060	0.054
Friday	12	0.058	0.057	0.051	0.055	0.060	0.062	0.060	0.057
Friday	13	0.060	0.054	0.057	0.055	0.060	0.063	0.059	0.060
Friday	14	0.061	0.056	0.058	0.055	0.058	0.061	0.058	0.058
Friday	15	0.060	0.055	0.055	0.056	0.056	0.053	0.056	0.058
Friday	16	0.058	0.056	0.054	0.053	0.050	0.049	0.053	0.055
Friday	17	0.053	0.055	0.058	0.049	0.049	0.046	0.048	0.052
Friday	18	0.047	0.050	0.054	0.042	0.047	0.041	0.040	0.049
Friday	19	0.045	0.044	0.046	0.035	0.042	0.036	0.032	0.042
Friday	20	0.040	0.041	0.042	0.029	0.035	0.031	0.026	0.037
Friday	21	0.036	0.038	0.036	0.025	0.032	0.029	0.022	0.035
Friday	22	0.031	0.032	0.034	0.020	0.028	0.025	0.020	0.030
Friday	23	0.025	0.027	0.027	0.018	0.024	0.020	0.018	0.025
Saturday	0	0.023	0.023	0.026	0.042	0.025	0.024	0.040	0.023
Saturday	1	0.024	0.024	0.029	0.039	0.022	0.019	0.035	0.027
Saturday	2	0.022	0.023	0.028	0.037	0.021	0.017	0.032	0.024
Saturday	3	0.022	0.023	0.025	0.036	0.022	0.021	0.032	0.022
Saturday	4	0.023	0.029	0.026	0.037	0.027	0.026	0.035	0.027
Saturday	5	0.029	0.037	0.034	0.041	0.036	0.035	0.039	0.035
Saturday	6	0.041	0.045	0.040	0.046	0.042	0.044	0.045	0.043
Saturday	7	0.049	0.050	0.052	0.050	0.050	0.050	0.050	0.051
Saturday	8	0.055	0.054	0.060	0.054	0.054	0.055	0.055	0.057
Saturday	9	0.058	0.057	0.061	0.056	0.060	0.059	0.060	0.060
Saturday	10	0.061	0.059	0.060	0.060	0.060	0.061	0.063	0.062

Profiles By Vehicle

Day of Week	Hour	Fresno	Kern	Kings	Madera	Merced	San Joaquin	Stanislaus	Tulare
Saturday	11	0.063	0.061	0.061	0.058	0.060	0.063	0.064	0.063
Saturday	12	0.064	0.061	0.057	0.056	0.060	0.061	0.062	0.058
Saturday	13	0.064	0.060	0.051	0.054	0.059	0.059	0.058	0.061
Saturday	14	0.058	0.058	0.059	0.051	0.056	0.058	0.054	0.058
Saturday	15	0.053	0.055	0.052	0.049	0.050	0.056	0.049	0.055
Saturday	16	0.050	0.051	0.048	0.046	0.049	0.050	0.045	0.049
Saturday	17	0.048	0.046	0.046	0.041	0.046	0.046	0.040	0.042
Saturday	18	0.044	0.042	0.040	0.035	0.046	0.042	0.033	0.042
Saturday	19	0.038	0.038	0.037	0.029	0.040	0.038	0.027	0.038
Saturday	20	0.034	0.031	0.035	0.025	0.034	0.034	0.024	0.032
Saturday	21	0.029	0.028	0.026	0.022	0.032	0.031	0.021	0.027
Saturday	22	0.026	0.025	0.026	0.019	0.027	0.028	0.019	0.024
Saturday	23	0.023	0.020	0.020	0.018	0.023	0.022	0.017	0.020

APPENDIX F
Additional Temporal Profiles

Additional Temporal Profiles

Ocean going vessel (OGV) temporal profiles were constructed based on 2016 port activities of all vessels, compiled by an in-house section in CARB. Fractions for the ports of Long Beach, Los Angeles, Oakland and San Diego were updated using aggregated AIS data from 2015 through 2019. All vessel types were grouped by port area boundary and divided into day of week and monthly activity fractions (Table 1 and Table 2). Some profiles are either area or inline specific, others will be used by both area and inline sources. Activity data was not available for all ports; a flat (emissions are spread evenly across the time period) monthly and daily profile was used for those ports. A flat profile was also used to represent the hourly variation for all OGV vessels at every port area/waters. The temporal profiles do not apply to OGV military, which assumes a flat at monthly, days of week, and hours of day intervals (see the profile labeled Elsewhere in the tables below). The areas labeled with a "+" received area source profile updates and "*" received inline only updates.

Table 1: OGV Monthly Profiles

Port areas waters	Profile ID	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eureka	M_EKA	0.000	0.000	0.000	0.000	0.167	0.167	0.167	0.000	0.167	0.167	0.167	0.000
Hueneme	M_NTD	0.065	0.088	0.090	0.093	0.095	0.083	0.083	0.075	0.078	0.080	0.088	0.085
Carquinez	M_CAR	0.068	0.076	0.080	0.076	0.087	0.093	0.090	0.085	0.085	0.090	0.075	0.095
Oakland	M_OAK	0.084	0.088	0.081	0.078	0.081	0.084	0.084	0.090	0.081	0.090	0.080	0.079
Redwood City	M_RWC	0.055	0.018	0.091	0.091	0.127	0.073	0.055	0.127	0.091	0.091	0.036	0.145
Richmond	M_RCH	0.083	0.092	0.086	0.081	0.086	0.095	0.083	0.097	0.075	0.062	0.084	0.076
Sacramento	M_SAC	0.018	0.036	0.018	0.054	0.054	0.089	0.036	0.036	0.054	0.071	0.482	0.054
San Diego	M_SGQ	0.081	0.078	0.077	0.086	0.088	0.093	0.085	0.075	0.088	0.086	0.082	0.082
San Francisco	M_SFO	0.070	0.071	0.074	0.080	0.095	0.093	0.071	0.087	0.080	0.087	0.091	0.100
Stockton	M_SCK	0.083	0.088	0.083	0.074	0.111	0.101	0.060	0.101	0.055	0.083	0.092	0.069
Elsewhere	1	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
Waters of LA County+	M_6059	0.093	0.071	0.084	0.088	0.084	0.075	0.080	0.091	0.074	0.087	0.081	0.092
El Segundo*	M_ELS	0.104	0.055	0.084	0.093	0.086	0.066	0.075	0.104	0.066	0.090	0.075	0.104
Port of Los Angeles*	M_LAX	0.087	0.088	0.087	0.087	0.084	0.083	0.081	0.082	0.081	0.079	0.081	0.081
Port of Long Beach*	M_LGB	0.084	0.086	0.082	0.083	0.081	0.087	0.084	0.082	0.086	0.084	0.081	0.080

Additional Temporal Profiles

Table 2: OGV Weekly Profiles

Port Areas/Waters	Profile ID	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Eureka	W_EKA	0.500	0.000	0.333	0.000	0.000	0.000	0.167
Hueneme	W_NTD	0.113	0.145	0.205	0.160	0.108	0.115	0.155
Carquinez	W_CAR	0.178	0.131	0.146	0.163	0.136	0.126	0.121
Oakland	W_OAK	0.150	0.151	0.161	0.151	0.135	0.121	0.130
Redwood City	W_RWC	0.109	0.127	0.200	0.091	0.218	0.109	0.145
Richmond	W_RCH	0.167	0.153	0.142	0.126	0.161	0.129	0.122
Sacramento	W_SAC	0.179	0.250	0.089	0.143	0.161	0.071	0.107
San Diego	W_SGQ	0.150	0.162	0.169	0.142	0.129	0.117	0.131
San Francisco	W_SFO	0.155	0.138	0.153	0.137	0.127	0.143	0.146
Stockton	W_SCK	0.152	0.147	0.106	0.157	0.161	0.106	0.171
Elsewhere	7	0.143	0.143	0.143	0.143	0.143	0.143	0.143
Waters of LA County+	W_6059	0.143	0.132	0.152	0.150	0.139	0.148	0.135
El Segundo*	W_ELS	0.137	0.137	0.154	0.148	0.137	0.145	0.143
Port of Los Angeles*	W_LAX	0.142	0.145	0.153	0.155	0.150	0.135	0.121
Port of Long Beach*	W_LGB	0.138	0.140	0.148	0.147	0.152	0.144	0.132

APPENDIX G
Spatial Surrogate Assignments

Spatial Surrogate Assignments

The primary spatial surrogate for each EICSUM and the corresponding data source are listed in table below.

Primary surrogate assignment at the EICSUM level, description, and data source

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
10	Electric Utilities	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
20	Cogeneration	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
30	Oil and Gas Production (Combustion)	211	Gas Well	California Department of Conservation, Division of Oil, Gas and Geothermal Resources
30	Oil and Gas Production (Combustion)	431	Oil well	Division of Oil, Gas, And Geothermal Resources
50	Manufacturing and Industrial	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
52	Food and Agricultural Processing	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
60	Service and Commercial	621	UCD Service, Commercial, Employment	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
99	Other (Fuel Combustion)	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
110	Sewage Treatment	470	Publicly Owned Treatment Works	State Water Resources Control Board
120	Landfills	341	Landfills	Calrecyle - Solid Waste Information System (Swis) Dataset
130	Incinerators	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
140	Soil Remediation	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
199	Other (Waste Disposal)	343	Compost	Calrecyle - Solid Waste Information System (SWIS) Dataset
199	Other (Waste Disposal)	390	Nonirrigated Pastureland	National Land Cover Database (NLCD)
199	Other (Waste Disposal)	470	Publicly Owned Treatment Works	State Water Resources Control Board
210	Laundering	150	Drycleaners	Dun & Bradstreet’s Market Insight Database
220	Degreasing	120	Autobody Shops	Dun & Bradstreet’s Market Insight Database
220	Degreasing	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
230	Coatings and Related Process Solvents	120	Autobody Shops	Dun & Bradstreet’s Market Insight Database

Spatial Surrogate Assignments

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
230	Coatings and Related Process Solvents	743	Wood Furniture	Dun & Bradstreet's Market Insight Database
230	Coatings and Related Process Solvents	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
240	Printing	731	Print	Dun & Bradstreet's Market Insight Database
250	Adhesives and Sealants	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
299	Other (Cleaning and Surface Coatings)	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
310	Oil and Gas Production	211	Gas well	California Department of Conservation, Division of Oil, Gas and Geothermal Resources
310	Oil and Gas Production	431	Oilwell	California Department of Conservation, Division of Oil, Gas and Geothermal Resources
330	Petroleum Marketing	460	Ports	(US DOT)/Bureau of Transportation Statistics' (BTS's) National Transportation Atlas Database (NTAD)
330	Petroleum Marketing	200	Gas Stations	Dun & Bradstreet's Market Insight Database
330	Petroleum Marketing	520	Refineries and Tank Farms	FEMA and the ARB CEIDAR Database
330	Petroleum Marketing	214	Gas Distribution	U.S. Energy Information Administration
399	Other (Petroleum Production and Marketing)	200	Gas Stations	Dun & Bradstreet's Market Insight Database
410	Chemical	741	Plastic	Dun & Bradstreet's Market Insight Database
420	Food and Agriculture	680	Wineries	Dun & Bradstreet's Market Insight Database
420	Food and Agriculture	320	Irrigated Cropland	National Land Cover Database (NLCD)
430	Mineral Processes	590	Sand and Gravel Mines	National Atlas
440	Metal Processes	738	Metal Parts	Dun & Bradstreet's Market Insight Database
450	Wood And Paper	732	Wood	Dun & Bradstreet's Market Insight Database
499	Other (Industrial Processes)	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
500	Solvent Evaporation Unspecified	441	UCD Population	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data

Spatial Surrogate Assignments

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
510	Consumer Products	550	Residential and Nonresidential Change Industrial Employment	Council of Government (Cog) Housing and Employment
510	Consumer Products	252	UCD Total Housing	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
510	Consumer Products	280	Housing and Restaurants	Combo: Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data and Dun & Bradstreet Market Insight
510	Consumer Products	260	Housing and Autobody	Combo: Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data and Dun & Bradstreet Market Insight
510	Consumer Products	120	Autobody Shops	Dun & Bradstreet's Market Insight Database
510	Consumer Products	739	Other Coatings	Dun & Bradstreet's Market Insight Database
510	Consumer Products	270	Housing and Commercial Employment	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
510	Consumer Products	651	UCD Single Family Housing	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
510	Consumer Products	450	Population, Commercial Employment and Hospitals	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data and ESRI
510	Consumer Products	672	Developed Land High Density	National Land Cover Database (NLCD)
520	Architectural Coatings and Related Process Solvents	230	HE Square Feet	Council of Government (COG) Housing and Employment
520	Architectural Coatings and Related Process Solvents	270	Housing and Commercial Employment	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data

Spatial Surrogate Assignments

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
520	Architectural Coatings and Related Process Solvents	110	All Paved Roads	Tiger Geodatabases from U.S. Census Bureau
530	Pesticides/Fertilizers	230	HE Square Feet	Council of Government (COG) Housing and Employment
530	Pesticides/Fertilizers	512	Pesticides No Methyl Bromide	Department of Pesticide Regulation
530	Pesticides/Fertilizers	514	Pesticides Methyl Bromide	Department of Pesticide Regulation
530	Pesticides/Fertilizers	732	Wood	Dun & Bradstreet’s Market Insight Database
540	Asphalt Paving / Roofing	588	UCD On-road Construction	Caltrans Highway Construction Projects Dataset (Line)
610	Residential Fuel Combustion	573	Fireplaces	Digital Map Products 2017 Parcel Data
610	Residential Fuel Combustion	572	Residential Liquid Petroleum Gas Heating	US Census American Community Survey (ACS)
620	Farming Operations	356	Horse Ranches	CARB Green House Gas Inventory Group
620	Farming Operations	320	Irrigated Cropland	National Land Cover Database (NLCD)
620	Farming Operations	690	Land Prep	Department of Pesticide Regulation
630	Construction and Demolition	588	UCD On-road Construction	Caltrans Highway Construction Projects Dataset (Line)
630	Construction and Demolition	587	UCD Offroad Construction	Storm Notice of Intent (NOI) Dataset
640	Paved Road Dust	590	Sand and Gravel Mines	National Atlas
640	Paved Road Dust	610	Secondary Paved Roads	Tiger Geodatabases from U.S. Census Bureau
645	Unpaved Road Dust	384	Military Tactical	Federal Aviation Administration / National Transportation Atlas Database (NTAD) And ESRI
645	Unpaved Road Dust	190	Forestland	National Land Cover Database (NLCD)
645	Unpaved Road Dust	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
645	Unpaved Road Dust	660	Unpaved Roads	Tiger Geodatabases from U.S. Census Bureau
650	Fugitive Windblown Dust	391	Pasture	National Land Cover Database (NLCD)
650	Fugitive Windblown Dust	660	Unpaved Roads	Tiger Geodatabases from U.S. Census Bureau
650	Fugitive Windblown Dust	160	Dry Lake Beds	U.S. Geological Survey (USGS)

Spatial Surrogate Assignments

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
660	Fires	441	UCD Population	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
660	Fires	480	Primary Roads	Tiger Geodatabases from U.S. Census Bureau
670	Managed Burning and Disposal	674	Developed Land Low Density	National Land Cover Database (NLCD)
670	Managed Burning and Disposal	190	Forestland	National Land Cover Database (NLCD)
670	Managed Burning and Disposal	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
680	Utility Equipment	651	UCD Single Family Housing	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
690	Cooking	561	Charbroiling	SJV APCD & Dun and Bradstreet Insight Market
699	Other (Miscellaneous Processes)	441	UCD Population	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
810	Aircraft	382	Military Aircraft	Federal Aviation Administration / National Transportation Atlas Database (NTAD) And ESRI
810	Aircraft	100	Airports	Federal Aviation Administration and ESRI
810	Aircraft	140	Commercial Airports	Federal Aviation Administration, National Transportation Atlas Database (NTAD)
810	Aircraft	320	Irrigated Cropland	National Land Cover Database (NLCD)
820	Trains	491	Linehaul	ARB In-House Rail Modeling
820	Trains	360	Metrolink Lines	Federal Railroad Administration / National Transportation Atlas Database (NTAD)
820	Trains	490	Rail Lines	Federal Railroad Administration / National Transportation Atlas Database (NTAD)
820	Trains	361	Passenger Rail	Offroad Diesel Analysis Section, AQPSD
820	Trains	501	Switcher Railyards	Off-Road Diesel Analysis Section, AQPSD: Union Pacific Railroad (Up) And Burlington Northern Santa Fe Railway (BNSF)

Spatial Surrogate Assignments

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
830	Ships and Commercial Boats	460	Ports	(US DOT)/Bureau of Transportation Statistics' (BTS's) National Transportation Atlas Database (NTAD)
830	Ships and Commercial Boats	431	Oilwell	Division of Oil, Gas, And Geothermal Resources
830	Ships and Commercial Boats	640	Ship Lanes	Marine Cadastre Automatic Identification System
833	Ocean Going Vessels	460	Ports	(US DOT)/Bureau of Transportation Statistics' (BTS's) National Transportation Atlas Database (NTAD)
833	Ocean Going Vessels	383	Military Ships	Marine Cadastre - Military Vessel
833	Ocean Going Vessels	640	Ship Lanes	Marine Cadastre Automatic Identification System
833	Ocean Going Vessels	642	Tanker	Marine Cadastre Automatic Identification System
833	Ocean Going Vessels	643	Passenger	Marine Cadastre Automatic Identification System
835	Commercial Harbor Craft	460	Ports	(US DOT)/Bureau of Transportation Statistics' (BTS's) National Transportation Atlas Database (NTAD)
835	Commercial Harbor Craft	332	Ferries	Ferry Company Websites and Google Maps
835	Commercial Harbor Craft	383	Military Ships	Marine Cadastre - Military Vessel
835	Commercial Harbor Craft	641	Crew Supply	Marine Cadastre Automatic Identification System
835	Commercial Harbor Craft	339	Dredge	Marine Cadastre Coastal Maintained Channels
840	Recreational Boats	338	Ocean Recreation Boats	Marine Cadastre Automatic Identification System - Pleasure Craft
840	Recreational Boats	651	UCD Single Family Housing	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
840	Recreational Boats	336	Ocean, Lakes and Recreation Boats	U.S. Geological Survey (USGS)
840	Recreational Boats	335	Lakes, Rivers, Recreation Boats	U.S. Geological Survey (USGS)
850	Off-Road Recreational Vehicles	220	Golf Courses	ESRI

Spatial Surrogate Assignments

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
850	Off-Road Recreational Vehicles	651	UCD Single Family Housing	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
850	Off-Road Recreational Vehicles	660	Unpaved Roads	Tiger Geodatabases from U.S. Census Bureau
850	Off-Road Recreational Vehicles	170	Elevation over 1500 m	U.S. Geological Survey (USGS)
860	Off-Road Equipment	580	Residential Nonresidential Change	Council of Government (COG) Housing and Employment
860	Off-Road Equipment	630	Service and Commercial Employment, Schools, Golf Courses and Cemeteries	Council of Government (COG) Service and Commercial Employment & Esri
860	Off-Road Equipment	460	Ports	(US DOT)/Bureau of Transportation Statistics' (BTS's) National Transportation Atlas Database (NTAD)
860	Off-Road Equipment	431	Oilwell	Division of Oil, Gas, And Geothermal Resources
860	Off-Road Equipment	384	Military Tactical	Federal Aviation Administration / National Transportation Atlas Database (NTAD) and ESRI
860	Off-Road Equipment	100	Airports	Federal Aviation Administration and Esri
860	Off-Road Equipment	500	Railyards	Federal Railroad Administration / National Transportation Atlas Database (NTAD)
860	Off-Road Equipment	485	TRU	Integrated Transportation Network and Caltrans Truck Network And Digital Map Products 2017 Parcel Data
860	Off-Road Equipment	302	UCD Industrial	Longitudinal Employer-Household Dynamics (LEHD)
860	Off-Road Equipment	339	Dredge	Marine Cadastre Coastal Maintained Channels
860	Off-Road Equipment	651	UCD Single Family Housing	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
860	Off-Road Equipment	190	Forestland	National Land Cover Database (NLCD)
860	Off-Road Equipment	191	Forestland Roads	NLCD in conjunction with TIGER road network

Spatial Surrogate Assignments

EICSUM	EICSUM Name	Primary Surrogate ID	Primary Surrogate Name	Data Source of Primary Surrogate
860	Off-Road Equipment	587	UCD Offroad Construction	Storm Notice of Intent (NOI) Dataset
870	Farm Equipment	720	Farm Road Vehicle Miles Traveled	Department of Pesticide Regulation
890	Fuel Storage And Handling	651	UCD Single Family Housing	Metropolitan Planning Organization (MPO)/Council of Government (COG) Data /California Statewide Travel Demand Model (CSTDM) Data
890	Fuel Storage and Handling	335	Lakes, Rivers, Recreation boats	U.S. Geological Survey (USGS)
910	Biogenic Sources	672	Developed Land High Density	National Land Cover Database (NLCD)
910	Biogenic Sources	190	Forestland	National Land Cover Database (NLCD)
920	Geogenic Sources	190	Forestland	National Land Cover Database (NLCD)
920	Geogenic Sources	212	Gas Seep	U.S. Geological Survey (USGS)
920	Geogenic Sources	432	Oil Seep	U.S. Geological Survey (USGS) – Pacific Coastal & Marine Science
930	Wildfires	190	Forestland	National Land Cover Database (NLCD)
930	Wildfires	391	Pasture	Sierra Research Agtool Contract
940	Windblown Dust	412	Fugitive Dust	National Land Cover Database (NLCD)

APPENDIX H
CARB 2022 Mobile Source Program

I. Key Mobile Source Regulations and Programs Providing Emission Reductions

Given the severity of California's air quality challenges and the need for ongoing emission reductions, the California Air Resources Board (CARB or Board) has implemented the most comprehensive mobile source emissions control program in the nation. CARB's comprehensive program relies on four fundamental approaches:

- Stringent emissions standards that minimize emissions from new vehicles and equipment;
- In-use programs that target the existing fleet and require the use of the cleanest vehicles and emissions control technologies;
- Cleaner fuels that minimize emissions during combustion; and,
- Incentive programs that remove older, dirtier vehicles and equipment and replace those vehicles with the cleanest technologies.

This multi-faceted approach has spurred the development of increasingly cleaner technologies and fuels and achieved significant emission reductions across all mobile source sectors that go far beyond national programs or programs in other states. These efforts extend back to the first mobile source regulations adopted in the 1960s, and pre-date the federal Clean Air Act Amendments (Act) of 1970, which established the basic national framework for controlling air pollution. In recognition of the pioneering nature of CARB's efforts, the Act provides California unique authority to regulate mobile sources more stringently than the federal government by providing a waiver of preemption for its new vehicle emission standards under Section 209(b). This waiver provision preserves a pivotal role for California in the control of emissions from new motor vehicles, recognizing that California serves as a laboratory for setting motor vehicle emission standards. Since then, CARB has consistently sought and obtained waivers and authorizations for its new motor vehicle regulations. CARB's history of progressively strengthening standards as technology advances, coupled with the waiver process requirements, ensures that California's regulations remain the most stringent in the nation.

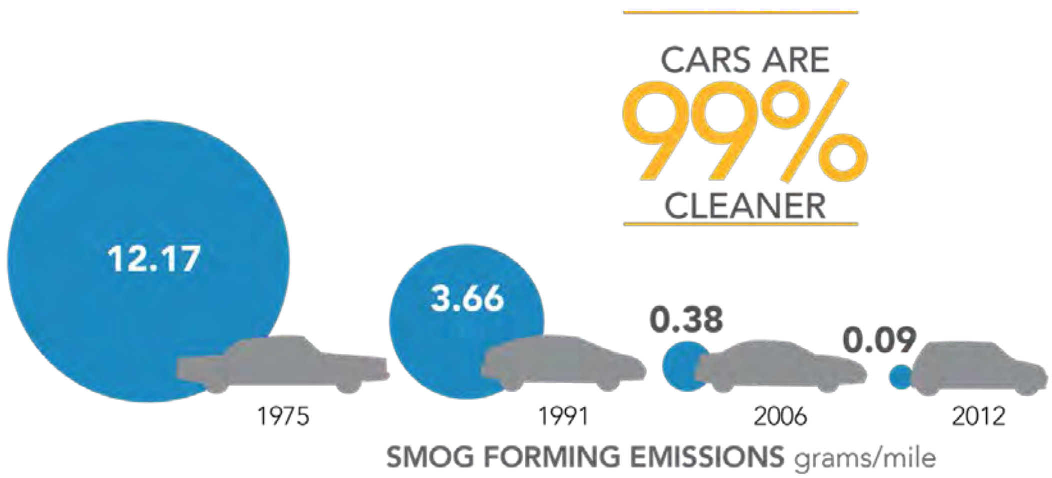
In 1998, CARB identified diesel particulate matter as a toxic air contaminant. Since then, CARB adopted numerous regulations aimed at reducing exposure to diesel particulate matter while concurrently providing reductions in oxides of nitrogen (NOx) from freight transport sources like heavy-duty diesel trucks, transportation sources like passenger cars and buses, and off-road sources like large construction equipment. Phased implementation of these regulations will continue to produce emission reduction benefits through 2032 and beyond, as the regulated fleets are retrofitted, and as older and dirtier portions of the fleets are replaced with newer and cleaner models at an accelerated pace.

Further, CARB and District staff work closely on identifying and distributing incentive funds to accelerate cleanup of vehicles and engines. Key incentive programs include: Low Carbon Transportation; Air Quality Improvement Program; VW Mitigation Trust; Community Air Protection; Carl Moyer Program; Goods Movement Program; Clean Off-Road Equipment (CORE); and Funding Agricultural Replacement Measures for Emission Reductions (FARMER). These incentive-based programs work in tandem with regulations to accelerate deployment of cleaner technology.

A. Light-Duty Vehicles

Figure 1 illustrates the trend in CARB smog forming emission standards for light-duty vehicles. Cars are 99 percent cleaner than they were in 1975 due to CARB's longstanding light-duty mobile source program. 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. In 1970, CARB required auto manufacturers to meet the first standards to control NOx emissions along with hydrocarbon emissions. The simultaneous control of emissions from motor vehicles and fuels led to the use of cleaner-burning reformulated gasoline (RFG) that has removed the emissions equivalent of 3.5 million vehicles from California's roads. Since CARB first adopted it in 1990, the Low Emission Vehicle Program (LEV and LEV II) and Zero-Emission Vehicle (ZEV) Program have resulted in the production and sales of hundreds of thousands of zero-emission vehicles (ZEVs) in California.

Figure 1: Light-Duty Emission Standards



As a result of these efforts, light-duty vehicle emissions in the Eastern Kern Nonattainment Area have been reduced significantly since 1990 and will continue to decrease through 2032. From today, light-duty vehicle NOx emissions are projected to decrease by over 54 percent in 2026, and by over 65 percent in 2032. Key light-duty programs include Advanced Clean Cars (ACC), On-Board Diagnostics, Reformulated Gasoline, Incentive Programs, and the Enhanced Smog Check Program.

1. Advanced Clean Cars

CARB's groundbreaking ACC program is now providing the next generation of emission reductions in California, and ushering in a new zero emission passenger transportation system. The success of this program is evident: California is the world's largest market for Zero Emission Vehicles (ZEVs), with over 87 models available today, including battery-electric, plug-in hybrid electric, and fuel cell electric vehicles. A wide variety are now available at lower price points, attracting new consumers. As of February 2022, Californians, who drive only 10 percent of the nation's cars, now account for over 40 percent of all zero-emission cars in the country. The U.S. makes up about half of the world market. This movement towards commercialization of advanced clean cars has occurred due to CARB's ZEV requirements, part of ACC, which affects passenger cars and light-duty trucks.

CARB's ACC Program, approved in January 2012, is a pioneering approach of a 'package' of regulations that - although separate in construction - are related in terms of the synergy developed to address both ambient air quality needs and climate change. The ACC program combines the control of smog, soot causing pollutants and greenhouse gas (GHG) emissions into a single coordinated package of requirements for model years 2015 through 2025. The ACC Program assures the development of environmentally superior cars that will continue to deliver the performance**,** utility, and safety vehicle owners have come to expect

The ACC Program also included amendments affecting the current ZEV requirements through the 2017 model year in order to enable manufacturers to successfully meet 2018 and subsequent model year requirements. These ZEV amendments are intended to achieve commercialization through simplifying the regulation and pushing technology to higher volume production in order to achieve cost reductions. The ACC Program will continue to achieve benefits into the future as new cleaner cars enter the fleet and displace older and dirtier vehicles.

Going beyond these regulations, California will be transitioning to zero emissions. In support of California's transition to zero-emission vehicles, in 2020, Governor Newsom signed Executive Order N-79-20[1] which established a goal that 100 percent of California sales of new passenger cars and trucks be zero-emission by 2035. Advanced Clean Cars II (ACC II), a measure in the 2016 State SIP Strategy, is a significant effort critical to meeting air quality standards, and was recently adopted by the CARB Board in August 2022. ACC II is consistent with the Governor Newson's Executive Order and has the goal of cutting emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035.

With this order and many other recent actions, Governor Newsom has recognized that air pollution remains a challenge for California that requires bold action. Zero-emission vehicle commercialization in the light-duty sector is well underway. Longer-range battery electric vehicles are coming to market that are cost-competitive with gasoline fueled vehicles and hydrogen fuel cell vehicles are now also seeing significant sales. Autonomous and connected vehicle technologies are being installed on an increasing number of new car models. A growing network of retail hydrogen stations is now available, along with a rapidly growing battery charger network.

2. On Board Diagnostics (OBD)

[1] Executive Order N-79-20 https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf

OBD systems serve an important role in helping to ensure that engines and vehicles maintain low emissions throughout their full life. 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. Many states currently use the OBD system as the basis for passing and failing vehicles in their inspection and maintenance programs, as is exemplified by California's Smog Check program.

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, CARB 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. The Board has modified the OBD II regulation in regular updates since initial adoption to address manufacturers' implementation concerns and, where needed, to strengthen specific monitoring requirements. Most recently, the Board amended the regulation in 2021 to require manufacturers to implement Unified Diagnostic Services (UDS) for OBD communications, which will provide more information related to emissions-related malfunctions that are detected by OBD systems, improve the usefulness of the generic scan tool to repair vehicles, and provide needed information on in-use monitoring performance. UDS implementation would be required for all 2027 and subsequent model year light- and medium-duty vehicles and engines, as well as some heavy-duty vehicles and engines.

3. California Enhanced Smog Check Program

The Bureau of Automotive Repair (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 vehicles by requiring periodic inspections for emission-control system problems, and by requiring repairs for any problems found. In 1998, the Enhanced Smog Check program began in which 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 where the vehicle was registered. For instance, vehicles registered in urbanized areas received an ASM test, while vehicles in rural areas received a TSI test.

In 2009, the following requirements were added in to improve and enhance the Smog Check Program, making it more inclusive of motor vehicles and effective on smog reductions:

- Low pressure evaporative test;
- More stringent pass/fail cutpoints;
- Visible smoke test; and
- Inspection of light- and medium-duty diesel vehicles.

The next major change in the Smog Check Program was due to AB 2289, adopted in October 2010, a new law restructuring California's Smog Check Program, streamlining and strengthening inspections, increasing penalties for misconduct, and reducing costs to motorists. This new law, supported by CARB and BAR, promised faster and less expensive Smog Check inspections by talking advantage of the second generation of OBD software installed on all vehicles. The new law also directs vehicles without this equipment to high-performing stations, helping to ensure that these cars comply with current emission standards. This program will reduce consumer costs by having stations take advantage of diagnostic software that monitors pollution-reduction components and tailpipe emissions. Beginning mid-2013, testing of passenger vehicles using OBD was required on all vehicles model years 2000 or newer.

4. Reformulated Gasoline (CaRFG)

Since 1992, CARB has been regulating the formulation of gasoline through the California Reformulated Gasoline program (CaRFG). The CaRFG program has been implemented in three phases, and has resulted in California gasoline being the cleanest in the world. California's cleaner-burning gasoline regulation is one of the cornerstones of the State's efforts to reduce air pollution and cancer risk. Reformulated gasoline is fuel that meets specifications and requirements established by CARB, which reduced motor vehicle toxics by about 40 percent and reactive organic gases by about 15 percent. The results from cleaning up fuel can have an immediate impact as soon as it is sold in the State. Vehicle manufacturers design low-emission emission vehicles to take full advantage of cleaner-burning gasoline properties.

5. Incentive Programs

There are many different incentive programs focusing on light-duty vehicles that produce extra emission reductions beyond traditional regulations. Incentive programs encourage both the early retirement of dirty, older cars and the purchase of newer, lower-emitting vehicle engines and technologies. 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.

The State, in partnership with the local air districts, has a well-established history of using incentive programs to advance technology development and deployment, and to achieve early emission reductions. Since 1998, CARB and California's local air districts have been administering incentive funding to accelerate the deployment and turnover to cleaner vehicles, starting with the Moyer Program. In recognition of the key role that incentives play in complementing State and local air quality regulations to reduce emissions, the scope and scale of California's air quality incentive programs has since greatly expanded. Each of CARB's incentive programs has its own statutory requirements, goals, and categories of eligible projects that collectively provide for a diverse and complex incentives portfolio. CARB uses this portfolio approach to incentives to accelerate development and early commercial deployment of the cleanest mobile source technologies and to improve access to clean transportation.

The Fiscal Year (FY) 2021-22 State Budget included an unprecedented level of investment in ZEVs, with $2.3 billion allocated for CARB over the next three years, specifically dedicated to incentive-based turnover of mobile source vehicles and equipment, as part of a $3.9 billion comprehensive, multi-agency package to accelerate progress toward the State's zero-emission vehicle goals established under Executive Order N-79-20. With the 2022-23 State Budget, Governor Newsom is further reinforcing California's commitment to transitioning away from combustion vehicles with an additional $6.1 billion in ZEV investments over the next 5 years.

a) Low Carbon Transportation Investments and Air Quality Improvement Program (Clean Transportation Incentives)

California's Low Carbon Transportation Investments and the Air Quality Improvement Program form CARB's major incentive funding program, which works in concert with the State's larger portfolio of clean transportation investments. Together, the Low Carbon Transportation Investments and Air Quality Improvement Program are known as the Clean Transportation Incentives program; they provide mobile source incentives to reduce greenhouse gas, criteria pollutant, and toxic air contaminant emissions through the deployment of advanced technology and clean transportation in the light-duty and heavy-duty sectors.

The Clean Transportation Incentives Program is part of California Climate Investments, and is designed to accelerate the transition to advanced technology low carbon freight and passenger transportation, with a priority on providing health and economic benefits to California's most disadvantaged communities, and with a focus on increasing deployment of zero-emission vehicles and equipment wherever possible. Low Carbon Transportation Investments are supported by California's Cap-and-Trade auction proceeds. The Air Quality Improvement Program (AQIP) is a mobile source incentive program that focuses on reducing criteria pollutant and diesel particulate emissions with concurrent GHG reductions. AQIP is appropriated from the Air Quality Improvement Fund.

Each year, the legislature appropriates funding to CARB for the Low Carbon Transportation Investments and Air Quality Improvement Programs, and allocations are used to fund multiple programs in the passenger vehicle, on-road heavy-duty, and off-road vehicle sectors, including: the Clean Vehicle Rebate Project (CVRP); Enhanced Fleet Modernization Program and Plus-Up Pilot Project (Clean Cars 4 All); and the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP).

i. Clean Vehicle Rebate Program (CVRP)

As one of the programs funded through the Clean Transportation Incentives program, CVRP is a vehicle purchasing incentives program that provides consumer rebates to reduce the price for new ZEV purchases, and is designed to offer vehicle rebates on a first-come, first-serve basis for light-duty ZEVs, plug-in hybrid electric vehicles, and zero-emission motorcycles. In FY 2021-22, CVRP was allocated $525 million.

ii. Clean Cars 4 All

Clean Cars 4 All (formerly known as the Enhanced Fleet Modernization Program Plus-Up Pilot Project) is another Clean Transportation Incentives program for passenger vehicles. Clean Cars 4 All provides incentives for lower-income consumers living in and near disadvantaged communities who scrap their old vehicles and purchase new or used hybrid, plug-in hybrid, or zero-emission vehicle replacement vehicles. The budget for FY 2021-22 included $75 million for the statewide expansion of Clean Cars 4 All.

iii. Other Clean Transportation Equity Investments

CARB also funds a suite of transportation equity pilot projects aimed at increasing access to clean transportation and mobility options for priority populations in disadvantaged and low-income communities, and for lower-income households. This includes clean vehicle ownership projects, clean mobility options, streamlining access to funding and financing opportunities, and increasing community outreach, education and exposure to clean technologies. Clean Transportation Equity pilot projects exemplify the importance of understanding the unique needs across communities and provide lessons for how we most directly address barriers to collectively achieve our equity, air quality, and climate goals. Major Clean Transportation Equity Investment programs include: Clean Mobility Options, Clean Mobility in Schools, Financing Assistance; and Sustainable Transportation Equity Project **(**STEP). Clean Transportation Equity Investment projects were allocated $150 million in the FY 2021-22 budget, which includes the $75 million for CC4A mentioned above.

Financing Assistance provides eligible consumers buy-down and financing opportunities to purchase or lease a new or used clean vehicle, such as a conventional hybrid electric vehicle (HEV), plug-in hybrid (PHEV), or battery electric vehicle (BEV). Clean Mobility in Schools Projects are located within disadvantaged communities, and are intended to encourage and accelerate the deployment of new zero-emission school buses, school fleet vehicles, passenger cars, lawn and garden equipment, and can incorporate alternative modes of transportation like transit vouchers, active transportation elements, and bicycle share programs. In the light-duty sector, some of the Clean Mobility Options programs that CARB funds include the Clean Mobility Options Voucher Pilot Program (CMO). CMO provides voucher-based funding for low-income, tribal, and disadvantaged communities to fund zero-emission shared and on-demand services such as carsharing, ridesharing, bike sharing, and innovative transit services. STEP is a new transportation equity pilot program that funds zero-emission carsharing, bike sharing, public transit and shared mobility subsidies, among other projects.

b) Consumer Assistance Program

California’s voluntary vehicle retirement program, the Consumer Assistance Program (CAP), is administered by BAR and provides low-income consumers repair assistance including up to $1,200 in emissions-related repairs if their vehicle fails its biennial Smog Check Test inspection, and/or up to $1,500 per vehicle for retiring operational vehicles at BAR-contracted dismantler sites.

B. Medium- and Heavy-Duty On-Road Trucks

Due to the benefits of CARB’s longstanding heavy-duty mobile source program, heavy-duty on-road vehicle emissions in the Eastern Kern Nonattainment Area have been reduced significantly since 1990 and will continue to decrease through 2032. From today, medium- and heavy-duty NOx emissions are projected to decrease by 63 percent in 2026, and by 73 percent in 2032. Key programs contributing to those reductions include new heavy-duty engine standards, cleaner diesel fuel requirements, California’s Truck and Bus Regulation and incentive programs.

1. Heavy-Duty Engine 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. Most recently in 2015, engine manufacturers were allowed to 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 CARB to preferentially provide incentive funding to buyers of cleaner trucks, and to encourage the development of cleaner engines.

2. Optional Low-NOx Standards for Heavy-Duty Diesel Engines

In 2013, California established optional low-NOx standards for heavy-duty diesel engines (Optional Reduced Emissions Standards for Heavy-Duty Engines regulation), with the most aggressive standard being 0.02 g/bhp-hr, 90 percent below the federally required standard. The optional low-NOx standards were developed to pave the way for more stringent mandatory standards by encouraging manufacturers to develop and certify low-NOx engines, and incentivizing potential customers to purchase these low-NOx engines. By 2019, a total of fifteen engines families, some using natural gas and others using liquefied petroleum gas, had been certified to the optional low-NOx standards.

3. Heavy-Duty Engine and Vehicle Omnibus Regulation

In 2021, CARB comprehensively overhauled how NOx emissions from new heavy-duty engines are regulated in California through the adoption of the Heavy-Duty Engine and Vehicle Omnibus Regulation which reduces NOx emissions from the engines in medium- and heavy-duty vehicle classes. The Omnibus Regulation includes NOx certification emission standards and in-use standards that significantly reduce tailpipe NOx emissions during most vehicle operating modes such as high-speed steady-state, transient, low load urban driving, and idling modes of operation. Additionally, revisions to the emissions warranty, useful life, emissions warranty and reporting information and corrective action procedures, and durability demonstration procedures provide additional emission benefits by encouraging more timely repairs to emission-related malfunctions and encouraging manufacturers to produce more durable emission control components, thereby reducing the rate at which engine emission controls fail and emissions increase.

4. Cleaner In-Use Heavy-Duty Trucks (Truck and Bus Regulation)

California’s Truck and Bus Regulation or In-Use Heavy-Duty Truck Rule was first adopted in December 2008. This rule represents a multi-year effort to turn over the legacy fleet of heavy-duty on-road engines and replace them with the cleanest technology available. In December 2010, CARB revised specific provisions of the In-Use Heavy-duty Truck Rule, in recognition of the deep economic effects of the recession on businesses and the corresponding decline in emissions.

Starting in 2012, the Truck and Bus Regulation phases in requirements applicable to an increasingly larger percentage of California's truck and bus fleet over time, so that by 2023 nearly all older vehicles will be upgraded to have exhaust emissions meeting 2010 model year engine emissions levels. The regulation applies to nearly all diesel-fueled trucks and buses with a gross vehicle weight rating (GVWR) greater than 14,000 pounds that are privately or federally owned, including on-road and off-road agricultural yard goat trucks, and privately and publicly owned school buses. Moreover, the regulation applies to any person, business, school district, or federal government agency that owns, operates, leases or rents affected vehicles. The regulation also establishes requirements for any in-State or out-of-state motor carrier, California-based broker, or any California resident who directs or dispatches vehicles subject to the regulation. Finally, California sellers of a vehicle subject to the regulation would have to disclose the regulation's potential applicability to buyers of the vehicles. Approximately 170,000 businesses in nearly all industry sectors in California, and almost a million vehicles that operate on California roads each year are affected. Some common industry sectors that operate vehicles subject to the regulation include: for-hire transportation, construction, manufacturing, retail and wholesale trade, vehicle leasing and rental, bus lines, and agriculture.

In 2017, California passed legislation ensuring compliance with the Truck and Bus Regulation through the California Department of Motor Vehicles (DMV) vehicle registration program. Starting January 1, 2020, DMV verifies compliance to ensure that vehicles subject to the Truck and Bus Regulation meet the requirements prior to obtaining DMV vehicle registration. The law requires the DMV to deny registration for any vehicle that is non-compliant or has not reported to CARB as compliant or exempt from the Truck and Bus Regulation.

CARB compliance assistance and outreach activities that are key in support of the Truck and Bus Regulation include:

- The Truck Regulations Upload and Compliance Reporting System (TRUCRS), an online reporting tool developed and maintained by CARB staff;
- The Truck and Bus regulation's fleet calculator, a tool designed to assist fleet owners in evaluating various compliance strategies;
- Targeted training sessions all over the State; and
- Out-of-state training sessions conducted by a contractor.

CARB staff also develops regulatory assistance tools, conducts and coordinates compliance assistance and outreach activities, administers incentive programs, and actively enforces the entire suite of regulations. Accordingly, CARB's approach to ensuring compliance is based on a comprehensive outreach and education effort.

5. Heavy-Duty Inspection and Maintenance Regulation

To ensure heavy-duty trucks remain clean in-use, CARB adopted in 2021 the Heavy-Duty Inspection and Maintenance Regulation, which requires periodic demonstrations that vehicles' emissions control systems are properly functioning in order to legally operate within the State. This regulation is designed to achieve criteria emissions reductions by ensuring that malfunctioning emissions control systems are repaired in a timely fashion.

6. Heavy-Duty On-Board Diagnostics (HD OBD)

OBD systems serve an important role in helping to ensure that engines and vehicles maintain low emissions throughout their full life. OBD systems monitor virtually all emission controls on gasoline and diesel engines, including catalysts, particulate matter (PM) filters, exhaust gas recirculation systems, oxygen sensors, evaporative systems, fuel systems, and electronic powertrain components as well as other components and systems that can affect emissions when malfunctioning. The systems also provide specific diagnostic information in a standardized format through a standardized serial data link on-board the vehicles. The use and operation of OBD systems ensure reductions of in-use motor vehicle and motor vehicle engine emissions through improvements in emission system durability and performance.

The Board originally adopted comprehensive Heavy-Duty OBD regulations in 2005 for model year 2010 and subsequent heavy-duty engines and vehicles, referred to as HD OBD. In 2009, the Board updated the HD OBD regulation, adopted specific enforcement requirements, and aligned the HD OBD with OBD requirements for medium-duty vehicles. In 2021, the Board again amended the HD OBD regulation; the 2021 amendments require manufacturers to implement Unified Diagnostic Services for OBD communications, which will provide more information related to emissions-related malfunctions that are detected by OBD systems, improve the usefulness of the generic scan tool to repair vehicles, and provide needed information on in-use monitoring performance.

7. Clean Diesel Fuel

Since 1993, CARB has required that diesel fuel have a limit on the aromatic hydrocarbon content and sulfur content of the fuel. Diesel powered vehicles account for a disproportionate amount of diesel particulate matter, which is considered a toxic air contaminant in California. In 2006, CARB required a low-sulfur diesel fuel to be used not only by on-road diesel vehicles but also for off-road engines. The diesel fuel regulation allows alternative diesel formulations as long as emission reductions are equivalent to the CARB formulation.

8. Advanced Clean Truck Regulation (ACT)

In June 2020, CARB adopted the Advanced Clean Trucks regulation, a first of its kind regulation requiring medium- and heavy-duty manufacturers to produce ZEVs as an increasing portion of their sales beginning in 2024. The Advanced Clean Trucks regulation is a manufacturers ZEV sales requirement and a one-time reporting requirement for large entities and fleets. This regulation is expected to result in roughly 100,000 heavy-duty ZEVs operating on California's roads by 2030 and nearly 300,000 heavy-duty ZEVs by 2035. With the adoption of the Advanced Clean Trucks regulation, CARB Resolution 20-19 directs staff to return to the Board with a zero-emission fleet rule and sets the following targets for transitioning California's heavy-duty vehicle sectors to ZEVs:

- 100 percent zero-emission drayage, last mile delivery, and government fleets by 2035;
- 100 percent zero-emission refuse trucks and local buses by 2040;
- 100 percent zero-emission-capable vehicles in utility fleets by 2040; and
- 100 percent zero-emission everywhere else, where feasible, by 2045.

As mentioned earlier, the Governor signed Executive Order N-79-20 in September 2020, which directs CARB to adopt regulations to transition the State's transportation fleet to ZEVs. This includes transitioning the State's drayage fleet to ZEVs by 2035 and transitioning the State's truck and bus fleet to ZEVs by 2045 where feasible.

9. Innovative Clean Transit (ICT) and Zero-Emission Airport Shuttle Regulation

To achieve the needed emission reductions from heavy-duty applications, CARB is driving the use of zero-emission heavy-duty vehicles in strategic applications, including urban transit buses and airport ground transportation. The Innovative Clean Transit regulation was the first of these programs. It was adopted in December 2018 and requires all public transit agencies to gradually transition to a 100 percent zero-emission bus fleet and encourages them to provide innovative first- and last-mile connectivity and improved mobility for transit riders. Beginning in 2029, 100 percent of new purchases by transit agencies must be Zero Emission Buses, with a goal for full transition by 2040. It applies to all transit agencies that own, operate, or lease buses in California with a GVWR greater than 14,000 lbs. It includes standard, articulated, over-the-road, double-decker, and cutaway buses.

The Zero-Emission Airport Shuttle Regulation, adopted in June 2019, requires airport shuttle operators in California to transition to 100 percent ZEV technologies. Airport shuttle operators must begin adding zero-emission shuttles to their fleets in 2027, and complete the transition to ZEVs by the end of 2035. The regulation applies to airport shuttle operators who own, operate, or lease vehicles at any of the 13 California airports regulated under this rule.

10. Incentive Programs

There are many different incentive programs focusing on heavy-duty vehicles that accelerate turnover to cleaner technologies, and thereby produce extra emission reductions beyond traditional regulations. 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.

a) Low Carbon Transportation Investments and Air Quality Improvement Program (Clean Transportation Incentives)

In addition to funding passenger vehicle incentive programs, the Low Carbon Transportation Investments and the Air Quality Improvement Program (Clean Transportation Incentives) also provides incentive funding for heavy-duty vehicles. This program both funds projects to accelerate fleet and engine turnover to cleaner existing technologies through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) and Truck Loan Assistance program, as well as funding demonstration and pilot projects.

Beyond the vehicle purchasing incentives programs (CVRP and Clean Cars 4 All) and Clean Transportation Equity Investments, an additional $873 million was allocated in the FY 2020-2021 budget for on-road heavy-duty trucks and off-road equipment. CARB provides these incentive funds following the principles of the portfolio approach, meaning that funding is provided across multiple sectors and applications – as well as across multiple technologies to support both the technologies that are providing emission reductions today, as well as those that are needed to meet future goals as the technology matures. This includes funding for demonstration and pilot projects, vouchers for advanced clean technologies, and financing and support for small fleets transitioning to cleaner technologies. Additionally, this year funding was set aside specifically for drayage trucks, transit buses, and school buses, all of which are primed to rapidly transition to zero-emission.

i. Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)

CARB's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) serves as the cornerstone program in CARB's advanced technology heavy-duty incentive portfolio. HVIP has provided funding since 2010 to support the long-term transition to cleaner combustion and zero-emission vehicles in the heavy-duty market. The program helps offset the higher costs of clean vehicles, and additional incentives are available for providing disadvantaged community benefits. HVIP responds to a key market challenge by making clean vehicles more affordable for fleets through point-of-purchase price reductions. With an HVIP voucher, technology-leading vehicles can be as affordable as their traditional fossil-fueled counterparts, enabling fleets of all sizes to deploy advanced technologies that are cleaner and quieter. HVIP is the earliest model in the United States to demonstrate the function, flexibility, and effectiveness of first-come first-served incentives that reduce the incremental cost of commercial vehicles. HVIP is fleet-focused, providing a streamlined and user-friendly option to encourage purchases and leases of advanced clean trucks and buses throughout California. Approved dealers are a key part of HVIP success and are trained to facilitate the application process**.** Vocations include freight and drayage trucks, delivery vans, utility vehicles, transit, school, and shuttle buses, refuse trucks, and more. In FY 2021-22, the Legislature allocated $569.5 million for HVIP.

ii. Truck Loan Assistance Program

CARB's Truck Loan Assistance Program was created through a one-time appropriation of approximately $35 million in the 2008 State Budget to implement a heavy-duty loan program that assists on-road fleets affected by the Truck and Bus Regulation and the Heavy-Duty

Tractor-Trailer Greenhouse Gas Regulation. CARB has continued to operate this program with subsequently appropriated AQIP funds of around $28 million annually to provide financing opportunities to small-business truckers who don't meet conventional lending criteria and are unable to qualify for traditional financing for cleaner trucks. As of February 2022, about $187 million in Truck Loan Assistance Program funding has been provided to small business truckers for the purchase of approximately 36,000 cleaner trucks, exhaust retrofits, and trailers. In FY 2021-22, $28.6 million was allocated for the Truck Loan Assistance Program.

iii. Demonstration and Pilot projects

In addition to funding HVIP and the Truck Loan Assistance Program, the Clean Transportation Incentives program is the only program in CARB's portfolio, and one of the only programs in the State, that funds demonstration and pilot projects to support early market deployment of nascent zero-emission technologies. The purpose of the Advanced Technology Demonstration and Pilot Projects is to help accelerate the next generation of advanced technology vehicles, equipment, or emission controls, which are not yet commercialized. As such, it provides a testing ground for innovative projects focused on improving access to clean transportation for priority communities. In FY 2021-22, $80 million was allocated for heavy-duty advanced technology demonstration and pilot projects, which are intended to help bring to market-readiness zero emission (ZE) heavy-duty technologies that are poised to deploy commercially in the near future in both on- and off-road applications. This includes zero-emission long-haul trucks, strategic truck range extenders, and ZE applications along freight facilities/corridors.

In heavy-duty applications, the goods movement sector is a focus for incentive funding, with CARB funding multiple demonstration and pilot programs to drive zero-emission technologies in last mile delivery trucks, drayage trucks, and heavy-duty trucks and tractors. The *USPS Zero-Emission Delivery Truck Pilot Commercial Deployment Project* is deploying battery electric last-mile delivery trucks in the USPS fleet, together with the associated charging infrastructure. The project will demonstrate the practicality and economic viability of the widespread adoption of a variety of ZE medium- and heavy-duty vehicle technologies in delivery applications. The *Battery Electric Drayage Truck Demonstration* project is a $40 million Statewide demonstration of forty-four zero-emission battery electric and plug-in hybrid drayage trucks that, since 2018, have been in operation serving major California ports in five air districts (San Joaquin Valley, South Coast, Bay Area, Sacramento, and San Diego). Battery electric drayage trucks are used to transport cargo to or from California's ports and intermodal rail yards. Installation of charging infrastructure that enables safe charging of the trucks for statewide demonstration is also included as part of this project. To accelerate the deployment of zero-emission technologies in heavier freight applications, the $44.8 million *Volvo Low Impact Green Heavy Transportation Solutions* project is funding Class 8 heavy-duty battery electric trucks equipped with battery electric tractors to facilitate creation of a zero-emission goods movement system from the Ports of Long Beach and Los Angeles to four freight handling facilities in disadvantaged communities.

Clean transportation incentives have also funded demonstration and pilot projects for ZE urban transit buses. The $22.3 million *Fuel Cell Electric Bus Commercialization Consortium* in the Bay

Area and Southern California is funding battery and fuel cell urban transit buses, which will better serve communities' transit needs, substantially reduce greenhouse gas emissions, eliminate criteria pollutants, and provide economic benefits.

iv. Clean Transportation Equity Investments

As mentioned earlier, Clean Mobility in Schools Projects are also encouraging and accelerating the deployment of new zero-emission heavy-duty engines and vehicles, including battery electric school buses and clean school fleet vehicles.

b) Moyer Program

The Carl Moyer Memorial Air Quality Standards Attainment Program (Moyer Program), funded by dedicated revenue from the DMV's smog abatement fee and a fee on the purchase of new tires, provides approximately $60 million in grant funding annually through local air districts for cleaner-than-required engines and equipment. Since 1998, approximately $1 billion has been allocated to date. The Moyer Program provides monetary grants to private companies and public agencies to clean up their heavy-duty engines beyond that required by law through retrofitting, repowering or replacing their engines with newer and cleaner ones. These grants are issued locally by air districts. Projects that reduce emissions from heavy-duty on-road engines qualify, including heavy-duty trucks, drayage trucks, emergency vehicles, public agency and utility vehicles, school buses, solid waste collection vehicles, and transit fleet vehicles.

As the regulatory, technological and incentives landscape has changed significantly since the creation of the Moyer Program and to address evolving needs, the Legislature has periodically modified the program to better serve California. Most recently, Senate Bill (SB) 513 (Beall, 2015) has provided new opportunities for the Moyer Program to contribute significant emission reductions alongside implemented regulations, advance zero and near-zero technologies, and combine program funds with those of other incentive programs.

In the FY 2021-22 budget, the Legislature appropriated an additional $45 million in Moyer Program funding to support the replacement of diesel trucks with ultra-low NOx trucks certified to meet the 0.02 g/bhp-hr NOx standard or lower. Currently, only the San Joaquin Valley Air Pollution Control District and the South Coast Air Quality Management District would be eligible for these funds. In November 2021, the Board approved increases to the Moyer Program cost-effectiveness limits and funding caps for optional advanced technology and zero-emission replacement projects for on-road heavy-duty trucks. Increasing the cost-effectiveness thresholds is designed to increase funding opportunities, and ensures that the Moyer Program continues to focus on developing the most advanced zero-emission and low emission technologies, consistent with encouraging further emissions reductions. These changes included increasing the threshold for on-road zero-emission vehicles, which includes zero-emission school buses, from $100,000 to $500,000 per unit.

The Moyer Program also funds CARB's On-Road Heavy-Duty Voucher Incentive Program (VIP), which provides funding opportunities for small fleet owners with 10 or fewer vehicles to quickly replace their older heavy-duty diesel or alternative fuel vehicles. Under this program, fleet owners may be eligible for funding of up to $410,000 for replacing their existing vehicle(s) to be scrapped and replaced by new trucks (zero-emission or certified to the optional 0.02 g/bhp-hr NOx standard), or up to $50,000 for replacing their existing fleet with used vehicles with 2013 model year or later engines. Air districts have the discretion to set certain local eligibility requirements based upon local priorities.

c) Goods Movement Emission Reduction Program (Prop 1B)

The Prop 1B Program was created to reduce exposure for populations living near freight corridors and facilities that were being adversely impacted by emissions from goods movement. This program provided incentives to owners of equipment used in freight movement to upgrade to cleaner technologies sooner than required by law or regulation. Voters approved $1 billion in total funding for the air quality element of the Prop 1B Program to complement $2 billion in freight infrastructure funding under the same ballot initiative.

Beginning in 2008, the Goods Movement Emission Reduction Program funded by Prop 1B has funded cleaner trucks for the region’s transportation corridors; the final increment of funds implemented projects through 2020. The $1 billion program was a partnership between CARB and local agencies, air districts, and seaports to quickly reduce air pollution emissions and health risk from freight movement along California's trade corridors. While all Prop 1B Program funds have been awarded to the local air districts for implementation, the program framework exists to serve as a mechanism to award clean truck funds through newer funding programs.

d) Volkswagen (VW) Mitigation Trust

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

e) Community Air Protection Incentives (AB 617 | Community Air Protection Program)

Since the 2016 State SIP Strategy elucidated the need for additional legislative assistance in funding turnover programs to accelerate the deployment and adoption of cleaner technologies, the Legislature has since 2017 established a number of new incentive programs that are implemented through CARB through various budget bills. The State Legislature has provided substantial funding to achieve early emissions reductions in the communities most impacted by air pollution. In its 2018 funding allocation, the Legislature expanded the possible uses of AB 617 funds to include Moyer and Proposition 1B eligible projects with a priority on zero-emission projects, zero-emission charging infrastructure, stationary source projects, and additional projects consistent with the CERPs.

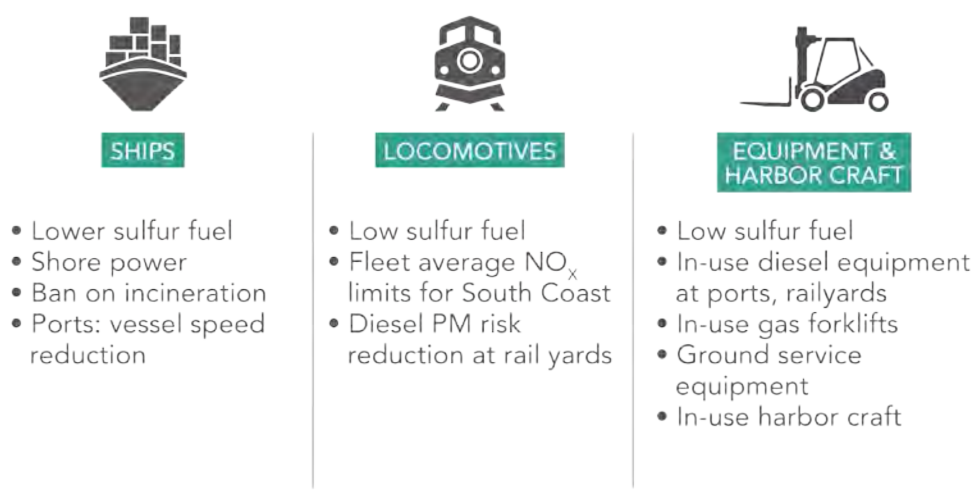
CARB and air districts partner to run the programs, with CARB developing guidelines and the districts administering funds for their regions. In most cases throughout the State, selected communities have identified mobile source emissions as a target for reductions. It is likely that a significant portion of the AB 617-allocated funding will incentivize the accelerated turnover to cleaner vehicles and equipment in and around low-income and disadvantaged communities.

C. Off-Road Sources

Off-road sources encompass equipment powered by an engine that does not operate on the road. Sources vary from ships to lawn and garden equipment and for example, include sources like locomotives, aircraft, tractors, harbor craft, off-road recreational vehicles, construction equipment, forklifts, and cargo handling equipment.

Figure 2 illustrates the comprehensive suite of emission control measures applicable to the broad variety of engines and vehicle that fall under the Off-Road category. As a result of these emission control efforts, off-road emissions in the Eastern Kern Nonattainment Area have been reduced since 1990 and will continue to decrease through 2032. From today, off-road NOx emissions from sources that are not primarily regulated Federally are projected to decrease by 38 percent in 2026, and by 51 percent in 2032. Key programs in this sector include the Off-Road Engine Standards, Locomotive Engine Standards, Clean Diesel Fuel, Cleaner In-Use Off-Road Regulation, and the In-Use Large Spark Ignition (LSI) Fleet Regulation.

Figure 2: Off-Road Vehicle and Equipment Control Programs



1. Off-Road Engine 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. 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.

CARB first approved regulations to control exhaust emissions from small off-road engines (SORE) such as lawn and garden equipment in December 1990 with amendments in 1998, 2003, 2010, 2011, 2016, and 2021. The 1990 - 2016 regulations were implemented through three tiers of progressively more stringent exhaust emission standards that were phased in between 1995 and 2008. The most recent suite of amendments (December 2021) requires most newly manufactured SORE engines be zero emission starting in 2024.

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.

To control emissions from Transport Refrigeration Units (TRUs), CARB adopted in 2004 the Airborne Toxic Control Measure (ATCM) for In-Use Diesel-Fueled TRUs, TRU Generator Sets, and Facilities where TRUs Operate, which set increasingly stringent engine standards to reduce diesel particulate matter emissions from TRUs and TRU generator sets. The ATCM for TRUs was subsequently amended in 2010 and 2011, and most recently in February 2022, as the first phase of CARB's current push to develop new requirements to transition diesel-powered TRUs to zero-emission technology in two phases. The February 2022 adoption, Part 1 amendments to the existing TRU Airborne Toxic Control Measure (ATCM), requires the transition of diesel-powered truck TRUs to zero-emission. CARB plans to develop a subsequent Part 2 regulation to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets, for future Board consideration.

2. Cleaner In-Use Off-Road Equipment (Off-Road Regulation)

The Off-Road Regulation was first approved in 2007 and subsequently amended in 2010 in light of the impacts of the economic recession. Equipment affected by this regulation are used in construction, manufacturing, the rental industry, road maintenance, airport ground support and landscaping. In December 2011, the Off-Road Regulation was modified to include on-road trucks with two diesel engines.

The Off-Road Regulation will significantly reduce emissions of diesel PM and NOx from the over 150,000 in-use off-road diesel vehicles that operate in California. The Regulation affects dozens of vehicle types used in thousands of fleets by requiring owners to modernize their fleets by replacing older engines or vehicles with newer, cleaner models, retiring older vehicles or using them less often, or by applying retrofit exhaust controls.

The Off-Road Regulation imposes idling limits on off-road diesel vehicles, requires a written idling policy, and requires a disclosure when selling vehicles. The Regulation also requires that all vehicles be reported to CARB and labeled, restricts the addition of older vehicles into fleets, and requires fleets to reduce their emissions by retiring, replacing, or repowering older engines, or installing verified exhaust retrofits. The requirements and compliance dates of the Off-Road Regulation vary by fleet size.

Fleets are subject to increasingly stringent restrictions on adding older vehicles. The regulation also sets performance requirements. While the regulation has many specific provisions, in general by each compliance deadline, a fleet must demonstrate that it has either met the fleet average target for that year, or has completed the Best Available Control Technology requirements. The performance requirements of the Off-Road Regulation were phased in from January 1, 2014 through January 1, 2019.

Compliance assistance and outreach activities in support of the Off-Road Regulation include:

- The Diesel Off-road On-line Reporting System, an online reporting tool developed and maintained by CARB staff;
- The Diesel Hotline (866-6DIESEL), which provides the regulated public with questions about the regulations and access to CARB staff. Staff is able to respond to questions in English, Spanish and Punjabi; and
- The Off-road Listserv, providing equipment owners and dealerships with timely announcement of regulatory changes, regulatory assistance documents, and reminders for deadlines.

3. Clean Diesel Fuel

Since 1993, CARB has required that diesel fuel have a limit on the aromatic hydrocarbon content and sulfur content of the fuel. Diesel powered vehicles account for a disproportionate amount of the diesel particulate matter which is considered a toxic air contaminant by the State of California. In 2006, CARB required a low-sulfur diesel fuel to be used not only by on-road diesel vehicles but also for off-road engines. The diesel fuel regulation allows alternative diesel formulations as long as emission reductions are equivalent to the CARB formulation.

4. Locomotive Engine Standards

The Clean Air Act and the U.S. EPA national locomotive regulations expressly preempt states and local governments from adopting or enforcing “any standard or other requirement relating to the control of emissions from new locomotives and new engines used in locomotives” (U.S. EPA interpreted new engines in locomotives to mean remanufactured engines, as well). U.S. EPA has approved two sets of national locomotive emission regulations (1998 and 2008). In 1998, U.S. EPA approved the initial set of national locomotive emission regulations. These regulations primarily emphasized NOx reductions through Tier 0, 1, and 2 emission standards.

Tier 2 NOx emission standards reduced older uncontrolled locomotive NOx emissions by up to 60 percent, from 13.2 to 5.5 g/bhphr.

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/bhphr), for model years 2012-2014, is the same as the Tier 2+ remanufacture PM emission standard. The 2008 regulations also included new Tier 4 (2015 and later model years) locomotive NOx and PM emission standards. The U.S. EPA Tier 4 NOx and PM emission standards further reduced emissions by approximately 95 percent from uncontrolled levels.

In April 2017, CARB petitioned U.S. EPA for rulemaking, seeking the amendment of emission standards for newly built locomotives and locomotive engines and lower emission standards for remanufactured locomotives and locomotive engines. The petition asks U.S. EPA to update its standards to take effect for remanufactured locomotives in 2023 and for newly built locomotives in 2025. The new emission standards would provide critical criteria pollutant reductions, particularly in the disadvantaged communities that surround railyards. U.S. EPA has not yet responded to this petition.

5. Large Spark-Ignition (LSI) Engines and Forklifts

Forklift fleets are subject to in-use fleet requirements either under the LSI fleet regulation, if fueled by gasoline or propane, or under the off-road diesel fleet regulation, if fueled by diesel. Both regulations require fleets to retire, repower, or replace higher-emitting equipment in order to maintain fleet average standards.

Large spark-ignition engines, which are defined as spark-ignition (i.e., Otto-cycle) engines greater than 25 horsepower, are used in a variety of equipment, including, but not limited to, forklifts, airport ground support equipment (GSE), sweeper/scrubbers, industrial tow tractors, generator sets, and irrigation pumps. LSI equipment is found in approximately 2,000 fleets throughout the state operating at warehouses and distribution centers, seaports, airports, railyards, manufacturing plants, and many other commercial and industrial facilities.

CARB first adopted emission standards for off-road LSI engines in 1998. The original LSI regulation required engine manufacturers to certify new LSI engines to a 3.0 gram per brake horsepower-hour (g/bhp-hr) standard that, by 2004, represented a 75 percent reduction in emissions compared with uncontrolled LSI. Building on this success, in 2002, U.S. EPA subsequently harmonized the national standard with California’s standard, starting with the 2004 model year and adopted a more stringent 2.0 g/bhp-hr standard for 2007 and subsequent model year engines. The federal program demonstrated that additional reductions from new engines were technically feasible and cost-effective. In the 2003 State Implementation Plan for Ozone (2003 SIP), California committed to two additional LSI measures—one for the development of more stringent new engine standards and another for the development of in-use fleet requirements.

CARB adopted these two LSI measures in a 2006 rulemaking, which harmonized California's standard with U.S. EPA's 2.0 g/bhp-hr standard starting with the 2007 model year, set forth a more stringent 0.6 g/bhp-hr California standard starting with the 2010 model year, and established in-use LSI fleet requirements. The 0.6 g/bhp-hr standard represents a 95 percent emission reduction versus uncontrolled LSI engines and is still in effect today.

The in-use element of the 2006 rulemaking, adopted as the Large Spark-Ignition Engine Fleet Requirements Regulation (LSI Fleet Regulation), which was eventually amended in 2010 and 2016, requires fleet operators with four or more LSI forklifts to meet fleet average emission standards. The 2006 LSI rulemaking and 2010 amendments required specific hydrocarbon + NOx fleet average emission level standards that became increasingly more stringent over time. The focus of the 2016 amendments was to collect data from fleet operators in order to inform the development of requirements that would support the broad-scale deployment of Zero-Emission equipment in LSI applications. The 2016 amendments also required fleet operators to report key compliance information to CARB, and extended to 2023 requirements from the prior LSI Fleet Regulations that were otherwise due to sunset in 2016.

6. Cargo Handling Equipment

Cargo handling equipment (CHE) include yard trucks (hostlers), rubber-tired gantry cranes, container handlers, forklifts, dozers, and other types. The Cargo Handling Equipment Regulation established requirements for in-use and newly purchased diesel-powered equipment at ports and intermodal rail yards. CARB adopted the CHE Regulation in 2005, which established best available control technology (BACT) for new and in-use mobile CHE that operate at California's ports and intermodal rail yards through accelerated turnover of older equipment through retrofits and/or replacement to cleaner on- or off-road engines. Since 2006, the CHE Regulation has resulted in reductions of diesel PM and NOx at ports and intermodal rail yards throughout California.

7. Incentive Programs

There are many different incentive programs focusing on off-road mobile sources that increase the penetration of cleaner technologies into the market. The incentive programs encourage the purchase of cleaner off-road combustion engines and equipment, and zero-emission technologies. CARB is expanding incentives for zero-emission off-road equipment through targeted demonstration and pilot project categories in the off-road sector, and increased funding.

a) Low Carbon Transportation Investments and Air Quality Improvement Program (Clean Transportation Incentives)

As mentioned earlier, $873 million was allocated in the FY 2020-2021 budget for off-road equipment and on-road heavy-duty trucks under the Clean Transportation Incentives programs.

In the off-road sector, major programs include the Clean Off-Road Equipment Voucher Incentive Project (CORE), and Demonstration and Pilot Programs. Off-road equipment categories that are prioritized for funding include agricultural and construction equipment, SORE such as lawn and garden equipment, heavier CHE, and ZE applications at railyards, marine ports, freight facilities, and along freight corridors.

i. Clean Off-Road Equipment Voucher Incentive Project

CORE is a voucher project similar to HVIP, but for advanced technology off-road equipment. CORE is intended to accelerate deployment of advanced technology in the off-road sector by providing a streamlined way for fleets to access funding that helps offset the incremental cost of such technology. CORE targets commercial-ready products that have not yet achieved a significant market foothold. By promoting the purchase of clean technology over internal combustion options, the project is expected to reduce emissions, particularly in areas that are most impacted, help build confidence in zero-emission technology in support of CARB strategies and subsequent regulatory efforts where possible, and provide other sector-wide benefits, such as technology transferability, reductions in advanced-technology component costs, and larger infrastructure investments. CORE provides vouchers to California purchasers and lessees of zero-emission off-road equipment on a first-come, first-served basis, with increased incentives for equipment located in disadvantaged communities.

CARB launched CORE at the end of 2019 through a one-time $40 million allocation in the fiscal year 2017-18 Funding Plan to support zero-emission freight equipment through CORE. Since that time, CORE has been allocated significant additional funds, including $194.95 million from the FY 2021-22 budget. This allocation includes $30 million of dedicated funds appropriated by the Legislature in SB 170 to provide incentives for professional landscaping services in California operated by small businesses or sole proprietors to purchase zero-emission small off-road equipment.

ii. Demonstration and Pilot Projects

As mentioned earlier, in FY 2021-22, $80 million was allocated for off-road and on-road heavy-duty advanced technology demonstration and pilot projects. CARB is focusing funding on off-road demonstration and pilot projects that include heavier CHE, clean equipment in rail, marine, and ports applications, and zero-emission equipment along freight facilities/corridors.

For the *Port of LA Multi-Source Facility Demonstration Project*, the Los Angeles Harbor Department (Port of LA) was awarded $14.5 million to operate multiple near zero- or zero-emission technologies to move goods from ships through the Green Omni Terminal. This project is demonstrating the viability of electrified CHE, forklifts, and a ships at-berth vessel emissions control system. The *Zero-Emission Freight "Shore to Store"* Project will use $41.1 million to fund electric yard tractors, hydrogen fuel cell Class 8 on-road trucks, and a large capacity hydrogen fueling station in Ontario, CA. Additional zero- and near zero-emission freight facility projects include a $5.8 million *Zero-Emission for California Ports* project at the Port of LA, which will fund hybrid fuel cell and electric yard trucks, as well as hydrogen fueling stations. Further, the San Joaquin Valley's *Net-Zero Farming and Freight Facility Demonstration Project* is funding battery electric trucks equipped with all-electric transport refrigeration units (eTRUs) to facilitate clean freight transport, and transportation of agricultural produce between packing and warehouse facilities.

b) Funding Agricultural Replacement Measures for Emission Reductions (FARMER)

California's agricultural industry consists of approximately 77,500 farms and ranches, providing over 400 different commodities, making agriculture one of the State's most diverse industries. In recognition of the strong need and this industry's dedication to reducing their emissions, the Legislature has allocated over $323 million towards the Funding Agricultural Replacement Measures for Emission Reductions (FARMER) Program since 2017. The program provides funding through local air districts for incentivizing the introduction of lower-emissions agricultural harvesting equipment, heavy-duty trucks, agricultural pump engines, tractors, and other equipment used in agricultural operations. Since October 2019, the FARMER Program also includes a project category for demonstration projects and modifications to the zero-emission agricultural utility terrain vehicle (UTV), heavy-duty agricultural truck, and off-road mobile agricultural equipment trade-up pilot project categories. As of March 31, 2022, the FARMER Program has spent $298 million on over 7,000 pieces of agricultural equipment and will reduce 1,210 tons of PM2.5 and 20,000 tons of NOx over the lifetime of the projects, Statewide.

c) Moyer Program

In addition to funding on-road incentives, the Moyer Program provides monetary grants to reduce emissions from off-road equipment such as construction and agricultural equipment, marine vessels and locomotives, forklifts, TRUs, and airport ground support equipment.

d) Goods Movement Emission Reduction Program (Prop 1B)

As discussed earlier, Proposition 1B was a $1 billion partnership between CARB and local agencies, air districts, and seaports to quickly reduce air pollution emissions and health risk from freight movement along California's trade corridors. Over the course of six years, the program has upgraded ships at-berth, cargo handling equipment, locomotives, TRUs, and harbor craft.

II. Conclusion

In conclusion, CARB has implemented the most comprehensive mobile source emissions control program in the nation. CARB's mobile source control program is robust and targets all sources of emissions through a four-pronged approach. First, increasingly stringent emissions standards drive the use of the cleanest available engines and equipment, and minimize emissions from new vehicles and equipment. Second, to speed the turnover of older, dirtier engines and equipment to cleaner new equipment, in-use programs target emissions from the existing fleet by requiring vehicle and fleet owners to transition legacy fleets and vehicles to the cleanest vehicles and emissions control technologies. Third, incentive programs help fleet owners to replace older, dirtier vehicles and equipment with the cleanest technologies, while also facilitating the development of the next generation of clean technologies that are needed to meet future air quality targets. Finally, cleaner fuels minimize emissions from all combustion engines being used across the State.

This multi-faceted approach has not only spurred the development and use of increasingly cleaner technologies and fuels, it has also provided significant emission reductions across all mobile source sectors that go far beyond national programs or programs in other states.

APPENDIX I
CARB Control Measures, 1985 to 2018

Board Action	Hearing Date
Public Meeting to Consider Proposed Amendments to the Low- Emission Vehicle III Greenhouse Gas Emission Regulation: The purpose of these proposed amendments is to clarify that the "deemed to comply" option for model years 2021 through 2025 is applicable only if the currently adopted federal regulations, as they existed as of the date the 2017 Final Determination was released (incorporated in the Code of Federal Regulations and last amended on October 25, 2016), is in effect.	9/27/18
Public Meeting to Consider Proposed California Greenhouse Gas Emissions Standards for Medium- And Heavy-Duty Engines and Vehicles (Phase 2) And Proposed Amendments To The Tractor-Trailer GHG Regulation: The proposed regulation would adopt new, more stringent California Phase 2 GHG emission standards that largely harmonize with the federal Phase 2 standards, and proposed amendments to the Tractor-Trailer GHG regulation to harmonize California's Tractor-Trailer GHG regulation with the proposed Phase 2 trailer standards. The proposed California Phase 2 GHG standards are needed to meet the mandates of both AB 32 and of SB 32, and the California HSC.	2/8/18
Public Meeting to Consider Proposed Amendments to California Specification for Fill Pipes and Openings Of Motor Vehicle Fuel Tanks: The proposed amendments will clarify fill pipe design and performance requirements to help ensure that the fill pipe minimizes air leakage and forms a good seal with the nozzle boot. This proposal will in turn assist in addressing overpressure at California's gasoline dispensing facilities (GDFs).	10/25/18
Public Meeting to Consider Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation: The proposed amendments will clarify existing requirements and pertain to the third compliance period of the Cap-and-Trade Program (Program), which began January 1, 2018, and beyond	3/22/18
Public Meeting to Consider Proposed Amendments to the California Cap on Greenhouse Gas Emissions and Market- Based Compliance Mechanisms Regulation: Staff proposed amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation (Cap-and-Trade Regulation or Regulation; title 17, California Code of Regulations, sections 95801 et seq.).	11/15/18
Public Hearing to Consider Proposed California Regulation and Certification Procedures for Light- Duty Engine Packages for Use in New Light-Duty Specially- Produced Motor Vehicles for 2019 and Subsequent Years: The proposed regulation would establish a certification process for new light-duty certified engine packages for use in an SPMV. These certified engine packages can be purchased by SPMV manufacturers and installed into an SPMV and then sold as a new current model year vehicle.	5/25/18
Public Hearing to Consider Proposed Amendments to the Consumer Products Regulation and Method 310: Proposed amendments to the Consumer Products Regulation to include an alternate compliance option to provide flexibility for manufacturers in meeting the requirements of the 10 percent by weight VOC limit for MPL products. Additionally, staff is proposing to prohibit the use of compounds with high global warming potentials (GWP) in MPL products.	5/25/18
Proposed Amendments to the Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program: The proposed amendments would require truck owners to maintain their particulate matter (PM)emissions control components, thereby reducing diesel PM emissions from the on-road HD vehicle sector.	5/25/18
Public Hearing to Consider Proposed Amendments to Enhanced Vapor Recovery Regulations to Standardize Gas Station Nozzle Spout Dimensions to Help Address Storage Tank Overpressure: Proposed amendments would amend nozzle spout assembly dimensional requirements contained in three existing vapor recovery certification procedures to help address storage tank overpressure conditions at gasoline dispensing facilities equipped with Phase II Enhanced Vapor Recovery (EVR) systems. Gasoline dispensing facilities include retail service stations as well as non-retail fueling facilities that serve rental car fleets, municipal fleets, and auto dealerships.	10/25/18

CARB Control Measures

Board Action	Hearing Date
Public Hearing to Consider Proposed Amendments to California Emission Control System Warranty Regulations and Maintenance Provisions for 2022 and Subsequent Model Year On-Road Heavy- Duty Diesel Vehicles with Gross Vehicle weight Ratings Greater Than 14,000 Pounds and Heavy-Duty Diesel Engines in such Vehicles: Heavy-duty diesel vehicles with a gross vehicle weight rating (GVWR) over 14,000 pounds are one of the largest sources of air pollution in California. They contribute approximately 45 percent of total statewide mobile source oxides of nitrogen (NOx) emissions and 19 percent of mobile source particulate matter (PM 2.5) emissions(CARB, 2017c).	6/28/18
Proposed Revisions to On-Board Diagnostic System Requirements, Including the introduction of Real Emissions Assessment Logging (Real), for Heavy Duty Engines, Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines: Proposed amendments would apply to the following sections in title 13, CCR: section 1971.1 "On-Board Diagnostic System Requirements – 2010 and Subsequent Model-Year Heavy-Duty Engines," 1971.5 "Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year HeavyDuty Engines," and 1968.2 "Malfunction and Diagnostic System Requirements – 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines."	11/15/18
Public Hearing to Consider Proposed Regulation for Prohibitions on Use of Certain Hydrofluorocarbons in Stationary Refrigeration and Foam End-Uses: The proposed regulation would adopt certain HFC prohibitions from U.S. EPA's SNAP Rules 20 and 21, which prohibit certain high-GWP HFCs in new equipment and in retrofits of existing equipment, and used as blowing agents in specific foam end-uses. Additionally certain HFCs would be prohibited in specific foam end-use sectors. The proposed regulation also requires record-keeping, and invoice disclosure language for equipment or materials sold or entered into commerce in the State of California and provides an enforcement mechanism if a regulated party violates the proposed regulation.	3/22/18
Public Hearing to Consider Proposed Innovative Clean Transit Regulation, a Replacement of the Fleet Rule for Transit Agencies: The Innovative Clean Transit (ICT) Regulation requires California transit agencies to gradually transition their buses to zero-emission technologies. The ICT regulation is structured to allow transit agencies to take advantage of incentive programs by acting early and in a manner to implement plans that are best suited for their own situations.	12/14/18
Public Hearing to Consider Proposed Amendments to the Regulation for the Mandatory Reporting of Greenhouse Gas Emissions: The proposed amendments clarify the existing requirements, add targeted new requirements necessary to support the GHG emissions reduction goals of AB 32 and SB 32, the Cap-and-Trade Program, and support the statewide GHG inventory. In supporting the Cap-and-Trade Program, data is needed to calculate reporting entities' compliance obligations and for allowance allocation. For GHG emissions inventory support, additional requirements give a clearer picture of the current portfolio of GHG emissions in the state, and a better understanding of the progress towards future GHG emissions goals	11/15/18
Public Hearing to Consider Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels: The purpose of this regulation is to implement a low carbon fuel standard, which will reduce the full fuel-cycle, carbon intensity of the transportation fuel pool used in California, pursuant to the California Global Warming Solutions Act of 2006 (Health & Safety Code [H&S], section 38500 et seq.)	9/27/18
Public Hearing to Consider Proposed Guidelines for the Clean Cars 4 All and Enhanced Fleet Moderization: Voluntary accelerated vehicle retirement or "scrap and replace" programs provide financial incentives to consumers to retire older, higher-polluting, and less fuel efficient vehicles. The purpose of these programs is to reduce fleet emissions by accelerating the turnover of the existing fleet and the subsequent replacement with newer, cleaner, and more efficient vehicles. Reducing emissions from the existing fleet is a component of California's State Implementation Plan for meeting air quality standards and supports efforts to meet the State's 2030 climate change goals.	7/26/18

CARB Control Measures

Board Action	Hearing Date
Public Hearing to Consider Proposed Amendments to California Evaluation Procedures For New Aftermarket Catalytic Converters: CARB staff is proposing amendments to the procedures it uses to evaluate and approve aftermarket catalytic converters designed for use on California passenger cars and trucks to allow them to be used for LEV III vehicles.	9/29/17
Public Meeting to Consider the Proposed Amendments to the Evaporative Emission Requirements for Small Off-Road Engines: The proposed amendments will address to non-compliance of small off-road engines (SORE) with existing evaporative emission standards, as well as amendments to streamline the certification process by harmonizing where feasible with federal requirements.	11/16/17
Public Meeting to Consider the Proposed Amendments to the Airborne Toxic Control Measure For Diesel Particulate Matter From Portable Engines: The purpose of this airborne toxic control measure (ATCM) is to reduce diesel particulate matter (PM) emissions from portable diesel-fueled engines having a rated brake horsepower of 50 and greater (≥ 50 bhp)	11/17/16
Notice of Public Hearing to Consider Proposed Regulation to Provide Certification Flexibility for Innovative Heavy-Duty Engine and California Certification and Installation Procedures for Medium and Heavy-Duty Vehicle Hybrid Conversion Systems: This proposed regulation's certification flexibility is tailored to encourage development and market launch of heavy-duty engines meeting California's optional low oxides of oxides of nitrogen emission standards, robust heavy-duty hybrid engines, and high-efficiency heavy-duty engines.	10/20/16
Public Hearing to Consider Amendments to the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulations: The proposed amendments would extend major provisions of the Regulation beyond 2020; link the Regulation with Ontario, Canada; continue cost-effective prevention of emission leakage through allowance allocations to entities; and enhance Program implementation and oversight.	9/22/16
Public Hearing to Consider Proposed Amendments to the Mandatory Reporting of Greenhouse Gas Emissions: The proposed amendments are to ensure reported GHG data are accurate and fully support the California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms and comply with the U.S. EPA Clean Power Plan.	9/22/16
Public Hearing to Consider Proposed Amendments to the Large Spark-Ignition Engine Fleet Requirements Regulation: The proposed amendment will establish new reporting and labeling requirements and extend existing recordkeeping requirements. The proposed regulatory amendments are expected to improve the reliability of the emission reductions projected for the existing LSI Fleet Regulation by increasing enforcement effectiveness and compliance rates.	7/21/16
Public Hearing to Consider Proposed Evaluation Procedure for New Aftermarket Diesel Particulate Filters Intended as Modified Parts for 2007 through 2009 Model Year On-Road Heavy-Duty Diesel Engines: The proposed amendment would establish a path for exempting aftermarket modified part DPFs intended for 2007 through 2009 on-road heavy-duty diesel engines from the prohibitions of the current vehicle code. Staff is also proposing to incorporate a new procedure for the evaluation of such DPFs.	4/22/16
Public Hearing to Consider Proposed Amendments to the Regulation for Small Containers of Automotive Refrigerant: The proposed amendments to the Regulation for Small Containers of Automotive Refrigerant to clarify any existing requirement that retailers must transfer the unclaimed consumer deposits to the manufacturers, clarify how the manufacturers spend the money, set the refundable consumer deposit at $10, and require additional language on the container label.	4/22/16
Amendments to the Portable Fuel Container Regulation Amendments to the Portable Fuel Container (PFC) regulation, which include requiring certification fuel to contain 10 percent ethanol, harmonizing aspects of the Board's PFC certification and test procedures with those of the U.S. EPA, revising the ARB's certification process, and streamlining, clarifying, and increasing the robustness of ARB's certification and test procedures.	2/18/16

CARB Control Measures

Board Action	Hearing Date
Technical Status and Proposed Revisions to On-Board Diagnostic System Requirements and Associated Enforcement Provisions for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II) Amendments to the OBD II regulations that update requirements to account for LEV III applications and monitoring requirements for gasoline and diesel vehicles, and clarify and improve the regulation; also, updates to the associated OBD II enforcement regulation to align it with the proposed amendments to the OBD II regulations and a minor amendment to the definition of "emissions-related part" in title 13, CCR section 1900.	9/25/15
2015 Low Carbon Fuel Standard (LCFS) Amendments (2 of 2) Re-adoption of the Low Carbon Fuel Standard, which includes updates and revisions to the regulation now in effect. The proposed regulation was first presented to the Board at its February 2015 public hearing, at which the Board directed staff to make modifications to the proposal.	9/24/15
Proposed Regulation on the Commercialization of Alternative Diesel Fuels (2 of 2) Regulation governing the introduction of alternative diesel fuels into the California commercial market, including special provisions for biodiesel.	9/24/15
CA Cap on GHG Emissions and Market-Based Compliance Mechanisms (2 of 2) Amendments to the Cap and Trade Regulation to include a new Rice Cultivation Compliance Offset Protocol and an update to the United States Forest Compliance Offset Protocol that would include project eligibility in parts of Alaska.	6/25/15
Intermediate Volume Manufacturer Amendments to the Zero Emission Vehicle Regulation (2 of 2) Amendments regarding intermediate volume manufacturer compliance obligations under the Zero Emission Vehicle regulation.	5/21/15
2015 Amendments to Certification Procedures for Vapor Recovery Systems at Gasoline Dispensing Facilities—Aboveground Storage Tanks and Enhanced Conventional Nozzles Amendments would establish new performance standards and specifications for nozzles used at fleet facilities that exclusively refuel vehicles equipped with onboard vapor recovery systems, would provide regulatory relief for owners of certain existing aboveground storage tanks, and would ensure that mass-produced vapor recovery equipment matches the specifications of equipment evaluated during the ARB certification process.	4/23/15
Proposed Regulation for the Commercialization of Alternative Diesel Fuels (1 of 2) Regulation governing the introduction of alternative diesel fuels into the California commercial market, including special provisions for biodiesel. This is the first of two hearings on the item, and the Board will not take action to approve the proposed regulation.	2/19/15
Evaporative Emission Control Requirements for Spark-Ignition Marine Watercraft Regulation for controlling evaporative emissions from spark-ignition marine watercraft. The proposed regulation will harmonize, to the extent feasible, with similar federal requirements, while adding specific provisions needed to support California's air quality needs.	2/19/15
2015 Low Carbon Fuel Standard (LCFS) Amendments (1 of 2) Regulation for a Low Carbon Fuel Standard that includes re- adoption of the existing Low Carbon Fuel Standard with updates and revisions. This is the first of two hearings on the item, and the Board will not take action to approve the proposed regulation.	2/19/15
CA Cap on GHG Emissions and Market-Based Compliance Mechanisms to Add the Rice Cultivation Projects and Updated U.S. Forest Projects Protocols (1 of 2) Updates to the Cap and Trade Regulation to include a new Rice Cultivation Compliance Offset Protocol and an update to the United States Forest Compliance Offset Protocol that would include project eligibility in parts of Alaska.	12/18/14
2014 Amendments to ZEV Regulation Additional compliance flexibility to ZEV manufacturers working to bring advanced technologies to market.	10/23/14
LEV III Criteria Pollutant Requirements for Light- and Medium-Duty Vehicles the Hybrid Electric Vehicle Test Procedures, and the HD Otto-Cycle and HD Diesel Test Procedures Applies to the 2017 and subsequent model years.	10/23/14

CARB Control Measures

Board Action	Hearing Date
Amendments to Mandatory Reporting Regulation for Greenhouse Gases Further align reporting methods with USEPA methods and factors, and modify reporting requirements to fully support implementation of California's Cap and Trade program.	9/19/14
Amendments to the California Cap on Greenhouse Gas Emissions and Market Based Compliance Mechanisms Technical revisions to Mandatory Reporting of Greenhouse Gas Emissions Regulation to further align reporting methods with U.S.EPA update methods and factors, and modify reporting requirements to fully support implementation of California's Cap and Trade program.	9/18/14
Amendments to the AB 32 Cost of Implementation Fee Regulation Amendments to the regulation to make it consistent with the revised mandatory reporting regulation, to add potential reporting requirements, and to incorporate requirements within the mandatory reporting regulation to streamline reporting.	9/18/14
Low Carbon Fuel Standard 2014 Update As a result of a California Court of Appeal decision, ARB will revisit the LCFS rulemaking process to meet certain procedural requirements of the APA and CEQA. Following incorporation of any modifications to the regulation, the Board will consider the proposed regulation for adoption at a second hearing held in the spring of 2015.	7/24/14
Revisions to the Carl Moyer Memorial Air Quality Standards Attainment Program Guidelines for On-Road Heavy-Duty Trucks Revisions to 1) reduce surplus emission reduction period, 2) reduce minimum CA usage requirement, 3) prioritize on-road funding to small fleets, 4) include light HD vehicles 14000-19500 libs, and 5) clarify program specifications.	7/24/14
Amendments to Enhanced Fleet Modernization (Car Scrap) Program Amendments consistent with SB 459 which requires ARB to increase benefits for low-income California residents, promote cleaner replacement vehicles, and enhance emissions reductions.	6/26/14
Proposed Approval of Amendments to CA Cap on GHG Emissions and Market-Based Compliance Mechanisms Second hearing of two, continued from October 2013.	4/24/14
Truck and Bus Rule Update Amendments to the Regulation to Reduce Emissions of Diesel Particulate Matter, Oxides of Nitrogen, and Other Criteria Pollutants From In-Use On-Road Diesel-Fueled Vehicles: increasing low-use vehicle thresholds, allowing owners to newly opt-in to existing flexibility provisions, adjusting "NOx exempt" vehicle provisions, and granting additional time for fleets in certain areas to meet PM filter requirements.	4/24/14
Heavy-Duty GHG Phase I: On-Road Heavy-Duty GHG Emissions Rule, Tractor-Trailer Rule, Commercial Motor Vehicle Idling Rule, Optional Reduced Emission Standards, Heavy-Duty Hybrid-Electric Vehicles Certification Procedure New GHG standards for MD and HD engines and vehicles identical to those adopted by the USEPA in 2011 for MYs 2014-18.	12/12/13
Agricultural equipment SIP credit rule Incentive-funded projects must be implemented using Carl Moyer Program Guidelines; must be surplus, quantifiable, enforceable, and permanent, and result in emission reductions that are eligible for SIP credit.	10/25/13
Mandatory Report of Greenhouse Gas Emissions Approved a regulation that establishes detailed specifications for emissions calculations, reporting, and verification of GHG emission estimates from significant sources.	10/25/13
CA Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Technical revisions to the Mandatory Reporting of Greenhouse Gas Emissions Regulation to further align reporting methods with U.S.EPA, update factors, and modify definitions to maintain consistency with the Cap and Trade program.	10/25/13

CARB Control Measures

Board Action	Hearing Date
Zero emission vehicle test procedures Existing certification test procedures for plug-in hybrid vehicles need to be updated to reflect technology developments. The ZEV regulation will require minor modifications to address clarity and implementation issues.	10/24/13
Consumer Products: Antiperspirants, Deodorants, Test Method 310, Aerosol Coatings, Proposed Repeal of Hairspray Credit) Amendments to require various consumer products to reformulate to reduce VOC or reactivity content to meet specified limits, and to clarify various regulatory provisions, improve enforcement, and add analytical procedures.	9/26/13
Alternative fuel certification procedures Amendments to current alternative fuel conversion certification procedures for motor vehicles and engines that will allow small volume conversion manufacturers to reduce the upfront demonstration requirements and allow systems to be sold sooner with lower certification costs than with the current process, beginning with MY 2018.	9/26/13
Vapor Recovery for Gasoline Dispensing Facilities Amendments to certification and test procedures for vapor recovery equipment used on cargo tanks and at gasoline dispensing facilities.	7/25/13
Off-highway recreational vehicle evaporative emission control Staff proposes to set evaporative emission standards to control hydrocarbon emissions from Off-Highway Recreational Vehicles. The running loss, hot soak, and diurnal performance standards can be met by using proven automobile type control technology.	7/25/13
Gasoline and diesel fuel test standards Adopted amendments to add test standards for the measurement of prohibited oxygenates at trace levels specified in existing regulations.	1/25/13
LEV III and ZEV Programs for Federal Compliance Option Adopted amendments to deem compliance with national GHG new vehicle standards in 2017-2025 as compliance with California GHG standards for the same model years.	11/15/12 12/6/12 EO
Consumer products (automotive windshield washing fluid) Adopted amendments to add portions of 14 California counties to the list of areas with freezing temperatures where 25% VOC content windshield washing fluid could be sold.	10/18/2012 EO 03/15/13
GHG mandatory reporting, Fee Regulation, and Cap and Trade 2012 Adopted amendments to eliminate emission verification for facilities emitting less than 25,000 MTCO2e and make minor changes in definitions and requirements.	9/20/12 11/2/12 EO
Amendments to Verification Procedure, Warranty and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines Approved amendments to the verification procedure used to evaluate diesel retrofits through emissions, durability, and field testing. Amendments will lower costs associated with required in-use compliance testing, streamline the in-use compliance process, and will extend time allowed to complete verifications.	8/23/2012 EO 07/02/13
Amendments to On-Board Diagnostics (OBD I and II) Regulations Approved amendments to the light- and medium-duty vehicle and heavy-duty engine OBD regulations.	8/23/2012 EO 06/26/13
Cap and Trade: Amendments to CA Cap on GHG Emissions and Market-Based Compliance Mechanisms, and Amendments Allowing Use of Compliance Instruments Issued by Linked Jurisdictions Amends Cap-and-Trade and compliance mechanisms to add security to the market system and to aid staff in implementation. Amendments include first auction rules, offset registry, market monitoring provisions, and information gathering necessary for the financial services operator.	6/28/12 7/31/12 EO
Vapor recovery defect list Adopted amendments to add defects and verification procedures for equipment approved since 2004, and make minor changes to provide clarity	6/11/12 EO

CARB Control Measures

Board Action	Hearing Date
Tractor-Trailer GHG Regulation: Emergency Amendment Adopted emergency amendment to correct a drafting error and delay the registration date for participation in the phased compliance option	2/29/2012 2/29/12 EO
Advanced Clean Cars (ACC) Regulation: Low-Emission Vehicles and GHG Adopted more stringent criteria emission standards for MY 2015-2025 light and medium duty vehicles (LEV III), amended GHG emission standards for model year 2017-2025 light and medium duty vehicles (LEV GHG), amended ZEV Regulation to ensure the successful market penetration of ZEVs in commercial volumes, amended hydrogen fueling infrastructure mandate of the Clean Fuels Outlet regulation, and amended cert fuel for light duty vehicles from an MTBE-containing fuel to an E10 certification fuel.	1/26/12
Zero Emission Vehicle (ZEV) Adopted amendments to increase compliance flexibility, add two new vehicle categories for use in creating credits, increase credits for 300 mile FCVs, increase requirements for ZEVs and TZEVs, eliminate credit for PZEVs and AT PZEVs, expand applicability to smaller manufacturers, base ZEV credits on range, and make other minor changes in credit requirements	1/26/12
Amendments to Low Carbon Fuel Standard Regulation The amendments address several aspects of the regulation, including: reporting requirements, credit trading, regulated parties, opt-in and opt-out provisions, definitions, and other clarifying language.	12/16/11 10/10/12 EO
Amendments to Small Off-Road Engine and Tier 4 Off-Road Compression-Ignition Engine Regulations And Test Procedures; also "Recreational Marine" Spark-Ignition Marine Engine Amendments (Recreational Boats) adopted. Aligns California test procedures with U.S. EPA test procedures and requires off-road CI engine manufacturers to conduct in-use testing of their entire product lines to confirm compliance with previously established Not-To-Exceed emission thresholds.	12/16/2011 10/25/12 EO
Regulations and Certification Procedures for Engine Packages used in Light-Duty Specially Constructed Vehicles (Kit Cars) Ensures that certified engine packages, when placed into any Kit Car, would meet new vehicle emission standards, and be able to meet Smog Check requirements.	11/17/11 9/21/12 EO
Amendments to the California Reformulated Gasoline Regulations Corrects drafting errors in the predictive model, deletes outdated regulatory provisions, updates the notification requirements, and changes the restrictions on blending CARBOB with other liquids.	10/21/11 8/24/12 EO
Amendments to the In-Use Diesel Transport Refrigeration Units (TRU) ATCM Mechanisms to improve compliance rates and enforceability.	10/21/11 8/31/12 EO
Amendments to the AB 32 Cost of Implementation Fee Regulation Clarifies requirements and regulatory language, revises definitions.	10/20/11 8/21/12 EO
Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation, Including Compliance Offset Protocols Greenhouse Gas Emissions Cap-and-Trade Program, including compliance offset protocols and multiple pathways for compliance.	10/21/11 8/21/12 EO
Amendments to the Regulation for Cargo Handling Equipment (CHE) at Ports and Intermodal Rail Yards (Port Yard Trucks Regulation) Provides additional compliance flexibility, and maintains anticipated emissions reductions. As applicable to yard trucks and two-engine sweepers.	9/22/11 8/2/12 EO
Amendments to the Enhanced Vapor Recovery Regulation for Gasoline Dispensing Facilities New requirement for low permeation hoses at gasoline dispensing facilities.	9/22/11 7/26/12 EO
Amendments to Cleaner Main Ship Engines and Fuel for Ocean-Going Vessels Adjusts the offshore regulatory boundary. Aligns very low sulfur fuel implementation deadlines with new federal requirements.	6/23/11 9/13/12 EO

CARB Control Measures

Board Action	Hearing Date
Particulate Matter Emissions Measurement Allowance For Heavy-Duty Diesel In-Use Compliance Regulation Emission measurement allowances provide for variability associated with the field testing required in the regulation.	6/23/11
Low Carbon Fuel Standard Carbon Intensity Lookup Table Amendments Adds new pathways for vegetation-based fuels	2/24/11
Amendments to Cleaner In-Use Heavy-Duty On-Road Diesel Trucks and LSI Fleets Regulations Amends five regulations to provide relief to fleets adversely affected by the economy, and take into account the fact that emissions are lower than previously predicted.	12/16/10 9/19/11 EO
Tractor-Trailer GHG Regulation Amendment Enacts administrative changes to increase compliance flexibility and reduce costs	12/16/10
Amendments to Cleaner In-Use Off-Road Diesel-Fueled Fleets Regulation Amendments provide relief to fleets adversely affected by the economy, and take into account the fact that emissions are lower than previously predicted.	12/16/10 10/28/11 EO
In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks at Ports and Rail Yard Facilities Amendments add flexibility to fleets' compliance schedules, mitigate the use of noncompliant trucks outside port and rail properties, and provide transition to the Truck and Bus regulation.	12/16/10 9/19/11 EO
Amendments to the Regulation for Mandatory Reporting of Greenhouse Gas Emissions Changes requirements to align with federal greenhouse gas reporting requirements adopted by US EPA.	12/16/10 10/28/11 EO
Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms Regulation Establishes framework and requirements for Greenhouse Gas Emissions Cap-and-Trade Program, including compliance offset protocols.	12/16/10 10/26/11 EO
Amendments to the Consumer Products Regulation Amendments set new or lower VOC limits for some categories, prohibit certain toxic air contaminants, high GWP compounds, and surfactants toxic to aquatic species. Also changes Method 310, used to determine aromatic content of certain products.	11/18/10 9/29/11 EO
Amendment of the ATCM for Diesel Transportation Refrigeration Units (TRU) Amendments expand the compliance options and clarify the operational life of various types of TRUs.	11/18/10 2/2/11 EO
Amendments to the ATCM for Stationary Compression Ignition Engines Approved amendments to closely align the emission limits for new emergency standby engines in the ATCM with the emission standards required by the federal Standards of Performance.	10/21/10 3/25/11 EO
Diesel Vehicle Periodic Smoke Inspection Program Adopted amendments to exempt medium duty diesel vehicles from smoke inspection requirements if complying with Smog Check requirements.	10/21/10 8/23/11 EO
Renewable Electricity Standard Regulation Approved a regulation that will require electricity providers to obtain at least 33% of their retail electricity sales from renewable energy resources by 2020.	9/23/10
Energy Efficiency at Industrial Facilities Adopted standards for the reporting of GHG emissions and the feasibility of emissions controls by the largest GHG-emitting stationary sources.	7/22/10 5/9/11 EO
Amendments to Commercial Harbor Craft Regulation Approved amendments to require the use of cleaner engines in diesel-fueled crew and supply, barge, and dredge vessels.	6/24/10 4/11/11 EO
Accelerated Introduction of Cleaner Line-Haul Locomotives Agreement with railroads sets prescribed reductions in diesel risk and target years through 2020 at four major railyards.	6/24/10
Amendments to New Passenger Motor Vehicle Greenhouse Gas Emission Standards Approved amendments deeming compliance with EPA's GHG standards as compliance with California's standards in 2012 through 2016 model years.	2/25/2010 03/29/10

CARB Control Measures

Board Action	Hearing Date
Sulfur Hexafluoride (SF6) Regulation Regulation to reduce emissions of sulfur hexafluoride (SF6), a high-GWP GHG, from high-voltage gas-insulated electrical switchgear.	2/25/10 12/15/10 EO
Amendments to the Statewide Portable Equipment Registration Regulation and Portable Engine ATCM Approved amendments that extend the deadline for removal of certain uncertified portable engines for one year.	1/28/10 8/27/10 EO 12/8/10 EO
Diesel Engine Retrofit Control Verification, Warranty, and Compliance Regulation Amendments Approved amendments to require per-installation compatibility assessment, performance data collection, and reporting of additional information, and enhance enforceability.	1/28/10 12/6/10 EO
Stationary Equipment High-GWP Refrigerant Regulation Approved a regulation to reduce emissions of high-GWP refrigerants from stationary non-residential equipment.	12/1/09 9/14/10 EO
Amendments to Limit Ozone Emissions from Indoor Air Cleaning Devices Adopted amendments to delay the labeling compliance deadlines by one to two years and to make minor changes in testing protocols.	12/9/09
Emission Warranty Information Reporting Regulation Amendments Repealed the 2007 regulation and readopted the 1988 regulation with amendments to implement adverse court decision.	11/19/09 9/27/10 EO
Amendments to Maximum Incremental Reactivity Tables Added many new compounds and modified reactivity values for many existing compounds in the tables to reflect new research data.	11/3/09 7/23/10 EO
AB 32 Cost of Implementation Fee Regulation AB 32 authorizes ARB to adopt by regulation a schedule of fees to be paid by sources of greenhouse gas emissions regulated pursuant to AB 32. ARB staff will propose a fee regulation to support the administrative costs of AB 32 implementation.	9/24/2009 05/06/10 EO
Passenger Motor Vehicle Greenhouse Gas Limits Amendments Approved amendments granting credits to manufacturers for compliant vehicles sold in other states that have adopted California regulations.	9/24/09 2/22/10 EO
Consumer Products Amendments Approved amendments that set new VOC limits for multi-purpose solvent and paint thinner products and lower the existing VOC limit for double phase aerosol air fresheners.	9/24/09 8/6/10 EO
Amendments to In-Use Off-Road Diesel-Fueled Fleets Regulation Approved amendments to implement legislatively directed changes and provide additional incentives for early action.	7/23/09 12/2/09 EO 6/3/10 EO
Methane Emissions from Municipal Solid Waste Landfills Approved a regulation to require smaller and other uncontrolled landfills to install gas collection and control systems, and also requires existing and newly installed systems to operate optimally.	6/25/09 5/5/10 EO
Cool Car Standards Approved a regulation requiring the use of solar management window glass in vehicles up to 10,000 lb GVWR.	6/25/09
Enhanced Fleet Modernization (Car Scrap) Approved guidelines for a program to scrap up to 15,000 light duty vehicles statewide.	6/25/09 7/30/10 EO
Amendments to Heavy-Duty On-Board Diagnostics Regulations Approved amendments to the light and medium-duty vehicle and heavy duty engine OBD regulations.	5/28/2009 4/6/10 EO
Smog Check Improvements BAR adopted amendments to implement changes in state law and SIP commitments adopted by ARB between 1996 and 2007.	5/7/09 By BAR 6/9/09 EO

CARB Control Measures

Board Action	Hearing Date
AB 118 Air Quality Improvement Program Guidelines The Air Quality Improvement Program provides for up to $50 million per year for seven years beginning in 2009-10 for vehicle and equipment projects that reduce criteria pollutants, air quality research, and advanced technology workforce training. The AQIP Guidelines describe minimum administrative, reporting, and oversight requirements for the program, and provide general criteria for how the program shall be implemented.	04/23/09 08/28/09 EO
Pesticide Element Reduce volatile organic compound (VOC) emissions from the application of agricultural field fumigants in the South Coast, Southeast Desert, Ventura County, San Joaquin Valley, and Sacramento Metro federal ozone ~~non-attainment~~nonattainment areas.	4/20/09 10/12/09 EO (2) 8/2/11 EO
Low Carbon Fuel Standard Approved new standards to lower the carbon content of fuels.	4/20/09 11/25/09 EO
Pesticide Element for San Joaquin Valley DPR Director approved pesticide ROG emission limit of 18.1 tpd and committed to implement restrictions on non-fumigant pesticide use by 2014 in the San Joaquin Valley.	4/7/09 DPR
Tire Pressure Inflation Regulation Approved a regulation requiring automotive service providers to perform tire pressure checks as part of every service.	3/26/09 2/4/10 EO
Sulfur Hexafluoride from Non-Utility and Non-Semiconductor Applications Approved a regulation to phase out use of Sulfur Hexafluoride over the next several years.	2/26/09 11/12/09 EO
Semiconductor Operations Approved a regulation to set standards to reduce fluorinated gas emissions from the semiconductor and related devices industry.	2/26/09 10/23/09 EO
Plug-In Hybrid Electric Vehicles Test Procedure Amendments Amends test procedures to address plug-in-hybrid electric vehicles.	1/23/09 12/2/09 EO
In-Use Off-Road Diesel-Fueled Fleets Amendments Makes administrative changes to recognize delays in the supply of retrofit control devices.	1/22/09
Small Containers of Automotive Refrigerant Approved a regulation to reduce leakage from small containers, adopt a container deposit and return program, and require additional container labeling and consumer education requirements.	1/22/09 1/5/10 EO
Aftermarket Critical Emission Parts on Highway Motorcycles Allows for the sale of certified critical emission parts by aftermarket manufacturers.	1/22/09 6/19/09 EO
Heavy-Duty Tractor-Trailer Greenhouse Gas (GHG) Reduction Approved a regulation to reduce greenhouse gas emissions by improving long haul tractor and trailer efficiency through use of aerodynamic fairings and low rolling resistance tires.	12/11/08 10/23/09 EO
Cleaner In-Use Heavy-Duty Diesel Trucks (Truck and Bus Regulation) Approved a regulation to reduce diesel particulate matter and oxides of nitrogen through fleet modernization and exhaust retrofits. Makes enforceability changes to public fleet, off-road equipment, and portable equipment regulations.	12/11/08 10/19/09 EO 10/23/09 EO
Large Spark-Ignition Engine Amendments Approved amendments to reduce evaporative, permeation, and exhaust emissions from large spark-ignition (LSI) engines equal to or below 1 liter in displacement.	11/1/08 3/12/09 EO
Small Off-Road Engine (SORE) Amendments Approved amendments to address the excessive accumulation of emission credits.	11/21/08 2/24/10 EO
Proposed AB 118 Air Quality Guidelines for the Air Quality Improvement Program and the Alternative and Renewable Fuel and Vehicle and Technology Program. The California Alternative and Renewable Fuel, Vehicle Technology, Clean Air, and Carbon Reduction Act of 2007 (AB 118) requires ARB to develop guidelines for both the Alternative and Renewable Fuel and Vehicle Technology Program and the Air Quality Improvement Program to ensure that both programs do not adversely impact air quality.	09/25/08 EO 05/20/09

CARB Control Measures

Board Action	Hearing Date
Portable Outboard Marine Tanks and Components (part of Additional Evaporative Emission Standards) Approved a regulation that establishes permeation and emission standards for new portable outboard marine tanks and components.	9/25/08 7/20/09 EO
Cleaner Fuel in Ocean Going Vessels Approved a regulation that requires use of low sulfur fuel in ocean-going ship main engines, and auxiliary engines and boilers.	7/24/08 4/16/09 EO
Spark-Ignition Marine Engine and Boat Amendments Provides optional compliance path for > 500 hp sterndrive/inboard marine engines.	7/24/08 6/5/09 EO
Consumer Products Amendments Approved amendments that add volatile organic compound (VOC) limits for seven additional categories and lower limits for twelve previously regulated categories.	6/26/08 5/5/09 EO
Zero emission vehicles Updated California's ZEV requirements to provide greater flexibility with respect to fuels, technologies, and simplifying compliance pathways. Amendments give manufacturers increased flexibility to comply with ZEV requirements by giving credit to plug-in hybrid electric vehicles and establishing additional ZEV categories in recognition of new developments in fuel cell vehicles and battery electric vehicles.	3/27/08 12/17/08 EO
Amendments to the Verification Procedure, Warranty, and In-Use Compliance Requirements for In-Use Strategies to Control Emissions from Diesel Engines Adds verification requirements for control technologies that only reduce NOx emissions, new reduction classifications for NOx reducing technologies, new testing requirements, and conditional extensions for verified technologies.	1/24/08 12/4/08 EO
Mandatory Report of Greenhouse Gas Emissions Approved a regulation that establishes detailed specifications for emissions calculations, reporting, and verification of GHG emission estimates from significant sources.	12/6/07 10/12/08 EO
Gaseous Pollutant Measurement Allowances for In-Use Heavy-Duty Diesel Compliance Measurement accuracy margins are to be determined through an ongoing comprehensive testing program performed by an independent contractor. Amendments include these measurement accuracy margins into the regulation.	12/6/07 10/14/08 EO
Ocean-Going Vessels While at Berth (aka Ship Hoteling) - Auxiliary Engine Cold Ironing and Clean Technology Approved a regulation that reduces emissions from auxiliary engines on ocean-going ships while at-berth.	12/6/07 10/16/08 EO
In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks at Ports and Rail Yard Facilities Approved a regulation that establishes emission standards for in-use, heavy-duty diesel-fueled vehicles that transport cargo to and from California's ports and intermodal rail facilities.	12/6/07 10/12/08 EO
Commercial Harbor Craft Approved a regulation that establishes in-use and new engine emission limits for both auxiliary and propulsion diesel engines on ferries, excursion vessels, tugboats, and towboats.	11/15/07 9/2/08 EO
Suggested Control Measure for Architectural Coatings Amendments Approved amendments to reduce the recommended VOC content of 19 categories of architectural coatings.	10/26/07
Aftermarket Catalytic Converter Requirements Approved amendments that establish more stringent emission performance and durability requirements for used and new aftermarket catalytic converters offered for sale in California.	10/25/07 2/21/08 NOD
Limiting Ozone Emissions from Indoor Air Cleaning Devices Approved ozone emission limit of 0.050 ppm for portable indoor air cleaning devices in response to requirements of AB 2276 (2006).	9/27/07 8/7/08 EO
Pesticide Commitment for Ventura County in 1994 SIP Approved substitution of excess ROG emission reductions from state motor vehicle program for 1994 SIP reduction commitment from pesticide application in Ventura County.	9/27/07 11/30/07 EO

CARB Control Measures

Board Action	Hearing Date
In-Use Off-Road Diesel Equipment Approved a regulation that requires off-road diesel fleet owners to modernize their fleets and install exhaust retrofits.	7/26/07 4/4/08 EO
Emission Control and Environmental Performance Label Regulations Approved amendments to add a Global Index Label and modify the formal of the Smog Index Label on new cars.	6/21/07 5/2/08 EO
Vapor Recovery from Aboveground Storage Tanks Approved a regulation to establish new performance standards and specifications for the vapor recovery systems and components used with aboveground storage tanks.	6/21/07 5/2/08 EO
CaRFG Phase 3 amendments Approved amendments to mitigate the increases in evaporative emissions from on-road motor vehicles resulting from the addition of ethanol to gasoline.	6/14/07 4/25/08 EO 8/7/08 EO
Formaldehyde from Composite Wood Products Approved an ATCM to limit formaldehyde emissions from hardwood plywood, particleboard, and medium density fiberboard to the maximum amount feasible.	4/26/07 3/5/08 EO
Portable equipment registration program (PERP) and airborne toxic control measure for diesel-fueled portable engines Approved amendments to allow permitting of Tier 0 portable equipment engines used in emergency or low use duty and to extend permitting of certain Tier 1 and 2 "resident" engines to 1/1/10.	3/22/07 7/31/07 EO
Perchloroethylene Control Measure Amendments Approved amendments to the Perchloroethylene ATCM to prohibit new Perc dry cleaning machines beginning 2008 and phase out all Perc machines by 2023.	1/25/07 11/7/07 EO
Amendments to Emission Warranty Information Reporting & Recall Regulations Approved amendments that tighten the provisions for recalling vehicles for emissions-related failures, helping ensure that corrective action is taken to vehicles with defective emission control devices or systems.	12/7/06 3/22/07 10/17/07 EO
Voluntary accelerated vehicle retirement regulations Approved amendments that authorize the use of remote sensing to identify light-duty high emitters and that establish protocols for quantifying emissions reductions from high emitters proposed for retirement.	12/7/06
Emergency regulation for portable equipment registration program (PERP), airborne toxic control measures for portable and stationary diesel-fueled engines	12/7/06
Amendments to the Hexavalent Chromium ATCM Approved amendments that require use of best available control technology on all chrome plating and anodizing facilities.	12/7/06
Consumer Products Regulation Amendments Approved amendments that set lower emission limits in 15 product categories.	11/17/06 9/25/07 EO
Requirements for Stationary Diesel In-Use Agricultural Engines Approved amendments to the stationary diesel engine ATCM which set emissions standards for in-use diesel agricultural engines.	11/16/06 7/3/07 NOD
Ships - Onboard Incineration Approved amendments to cruise ship incineration ATCM to include all oceangoing ships of 300 gross registered tons or more.	11/16/06 9/11/07 EO
Zero Emission Bus Approved amendments postponing the 15 percent purchase requirement three years for transit agencies in the diesel path and one to two years for transit agencies in the alternative fuel path, in order to keep pace with developments in zero emission bus technology, and adding an Advanced Demonstration requirement to offset emission losses.	10/19/06 8/27/07 EO
Distributed generation certification Approved amendments improving the emissions durability and testing requirements, adding waste gas emission standards, and eliminating a redundant PM standard in the current 2007 emission standards.	10/19/06 5/17/07 NOD

CARB Control Measures

Board Action	Hearing Date
Heavy-Duty Diesel In-Use Compliance Regulation Approved amendments to the heavy-duty diesel engine regulations and test procedures to create a new in-use compliance program conducted by engine manufacturers. The amendments would help ensure compliance with applicable certification standards throughout an engine's useful life.	9/28/06 7/19/07 NOD
Revisions to OBD II and the Emission Warranty Regulations Approved amendments to the OBD II regulation to provide for improved emission control monitoring including air-fuel cylinder imbalance monitoring, oxygen sensor monitoring, catalyst monitoring, permanent fault codes for gasoline vehicles and new thresholds for diesel vehicles.	9/28/06 8/9/07 EO
Off-Highway Recreational Vehicle Amendments Approved amendments to the Off-Highway Recreational Vehicle Regulations including harmonizing evaporative emission standards with federal regulations, expanding the definition of ATVs, modifying labeling requirements, and adjusting riding seasons.	7/20/06 6/1/07 EO
Portable Equipment Registration Program (PERP) Amendments Approved amendments to the Statewide Portable Equipment Registration program that include installation of hour meters on equipment, and revisions to recordkeeping, reporting, and fees.	6/22/06 11/13/06 NOD
Heavy Duty Vehicle Service Information Approved amendments to the Service Information Rule to require manufacturers to make available diagnostic equipment and information for sale to the aftermarket.	6/22/06 5/3/07 EO
LEV II technical amendments Approved amendments to evaporative emission test procedures, four-wheel drive dynamometer provisions, and vehicle label requirements.	6/22/06 9/27/06 NOD
Dry Cleaning ATCM Amendments Approved amendments to the Dry Cleaning ATCM to limit siting of new dry cleaners, phase out use of Perc at co-residential facilities, phase out higher emitting Perc sources at other facilities, and require enhanced ventilation at existing and new Perc facilities.	5/25/06
Forklifts and other Large Spark Ignition (LSI) Equipment Adopted a regulation to reduce emissions from forklifts and other off-road spark-ignition equipment by establishing more stringent standards for new equipment, and requiring retrofits or engine replacement on existing equipment. Adopts EPA's standards for 2007; adopts more stringent standards for 2010.	5/25/06 3/2/07 EO
Enhanced Vapor Recovery Amendments Approved amendments to the vapor recovery system regulation and adopted revised test procedures.	5/25/06
Diesel Retrofit Technology Verification Procedure Approved amendments to the Diesel Emission In-use Control Strategy Verification Procedure to substitute a 30% increase limit in NOx concentration for an 80% reduction requirement from PM retrofit devices.	3/23/06 12/21/06 NOD
Heavy duty vehicle smoke inspection program amendments Approved amendments to impose a fine on trucks not displaying a current compliance certification sticker.	1/26/06 12/4/06 EO
Ocean-going Ship Auxiliary Engine Fuel Approved a regulation to require ships to use cleaner marine gas oil or diesel to power auxiliary engines within 24 nautical miles of the California coast.	12/8/05 10/20/06 EO
Diesel Cargo Handling Equipment Approved a regulation to require new and in-use cargo handling equipment at ports and intermodal rail yards to reduce emissions by utilizing best available control technology.	12/8/05 6/2/06 EO
Public and Utility Diesel Truck Fleets Approved a regulation to reduce diesel particulate matter emissions from heavy duty diesel trucks in government and private utility fleets.	12/8/05 10/4/06 EO
Cruise ships – Onboard Incineration Adopted an Air Toxic Control Measure to prohibit cruise ships from conducting onboard incineration within three nautical miles of the California coast.	11/17/05 2/1/06 NOD
Inboard Marine Engine Rule Amendments Approved amendments to the 2001 regulation to include additional compliance options for manufacturers.	11/17/05 9/26/06 EO
Board Action	**Hearing Date**

CARB Control Measures

Heavy-Duty Diesel Truck Idling Technology Approved a regulation to limit sleeper truck idling to 5 minutes. Allows alternate technologies to provide cab heating/cooling and power.	10/20/05 9/1/06 EO
Automotive Coating Suggested Control Measure Approved an SCM for automotive coatings for adoption by air districts. The measure will reduce the VOC content of 11 categories of surface protective coatings.	10/20/05
2007-09 Model-year heavy duty urban bus engines and the fleet rule for transit agencies Adopted amendments to align urban bus emission limits with on-road heavy duty truck emission limits and allow for the purchase of non- complying buses under the condition that bus turnover increase to offset NOx increases.	10/20/05 10/27/05 7/28/06 EO
Portable fuel containers (part 2 of 2) Approved amendments to revise spout and automatic shutoff design.	9/15/05 7/28/06 EO
Portable Fuel Containers (part 1 of 2) Approved amendments to include kerosene containers in the definition of portable fuel containers.	9/15/05 11/9/05 NOD
2007-09 Model-year heavy duty urban bus engines and the fleet rule for transit agencies Adopted amendments to require all transit agencies in SCAQMD to purchase only alternate fuel versions of new buses.	9/19/05 Superceded by 10/20/05
Reid vapor pressure limit emergency rule Approved amendments to relax Reid vapor pressure limit to accelerate fuel production for Hurricane Katrina victims.	9/8/05 Operative for September and October 2005 only
Heavy-Duty Truck OBD Approved a regulation to require on-board diagnostic (OBD) systems for new gas and diesel trucks, similar to the systems on passenger cars.	7/21/05 12/28/05 EO
Definition of Large Confined Animal Facility Adopted a regulation to define the size of a large CAF for the purposes of air quality permitting and reduction of ROG emissions to the extent feasible.	6/23/05 4/13/06 EO
ATCM for stationary compression ignition engines Approved emergency amendments (3/17/05) and permanent amendments (5/26/05) to relax the diesel PM emission limits on new stationary diesel engines to current off-road engine standards to respond to the lack of availability of engines meeting the original ATCM standard.	3/17/05 5/26/05 7/29/05 EO
Transit Fleet Rule Approved amendments to add emission limits for non-urban bus transit agency vehicles, require lower bus and truck fleet-average NOx and PM emission limits, and clarify emission limits for CO, NMHC, and formaldehyde.	2/24/05 10/19/05 NOD
Thermal Spraying ATCM Approved a regulation to reduce emissions of hexavalent chromium and nickel from thermal spraying operations.	12/9/04 7/20/05 EO
Tier 4 Standards for Small Off-Road Diesel Engines (SORE) Approved new emission standards for off-road diesel engines to be phased in between 2008 and 2015.	12/9/04 10/21/05 EO
Emergency Regulatory Amendment Delaying the January 1, 2005 Implementation Date for the Diesel Fuel Lubricity Standard Adopted an emergency regulation delaying the lubricity standard compliance deadline by five months to respond to fuel pipeline contamination problems.	11/24/04 12/10/04 EO
Enhanced vapor recovery compliance extension Approved amendments to the EVR regulation to extend the compliance date for onboard refueling vapor recovery compatibility to the date of EVR compliance.	11/18/04 2/11/05 EO
CaRFG Phase 3 amendments Approved amendments correcting errors and streamlining requirements for compliance and enforcement of CaRFG Phase 3 regulations adopted in 1999.	11/18/04
Clean diesel fuel for harborcraft and intrastate locomotives Approved a regulation that required harborcraft and locomotives operating solely within California to use clean diesel fuel.	11/18/04 3/16/05 EO

CARB Control Measures

Board Action	Hearing Date
Nonvehicular Source, Consumer Product, and Architectural Coating Fee Regulation Amendment Approved amendments to fee regulations to collect supplemental fees when authorized by the Legislature.	11/18/04
Greenhouse gas limits for motor vehicles Approved a regulation that sets the first ever greenhouse gas emission standards on light and medium duty vehicles starting with the 2009 model year.	9/24/04 8/4/05 EO
Gasoline vapor recovery system equipment defects list Approved the addition of defects to the VRED list for use by compliance inspectors.	8/24/04 6/22/05 EO
Unihose gasoline vapor recovery systems Approved an emergency regulation and an amendment to delay the compliance date for unihose installation to the date of dispenser replacement.	7/22/04 11/24/04 EO
General Idling Limits for Diesel Trucks Approved a regulation that limits idling of heavy-duty diesel trucks operating in California to five minutes, with exceptions for sleeper cabs.	7/22/04
Consumer Products Approved a regulation to reduce ROG emissions from 15 consumer products categories, prohibit the use of 3 toxic compounds in consumer products, ban the use of PDCB in certain products, allow for the use of Alternative Control Plans, and revise Test Method 310.	6/24/04 5/6/05 EO
Urban bus engines/fleet rule for transit agencies Approved amendments to allow for the purchase of hybrid diesel buses and revise the zero emission bus demonstration and purchase timelines.	6/24/04
Engine Manufacturer Diagnostics Approved a regulation that would require model year 2007 and later heavy duty truck engines to be equipped with engine diagnostic systems to detect malfunctions of the emission control system.	5/20/04
Chip Reflash Approved a voluntary program and a backstop regulation to reduce heavy duty truck NOx emissions through the installation of new software in the engine's electronic control module.	3/25/04 3/21/05 EO
Portable equipment registration program (PERP) Approved amendments to allow uncertified engines to be registered until December 31, 2005, to increase fees, and to modify administrative requirements.	2/26/04 1/7/05 EO 6/21/05 EO
Portable Diesel Engine ATCM Adopted a regulation to reduce diesel PM emissions from portable engines through a series of emission standards that increase in stringency through 2020.	2/26/04 1/4/05 EO
California motor vehicle service information rule Adopted amendments to allow for the purchase of heavy duty engine emission-related service information and diagnostic tools by independent service facilities and aftermarket parts manufacturers.	1/22/04 5/20/04
Transportation Refrigeration Unit ATCM Adopted a regulation to reduce diesel PM emissions from transport refrigeration units by establishing emission standards and facility reporting requirements to streamline inspections.	12/11/03 2/26/04 11/10/04 EO
Diesel engine verification procedures Approved amendments that reduced warranty coverage to the engine only, delayed the NOx reduction compliance date to 2007, added requirements for proof-of-concept testing for new technology, and harmonized durability requirements with those of U.S. EPA.	12/11/03 2/26/04 10/17/04
Chip Reflash Approved a voluntary program and a backstop regulation to reduce heavy duty truck NOx emissions through the installation of new software in the engine’s electronic control module.	12/11/03 3/27/04 3/21/05 EO
Revised tables of maximum incremental reactivity values Approved the addition of 102 more chemicals with associated maximum incremental reactivity values to existing regulation allowing these chemicals to be used in aerosol coating formulations.	12/3/03

CARB Control Measures

Board Action	Hearing Date
Stationary Diesel Engines ATCM Adopted a regulation to reduce diesel PM emissions from stationary diesel engines through the use of clean fuel, lower emission standards, operational practices.	11/20/03 12/11/03 2/26/2004 9/27/04 EO
Solid waste collection vehicles Adopted a regulation to reduce toxic diesel particulate emissions from solid waste collection vehicles by over 80 percent by 2010. This measure is part of ARB's plan to reduce the risk from a wide range of diesel engines throughout California.	9/25/03 5/17/04 EO
Small off-road engines (SORE) Adopted more stringent emission standards for the engines used in lawn and garden and industrial equipment, such as string trimmers, leaf blowers, walk-behind lawn mowers, generators, and lawn tractors.	9/25/03 7/26/04 EO
Off-highway recreational vehicles Changes to riding season restrictions.	7/24/03
Clean diesel fuel Adopted a regulation to reduce sulfur levels and set a minimum lubricity standard in diesel fuel used in vehicles and off-road equipment in California, beginning in 2006.	7/24/03 5/28/04 EO
Ozone Transport Mitigation Amendments Adopted amendments to require upwind districts to (1) have the same no-net-increase permitting thresholds as downwind districts, and (2) Adopt "all feasible measures."	5/22/03 10/2/03 NOD
Zero emission vehicles Updated California's ZEV requirements to support the fuel cell car development and expand sales of advanced technology partial ZEVs (like gasoline-electric hybrids) in the near-term, while retaining a role for battery electric vehicles.	3/27/03 12/19/03 EO
Heavy duty gasoline truck standards Aligned its existing rules with new, lower federal emission standards for gasoline-powered heavy-duty vehicles starting in 2008.	12/12/02 9/23/03 EO
Low emission vehicles II Minor administrative changes.	12/12/02 9/24/03 EO
Gasoline vapor recovery systems test procedures Approved amendments to add advanced vapor recovery technology certification and testing standards.	12/12/02 7/1/03 EO 10/21/03 EO
CaRFG Phase 3 amendments Approved amendments to allow for small residual levels of MTBE in gasoline while MTBE is being phased out and replaced by ethanol.	12/12/02 3/20/03 EO
School bus Idling Adopted a measure requiring school bus drivers to turn off the bus or vehicle engine upon arriving at a school and restart it no more than 30 seconds before departure in order to limit children's exposure to toxic diesel particulate exhaust.	12/12/02 5/15/03 EO
California Interim Certification Procedures for 2004 and Subsequent Model Year Hybrid-Electric Vehicles in the Urban Transit Bus and Heavy-Duty Vehicle Classes Regulation Amendment Adopted amendments to allow diesel-path transit agencies to purchase alternate fuel buses with higher NOx limits, establish certification procedures for hybrid buses, and require lower fleet-average PM emission limits.	10/24/02 9/2/03 EO
CaRFG Phase 3 amendments Approved amendments delaying removal of MTBE from gasoline by one year to 12/31/03.	7/25/02 11/8/02 EO
Diesel retrofit verification procedures, warranty, and in-use compliance requirements Adopted regulations to specify test procedures, warranty, and in-use compliance of diesel engine PM retrofit control devices.	5/16/02 3/28/03 EO
On-board diagnostics for cars Adopted changes to the On-Board Diagnostic Systems (OBD II) regulation to improve the effectiveness of OBD II systems in detecting motor vehicle emission-related problems.	4/25/02 3/7/03 EO

CARB Control Measures

Board Action	Hearing Date
Voluntary accelerated light duty vehicle retirement regulations Establishes standards for a voluntary accelerated retirement program.	2/21/02 11/18/02 EO
Residential burning Adopted a measure to reduce emissions of toxic air contaminants from outdoor residential waste burning by eliminating the use of burn barrels and the outdoor burning of residential waste materials other than natural vegetation.	2/21/02 12/18/02 EO
California motor vehicle service information rule Adopted regulations to require light- and medium-duty vehicle manufacturers to offer for sale emission-related service information and diagnostic tools to independent service facilities and aftermarket parts manufacturers.	12/13/01 7/31/02 EO
Vapor recovery regulation amendments Adopted amendments to expand the list of specified defects requiring equipment to be removed from service.	11/15/01 9/27/02 EO
Distributed generation guidelines and regulations Adopted regulations requiring the permitting by ARB of distributed generation sources that are exempt from air district permitting and approved guidelines for use by air districts in permitting non-exempt units.	11/15/01 7/23/02 EO
Low emission vehicle regulations (LEV II) Approved amendments to apply PM emission limits to all new gasoline vehicles, extend gasoline PZEV emission limits to all fuel types, and streamline the manufacturer certification process.	11/15/01 8/6/02 EO
Gasoline vapor recovery systems test methods and compliance procedures Adopted amendments to add test methods for new technology components, streamline test methods for liquid removal equipment, and***.	10/25/01 7/9/02 EO
Heavy-duty diesel trucks Adopted amendments to emissions standards to harmonize with EPA regulations for 2007 and subsequent model year new heavy-duty diesel engines.	10/25/01
Automotive coatings Adopted Air Toxic Control Measure which prohibits the sale and use in California of automotive coatings that contain hexavalent chromium or cadmium.	9/20/01 9/2/02 EO
Inboard and sterndrive marine engines Lower emission standards for 2003 and subsequent model year inboard and sterndrive gasoline-powered engines in recreational marine vessels.	7/26/01 6/6/02 EO
Asbestos from construction, grading, quarrying, and surface mining Adopted an Airborne Toxic Control Measure for construction, grading, quarrying, and surface mining operations requiring dust mitigation for construction and grading operations, road construction and maintenance activities, and quarries and surface mines to minimize emissions of asbestos-laden dust.	7/26/01 6/7/02 EO
Zero emission vehicle infrastructure and standardization of electric vehicle charging equipment Adopted amendments to the ZEV regulation to alter the method of quantifying production volumes at joint-owned facilities and to add specifications for standardized charging equipment.	6/28/01 5/10/02 EO
Pollutant transport designation Adopted amendments to add two transport couples to the list of air basins in which upwind areas are required to adopt permitting thresholds no less stringent than those adopted in downwind areas.	4/26/01
Zero emission vehicle regulation amendments Adopted amendments to reduce the numbers of ZEVs required in future years, add a PZEV category and grant partial ZEV credit, modify the ZEV range credit, allow hybrid-electric vehicles partial ZEV credit, grant ZEV credit to advanced technology vehicles, and grant partial ZEV credit for several other minor new programs.	1/25/01 12/7/01 EO 4/12/02 EO
Heavy duty diesel engines supplemental test procedures Approved amendments to extend "Not-To-Exceed" and EURO III supplemental test procedure requirements through 2007 when federal requirements will include these tests.	12/7/00
Board Action	**Hearing Date**
Light and medium duty low emission vehicle alignment with federal standards Approved amendments that require light and medium duty vehicles sold in California to meet the more restrictive of state or federal emission standards.	12/7/00 12/27/00 EO

CARB Control Measures

Exhaust emission standards for heavy duty gas engines Adopted amendments that establish 2005 emission limits for heavy duty gas engines that are equivalent to federal limits.	12/7/00 12/27/00 EO
CaRFG Phase 3 amendments Approved amendments to regulate the replacement of MTBE in gasoline with ethanol.	11/16/00 4/25/01 EO
CaRFG Phase 3 test methods Approved amendments to gasoline test procedures to quantify the olefin content and gasoline distillation temperatures.	11/16/00 7/11/01 EO 8/28/01 EO
Antiperspirant and deodorant regulations Adopted amendments to relax a 0% VOC limit to 40% VOC limit for aerosol antiperspirants.	10/26/00
Diesel risk reduction plan Adopted plan to reduce toxic particulate from diesel engines through retrofits on existing engines, tighter standards for new engines, and cleaner diesel fuel.	9/28/00
Conditional rice straw burning regulations Adopted regulations to limit rice straw burning to fields with demonstrated disease rates reducing production by more than 5 percent.	9/28/00
Asbestos from unpaved roads Tightened an existing Air Toxic Control Measure to prohibit the use of rock containing more than 0.25% asbestos on unsurfaced roads.	7/20/00
Aerosol Coatings Approved amendments to replace mass-based VOC limits with reactivity-based limits, add a table of Maximum Incremental Reactivity values, add limits for polyolefin adhesion promoters, prohibit use of certain toxic solvents, and make other minor changes.	6/22/00 5/1/01 EO
Consumer products aerosol adhesives Adopted amendments to delete a 25% VOC limit by 2002, add new VOC limits for six categories of adhesives, prohibit the use of toxic solvents, and add new labeling and reporting requirements.	5/25/00 3/14/01 EO
Automotive care products Approved an Air Toxic Control Measure to eliminate use of perchloroethylene, methylene chloride, and trichloroethylene in automotive products such as brake cleaners and degreasers.	4/27/00 2/28/01 EO
Enhanced vapor recovery emergency regulation Adopted a four-year term for equipment certifications.	5/22/01 EO
Enhanced vapor recovery Adopted amendments to require the addition of components to reduce spills and leakage, adapt to onboard vapor recovery systems, and continuously monitor system operation and report equipment leaks immediately.	3/23/00 7/25/01 EO
Agricultural burning smoke management Adopted amendments to add marginal burn day designations, require day-specific burn authorizations by districts, and smoke management plans for larger prescribed burn projects.	3/23/00 1/22/01 EO
Urban transit buses Adopted a public transit bus fleet rule and emissions standards for new urban buses that mandates a lower fleet-average NOx emission limit, PM retrofits, lower sulfur fuel use, and purchase of specified percentages of zero emission buses in future years.	1/27/00 2/24/00 11/22/00 EO 5/29/01 EO
Small Off-Road (diesel) Equipment (SORE) Adopted amendments to conform with new federal requirements for lower and engine power-specific emission limits, and for the averaging, banking, and trading of emissions among SORE manufacturers.	1/28/00

CARB Control Measures

Board Action	Hearing Date
CaRFG Phase 3 MTBE phase out Adopted regulations to enable refiners to produce gasoline without MTBE while preserving the emissions benefits of Phase 2 cleaner burning gasoline.	12/9/99 6/16/00 EO
Consumer products – mid-term measures II Adopted a regulation which adds emission limits for 2 new categories and tightens emission limits for 15 categories of consumer products.	10/28/99
Portable fuel cans Adopted a regulation requiring that new portable fuel containers, used to refuel lawn and garden equipment, motorcycles, and watercraft, be spill-proof beginning in 2001.	9/23/99 7/6/00 EO
Clean fuels at service stations Adopted amendments rescinding requirements applicable to SCAB in 1994-1995, modifying the formula for triggering requirements, and allowing the Executive Officer to make adjustments to the numbers of service stations required to provide clean fuels.	7/22/99
Gasoline vapor recovery Adopted amendments to certification and test methods.	6/24/99
Reformulated gasoline oxygenate Adopted amendments rescinding the requirement for wintertime oxygenate in gasoline sold in the Lake Tahoe Air Basin and requiring the statewide labeling of pumps dispensing gasoline containing MTBE.	6/24/99
Marine pleasurecraft Adopted regulations to control emissions from spark-ignition marine engines, specifically, outboard marine engines and personal watercraft.	12/11/98 2/17/00 EO 6/14/00 EO
Voluntary accelerated light duty vehicle retirement Adopted regulation setting standards for voluntary accelerated retirement program.	12/10/98 10/22/99 EO
Off-highway recreational vehicles and engines Approved amendments to allow non-complying vehicles to operate in certain seasons and in certain ORV-designated areas.	12/10/98 10/22/99 EO
On-road motorcycles Amended on-road motorcycle regulations, to lower the tailpipe emission standards for ROG and NOx.	12/10/98
Portable equipment registration program (PERP) Approved amendments to exclude non-dredging equipment operating in OCS areas and equipment emitting hazardous pollutants, include NSPS Part OOO rock crushers, require SCR emission limits and onshore emission offsets from dredging equipment operating in OCS areas, set catalyst emission limits for gasoline engines, and relieve certain retrofitted engines from periodic source testing.	12/10/98
Liquid petroleum gas motor fuel specifications Approved amendment rescinding 5% propene limit and extending 10% limit indefinitely.	12/11/98
Reformulated gasoline Approved amendments to rescind the RVP exemption for fuel with 10% ethanol and allow for oxygen contents up to 3.7% if the Predictive Model weighted emissions to not exceed original standards.	12/11/98
Consumer products Adopted amendments to add new VOC test methods, to modify Method 310 to quantify low vapor pressure VOC (LVP-VOC) constituents, and to exempt LVP-VOC from VOC content limits	11/19/98
Consumer products Approved amendments to extend the 1999 VOC compliance deadline for several aerosol coatings, antiperspirants and deodorants, and other consumer products categories to 2002, to exempt methyl acetate from the VOC definition, and make other minor changes.	11/19/98
Low-emission vehicle program (LEV II) Adopted regulations adding exhaust emission standards for most sport utility vehicles, pick-up trucks and mini-vans, lowering tailpipe standards for cars, further reducing evaporative emission standards, and providing additional means for generating zero-emission vehicle credits.	11/5/98 9/17/99 EO
Board Action	**Hearing Date**
Off-road engine aftermarket parts Approved implementation of a new program to test and certify aftermarket parts in gasoline and diesel, light-duty through heavy duty, engines used in off-road vehicles and equipment.	11/19/98 10/1/99 EO 7/18/00 EO

CARB Control Measures

Off-road spark ignition engines Adopted new emission standards for small and large spark ignition engines for off-road equipment, a new engine certification program, an in-use compliance testing program, and a three-year phase-in for large LSI.	10/22/98
Gasoline deposit control additives Adopted amendments to decertify pre-RFG additives, tighten the inlet valve deposit limits, add a combustion chamber deposit limit, and modify the test procedures to align with the characteristics of reformulated gasoline formulations.	9/24/98 4/5/99 EO
Stationary source test methods Adopted amendments to stationary source test methods to align better with federal methods.	8/27/98 7/2/99 EO
Locomotive MOA for South Coast Memorandum of agreement (MOA) signed by ARB, U.S. EPA and major railroads to concentrate cleaner locomotives in the South Coast by 2010 and fulfill 1994 ozone SIP commitment.	7/2/98
Gasoline vapor recovery Adopted amendments to certification and test methods to add methods for onboard refueling vapor recovery, airport refuelers, and underground tank interconnections, and make minor changes to existing methods.	5/21/98 8/27/98
Reformulated gasoline Approved amendments to rescind the wintertime oxygenate requirement, allow for sulfur content averaging, and make other minor technical amendments.	8/27/98
Ethylene oxide sterilizers Adopted amendments to the ATCM to streamline source testing requirements, add EtO limits in water effluent from control devices, and make other minor changes.	5/21/98
Chrome platers Adopted amendments to ATCM to harmonize with requirements of federal NESHAP standards for chrome plating and chromic acid anodizing facilities.	5/21/98
On-road heavy-duty vehicles Approved amendments to align on-road heavy duty vehicle engine emission standards with EPA's 2004 standards and align certification, testing, maintenance, and durability requirements with those of U.S. EPA.	4/23/98 2/26/99 EO
Small off-road engines (SORE) Approved amendments to grant a one-year delay in implementation, relaxation of emissions standards for non-handheld engines, emissions durability requirements, averaging/banking/trading, harmonization with the federal diesel engine regulation, and modifications to the production line testing requirements.	3/26/98
Heavy duty vehicle smoke inspection program Adopted amendments to require annual smoke testing, set opacity limits, and exempt new vehicles from testing for the first four years.	12/11/97 3/2/98 EO
Consumer products (hairspray credit program) Adopted standards for the granting of tradable emission reduction credits achieved by sales of hairspray products having VOC contents less than required limits.	11/13/97
Light-duty vehicle off-cycle emissions Adopted standards to control excess emissions from aggressive driving and air conditioner use in light duty vehicles and added two light duty vehicle test methods for certification of new vehicles under these standards.	7/24/97 3/19/98 EO
Consumer products Adopted amendments to add VOC limits to 18 categories of consumer products used in residential and industrial cleaning, automobile maintenance, and commercial poisons.	7/24/97
Enhanced evaporative emissions standards Adopted amendments extending the compliance date for ultra-small volume vehicle manufacturers by one year.	5/22/97
Board Action	**Hearing Date**
Emission reduction credit program Adopted standards for District establishment of ERC programs including certification, banking, use limitation, and reporting requirements.	5/22/97

CARB Control Measures

Lead as a toxic air contaminant Adopted an amendment to designate inorganic lead as a toxic air contaminant.	4/24/97
Consumer products (hair spray) Adopted amendments to (1) delay a January 1, 1998, compliance deadline to June 1, 1999, (2) require progress plans from manufacturers, and (3) authorize the Executive Officer to require VOC mitigation when granting variances from the June 1, 1999 deadline.	3/27/97
Portable engine registration program (PERP) Adopted standards for (1) the permitting of portable engines by ARB and (2) District recognition and enforcement of permits.	3/27/97
Liquefied petroleum gas Adopted amendments to extend the compliance deadline from January 1, 1997, to January 1, 1999, for the 5% propene limit in liquefied petroleum gas used in motor vehicles.	3/27/97
Onboard diagnostics, phase II Adopted amendments to extend the phase-in of enhanced catalyst monitoring, modify misfire detection requirements, add PVC system and thermostat monitoring requirements, and require manufacturers to sell diagnostic tools and service information to repair shops.	12/12/96
Consumer products Adopted amendments to delay 25% VOC compliance date for aerosol adhesives, clarify portions of the regulation, exempt perchloroethylene from VOC definition, extend the sell-through time to three years, and add perchloroethylene reporting requirements.	11/21/96
Consumer products (test method) Adopted an amendment to add Method 310 for the testing of VOC content in consumer products.	11/21/96
Pollutant transport designation Adopted amendments to modify transport couples from the Broader Sacramento area and add couples to the newly formed Mojave Desert and Salton Sea Air Basins.	11/21/96
Diesel fuel certification test methods Approved amendments specifying the test methods used for quantifying the constituents of diesel fuel.	10/24/96 6/4/97 EO
Wintertime requirements for utility engines & off-highway vehicles Optional hydrocarbon and NOx standards for snow throwers and ice augers, raising CO standard for specialty vehicles under 25hp.	9/26/96
Large off-road diesel Statement of Principles National agreement between ARB, U.S. EPA, and engine manufacturers to reduce emissions from heavy-duty off-road diesel equipment four years earlier than expected in the 1994 SIP for ozone.	9/13/96
Regulatory improvement initiative Rescinded two regulations relating to fuel testing in response to Executive Order W-127-95.	5/30/96
Zero emission vehicles Adopted amendments to eliminate zero emission vehicle quotas between 1998 and 2002, and approved MOUs with seven automobile manufacturers to accelerate release of lower emission "49 state" vehicles.	3/28/96 7/24/96 EO
CaRFG variance requirements Approved amendments to add a per gallon fee on non-compliant gasoline covered by a variance and to made administrative changes in variance processing and extension.	1/25/96 2/5/96 EO 4/2/96 EO
Utility and lawn and garden equipment engines Adopted an amendment to relax the CO standard from 300 to 350 ppm for Class I and II utility engines.	1/25/96
National security exemption of military tactical vehicles Such vehicles would not be required to adhere to exhaust emission standards.	12/14/95

CARB Control Measures

Board Action	Hearing Date
CaRFG regulation amendments Approved amendments to allow for downstream addition of oxygenates and expansion of compliance options for gasoline formulation.	12/14/95
Required additives in gasoline (deposit control additives) Terms, definitions, reporting requirements, and test procedures for compliance are to be clarified.	11/16/95
CaRFG test method amendments Approved amendments to designate new test methods for benzene, aromatic hydrocarbon, olefin, and sulfur content of gasoline.	10/26/95
Motor vehicle inspection and maintenance program Handled by BAR.	10/19/95 by BAR
Antiperspirants and deodorants, consumer products, and aerosol coating products Ethanol exemption for all products, modifications to aerosol special requirements, modifications for regulatory language consistency, modifications to VOC definition.	9/28/95
Low emission vehicle (LEV III) standards Reactivity adjustment factors, introduction of medium-duty ULEVs, window labels, and certification requirements and test procedures for LEVs.	9/28/95
Medium- and heavy-duty gasoline trucks Expedited introduction of ultra-low emission medium-duty vehicles and lower NOx emission standards for heavy-duty gasoline trucks to fulfill a 1994 ozone SIP commitment.	9/1/95
Retrofit emission standards: all vehicle classes to be included in the alternate durability test plan, kit manufacturers to be allowed two years to validate deterioration factors under the test plan, update retrofit procedures allowing manufacturers to disable specific OBDs if justified by law.	7/27/95
Gasoline vapor recovery systems Adopts revised certification and test procedures.	6/29/95
Onboard refueling vapor recovery standards 1998 and subsequent MY engine cars, LD trucks, and MD trucks less than 8500 GVWR.	6/29/1995 4/24/96 EO
Heavy duty vehicle exhaust emission standards for NOx Amendments to standards and test procedures for 1985 and subsequent MY HD engines, amendments to emission control labels, amendments to Useful Life definition and HD engines and in-use vehicle recalls.	6/29/95
Aerosol coatings regulation Adopted regulation to meet California Clean Air Act requirements and a 1994 ozone SIP commitment.	3/23/95
Periodic smoke inspection program Delays start of PSIP from 1995 to 1996.	12/8/94
Onboard diagnostics phase II Amendments to clarify regulation language, ensure maximum effectiveness, and address manufacturer concerns regarding implementation.	12/8/94
Alternative control plan (ACP) for consumer products A voluntary, market-based VOC emissions cap upon a grouping of consumer products, flexible by manufacturer that will minimize overall costs of emission reduction methods and programs.	9/22/94
Diesel fuel certification: new specifications for diesel engine certification fuel, amended oxygen specification for CNG certification fuel, and amended commercial motor vehicle liquefied petroleum gas regulations.	9/22/94
Utility and lawn and garden equipment (UGLE) engines Modification to emission test procedures, ECLs, defects warranty, quality-audit testing, and new engine compliance testing.	7/28/94
Evaporative emissions standards and test procedures Adopted evaporative emissions standards for medium-duty vehicles.	2/10/94

CARB Control Measures

Board Action	Hearing Date
Off-road recreational vehicles Adopted emission control regulations for off-road motorcycles, all-terrain vehicles, go-karts, golf carts, and specialty vehicles.	1/1/94
Perchloroethylene from dry cleaners Adopted measure to control perchloroethylene emissions from dry cleaning operations.	10/1/93
Wintertime oxygenate program Amendments to the control time period for San Luis Obispo County, exemption for small retailers bordering Nevada, flexibility in gasoline delivery time, calibration of ethanol blending equipment, gasoline oxygen content test method.	9/9/93
Onboard diagnostic phase II	7/9/93
Urban transit buses Amended regulation to tighten state NOx and particulate matter (PM) standards for urban transit buses beyond federal standards beginning in 1996.	6/10/93
1-year implementation delay in emission standards for utility engines	4/8/93
Non-ferrous metal melting Adopted Air Toxic Control Measure for emissions of cadmium, arsenic, and nickel from non-ferrous metal melting operations.	1/1/93
Certifications requirements for low emission passenger cars, light-duty trucks & medium duty vehicles	1/14/93
Airborne toxic control measure for emissions of toxic metals from non-ferrous metal melting	12/10/92
Periodic self-inspection program Implemented state law establishing a periodic smoke self-inspection program for fleets operating heavy-duty diesel-powered vehicles.	12/10/92
Notice of general public interest for consumer products	11/30/92
Substitute fuel or clean fuel incorporated test procedures	11/12/92
New vehicle testing using CaRFG Phase 2 gasoline Approved amendments to require the use of CaRFG Phase 2 gasoline in the certification of exhaust emissions in new vehicle testing.	8/13/92
Standards and test procedures for alternative fuel retrofit systems	5/14/92
Alternative motor vehicle fuel certification fuel specification	3/12/92
Heavy-duty off-road diesel engines Adopted the first exhaust emission standards and test procedures for heavy-duty off-road diesel engines beginning in 1996.	1/9/92
Consumer Products - Tier II Adopted Tier II of regulations to reduce emissions from consumer products.	1/9/92
Wintertime oxygen content of gasoline Adopted regulation requiring the addition of oxygenates to gasoline during winter to satisfy federal Clean Air Act mandates for CO ~~non-attainment~~nonattainment areas.	12/1/91
CaRFG Phase 2 Adopted CaRFG phase 2 specifications including lowering vapor pressure, reducing the sulfur, olefin, aromatic, and benzene content, and requiring the year-round addition of oxygenates to achieve reductions in ROG, NOx, CO, oxides of sulfur (SOx) and toxics.	11/1/91
Low emissions vehicles amendments revising reactivity adjust factor (RAF) provisions and adopting a RAF for M85 transitional low emission vehicles	11/14/91
Onboard diagnostic, phase II	11/12/91
Onboard diagnostics for light-duty trucks and light & medium-duty motor vehicles	9/12/91
Utility and lawn & garden equipment Adopted first off-road mobile source controls under the California Clean Air Act regulating utility, lawn and garden equipment.	12/1/90
Control for abrasive blasting	11/8/90

CARB Control Measures

Board Action	Hearing Date
Roadside smoke inspections of heavy-duty vehicles Adopted regulations implementing state law requiring a roadside smoke inspection program for heavy-duty vehicles.	11/8/90
Consumer Products Tier I Adopted Tier I of standards to reduce emissions from consumer products.	10/11/90
CaRFG Phase I Adopted CaRFG Phase I reformulated gasoline regulations to phase-out leaded gasoline, reduce vapor pressure, and require deposit control additives.	9/1/90
Low-emission vehicle (LEV) and clean fuels Adopted the landmark LEV/clean fuel regulations which called for the gradual introduction of cleaner cars in California. The regulations also provided a mechanism to ensure the availability of alternative fuels when a certain number of alternative fuel vehicles are sold.	9/1/90
Evaporative emissions from vehicles Modified test procedure to include high temperatures (up to 105 F) and ensure that evaporative emission control systems function properly on hot days.	8/9/90
Dioxins from medical waste incinerators Adopted Airborne Toxic Control Measure to reduce dioxin emissions from medical waste incinerators.	7/1/90
CA Clean Air Act guidance for permitting Approved California Clean Air Act permitting program guidance for new and modified stationary sources in ~~non-attainment~~nonattainment areas.	7/1/90
Consumer products BAAQMD	6/14/90
Medium duty vehicle emission standards Adopted three new categories of low emission MDVs, required minimum percentages of production, and established production credit and trading.	6/14/90
Medium-duty vehicles Amended test procedures for medium-duty vehicles to require whole-vehicle testing instead of engine testing. This modification allowed enforcement of medium-duty vehicle standards through testing and recall.	6/14/90
Ethylene oxide sterilizers Adopted Airborne Toxic Control Measure to reduce ethylene oxide emissions from sterilizers and aerators.	5/10/90
Asbestos in serpentine rock Adopted Airborne Toxic Control Measure for asbestos-containing serpentine rock in surfacing applications.	4/1/90
Certification procedure for aftermarket parts	2/8/90
Antiperspirants and deodorants Adopted first consumer products regulation, setting standards for antiperspirants and deodorants.	11/1/89
Residential woodstoves Approved suggested control measure for the control of emissions from residential wood combustion.	11/1/89
On-Board Diagnostic Systems II Adopted regulations to implement the second phase of on-board diagnostic requirements which alert drivers of cars, light-trucks and medium-duty vehicles when the emission control system is not functioning properly.	9/1/89
Cars and light-duty trucks Adopted regulations to reduce ROG and CO emissions from cars and light trucks by 35 percent.	6/1/89
Architectural coatings Approved a suggested control measure to reduce ROG emissions from architectural coatings.	5/1/89
Chrome from cooling towers Adopted Airborne Toxic Control Measure to reduce hexavalent chromium emissions from cooling towers.	3/1/89

CARB Control Measures

Board Action	Hearing Date
Reformulated Diesel Fuel Adopted regulations requiring the use of clean diesel fuel with lower sulfur and aromatic hydrocarbons beginning in 1993.	11/1/88
Vehicle Recall Adopted regulations implementing a recall program which requires auto manufacturers to recall and fix vehicles with inadequate emission control systems (Vehicles are identified through in-use testing conducted by the ARB).	9/1/88
Suggested control measure for oil sumps Approved a suggested control measure to reduce emissions from sumps used in oil production operations.	8/1/88
Chrome platers Adopted Airborne Toxic Control Measure to reduce emissions of hexavalent chromium emissions from chrome plating and chromic acid anodizing facilities.	2/1/88
Suggested control measure for boilers Approved suggested control measure to reduce NOx emissions from industrial, institutional, and commercial boilers, steam generators and process heaters.	9/1/87
Benzene from service stations Adopted Airborne Toxic Control Measure to reduce benzene emissions from retail gasoline service stations (Also known as Phase II vapor recovery).	7/1/87
Agricultural burning guidelines Amended existing guidelines to add provisions addressing wildland vegetation management.	11/1/86
Heavy-duty vehicle certification Amended certification of heavy-duty diesel and gasoline-powered engines and vehicles to align with federal standards.	4/1/86
Cars and light-duty trucks Adopted regulations reducing NOx emissions from passenger cars and light-duty trucks by 40 percent.	4/1/86
Sulfur in diesel fuel Removed exemption for small volume diesel fuel refiners.	6/1/85
On-Board Diagnostics I Adopted regulations requiring the use of on-board diagnostic systems on gasoline-powered vehicles to alert the driver when the emission control system is not functioning properly.	4/1/85
Suggested control measure for wood coatings Approved a suggested control measure to reduce emissions from wood furniture and cabinet coating operations.	3/1/85
Suggested control measure for resin manufacturing Approved a suggested control measure to reduce ROG emissions from resin manufacturing.	1/1/85

APPENDIX J
CARB 2022, STATE STRATEGY FOR THE STATE IMPLEMENTATION PLAN

2022 State Strategy for the State Implementation Plan

Adopted
September 22, 2022

CALIFORNIA
AIR RESOURCES BOARD

Electronic copies of this document are available for download from the California Air Resources Board's Internet site at: *https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy*. In addition, written copies may be obtained from the Public Information Office, California Air Resources Board, 1001 I Street, 1st Floor, Visitors and Environmental Services Center, Sacramento, California 95814. Because of current travel, facility, and staffing restrictions, the California Air Resources Board's offices may have limited public access. Please contact Candace Clawson, Office Technician, at candace.clawson@arb.ca.gov if you need physical copies of the documents.

For individuals with sensory disabilities, this document is available in Braille, large print, audiocassette or computer disk. Please contact CARB's Disability Coordinator at (916) 323-4916 by voice or through the California Relay Services at 711, to place your request for disability services. If you are a person with limited English and would like to request interpreter services, please contact CARB's Bilingual Manager at (916) 323-7053.

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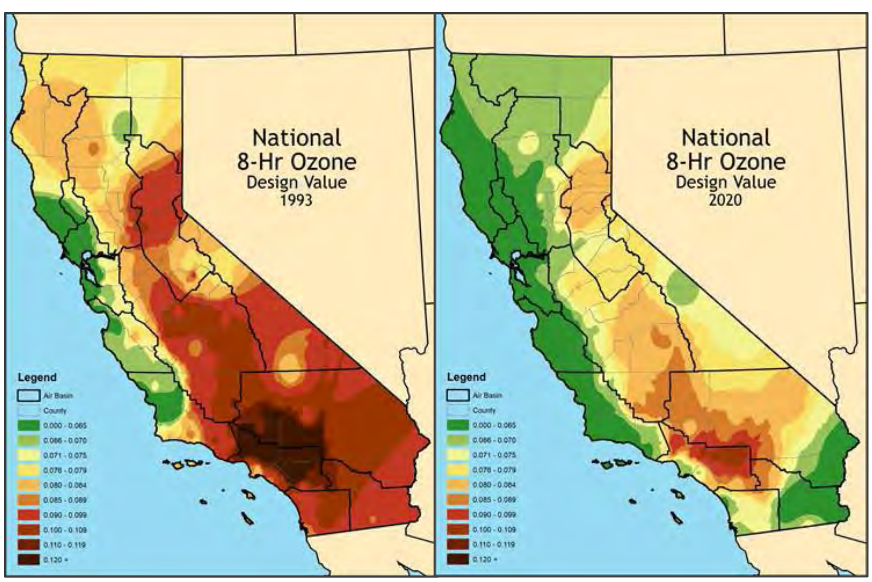
Executive Summary

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

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

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

Figure 1 – Ozone Air Quality Progress in California



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

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

Figure 2 - 70 ppb Ozone Nonattainment Areas

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

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

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

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

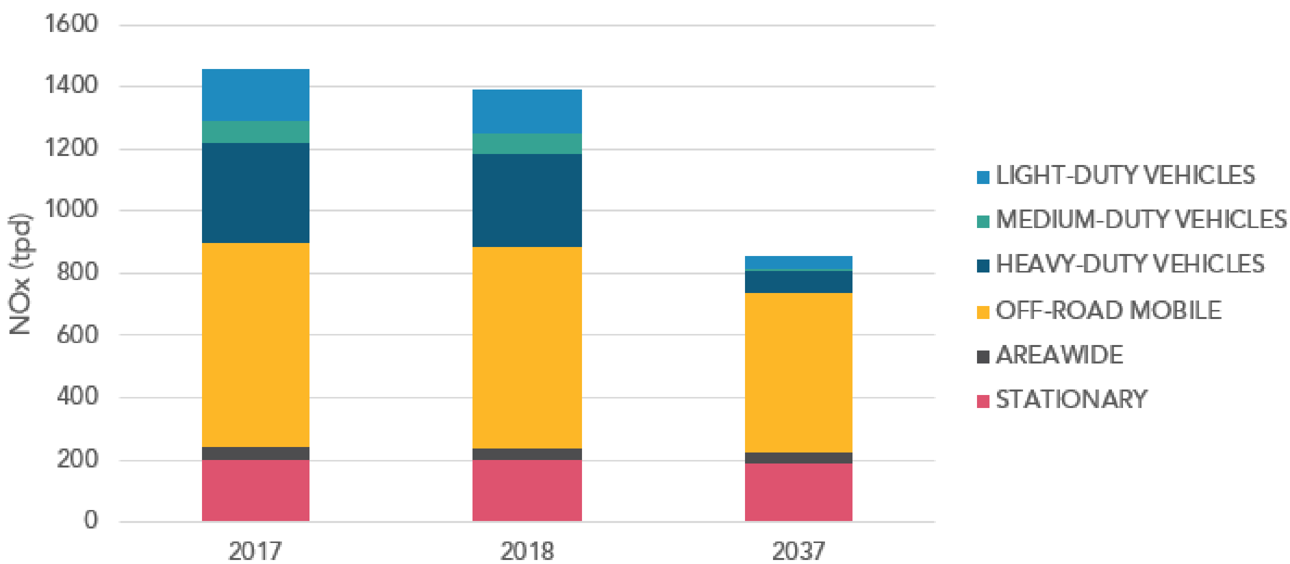
Central to CARB's planning efforts and programs going forward will be prioritizing environmental justice, incorporating racial equity, and conducting meaningful community engagement as CARB strives to address the longstanding environmental and health inequities from elevated levels of toxics, criteria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

This Proposed 2022 State SIP Strategy effort builds on the measures and commitments already made in the *2016 State Strategy for the State Implementation Plan* (2016 State SIP Strategy), and expands on the scenarios and concepts included in the *2020 Mobile Source Strategy* (2020 MSS), CARB's multi-pollutant planning effort that identifies the pathways forward to achieve the State's many air quality, climate, and community risk reduction goals. CARB finalized the 2020 MSS in October 2021, as a conceptual road map for potential future measures. The measure concepts in the 2020 MSS form the basis for many of the measures in this document and have since been developed further and translated into detailed measures with, where possible, anticipated emissions reductions. This document, the Proposed 2022 State SIP Strategy, will be considered for adoption by the Board and embodies input from stakeholders and the Board, and staff assessment of the feasibility of specific measures. Board consideration is scheduled for September 2022. The Proposed 2022 State SIP Strategy is also being developed in parallel with the 2022 Climate Change Scoping Plan Update (2022 Scoping Plan Update); the 2022 Scoping Plan Update is on a similar development timeline and will lay out the State's path to achieving carbon neutrality by 2045. The 2022 Scoping Plan Update will incorporate actions in the Proposed 2022 State SIP Strategy and rely on these actions included in the SIP to also deliver greenhouse gas reductions.

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

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

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



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

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

2022 State SIP Strategy

Figure 4 - Proposed 2022 State SIP Strategy Measures

On-Road Vehicles

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

Off-Road Vehicles and Equipment

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

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

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

Other Categories

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

2022 State SIP Strategy

Table 1 – Potential Emissions Reductions Commitments

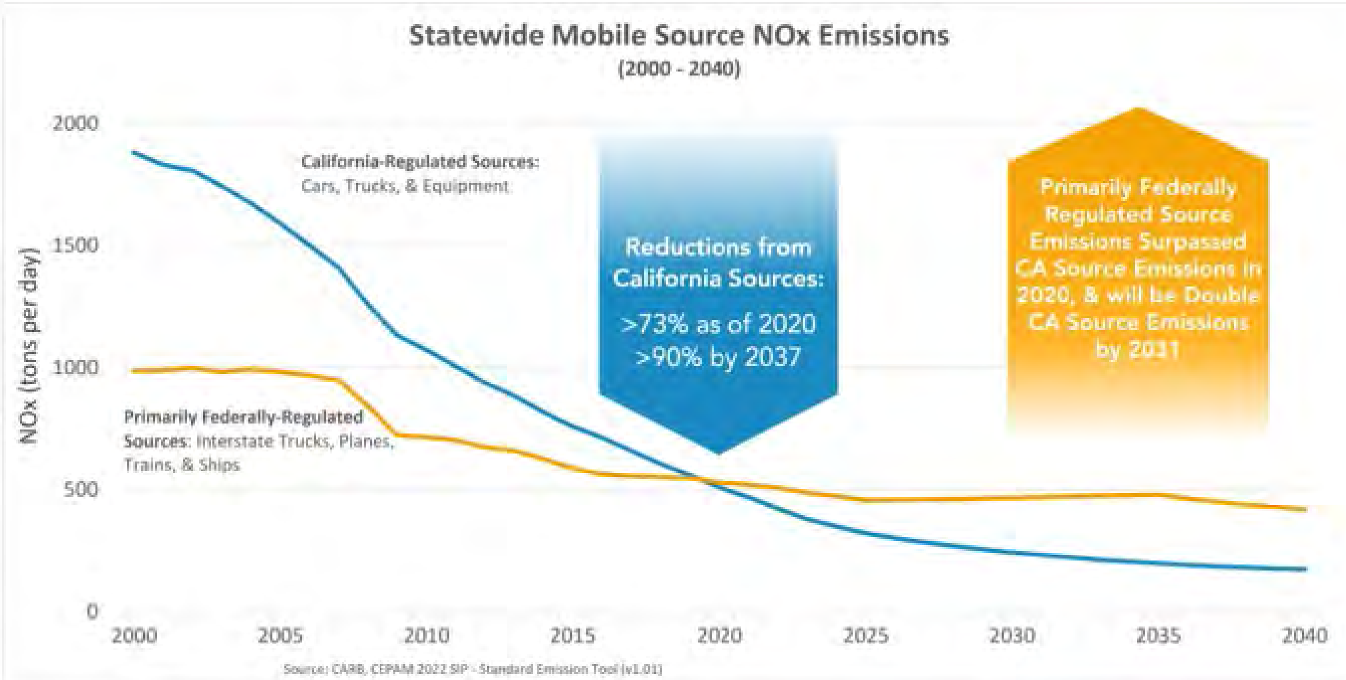
Nonattainment Area	2026 NOx (tpd)	2032 NOx (tpd)	2037 NOx (tpd)	2037 ROG (tpd)
Ventura County	0.3	n/a	n/a	n/a
Eastern Kern County	n/a	1.8	n/a	n/a
Sacramento Metro Area	n/a	6.1	n/a	n/a
Western Mojave Desert	n/a	20.6	n/a	n/a
Coachella Valley	n/a	n/a	5.2	0.6
San Joaquin Valley	n/a	n/a	25.3	4.2
South Coast*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

*Includes emissions reductions from Federal Actions Needed

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

2022 State SIP Strategy

Figure 5 – Federal Action Is Critical[4]



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

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

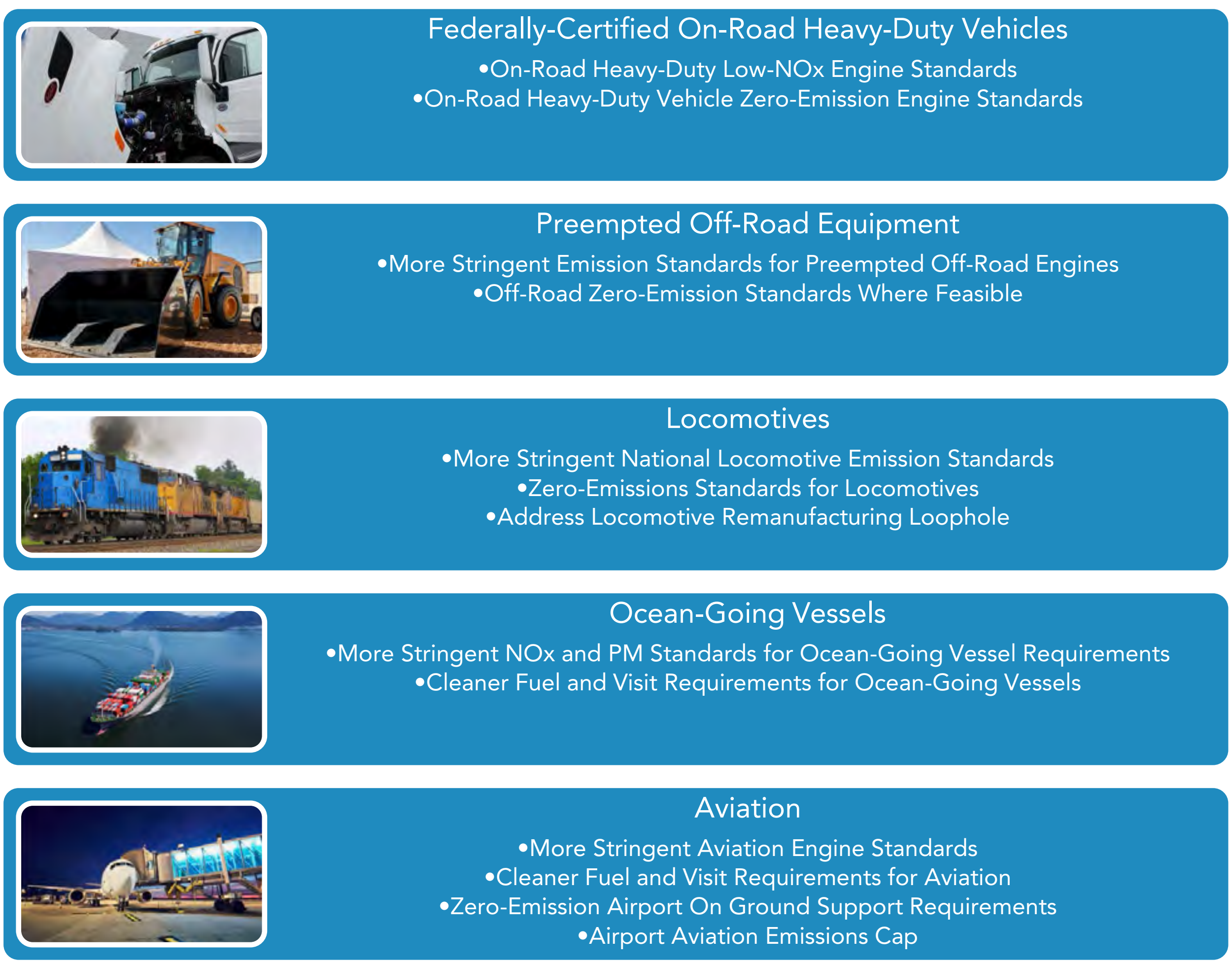
[4] Source: CARB 2022 CEPAM v1.01; represents the current baseline emissions out to 100 nautical miles with adopted CARB and district measures

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

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

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

Figure 6 – Federal Actions Needed



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

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

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

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

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

 2022 State SIP Strategy

Chapter 1: Introduction

Overview of Strategy

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

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

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

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

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

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

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

Blueprint for Success

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

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

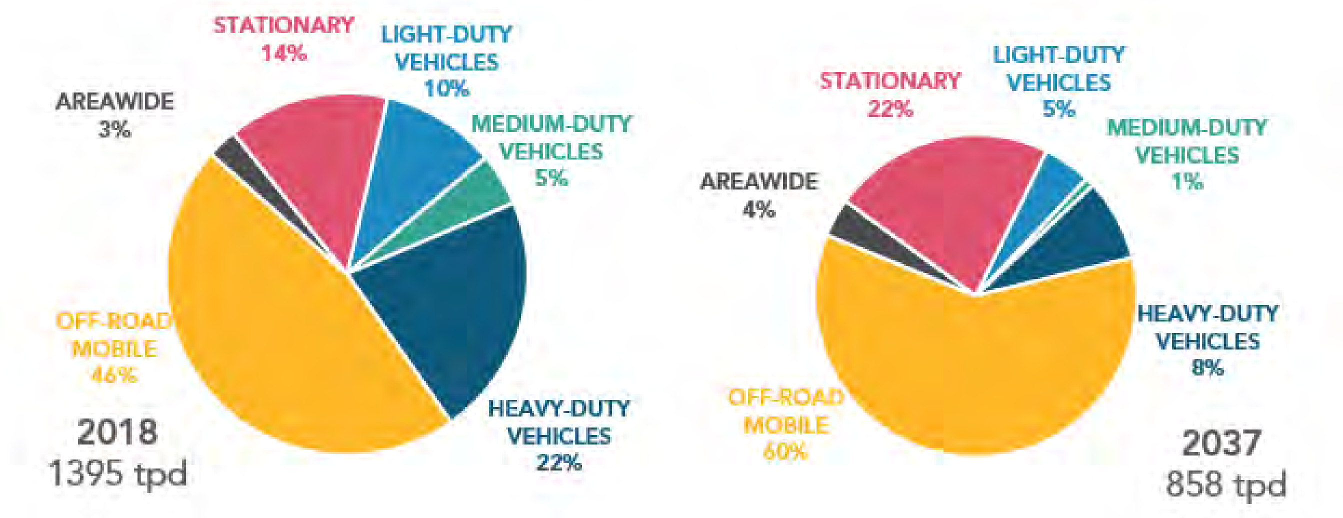
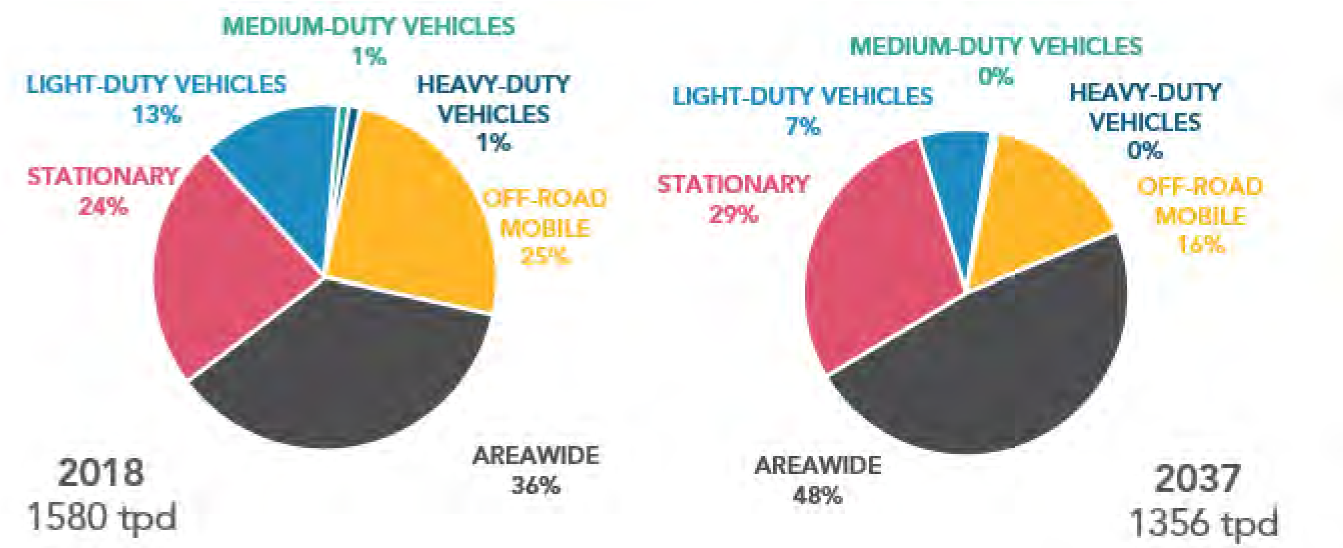


Figure 8 – Statewide ROG Emissions by Sector under Current Control Program[8]



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

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

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

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

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

Proposed Actions

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

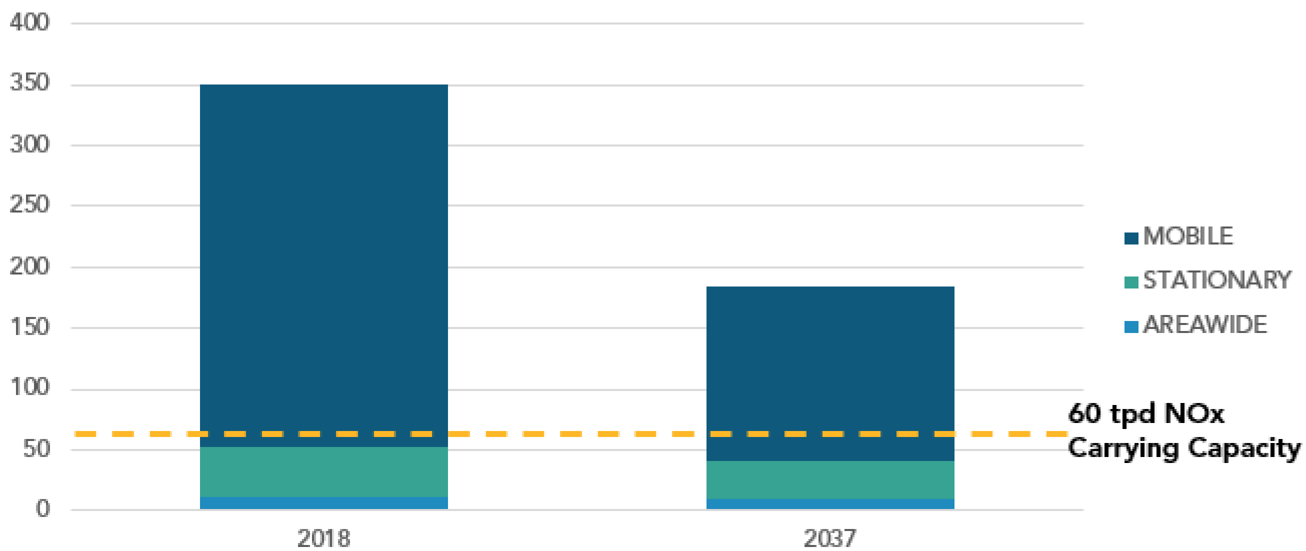
For passenger vehicles, the Proposed 2022 State SIP Strategy includes actions to increase the penetration of ZEV by targeting ride-hailing services offered by transportation network companies and, for motorcycles, the Proposed 2022 State SIP Strategy proposes more stringent exhaust and evaporative emissions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

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

Finally, for sources that are primarily-federally and internationally regulated, such as interstate trucks, preempted off-road equipment, locomotives, aviation, and ocean-going vessels, the Proposed 2022 State SIP Strategy includes proposed commitments for certain CARB actions within our authority. Further, this strategy proposes petitions and other advocacy calling for U.S. EPA and other federal and international entities to take action to provide the needed emissions reductions. Actions needed at the federal and international levels include setting more stringent engine standards, requiring zero-emission technologies where feasible, and potential requirements to require that only the cleanest vessels and aircraft visit California, given the severity of our attainment challenges. Strong federal and international action is critical as these sources represent an increasing fraction of ozone-forming emissions in California.

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

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



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

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

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

Health Impacts

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

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

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

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

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

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

[12] Ibid.

2022 State SIP Strategy

Health Impacts from Mobile Source Emissions

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

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

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

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

[14] Ibid

[15] U.S. EPA. (2019a). Integrated Science Assessment for Ozone and Related Photochemical Oxidants (External Review Draft).

[16] Ibid.

[17] Ibid.

[18] Boothe, V. L., Shendell, D. G. (2008). Potential health effects associated with residential proximity to freeways and primary roads: review of scientific literature, 1999–2006. Journal of Environmental Health, 70(8), 33-41.; Wang et al (2020). Traffic-related Metrics and Adverse Birth Outcomes: A Systematic Review and Meta-analysis. Environmental Research, 109752.
Woods et al (2017). The influence of the built environment on adverse birth outcomes. Journal of Neonatal-Perinatal Medicine, 10(3), 233-248.
CARB (2018) Air Pollution and the Brain *https://ww2.arb.ca.gov/resources/fact-sheets/air-pollution-and-brain*

[19] CARB (2020). Overview: Diesel Exhaust & Health *https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health*

[20] Ibid.

[21] Ibid.

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

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

Environmental Justice and Pollution Exposure Disparities

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

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

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

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

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Economic and Environmental Analyses

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

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

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

Next Steps

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

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

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

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

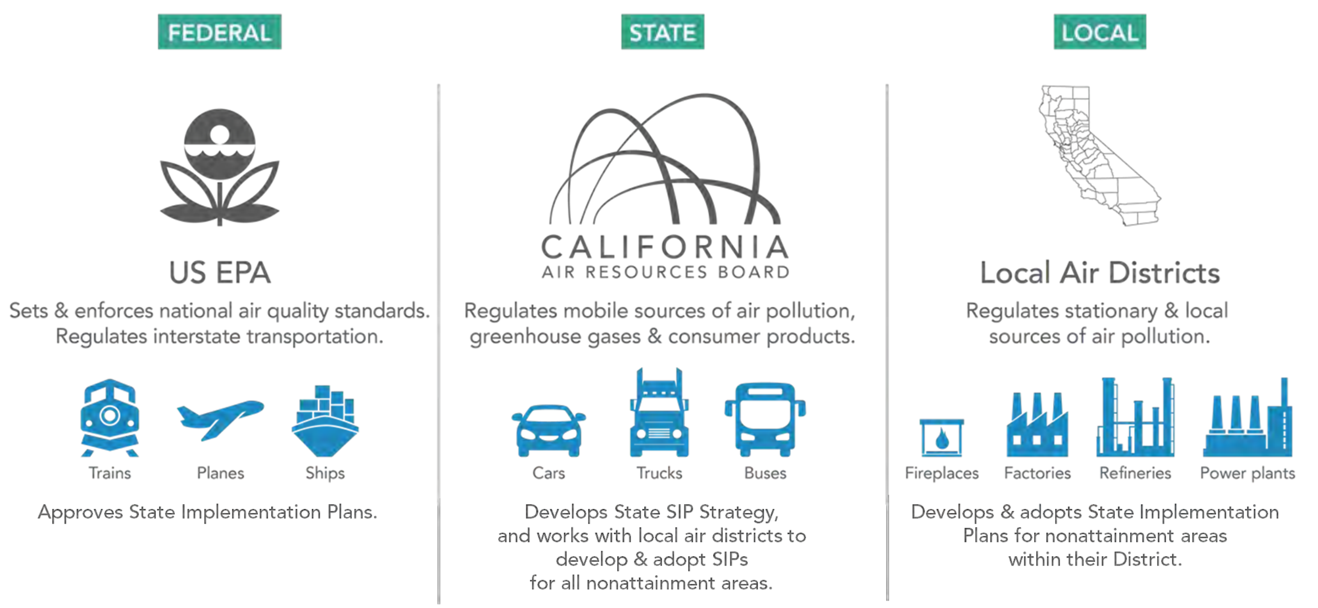
Chapter 2: Nonattainment Areas and Emissions Reduction Needs

Federal Clean Air Act Requirements

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

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

Figure 10 – Air Agency Roles and Responsibilities



Decades of research programs and technical work conducted by CARB, air districts, U.S. EPA, academic institutions, other research organizations, and the private sector provide the scientific foundation for determining effective control approaches. Because of the critical role of State-regulated sources towards attainment, CARB staff continue to work closely with air districts in development of the overall Proposed 2022 State SIP strategy. As part of this effort, air districts develop corresponding strategies for sources under their authority. These strategies are included in area-specific SIPs that are first considered at the local level. As the lead air quality agency for the State, CARB must then evaluate these SIPs to ensure they meet State law and federal Clean Air Act requirements. These SIPs are then considered by the Board, and if approved, submitted to U.S. EPA.

Nonattainment Areas

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

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

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

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

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

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

[29] Ibid.

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

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

[32] Ibid.

[33] Ibid.

[34] Ibid.

[35] Ibid.

[36] Ibid.

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

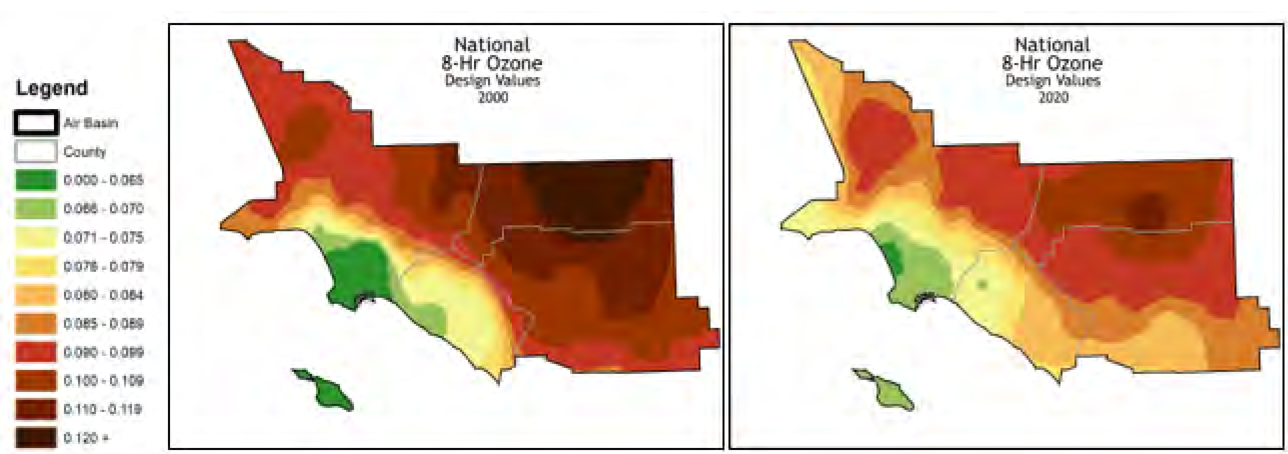
Emission Reduction Needs

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

South Coast Emission Reduction Needs

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

Figure 11 - South Coast Ozone Progress



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

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

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

San Joaquin Valley Emission Reduction Needs

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

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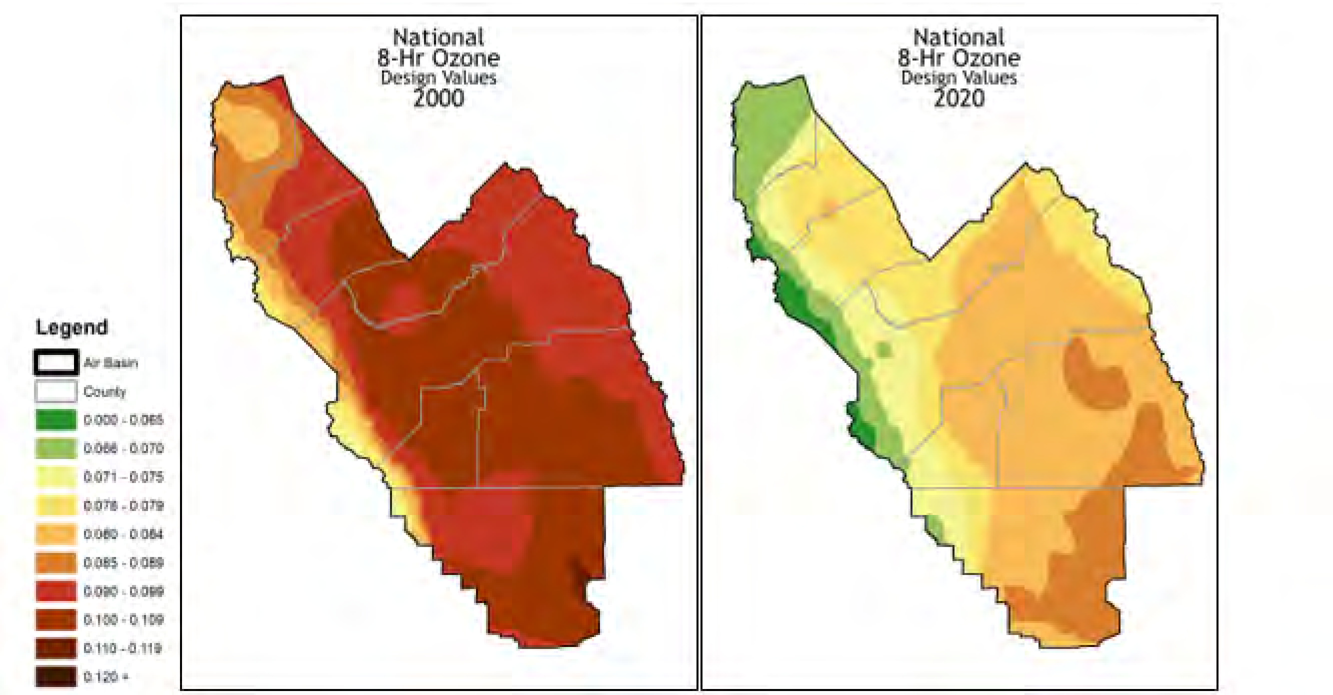
Figure 12 - San Joaquin Valley Ozone Progress



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

Remaining Nonattainment Areas – Reduction Needs

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

Coachella Valley

The Coachella Valley nonattainment areas is the portion of Riverside County that lies in the Salton Sea Air Basin. The Coachella Valley is surrounded by large mountain ranges and have average daytime temperatures in the summer months of over 100 degrees. These conditions, coupled with transport of ozone and ozone precursors from the South Coast through the San Gorgonio Pass, along with local emissions, result in higher ozone levels. Although substantial reductions in emissions and ozone levels have occurred over the last twenty years, additional reductions are needed upwind in the South Coast, and could be supplemented with reductions in the Coachella Valley, to address the challenge of attaining the 70 ppb ozone standard.

Eastern Kern County

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

Sacramento Metro

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

Ventura County

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

Western Mojave Desert

The Western Mojave Desert is part of the Mojave Desert Air Basin which is shared between the Mojave Desert and Antelope Valley AQMDs. The Mojave Desert AQMD portion of the Western Mojave Desert includes the southwestern desert portion of San Bernardino County and the segment of eastern Riverside County known as the Palo Verde Valley. The Antelope Valley AQMD portion of the Western Mojave Desert includes the northeastern desert portion of Los Angeles County. The Mojave Desert AQMD portion is characterized by hot, dry summers and cool winters, with little precipitation. The Antelope Valley AQMD portion is characterized by a wide, arid valley with verly little precipitation and high summer temperatures. The Western Mojave Desert serves as a growing bedroom community for the greater Los Angeles area, and the primary roadways carry a substantial amount of daily commute traffic from Western Mojave Desert into Los Angeles. Ozone and ozone precursors are often transported inland by the prevailing winds from the South Coast and to lesser extent from the San Joaquin Valley. While substantial reductions in emissions and ozone levels have occurred over the last twenty years, additional reductions are needed in upwind areas, and could be supplemented with reductions in the Western Mojave Desert, to address the significant challenge that remain, including to provide for attainment of the 70 ppb ozone standard.

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Chapter 3: Public Process and Measure Suggestions

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

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

On-Road Heavy-Duty Vehicle Useful Life Regulation

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

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

Additional Incentive Programs - Zero-Emission Trucks

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

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

Enhanced Transportation Choices

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

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

Indirect Source Rule – Suggested Control Measure or Regulation

An indirect source can be any facility, building, structure, or installation, or combination thereof, which attracts or generates mobile source activity that results in emissions – these include warehouses, railyards, ports, airports, and mobile sources attracted to those warehouses, railyards, ports, and airports. Only a few air districts in California have indirect source rules to limit emissions of this nature on a facility basis. This measure could involve CARB writing a Suggested Control Measure which acts as a model rule to assist the air districts in the rule development process. In addition, CARB staff will explore opportunities to expand existing State law to provide partnership opportunities for CARB and air districts to work together to develop, adopt, and implement indirect source rules.

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

BACT/BARCT Determination

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

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

Additional Building Emission Standards

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

CARB could propose additional emissions standards for combustion sources used in buildings by working with air districts to set such standards and, with building and energy code agencies on standards for new construction, or by taking other actions (including potentially incentive programs) to accelerate the removal of fossil fuels from the building stock in both new and existing buildings. Such measures could potentially significantly accelerate the transition away from pollution associated with combustion in these sources while creating economic opportunities for building retrofits. Any such measures would be developed with careful consideration for community needs, and housing cost concerns, with full community engagement.

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

Pesticides Regulation

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

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

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

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

Enhanced Bureau of Automotive Repair Consumer Assistance Program

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

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

Light-Duty Vehicle Fleet Regulation

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

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

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Chapter 4: Proposed SIP Commitment

Overview of Commitment

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

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

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

Commitment to Act on Proposed Measures

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

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

Commitment to Achieve Emissions reductions

The following sections describe the estimated emission reduction and potential commitments from the proposed SIP measures identified and quantified to date for the South Coast, the San Joaquin Valley, Coachella Valley, Eastern Kern County, Sacramento Metro, Ventura County, and Western Mojave Desert. The SIPs for each nonattainment area are still under development, and the emissions reductions may change as each attainment demonstration is finalized. The aggregate commitment of emissions reductions from State sources to be proposed for Board consideration will be found in CARB's staff report for the respective nonattainment area's SIP.

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

2022 State SIP Strategy

Table 3 - Proposed Measures and Schedule

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

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

2022 State SIP Strategy

Table 4 – Proposed Measures and Schedule*

Measures	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Advanced Clean Fleets			★	■													
Zero-Emissions Trucks Measure								★		■							
On-Road Motorcycle New Emissions Standards		★			■												
Clean Miles Standard	★		■														
Tier 5 Off-Road Vehicles and Equipment					★				■								
Amendments to the In-Use Off-Road Diesel Fueled Fleets		★		■													
Transport Refrigeration Unit Regulation Part 2						★		■									
Commercial Harbor Craft Amendments		★	■														
Cargo Handling Equipment Amendments					★	■											
Off-Road Zero-Emission Targeted Manufacturer Rule							★				■						
Clean Off-Road Fleet Recognition Program					★		■										
Spark-Ignition Marine Engine Standards									★		■						
Consumer Products Standards							★	■									
Zero-Emission Standard for Space and Water Heaters					★					■							
Enhanced Regional Emission Analysis in SIPs			■														
In-Use Locomotive Regulation			★	■													
Pesticides: 1,3-Dichloropropene Health Risk Mitigation		★		■													
Future Measures for Aviation Emission Reductions (TBD)							★		■								
Future Measures for OGV Emission Reductions (TBD)							★										

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

2022 State SIP Strategy

Statewide Emissions Reductions

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

Emissions reductions from Current Programs

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

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

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

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

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

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

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

Emissions reductions from Proposed New Measures

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

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

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

[45] Numbers may not add up due to rounding

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

2022 State SIP Strategy

South Coast

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

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

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

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

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

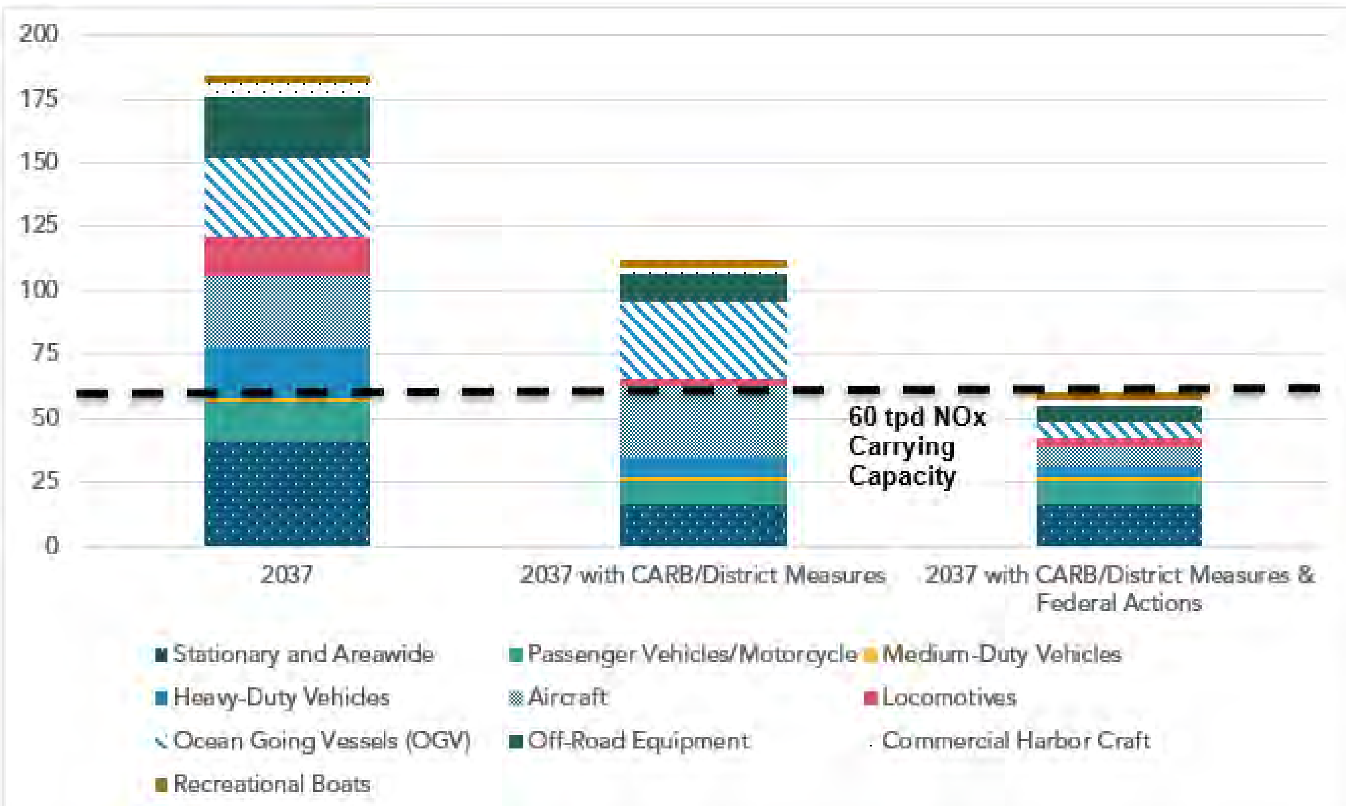
[47] Numbers may not add up due to rounding

2022 State SIP Strategy

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

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

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



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

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

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

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

[50] Numbers may not add up due to rounding
[51] Reductions may be achieved through CARB and/or complementary South Coast AQMD control measures for this sector.
[52] Request U.S. EPA approval under the provisions of Section 182(e)(5) of the Clean Air Act

San Joaquin Valley

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

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

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

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

[53] Numbers may not add up due to rounding

2022 State SIP Strategy

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

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

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

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

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

[55] Numbers may not add up due to rounding

Coachella Valley

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

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

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

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

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

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

[56] Numbers may not add up due to rounding

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

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

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

[58] Numbers may not add due to rounding

2022 State SIP Strategy

Eastern Kern County

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

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

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

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

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

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

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

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

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

[60] Numbers may not add due to rounding

2022 State SIP Strategy

Sacramento Metro

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

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

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

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

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

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

[61] Numbers may not add due to rounding

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

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

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

[63] Numbers may not add due to rounding

2022 State SIP Strategy

Western Mojave Desert

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

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

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

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

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

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

[64] Numbers may not add due to rounding

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

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

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

[66] Numbers may not add due to rounding

2022 State SIP Strategy

Ventura County

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

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

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

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

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

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

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

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

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

[68] Numbers may not add due to rounding

Commitment to Emissions Reduction from On-Road Mobile Sources

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

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

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

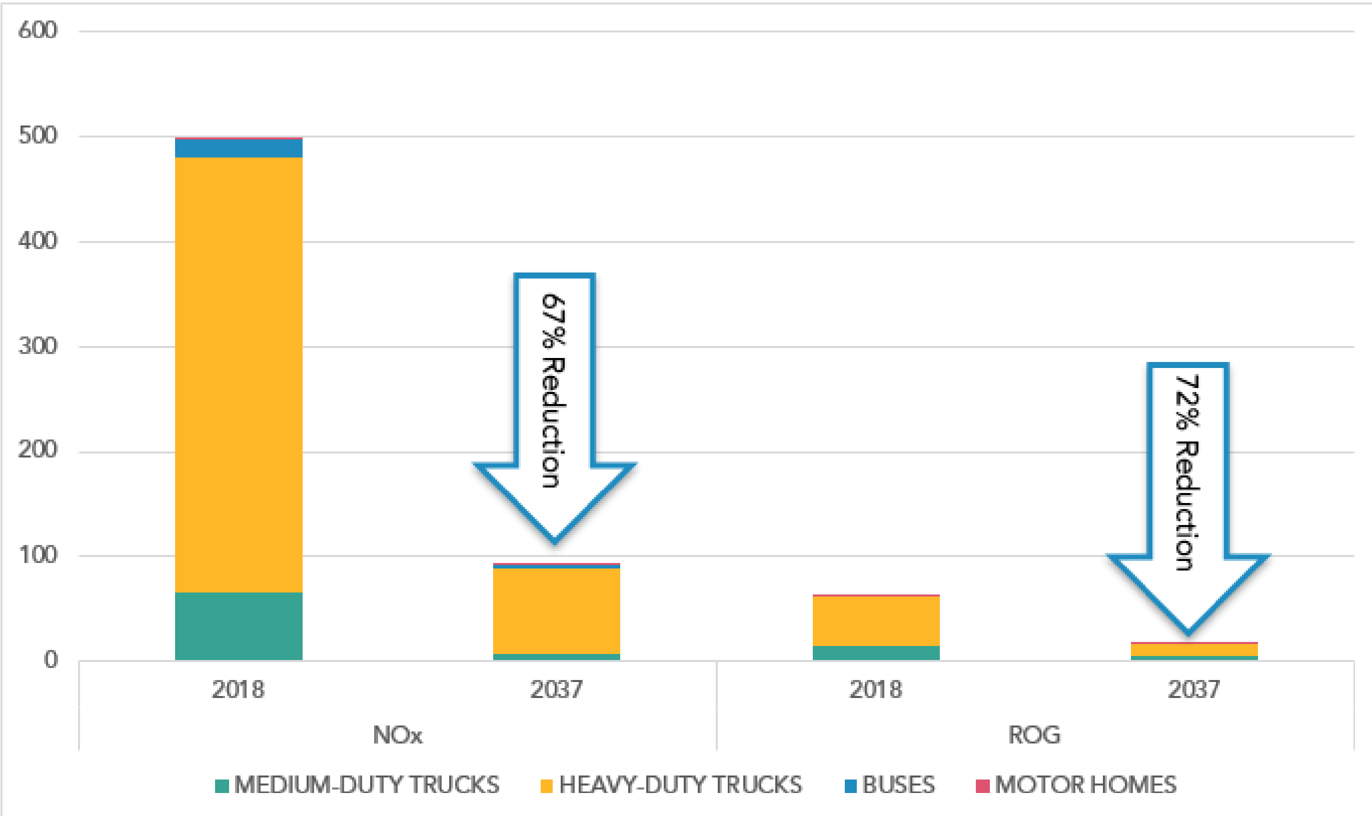
Chapter 5: State SIP Measures

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

Description of Source Category

Medium- and heavy-duty vehicles are defined as vehicles with a GVWR over 8,500 pounds and include heavier pick-up trucks and walk-in vans, as well as a wide range of vocational and drayage trucks (big-rig trucks) and buses. These vehicles are one of the fastest growing transportation sectors in the United States, responsible for about 32 percent of total Statewide NOx emissions, and are a significant source of Statewide diesel PM and GHG emissions. CARB has numerous programs already in place to control emissions from medium- and heavy-duty vehicles including the Truck and Bus Regulation, Heavy-Duty Omnibus, Advanced Clean Trucks, as well as incentive programs such as the widely successful Carl Moyer Program. In addition, CARB recently adopted the Heavy-Duty Inspection and Maintenance regulation, a 2016 State SIP Strategy measure. Most of the NOx emissions from heavy-duty engines come from diesel-cycle engines, especially in the higher weight classes (Figure 14). Gasoline and natural gas otto-cycle spark-ignited engines are also used in heavy-duty trucks, to a lesser extent, and primarily in the lower weight classification vehicles.

Figure 14 - On-Road Medium- and Heavy-Duty Vehicles: Statewide Baseline Emissions Inventory with Current Control Program[69]



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

Advanced Clean Fleets Regulation

Overview

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

Background/Regulatory History

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

Proposed Action

For this measure, CARB would phase in ZEV requirements for different fleets as follows:

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

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

2022 State SIP Strategy

Drayage trucks:

- All drayage trucks would need to be reported in the CARB reporting system if they transport containers or bulk goods to and from California's intermodal seaports and railyards.
- Legacy trucks that are reported prior to 2024 would be able to remain in service until the model year of the engine exceeds 13 years or 800,000 miles with a maximum of 18 years from the truck engines certification date.
- Beginning January 1, 2024, any truck added to drayage service would need to be a ZEV.
- All drayage trucks entering seaports and intermodal railyards would be required to be zero-emission by 2035.

High priority and federal fleets:

- Affected fleets include any business or entity with an annual revenue greater than $50 million, fleets and brokers who own, direct, or operate more than 50 trucks under common ownership and control.
- High priority and federal fleets would be required to report all vehicles that operate in California starting 2024.
- Affected fleet owners would have to meet one of two compliance options:
    - First, starting in 2024, all additions to the fleet would be ZEVs and existing trucks would be upgraded to ZEVs when the model year of the engine exceeds 13 years or 800,000 miles with a maximum of 18 years from the truck engines certification date.
    - Second, affected fleets could use a more flexible alternative compliance option to meet zero-emission fleet milestones as a percentage of the fleet. This option would provide fleet owners the flexibility to manage their fleet consistent with their normal vehicle purchase patterns provided they continue to meet the ZEV fleet milestones. The fleet milestones are phased-in based on ZEV suitability by vehicle body type as follows:
        - Vans, box trucks, light-duty package delivery vehicles, and buses would start at 10 percent of the fleet being zero -emission in 2025 and 100 percent zero-emission by 2035.
        - Work trucks, day cab tractors, and motor coaches would start at 10 percent of the fleet being zero-emission in 2027 and 100 percent zero-emission by 2039.
        - Sleeper cab tractors and other specialty vehicles would start at 10 percent of the fleet being zero-emission in 2030 and 100 percent zero-emission by 2042.

100 percent ZEV Sales

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

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

Estimated Emissions Reductions

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

Table 30 - Advanced Clean Fleets Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

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

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

2022 State SIP Strategy

Zero Emissions Trucks Measure

Overview

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

Options:

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

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

Background/Regulatory History

- NOx emissions from trucks are currently the largest category of on-road mobile source emissions and will remain a major portion of pollution in the future absent acceleration of fleets to ZE technology.
- Freight trucking activity occurs at seaports, warehouses, railyards, and other major freight hubs throughout California. Nearby communities are disproportionately burdened by the cumulative health impacts from these facilities.
- In June 2020, the Board adopted the ACT regulation, a first-of-its-kind regulation requiring medium- and heavy-duty manufacturers to produce ZEV as an increasing portion of their sales beginning in 2024. This regulation is expected to result in roughly 100,000 ZEVs by 2030 and nearly 300,000 ZEVs by 2035 operating in California.
- With the adoption of the ACT regulation, Resolution 20-19 directs staff to return to the Board with a ZE fleet rule and sets the following targets for transitioning sectors to ZEVs:
    - 100 percent ZE drayage, last mile delivery, and government fleets by 2035;
    - 100 percent ZE refuse trucks and local buses by 2040;
    - 100 percent ZE-capable vehicles in utility fleets by 2040; and

  - 100 percent ZE everywhere else, where feasible, by 2045.
- In September 2020, the Governor signed Executive Order N-79-20 which directs CARB to adopt regulations to transition the state's transportation fleet to ZEVs. This includes transitioning the state's drayage fleet to ZEVs by 2035 and transitioning the State's truck and bus fleet to ZEVs by 2045 where feasible.
- Staff are developing the ACF regulation which targets drayage, public, and other high priority fleets with 50 or more trucks or entities with trucks and $50 million in annual revenues. If adopted as proposed in 2022, the number of medium- and heavy-duty ZEV will be about 1.2 million by 2045 operating in California.
- The public suggested a measure to turn over in-use heavy-duty vehicles at the end of their useful life to ZE trucks or newer combustion engines in the secondary market. The staff proposed measure would phase-in used ZEVs in the secondary market and would not include upgrades to trucks with combustion engines (given the deterioration of combustion engine control systems over time).
- Even after the implementation of ACT and ACF, about 480,000 heavy-duty combustion trucks will still be on California's roads in 2037 and 400,000 would remain by 2045.
- The proposed new measure would go beyond proposed ACF requirements to further increase the number of ZEVs with the goal of achieving a full ZEV fleet by 2045 everywhere feasible.
- The experience of developing, implementing, and enforcing the 2008 Truck and Bus regulation highlights the challenges of using a regulatory mechanism to require widespread fleet turnover. Such an approach has economic consequences and takes a great deal of time to phase-in (Truck and Bus took 15+ years to full implementation).
- The new measure would seek to expand the ZEV market in a manner that is economically feasible for more than 100,000 fleets where some cannot afford to purchase new trucks and will not be able to operate without access to retail ZEV infrastructure, especially for long-haul and inter-state vehicles.
- An approach using new authorities could minimize administrative burden for fleet owners and CARB. New tools such as differentiated registration fees would create market mechanisms that can be leveraged to tip the scales to encourage those who have operations that are suitable for electrification to act early and would allow more time for those who can't.
- These new approaches would build on ACT and ACF. When combined with the significant investment California is making to upgrade trucks to ZEVs, install needed ZE infrastructure, and other strategies described in this document if granted new authorities, these approaches will rapidly accelerate the transition from combustion to ZE trucks needed throughout the State and particularly in priority communities.
- Without new authorities to facilitate approaches such as differentiated registration fees and ISR, staff would use existing authority to implement direct fleet rules to phase-in new ZE trucks or used ZE trucks from the secondary market.

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

Proposed Action

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

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

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

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

Estimated Emissions Reductions

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

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

2022 State SIP Strategy

Table 31 – Zero-Emissions Trucks Measure Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

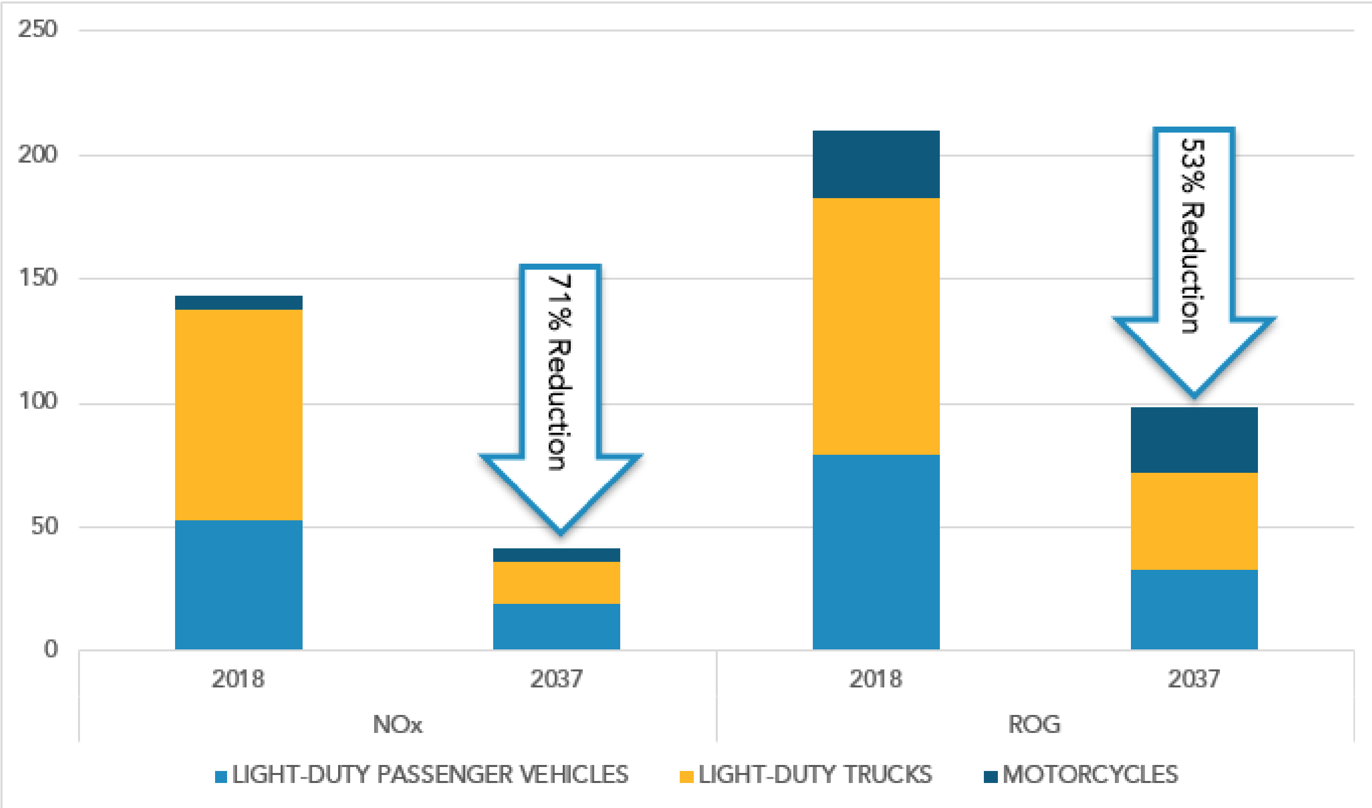
2022 State SIP Strategy

Proposed Measures: On-Road Light-Duty Vehicles

Description of Source Category

Passenger cars and light trucks (gross vehicle weight rating, or GVWR, up to 8,500 lbs.), otherwise called light-duty vehicles, are a major contributor to NOx and GHG emissions in California. The State's 39 million residents collectively own over 26 million passenger vehicles and drive more than most other Americans. CARB has a number of programs to control emissions from light-duty vehicles and drive the introduction of ZEVs into the fleet including Advanced Clean Cars, incentive projects like Clean Cars 4 All, the recently adopted Clean Miles Standard and soon to be adopted Advanced Clean Cars 2. Advanced Clean Cars 2 was a measure in the 2016 State SIP Strategy and is a significant effort critical to meeting air quality standards to cut emissions from new combustion vehicles while taking all new vehicle sales to 100 percent zero-emission no later than 2035. Even with CARB's programs to accelerate the transition of the light-duty fleet to zero-emission, the vast majority of these vehicles on the road today still have internal combustion engines and use gasoline, as shown in Figure 15. A small portion today is powered by electric powertrains, and a smaller portion still has diesel compression ignition engines.

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



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

On-Road Motorcycles New Emissions Standards

Overview

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

Background/Regulatory History

- CARB last updated motorcycle emissions standards for this category in 1998.
- In September 2020, the Governor signed *Executive Order N-79-20* which directs CARB to adopt regulations to transition to zero-emissions.
- Since then, more stringent exhaust emissions standards have been developed by other jurisdictions around the world, most notably the European Union's EU5 standard which became effective in 2020. These stringent exhaust standards have prompted the development of cleaner motorcycles than what are currently required in California.
- While CARB motorcycle evaporative standards are on par with most other jurisdictions around the world, additional evaporative reductions are technically feasible and other vehicle categories regulated by CARB have adopted much lower evaporative emissions standards. For example, CARB's Off Highway Recreational Vehicle (OHRV) category, which includes vehicles closely related to motorcycles such as off-highway motorcycles, requires lower evaporative emissions limits with more robust test methods.
- Since 2017, CARB has been working closely with many other jurisdictions in the spirit of trying to achieve harmonization where possible on lower and more robust motorcycle emissions standards. Specifically, CARB has worked closely with U.S. EPA, Environment Climate Change Canada, the European Union, and the United Nations.
- California currently has no inspection and maintenance program for motorcycles. CARB has determined that tampering with emissions controls is a significant problem for this category.
- In 2020, motorcycles accounted for:
    - 9.3 percent of all California mobile ROG emissions
    - 0.6 percent of all California mobile NOx emissions
    - 3.6 percent of all California mobile carbon monoxide (CO) emissions

Proposed Action

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

Estimated Emissions Reductions

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

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

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Clean Miles Standard

Overview

The primary goal of the *Clean Miles Standard* (CMS) regulation, which was adopted by CARB in 2021 and will be implemented by the California Public Utilities Commission (CPUC), is to reduce GHG emissions from ride-hailing services offered by transportation network companies (TNCs), on a per--passenger mile basis, and promote electrification of the fleet by setting an electric vehicle mile target. TNCs provide on-demand rides through a technology--based platform that connects passengers with drivers using personal or rented vehicles. The TNC sector has potential for continued growth beyond their market share rapid expansion after their inception in 2012. Given the potential for GHG emissions reductions and criteria pollutant co-benefits, the sector is well-positioned to help state and local agencies meet air quality and climate goals and Lyft and Uber, the largest TNCs, have made public commitments to promote electrification in their fleet.

Background/Regulatory History

- Mobile sources account for around 80 percent of statewide NOx emissions and are a significant source of toxic air contaminants. In addition, the transportation sector accounts for approximately 50 percent of GHG emissions in California when accounting for direct vehicle emissions and upstream fuel production facility emissions, with light-duty vehicles comprising 70 percent of the transportation sector's direct vehicle emissions. Transportation sector GHG emissions are increasing, despite increases in vehicle fuel efficiency, amplifying the need for new actions with mobility.
- In September 2018, Governor Brown signed into law Senate Bill (SB) 1014 (Skinner, Chapter 369, Statutes of 2018), which established the Clean Miles Standard and Incentive Program. The bill directs CARB to develop, and the CPUC to implement, annual electrification and GHG emission targets for TNCs that provide ride-hailing services.
- Though TNCs accounted for only 1.25 percent of the total light-duty vehicle miles traveled (VMT) in California in 2018, it was the fastest growing sector relative to other categories of commercial passenger vehicle fleets regulated by the CPUC. Staff expect ride-hailing to continue their previous growth trajectory in the years after the COVID-19 pandemic.
- Per SB 1014, CARB staff used 2018 TNC data to determine the base year emissions for the ride-hailing sector on a per-passenger mile basis. From 1.4 billion trip records, CARB staff deduced the TNC base year emissions to be 301 grams carbon dioxide (CO_2) per passenger mile traveled (g CO_2/PMT). In comparison, the overall California fleet emissions in 2018 was 203 g CO_2/PMT. On a per-passenger mile basis, the GHG emissions of the TNC fleet were 50 percent higher than the overall California light duty vehicle fleet.
- To develop the annual electrification targets, CARB assessed the availability of zero -emission vehicle (ZEV) models with adequate range for ride-hailing operation and utilized a cost optimization model to derive the maximum feasible percent electric vehicle miles traveled (eVMT) taking into account one year of operational costs.
- The potential GHG emissions reductions are approximately three times higher for an electric vehicle in ride-hailing service compared to personal use in California, depending

on the energy source mix in the electric grid and vehicle usage. Additionally, each ride-hailing vehicle serves numerous passengers, and thus TNCs can help facilitate widespread education and awareness about ZEVs.

Action

The new regulation, adopted by the Board in May 2021 and set for implementation to begin in 2023, includes two annual targets – an eVMT target as well as a GHG target in the metric of g CO_2/PMT. The eVMT target would require TNCs to achieve 90 percent eVMT by 2030. The GHG target would require TNCs to achieve 0 g CO_2/PMT by 2030 through electrification as well as other strategies, including increasing shared rides on their platform, improving operational efficiency (route planning and reduced mileage without passengers), and obtaining optional GHG credits.

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

Estimated Emissions Reductions

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

Table 33 - Clean Miles Standard Estimated Emissions Reductions

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

Timing

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

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Proposed Measures: Reducing Vehicle Miles Travelled

Description of Source Category

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

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

2022 State SIP Strategy

Enhanced Regional Emission Analysis in State Implementation Plans

Overview

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

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

Background/Regulatory History

- Transportation conformity refers to the federal regulatory procedure for coordinating the transportation and air quality planning processes to ensure transportation plans support the attainment of air quality standards. Under section 176(c) of the federal Clean Air Act, federal agencies may not approve or fund transportation plans and projects unless they conform with a region's SIP. Conformity with the SIP requires that transportation activities not (1) cause or contribute to new air quality violations, (2) increase the frequency or severity of any existing violation, or (3) delay timely attainment of the NAAQS. Demonstrating transportation conformity entails evaluating whether a transportation project or plan would increase emissions beyond the MVEB established in a SIP. In this way, the MVEB acts as a ceiling on emissions from the on-road mobile sources within that air basin.

- The federal Clean Air Act requires States and air districts in all nonattainment areas to include RACM in the SIP. For areas projected to attain within five years of designation of NAAQS, areas must include reasonable control measures, potential emissions reductions, and the timeline to implement these measures. Those areas that cannot reach attainment within five years must conduct a thorough analysis of all control measures (including measures considered by federal, state, and other air districts) and implement those measures in the earliest practical manner to achieve attainment at least one year earlier than otherwise projected. If not, air districts must include justifications and demonstrate that no additional control measures are available to advance the attainment date.

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

Proposed Action

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

Change MVEB Development Process: CARB would evaluate the existing MVEB development process, including tools and the latest planning assumptions used in the analysis. Based on the review, CARB could modify the framework for developing MVEBs when considering how to address gaps in emissions reductions needed to demonstrate attainment of different NAAQS. This framework could explore additional emissions reductions from the on-road sector to attain the 70 ppb 8-hour ozone standard and progress towards State air quality goals. This framework would need to ensure that the MVEB is consistent with other applicable requirements such as emission inventory, reasonable further progress, control measures, and attainment demonstration.

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

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

Estimated Emissions Reductions

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

Timing

Proposed implementation begins:	2023+
Proposed CARB finalization:	2025

Proposed SIP Commitment

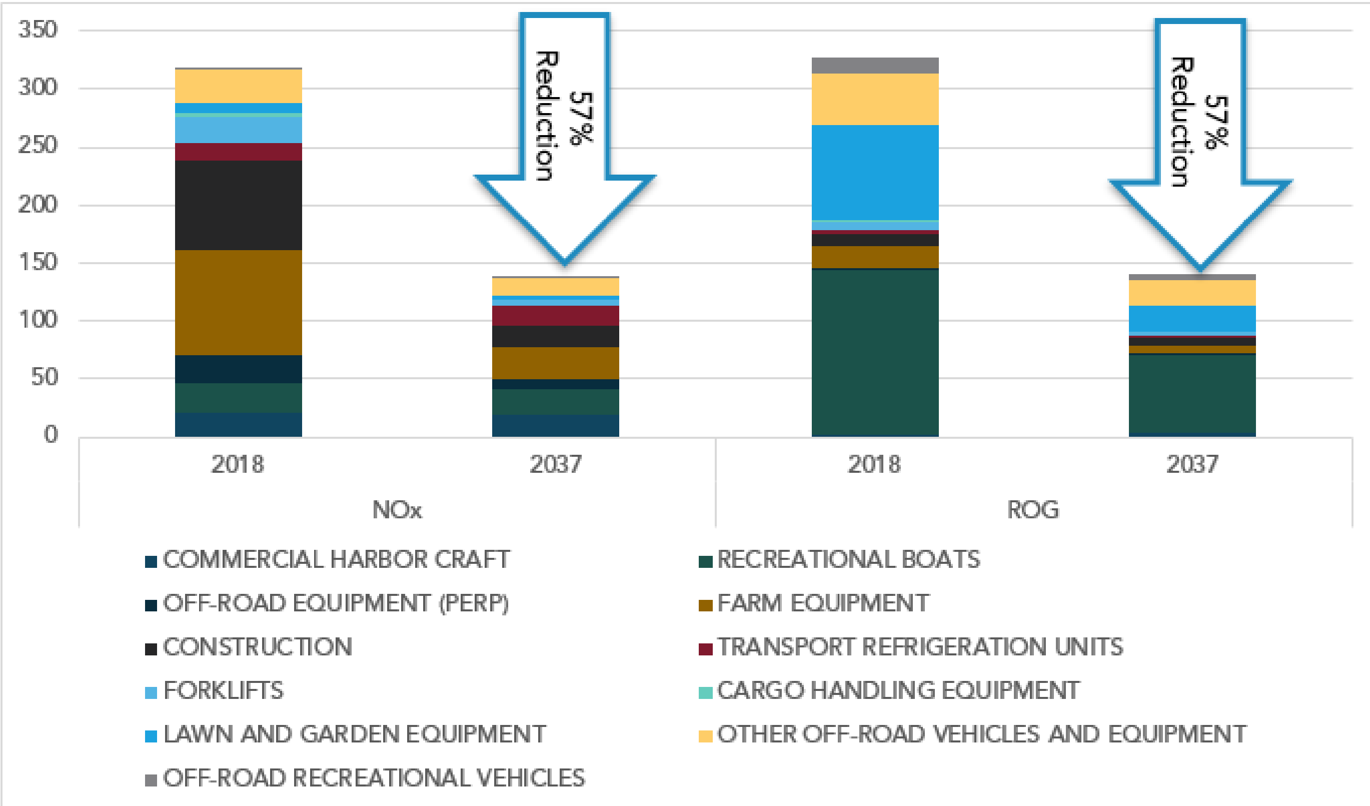
CARB staff proposes to commit to investigating the measures outlined above to support reductions in emissions and VMT from the on-road sources. Staff further proposes to commit to preparing the relevant written guidance and/or web tool and making them available to the public by 2025.

Proposed Measures: Off-Road Equipment

Description of Source Category

The Off-Road Vehicles and Equipment category includes lawn and garden equipment, transport refrigeration units, vehicles and equipment used in construction and mining, generators, forklifts, cargo handling equipment, commercial harbor craft, farm equipment, and other industrial equipment. CARB has programs in place to control emissions from various new off-road vehicles and equipment. CARB also has in-use programs for off-road vehicles and equipment, including the In-Use Off-Road Diesel Fueled Fleets Regulation and Large Spark-Ignition Engine Fleet Requirements Regulation, as well as incentive programs including the Clean Off-Road Equipment (CORE) Voucher Incentive Project. CARB adopted amendments to the small off-road engine regulations in December 2021, and will be proposing Zero-Emission Off-Road Forklift and Transport Refrigeration Unit Part 1 regulations this year. While CARB's control programs to date have provided substantial emissions reductions, the Off-Road Vehicles and Equipment category continues to contribute a significant and growing fraction of the overall NOx and ROG emissions statewide. As shown in Figure 16 below, by 2037, existing control programs will reduce ROG and NOx emissions from Off-Road Vehicles and Equipment by 43 percent and 25 percent, respectively, compared to 2018 levels.

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



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

Tier 5 Off-Road New Compression-Ignition Engine Standards

Overview

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

California is dependent on the U.S. EPA to regulate the emissions from farm and construction equipment under 175 horsepower because only U.S. EPA has the authority to set emission standards for this equipment under the Clean Air Act. These preempted equipment are responsible for approximately 50 percent of the NOx off-road emissions inventory in California. Federal action is necessary to address preempted equipment by adopting standards similar in stringency to those proposed in the measure to achieve attainment with both federal and State ambient air quality standards – this is discussed further in the Federal Actions portion of this document.

Background/Regulatory History

- NOx emissions from land based off-road CI engines are currently the second largest category of mobile source emissions subject to the CARB regulation. Off-road CI engine NOx emissions are projected to make up 24 percent of the mobile source diesel emissions inventory, and 34 percent of the PM inventory, in 2030.
- Lower NOx standards, up to 90 percent below the current Tier 4 final emission standard levels, coupled with lower PM standards, would force engine manufacturers to incorporate DPFs, which many currently do not have. DPFs would also ensure greater reductions in ultrafine PM, which may pose a health concern separate from PM emissions as a whole.
- Small off-road CI engines (less than 56-kilowatt [kW] or 75 hp) are not currently required to comply with advanced NOx aftertreatment-based standards, and a subset of these engines that are less than 19 kW (25 hp) are not required to comply with advanced PM aftertreatment--based standards. Small off-road CI engines account for between 20 to 40 percent of the off-road diesel PM and NOx emissions inventories in California. CARB funded a research effort demonstrating the feasibility of advanced aftertreatment on

small off-road CI engines, which was completed by the Center for Environmental Research and Technology (CE-CERT) in 2019[73].

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

Proposed Action

CARB would develop and propose standards and test procedures for new off-road CI engines including the following: aftertreatment-based PM standards for engines less than 19 kW (25 hp), aftertreatment-based NOx standards for engines greater than or equal to 19 kW (25 hp) and less than 56 kW (75 hp), and more stringent PM and NOx standards for engines greater than or equal to 56 kW (75 hp) and first time CO_2 tailpipe standards targeting a 5 to 8.6 percent reduction. Other possible elements include enhancing in-use compliance, proposing more representative useful life periods, idle requirements and developing a low load test cycle. It is expected that Tier 5 requirements would rely heavily on technologies manufacturers are

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

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

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

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

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

Estimated Emissions Reductions

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

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

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

Timing

Proposed CARB Board hearing: 2025
Proposed implementation begins: 2029

Proposed SIP Commitment

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

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

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

Overview

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

Background/Regulatory History

- The in-use off-road equipment sector includes equipment used in industries such as construction, mining, industrial, oil drilling, and similar industries, and covers mobile diesel vehicles 25 horsepower or greater. Common examples are loaders, backhoes, excavators, forklifts, workover rigs, and other off-road equipment.
- The diesel equipment in this category is currently subject to CARB's In-Use Off-Road Diesel-Fueled Fleets Regulation, approved by the Board in 2007, and amended in 2009 and 2010. The regulation covers all self-propelled off-road diesel vehicles 25 horsepower or greater used in California and most two-engine vehicles (except on--road two-engine sweepers). The existing rule requires that fleets meet an increasingly stringent set of fleet average targets, culminating in 2023 for large and medium fleets (large fleets represent about 54 percent of vehicle ownership) and in 2028 for small fleets. The most stringent fleet average target generally corresponds to roughly a 2012 model year, or a Tier 3 average standard. In addition to the declining fleet emission targets, the regulation also includes idling limits, requires reporting and labeling, and restricts adding older vehicles into fleets.
- While this regulation has resulted in significant emissions reductions from the sector, the regulation does allow Tier 0, 1 and 2 equipment to continue operating indefinitely with no activity restrictions (dependent on the mix of other equipment owned by the fleet). For comparison, a single Tier 0 off-road engine in the 100-175 horsepower bin has 80 times higher NOx emissions than a Tier 4 Final off-road engine. By 2031, this Tier 0 equipment will be 32 years old or more, Tier 1 will be 28 to 31 years old, and Tier 2 will be 24 to 27 years old.

Proposed Action

For this measure, CARB would propose adding a Tier phase-out to the current In-Use Off-Road Diesel-Fueled Fleets Regulation for Tier 0, 1 and 2 engines between 2024 and 2032. CARB would propose that all low-use Tier 0 vehicles be subject to the phase-out in 2036. This scenario will allow 12-year phase out of these oldest engines. Along with the Tier phase-out, CARB would propose extending the adding vehicle provisions in the current regulation to phase in a limitation on the adding of Tier 3 and Tier 4i vehicles to fleets. CARB would propose that all fleets must use renewable diesel with some limited exceptions. Requiring the use of renewable diesel will achieve significant near-term NOx and PM reductions, reductions especially needed in highly impacted communities. CARB would propose some voluntary compliance flexibilities for fleets that are incorporating ZEVs into their fleets. CARB would also propose additional modifications to clarify implementation and to sunset provisions that would have allowed small fleets to continue to operate vehicles that could not be retrofitted with a verified diesel emission control strategy indefinitely. In addition to the development process for the Proposed 2022 State SIP Strategy, the measure as proposed by staff or adopted by the Board is in the process of a full independent public rulemaking proceeding where, to date, multiple public workshops and workgroups have occurred.

Estimated Emissions Reductions

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

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

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

Timing

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

Proposed SIP Commitment

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

Transport Refrigeration Unit Regulation Part 2

Overview

CARB is developing new requirements to transition diesel-powered transport refrigeration unit (TRU) to zero-emission technology in two phases. In the 2016 State SIP Strategy, CARB proposed Part 1 amendments to the existing *TRU Airborne Toxic Control Measure* (ATCM) to require the transition of diesel-powered truck TRUs to zero-emission, a diesel PM emission standard for newly-manufactured TRUs in the remaining categories, and lower global warming potential refrigerant. The Board adopted the Part 1 amendments to the TRU ATCM on February 24, 2022. CARB plans to develop a subsequent Part 2 regulation to require zero-emission trailer TRUs, domestic shipping container TRUs, railcar TRUs, and TRU generator sets for future Board consideration.

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

Background/Regulatory History

- TRUs emit multiple air pollutants, including diesel PM, PM2.5, NOx, and GHG.
- TRUs typically operate at refrigerated warehouses or distribution centers, grocery stores, seaport facilities, intermodal railyards, and other locations that are often near sensitive receptors, such as schools, hospitals, senior care facilities, and residential neighborhoods that are disproportionately burdened by the cumulative health impacts from these facilities.
- CARB adopted the existing TRU ATCM in 2004 to require TRU engines that operate in California to meet specific in use PM performance standards.

Proposed Action

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

Estimated Emissions Reductions

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

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

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

Timing

Proposed CARB Board hearing: 2026
Proposed implementation begins: 2028

Proposed SIP Commitment

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

2022 State SIP Strategy

Commercial Harbor Craft Amendments

Overview

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

Background

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

Action

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

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

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

Estimated Emissions Reductions

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

Table 37 – Commercial Harbor Craft Amendments Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Cargo Handling Equipment Amendments

Overview

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

Background

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

Proposed Action

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

Estimated Emissions Reductions

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

Table 38 – Cargo Handling Equipment Amendments Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Off-Road Zero-Emission Targeted Manufacturer Rule

Overview

The goal of the Off-Road Zero-Emission Targeted Manufacturer Rule is to achieve criteria pollutant and GHG emissions reductions by accelerating the development and production of zero-emission off-road equipment and powertrains. Existing zero-emission regulations and regulations currently under development target a variety of sectors (e.g., forklifts, cargo handling equipment, off-road fleets, small off-road engines, etc.) however, as technology advancements occur, more sectors, including wheel loaders, excavators, and bulldozers, could be accelerated through this measure. Fully addressing control of emissions from new farm and construction equipment under 175 horsepower that are preempt, will require partnership on needed Federal zero-emission standards for off-road equipment.

Background/Regulatory History

- Zero-emission off-road equipment has been consistently and successfully manufactured in a number of equipment categories (e.g., forklifts, man lifts, etc.) for decades, with wide fleet adoption taking place without mandates that required such equipment to be produced or purchased.
- For next-generation zero-emission off-road equipment, CARB and other air quality agencies have funded numerous successful demonstration and pilot projects, as well as commercial-launch voucher incentive programs, like the Clean Off-Road Equipment Voucher Incentive Project, and SIP creditable emission-reduction programs, like the Carl Moyer Program.
- Studies have been performed to identify the off-road equipment types and engine horsepower ranges that have greater potential to be zero-emission powered. Although more analysis is necessary, existing information suggests that zero-emission technology are feasible in many applications in which zero-emission technology has not yet achieved meaningful penetration today. These studies have also identified potential electric powertrains and corresponding energy storage systems that could be used to replace existing internal combustion engines in said equipment types.
- Zero-emission off-road equipment examples are already appearing and entering demonstration and commercialization across a range of other applications and across operating weight classes from small compact equipment to >35 ton machines with deployments ongoing in Norway, Denmark, Netherlands, Germany, China, Canada and elsewhere. Such examples include agricultural specialized implements and utility tractors, paving including rollers, compactors, slipform pavers and screeds, asphalt and concrete delivery and placement, municipal equipment including landscaping maintenance and full-sized street sweepers, and earthmoving including skidsteers, compact trackloader, mini and full-sized excavators, mini and full-sized wheel loaders and various foundation drill, piledriver, demolition and large crane applications. There are 20 ton battery electric bulldozers and wheel loaders already operating in industrial settings. A number of manufacturers have already commercialized a variety of compact construction equipment and indicated a long-term zero-emission shift for the compact size class.

- Governor Newsom's Executive Order N-79-20 states that "it shall further be a goal of the State to transition to 100 percent zero-emission off-road vehicles and equipment by 2035 where feasible." The Governor's Executive Order further directs CARB to develop and propose "strategies, in coordination with other State agencies, U.S. EPA and local air districts, to achieve 100 percent zero emission from off-road vehicles and equipment operations in the State by 2035."
- California has some of the most-impacted regions in the nation with respect to poor air quality. As such, significant NOx and PM reductions are needed to reduce air pollution and improve public health, particularly in communities that experience disproportionate burdens from exposure. Off-road equipment is one of the largest contributors to emissions in the state, and actions beyond current programs are needed to meet California's air quality and climate goals. Developing and successfully implementing zero-emission measures for off-road equipment will be a key component to achieving said air quality goals.

Proposed Action

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

Estimated Emissions Reductions

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

Timing

Proposed CARB Board hearing:	2027
Proposed implementation begins:	2031

Proposed SIP Commitment

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

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

2022 State SIP Strategy

Clean Off-Road Fleet Recognition Program

Overview

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

Background/Regulatory History

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

Proposed Action

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

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

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

Estimated Emissions Reductions

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

Timing

Proposed CARB finalization:	2025
Proposed implementation begins:	2027

Proposed SIP Commitment

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

2022 State SIP Strategy

Spark-Ignition Marine Engine Standards

Description

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

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

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

Background

- U.S. EPA first promulgated exhaust emission standards to reduce emissions of HC and NOx from new outboard and personal watercraft engines in 1996, which were to begin in 2006.
- In 1998, CARB adopted regulations that accelerated the federal standard's 2006 implementation date to 2001 in California. The regulations also set more stringent California standards for outboard and personal watercraft engines that took effect in 2004 and 2008.
- On July 26, 2001, the Board amended the SI marine regulations to include HC+NOx emission standards for new sterndrive and inboard marine engines. These standards initially capped HC+NOx emissions at 16.0 g/kW-hr from 2003 to 2006, but beginning in 2007, sterndrive and inboard engines had to meet a catalyst-based 5.0 g/kW-hr HC+NOx standard. Most sterndrive and inboard engines are derived from truck engines and their aftertreatment technology makes the transition to catalysts far less complicated than for outboard and personal watercraft engines.
- In 2007, U.S. EPA harmonized with CARB's accelerated implementation schedule and more stringent exhaust standards for outboard and personal watercraft engines.
- In 2010, Mercury Marine Corporation demonstrated the ability of catalyst-equipped 45 kW and 150 kW outboard engines to meet a 5.0 g/kW-hr HC+NOx standard in a feasibility program sponsored by CARB.
- In 2013, Mercury Marine Corporation demonstrated that a catalyst-equipped 30 kW outboard engine was able to meet a 5.0 g/kW-hr HC+NOx standard in another feasibility program sponsored by CARB.

Proposed Action

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

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

Estimated Emissions Reductions

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

Table 39 – Spark Ignition Marine Engine Standards Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Proposed Measures: Consumer Products

Description of Source Category:

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

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

Consumer Products Standards

Overview

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

Background/Regulatory History

- Consumer products are a diverse group of chemically formulated products used by household and institutional consumers and are a significant source of both VOC and ROG emissions. CARB has regulated consumer products by setting regulatory standards applicable to their chemical constituents.

- As part of the State's effort to reduce air pollutants, in 1988 the Legislature added section 41712 to the California Clean Air Act (California Act) in the Health and Safety Code. Along with subsequent amendments, this section requires CARB to adopt regulations to achieve the maximum feasible reduction in VOC emissions from consumer products. In doing so, the Board must first determine that adequate data exist to establish that the regulations are necessary to attain State and federal ambient air quality standards. Commercial and technological feasibility of the regulations must also be demonstrated. The California Act requires that regulations must not eliminate any product form, and that recommendations from health professionals must be considered when developing control measures for health benefit products.
- Historically, regulated consumer products have been subject to standards that limit VOC content by mass. Some regulated product categories—aerosol coatings and multi-purpose lubricants—have subsequently been regulated by setting reactivity-based limits. Both regulatory approaches are intended to reduce ozone formation from consumer products. The relative effectiveness of each regulatory approach varies by product category. Product manufacturers have complied with VOC content standards and reactivity limits by reformulating products. Since the program's inception, CARB's progressively declining VOC standards and reactivity limits have reduced VOC emissions by 250 tpd.
- Several reformulation approaches may be used to comply with VOC content standards. These include: substituting much less reactive VOCs (known as exempt VOCs) for more reactive chemical species; using less volatile organic constituents (known as low vapor pressure VOCs, or LVP-VOCs); increased use of water and other volatile inorganic ingredients; and increased use of non-volatile constituents. Chemicals in the four groupings listed above are not included when determining whether the VOC content of a product exceeds the applicable VOC standard.
- CARB controls emissions from aerosol coating products using a reactivity-based regulation. This regulation uses product-weighted reactivity-based limits to reduce product ozone formation potential. Reactivity limits apply to the entirety of a product's volatile organic content, including VOCs, LVP-VOCs, and exempt VOCs. This approach emphasizes use of less reactive rather than less volatile ingredients. Historically, reductions from reactivity limits are expressed as either VOC reductions or equivalent VOC reductions.
- CARB has reduced exposure to toxic air contaminants (TACs) by prohibiting use of certain chlorinated compounds in 83 categories of consumer products. Since the first prohibition on TAC became effective in 2002, CARB has achieved a total emissions reduction of over 13 tpd of TACs. Furthermore, when setting VOC or reactivity-based limits, CARB has applied California Environmental Quality Act provisions requiring that environmental impacts of proposed regulations be evaluated.
- CARB prohibitions on use of ingredients with a global warming potential (GWP) above 150 in several consumer product categories have reduced GHG emission growth by approximately 0.24 million metric tons of carbon dioxide equivalents by 2030. However, increased use of HFC-152a propellant, an exempt VOC with a GWP of 124, could offset the benefits of adopted high GWP compound prohibitions.

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

Proposed Action

For this measure, CARB is seeking further emissions reductions to support ozone attainment in the South Coast and elsewhere in California. To accomplish this, CARB staff anticipates casting a wide net in its review of product categories. CARB staff will conduct additional targeted product surveys to guide rule development and ensure emissions reductions are based on the state-of-the-science. Staff will consider opportunities to reduce ozone formation from both already regulated product categories as well as previously unregulated categories. For categories with relatively high contributions to ozone formation, whether currently regulated or unregulated, staff will evaluate the merits of proposing reactivity limits.

Approaches to be considered also include investigating concepts for expanding manufacturer compliance options, market-based approaches, and reviewing existing exemptions. Staff will work with stakeholders to explore mechanisms that would encourage the development, distribution, and sale of cleaner, very low, or zero-emitting products. In undertaking these efforts staff will prioritize strategies that achieve the maximum feasible reductions in ozone-formation, TACs and GHG emissions.

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

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

Estimated Emissions Reductions

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

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

Emission reduction targets in this measure are expressed as VOC reductions or equivalent VOC reductions, as has historically been the case when describing SIP-creditable emissions reductions resulting from more stringent VOC standards or reactivity limits, respectively. The term equivalent VOC reduction recognizes that reductions in ozone formation may be achieved by reformulating a product to use less reactive VOCs. For example, ozone formation reductions could be achieved by substituting less reactive VOC for more reactive VOC in a product. While total VOC content may not be reduced by such a reformulation, a reactivity limit would translate to an equivalent VOC reduction, based on the resulting ozone formation reduction. Similarly, equivalent VOC reductions could result from substitution of less reactive VOCs for LVP-VOCs in a product. In such a case, the total VOC content of a product could increase even as its ozone formation potential decreases. The benefits of such a regulatory approach would be appropriately expressed as equivalent VOC reductions.

Table 40 - Consumer Products Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Proposed Measures: Residential and Commercial Buildings

Description of Source Category

Residential and commercial buildings are responsible for roughly 5 percent of statewide NOx emissions due to natural gas combustion. California's buildings emit about 66 tpd of NOx[78] to the ambient air, about four times the emissions from electric utilities and nearly two-thirds the emissions from light-duty vehicles statewide. Space and water heating comprise nearly 90 percent of all building-related natural gas demand.[79] Buildings also contribute to approximately 25 percent of California's GHG emissions when accounting for fossil fuels consumed onsite and through electricity demand as well as refrigerants used in air conditioning systems and refrigerators. The fuels we use and burn in buildings, primarily natural gas, for space and water heating contribute significantly to building-related criteria pollutant and GHG emissions and provide an opportunity for substantial emissions reductions where zero-emission technology is available.

Zero-Emission Standard for Space and Water Heaters

Overview

The primary goal of this measure is to reduce emissions from new residential and commercial space and water heaters sold in California. CARB would set an emission standard for space and water heaters to go into effect in 2030. Through meaningful engagement with communities and the process outlined below, CARB would adopt a statewide zero-emission standard which would have criteria pollutant benefits as a key result along with GHG reductions. Beginning in 2030, 100 percent of sales of new space heaters and water heaters would need to comply with the emission standard. CARB would design any such standard in collaboration with energy and building code regulators, and with air districts, to ensure it was consistent with all state and local efforts, and would work carefully with communities to consider any housing cost or affordability impacts, recognizing that reducing emissions from space and water heaters can generate health benefits and cost-savings with properly designed standards. CARB understands that this measure needs to be part of a suite of equity-promoting and complementary building decarbonization policies deeply informed by public process that include scaling back natural gas infrastructure, expanding construction of zero-emission buildings, and building a sustainable market by increasing affordability and accessibility through expanding incentive programs, ensuring utility rates are supportive of electrification, developing the workforce, and increasing consumer education. Although this measure is the only component appropriate for including in the SIP, before setting an emission standard, CARB will work in collaboration with other agencies, industry, environmental stakeholders, and community representatives to ensure that the measure is developed and implemented in an equitable manner to benefit low-income and

[78] CARB's Criteria Emission Inventory CEPAM: 2022 Version 1.01 - Standard Emission Tool. NOx emission estimates are based on annual average daily emissions.
[79] Kenney, Michael, Nicholas Janusch, Ingrid Neumann, and Mike Jaske. 2021. California Building Decarbonization Assessment. California Energy Commission. Publication Number: CEC-400-2021-006-CMF. Web link: https://www.energy.ca.gov/data-reports/reports/building-decarbonization-assessment.

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

Background/Regulatory History

- Nine air districts regulate NOx emissions from space heaters and water heaters. Bay Area, San Joaquin Valley, South Coast, Yolo-Solano, San Diego County, and Sacramento Metro enforce the most stringent emission limit of 10 ng/J NOx for water heaters. San Joaquin Valley and South Coast enforce the most stringent emission limit of 14 ng/J NOx for space heaters.
- Even with low NOx emission limits in place, NOx emissions from natural gas combustion in residential and commercial buildings are projected to total 37.7 tpd NOx in the year 2030 and 36.2 tpd NOx in the year 2037[80]. If no further action is taken to further limit emissions from natural gas combustion, building-related emissions are projected to total 11.2 tpd NOx in South Coast and 4.6 tpd NOx in San Joaquin Valley by 2037.
- A statewide zero-emission standard for space and water heaters has the potential to reduce 13.55 tpd NOx in 2037. If the statewide zero-emission standard was expanded to include cooking, clothes drying, and all other end-uses of natural gas in residential and commercial buildings, it would have the potential to reduce 19.96 tpd NOx in 2037.

Proposed Action

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

This measure would not mandate retrofits in existing buildings, but some buildings would require retrofits to be able to use the new technology that this measure would require. Beginning in 2030, 100 percent of new space and water heaters (for either new construction or

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

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

Estimated Emissions Reductions

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

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

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

Timing

Proposed CARB Board hearing: 2025
Proposed implementation begins: 2030

Proposed SIP Commitment

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

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

2022 State SIP Strategy

Proposed Measures: Pesticides

Description of Source Category

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

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

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

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

1,3-Dichloropropene Health Risk Mitigation

Background/Regulatory History

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

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

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

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

Proposed Action

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

Potential Emissions Reductions

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

Timing

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

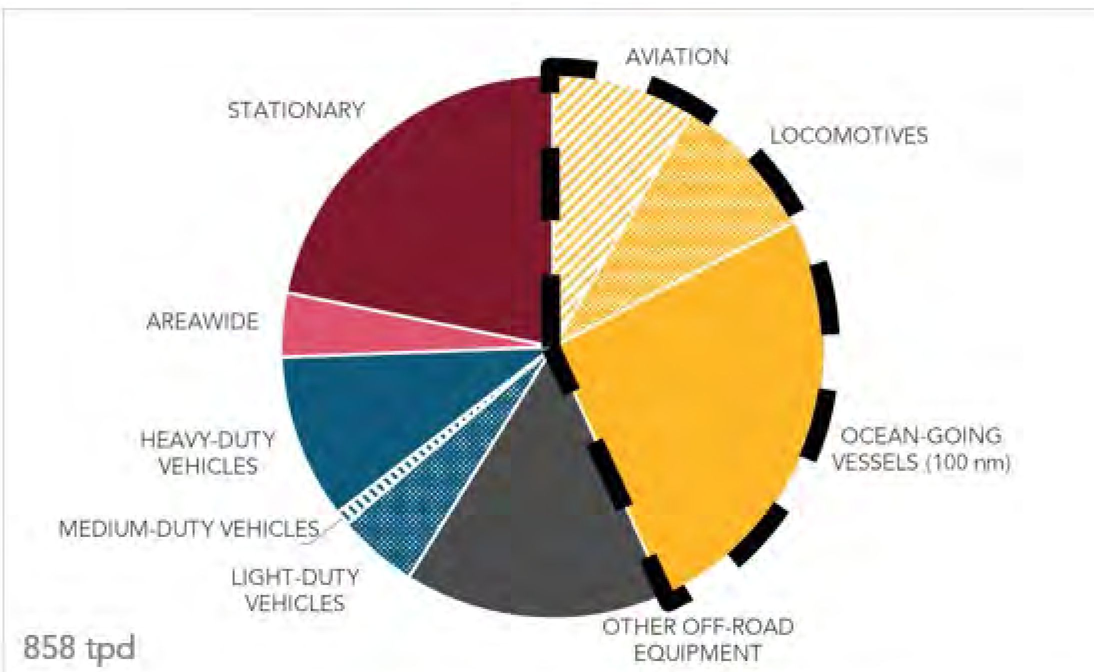
Proposed SIP Commitment

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

Proposed Measures: Primarily-Federally and Internationally Regulated Sources

In addition to reducing emissions from on-road vehicles and off-road equipment, it is critical to achieve emissions reductions from sources that are primarily regulated at the federal and international level. CARB and the air districts in California have taken actions to not only petition federal agencies for action, but also to directly reduce emissions using programmatic mechanisms within our respective authorities. CARB continues to explore additional actions, many of which may require a waiver or authorization under the Clean Air Act, as described below. That said, given that aviation, locomotives, and oceangoing vessels are projected to contribute more than 40 percent of statewide NOx emissions by 2037, as shown in Figure 17, actions by the U.S. EPA and other federal and international entities are needed to reduce emissions from these sources. As shown below and in Figure 18, emissions of both ROG and NOx from these sources are projected to increase from 2018 through 2037 absent additional federal action.

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



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

2022 State SIP Strategy

Description of Source Categories:

Locomotives

Locomotives are self-propelled vehicles used to push or pull trains, including both freight and passenger operations. Union Pacific Railroad (UP) and BNSF Railway (BSNF) are the two Class I, or major, freight railroads operating in California. There are also seven intrastate passenger commuter operators and up to 26 freight shortline railroads currently operating in California. UP and BNSF, however, generate the vast majority (90 percent) of locomotive emissions within the State, with most attributable to interstate line haul locomotives.

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

Locomotives operating at railyards and traveling throughout the nation are a significant source of emissions of diesel PM (which CARB has identified as a toxic air contaminant), NOx, and GHGs. These emissions often occur in or near densely populated areas and neighborhoods, exposing residents to unhealthy levels of toxic diesel PM, plus regional ozone and secondary PM2.5.

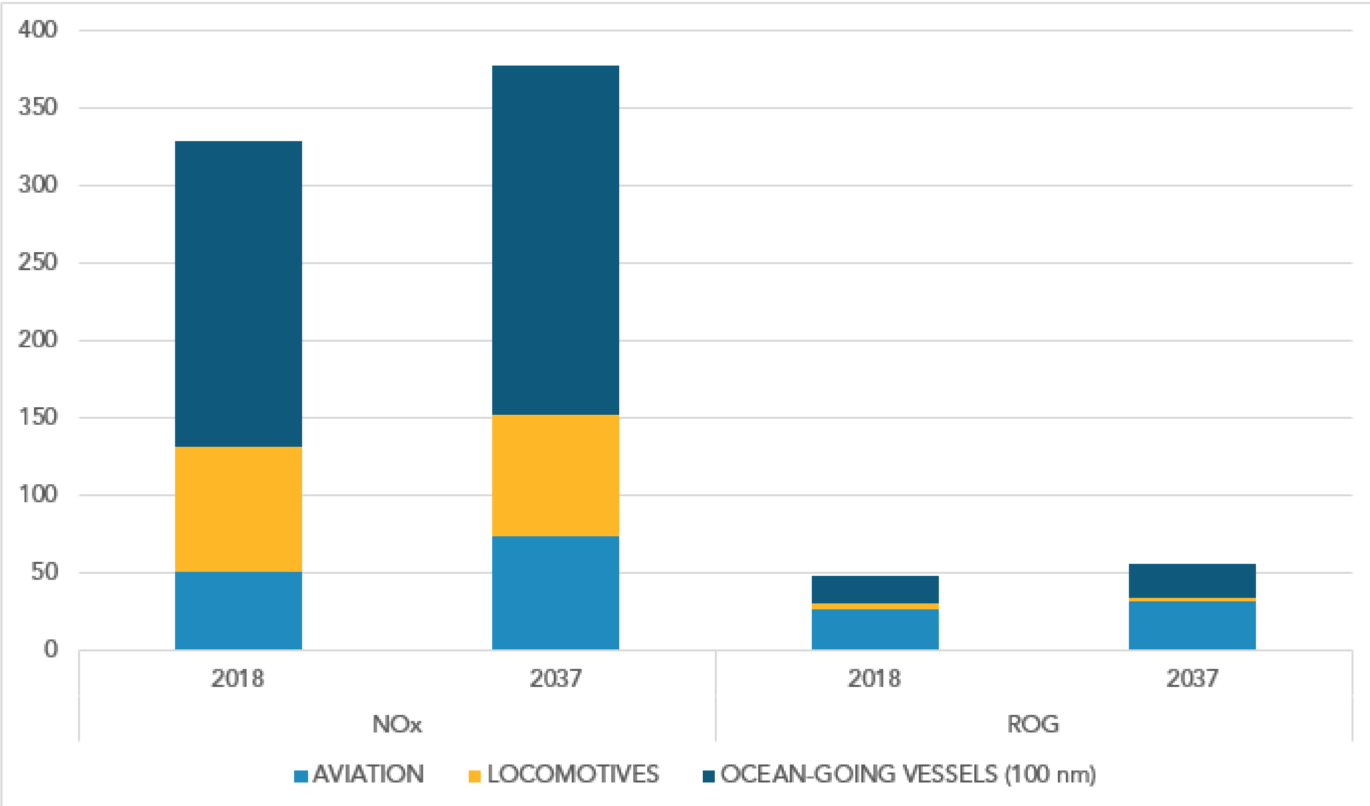
Aviation

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

Ocean-Going Vessels

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

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



Federally Certified On-Road Heavy-Duty Vehicles

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

Preempted Off-Road Equipment

The off-road equipment category includes some equipment in the following categories: lawn and garden equipment, transportation refrigeration units, vehicles and equipment used in construction and mining, forklifts, cargo handling equipment, commercial harbor craft, and other

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

industrial equipment. California is the only state with authority to adopt and enforce emission standards for new and in-use off-road engines that differ from the federal emission standards. That said, the Clean Air Act does preempt California from establishing more stringent standards for equipment under 175 horsepower in a select group of off-road equipment categories. These preempted off-road equipment categories are only required to meet the less stringent federal emission standards and not California's emission standards.

2022 State SIP Strategy

Proposed CARB Measures

In-Use Locomotive Regulation

Overview

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

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

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

Background/Regulatory History

- Locomotive emissions are projected to contribute 14 percent to the State's freight diesel emissions NOx inventory and 16 percent to the State's freight diesel emissions PM2.5 inventory in 2030.
- Locomotive activity occurs at seaports, railyards, and other major freight hubs throughout California. Nearby communities are disproportionately burdened by the cumulative health impacts from these facilities.
- In 2017, CARB petitioned U.S. EPA to promulgate a Tier 5 standard. The proposed standard would include using on-board batteries to support zero-emission rail operation in sensitive areas, as well as cut fuel consumption and GHG emissions. As of March 2022, U.S. EPA has taken no action on this petition.
- The proposed In-Use Locomotive Regulation is California's first regulation of locomotives in-use. In the past, CARB obtained emissions reductions from locomotives through enforceable agreements with two Class I railroads: Union Pacific (UP) and BNSF Railway (BNSF). The 1998 Locomotive NO_x Fleet Average Emissions Agreement in the South Coast Air Basin (1998 MOU[84]) mandated a Tier 2-average NOx emission standard throughout the South Coast Air Basin by 2010.

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

- The 2005 Statewide Railyard Agreement (2005 Agreement[85]) initiated early use of low--sulfur diesel in locomotives, established a statewide idle-reduction program, and ensured that BNSF and UP would work with CARB to obtain Health Risk Assessments at 18 of California's major railyards.
- While enforceable agreements and federal locomotive standards have achieved emissions reductions, more stringent emission standards are needed to address the air quality, public health, and climate change concerns associated with locomotive operations.
- In September 2020, Governor Newsom signed Executive Order N-79-20 which directs CARB to adopt regulations to transition the State's transportation fleet to ZEV. This includes transitioning the state's off-road fleet (including locomotives) to ZEVs by 2035 where feasible.

Proposed Action

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

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

- By July 1, 2024, a spending account would be established for each locomotive operator.
- The amount deposited annually into the operator's spending account is determined by the NOx and PM emission levels of the locomotive engines and activity in megawatt hours of each locomotive operated in California.
- Funds in the account would be required to go toward the Tier 4 locomotives from 2023-2030, and toward zero-emission locomotives from 2030 and beyond.
- At any time, the spending account funds may be used for zero-emission locomotives, zero-emission railcar movers, zero-emission infrastructure and zero-emission locomotive pilots and demonstration projects.

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

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

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

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

Idling Limit: Reducing unnecessary idling.

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

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

Estimated Emissions Reductions

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

Table 42 – In-Use Locomotive Regulation Emissions Reductions

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

Timing

Proposed CARB Board hearing: 2023
Proposed implementation begins: 2024

Proposed SIP Commitment

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

2022 State SIP Strategy

Future Measures for Aviation Emissions Reductions

Overview

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

At the State level, CARB has implemented regulations aimed at reducing on-ground emissions from airports and some local air districts have Memorandums of Understandings (MOUs) with airports to further reduce on-ground emissions. To support emissions reductions on the scale needed, CARB will continue to advocate and coordinate with local, district, State, and federal partners to promulgate measures and regulations to achieve reductions.

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

Background/Regulatory History

- NOx emissions from aircraft are projected to grow significantly. In California, aircraft are projected to make up 9.5 percent of mobile source NOx emissions in 2035, increasing from 5.4 percent in 2020.[86]
- International Civil Aviation Organization (ICAO) is the United Nations body that sets and adopts civil aviation standards and practices for its 193 national government members. The Committee on Aviation Environmental Protection (CAEP) is a technical committee of ICAO. CAEP assists ICAO with formulating new policies and adopting new standards and recommended practices. The most recent standards adopted by ICAO are:[87]

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

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

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

- U.S. EPA is required to set emission standards for any air pollutant emitted by aircraft that may reasonably be anticipated to endanger public health or welfare.[88] U.S. EPA is not bound by ICAO standards and can adopt standards that are stricter than those set by ICAO. EPA has historically adopted ICAO standards and has most recently adopted a GHG emission standard and has proposed a PM emission standard for aircraft that are both equivalent to the ICAO standards.
- FAA's CLEEN program is a cost-sharing program aimed at accelerating the development and commercialization of new certifiable aircraft technologies and sustainable aviation fuels. The program has been successful in developing technologies relating to composite airframe technologies, advanced wing technologies, advanced fan systems, and many other technologies.[89]
- There are certified aircraft engines available that achieve NOx emissions below the CAEP/8 standard and PM emissions below the latest CAEP/11 standard. Engine manufacturers are also currently developing engines that achieve significant reductions beyond the current standards. These new technology advances enable reductions in both NOx and PM emissions and provide a pathway for achieving effective ways to reduce harmful emissions.
- CARB implemented the In-Use Off-Road Diesel-Fueled Fleets Regulation, Large Spark -Ignition Fleet Requirements Regulation, and the Zero-Emission Airport Shuttle Regulation, all aimed at targeting airport related on-ground emissions. Current regulations aim to reduce harmful emissions such as NOx, HC, GHGs, and PM among others.

Proposed Action

Due to U.S. EPA's authority on setting emission standards, for this measure, CARB would strongly advocate for stricter emission regulations and highlight the need to reduce pollution to protect public health – this is discussed further in the Federal Actions portion of this document.

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

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

[88] Clean Air Act sec. 231, 42 U.S.C. § 7571.
[89] FAA, CLEEN Phase I and II Projects, Feb. 27, 2020, available at *https://www.faa.gov/about/office_org/headquarters_offices/apl/research/aircraft_technology/cleen*

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

CARB would evaluate federal, State, and local authority in setting operational efficiency practices to achieve emissions reductions. Operational practices include landing, takeoff, taxi, and running the APU, and contribute to on-ground and near-ground emissions. Near ground emissions are emissions between ground level up to 3,000 feet. Operational practices such as de-rated take-off[90] and reduced power taxiing[91] have the potential to achieve emissions reductions.

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

Estimated Emissions Reductions

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

Timing

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

Proposed CARB Board hearing: 2027
Proposed implementation schedule: 2029

Proposed SIP Commitment

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

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

2022 State SIP Strategy

Future Measures for Ocean-Going Vessel Emissions Reductions

Overview

The primary goal of future measures for OGVs is to further reduce emissions from OGVs that are transiting, maneuvering, or anchoring in Regulated California Waters (RCW) and while docking at berth in California seaports.[92] California has two primary regulations currently in place to reduce emissions from OGVs: 1) the OGV Fuel Regulation, which was adopted in 2008 and requires all OGVs to use cleaner 0.1 percent sulfur distillate grade fuels while in RCW, and 2) the At Berth Regulation, which requires regulated vessels to connect to shore power or use an alternative emissions control technology to reduce emissions while docked at berth at regulated California seaports.[93,94] The original At-Berth Regulation was adopted in 2007, and requires 80 percent of regulated container, refrigerated cargo, and passenger cruise vessels to reduce emissions while berthed at regulated California seaports. The 2020 At Berth Regulation expansion extended emissions control requirements to auto carrier (also called "roll-on/roll-off" or "ro-ro") and tanker vessels, as well as new seaports and marine terminals that receive these two vessel types, and requires all regulated vessel types to connect to shore power or a CARB approved emissions control strategy during every visit to a regulated marine terminal.[95]

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

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

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

[92] Regulated California Waters is defined as within 24 nautical miles of the California coast.
[93] Regulated container and refrigerated cargo fleets are any fleet making 25 or more visits to a regulated seaport, while regulated cruise fleets are any fleet making 5 or more visits to a regulated seaport.
[94] Under the 2007 At-Berth Regulation, six California seaports are subject to emissions control requirements: the Ports of Los Angeles, Long Beach, Oakland, San Francisco, San Diego, and Hueneme.
[95] Under the 2020 At Berth Regulation, any marine terminal receiving 20 or more visits from container, refrigerated cargo, cruise, ro-ro, or tanker vessels is subject to emission control requirements.

2022 State SIP Strategy

Background/Regulatory History

- The majority of emissions from OGVs occur while vessels are in transit and operating their large slow-speed marine engines, which are typically powered by heavy fuel oil (or "bunker fuel").[96] CARB's Vessel Clean Fuel Regulation requires OGVs to use 0.1 percent sulfur distillate grade fuels (marine diesel oil/marine gas oil) for all OGVs sailing within RCW to help reduce emissions from OGVs, namely sulfur oxide (SOx) emissions.
- OGV emissions (up to 100 nautical miles) are projected to account for 20 percent of mobile source NOx emissions in 2037, up from 10 percent in 2017.[97]
- Increased emissions are occurring from all modes of OGV operations (in transit, maneuvering, anchoring, and at berth) because of increased import/export activity and seaport congestion (which may be associated with a variety of factors, including the global pandemic, increased purchasing by consumers, periodic labor disputes, tariff changes, etc.).
- OGVs and emissions standards are largely regulated on an international level by the International Maritime Organization (IMO), whose primary focus is reducing NOx and GHG emissions from OGVs. IMO marine engine standards for OGVs regulate NOx emissions only, with no PM standards in place. Tier I and II engine standards exist for any vessel with a keel-laid date beginning on January 1, 2000, and January 1, 2011, respectively. Stricter Tier III IMO marine engines, which achieve a significant reduction in NOx emissions (around an 80 percent reduction from Tier II) are currently required for any OGV with a keel-laid date of January 1, 2016, or later. However, due to the long lifespan of OGVs and the fact that OGVs with keel laid dates after January 1, 2016, are only required to have Tier III engines when sailing within Emission Control Areas (ECA), turnover to Tier III engines is slow and not expected for most vessel categories until 2030+.[98]
- Significant reductions in SOx emissions from OGVs have been achieved through implementation of the OGV Fuel Regulation and North American Emissions Control Area. Reductions in NOx, PM, and GHGs have also been achieved through implementation of the At Berth Regulation, however, additional reductions of these pollutants are needed, particularly from OGVs in transit and anchoring near the California coast, in order to achieve federal air quality standards and reduce health impacts from ultrafine diesel particles in portside communities.
- Advocacy at the federal/international level for measures such as cleaner vessel engine standards, cleaner fuels, and increased use of vessel speed reduction outside of RCW are necessary to achieve further reductions from OGVs.

[96] California Air Resources Board. Staff Report: Initial Statement of Reasons. October 15, 2019. *https://ww2.arb.ca.gov/sites/default/files/classic/regact/2019/ogvatberth2019/isor.pdf*

[97] California Air Resources Board. CARB's Potential Future Measures for Reducing Emissions from OGVs. 2022 AQMP Mobile Source Working Group. April 1, 2021. Retrieved from *http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2022-air-quality-management-plan/ogv-presentations-combined-04-01-21.pdf*

[98] CARB. Appendix H - Update to Inventory for Ocean-Going Vessels At Berth: Methodology and Results. October 9, 2019. Retrieved at *https://ww2.arb.ca.gov/sites/default/files/classic/regact/2019/ogvatberth2019/apph.pdf*

- Cleaner marine fuels being explored include hydrogen, methanol, ammonia, and liquid natural gas (LNG). There is no consensus within the maritime industry yet as to which alternative fuel(s) might be best suited for OGV applications.

Proposed Action

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

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

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

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

- Using cleaner engines or cleaner fuels than those required by U.S. EPA and the IMO;
- Reducing emissions while anchored within RCW;
- Sailing at slower speeds while in RCW; and
- Requiring bulk and general cargo vessels to reduce emissions while at berth.

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

Estimated Emissions Reductions

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

Timing

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

Proposed CARB Board hearing: 2027
Proposed implementation schedule: TBD

Proposed SIP Commitment

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

2022 State SIP Strategy

Federal Actions Needed

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

On-Road Heavy-Duty Vehicles

Overview

In the 2016 State SIP Strategy, CARB included a measure to petition for federal low-NOx standards that would apply to all new heavy-duty trucks sold nationwide. This would ensure that all trucks traveling within California would eventually be equipped with an engine meeting the lower NOx standard. Federal action is critical to implement this emission standard.

In addition to the need for cleaner combustion engine standards, actions are also needed at the federal level to drive the introduction of zero-emission heavy-duty vehicles into the on-road fleet nation-wide. The goal of these proposed measures is to reduce emissions from combustion engine on-road heavy-duty trucks sold outside of California but operating within California.

Background/Regulatory History

Due to the preponderance of interstate trucking's contribution to emissions in California, timely federal action to implement a national low-NOx engine standard is critical to provide the emissions reductions needed for attainment. The 2016 State SIP Strategy called for U.S. EPA to develop a national low-NOx standard. In June of 2016, the South Coast, San Joaquin Valley and Bay Area air districts and nine other state and local air control agencies formally petitioned U.S. EPA to adopt 0.02 g/bhp-hr NOx standards for medium- and heavy--duty truck engines nationally. U.S. EPA responded to those petitions on December 20, 2016, stating that they will initiate the work necessary to issue a Notice of Proposed Rulemaking for a new on-road heavy-duty NOx program, with the intention of proposing standards that could begin in model year 2024, consistent with the lead-time requirements of the Clean Air Act. In November 2018, U.S. EPA announced the national program, known as the *Cleaner Trucks Initiative* (CTI), and an Advanced Notice of Proposed Rulemaking was released on January 21, 2020.[99] On August 5, 2021, U.S. EPA announced an update to CTI called the *Clean Trucks Plan* (CTP). CTP plans to reduce GHG and other harmful air pollutants from heavy-duty trucks through a series of rulemakings over the next three years. On March 28, 2022, U.S. EPA proposed the CTP[100], but the proposed rule provides options that are less stringent than previously suggested by U.S. EPA and CARB's Heavy-Duty Omnibus Regulation. CARB will advocate to align the federal CTP with CARB's low-NOx Omnibus regulations to the maximum degree possible, given the need for deep emissions reductions and the benefits of consistency in this area given the multiple jurisdictions in which trucks are purchased and used.

[99] *Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine Standards*, 85 Fed. Reg. 3306 (Jan. 21, 2020). *https://www.govinfo.gov/content/pkg/FR-2020-01-21/pdf/2020-00542.pdf*
[100] U.S. EPA proposed rulemaking on the CTP, *EPA-HQ-OAR-2019-0055-0983_content.pdf*

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

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

Proposed Action

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

Estimated Emissions Reductions

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

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

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

Timing

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

Proposed SIP Commitment

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

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

degree possible, given the need for deep emissions reductions and the benefits of consistency in this area given the multiple jurisdictions in which trucks are purchased and used.

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

Proposed Action

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

Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Preempted Off-Road Equipment

Overview

Off-road equipment regulated at the federal level also contributes significant ozone precursor emissions in California. The goal of more stringent standards would be to reduce NOx and PM emissions from new, off-road compression-ignition and spark-ignition engines by adopting more stringent exhaust standards for all power categories, including those that do not currently utilize exhaust aftertreatment such as diesel particulate filters (DPFs) and selective catalytic reduction (SCR). Included in the CARB measures is a proposed action for Tier 5 standards on State-regulated off-road equipment.

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

Background/Regulatory History

The off-road category includes spark-ignition engines that mostly operate on gasoline and alternative fuels, as well as compression-ignition engines which operate on diesel fuel. Spark--ignition engines include small off-road engines (SORE) and large spark-ignition engines (LSI). The SORE category includes lawn, garden, and small industrial equipment that are less than or equal to 19 kilowatts (kW). The LSI engine category includes engines greater than 19 kW that are used in forklifts, portable generators, large turf care equipment, airport ground support equipment, and general industrial equipment. Compression--ignition engines are used in off-road equipment including tractors, excavators, bulldozers, graders, and backhoes. As of model year 2020, more than half of all new off-road compression-ignition engine families continue to be certified in California to the Tier 4 final emission standards without DPFs. This means that the majority of new off-road compression--ignition engines are not reducing toxic diesel PM to the greatest extent feasible using the best available control technology because the current standards are insufficient. The standards considered for a national Tier 5 compression-ignition measure would be more stringent than required by current U.S. EPA and European Stage V nonroad regulations and more stringent spark-ignition standard for preempted engines would require the use of best available control technologies for both PM and NOx, while encouraging transitions to zero--emission equipment where feasible.

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

Zero-emission off-road equipment has been consistently and successfully manufactured in a number of equipment categories (e.g., forklifts, man lifts, etc.) for decades, with wide fleet adoption taking place without mandates that required such equipment to be produced or purchased. For next-generation zero-emission off-road equipment, CARB and other air quality agencies have funded numerous successful demonstration and pilot projects, as well as commercial-launch voucher incentive programs, like the Clean Off-Road Equipment Voucher Incentive Project, and SIP creditable emission-reduction programs, like the Carl Moyer Program. Studies have been performed to identify the off-road equipment types and engine horsepower ranges that have greater potential to be zero-emission powered. Although more analysis is necessary, existing information suggests that zero-emission technology may be feasible in many applications in which zero-emission technology has not yet achieved meaningful penetration today. These studies have also identified potential electric powertrains and corresponding energy storage systems that could be used to replace existing internal combustion engines in said equipment types.

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

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

Proposed Action

CARB would petition and/or advocate to U.S. EPA to promulgate off-road equipment Tier 5 compression-ignition standards and new spark-ignition standards for preempted engines, akin to those that CARB is pursuing for equipment under State authority to prevent the availability of equipment meeting a less stringent standard.

Estimated Emissions Reductions

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

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

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

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

Timing

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

Proposed SIP Commitment

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

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

Proposed Action

CARB would petition and/or advocate to U.S. EPA to require zero-emission standards for off-road equipment where the technology is feasible. Zero-emission technology is maturing and penetrating the off-road equipment categories, and federal zero-emission standards for off-road equipment would provide a clear path for zero-emission technology to continue maturing.

Estimated Emissions Reductions

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

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

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

Timing

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

Proposed SIP Commitment

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

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

2022 State SIP Strategy

Aviation

Overview

Controlling emission sources that are primarily regulated by the federal government is critical to protect public health and to achieve our clean air and climate targets. Despite the reductions achieved by existing federal programs, additional measures are needed to meet climate and air quality goals and obtain local health exposure reductions. While engine standards and requirements do exist at the federal and international level for aircraft, these standards and requirements do not reflect the current state of technology. As a result, emissions from the aviation sector have not decreased at the same pace as those for other mobile sources in California. To achieve the magnitude of emissions reductions necessary from this category, and due to the local, national and international nature of aircraft travel, strong action and advocacy is required at the federal and international level.

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

Background/Regulatory History

In California, aircraft are projected to make up 9.5 percent of mobile source NOx emissions in 2035, increasing from 5.4 percent in 2020.[104] ICAO is the United Nations body that sets and adopts civil aviation standards and practices for its 193 national government members. The Committee on Aviation Environmental Protection (CAEP) is a technical committee of ICAO. CAEP assists ICAO with formulating new policies and adopting new standards and recommended practices.

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

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

[104] 2021_line_haul_locomotive_emission_inventory_final.pdf (ca.gov) ww2.arb.ca.gov/sites/default/files/2021-02/2021_line_haul_locomotive_emission_inventory_final.pdf
[105] Committee on Aviation Environmental Protection (CAEP) (icao.int) *www.icao.int/ENVIRONMENTAL-PROTECTION/Pages/CAEP.aspx*

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

There are certified aircraft engines available that achieve NOx emissions below the latest CAEP/8 standard, and engine manufacturers are also currently developing engines that achieve significant reductions beyond the current standards.

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

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

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

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

1. More Stringent Aviation Engine Standards

Proposed Action

CARB would petition and/or advocate to U.S. EPA for more stringent criteria and GHG standards for aircraft engines. With innovative research and advanced optimization of engine design, it has been demonstrated that NOx emissions can be further reduced beyond the CAEP/8 standards. For example, under the FAA's Continuous Lower Energy, Emissions, and Noise Phase II (CLEEN II) Program, FAA awarded five-year agreements to a variety of companies to accelerate the development of new aircraft and engine technologies. The goal of the program

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

is to achieve 70 percent NOx and 40 percent fuel burn reduction below the CAEP/8 standards. In 2016, GE's Twin Annular Premixing Swirler (TAPS) II combustor matured under CLEEN I and entered into service as part of CFM International's TAPS Leading Edge Aviation Propulsion (LEAP) engine, currently onboard Airbus 320neo, Boeing 737 MAX, and COMAC C919 aircraft. Under CLEEN I, GE engine emissions tests of TAPS II had results that were more than 60 percent below the 2004 ICAO CAEP NOx standards. The FAA anticipates that more of these technologies could go into service in the next several years.[107]

Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2. Cleaner Fuel and Visit Requirements for Aviation

Proposed Action

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

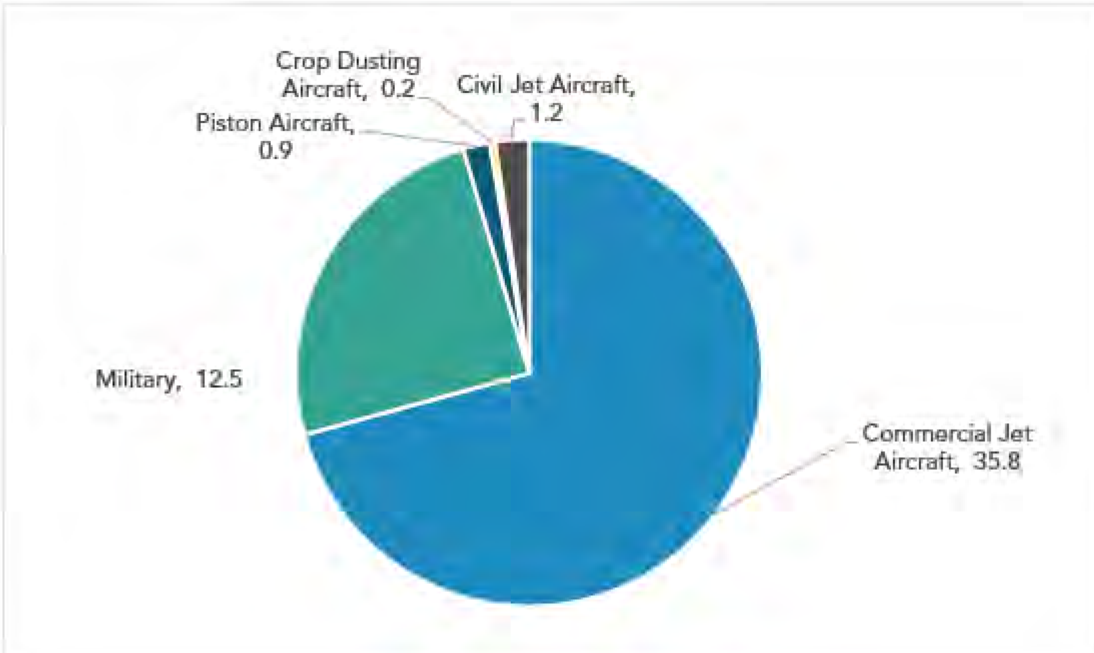
Additionally, a recent study conducted at the Bay Area's three largest airports showed that a jet fuel blend made with 50 percent of Sustainable Aviation Fuels (SAF) reduced PM emissions by 65 percent. Note that this is certified jet fuel being used in an existing and commercially available aircraft,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

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

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

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

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



Estimated Emissions Reductions

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

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

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

Timing

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

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

Proposed SIP Commitment

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

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

Proposed Action

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

Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

4. Airport Aviation Emissions Cap

Proposed Action

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

Estimated Emissions Reductions

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

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

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

Timing

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

Proposed SIP Commitment

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

Locomotives

Overview

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

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

Further, federal rules currently define remanufactured locomotives as "new" when they are remanufactured, and do not set limits on how often locomotives can be remanufactured. The result is continued remanufacturing of old and polluting locomotives to the same pollution tier standards, and persistent pollution from these sources. It is imperative that U.S. EPA remove this regulatory provision in order to ensure emissions reductions as locomotives require updating over time.

Background/Regulatory History

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

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

In the 2016 State SIP Strategy, CARB included a measure to petition for more stringent national locomotive emission standards and, in 2017, *CARB petitioned U.S. EPA* to promulgate a Tier 5 standard. The proposed standard would include the first-ever zero-emission capability using on-board batteries to support zero-emission rail operation in sensitive areas, as well as cut fuel consumption and GHG emissions. As of July 2022, U.S. EPA has taken no action on this petition.

1. More Stringent National Locomotive Emission Standards

Proposed Action

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

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

Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2. Zero-Emission Standards for Locomotives

Proposed Action

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

Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

3. Address Unlimited Locomotive Remanufacturing

Proposed Action

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

Estimated Emissions Reductions

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Ocean-Going Vessels

Overview

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

To the maximum extent possible, all Tier 0, Tier 1, and Tier 2 vessel visits should be replaced with visits made by Tier 3 or cleaner vessels. Biofuels, renewable hydrogen and other hydrogen-derived fuels such as ammonia, methanol, batteries and fuel cells are being considered as potential fuel choices for vessels. All options need to be considered to achieve the needed emissions reductions.

Background/Regulatory History

OGVs and emissions standards are largely regulated on an international level by the IMO, whose primary focus is reducing NOx and GHG emissions from OGVs. IMO marine engine standards for OGVs regulate NOx emissions only, with no PM standards in place. Tier I and II engine standards exist for any vessel with a keel-laid date of January 1, 2000, and January 1, 2011, respectively. Stricter Tier III IMO marine engines, which achieve a significant reduction in NOx emissions (around an 80 percent reduction from Tier II) are currently required for any OGV with a keel-laid date of January 1, 2016, or later. However, due to the long lifespan of OGVs and the fact that OGVs with keel laid dates after January 1, 2016, are only required to have Tier III engines when sailing within Emission Control Areas (ECA), turnover to Tier III engines is slow and not expected for most vessel categories until 2030+.[109]

The majority of emissions from OGVs occur while vessels are in transit and operating their large slow-speed marine engines, which are typically powered by heavy fuel oil (or "bunker fuel").[110] CARB's Vessel Clean Fuel Regulation requires OGVs to use 0.1 percent sulfur distillate grade fuels (marine diesel oil/marine gas oil) for all OGVs sailing within RCW to help reduce emissions from OGVs, namely SOx emissions.

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

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

increased import/export activity and seaport congestion (which may be associated with a variety of factors, including the global pandemic, periodic labor disputes, tariff changes, etc.).

Significant reductions in SOx emissions from OGVs have been achieved through implementation of the Vessel Clean Fuel Regulation and North American ECA. Reductions in NOx, PM, and GHGs have also been achieved through the implementation of the At Berth Regulation, however, additional reductions of these pollutants are needed, particularly from OGVs in transit and anchoring near the California coast, to achieve federal air quality standards and reduce health impacts from ultrafine diesel particles in portside communities.

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

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

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

Proposed Action

Emissions from main engines and auxiliary engines of OGVs during transit, anchorage, and maneuvering must be addressed in order to achieve NOx reductions needed to meet air quality standards in California. Currently, very few vessels with Tier 3 main engines visit California ports, even though the Tier 3 engine standard applied to new marine engines beginning in 2016. Tier 2 vessels emit three times higher NOx than Tier 3 vessels; thus, phasing out of older Tier 5 vessels is key to reducing criteria and toxics emissions from OGVs.

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

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

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

Estimated Emissions Reductions

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

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

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

Timing

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

Proposed SIP Commitment

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

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

Proposed Action

To the maximum extent possible all Tier 0, Tier 1, and Tier 2 vessel visits should be replaced with visits made by Tier 3 or cleaner vessels. Current Tier 3 vessel manufacturing data suggest that there may not be sufficient Tier 3 vessels to satisfy all vessel visits to the State, even if California were to receive a large majority of the worldwide Tier 3 vessels. However, these reductions may be achieved by incentivizing visits from Tier 2 vessels that have been retrofit to reduce NOx emissions. Some of the current retrofit technologies for marine engines include exhaust gas recirculation (EGR) and SCR, which both have potential to reduce emissions by up to 80 percent. It is possible that Tier 3 and retrofit strategies may not achieve full potential benefits when operating or maneuvering at lower loads in the vicinity of seaports in Regulated California Waters. Therefore, other strategies such as water-in-fuel emulsion, biofuels, renewable hydrogen and other hydrogen-derived fuels such as ammonia, methanol, batteries and fuel cells are being considered as potential or complementary fuel choices for vessels to achieve maximum emissions reductions. All options need to be considered to achieve the needed emissions reductions. CARB would petition and/or advocate to U.S. EPA to require vessels to use cleaner fuels and visits from cleaner OGVs.

Estimated Emissions Reductions

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

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

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

Timing

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

Proposed SIP Commitment

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

2022 State SIP Strategy

Chapter 6: Incentives

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

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

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

Incentive programs to promote and accelerate the use of advanced technologies, to enhance transportation options, and to shift transportation systems generally towards lower-pollution modes by reducing vehicle miles travelled as well as reducing emissions from individual vehicles, will be essential to meeting our pre-2030 air quality goals and setting us on the trajectory for future goals like the 70 ppb 8-hour ozone standard. Therefore, strategic use of incentive funding is essential to achieve earlier penetration of cleaner combustion and zero-emission technologies than would happen through natural turnover, and to support transportation systems improvements. For instance, in its approval of the most recent Funding Plan for Clean Transportation Incentives, CARB's Board called out the continuing need for implementation of the Climate Action Plan for Transportation Infrastructure (CAPTI) and related actions in order to improve the system as a whole. In addition to funding, it is critical that clean transportation is accessible to all Californians, particularly those in low-income and disadvantaged communities who experience a disproportionate share of pollution impacts.

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

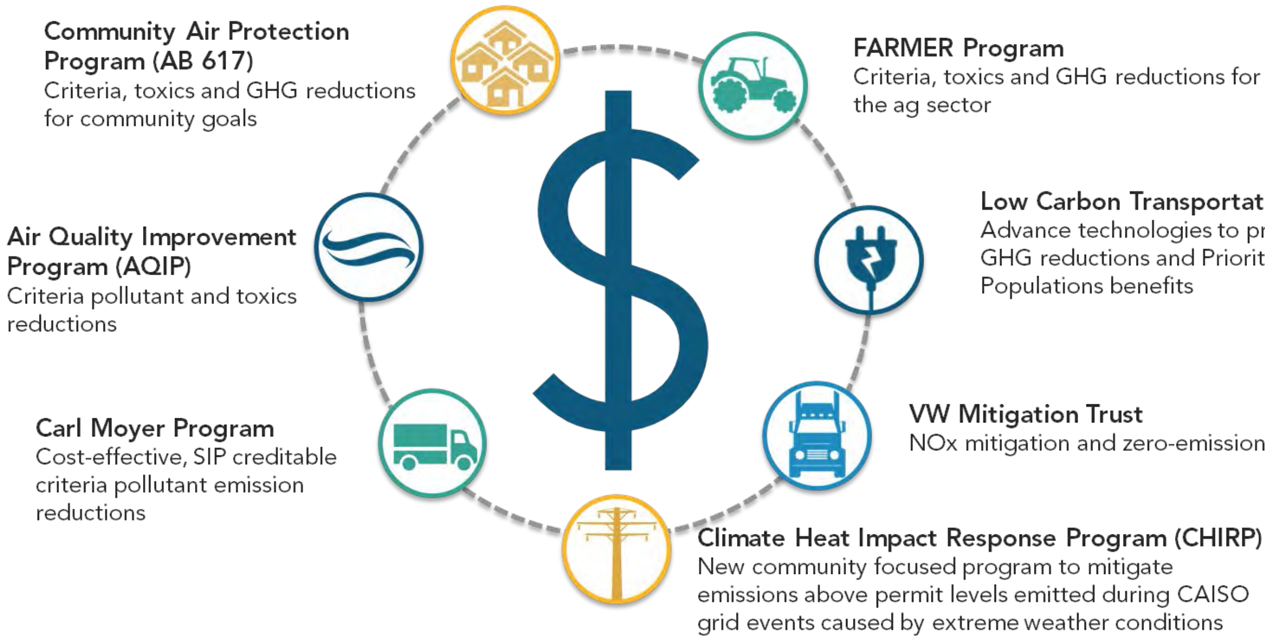
Each of CARB's incentive programs has its own statutory requirements, goals, and categories of eligible projects that collectively provide for a diverse and complex incentives portfolio. In total, these programs address multiple goals, including:

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

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

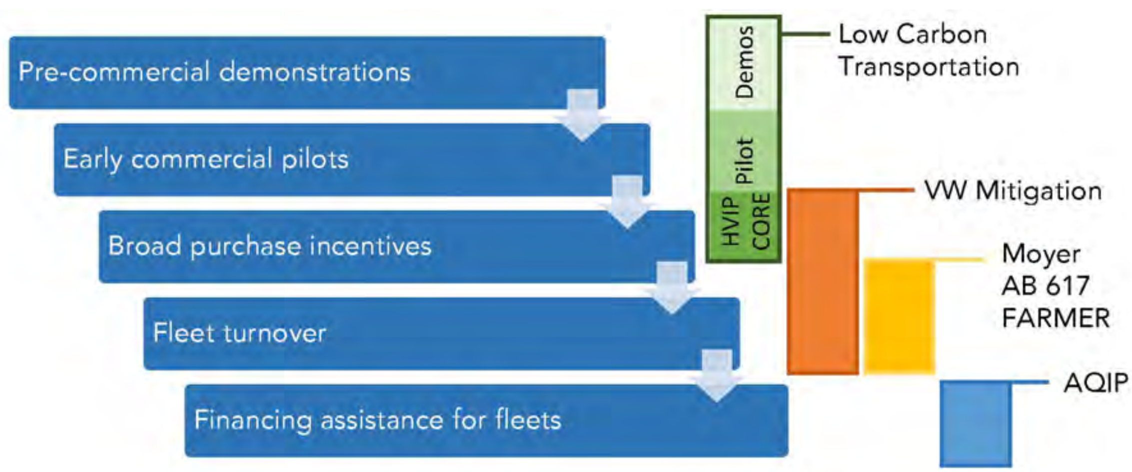
2022 State SIP Strategy

Figure 20 – CARB's Portfolio of Incentive Programs



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

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



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

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

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

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

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

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

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

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

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

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

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Chapter 7: Infrastructure

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

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

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

Infrastructure Demand

Overview of ZEV Infrastructure Analysis

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

114 Assembly Bill 2127 (Ting), Statutes of 2018, Chapter 365. *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2127*.
115 Governor Gavin Newsom. Executive Order N-79-20. Issued September 23, 2020. *https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-text.pdf*.

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

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

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

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

116 Alexander, Matt, Noel Crisostomo, Wendell Krell, Jeffrey Lu, and Raja Ramesh. July 2021. Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment: Analyzing Charging Needs to Support Zero-Emission Vehicles in 2030 – Commission Report. California Energy Commission. Publication Number: CEC-600-2021-001-CMR.
117 CARB. 2020. Draft 2020 Mobile Source Strategy. *https://ww2.arb.ca.gov/resources/documents/2020-mobile-source-strategy*
118 Assembly Bill 8 (Perea), Statutes of 2013, Chapter 401. *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB8*
119 CARB. 2021. Annual Hydrogen Evaluation. *https://ww2.arb.ca.gov/resources/documents/annual-hydrogen-evaluation*
120 Baronas, Jean, Gerhard Achtelik, et al. 2020. Joint Agency Staff Report on Assembly Bill 8: 2020 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California. California Energy Commission and California Air Resources Board. Publication Number: CEC-600-2020-008.
121 The CEC will embark in new and expanded hydrogen infrastructure analysis pursuant to Senate Bill 643.
122 CARB. 2017. California Hydrogen Infrastructure Tool. *https://ww2.arb.ca.gov/resources/documents/california-hydrogen-infrastructure-tool-chit*
123 The CEC anticipates reaching 200 stations as the result of funding from the 2021-2022 budget (Senate Bill 170, Skinner, Budget Act of 2021).

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

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

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

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

ZEV Population Projections and Infrastructure Analysis Updates

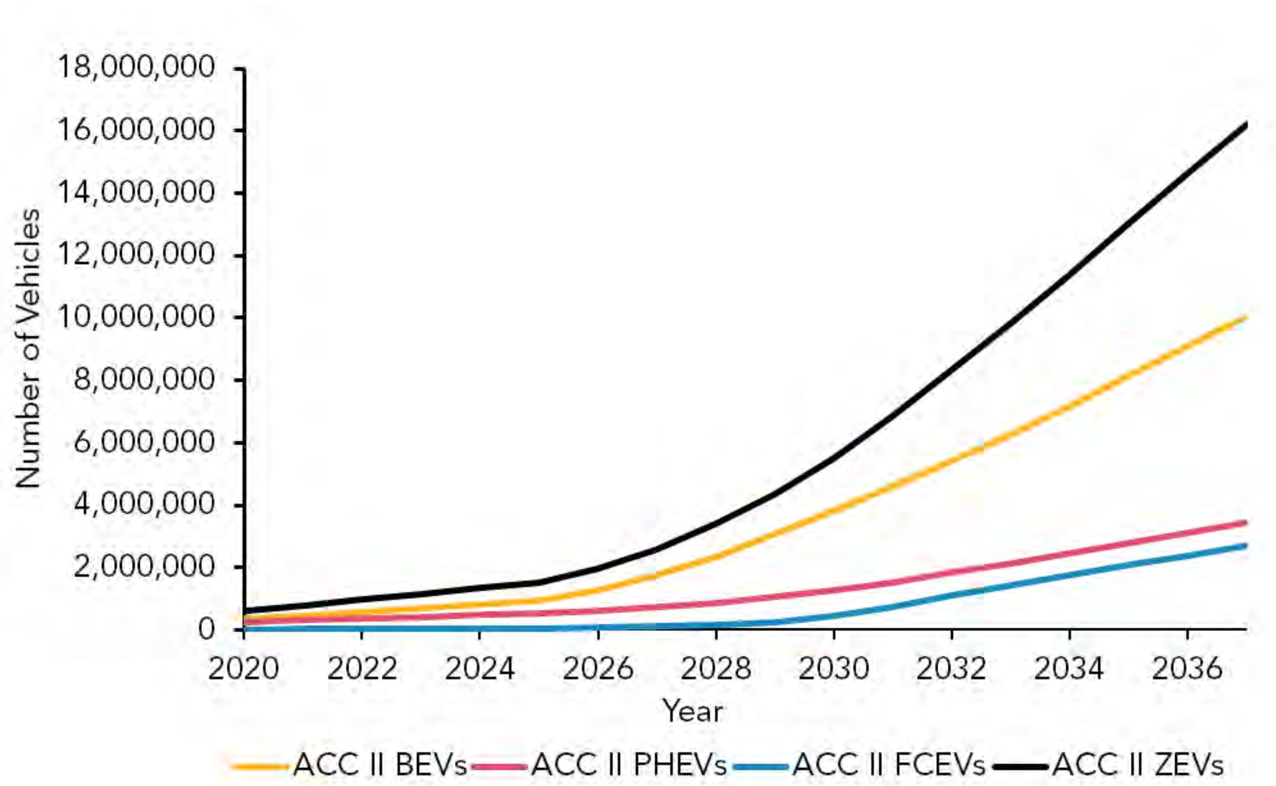
The 2020 MSS builds concepts and presents top-down scenarios that define the technology mixes needed to achieve emissions reduction targets. Built upon the measures and commitments already made in the 2016 State SIP Strategy, the Proposed 2022 State SIP Strategy further expand and translate the concepts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

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

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

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

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



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

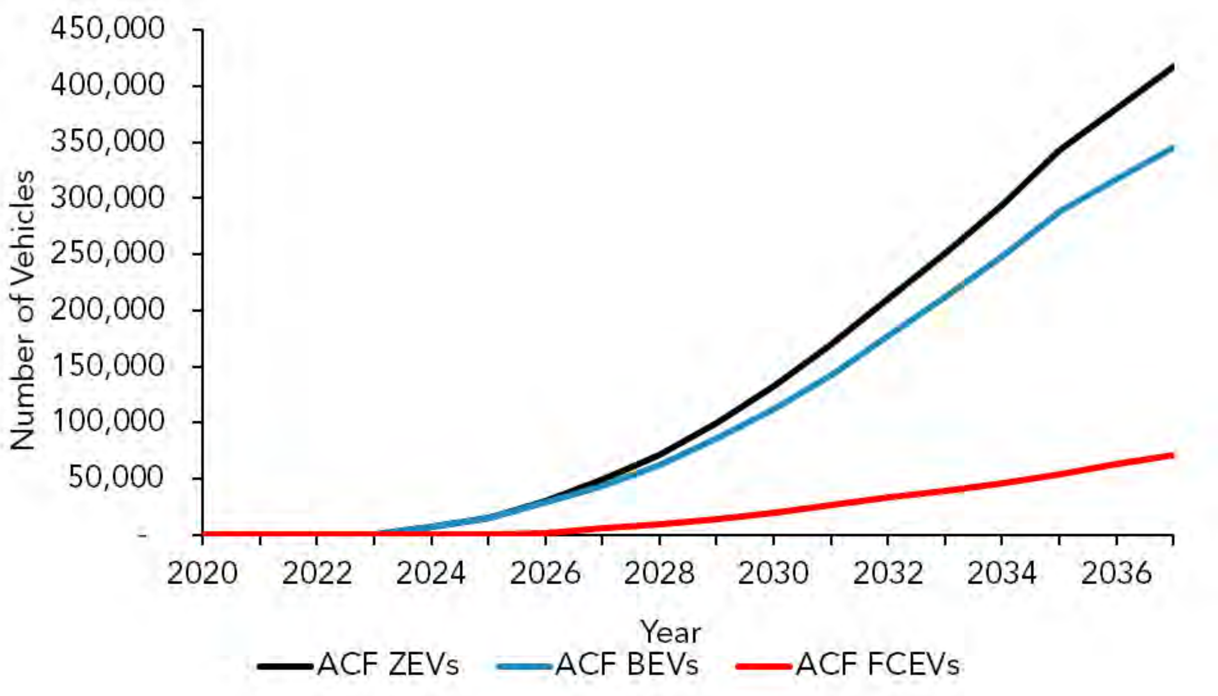
[126] California Air Resources Board (CARB) (2021). Advanced Clean Fleets - Meetings & Events (*https://ww2.arb.ca.gov/sites/default/files/2021-09/210909acfpres_ADA.pdf*)

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

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

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

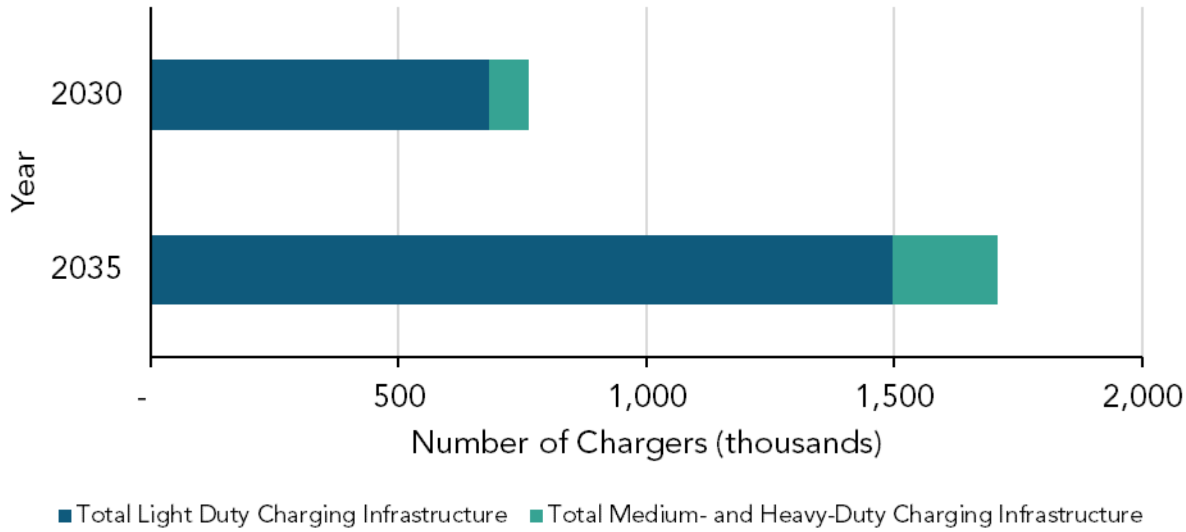
Figure 23 - Medium- and Heavy-Duty ZEV (>10,000 GVWR) Projections in the Proposed Advanced Clean Fleets Regulation (EMFAC2017 with MPO Activity)[129]



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

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

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



Charging Infrastructure

Intraregional Light-Duty Charging Infrastructure Needs to Enable Local Travel

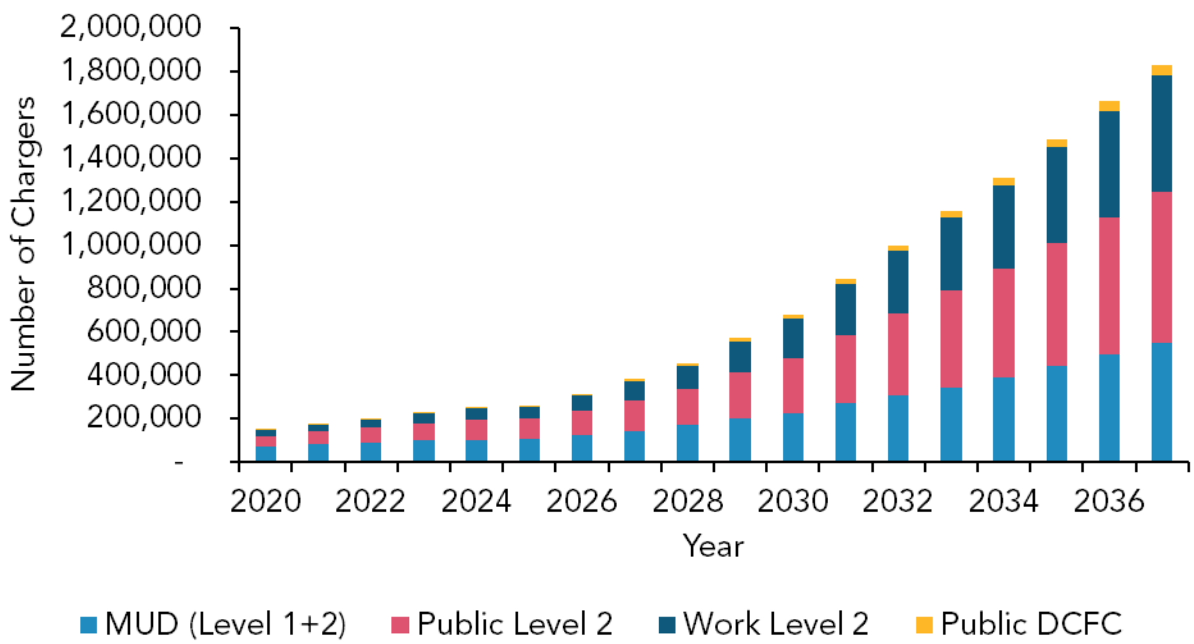
EVI-Pro 2 is a model that calculates the number, locations, and types of chargers required to meet the local travel and charging needs of California's light-duty PEV drivers. Infrastructure results to support the vehicle projections based on the proposed ACC II regulation are provided in Table 51 for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

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

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

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

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



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

Source: CEC and NREL

[131] Source: CEC and NREL

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

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

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

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

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

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

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

[132] Source: CEC and NREL

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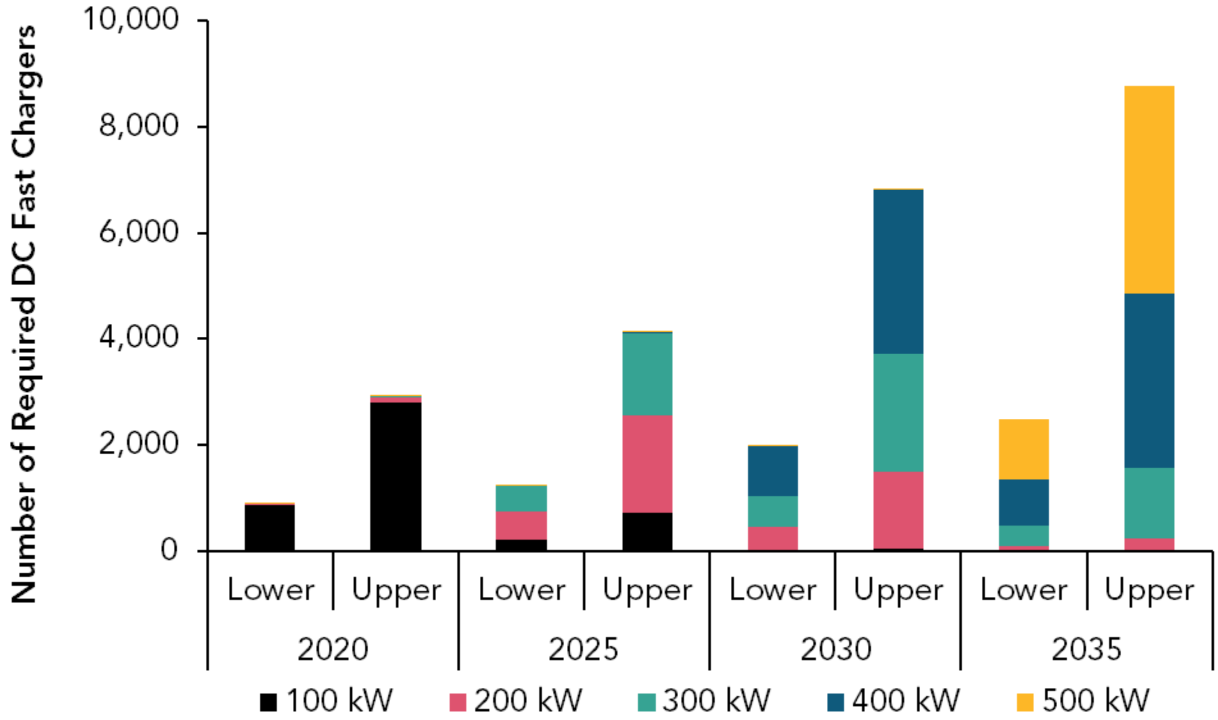
Figure 26 - EVI-RoadTrip DC Fast Charger Requirements by Power Level[133]



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

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

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

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

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

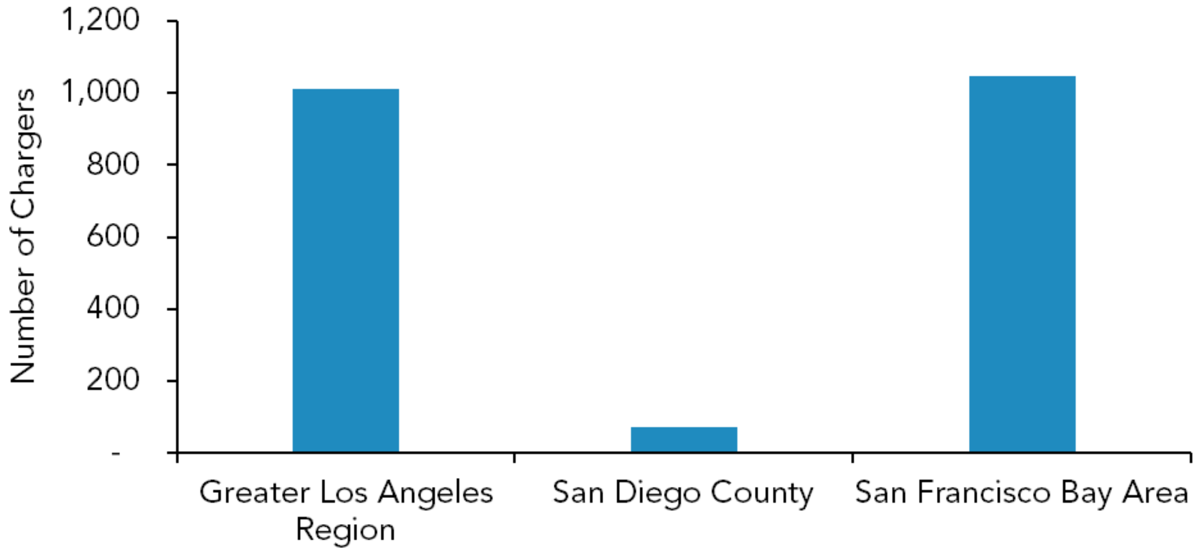
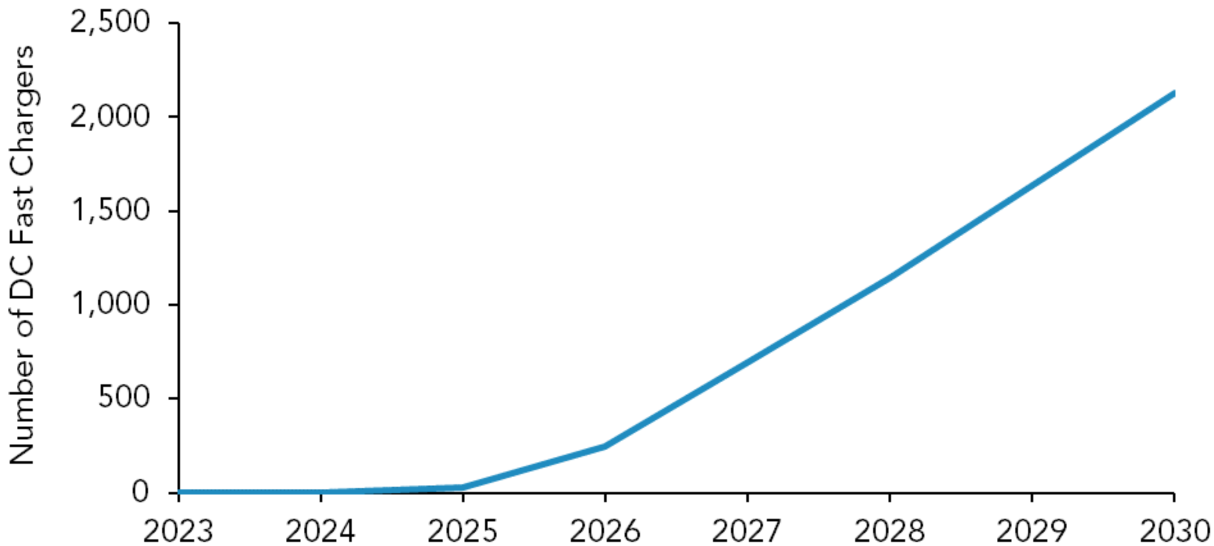


Figure 28 - DC Fast Chargers Needed to Support TNC PEVs (2023–2030)[136]



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

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

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

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

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

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

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

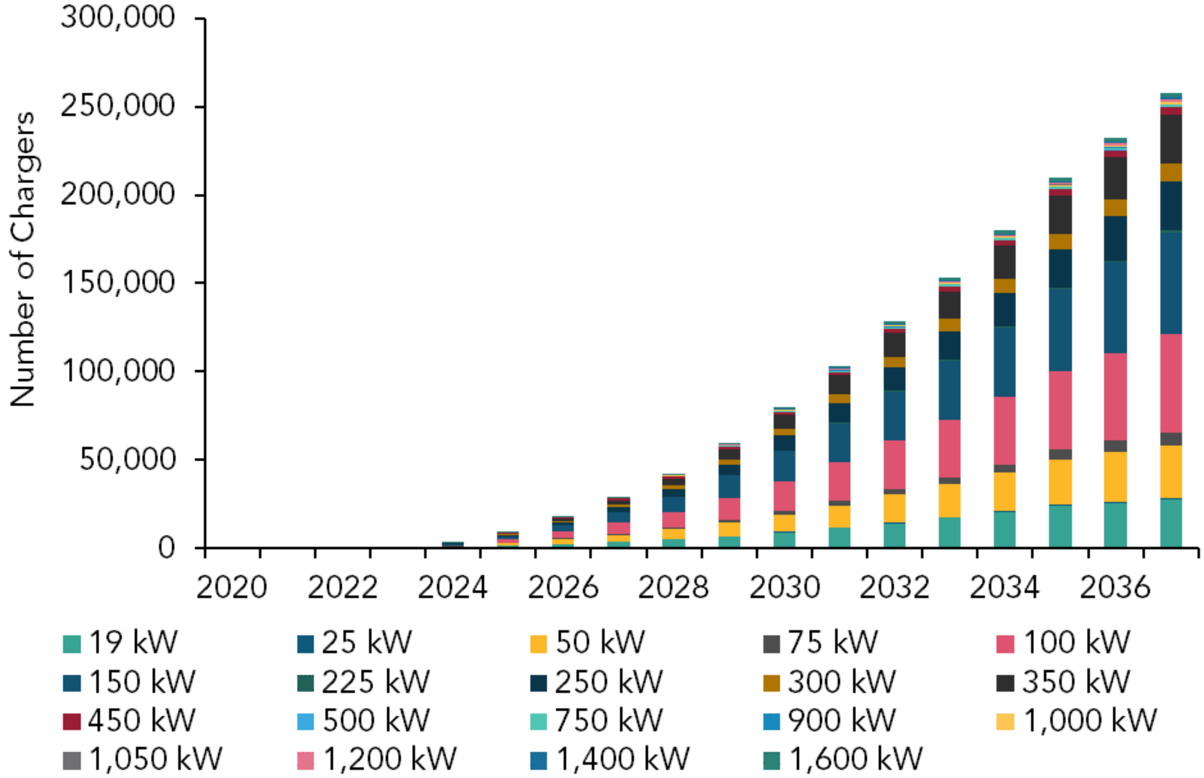
Table 53 - HEVI-LOAD Infrastructure Results for 112,000 BEVs in 2030 and 289,000 BEVs in 2035[137]

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

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

[137] Source: CEC and LBNL

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



Hydrogen Infrastructure

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

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

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

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

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

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

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

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

Barriers and Opportunities to Meeting the ZEV Infrastructure Demand

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

Plug-In Electric Vehicle Infrastructure Costs

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

[140] California Fuel Cell Partnership. July 2021. Fuel Cell Electric Trucks: A Vision for Freight Movement in California – and Beyond. *https://app.greenrope.com/content/Fuel-Cell-Electric-Trucks-Vision-CaFCP.pdf*.

[141] CEC. 2021. California Energy Commission Zero Emission Vehicle and Infrastructure Statistics. Data last updated October 29, 2021. Retrieved October 29, 2021 from *https://www.energy.ca.gov/zevstats*.

142 Senate Bill 643 (Archuleta), Statutes of 2021, Chapter 646. *https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=202120220SB643*.

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

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

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

Plug-In Electric Vehicle Infrastructure Funding and Revenue

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Hydrogen Refueling Infrastructure Costs

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

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

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

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

Scaling Infrastructure Deployment

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[160] CEC. "GFO-20-605 — BESTFIT Innovative Charging Solutions." *https://www.energy.ca.gov/solicitations/2020-08/gfo-20-605-bestfit-innovative-charging-solutions*.
[161] CEC. "GFO-21-601 — Charging Access for Reliable On-Demand Transportation Services (CARTS)." *https://www.energy.ca.gov/solicitations/2021-08/gfo-21-601-charging-access-reliable-demand-transportation-services-carts*.
[162] California Energy Commission. Staff Pre-Solicitation Workshop for Light-Duty Electric Vehicle Infrastructure Projects Serving Rural and Multi-Unit Dwelling Residents, June 28, 2021. *https://www.energy.ca.gov/event/workshop/2021-06/staff-pre-solicitation-workshop-light-duty-electric-vehicle-infrastructure*.
[163] Ibid.
[164] Regulated utilities include three large investor-owned utilities (Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric) along with three small or multi-jurisdictional investor-owned utilities (Liberty, PacifiCorp, and Bear Valley).
[165] CPUC's Draft Transportation Electrification Framework (*https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M326/K281/326281940.PDF*)
[166] Decision Setting Near-Term Priorities For Transportation Electrification Investments By The Electrical Corporations (*http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=394347617*)

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

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

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

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

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

[167] See *https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO:RP,57,RIR:P5_PROCEEDING_SELECT:R2106017*
[168] Administrative Law Judge's Ruling Seeking Comments on Proposed Preferred System Plan, pp. 23-28 (*https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M399/K450/399450008.PDF*)
[169] Decision Concerning Implementation of Senate Bill 676 And Vehicle-Grid Integration Strategies (*http://docs.cpuc.ca.gov/SearchRes.aspx?DocFormat=ALL&DocID=355794454*)
[170] Resolution E-5165 (*https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M420/K342/420342816.PDF)*

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

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

Additional Policies to Accelerate Infrastructure Deployment

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

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

[171] CEC's Draft Zero-Emission Vehicle Infrastructure Plan (ZIP) (*https://www.energy.ca.gov/publications/2022/draft-zero-emission-vehicle-infrastructure-plan-zip*)

[172] Caltrans and CEC's California's Deployment Plan for the National Electric Vehicle Infrastructure Program (*https://efiling.energy.ca.gov/GetDocument.aspx?tn=243505*)

[173] For more information, visit *https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/electricity-rates-and-cost-of-fueling*

[174] See "When might lower-income drivers benefit from electric vehicles? Quantifying the economic equity implications of electric vehicle adoption (International Council on Clean Transportation)" at *https://theicct.org/publications/EV-equity-feb2021*

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

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

[175] Electrify America (EA) (2021), California ZEV Investment Plan: Cycle 3, available at https://media.electrifyamerica.com/assets/documents/original/685-20210503PublicCaliforniaC3ZEVInvestmentPlanFinalvF.pdf?utm_medium=email&utm_source=govdelivery
[176] Great Plains Institute (2019). Analytical White Paper: Overcoming Barriers to Expanding Fast Charging Infrastructure in the Midcontinent Region. Available at : *https://scripts.betterenergy.org/reports/GPI_DCFC_Analysis_July_2019.pdf*
[177] Rocky Mountain Institute (2019). DCFC Rate Design Study. Available at: https://rmi.org/insight/dcfc-rate-design-study/
[178] National Renewable Energy Laboratory (NREL) (2017).Identifying Potential Markets for Behind-the-Meter Battery Energy Storage: A Survey of U.S. Demand Charges. Available at: *https://www.nrel.gov/docs/fy17osti/68963.pdf*
[179] https://www.dgs.ca.gov/BSC/Rulemaking/2021-Triennial-Code-Adoption-Cycle/Dec-2021-Commission-Mtg

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

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

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

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

APPENDIX K
EKAPCD 2015 Ozone NAAQS (70 ppb)
Emissions Statement and Certification

Emission Statement

Emissions Statement

§182(a)(3)(B) of the Clean Air Act (CAA) requires all ozone nonattainment areas to have a program in place that requires emissions statements from stationary sources of oxides of nitrogen (NOx) or volatile organic compounds (VOC). Specifically, §182(a)(3)(B)(i) of the CAA requires air agencies to submit to the U.S. EPA, a revision to the State Implementation Plan (SIP) requiring the owner or operator of each stationary source to report and certify the accuracy of their reported NOx and VOC emissions, beginning in 1993, and annually thereafter.

§182(a)(3)(B)(ii) of the CAA allows air agencies to waive the requirements under subsection (i) for stationary sources emitting less than 25 tons per year of NOx or VOC if the State provides an inventory of emissions from such class or category of sources, based on the use of the emission factors established by the U.S. EPA or other methods acceptable to the U.S. EPA as part of the inventories required under §182(a)(1) (the base year emissions inventory) and §182(a)(3)(A) (the periodic emissions inventory).

The emissions statement requirement for the 70 parts per billion (ppb) 8-hour ozone standard are described in *Implementation of the 2015 National Ambient Air Quality Standards for Ozone*: *Nonattainment Area State Implementation Plan Requirements* (83 FR 62998, December 6, 2018). If a nonattainment area has a previously-approved emissions statement rule in force for a previous 8-hour or 1-hour ozone standard covering all portions of the nonattainment area for the 70 ppb 8-hour ozone standard, the existing rule should be sufficient for the 70 ppb 8-hour ozone standard. If the existing rule does not meet §182(a)(3)(B) requirements, a revised or new rule would have to be submitted as part of the current ozone SIP.

Eastern Kern Air Pollution Control District (District) Rule 108.2, Emission Statement Requirements, fulfills the CAA §182(a)(3)(B) emissions statement requirements. District Rule 108.2 was adopted July 13, 1992, and was last amended May 2, 1996. U.S. EPA promulgated Rule 108.2 into the SIP May 26, 2004 (69 FR 29880, May 26, 2004). The boundaries of the District’s nonattainment area for the 70 ppb 8-hour ozone standard are the same as those for the 75 ppb ozone standard. District staff has reviewed existing Rule 108.2 to ensure it is adequate and, based on the rationale in the table below, determined that the existing rule is adequate to meet the §182(a)(3)(B) emissions statement requirements for the 70 ppb 8-hour ozone standard.

Emission Statement Certification

The District hereby certifies that the existing provisions of Rule 108.2 adequately meets the emissions statement requirements of §182(a)(3)(B)of the CAA for the purposes of the 70 ppb 8-hour ozone standard, and that no revision of the rule is required.

The District is certifying that the Emission Statement covering the nonattainment area pursuant to the 70 ppb 8-hour ozone standard, is at least as stringent as the requirements of CAA §182(a)(3)(B) as specified in the final rule titled: *Implementation of the 2015 National Ambient Air Quality Standard for Ozone: State Implementation Plan Requirements* (83 FR 62998, December 6, 2018).

Emission Statement

Rationale that District Rule 108.2 is adequate to meet the requirements of CAA §182(a)(3)(B) for the 70 ppb 8-hour ozone standard

CAA §182(a)(3)(B)	**District Rule 108.2**
CAA §182(a)(3)(B)(i)	
Within 2 years after November 15, 1990, the State shall submit revision to SIP to require that the owner or operator of each stationary source of NOx or VOC to provide the State with a statement, in such form as the Administrator may prescribe (or accept an equivalent alternative developed by the State), for classes or categories of sources, showing the actual emissions of NOx or VOC from that source.	Rule 108.2 was adopted in July 1992 and amended in May 1996. U.S. EPA promulgated Rule 108.2 into the SIP on May 26, 2004 (69 FR 29880).
Requires the owner/operator of stationary sources of NOx or VOC to provide the State with statements showing the actual NOx and VOC emissions.	The owner or operator of any source operation emitting or with the potential to emit NOx or VOC shall provide the District with a written statement, in such form as prescribed, showing actual emissions of NOx and VOC from such source.
Submittal of the first statement was required to be submitted within three years after November 15, 1990. Submittal of subsequent statements is required at least every year thereafter.	The first statement shall cover 1992 emissions and shall be submitted to the district by June 1993. Statements shall be submitted annually thereafter.
Statements shall contain a certification that the information contained in the statement in accurate to the best knowledge of the individual certifying the statement.	The statement shall also contain a certification by a responsible official of the company that information contained in the statement is accurate to the best knowledge of the individual certifying the statement.
CAA §182(a)(3)(B)(ii)	
The State may elect to waive the application of clause (i) to any class or category of stationary sources which emit less than 25 tons per year of VOC or NOx if the State provides an inventory of emissions from such class or category of source, based on the use of the emission factors established by the Administrator or other methods acceptable to the Administrator.	The Control Officer may waive this requirement to any class or category of stationary sources emitting less than 25 tons per year of oxides of nitrogen or reactive organic gases if the district provides CARB with an emission inventory of sources emitting greater than 10 tons per year of nitrogen oxides or reactive organic gases based on the use of emission factors acceptable to the CARB.

BEFORE THE AIR POLLUTION CONTROL BOARD
EASTERN KERN AIR POLLUTION CONTROL DISTRICT

In the matter of:

RESOLUTION APPROVING EASTERN KERN AIR POLLUTION CONTROL DISTRICT EMISSIONS STATEMENT FOR THE 2015 OZONE NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Resolution No. 2021-001-07

I, Katharine Lantz, SECRETARY TO THE AIR POLLUTION CONTROL BOARD OF THE EASTERN KERN AIR POLLUTION CONTROL DISTRICT, certify that the following Resolution, proposed by Director Scrivner and seconded by Director Blades, was duly passed and adopted by said Board at an official meeting on this 22nd Day of July, 2021, by the following vote:

AYES: Davies, Scrivner, Blades

NOES: None

ABSENT: Creighton, Peters

KATHARINE LANTZ
Secretary to the Air Pollution Control Board of the Eastern Kern Air Pollution Control District

By ____________________

RESOLUTION

1

Section 1. RECITALS:

(a) Section 182(a)(3)(B) of the Clean Air Act (CAA) requires all ozone nonattainment areas to have a program in place that requires emissions statements from stationary sources of oxides of nitrogen (NOx) or volatile organic compounds (VOC); and

(b) The emissions statement requirement for the 2015, 8-Hour Ozone National Ambient Air Quality Standards (NAAQS) of 70 parts per billion (ppb) are described in "Implementation of the 2015, National Ambient Air Quality Standards for Ozone: Nonattainment Area State Implementation Plan Requirements" (83 FR 62998, December 6, 2018); and

(c) A portion of the Eastern Kern Air Pollution Control District (District) has been designated nonattainment due to exceeding the 2015, ozone NAAQS and is therefore required to adopt an emissions statement certifying that its existing program, or rule, continues to comply with the requirement and that the boundaries of the District have not changed (83 FR 25786, June 4, 2018); and

(d) District Rule 108.2, Emission Statement Requirements was adopted July 13, 1992, and last amended May 2, 1996, fulfills the CAA §182(a)(3)(B) emissions statement requirements; and

(e) The District's boundaries have not changed since the United States Environmental Protection Agency (EPA) promulgated Rule 108.2 into the State Implementation Plan (SIP) (69 FR 29880, May 26, 2004) ; and

(f) The District prepared the 2015, Ozone NAAQS (70 ppb) Emissions Statement and Certification to certify that the existing provisions of Rule 108.2 adequately meets the emissions statement requirements of §182(a)(3)(B) of the CAA for the purposes of the 2015, 8-hour ozone NAAQS, and that no revision of the rule is required; and

(g) A notice of a public hearing on July 22, 2021, at the hour of 2:00 p.m. at the District Field office located at 20406 Brian Way, Suite 4A in Tehachapi, CA 93561, to consider adoption of the District's 2015, Ozone NAAQS (70 ppb) Emissions Statement and Certification, was duly given; and

(h) The matter was heard at the time and place so specified, evidence was received and all persons desiring to be heard in said matter were given an opportunity to be heard.

Section 2. IT IS RESOLVED by the Board as follows:

1. This Board hereby approves and adopts this Resolution thereby approving the 2015, Ozone NAAQS (70 ppb) Emissions Statement and Certification.

2. All notices required to be given by law have been duly given in accordance with Health and Safety Code section 40725, and the Board has allowed public comment, both oral and written, in accordance with Health and Safety Code section 40726.

3. This Board finds that this action poses no significant impact on the environment and is exempt from CEQA under CEQA Guidelines sections 15061(b)(2) and 15300.

4. District staff is directed to prepare a Notice of Exemption for this project, and the Secretary of this Board is hereby directed to file the Notice of Exemption with the Kern County Clerk.

5. The Secretary of this Board is directed to cause a certified copy of this Resolution to be forwarded to the Air Pollution Control Officer (APCO) for said District and to the County Counsel of Kern County.

6. The APCO for said District is hereby authorized and directed to submit this resolution and all necessary supporting documents to the California Air Resources Board for submittal to EPA as a revision to the California SIP.

7. The Board authorizes the APCO for said District to include in the submittal or subsequent documentation any technical corrections, clarifications, or additions that may be needed to secure EPA approval, provided such changes do not alter the substantive requirements of the approved rule.

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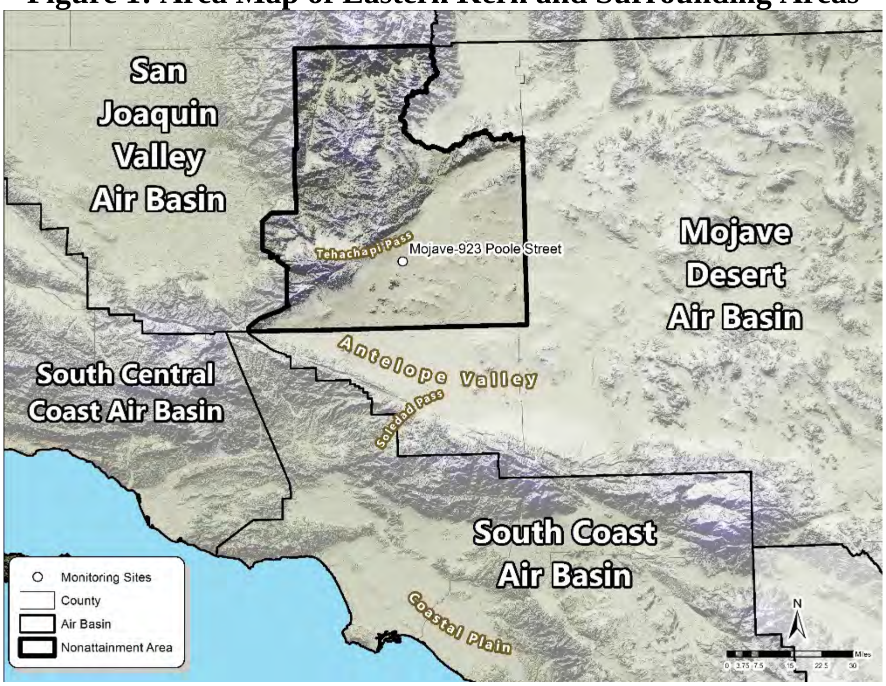
APPENDIX L
Weight of Evidence

Introduction

The Eastern Kern 8-Hour Ozone Nonattainment Area (Eastern Kern) includes the eastern portion of Kern County that lies outside of the San Joaquin Valley Air Basin (San Joaquin Valley) and is under the jurisdiction of the Eastern Kern Air Pollution Control District (District). The northeast corner of Kern County, as outlined by the watershed boundary and containing the China Lake Naval Air Weapons Station, is not included in Eastern Kern. Eastern Kern is currently classified as a severe nonattainment area for the 2008 federal 8-hour ozone standard (0.075 standard) of 0.075 parts per million (ppm) and as a serious nonattainment area for the 2015 federal 8-hour ozone standard (0.070 standard) of 0.070 ppm, with an attainment deadline of 2026 for both standards. For areas classified as moderate nonattainment or above, photochemical modeling is a required element of the State Implementation Plan (SIP) to ensure that existing and proposed control strategies provide the reductions needed to meet the federal standards by the relevant attainment deadlines.

Figure 1: Area Map of Eastern Kern and Surrounding Areas



To address the uncertainties inherent to photochemical modeling assessments, U.S. Environmental Protection Agency (U.S. EPA) guidance, Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, recommends that supplemental analyses accompany all modeled attainment demonstrations. To complement regional photochemical modeling analyses included in the Eastern Kern Ozone SIP, the following Weight of Evidence (WOE) demonstration includes detailed analyses of ambient ozone data and trends, transport impacts, precursor emission trends and reductions, population exposure trends, and a discussion of conditions that contribute to exceedances of the federal standards. All analysis methods have inherent strengths and weaknesses; therefore, examining an air quality problem in a variety of ways helps offset the limitations and uncertainties associated with any one approach.

The impact of emissions generated in the upwind South Coast and San Joaquin Valley Air Basins, which are both classified as extreme ozone nonattainment areas, have a significant impact on air quality in Eastern Kern. Ozone air quality data, along with photochemical modeling results show that while Eastern Kern has made progress, the magnitude of emission reductions in the upwind area that are necessary to provide for attainment will not occur by the 2026 attainment date for the 0.070 standard.

As shown in Table 1, the most recent design value for the site is 10 percent above the level of the 0.070 standard and 2.7 percent above the level of the 0.075 standard. The following sections of this WOE provide the documentation to support the District's reclassification as a severe nonattainment area for the 0.070 standard, with an attainment deadline of 2032.

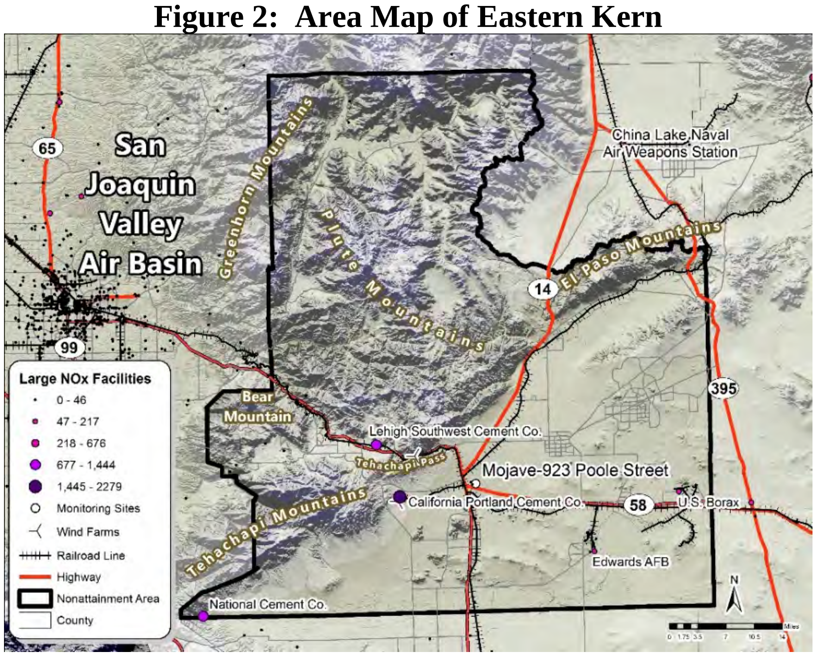
Table 1: Ozone Design Values at the Western Mojave Monitoring Site

Site Name	AQS ID	2019 Design Value (ppm)*	2020 Design Value (ppm)*	% Above Standard in 2020
Mojave-923 Poole Street	060290011	0.078	0.077	10%**
Mojave-923 Poole Street	060290011	0.078	0.077	2.7%***

* with 2018 and 2020 wildfire days (as identified in the wildfire section of this document) removed.
** above 0.070 standard.
*** above 0.075 standard.

<u>Area Description</u>
Eastern Kern comprises the portion of Kern County located in the northwestern corner of the Mojave Desert Air Basin, in California's high desert, as shown in Figure 2. Eastern Kern, to the south, is separated from the South Coast Air Basin (extreme nonattainment area) by the Antelope Valley (severe nonattainment area) and San Gabriel Mountains. The Tehachapi and the Sierra Nevada Mountains separate Eastern Kern from the San Joaquin Valley (extreme nonattainment area), to the west and north. Directly to the east is San Bernardino County. The northeast portion of Kern County, where the China Lake Naval Air Weapons Station is located, in not included in Eastern Kern.

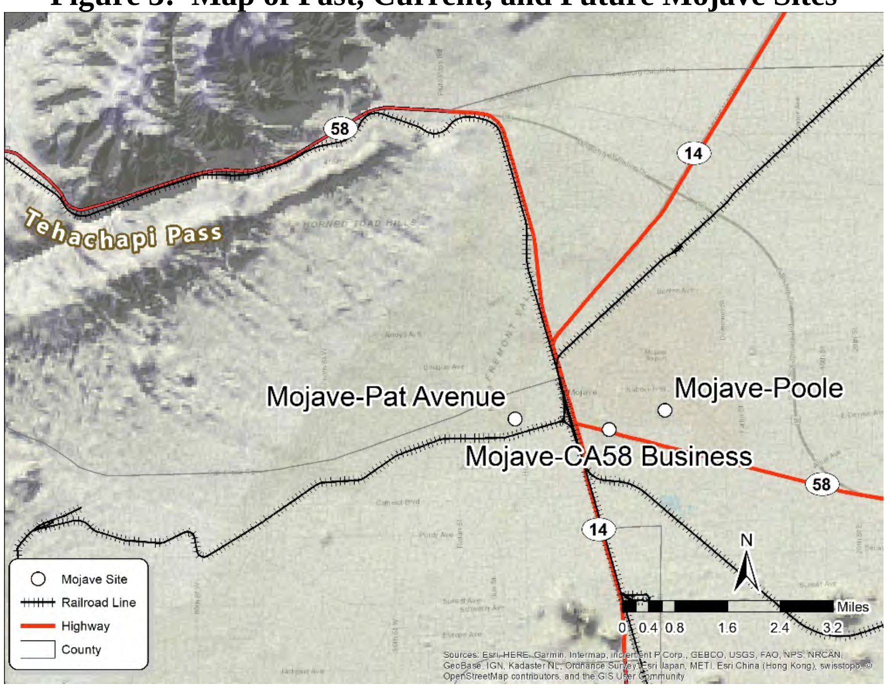
Figure 2: Area Map of Eastern Kern



Eastern Kern's population of 90,487 (Census, 2020) resides primarily in and around the major towns of Rosamond, Tehachapi, California City, and Mojave. Major highways serving Eastern Kern are U.S. Highways 58, 14, and 395. Eastern Kern is home to two large wind farms, one of which has a current capacity of over 1,500 megawatts and a planned future capacity of 3,000 megawatts by 2040. It is also home to approximately 40 large-scale commercial solar power generating facilities with many more scheduled for construction in the future. There are also two large cement facilities within 14 miles of the monitoring site, as is the Mojave Air and Space Port. A third large cement facility and California's largest open pit mine located in Boron, where borax is mined, are within 38 miles of the monitor.

Within Eastern Kern, there is one long-term monitoring site located in the town of Mojave. The ozone monitor was moved from the original location at 923 Poole Street to a temporary location at 1773 CA-58 Business starting from October 1, 2020. Currently, the plan is to move the site to a permanent spot located at 3200 Pat Avenue in Mojave (see Figure 3). In this analysis, the data from the 923 Poole Street and 1773 CA-58 Business are merged. In addition to the long term site, two special study sites were operated in 1995 at Boron-26965 Cote Street and Tehachapi-Jameson Road. However, because data for these sites are only for that single year, they are not included in this evaluation.

Figure 3: Map of Past, Current, and Future Mojave Sites



Conceptual Model

Weather in Eastern Kern is dominated by mostly sunny days, low humidity, and warm to hot temperatures during the spring and summer months. These conditions are conducive to the formation and buildup of ozone. However, limited local emissions sources, relative to the two neighboring extreme ozone nonattainment areas to the west/northwest and south of Eastern Kern, are not sufficient to produce the magnitude of peak ozone concentrations and the quantity of ozone exceedance days observed in the area. The transport of emissions from the San Joaquin Valley air basin, and to a lesser extent the South Coast air basin, is the predominant cause of high ozone concentrations and exceedances in Eastern Kern. The terrain, meteorology, regional transport, and distribution of emissions are important considerations for understanding the ozone challenges facing Eastern Kern.

I. Terrain and Meteorology

The nonattainment area includes the eastern half of Kern County and is located on the western edge of the Mojave Desert. Eastern Kern is separated from populated areas to the west and south by several mountain ranges and is considered high desert. The mountainous area of the County ranges between 2,000-7,000 feet above sea level. The town of Mojave is also elevated, with the flat, plateau area generally around 2,500-3,000 feet above sea level.

The mountains surrounding Eastern Kern contain a limited number of passes that act as conduits for transport from the neighboring San Joaquin Valley and South Coast air basins. The Tehachapi Pass, at around 4,000 feet above sea level, connects the Bakersfield area in the southern San Joaquin Valley and Eastern Kern. This pass provides the primary outlet for air from the San Joaquin Valley to overflow into Eastern Kern.

During the summer months, air frequently flows in a southwesterly direction in the San Joaquin Valley, from the delta region in the north towards the Tehachapi Mountains in the south. Some of this air and the pollutants it contains move through the Tehachapi Pass and into the Mojave Desert (see multiple citations from p16, ARB, 1996 Triennial Assessment Report). It was first noted as far back as 1982 that the Tehachapi Pass does not pose a significant barrier to transport due to its elevation of 4000 feet (Reible et al, 1982) compared to the rest of the southern Sierra Nevada Mountain range, which is generally much higher in altitude. From the south, the Soledad Pass allows air to flow from the South Coast into the Antelope Valley and then northeastward into the eastern portion of Eastern Kern.

Airflow from the San Joaquin Valley through the Tehachapi Pass to the west is dominant on many more days than airflow from the South Coast through the Soledad Pass to the south. Past CARB transport analyses of hourly surface winds documented that winds blow through the Tehachapi Pass from the San Joaquin Valley to the Mojave Desert on most days during the summer ozone season of April through October. Based on the high frequency and magnitude of this airflow, along with other in-depth transport analyses, CARB identified the San Joaquin Valley as an overwhelming transport contributor to State ozone exceedances in Eastern Kern.

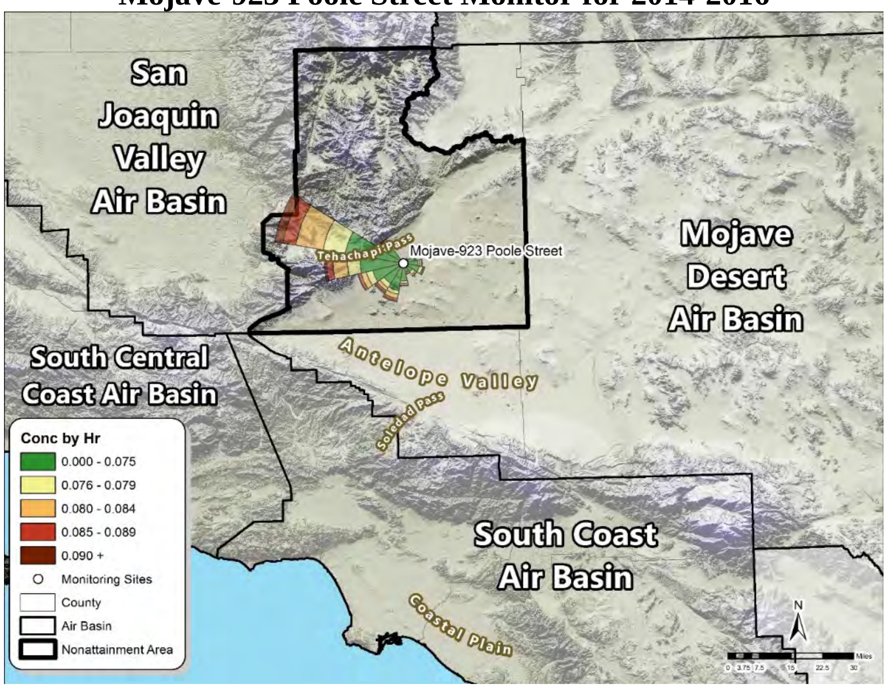
The close proximity of the Mojave-923 Poole Street monitor to the Tehachapi Pass allows it to capture ozone transported into Eastern Kern. However, due to the complexity of the terrain and variations in large-scale weather patterns, there are occasional periods when airflow from the South Coast could influence Eastern Kern. A previous CARB review of Edwards Air Force Base wind data indicated that during the summer months, a convergence of air from the Soledad Pass to the south and air parcels exiting the Tehachapi Pass to the west could occur in the eastern portion of the nonattainment area, potentially resulting in some surface or upper air transport impacts.

The frequency of transport from the San Joaquin Valley to Eastern Kern is evident in the evaluation of pollution roses. Figure 4 shows hourly measurements of ozone concentration and coincident resultant wind direction on all federal 8-hour exceedance days (2014-2016) on a relief map. This map provides a visual representation of the dominance of transport from the San

Joaquin Valley through the Tehachapi pass as compared to the South Coast. These data are from the ARB Air Quality and Meteorological Information System (AQMIS) for the ozone monitor wind instruments at the Mojave-923 Poole Street monitoring site.

Exceedance days in Eastern Kern that are attributable to San Joaquin Valley emissions are generally characterized by afternoon surface winds from the west/northwest, resulting from strong temperature differences between the San Joaquin Valley and the desert. The pollution/wind rose in Figure 4 shows that the majority of the wind flow on exceedance days is coming from the direction of the southern part of the San Joaquin Valley, giving a clear indication of ozone or ozone precursors transported from the San Joaquin Valley to Eastern Kern through the Tehachapi Pass. Figure 4 also shows that the winds can be from the southwest during periods of higher ozone concentrations, indicating that the South Coast Air Basin may be an ozone source region at times; however, the frequency of winds from this direction is much lower than the San Joaquin Valley (from west and northwest directions).

Figure 4: Exceedance Day Pollution Roses for the Mojave-923 Poole Street Monitor for 2014-2016



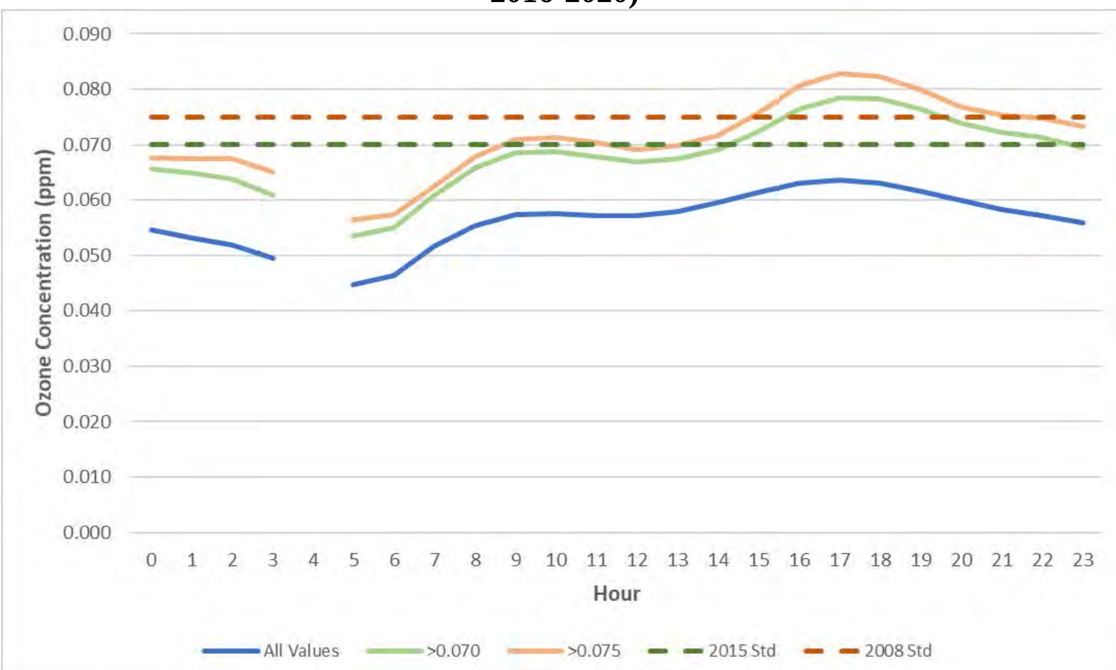
Wind roses represent hourly concentrations on 8 hour ozone exceedance days. Hourly measurements on exceedance days can include both values above and below the standards.

In addition, research has shown that the air masses moving through mountain gaps and passes in Southern California contain multiple, distinct pollutant layers at various altitudes (Smith and Edinger, 1983). As air moves through these gaps and passes at various altitudes, it warms and accelerates. Upon exiting the gaps and passes, the accumulated momentum is depleted causing air masses to slow and disperse. As these layers disperse, transported pollution may become entrained in the near-surface air of downwind areas. Alternatively, air masses can be lofted and transported over mountain peaks into the high desert (VanCuren 2015).

II. Regional Transport

Areas impacted by transport generally show ozone concentrations peaking in the late afternoon or evening. Figure 5 shows the average diurnal pattern for 1 hour ozone concentrations from May-September on all days, days when 8 hour ozone concentrations were above 0.070 ppm, and days when 8-hour ozone concentrations were above 0.075 ppm. The diurnal patterns for all three data sets show the same pattern of a modest morning peak and then a higher peak occurring in the late afternoon/evening. This is unlike typical patterns for photochemical production of ozone from local sources which have one bell curve shaped peak in the early afternoon.

Figure 5: Average Hourly Ozone Concentrations at Mojave-923 Poole Street (May - Sept; 2016-2020)



The profiles at Mojave are indicative of rural, transport dominated monitoring sites where pollutants transported into the area the previous evening remain in place during the morning, leading to ozone formation under a shallow temperature inversion. As the temperatures quickly rise, the mixing depth increases and ozone concentrations remain level or even drop. However, as the heating induces low-level winds to develop, transport from neighboring nonattainment areas move into Eastern Kern producing the second and more significant ozone peak a few hours later.

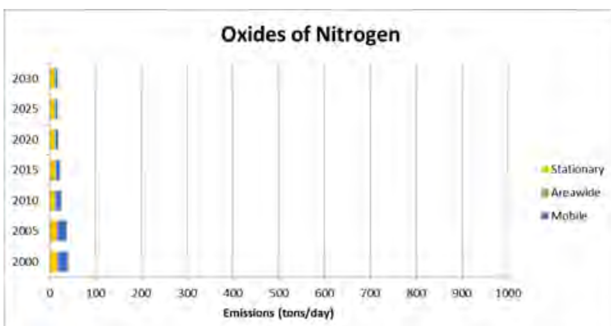
Another factor leading to persistently elevated ozone concentrations at the Mojave-923 Poole Street monitor is the lack of widespread combustion emissions, which would otherwise tend to break down ozone during the nighttime hours when sunlight is not available to drive ozone formation processes. Without the continuous influx of fresh emissions that are emitted in metropolitan areas, ozone concentrations remain high overnight, requiring fewer hours to reach higher concentrations the following day. Because locally generated emissions in Eastern Kern are lower than in neighboring metropolitan areas, the morning peak and early afternoon ozone concentrations at the Mojave monitor are lower than they would be in the metropolitan areas.

III. Regional Distribution of Precursor Emissions

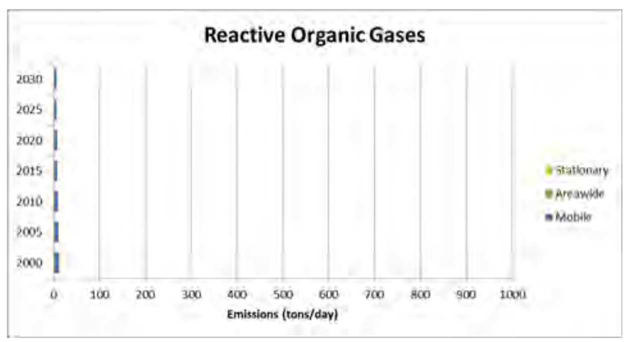
Precursor emissions generated in the San Joaquin Valley overshadow those from Eastern Kern. The emissions inventory, summarized in Figure 6, indicates that the emissions of oxides of nitrogen (NOx) and reactive organic gases (ROG) in Eastern Kern are a fraction of emissions generated in the San Joaquin Valley. Eastern Kern’s NOx and ROG emissions in 2021 amounted to only 10 and 2 percent, respectively, of San Joaquin Valley emissions. Additionally, the South Coast surpasses both the San Joaquin Valley and Eastern Kern in terms of emissions. While more transport days are shown to come from the San Joaquin Valley, it is clear that on the minority of days showing transport from the South Coast that this transport comes from an area with higher emissions levels. The difference in emissions between these areas helps explain the important role of transport in Eastern Kern’s ozone air quality.

The connection between ozone, a secondary pollutant, and emissions of ozone precursor compounds is characterized by considerable temporal and spatial variability. In general, as air masses travel downwind, entrainment of fresh emissions, atmospheric reactions, depositional processes, and dilution increase the ROG

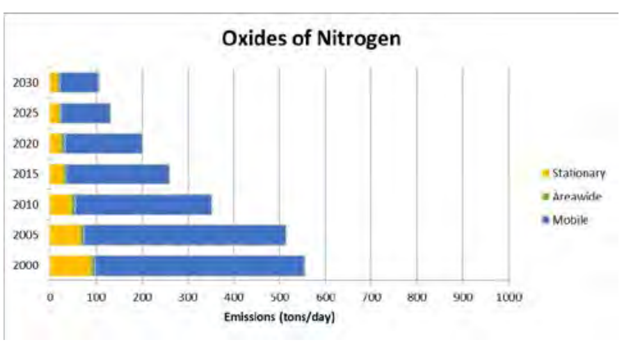
Figure 6: Inventory of Eastern Kern, San Joaquin Valley, and South Coast Emissions by Source Category



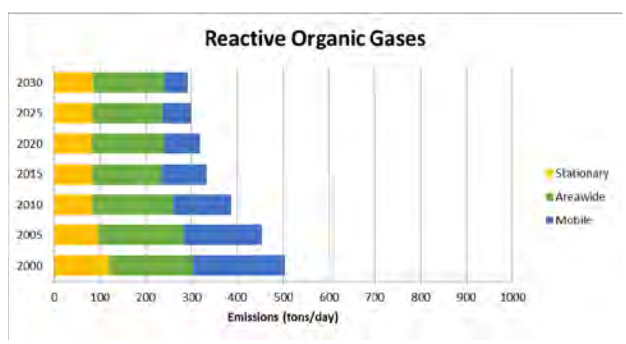
Eastern Kern



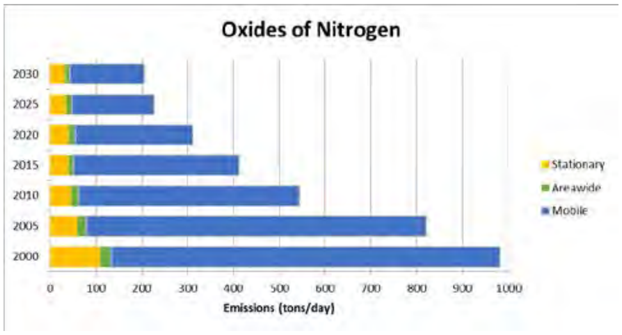
Eastern Kern



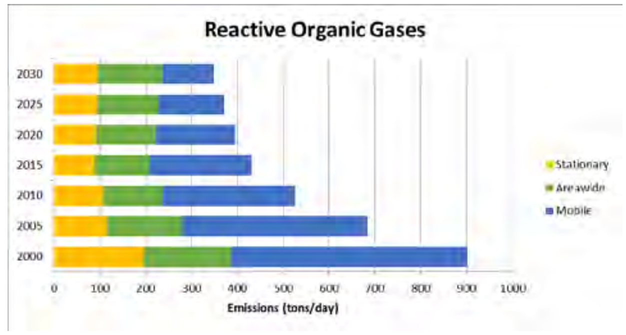
San Joaquin Valley



San Joaquin Valley



South Coast



South Coast

<u>Anthropogenic Emission Trends</u>

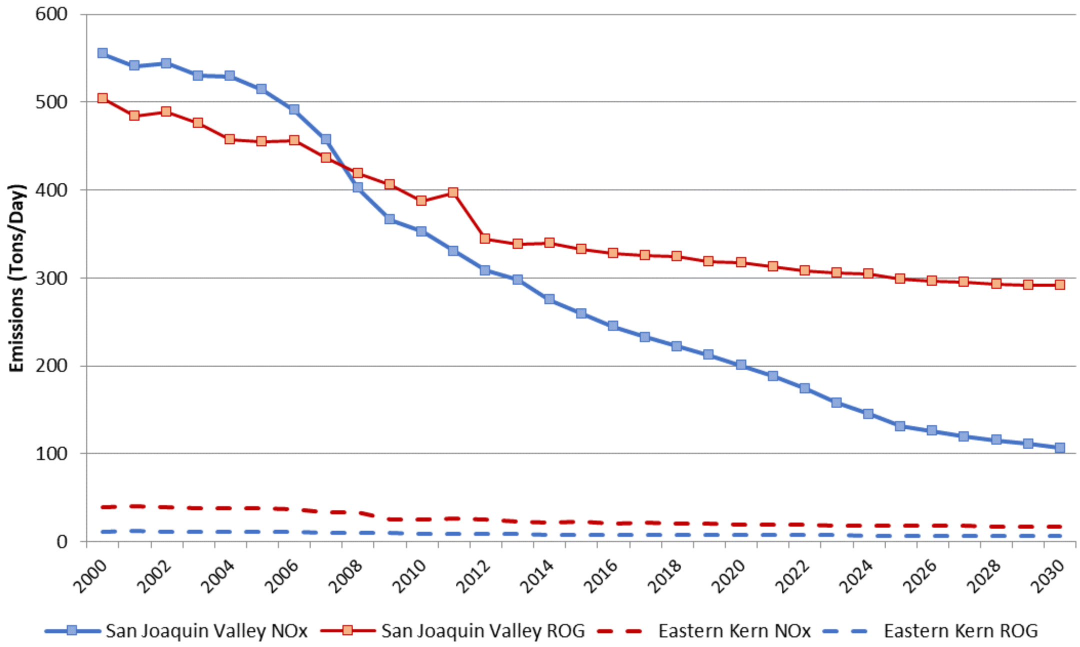
In 2020, NOx summer emissions generated within Eastern Kern were dominated by mineral processes (which includes cement manufacturing), heavy-duty diesel trucks, trains, and manufacturing and industrial. The primary contributing categories of ROG summer emissions within Eastern Kern were aircraft, consumer products, recreational boats, and degreasing. As previously discussed and shown in Figure 7, emissions in Eastern Kern are a fraction of those in the San Joaquin Valley. By comparison, the San Joaquin Valley NOx and ROG emissions are, respectively, 10 and 43 times those in Eastern Kern. It is important to note that a substantial portion of the San Joaquin Valley (60 to 82 percent) and Eastern Kern (87 to 96 percent) ROG emissions come from biogenic sources and when included in comparisons can mask the reductions attributable to emission control programs. As such, statistics in this section only represent anthropogenic sources of precursor emissions[1].

Figure 7 shows the estimated trend in Eastern Kern and San Joaquin Valley precursor emissions from 2000 to 2030. Throughout the San Joaquin Valley, emissions controls have substantially reduced the amounts of both ROG and NOx emitted by various sources. Since 2000, there has been a significant reduction in ozone precursor emissions:

- Total NOx emissions declined by 66 percent, and
- Total ROG emissions declined by 38 percent.

[1] Data source: ARB 2019 Ozone SIP Inventory for summer (Version 1.04 with approved external adjustments)

Figure 7: Eastern Kern and San Joaquin Valley Estimated NOx and ROG Emissions 2000 to 2030 (without biogenics)



In Eastern Kern, NOx and ROG emissions show a slightly downward trend respectively, over the entire period. Similarly, in Eastern Kern since 2000 there has been a reduction in ozone precursor emissions:

- Total NOx emissions declined by 50 percent, and
- Total ROG emissions declined by 38 percent.

However, it is important to keep in mind that estimates for 2026 show NOx and ROG emissions for Eastern Kern still as only 14 and 2 percent, respectively, of the NOx and ROG emissions totals for the San Joaquin Valley.

Local sources of ozone precursor emissions in Eastern Kern have historically been dominated by stationary and mobile sources (see Table 2). These include passenger vehicles, trains, and heavy-duty trucks. However, as federal and State mobile source control programs have been implemented, stationary sources are emerging as an increasingly significant portion of NOx emissions in Eastern Kern. As show below, beginning around 2015, stationary NOx surpassed mobile sources as the dominant source of NOx and has become a larger share of the District's NOx emissions as mobile sources continue to decline.

While San Joaquin Valley emissions continue to overwhelm the area, it is important to keep local emission sources and reductions in mind to ensure continued progress. Currently, the District is updating three RACT rules covering organic solvents, aerospace assembly and coating, and polyester resin. Emission reductions from these three updates are estimated to reduce ROG around 73 tons per year.

Table 2: Eastern Kern Emissions Totals in tons/day (2000-2030)

	2000	2005	2010	2015	2020	2025	2030
NOx							
Stationary	17.371	15.659	11.430	12.662	11.962	12.372	12.298
Areawide	0.121	0.155	0.136	0.111	0.124	0.125	0.128
Mobile	22.095	21.675	13.938	9.505	7.114	5.393	5.062
Total	**39.587**	**37.490**	**25.504**	**22.278**	**19.200**	**17.890**	**17.487**
ROG							
Stationary	1.090	1.126	1.279	1.078	1.392	1.472	1.520
Areawide	1.257	1.238	1.089	1.099	1.176	1.175	1.240
Mobile	9.398	8.651	7.026	5.747	4.842	4.386	4.048
Total	**11.745**	**11.015**	**9.395**	**7.924**	**7.410**	**7.034**	**6.807**

* Data from CEPAM: California 2019 Ozone SIP Baseline Emission Projections - Version 1.04 Eastern Kern Nonattainment Area Tool

Wildfire Impacts

As with the rest of the State, Eastern Kern has been impacted by wildfires both near and far. Due to heavy fuel load throughout the State along with exceptionally dry conditions stemming from years of drought, the State has seen the numbers and severity of fires increasing. Modeling has utilized information submitted to them regarding fires in the vicinity of the monitor to remove those days which were impacted by smoke and thus were likely not representative of current anthropogenic ozone trends. The removal of those dates resulted in modified fourth high and thus modified design values as shown in the ozone portion of this document.

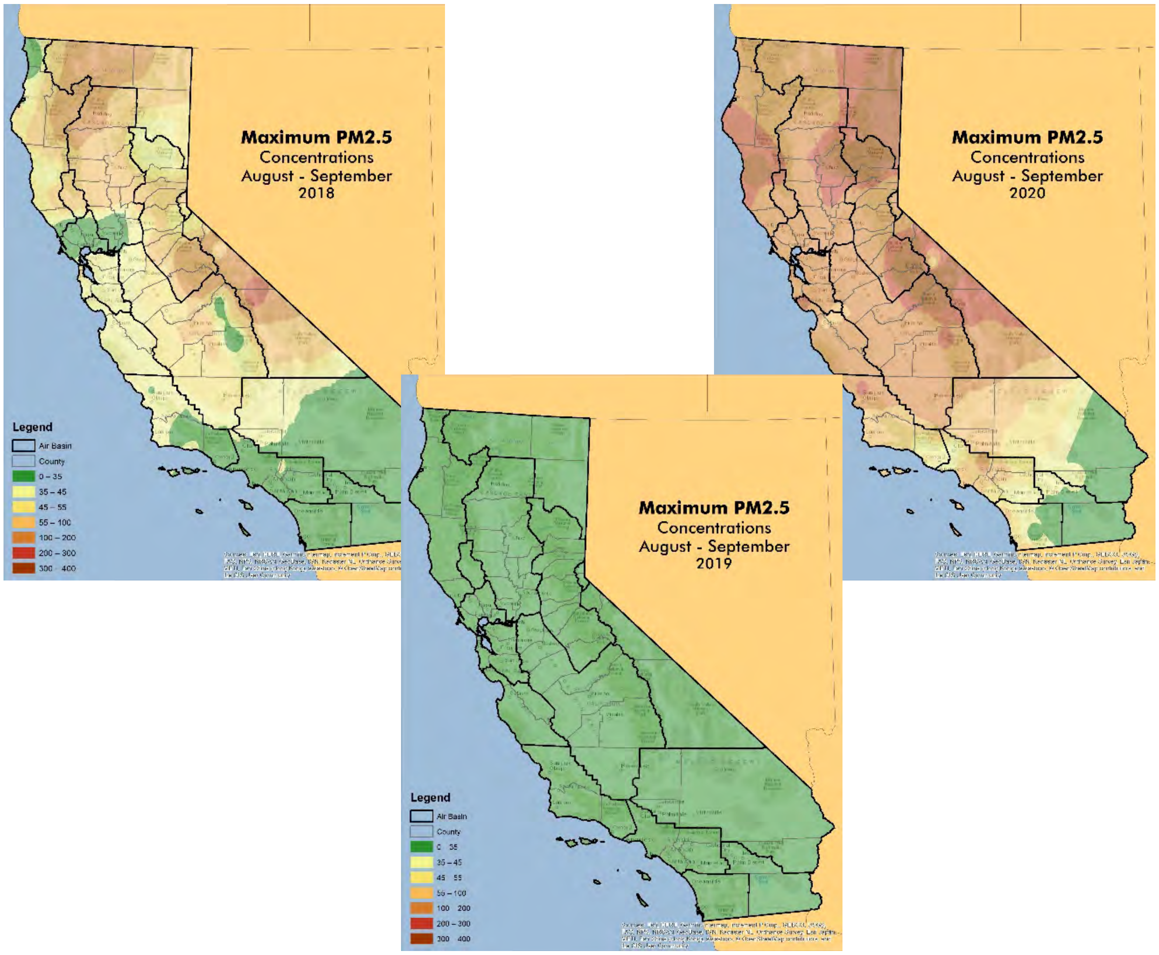
Table 3 contains a list of fires in the vicinity or upwind of the monitor during or preceding the impacted dates which were removed from modeling calculations.

Table 3: List of Large Fires in Close Proximity and Upwind of Mojave Site on Affected Dates

Name	Acreage	Start Date	Distance (miles)	Direction*	Latitude	Longitude
Stone	1352	6/4/2018	36	SW	34.54860	-118.31138
Breckenridge	993	7/27/2018	44	NW	35.38741	-118.81793
Tarina	2950	8/3/2018	45	NW	35.37444	-118.83556
Stagecoach	7760	8/3/2020	34	NW	35.43044	-118.53361
Lake	31089	8/12/2020	31	SW	34.67900	-118.45200

In exceptional events demonstrations submitted to U.S. EPA, fires from hundreds of miles away have been shown to have impacts on transported ozone precursor emissions, and the resultant ozone formation, in downwind communities due to the airflow dynamics related to fires and their ability to send precursor emissions high into the atmosphere and transport them aloft for hundreds of miles. Below are three maps showing the wildfire impacted years of 2018 and 2020 as well as the relatively wildfire free intervening year of 2019. This juxtaposition makes it clear that despite how relatively small the actual wildfire acreage footprints can be, compared against the entirety of California, just how widespread their impacts can be felt.

Figure 8: PM2.5 Contour Maps of Maximum Concentrations August-September of 2018, 2019, and 2020

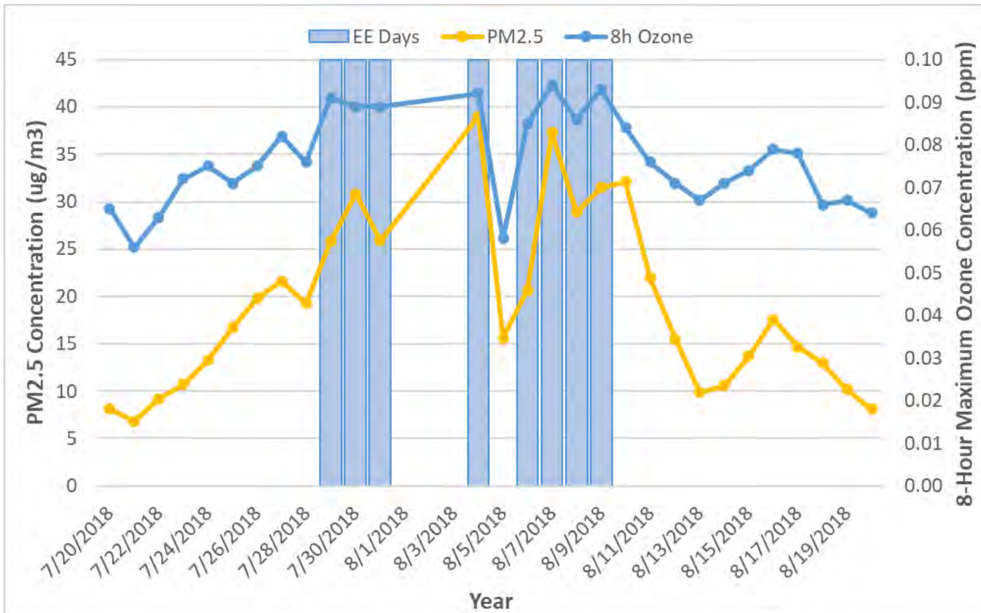


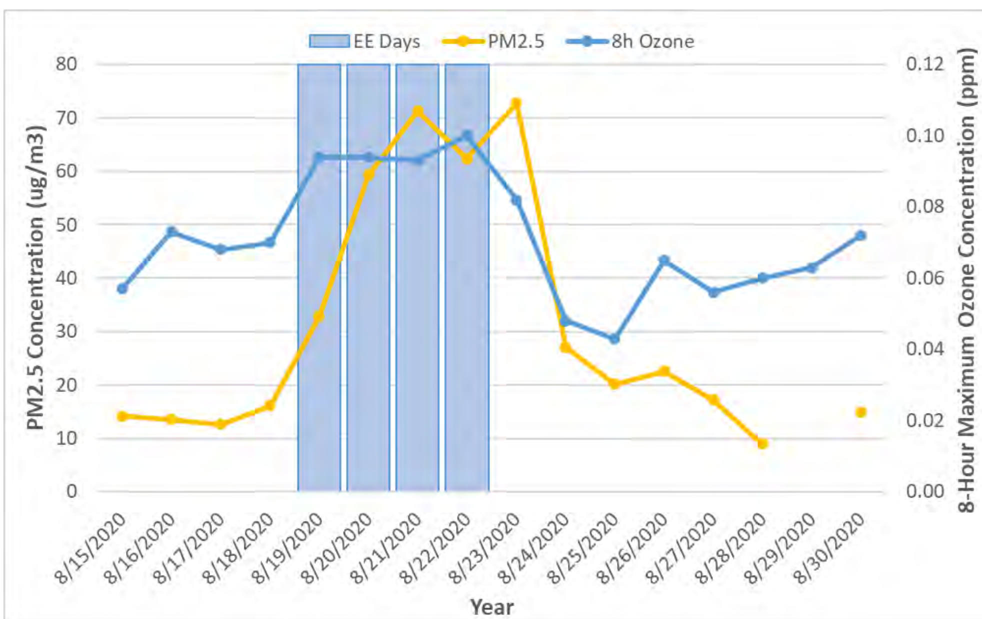
During a normal year with no wildfire impacts, such as in 2019, August and September are normally the cleanest months for PM2.5. Conversely, large wildfires occurring in both 2018 and 2020 resulted in significant impacts across the majority of California. As shown here, wildfire smoke contributed to higher concentrations and exceedances across much of California in 2018, while even worse in concentrations and coverage in 2020.

In the first few weeks of the firestorm in August 2020, about half of California’s population — an estimated 19.6 million people — experienced levels of fine particulate matter exceeding national ambient air quality standards. By the end of September, the smoke had spread across Southern California and to nearly every corner of the state, with almost 95 percent of Californians exposed to unhealthy pollution levels.

Figure 9 contains plots of the ozone and PM2.5 trends for periods containing the days in question. These days include 7/29-7/31/2018, 8/4/2018, 8/6-8/9/2018, and 8/19-8/22/2020. As the time series plots indicate, the dates removed have exceptionally high PM2.5 values and correlating high ozone values that increase on the same days. These days have been found to have strong connections to the related ozone exceedances and occur during or after the wildfires listed above. The peak PM2.5 value at Mojave for 2018 outside of the related period was 22 ug/m3 and on the days removed for 2018, 138 of the hourly values were above that maximum. The peak PM2.5 value at Mojave for 2020 outside of the related period was 27.1 ug/m3 and on the days removed for 2020, 79 of the hourly values were above that maximum.

Figure 9: PM2.5 and 8-Hour Ozone Concentrations for the Time Periods Containing the Removed Ozone Values

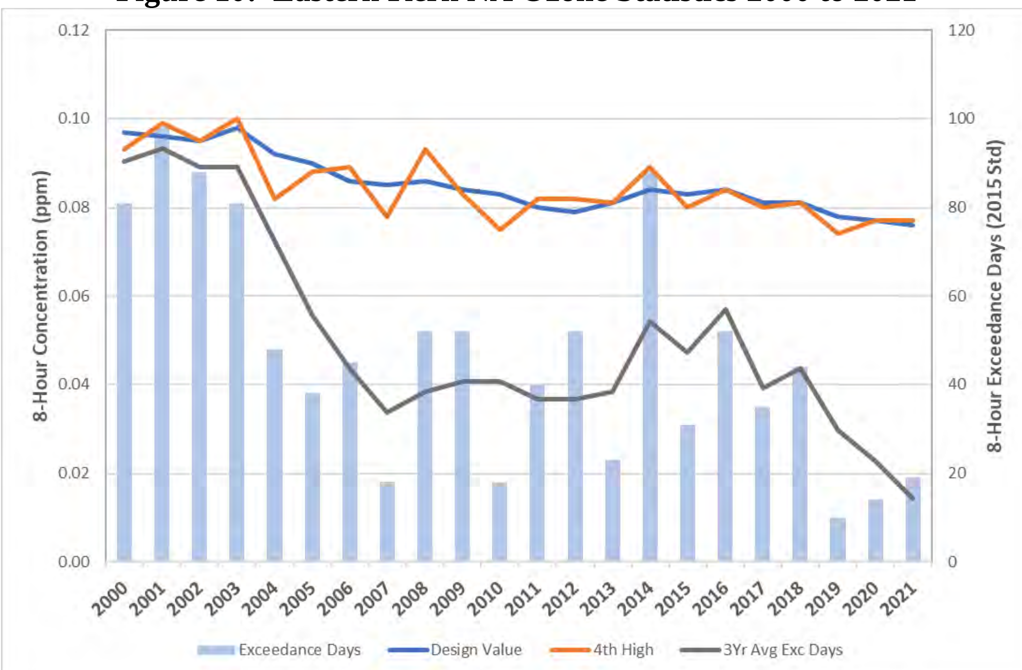




Ozone Air Quality

Long-term ozone trends from 2000 to 2020 indicate progress has been achieved in Eastern Kern. Preliminary design values and certain statistics for 2021 have been included where feasible. The adjusted 2021 design value of 0.076 ppm is about nine percent above the level of the 0.070 standard. By comparison, the 2000 design value (0.097 ppm) was nearly 39 percent above the 0.070 standard. As shown in Figure 10, adjusted design values have declined by nearly 22 percent from 0.097 ppm in 2000 to 0.076 ppm in 2021. During this same period, the adjusted 4th highest concentration has declined by 17 percent.

Figure 10: Eastern Kern NA Ozone Statistics 2000 to 2021



Identified Wildfire Impacted Days Removed.

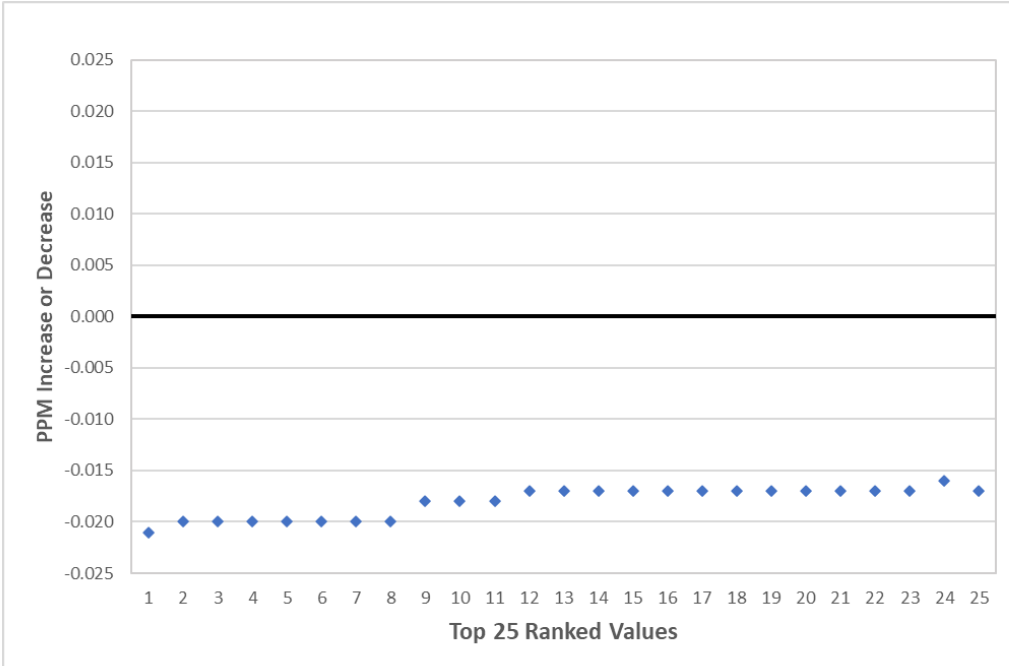
I. Top 25 Analysis

To complement the design value and exceedance day analyses which indicate an improvement in air quality from 2000 and 2020, the top 25 daily maximum 8 hour average ozone concentrations in 2018-2020 were ranked and compared to those measured in 2000-2002.

The comparison of ranked values provides insight as to the extent to which the highest ozone concentrations are responding to control measures over time without relying on any assumptions regarding the distribution of the data. In Figure 11, markers below the line indicate that 2018-20 ranked concentrations were lower than the corresponding 2000-02 ranked concentrations. Analyses indicate that concentrations across the range saw decreases in 2018-2020 as compared to 2000-2002.

It is important to keep in mind that while the data does indicate that the top 25 values in 2018-2020 were consistently lower than the 2000-2002 values, there were no days of those top 25 values in which concentrations fell below the 0.070 standard for the six years analyzed and only four days which concentrations were at or below the 0.075 standard.

Figure 11: Comparison of Top 25 days in 2000-02 and 2018-20
Eastern Kern NA



II. Spatial Distribution of Concentrations

To evaluate changes in distribution of ozone, spatial analysis tools were used to plot design values by year to determine trends in Eastern Kern and surrounding areas. These analyses (Figure 12) show that between 2000 and 2020, the concentrations within Eastern Kern and in the surrounding areas, which are the primary transport contributors (San Joaquin Valley and South Coast), decreased significantly. Eastern Kern has seen a reduction in their design value between 2000 and 2020 of nearly 21 percent, during this same time the San Joaquin Valley has seen a 16 percent reduction and the South Coast has seen a 22 percent reduction. The progress in these upwind areas continues to be integral to the continuing progress in areas downwind of their transport.

However, despite the clear improvements in ozone concentrations, the nonattainment area continues to exceed both the 0.075 and 0.070 ozone standards. These maps again highlight the challenge of transport from the San Joaquin Valley and South Coast.

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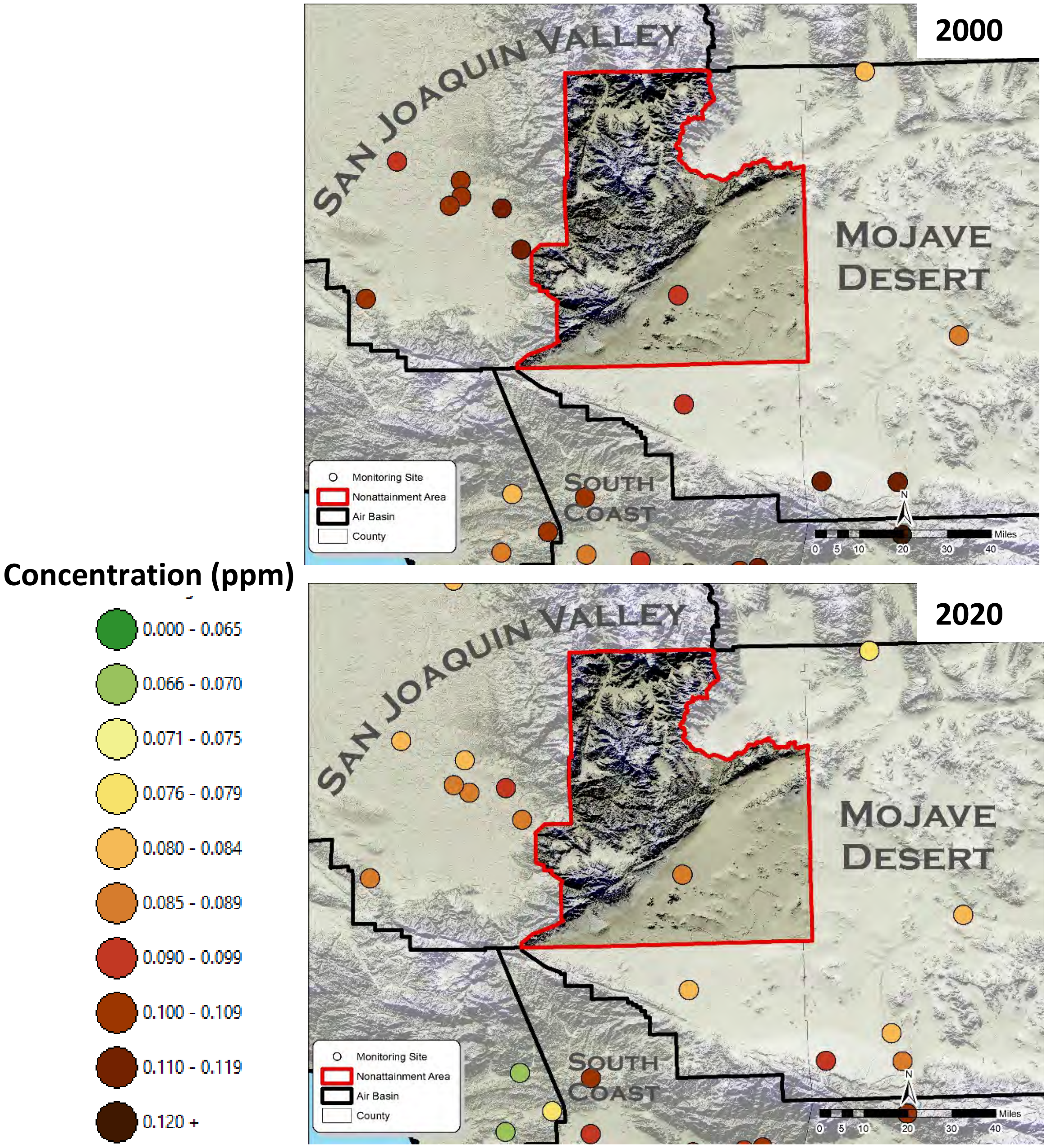
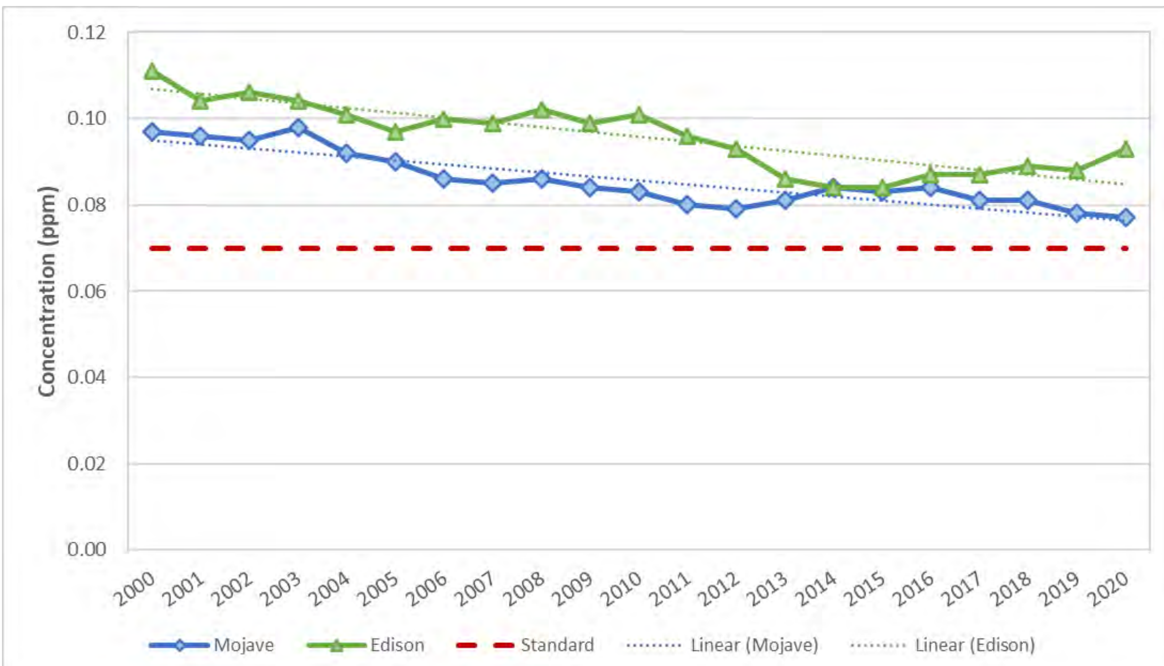
Figure 12: Concentration Dot Maps Representing the Spatial Distribution of Ozone Air Quality in Eastern Kern and Surrounding Areas (2000 & 2020)



III. Upwind and Downwind Trends

Design values were compared between upwind and downwind sites to confirm that progress in the San Joaquin Valley was translating to similar progress in Eastern Kern. Figure 13 shows the design value trends and linear trend lines for Edison in the San Joaquin Valley and Mojave-Poole in Eastern Kern. As shown, overall the linear trend for both sites shows a similar path towards the 0.070 standard. Design values at the two sites generally track each other over time given the complex nature of the ozone problem and potential for transport contributions from the South Coast. Only in the past four or so years can a divergence be seen as Mojave continues a downward trend and Edison starts trending upwards. Some of this divergence might be due to wildfire days not being removed from the Edison site, but likely not all of it due to the divergence starting in 2016.

Figure 13: Ozone Design Value Trends in Edison and Mojave Sites
8-hour Ozone Design Values 2000 – 2020



A notable difference between sites is that the Edison site saw a reduction in the design value of 16 percent over 20 years, as compared to nearly 21 percent for Mojave. The Edison site's smaller decrease might reflect the aforementioned recent uptick in design values, potentially driven by increasingly serious wildfire seasons and the related impacted days. The Mojave design values which include the years 2018 or 2020 reflect the removal of dates in those years identified as smoke impacted and adjustment of the 4th high value used to calculate the design value.

IV. Ozone Air Quality Summary

Based on ozone air quality trends, there has been measurable progress towards meeting both the 0.075 and 0.070 8-hour ozone standards. Eastern Kern's future progress towards these standards is linked to the upwind areas surrounding it and their progress in making significant reductions and ensuring Eastern Kern has a path towards attaining the standards. Recent design values for 2019 and 2020 are more than 10 percent above the 0.070 standard (0.078 in 2019 and 0.077 in 2020) and the magnitude of exceedance days (18) represents a challenge that cannot be addressed in the four year time period given the current classification (0.070 standard).

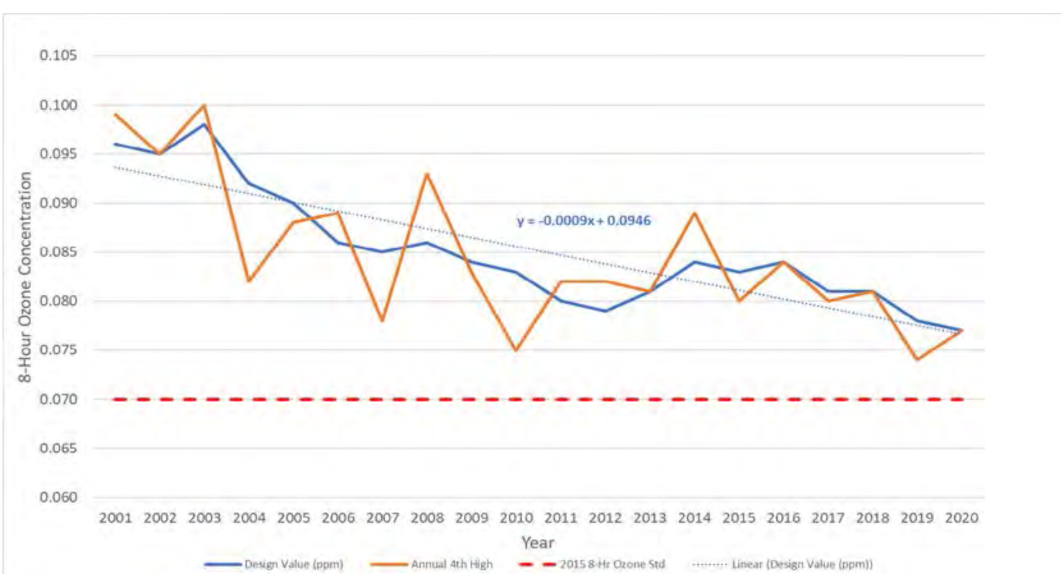
Attainment Projections

Currently, Eastern Kern has an attainment deadline of 2026 for both the 0.075 and 0.070 standards. After reviewing air quality trends, given recent measurements, a 2026 attainment (0.070 standard) would be very unlikely and that a 2032 attainment date would be much more feasible for the 0.070 standard.

The District is requesting as a part of the SIP that U.S EPA classify Eastern Kern from serious to a severe classification with a 2032 attainment deadline for the 0.070 ozone standard. An analysis of photochemical modeling, discussed later in this document, combined with ozone air quality data demonstrates that attainment by 2026 for the 0.075 standard and 2032 for the 0.070 standard is feasible.

Figure 14 includes a 20-year trend in 8-hour design values and includes the adjusted 2018 and 2020 fourth high values and the related effects on the design values calculated using them. These values and the resulting trend, lead to a formula predicting a design value of 0.075 ppm by 2023 and a design value of 0.070 ppm by 2029. This contrasts with a similar trend which did not account for fire days and which resulted in a predicted design value of 0.075 ppm by 2026 and a design value of 0.070 ppm by 2033. Indicating how important it is to quantify the impacts of the increasing severity and number of wildfires in and around California.

Figure 14: Ozone Design Value and Fourth High Trends at Mojave Site, Including Design Value Trendline and Formula



CARB modeling used an observation and relative response approach to determine future design values at the Mojave site for both 2026 and 2032. Table 4 shows that attainment by 2026 (0.075 standard) and 2032 (0.070 standard) are achievable. CARB modeling used a weighted 2018 base year design value which accounted for the effects of the pandemic by using the average of the fourth high for 2018 and 2019 to fill in for the 2020 value. This modeling projected a 0.074 ppm 2026 design value and a 0.069 ppm 2032 design value.

Table 4: ARB Modeling Design Value Projections

Site Name	ARB Modeling 2026 (ppm)	ARB Modeling 2032 (ppm)
Mojave-923 Poole Street	0.074	0.069

<u>**Summary**</u>

This Weight of Evidence evaluation comprises a set of analyses that provide support for attainment. The District has requested to be classified by the U.S. EPA as a severe nonattainment area for the 0.075 and 0.070 federal 8 hour ozone standards, with attainment deadlines of 2026 and 2032 respectively.

Ozone concentrations in Eastern Kern are overwhelmed by the transport of pollutants and precursor emissions, primarily from the San Joaquin Valley. Therefore, attainment in Eastern Kern relies primarily on emission reductions occurring from statewide measures, as well as local measures in the upwind areas. It also cannot be understated the impact more severe wildfire events, as well as their associated emissions, will have and have already had in districts across this State.

Based on the supporting analyses completed as part of this WOE evaluation, attainment of the 0.075 and 0.070 8-hour ozone standards by 2026 and 2032 respectively, can be supported due to the following factors:

- Eastern Kern is bordered by two extreme nonattainment areas: the San Joaquin Valley and the South Coast. Complex terrain, the regional distribution of emissions, and persistent summertime winds blowing from the San Joaquin Valley into Eastern Kern, via the Tehachapi Pass, result in transport playing a fundamental role both in Eastern Kern's ozone problem and its attainment strategy. Transport from the South Coast, through the Soledad Pass, can also contribute to the ozone problem in Eastern Kern. However, only a limited quantity of the overall emissions produced in the South Coast Air Basin flow through this pass. Past and current analyses show that transport from the San Joaquin Valley is dominant on many more days than that from the South Coast.

- Local emissions of ozone precursors declined significantly between 2000 and 2021. Total NOx emissions declined by 50 percent and ROG emissions by 38 percent. Local emissions, however, are much lower than emissions in the upwind San Joaquin Valley and South Coast. ROG and NOx emissions in comparison with Eastern Kern are eight percent of San Joaquin Valley emissions and five percent of South Coast emissions.

- Long-term trends demonstrate that ozone air quality has improved in Eastern Kern. Between 2000 and 2020, the adjusted design value decreased by nearly 20 percent, the adjusted fourth high concentration by 17 percent, and averaged exceedance days were cut by over three quarters, declining from 81 to 14. Average peak concentrations are lower in 2020 when compared to the year 2000.

- Air quality progress to date is not sufficient to attain the 0.070 standard by 2026. The 2020 design value was 10 percent above the 0.070 standard and both the design value trend and modeling point to attainment by 2026 as not achievable. In addition, although peak concentrations have declined since 2000, the majority of these concentrations are still greater than 0.070 ppm.

- The San Joaquin Valley is the primary transport contributor to Eastern Kern. An analysis of design value trends in the upwind San Joaquin Valley and Eastern Kern indicates that progress in Eastern Kern has tracked with progress in the San Joaquin Valley for the most part.

- Significant further emission reductions in the San Joaquin Valley are projected to provide for attainment in the San Joaquin Valley by 2037. These emissions reductions will also help with attainment in downwind areas including Eastern Kern. Ozone levels in Eastern Kern are not as high as those in the San Joaquin Valley, thus the quantity of emissions reductions needed for attainment in the Eastern Kern is not as great.

Taken together, the results from all of these analyses indicate that the Eastern Kern ozone nonattainment area can expect to show attainment of the 0.075 standard by 2026, the required attainment date for severe nonattainment areas for the 2008 8-hour ozone Standard. Additionally, the Eastern Kern Nonattainment Area can expect to show attainment of the 0.070 standard by 2032, the required attainment date for severe nonattainment areas for the 2015 8-hour ozone Standard.

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References

California Air Resource Board. "ARB 2016 Ozone SIP Inventory for summer (Version 1.05 with approved external adjustments)" arb.ca.gov 28 Nov. 2016 Web. 23 Feb 2017 http://outapp.arb.ca.gov/cefs/2016ozsip/

U.S. EPA. Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze, December 2014.

United States Census Bureau. "Population Trends." census.gov. 23 Oct. 2013. Web. 13 Jan. 2017. https://www.census.gov/geo/maps-data/data/tiger-data.html

California Air Resources Board. "Second Triennial Review of the assessment of the Impacts of Transported Pollutants on Ozone Concentrations in California" arb.ca.gov. Nov, 1996. Web. 20 Jun. 2017. https://www.arb.ca.gov/regact/transpol/isor.pdf

Reible, et al. (1982). Atmospheric transport of visibility degrading pollutants into the California Mojave desert, Atmospheric Environment, 16, 599-613.

Beaver, S. and Palazoglu, A., (2009). Influence of synoptic and mesoscale meteorology on ozone pollution potential for San Joaquin Valley of California, Atmospheric Environment, 43, 1779-1788.

Smith, T.B. and Edinger, J.G. (1983). Utilization of Remote Sensing Data in the Evaluation of Air Pollution Characteristics in the South Coast/Southeast Desert Air Basin, ARB Contract No. A2-106-32

VanCuren, R. (2015). Transport aloft drives peak ozone in the Mojave Desert. Atmospheric Environment, 109, 331-341.

Finlayson-Pitts, B.J., Pitts, J.N., 1993. Atmospheric Chemistry of Tropospheric Ozone Formation: Scientific and Regulatory Implications Journal of Air and Waste Management Association, 43: 1091–1100.

Finlayson-Pitts, B.J., Pitts, J.N., 2000. Chemistry of the Upper and Lower Atmosphere. Academic Press, San Diego CA, 969 pp.

APPENDIX M

Modeling Protocol & Attainment Demonstration for the 2022 Eastern Kern Ozone State Implementation Plan

Modeling Protocol & Attainment Demonstration for the 2022 Eastern Kern Ozone State Implementation Plan

Prepared by
California Air Resources Board
Eastern Kern Air Pollution Control District

Prepared for
United States Environmental Protection Agency Region IX

September 2022

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Acronyms

ADAM – Aerometric Data Analysis and Management

AQMIS – Air Quality and Meteorological Information System

ARB – Air Resources Board

BCs – Boundary Conditions

CAM-Chem – Community Atmosphere Model with Chemistry

CEPAM – California Emissions Projection Analysis Model

CESM – Community Earth System Model

CMAQ Model – Community Multi-scale Air Quality Model

CTM – Chemical Transport Model

DV – Design Value

EKNA – Eastern Kern county Non-attainment Area

HD I/M – Heavy-Duty Vehicle Inspection and Maintenance

ICs – Initial Conditions

IOA – Index of Agreement

LA – Los Angeles

LAI – Leaf Area Index

MB – Mean Bias

MCIP – Meteorology-Chemistry Interface Processor

MDAB – Mojave Desert Air Basin

MDA8 – Maximum Daily Average 8-hour Ozone

ME – Mean Error

MEGAN – Model of Emissions of Gases and Aerosols

MFB – Mean Fractional Bias

MFE – Mean Fractional Error

MOZART – Model for Ozone and Related chemical Tracers

NAAQS – National Ambient Air Quality Standard

NASA – National Aeronautics and Space Administration

NARR - North American Regional Reanalysis

NCAR – National Center for Atmospheric Research

NMB – Normalized Mean Bias

NME – Normalized Mean Error

NAAQS – National Ambient Air Quality Standards

NOAA - National Oceanic and Atmospheric Administration

NO_x – Oxides of nitrogen

OGV – Ocean Going Vessels

R – Correlation coefficient

R^2 – R-squared/Coefficient of determination

RH – Relative Humidity

RMSE – Root Mean Square Error

ROG – Reactive Organic Gases

RRF – Relative Response Factor

SAPRC – Statewide Air Pollution Research Center

SIP – State Implementation Plan

SJV – San Joaquin Valley

SJVAB – San Joaquin Valley Air Basin

SoCAB – South Coast Air Basin

U.S. EPA – United States Environmental Protection Agency

VOCs – Volatile Organic Compounds

WRF Model – Weather and Research Forecast Model

I. Introduction

The Eastern Kern County Non-attainment Area (EKNA) encompasses an area of 3,707 square miles and is home to ~132,000 residents (Figure 1). It is geographically situated in the eastern half of Kern County on the western edge of the Mojave Desert Air Basin (MDAB) and extends from the Sierra-Nevada mountains and Transverse Ranges in the northwest and southwest, respectively, to the Searles Valley and Valley Wells to the north, and the Mojave Desert and Antelope Valley in the east and south, respectively. The mountain ranges to the northwest and southwest separate the sparsely populated EKNA from the more densely populated areas in the Southern San Joaquin Valley Air Basin (SJVAB) and Northern South Coast Air Basin (SoCAB). However, mountain passes such as the Tehachapi and Soledad Canyon/Cajon passes that connect MDAB to SJV and SoCAB, respectively, facilitate the transport of emissions and pollutants into the region.

Due to its location in the northwest of the Mojave Desert, the climate of Eastern Kern is similar to that of a desert, but not as extreme, and quite different from regions located in the coastal areas such as Los Angeles. The elevation of the area varies between ~700-1000 meters above sea level and has low humidity. Summer months are generally hot and dry, and the winter months are cool and wet. The average high temperatures generally stay in the 90s (°F) and 60s (°F) in the summer and winter months, respectively. The average annual rainfall is less than 6 inches with most of the rainfall occurring in the winter months. Both winter and summer seasons can experience periods of high pressure and stagnation, which are conducive to pollutant buildup. The local sources of pollution along with polluted air masses from the nearby regions (SJVAB and SoCAB) that are frequently transported into this area through mountain passes tend to stagnate over Eastern Kern under unfavorable meteorological conditions, resulting in high ozone levels, which exceed the U.S. EPA 2008 and 2015 National Ambient Air Quality Standards (NAAQS) for 8-hour ozone. Furthermore, in regions like the EKNA the absence of large sources of fresh Oxides of nitrogen (NO_x) emissions at night prevents the removal of ozone through the NO_x titration process, and allows the nighttime ozone levels to remain elevated. This can facilitate pollutant carryover the following morning, and can also contribute to elevated ozone levels on the following day.

Summer emission trends from 2000 to 2020 in the EKNA are shown in Figure 2 for anthropogenic NOx and Reactive Organic Gases (ROG), along with summer biogenic ROG emissions in the EKNA averaged from May to October 2018 (green circle marker). Figure 2 clearly shows a significant decrease in both local anthropogenic NOx (from 39.6 tpd to 19.2 tpd) and ROG (from 11.8 tpd to 7.4 tpd) emissions from 2000 to 2020. While the ROG emissions declined steadily throughout the entire 20 year period, the decline in NOx emissions slowed significantly after 2009. In 2018, biogenic ROG (49.5 tpd) is estimated to be ~6 times higher than the corresponding anthropogenic emissions (7.7 tpd) in the EKNA.

The transport of pollutants from the SJVAB and SoCAB can significantly contribute to the exceedances of the federal ozone NAAQS in the EKNA. As such, it is useful to examine the emissions trend in Western Kern County (i.e., SJV portion of Kern County) and Los Angeles (LA) County of SoCAB as well. The anthropognic NOx and ROG emissions trends for Western Kern and LA County are also displayed in Figure 2 and show a substantial decline in emissions from 2000 to 2020. However, these upwind source regions exhibit much higher emissions compared to local sources in EKNA. For 2018, the Western Kern anthropogenic NOx and ROG emissions are estimated to be 49.5 tpd and 64.7 tpd, which are ~2.5 and 8 times higher than the corresponding local emissions in EKNA. The biogenic ROG emissions in Western Kern are estimated to be ~110 tpd for 2018, which is more than twice of the corresponding biogenic emissions (49.5 tpd) in the EKNA. Similarly, the LA County anthropogenic NOx and ROG emissions for the year 2018 are estimated to be 221.6 and 252.8 tpd, which are ~11.5 and ~33 times higher than the corresponding emissions in the EKNA. The biogenic ROG emissions in LA County are estimated to be 128 tpd and ~2.5 times higher than the corresponding anthropogenic emissions (49.5 tpd) in the EKNA. It can be clearly seen from Figure 2 that the upwind source regions have emissions that are an order of magnitude or higher than the local emissions, and when aided by conducive meteorological conditions that facilitate pollutant transport, can be the dominant contributor to ozone levels in this region (EKAPCD, 2003).

Over the same 2000 to 2020 time period, the 8-hour ozone design value (DV) within the EKNA declined steadily (Figure 3), but also exhibited a fair amount of variability due to year-to-year differences in meteorology, which impacts the transport of pollutants from upwind sources and the associated changes in biogenic emissions. Overall, the area-wide design values have declined by ~11 ppb from 97 ppb in 2000 to 86 ppb in 2020, albeit with fluctuations due to the year-to-year meteorological variability. However, these DVs are still substantially higher than the current 2015 70 ppb and the 2008 75 ppb 8-hour ozone standards. Exceedances of the 70 ppb standard in the EKNA (Figure 3 bottom panel) have substantially declined over time from 81 in 2000 to 18 in 2020 indicating significant improvements in ozone air quality across the region. In recent years, the prevalence of forest fires during the summer ozone season significantly impacted the air quality in the EKNA. High ozone concentrations were observed at EKNA's Mojave PooleSt monitor and other surrounding sites in the upwind SJVAB and SCAB on days impacted by forest fires (see Weight of Evidence section of the SIP document) and likely caused the increase in the DVs seen from 2018 to 2020. To remove the impact of forest fires in 2018 and 2020, ozone DVs were calculated by excluding high ozone days that were impacted by forest fires. Details of the fire impact days can be found in the Weight of Evidence analysis. Excluding the fire impacts, ozone DVs would be 81 ppb, 78 ppb and 77 ppb in 2018, 2019 and 2020, respectively, and are denoted by black circle markers in the top panel of Figure 3. The number of exceedance days also dropped to 44 (from 53) and 14 (from 18) in 2018 and 2020 when the forest fire impacted days were excluded (black triangle markers in bottom panel of Figure 3).

Figure 1. Map of California (left) along with the location of Eastern Kern County Nonattainment Area (EKNA) in magenta. The shaded and gray line contours denote the gradients in topography (km). The outer box of the top panel is the California statewide 12 km modeling domain, while the inner box shows the 4 km modeling domain covering Central California. The insert on the bottom shows a zoomed-in view of the spatial extent (magenta lines) and approximate regional boundary of the EKNA and the location of ozone and meteorological monitoring sites (circle markers) in its vicinity.

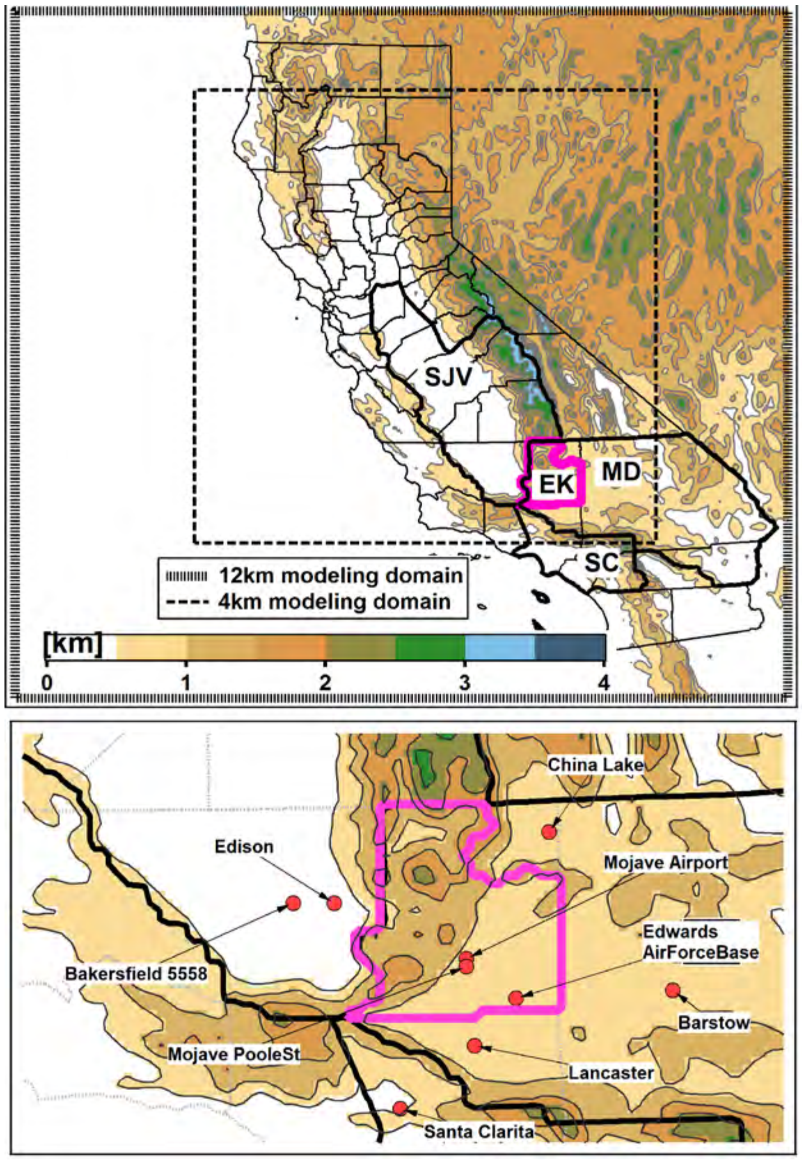


Figure 2. Trends in summer emissions of NOx and ROG (tons per day) between 2000 and 2020 in Eastern Kern, Western Kern and Los Angeles Counties. Anthropogenic emissions estimates are from the California Emission Projection Model (CEPAM) 2019 Ozone SIP Baseline Projection Version 1.04 with 2017 base year. 2018 biogenic ROG emissions are from MEGAN 3.0 biogenic model calculations. Note that emissions are represented on a log scale, which can mask small changes in the emissions.

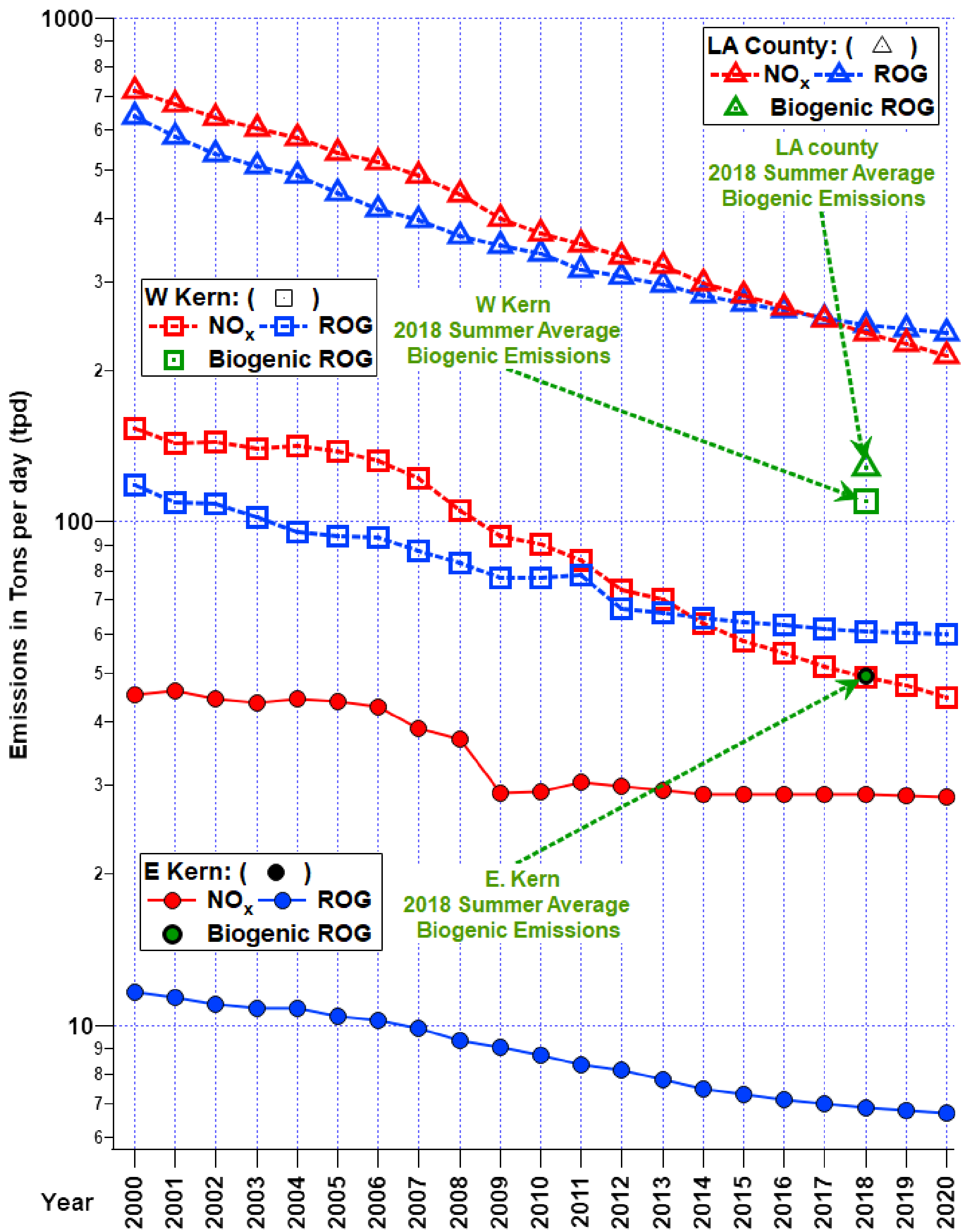
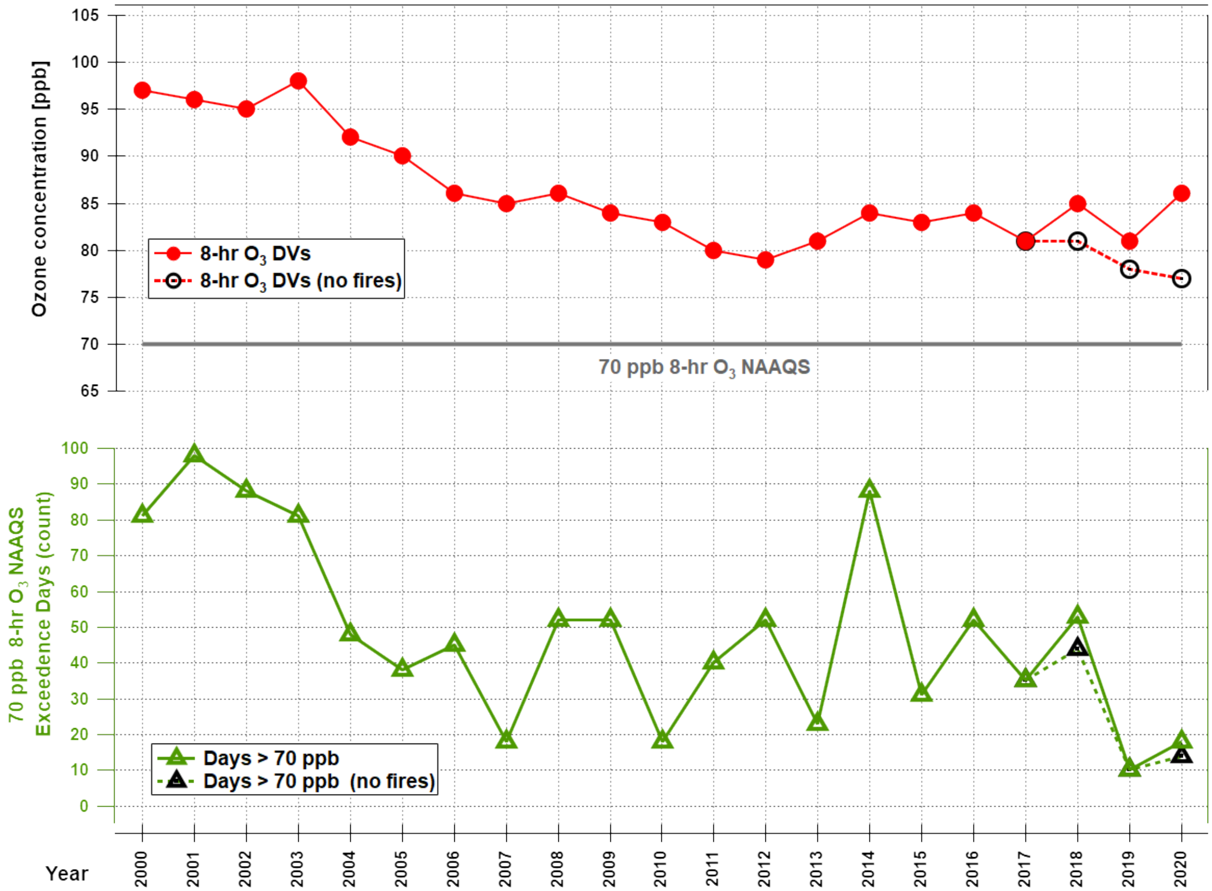


Figure 3. Trends in Eastern Kern's Maximum Daily Average 8-hour Ozone Design Value (ppb) and 70 ppb 8-hour Ozone NAAQS exceedance days between 2000 and 2020.



The EKNA is classified as severe nonattainment for the 2008 75 ppb O_3 standard and 2015 70 ppb O_3 standard, which means it has an attainment year of 2026 for the 75 ppb O_3 standard and an attainment year of 2032 for the 70 ppb O_3 standard. The remainder of this document serves as the modeling protocol and attainment demonstration for EKNA's 2022 Plan for both the 2008 75 ppb and 2015 70 ppb 8-hour ozone standards, which utilizes a base and reference year of 2018 and demonstrates attainment of the standard in 2026 (75 ppb) and 2032 (70 pbb).

II. Methodology

U.S. EPA modeling guidance (U.S. EPA, 2018) outlines the approach for utilizing regional chemical transport models (CTMs) to predict future attainment of the 2015 (70 ppb) 8-hour ozone standard. This model attainment demonstration requires that CTMs be used in a relative sense, where the relative change in ozone to a given set of emission reductions (i.e., predicted change in future anthropogenic emissions) is modeled, and then used to predict how current/present-day ozone levels would change under the future emissions scenario.

The starting point for the attainment demonstration is the observational based design value (DV), which is used to determine compliance with the ozone standards. The DV for a specific monitor and year represents the three-year average of the annual 4th highest 8-hour ozone mixing ratio observed at the monitor. For example, the 8-hour O_3 DV for 2018 is the average of the observed 4th highest 8-hour O_3 mixing ratio from 2016, 2017, and 2018 (Table 1). The U.S. EPA recommends using an average of three DVs to better account for the year-to-year variability in ozone levels due to meteorology. This average DV is called the weighted DV (in the context of this SIP document, the weighted DV will also be referred to as the reference year DV or DV_R). Since 2018 represents the reference year for projecting DVs to the future, site-specific DVs should be calculated for the three-year periods ending in 2018, 2019, and 2020, and then these three DVs are averaged. However, 2020 was an atypical year with large societal changes in response to the COVID19 pandemic and is not suitable for use in the DV_R calculation. To remove the impact from 2020 observations, we utilize an alternative methodology for calculating the average DVs by excluding year 2020. In this method, the 8-hour O_3 DV for 2020 was replaced by the two-year average of the 4th highest 8-hour O_3 concentrations from 2018 and 2019. Table 1 illustrates the observational data from each year that goes into the average DV_R and Equation 1 shows how the DV_R is calculated.

Table 1. Data from each year that are utilized in the Design Value calculation for a specific year (DV Year), and the yearly weighting of data for the average Design Value calculation (or DV_R).

DV Year	Years Averaged for the Design Value (4th highest observed 8-hr O_3)			
2018	2016	2017	2018	
2019		2017	2018	2019
2020			2018	2019

$$DV_R = \frac{DV_{2018} + DV_{2019} + \dfrac{4th\ highest\ MDA8\ \ O_3\ (2018 + 2019)}{2}}{3} \tag{1}$$

Table 2 lists the 8-hour design values for the Mojave monitoring site in the EKNA that are utilized in this model attainment demonstration. The 2018 ozone average baseline design value at this site is 82.7.

Table 2. Year-specific 8-hour ozone design values for 2018, 2019 and 2020, and the average baseline design value (DV_R, represented as the average of three design values) for 2018 at the Mojave site located in the EKNA. The 2020 DV is the two-year average of the 4th highest 8-hour O_3 concentrations from 2018 and 2019.

Site (County, Air Basin)	2018 DV (ppb)	2019 DV (ppb)	2020 DV (ppb)	2018-2020 Average DV (ppb)
Mojave-923PooleSt (Kern, MDAB)	85	81	82	82.7

Projecting the reference DVs to the future requires three photochemical model simulations, described below:

1. ***Base Year Simulation***
   The base year simulation for 2018 is used to assess model performance (i.e., to ensure that the model is reasonably able to reproduce the observed ozone mixing ratios). Since this simulation will be used to assess model performance, it is essential to include as much day-specific detail as possible in the emissions inventory, including, but not limited to hourly adjustments to the motor vehicle and biogenic inventories based on local meteorological conditions, known wildfire and agricultural burning events, and any exceptional events such as refinery fires.

2. ***Reference Year Simulation***
   The reference year simulation was identical to the base year simulation, except that certain emissions events which are either random and/or cannot be projected to the future are removed from the emissions inventory. For 2018, the only difference between the base and reference year simulations was that wildfires were excluded from the reference year simulation.

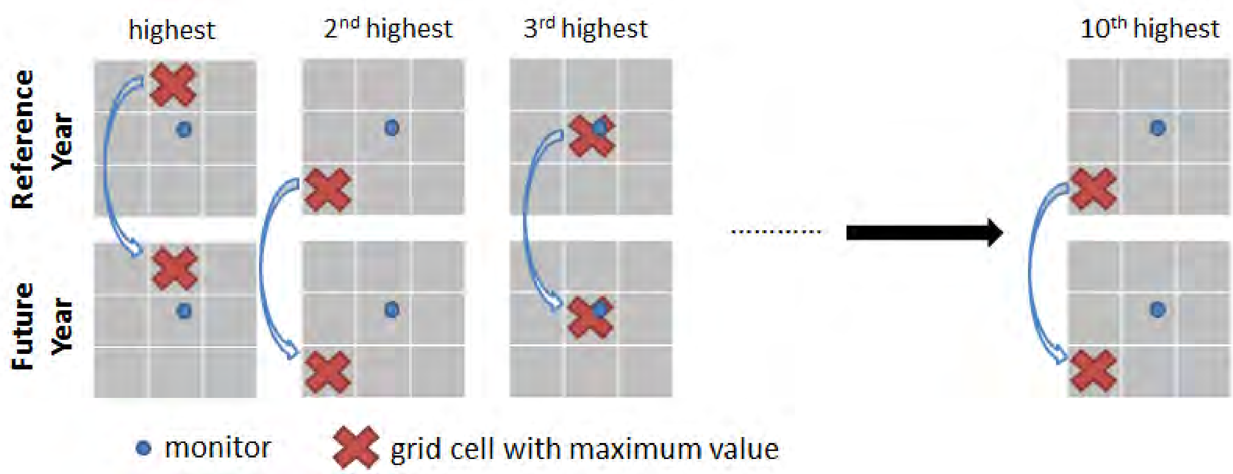
3. ***Future Year Simulation***
   The future year simulation (2026 or 2032) was identical to the reference year simulation, except that the projected future year anthropogenic emission levels were used rather than the reference year emission levels. All other model inputs (e.g., meteorology, chemical boundary conditions, biogenic emissions, and calendar for day-of-week specifications in the inventory) are the same as those used in the reference year simulation.

Projecting the reference DVs to the future is done by first calculating the fractional change in ozone between the modeled future and reference years for each monitor location. These ratios, called “relative response factors” or RRFs, are calculated based on the ratio of modeled future year ozone to the corresponding modeled reference year ozone (Equation 2).

$$\text{RRF} = \frac{\frac{1}{N}\sum_{d=1}^{N}(MDA8\ O_3)_{future}^{d}}{\frac{1}{N}\sum_{d=1}^{N}(MDA8\ O_3)_{reference}^{d}} \quad (2)$$

Where, MDA8 O_3 refers to the maximum daily average 8-hour ozone, d refers to the day (chosen from the reference year), and N is the total number of days used in the RRF calculation. These MDA8 ozone values are based on the maximum simulated ozone within a 3x3 array of cells surrounding the monitor (Figure 4). Not all modeled days are used to calculate the average MDA8 ozone from the reference and future year simulations. The form of the 8-hour ozone NAAQS is such that it is focused on the days with the highest mixing ratios in any ozone season (i.e., the 4th highest MDA8 ozone). Therefore, the modeled days used in the RRF calculation also reflect days with the highest ozone levels. As a result, the current U.S. EPA modeling guidance (U.S. EPA, 2018) recommends using the 10 days with the highest modeled MDA8 ozone at each monitor location, where the 10 days are chosen from the reference year simulation and then the same corresponding days are selected from the future year simulation. Since the relative sensitivity to emissions changes (in both the model and real world) can vary from day-to-day due to meteorology and emissions (e.g., temperature dependent emissions or day-of-week variability) using the top 10 days ensures that the calculated RRF is not overly sensitive to any single day. Note that the MDA8 ozone from the reference and future year simulations are paired in both time (the same days are selected from each simulation) and space (the location of the peak MDA8 ozone within the 3x3 array of grid cells surrounding the monitor is selected from the reference year simulation and the same location is used when selecting the corresponding data from the future year simulation).

Figure 4. Example showing how the location of the MDA8 ozone for the top ten days in the reference and future years are chosen.



When choosing the top 10 days, the U.S. EPA recommends beginning with all days in which the simulated reference year MDA8 ozone is >= 60 ppb and then calculating RRFs based on the 10 days with the highest ozone in the reference simulation. If there are fewer than 10 days with MDA8 ozone >= 60 ppb then all days >= 60 ppb are used in the RRF calculation, as long as there are at least 5 days used in the calculation. If there are fewer than 5 days >= 60 ppb, an RRF cannot be calculated for that monitor. To ensure that only modeled days which are consistent with the observed ozone levels are used in the RRF calculation, the modeled days are further restricted to days in which the reference MDA8 ozone is within ± 20% of the observed value at the monitor location.

Future year DVs at each monitor are then calculated by multiplying the corresponding reference year DV by the site-specific RRF.

$$DV_F = DV_R \times RRF \tag{3}$$

where, DV_F is the future year design value, DV_R is the reference year design value, and RRF is the site-specific RRF from Equation 2. The resulting future year DVs are then compared to the 8-hour ozone NAAQS to demonstrate whether attainment will be reached under the emissions scenario utilized in the future year modeling. A monitor is considered to be in attainment of the 8-hour ozone standard if the estimated future year DV does not exceed the level of the standard.

A. Meteorological Modeling

California's proximity to the ocean, complex terrain, and diverse climate represents a unique challenge for reproducing meteorological fields that adequately represent the synoptic and mesoscale features of the regional meteorology. In summertime, the majority of the storm tracks are far to the north of the state and a semi-permanent Pacific high pressure system typically sits off the California coast. Interactions between this eastern Pacific subtropical high-pressure system and the thermal low-pressure further inland over the Central Valley or South Coast lead to conditions conducive to pollution buildup over large portions of the state (Bao et al., 2008; Fosberg et al., 1966).

The state-of-the-science Weather Research and Forecasting (WRF) prognostic model (Skamarock, et al. 2008) version 4.2.1 was employed in the modeling. Its domain consisted of three nested Lambert projection grids of 36 km (D01), 12 km (D02), and 4 km (D03) uniform horizontal grid spacing as shown in Figure 5. The 4 km innermost domain has 427x427 grid points and spans 1748 km in the east-west and the north-south directions. All three domains utilized 30 vertical sigma layers with the lowest layer extending to 30 m above the surface (Table 3). The North America Regional Reanalysis (NARR) fields, enhanced with surface and upper-air observations, were used for initial and boundary conditions as well as Four Dimension Data Assimilation (FDDA) on the outermost (36 km) domain. The horizontal spatial resolution of the NARR data is 32 km. The major physics options for each domain are listed in Table 4, which include the Yon-Sei University (YSU) planetary boundary layer (PBL) scheme, Kain-Fritsch cumulus parameterization for the outer two domains, and 5-layer thermal diffusion land-surface option.

Figure 5. WRF modeling domains (D01 36 km; D02 12 km; and D03 4 km).

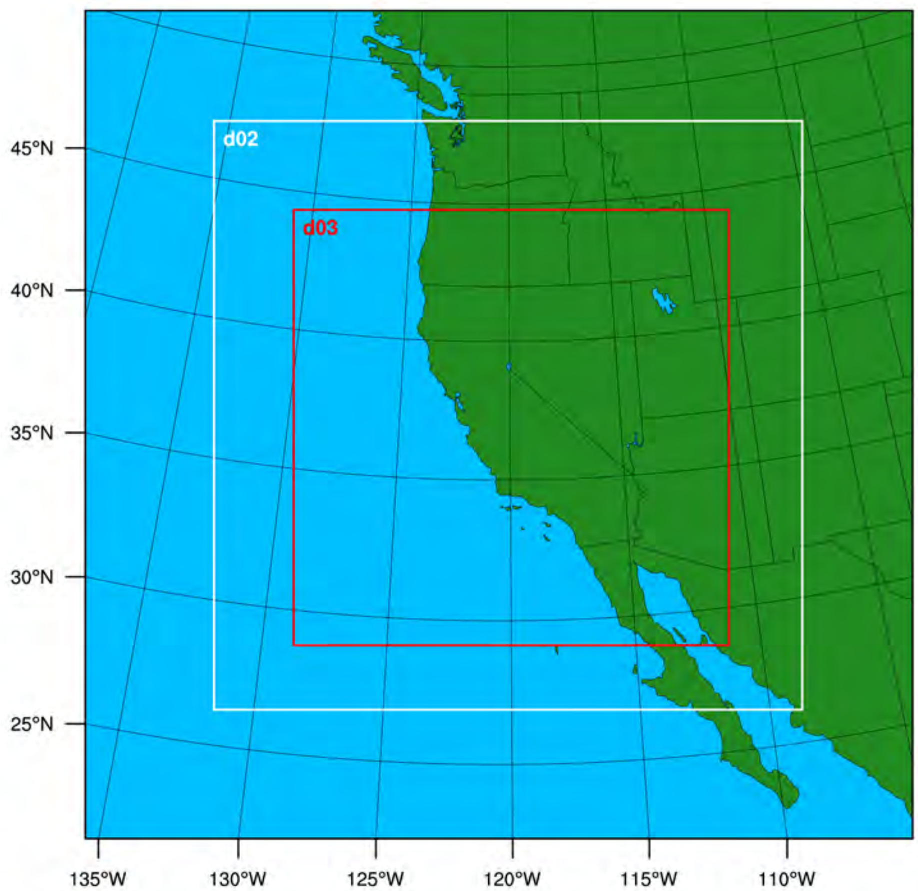


Table 3. WRF vertical layer structure.

Layer Number	Height (m)	Layer Thickness (m)	Layer Number	Height (m)	Layer Thickness (m)
30	16082	1192	15	2262	403
29	14890	1134	14	1859	334
28	13756	1081	13	1525	279
27	12675	1032	12	1246	233
26	11643	996	11	1013	194
25	10647	970	10	819	162
24	9677	959	9	657	135
23	8719	961	8	522	113
22	7757	978	7	409	94
21	6779	993	6	315	79
20	5786	967	5	236	66
19	4819	815	4	170	55
18	4004	685	3	115	46
17	3319	575	2	69	38
16	2744	482	1	31	31

To prevent any large deviations from the reanalysis data, analysis nudging was applied to the outermost domain (D01) above the planetary boundary layer (PBL) for moisture and above 2 km for wind and temperature. No nudging was used on the two inner domains to allow the model physics to work fully without externally imposed forcing. Boundary conditions on the outermost domain were updated every 6 hours, while WRF was reinitialized every 6 days with one day overlap, where the first day after being reinitialized was discarded as model spin-up. The Meteorology-Chemistry Interface Processor (MCIP) version 5.1 was used to process the 12 km (D02) and 4 km (D03) WRF output for use in the CTM simulations.

Table 4. WRF Physics options.

Physics Option	D01 (36 km)	D02 (12 km)	D03 (4 km)
Microphysics	WSM 6-class	WSM 6-class	WSM 6-class
Longwave Radiation	RRTM	RRTM	RRTM
Shortwave Radiation	Dudhia	Dudhia	Dudhia
Surface Layer	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov	Revised MM5 Monin-Obukhov
Land Surface	5-layer Thermal Diffusion	5-layer Thermal Diffusion	5-layer Thermal Diffusion
Planetary Boundary Layer	YSU	YSU	YSU
Cumulus Parameterization	Kain-Fritsch Scheme	Kain-Fritsch Scheme	No

B. Emissions

The anthropogenic emissions inventory used in this modeling was based on the California Emissions Projection Analysis Model (CEPAM) v1.03 augmented with updates consistent with CEPAM v1.04 for select source categories. These sources are described in *http://outapp.arb.ca.gov/cefs/2019ozsip/CEPAM2019_key_updates_chron.pdf* under version "March 29, 2022 Release of Version 1.04 Planning Projections", except for emissions from Ocean Going Vessels (OGV). For a detailed description of the anthropogenic emissions inventory, updates to the inventory, and how it was processed from the planning totals to a gridded inventory for modeling, see the Modeling Emissions Inventory Appendix.

Table 5 summarizes the 2018, 2026 and 2032 EKNA anthropogenic emissions. Overall, anthropogenic NOx emissions in CEPAMv1.04 were projected to decrease by ~13.6% (from 20.5 tpd to 17.8 tpd) and 15% (20.5 tpd to 17.5 tpd) respectively in 2026 and 2032 when compared to 2018 levels with bulk of the reductions coming from on-road mobile sources. In contrast, anthropogenic ROG was projected to decrease by ~9.5% (from 7.7 tpd to 7.0 tpd) and 12% (from 7.7 tpd to 6.8 tpd) respectively in 2026 and 2032 when compared to the 2018 levels with the bulk of those reductions coming from all mobile sources including on-road and other mobile sources. CEPAMv1.04 emissions for 2026 and 2032 reflect emission reductions from CARB's Heavy-Duty Vehicle Inspection and Maintenance (HD I/M) Program. The right two columns in Table 5 show the 2032 emissions after further incorporating CARB commitments from the State SIP Strategy, which are estimated at ~1.8 and 0.3 tpd additional reductions to the 2032 NO_x and ROG emission levels, respectively. Details on these rules/adjustments can be found in the Modeling Emissions Inventory Appendix.

Table 5. EKNA Summer Planning Emissions for 2018, 2026, and 2032 (tons/day).

	CEPAM1.04						With CARB Commitments	
Source Category	2018 NOx (tpd)	2018 ROG (tpd)	2026 NOx (tpd)	2026 ROG (tpd)	2032 NOx (tpd)	2032 ROG (tpd)	2032 NOx (tpd)	2032 ROG (tpd)
Stationary	12.8	1.4	12.3	1.5	12.4	1.6	12.4	1.6
Area	0.1	1.2	0.1	1.2	0.1	1.3	0.1	1.3
On-road Mobile	3.7	1.2	1.4	0.7	1.0	0.6	0.8	0.5
Other Mobile	4.0	3.9	3.9	3.6	3.9	3.4	2.3	3.2
Total	20.5	7.7	17.8	7.0	17.5	6.8	15.7	6.5

* Note that rounding errors may result in emissions totals that do not exactly match the sum of the individual categories.

Biogenic emissions were generated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN3.0) biogenics emissions model (*https://bai.ess.uci.edu/megan*). MEGAN3.0 incorporates a new pre-processor (MEGAN-EFP) for estimating biogenic emission factors based on available landcover and emissions data. The MEGAN3.0 default datasets for plant growth form, eco-type, and emissions were utilized. Leaf Area Index (LAI) for non-urban grid cells was based on the 8-day 500 m resolution MODIS Terra/Aqua combined product (MCD15A2H) for 2018 (*https://earthdata.nasa.gov/*). The LAI data was converted to LAIv, which represents the LAI for the vegetated fraction within each grid cell, by dividing the gridded MODIS LAI values by the Maximum Green Vegetation Fraction for each grid cell (*https://archive.usgs.gov/archive/sites/landcover.usgs.gov/green_veg.html*). The MODIS LAI product does not provide information on LAI in urban regions, so urban LAIv was estimated from the US Forest Service's Forest Inventory and Analysis urban tree plot data, processed through the i-Tree v6 software (*https://www.itreetools.org/tools/i-tree-eco*). Hourly meteorology for MEGAN was provided by the 4 km WRF simulation described above, and all stress factor adjustments were turned off.

Monthly biogenic ROG totals for 2018 within the EKNA are shown in Figure 6 (note that the same biogenic emissions were used in the 2018, 2026 and 2032 modeling). Throughout the summer, biogenic ROG emissions ranged from ~25 tpd in May to 95 tpd in July and ~70 tpd in August, with the difference in emissions primarily due to monthly differences in temperature, solar radiation, and leaf area. In addition to biogenic ROG emissions, the MEGAN model also estimates NOx emissions from soils using the Yienger and Levy scheme (Yienger and Levy, 1995) that accounts for natural emissions from soils as well as enhanced emissions from managed crop lands. Figure 7 shows the monthly average soil NOx emissions for 2018 from MEGAN. Soil NOx emissions are highest during summer months where the emissions peak at 1.1 tpd in July.

Figure 6. Monthly average biogenic ROG emissions for 2018 in the EKNA.

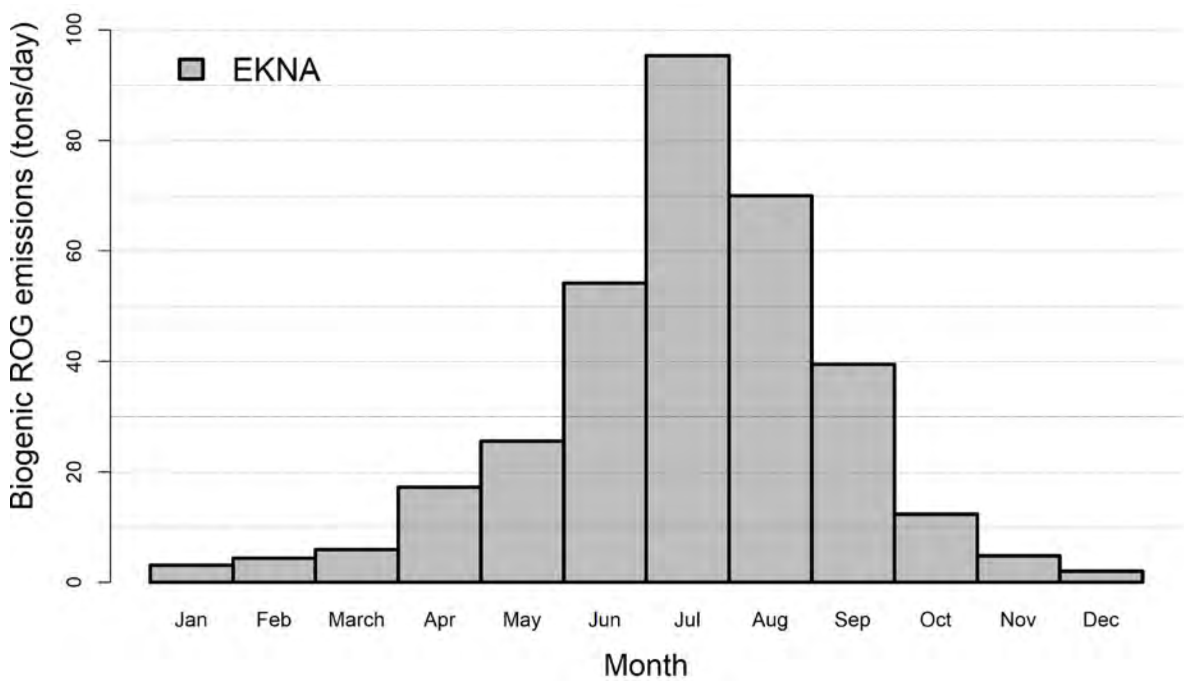


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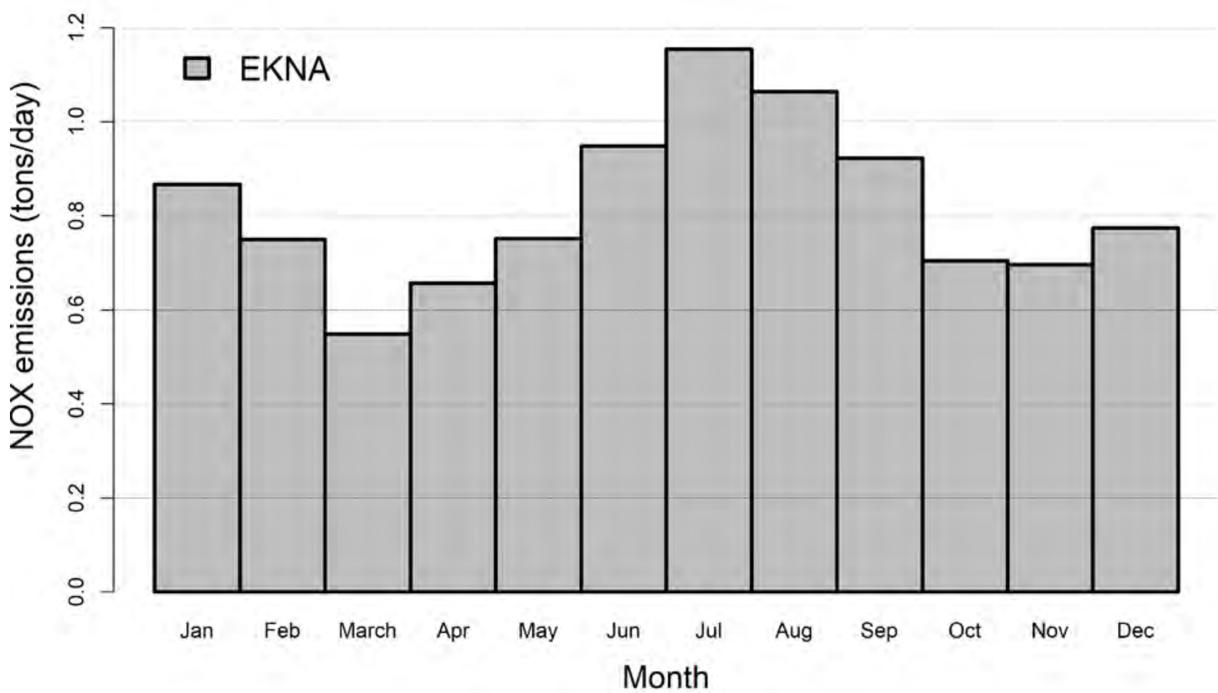
Figure 7. Monthly average soil NOx emissions for 2018 in the EKNA



C. **Air Quality Modeling**

Figure 1 shows the Community Multiscale Air Quality (CMAQ) modeling domains used in this work. The larger domain covering all of California has a horizontal grid size resolution of 12 km with 107x97 lateral grid cells for each vertical layer and extends from the Pacific Ocean in the west to Eastern Nevada in the east and runs from the U.S.-Mexico border in the south to the California-Oregon border in the north. The smaller nested domain covering the Central valley region, including the San Joaquin Valley, Sacramento Valley, Mountain Counties air basins and the EKNA, has a finer scale 4 km grid resolution and includes 192x192 lateral grid cells. The 12 km and 4 km domains are based on a Lambert Conformal Conic projection with reference longitude at -120.5°W, reference latitude at 37°N, and two standard parallels at 30°N and 60°N, which is consistent with WRF domain settings. The CMAQ vertical layer structure is based on the WRF sigma-pressure coordinates and the exact layer structure used can be found in Table 3. The original 30 vertical layers from WRF were used for the CMAQ simulations, extending from the surface to 100 mb such that the majority of the vertical layers fall within the planetary boundary layer.

The CTM utilized in the modeling is the CMAQ model version 5.2.1 (U.S. EPA, 2018). CMAQ is the U.S. EPA's open-source regional air quality model, which is widely used in the regulatory and scientific communities, and represents the current state-of-the-science. CMAQ has been utilized for studying ozone and $PM_{2.5}$ formation in California for over a decade (e.g., Cai et al., 2016, 2019; Jin et al., 2008, 2010; Kelly et al., 2010, 2014; Livingstone et al., 2009; Pun et al., 2009; Tonse et al., 2008; Vijayaraghavan et al., 2006; Zhang et al., 2010), and has been the primary CTM used in California SIPs since 2008 (SJV, 2008), having been used in over a dozen ozone and $PM_{2.5}$ SIPs (Eastern Kern, 2017; Imperial, 2017, 2018; Sacramento, 2017; SJV, 2012, 2013, 2016a,b, 2018; South Coast, 2012, 2016; Ventura, 2016; Western Mojave, 2016; Western Nevada, 2018).

The SAPRC07tic chemical mechanism (Carter, 2010a,b) was chosen to represent the gas-phase photochemistry in the atmosphere, along with the aero6 aerosol module for simulating aerosol dynamics and chemistry. Photolysis rates were calculated in-line to better represent changes in photolysis rates due to meteorological conditions and gaseous and particulate pollutant levels in the atmosphere.

Global chemical transport Community Atmosphere Model with Chemistry (CAM-Chem) coupled to the Community Earth System Model (CESM2) (Emmons, 2020; Lamarque et al., 2012) was developed by National Center for Atmospheric Research (NCAR) and used for simulations of global tropospheric and stratospheric atmospheric compositions. CAM-Chem modeling outputs have been widely used to provide chemical boundary conditions for various regional air quality models (Yan et al., 2021; He et al., 2018; Shahrokhishahraki et al., 2022; Wang et al., 2022). In this work, chemical boundary conditions for the outer 12-km domain were extracted from the CAM-Chem output based on vertical and horizontal setups of CMAQ meteorological inputs, and processed into CMAQ model ready format as well as mapped to CMAQ chemical species. The CAM-chem data for 2018 was obtained from the National Center for Atmospheric Research (*https://www.acom.ucar.edu/cam-chem/cam-chem.shtml*) *(Buchholz, 2019) and processed using the mozart2camx preprocessor version 3.2.3 (https://www.camx.com/download/support-software/)*. The same CAM-chem derived BCs for the 12 km outer domain were used for both base year, reference year and future year simulations. The inner 4 km domain simulations utilized BCs that were based on the output from the corresponding12 km domain simulations.

The extended ozone season (April – October) was simulated through parallel individual monthly simulations for the base year, reference year and future year. For each month, the CMAQ simulations included a seven-day spin-up period (i.e., the last seven days of the previous month) for the outer 12 km domain where initial conditions for the beginning day were set to the default initial conditions included with the CMAQ release. The 4 km inner domain simulations utilized a three-day spin-up period, where the initial conditions for the starting day were based on output from the corresponding day of the 12 km domain simulation. These spin-up periods were chosen based on previous testing, which showed that influence from the initial conditions was negligible after the seven- and three-day spin-up periods for the 12 km and 4 km simulations, respectively. Table 6 lists the CMAQ configuration and settings used in the modeling.

Table 6. CMAQ configuration and settings.

Process	Scheme
Advection	Yamo module for horizontal and WRF module for vertical
Horizontal diffusion	Multi-scale
Vertical diffusion	ACM2 (Asymmetric Convective Model version 2)
Gas-phase chemical mechanism	SAPRC version 07tc gas-phase mechanism with extended isoprene chemistry
Chemical solver	EBI (Euler Backward Iterative solver)
Aerosol module	Aero6 (the sixth generation CMAQ aerosol mechanism)
Cloud module	ACM_AE6 (ACM cloud processor that uses the ACM methodology to compute convective mixing with heterogeneous chemistry for AERO6)
Photolysis rate	Phot/inline (calculating photolysis rates inline)

III. Results

A. Meteorological Model Evaluation

Simulated surface wind speed, temperature, and relative humidity from the 4 km domain were validated against hourly observations from 25 surface stations in the region (Figure 8). The observational data for the surface stations were obtained from the ARB archived meteorological database available at *http://www.arb.ca.gov/aqmis2/aqmis2.php*. Table 7 lists the monitoring stations and the meteorological parameters that are measured at each station, including wind speed and direction (wind), temperature at 2 meters (T2) above ground level (AGL) and relative humidity at 2 meters (RH2) AGL. Several quantitative performance metrics were used to compare hourly surface observations and modeled estimates: mean bias (MB), mean error (ME) and index of agreement (IOA) based on the recommendations from Simon et al. (2012). The model performance statistical metrics were calculated using the available data at all the sites. A summary of these statistics for the area is shown in Table 8.

The average hourly wind speed bias for April-October 2018 is relatively small at -0.07 m/s, while the average mean error is 0.48 m/s. The index of agreement for the wind speed in this period is 0.92. Temperature is biased low with an average bias of -0.72 K, while the IOA for temperature is 0.96. Consistent with the negative temperature bias, relative humidity has a positive bias of 12.9%. The distribution of daily mean bias and mean error for wind speed, temperature and relative humidity are shown in Figure 9. The spatial distributions of the mean bias and mean error of modeled surface wind, temperature and relative humidity are shown in

Figure 10. Observed vs. modeled scatter plots of hourly wind speed, temperature, and relative humidity are shown in Figure 11. These results are comparable to other WRF modeling efforts in California investigating ozone formation in Central California (e.g. Hu et al., 2012) and modeling analysis for the CalNex, CARES and Discover-AQ field studies (e.g. Fast et al., 2012; Baker et al., 2013; Kelly et al., 2014; Angevine et al., 2012; Chen et al., 2020). Detailed hourly time-series of surface temperature, relative humidity, wind speed, and wind direction can be found in the supplemental materials.

Table 7. Meteorological site location and parameter measured.

Site Number (Figure 8)	Site ID	Site Name	Parameter(s) Measured
1	5823	Delano #2	Wind, T2, RH2
2	3476	UHL	Wind
3	5729	Blackwells Corner	Wind, T2, RH2
4	5709	Shafter – USDA	Wind, T2, RH2
5	5791	Belridge	Wind, T2, RH2
6	2981	Shafter-Walker Street	Wind
7	2772	Oildale-3311 Manor Street	Wind
8	3146	Bakersfield-5558 Cali. Avenue	Wind
9	2312	Edison	Wind
10	3353	Jawbone	Wind
11	5771	Arvin-Edison	Wind, T2, RH2
12	2919	Maricopa-Stanislaus Street	Wind
13	3121	Mojave-923 Poole Street	Wind
14	5414	Lebec	Wind
15	3316	Poppy Park	Wind
16	3645	Saddleback Butte	Wind

Site Number (Figure 8)	Site ID	Site Name	Parameter(s) Measured
17	5834	Palmdale #4	Wind, T2, RH2
18	3326	Acton	Wind
19	3544	Del Valle	Wind
20	7220	Santa Clarita (CIMIS)	Wind, T2, RH2
21	3358	Saugus	Wind
22	3480	Mill Creek (ANF)	Wind
23	3502	Santa Clarita	Wind
24	3359	Camp 9	Wind
25	3329	Chilao	Wind

Figure 8. Meteorological monitoring sites utilized in the model evaluation for Eastern Kern. Numbers reflect the sites listed in Table 7.

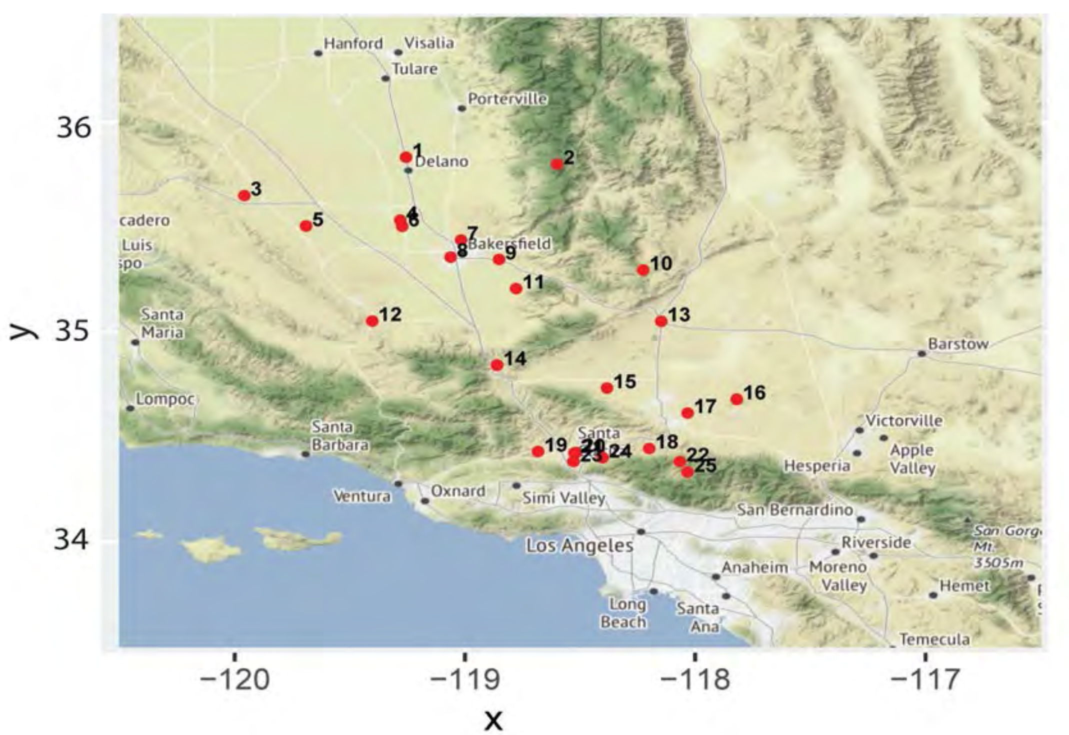


Table 8. Hourly surface wind speed, temperature and relative humidity statistics for April through October, 2018. IOA denotes index of agreement.

	Observed Mean	Modeled Mean	Mean Bias	Mean Error	IOA
Wind Speed (m/s)	3.10	3.03	-0.07	0.48	0.92
Temperature (K)	295.48	294.76	-0.72	2.17	0.96
Relative Humidity (%)	48.21	61.11	12.9	13.57	0.78

Figure 9. Distribution of daily mean bias (left) and mean error (right) from April –October 2018. Results are shown for wind speed (top), temperature (middle), and RH (bottom).

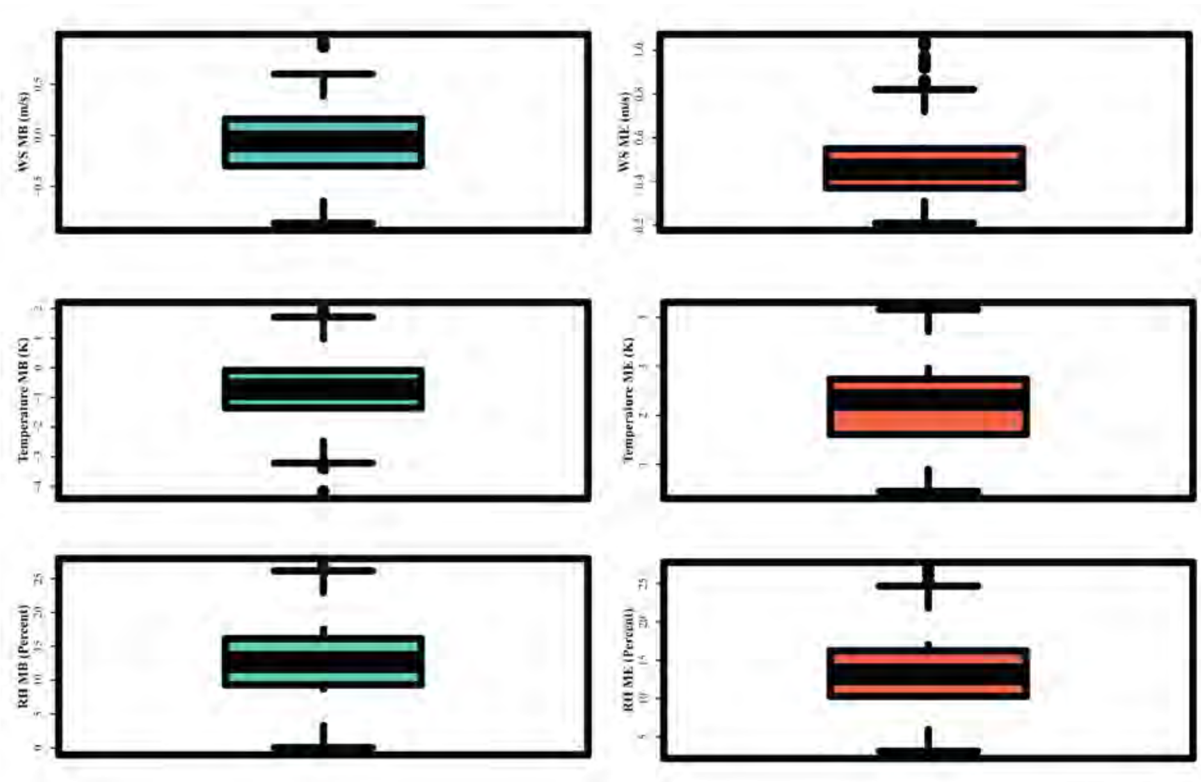


Figure 10. Spatial distribution of mean bias (left) and mean error (right) for April-October 2018. Results are shown for wind speed (top), temperature (middle), and RH (bottom).

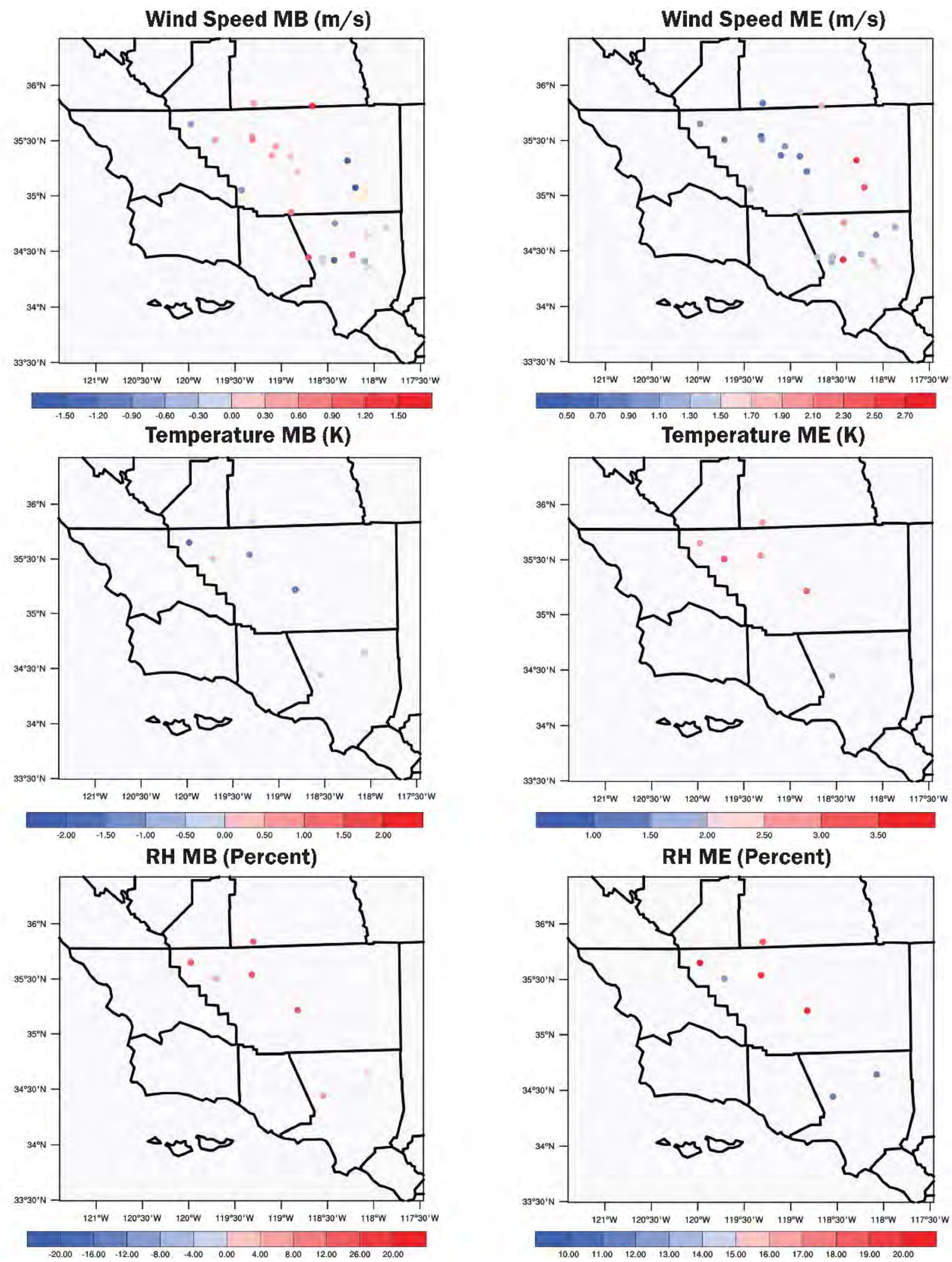
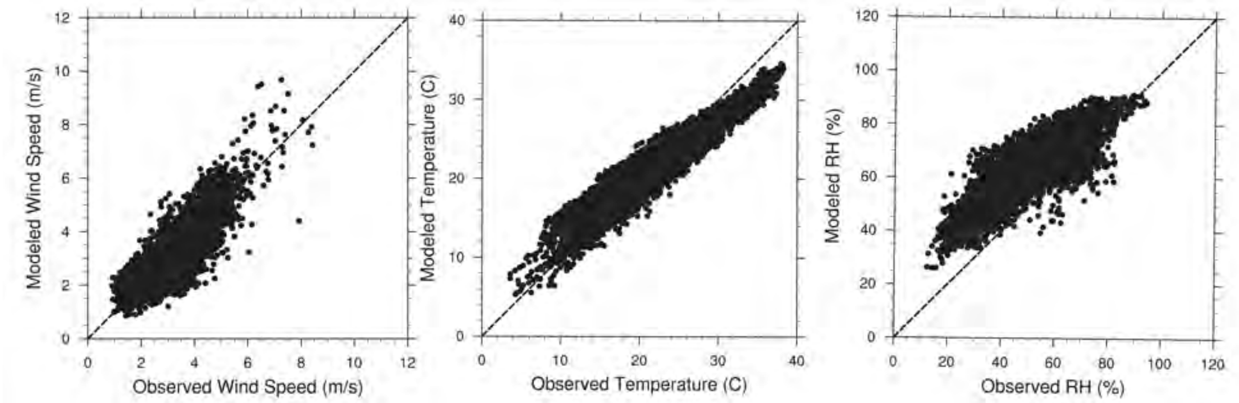


Figure 11. Comparison of modeled and observed hourly wind speed (left), 2-meter temperature (center), and relative humidity (right), April – October 2018.



B. Phenomenological Evaluation

Conducting a detailed phenomenological evaluation for all modeled days can be resource intensive given that the entire ozone season (April – October) was modeled for the attainment demonstration. However, some insight and confidence that the model is able to reproduce the meteorological conditions leading to elevated ozone can be gained by investigating the meteorological conditions during peak ozone days within the EKNA in more detail.

Meteorological conditions that produced peak ozone levels in the area occurred on August 7, 2018, with a daily maximum 8-hour ozone mixing ratio of 94 ppb observed at the Mojave ozone monitoring site. The upper-air weather charts showed that a 500 mb high pressure system was observed over California. The pressure gradient of this system was weak and the daytime temperature at the Mojave monitor reached 97 ˚F.

Figure 12 shows the surface wind fields in the early afternoon (13:00 PST) and evening (20:00 PST) on August 7, 2018 with the observed and modeled values denoted by red and black arrows, respectively. Overall, modeled winds compare relatively well with the observed values, with winds during the early afternoon hours being influenced by up slope flows, while evening winds were impacted by down slope flows. The winds were stronger through the mountain passes such as Soledad Canyon between Santa Clarita and Palmdale and the Tehachapi pass, facilitating transport of pollutants from SoCAB and SJVAB into the EKNA.

Since RRF calculations in the model attainment test described previously are based on the top 10 peak ozone days, the modeled and measured winds in the area were examined further for the top 10 ozone days observed at the Mojave site in 2018. The ten highest maximum daily average 8-hour ozone mixing ratios observed at the Mojave site in 2018 occurred on August 7, August 9, August 4, July 29, July 30, July 31, August 8, August 6, August 10, June 20, respectively. Figure 13 shows the mean wind field (vector average) for the top 10 ozone days at 05:00 PST and 13:00 PST, respectively. Overall, the surface wind distribution indicates that the model is in general agreement with the observations and is able to capture many of the important features of the observed meteorological fields on those days when elevated ozone levels occurred.

Figure 12. Surface wind field at 13:00 PST (top) and 20:00 PST (bottom) on August 07, 2018. Modeled wind field is shown with black wind vectors, while observations are shown in red.

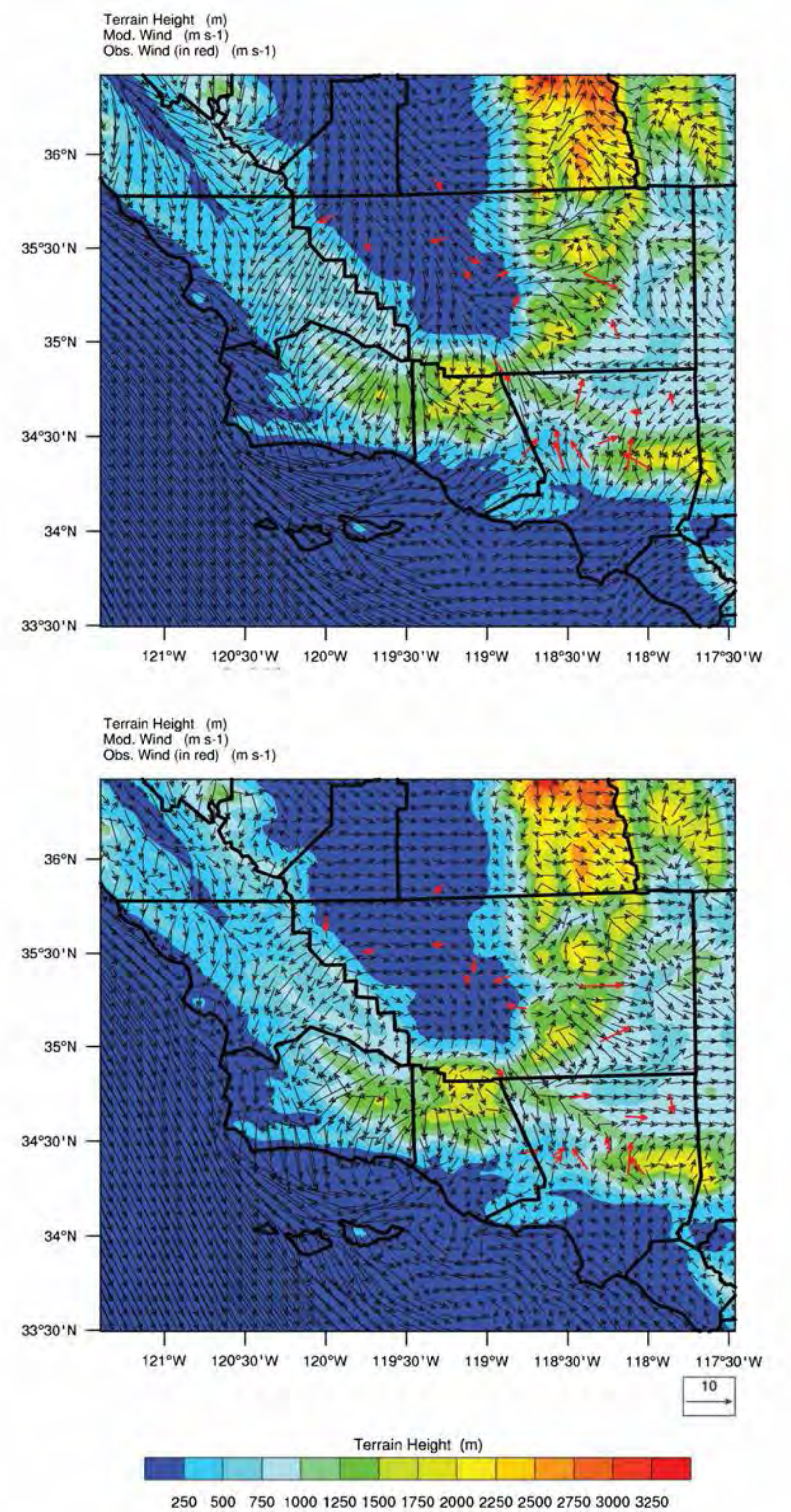


Figure 13. Average wind field at 5:00 PST (top) and 13:00 PST (bottom) for the top 10 observed ozone days at Mojave monitor in 2018. Modeled wind field is shown with black wind vectors, while observations are shown in red.

In addition, it is useful to examine the direction of predominant wind flow, through wind rose plots, on peak ozone days to ensure the same transport patterns from source to receptor observed in the atmosphere are also captured in the model. Figure 14 shows the observed and simulated wind speed frequency and direction at the Mojave site for the top 10 ozone days in 2018. From Figure 14, it is clear that the dominant wind flow pattern on peak ozone days is from the west/north-west. The model predicted higher occurrences of winds from the west/north-west, and lower occurrences of winds from the west and west/south-west compared to observations. Despite less variability in wind directions, the model was generally able to reproduce the predominant wind directions.

Figure 14. Observed (left) and modeled (right) wind roses at the Mojave site for the top 10 observed ozone days in 2018.

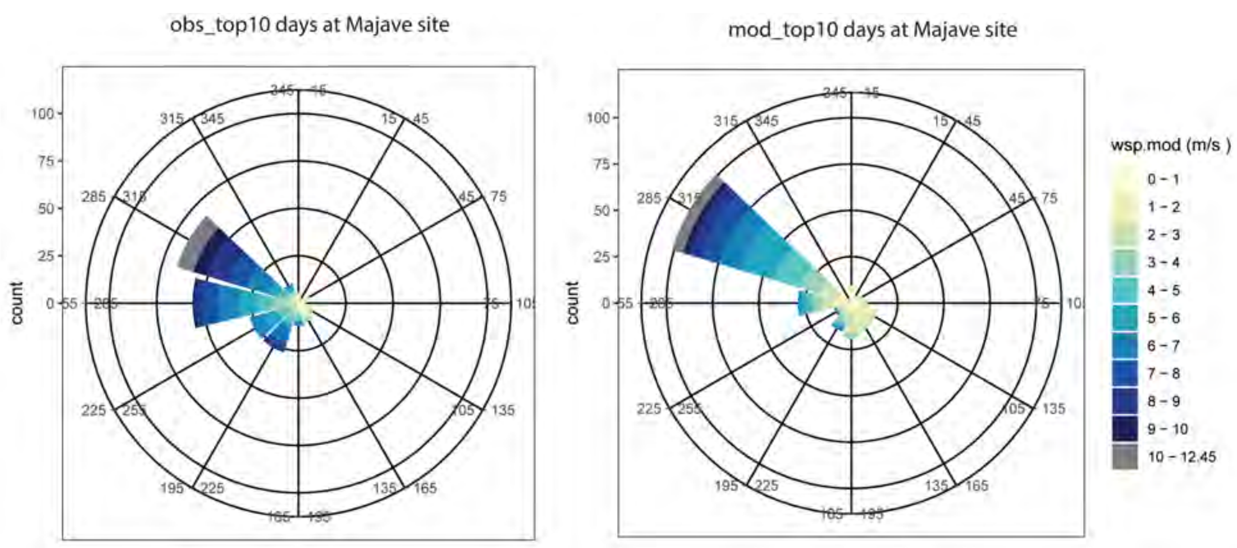
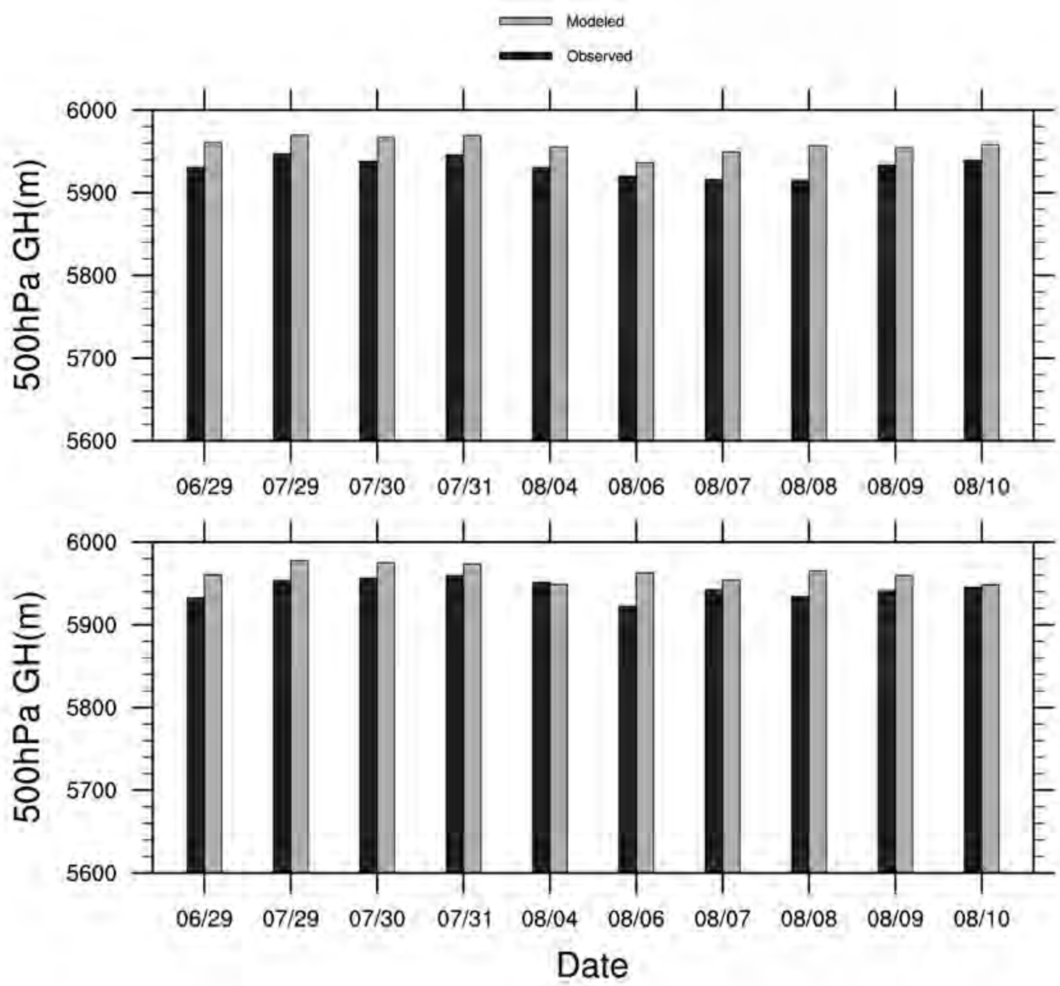


Figure 15 shows the 500 hPa geopotential height at 12:00 UTC and 00:00 UTC for the top 10 ozone days in 2018 at the Mojave site. These times were chosen to coincide with timing of the upper-air observations. In this figure, the North American Regional Reanalysis (NARR) data is used to represent the observations. The NARR dataset is a product of observational data assimilated into some of the NOAA model products for the purpose of producing a snapshot of the weather over North America at any given time. The 500 hPa geopotential height is a useful metric to evaluate, because most weather systems follow the winds at this level. It can be seen from Figure 15 that on average the 500 hPa geopotential height is ~5900 m above sea level and the modeled 500 hPa geopotential height closely matches the observed values.
Although a phenomenological evaluation of only a subset of peak ozone days does not necessarily mean the model performs equally well on all days, the fact that the model can adequately reproduce wind flows consistent with the ozone conceptual model, combined with reasonable performance statistics over the ozone season (Table 8), provides added confidence in the meteorological fields utilized for this attainment demonstration modeling.

Figure 15. Modeled and observed at 12:00 UTC (top) and 00:00 UTC (bottom) 500 hPa geopotential height for the top 10 observed ozone days in 2018.



C. Air Quality Model Evaluation

Observed ozone data from CARB's Air Quality and Meteorological Information System (AQMIS) database (*www.arb.ca.gov/airqualitytoday/*) and Aerometric Data Analysis and Management (ADAM) database (*www.arb.ca.gov/adam/*) were used to evaluate the accuracy of the 4 km CMAQ modeling for ozone at the Mojave site in the EKNA. The U.S. EPA modeling guidance (U.S. EPA, 2018) recommends using the grid cell value where the monitor is located, to pair observations with simulated values in operational evaluation of model predictions. Since the future year design value calculations are based on simulated values near the monitor (i.e., the maximum simulated ozone within a 3x3 array of grid cells with the grid cell containing the monitor located at the center of the array), model performance was evaluated by comparing observations against the simulated values at the monitored grid cell as well as the peak grid cell within the 3x3 grid array centered on the monitor (i.e., the 3x3 maximum). While different cutoff criteria have be used in different model evaluation studies (Emery et al., 2017), U.S. EPA suggests the days with simulated values > 60 ppb should receive higher priority in evaluation to give more attention to the model outputs that could potentially impact the outcome of the attainment test.

As recommended by U.S. EPA modeling guidance, a number of statistical metrics have been used to evaluate the model performance for ozone. These metrics include mean bias (MB), mean error (ME), mean fractional bias (MFB), mean fractional error (MFE), normalized mean bias (NMB), normalized mean error (NME), root mean square error (RMSE), and correlation coefficient (R^2). In addition, the following plots were used in evaluating the modeling with all available data: time-series plots comparing the predictions and observations, scatter plots for comparing the magnitude of the simulated and observed concentrations, as well as frequency distributions.

The model performance evaluation is presented for the Mojave site in the EKNA. Performance statistics for modeling scenarios with all valid data and only data above 60 ppb are reported separately for different ozone metrics including maximum daily average 8-hour ozone, maximum daily average 1-hour ozone, and hourly ozone (all hours of the day) for the monitored grid cell as well as the 3x3 maximum. Performance statistics for maximum daily average 8-hour ozone are shown in Table 9 and Table 10. Overall, when simulated data extracted at the grid cell are used for comparison with observations (as shown in Table 9), the model shows a bias of 0.41 ppb of maximum daily average 8-hour ozone in the EKNA. However, when only data greater than 60 ppb are used, model shows a negative bias of -3.49 ppb. Similarly, when the 3x3 maximum data is used for comparison, there is a positive bias in the model with all the valid data (1.74 ppb) and a negative bias with only data over 60 ppb (-2.15 ppb). This result indicates the model has a slight under-prediction of maximum daily average 8-hour ozone at high values in the EKNA. Similar statistics for maximum daily average 1-hour ozone and hourly ozone can be found in Table 11 to Table 13.

Model performance statistics within the range of values shown in Table 9 to Table 13 are consistent with previous studies in California and studies elsewhere in the U.S. Hu et al. (2012), simulated an ozone episode in central California (July 27 – August 2, 2000) using SAPRC07 chemical mechanism and found that a model bias of -10.8 ppb for maximum daily average 8-hour ozone with 60 ppb cutoff (compared to -3.49 ppb for EKNA in Table 9 of this work). Hu et al. also shows a model bias of -12.7 ppb for maximum daily average 1-hour ozone in Central California with 60 ppb cutoff (compared to -3.83 ppb in Table 11 of this work).

Similarly, Shearer et al. (2012) compared model performance in Central California during two episodes in 2000 (July 24 – 26 and July 31 – August 2) for two different chemical mechanisms and found that normalized bias for maximum daily average 8-hour ozone ranged from -7% to -14% with hourly peak ozone showing a range of -7% to -18%. These values are greater than the statistics found in this work, which were calculated as 0.65% for maximum daily average 8-hour ozone and -0.94% for maximum daily average 1-hour ozone. Jin et al. (2010) conducted a longer term simulation over Central California (summer 2000) and found a RMSE for maximum daily average 8-hour ozone of 14 ppb, which is greater than the 8.91 ppb found in this work. Jin et al. (2010) also showed an overall negative bias of -2 ppb, which is in the similar range of 0.41 ppb (1.74 ppb with 3x3 maximum values) found in this work. Zhu et al. (2019) shows hourly O_3

NMB of 8.2% and NME of 11.3% for July and August 2012 with 20ppb cutoff, both are similar to the NMB and NME shown in Table 13.

Table 9. Maximum daily average 8-hour ozone performance statistics in the EKNA for the 2018 ozone season (April - October). Maximum daily average 8-hour ozone with simulated data extracted at grid cell where the monitor is located.

Parameter	EKNA	EKNA with data over 60 ppb
Number of data points	212	130
Mean obs (ppb)	62.67	70.09
Mean Bias (ppb)	0.41	-3.49
Mean Error (ppb)	6.94	6.12
RMSE (ppb)	8.91	8.07
Mean Fractional Bias (%)	1.40	-5.20
Mean Fractional Error (%)	11.36	8.98
Normalized Mean Bias (%)	0.65	-4.98
Normalized Mean Error (%)	11.07	8.73
R-squared	0.42	0.28

Table 10. Maximum daily average 8-hour ozone performance statistics in the EKNA for the 2018 ozone season (April - October). Maximum daily average 8-hour ozone with simulated data extracted from the 3x3 grid cell array maximum centered at the monitor.

Parameter	EKNA	EKNA with data over 60 ppb
Number of data points	212	130
Mean obs (ppb)	62.67	70.09
Mean Bias (ppb)	1.74	-2.15
Mean Error (ppb)	7.14	5.91

Parameter	EKNA	EKNA with data over 60 ppb
RMSE (ppb)	9.14	7.73
Mean Fractional Bias (%)	3.51	-3.19
Mean Fractional Error (%)	11.63	8.58
Normalized Mean Bias (%)	2.78	-3.06
Normalized Mean Error (%)	11.39	8.44
R-squared	0.42	0.26

Table 11. Maximum daily average 1-hour ozone performance statistics in the EKNA for the 2018 ozone season (April - October). Maximum daily 1-hour ozone with simulated data extracted at grid cell where the monitor is located.

Parameter	EKNA	EKNA with data over 60 ppb
Number of data points	211	154
Mean obs (ppb)	67.90	73.90
Mean Bias (ppb)	-0.64	-3.83
Mean Error (ppb)	7.81	7.36
RMSE (ppb)	10.02	9.53
Mean Fractional Bias (%)	-0.17	-5.38
Mean Fractional Error (%)	11.81	10.28
Normalized Mean Bias (%)	-0.94	-5.18
Normalized Mean Error (%)	11.50	9.96
R-squared	0.45	0.36

Table 12. Daily maximum 1-hour ozone performance statistics in the EKNA for the 2018 ozone season (April - October). Daily Maximum 1-hour ozone with simulated data extracted from the 3x3 grid cell array maximum centered at the monitor.

Parameter	EKNA	EKNA with data over 60 ppb
Number of data points	211	154
Mean obs (ppb)	67.90	73.90
Mean Bias (ppb)	1.19	-1.89
Mean Error (ppb)	7.83	6.98
RMSE (ppb)	10.17	9.20
Mean Fractional Bias (%)	2.52	-2.63
Mean Fractional Error (%)	11.77	9.59
Normalized Mean Bias (%)	1.75	-2.56
Normalized Mean Error (%)	11.53	9.45
R-squared	0.44	0.33

Table 13. Hourly ozone performance statistics in the EKNA for the 2018 ozone season (April - October). Hourly ozone with simulated data extracted at grid cell where the monitor is located. Note that only statistics for the grid cell in which the monitor is located were calculated for hourly ozone.

Parameter	EKNA	EKNA with data over 60 ppb
Number of data points	4903	1949
Mean obs (ppb)	55.49	68.86
Mean Bias (ppb)	1.40	-5.93
Mean Error (ppb)	8.70	8.42
RMSE (ppb)	11.19	10.76

Parameter	EKNA	EKNA with data over 60 ppb
Mean Fractional Bias (%)	4.57	-9.34
Mean Fractional Error (%)	16.77	12.96
Normalized Mean Bias (%)	2.52	-8.61
Normalized Mean Error (%)	15.68	12.22
R-squared	0.39	0.14

Simon et al. (2012) conducted a review of photochemical model performance statistics published between 2006 and 2012 for North America (from 69 peer-reviewed articles). In Figure 16, the statistical evaluation of this model attainment demonstration is compared to the model performance summary presented in Simon et al. (2012) by overlaying various summary statistics onto the Simon et al. (2012) model performance summary. Note that the box-and-whisker plot (colored in black) shown in Figure 16 is reproduced using data from Figure 4 of Simon et al. (2012). The red dot and blue triangle in each of the panels in Figure 16 denote the model performance statistics from the current modeling work, calculated using the simulated monitor grid cell and the 3x3 maximum, respectively.

Figure 16. Comparison of various statistical metrics from the model attainment demonstration modeling to the range of statistics from the 69 peer-reviewed studies summarized in Simon et al (2012). (MDA denotes Maximum Daily Average). Red circular markers show statistics calculated from modeled ozone at the monitor location, while blue triangular markers show statistics calculate from the maximum ozone in the 3x3 array of grid cells surrounding the monitor.

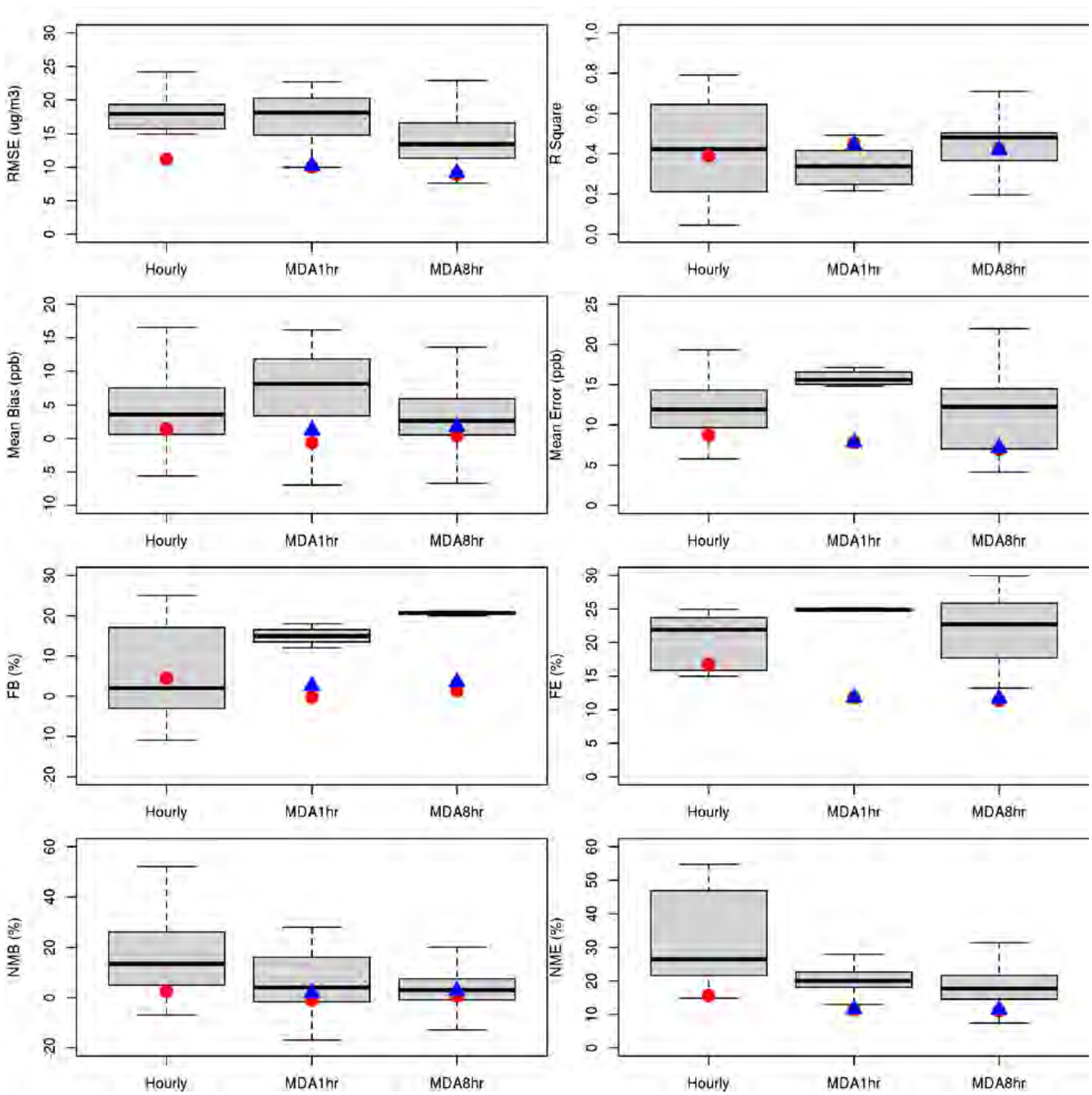
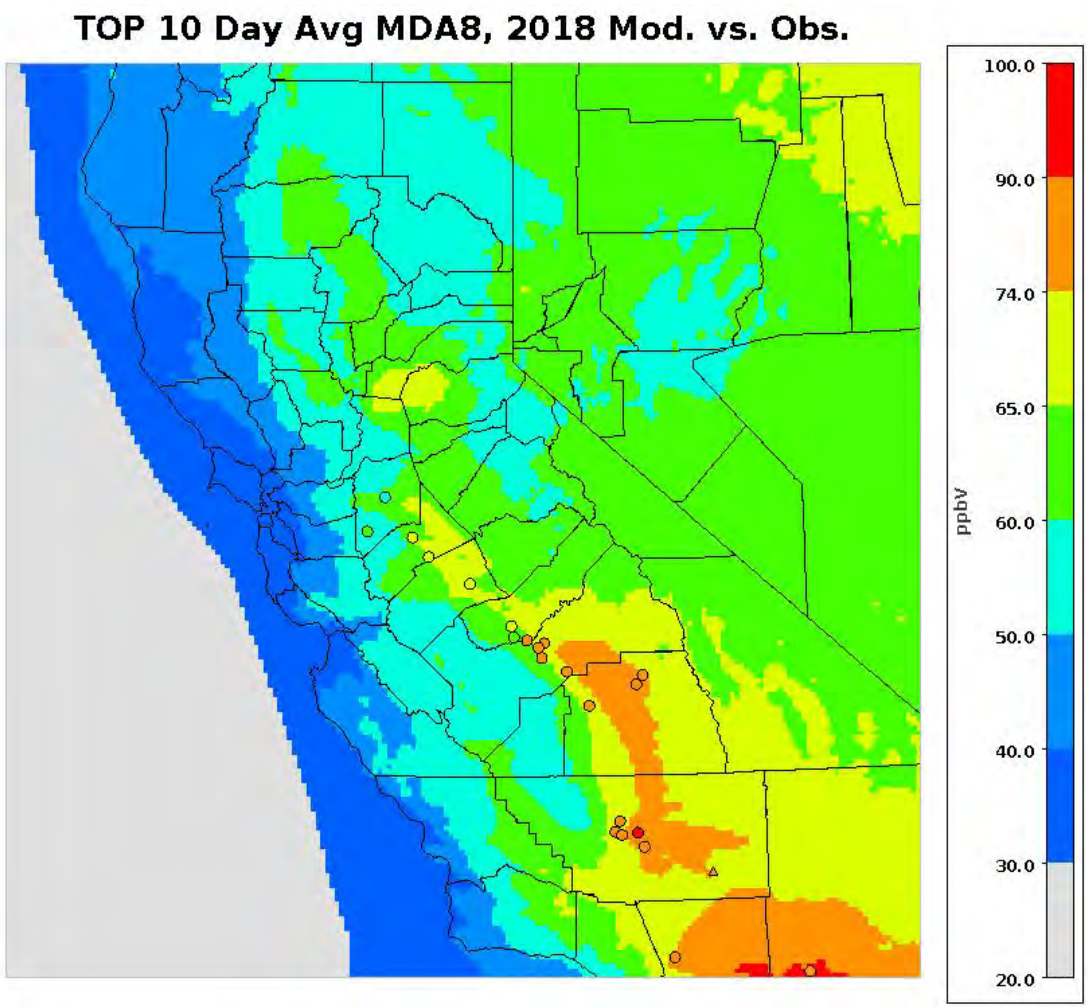


Figure 16 clearly shows that the model performance statistical metrics for hourly, maximum daily average 8-hour and maximum daily 1-hour ozone from this work are consistent with previous modeling studies reported in the scientific literature, and in most cases are better than those statistics. In particular, the Simon et al. (2012) study found that mean bias for maximum daily average 8-hour ozone ranged from approximately -7 ppb to 13 ppb, while mean error ranged from around 4 ppb to 22 ppb, and RMSE varied from approximately 8 ppb to 23 ppb; all of which are similar in magnitude to the statistics presented in Table 9 and Table 10.

Figure 17. Average MDA8 ozone for the top 10 ozone days in 2018 from the model simulations overlaid with observation data (SJV and SoCAB sites marked as circle, Mojave-923PooleSt marked as triangle), where the top 10 days from the observations were chosen based on the Mojave-923PooleSt site.



Spatial distributions of modeled and observed average maximum daily average 8-hour ozone for the top 10 O_3 days at the Mojave-923 Poole Street site are displayed in Figure 17. The observation data are from the monitoring sites located in SJV, EKNA and SoCAB that are within the modeling domain. The model is able to capture the observed spatial gradient of ozone in the modeling domain with good agreement between model and observation at the Mojave-923 Poole Street site. Additional analysis including time series of the hourly, maximum daily average 1-hr and maximum daily average 8-hour ozone data at Mojave-923 Poole Street site as well as the time series of NO_2 at a nearby SJV site (Shafter) and a nearby SoCAB site (Santa Clarita) can be found in the supplemental materials.

D. Air Quality Model Diagnostic Evaluation

In addition to the statistical evaluation presented above, since the modeling is utilized in a relative sense, it is also useful to consider whether the model is able to reproduce observable relationships between changes in emissions and ozone. One approach to this would be to conduct a retrospective analysis where additional years are modeled (e.g., 2000 or 2005) and then investigate the ability of the modeling system to reproduce the observed changes in ozone over time. Since this approach is extremely time consuming and resource intensive, it is generally not feasible to perform such an analysis under the constraints of a typical SIP modeling application. An alternative approach for investigating the ozone response to changes in emissions is through the so called “weekend effect”.

The “weekend effect” is a well-known phenomenon in some major urbanized areas where emissions of NO_x are substantially lower on weekends than on weekdays, but measured levels of ozone are higher on weekends than on weekdays. This is due to the complex and non-linear relationship between NO_x and ROG precursors and ozone (e.g., Sillman, 1999).

In general terms, under ambient conditions of high-NO_x and low-ROG (NO_x-disbenefit region in Figure 18 ozone formation tends to exhibit a disbenefit to reductions in NO_x emissions (i.e., ozone increases with decreases in NO_x) and a benefit to reductions in ROG emissions (i.e., ozone decreases with decreases in ROG). In contrast, under ambient conditions of low-NO_x and high-ROG (NO_x-limited region in Figure 18), ozone formation shows a benefit to reductions in NO_x emissions, while changes in ROG emissions result in only minor decreases in ozone. These two distinct “ozone chemical regimes” are illustrated in Figure 18 along with a transitional regime that can exhibit characteristics of both the NO_x-disbenefit and NOx-limited regimes. Note that Figure 18 is shown for illustrative purposes only and does not represent the actual ozone sensitivity within the EKNA for a given combination of NO_x and ROG (VOC) emissions.

In this context, the prevalence of a weekend effect in a region suggests that the region is in a NO_x-disbenefit regime. A lack of a weekend effect (i.e., no pronounced high O_3 occurrences during weekends) would suggest that the region is in a transition regime and moving between exhibiting a NO_x-disbenefit and being NO_x-limited. A reversed weekend effect (i.e., lower O_3 during weekends) would suggest that the region is NO_x-limited.

Figure 18. Illustration of a typical ozone isopleth plot, where each line represents ozone mixing ratio, in 10 ppb increments, as a function of initial NOx and VOC (or ROG) mixing ratio (adapted from Seinfeld and Pandis, 1998, Figure 5.15). General chemical regimes for ozone formation are shown as NOx-disbenefit (red circle), transitional (blue circle), and NOx-limited (green circle).

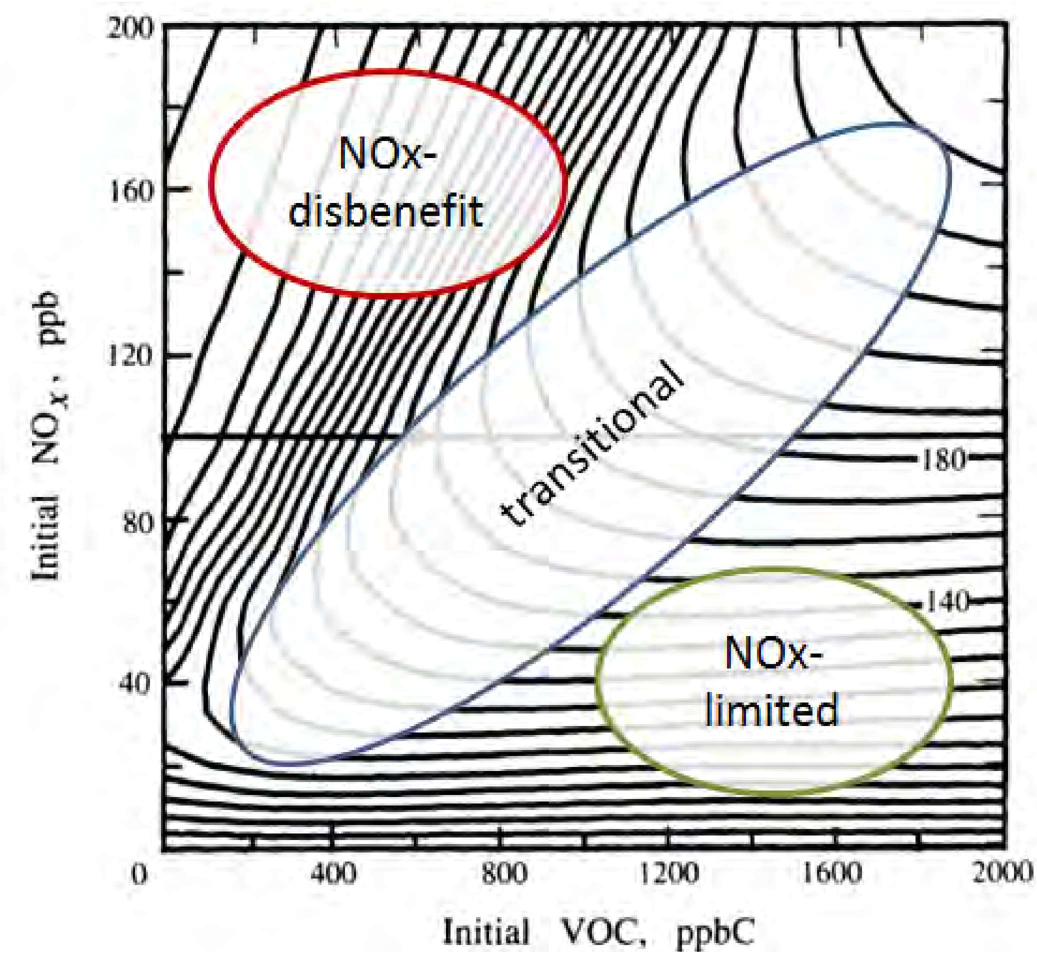
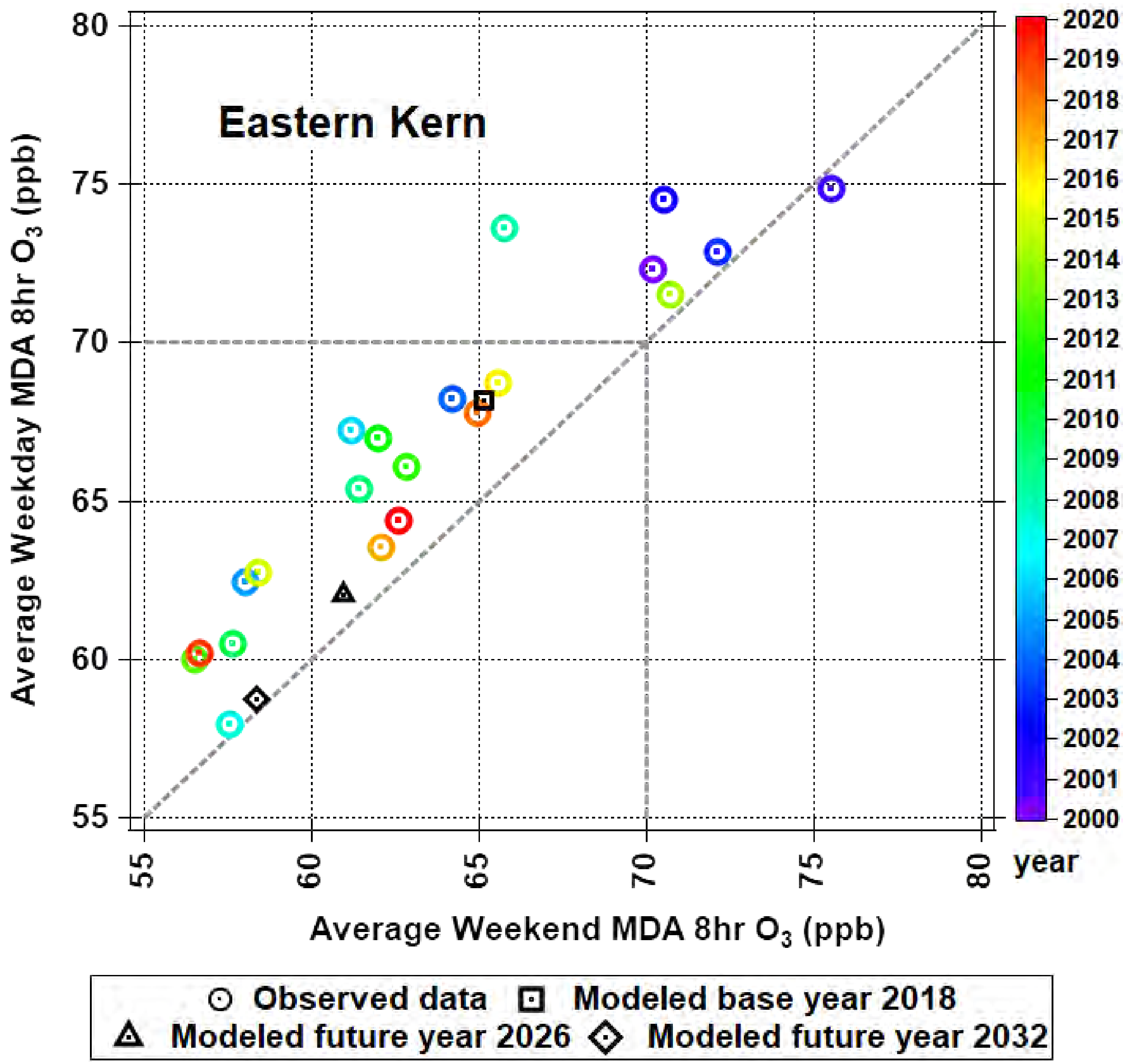


Figure 19. Site-specific average weekday and weekend maximum daily average 8-hour ozone for each year from 2000 to 2020 in the EKNA. The colored circle markers denote observed values while the black square, triangle add diamond markers denote the simulated baseline 2018, future years 2026 and 2032 values. Points falling below the 1:1 dashed line represent a NO_x-disbenefit regime, those on the 1:1 dashed line represent a transitional regime, and those above the 1:1 dashed line represent a NO_x-limited regime.



Investigating the "weekend effect" and how it has changed over time is a useful real-world metric for evaluating the ozone chemistry regime in the EKNA and how well it is represented in the modeling. The trend in day-of-week dependence in the EKNA was analyzed using the ozone observations between 2000 and 2020 and the average site-specific weekday (Wednesday and Thursday) and weekend (Sunday) observed summertime (June through September) maximum daily average 8-hour ozone values by year (2000 to 2020) are compared (Figure 19). Different definitions of weekday and weekend days were also investigated and did not show appreciable differences from the Wednesday/Thursday and Sunday definitions.

A key observation in Figure 19 is that the summertime average weekday and weekend ozone levels have steadily declined between 2000 and 2020. Along with the declining ozone, it can be seen that the EKNA has been in a NO_x limited regime for the past two decades as seen from the greater weekday ozone when compared to the weekend ozone. This region is in close proximity to biogenic ROG emissions sources and farther away from the anthropogenic NO_x sources, such that low NO_x and high ROG reactivity conditions are prevalent, which is consistent with the region being in a NO_x-limited regime. The occasional shift in weekday/weekend ozone levels closer to the 1:1 dashed line (and in some years crossing over the line) is likely due to interannual variability in meteorological conditions and its impact on the regional transport patterns and local biogenic ROG emissions.

The simulated baseline 2018 weekday/weekend values (black square marker in Figure 19) from the attainment demonstration modeling show greater weekday ozone compared to weekend ozone in the EKNA. These predicted values are consistent with observed findings in 2018 that show a prevalence of NO_x-limited conditions in the EKNA. The predicted future 2026 and 2032 values, denoted by black triangle and diamond markers respectively in Figure 19, clearly show that weekday and weekend ozone decline significantly (all values are below 65 ppb) suggesting that NO_x controls will be more effective than corresponding ROG controls in lowering the ozone levels in the EKNA.

E. Future Design Values in 2026 and 2032

The RRFs and the 2026 and 2032 future ozone design values for the Mojave site of the EKNA were calculated using the procedures outlined in the Methodology section of this document and are summarized in Table 14 and Table 15. The projected ozone design value in 2026 is 74 ppb and in 2032 is 69 ppb at the site. Therefore, the attainment demonstration modeling predicts that the EKNA will attain the 2008 75 ppb 8-hour ozone standard by 2026 and the 2015 70 ppb 8-hour ozone standard by 2032 with the commitments outlined in the SIP.

Table 14. Summary of key parameters related to the future year 2026 ozone design value (DV) calculation.

Site	RRF	2018 Average DV (ppb)	2026 DV (ppb)	2026 Truncated DV (ppb)
Mojave-923PooleSt	0.8979	82.7	74.3	74

Table 15. Summary of key parameters related to the future year 2032 ozone design value (DV) calculation.

Site	RRF	2018 Average DV (ppb)	2032 DV (ppb)	2032 Truncated DV (ppb)
Mojave-923PooleSt	0.8400	82.7	69.5	69

F. NOx/VOC Sensitivity Analysis for Reasonable Further Progress (RFP)

For the Clean Air Act 182(c)(2)(B) Reasonable Further Progress (RFP) requirement for areas classified as Serious nonattainment and above, U.S. EPA guidance allows for NOx substitution to demonstrate the annual 3 percent reduction of ozone precursors if it can be demonstrated that substitution of NOx emission reductions (for ROG reductions) yield equivalent decreases in ozone. Additional U.S. EPA guidance states that certain conditions are needed to use NOx substitution in an RFP demonstration (U.S.EPA 1993). First, an equivalency demonstration must show that cumulative RFP emission reductions are consistent with the NOx and ROG emission reductions determined in the ozone attainment demonstration. Second, the reductions in NOx and ROG emissions should be consistent with the continuous RFP emission reduction requirement.

For the equivalency demonstration, ROG and NOx emissions within the nonattainment area boundary were reduced by 45% (3% for each of the 15 years between the designation year of 2017 and attainment year of 2032) independently from the baseline modeling year of 2018. These sensitivity simulations were used to develop RRFs and design values following the same methodology utilized in the attainment demonstration, where the sensitivity simulation was treated analogous to the future year. Table 16 summarizes the design values calculated for the 45% NOx and ROG sensitivity simulations. At the Mojave site, the ratio of the change in ozone design value to the NOx emissions change ($\Delta O_3/\Delta NOx$) are greater than that of the ROG emissions change ($\Delta O_3/\Delta ROG$). Since the ozone improvement from NOx reductions is greater than that for ROG reductions, the use of NOx substitution will result in improved ozone air quality.

Table 16. Summary of the ozone improvement from the 45% emissions reductions at the monitoring site in the EKNA.

Site	2018 Average DV (ppb)	DV After 45% NOx Reductions (ppb)	$\Delta O_3/\Delta NOx$ (ppb/tpd)	DV After 45% ROG Reductions (ppb)	$\Delta O_3/\Delta ROG$ (ppb/tpd)
Mojave-923PooleSt	82.7	82.2	0.0426	82.7	0.0000

G. Unmonitored Area Analysis

The unmonitored area analysis is used to ensure that there are no regions outside of the existing monitoring network that would exceed the NAAQS if a monitor was present (U.S. EPA, 2018). U.S. EPA recommends combining spatially interpolated design value fields with modeled ozone gradients and grid-specific RRFs in order to generate gridded future year gradient adjusted design values.

This analysis can be done using SMAT-CE (Software for the Modeled Attainment Test – Community Edition, https://www.epa.gov/scram/photochemical-modeling-tools). However, this software is not open source and comes as a precompiled software package. To maintain transparency and flexibility in the analysis, in-house R codes developed at ARB, were utilized in this analysis.

The unmonitored area analysis was conducted using the 8-hr O_3 weighted DVs from all the available sites that fall within the 4 km inner modeling domain along with the reference year 2018 and future years (2026 and 2032) 4 km CMAQ model output. The steps followed in the unmonitored area analysis are as follows:

Step 1: At each grid cell, the top 10 modeled maximum daily average 8-hour ozone mixing ratios from the reference year simulation were averaged, and a gradient in this top 10 day average between each grid cell and grid cells which contain a monitor was calculated.

Step 2: A single set of spatially interpolated 8-hour ozone DV fields was generated based on the observed 5-year weighted base year 8-hour ozone DVs from the available monitors. The interpolation is done using normalized inverse distance squared weightings from each monitor within the Voronoi regions that boarder that of the grid cell (calculated with the R tripack library), and adjusted based on the gradients between the grid cell and the corresponding monitor from Step 1.

Step 3: At each grid cell, the RRFs are calculated based on the reference- and future-year modeling following the same approach outlined in in the Methodology section of this document, except that the +/- 20% limitation on the simulated and observed maximum daily average 8-hour ozone was not applied because observed data do not exist for grid cells in unmonitored areas.

Step 4: The future year gridded 8-hour ozone DVs were calculated by multiplying the gradient-adjusted interpolated 8-hour ozone DVs from Step 2 with the gridded RRFs from Step 3

Step 5: The future-year gridded 8-hour ozone DVs (from Step 4) were examined to determine if there are any peak values higher than those at the monitors, which could potentially cause violations of the applicable 8-hour ozone NAAQS.

Under the Voronoi diagram method, each monitoring site was assigned to a Voronoi region based on location and the distance to each grid cell (Sen 2016), and the interpolations were done between each grid cell and all the monitors in surrounding Voronoi regions. Voronoi diagram with inverse distance weighting method has been used in various 2-D data analysis areas, including air quality measurements interpolations (Atsuyuki, et al., 2009; Deligiorgi and Philippopoulos 2011).

The spatial distribution of gridded DVs in 2026 (left panel) and 2032 (right panel) for the EKNA unmonitored area analysis (described above) are shown in Figure 20. The black colored star markers denote the monitoring sites, which had valid reference year 2018 DVs and were used in the analysis. The unmonitored area analysis for future year 2026 in the EKNA shows an area within the region located to the center of the western boundary, which has 2026 DVs greater than 75 ppb. The 2032 unmonitored area analysis shows some isolated spots located close to the southern boundary with future DVs above 70 ppb.

Wildfires have significantly impacted the SJVAB and EKNA ozone levels over the past years (Weight of Evidence of this SIP document and SJV 2022). Fire impacted days from 2016 – 2019 that influenced the ozone DVs within the SJVAB and EKNA are listed in Table S 1. Figure 21 shows the spatial distribution of interpolated future year ozone DVs within EKNA when fire impacted days were excluded from the base year DV calculations for both the SJVAB and EKNA monitoring sites. Compared to the results shown in Figure 20, there is a clear decrease in ozone DVs across the entire region for both 2026 and 2032. The non-attainment area in the center along the western boundary for 2026 is much smaller after fire days are excluded. For year 2032, the entire EKNA will attain the 70 ppb standard with fire days excluded.

The small non-attainment area in 2026 is in close proximity and lies directly downwind of the SJVAB. Based on the phenomenological evaluation of the wind fields shown in the bottom panel of Figure 13, there were prevailing westerly winds at mid-day during the top 10 ozone days, indicating significant contributions from regional transport of emissions in the SJVAB/Bakersfield region to the ozone levels in EKNA. In contrast, due to the mountains (see terrain plots in Figure 22) that separate EKNA from SJVAB in the west, the unmonitored region exhibiting elevated ozone levels in 2026 is generally isolated from air pollutants emitted in other regions of the EKNA.

From 2026 to 2032, the unmonitored area that exceeded the 75 ppb standard in 2026 is predicted to experience a decrease in ozone of over 5 ppb, bringing the region into attainment of the 70 ppb standard. Over that same time period, emissions of NOx and ROG in the EKNA are predicted to decrease very little from 17.8 tpd and 7.0 tpd to 17.5 tpd and 6.8 tpd, respectively. In contrast, NOx and ROG emissions in the SJVAB are predicted to decrease much more significantly, particularly for NOx, from 126 tpd and 296 tpd in 2026 to 100 tpd and 290 tpd in 2032, respectively. Given the predominant wind patterns and topography, it is clear that the unmonitored region along the western boundary between EKNA and SJVAB is influenced more by emissions from the SJVAB than from EKNA and that as SJVAB emissions are reduced, the unmonitored region will be brought into attainment of both the 75 ppb and 70 ppb ozone standards.

Figure 20. Spatial distribution of the future 2026 DVs (left) and 2032 DVs (right) based on the unmonitored area analysis in the EKNA.

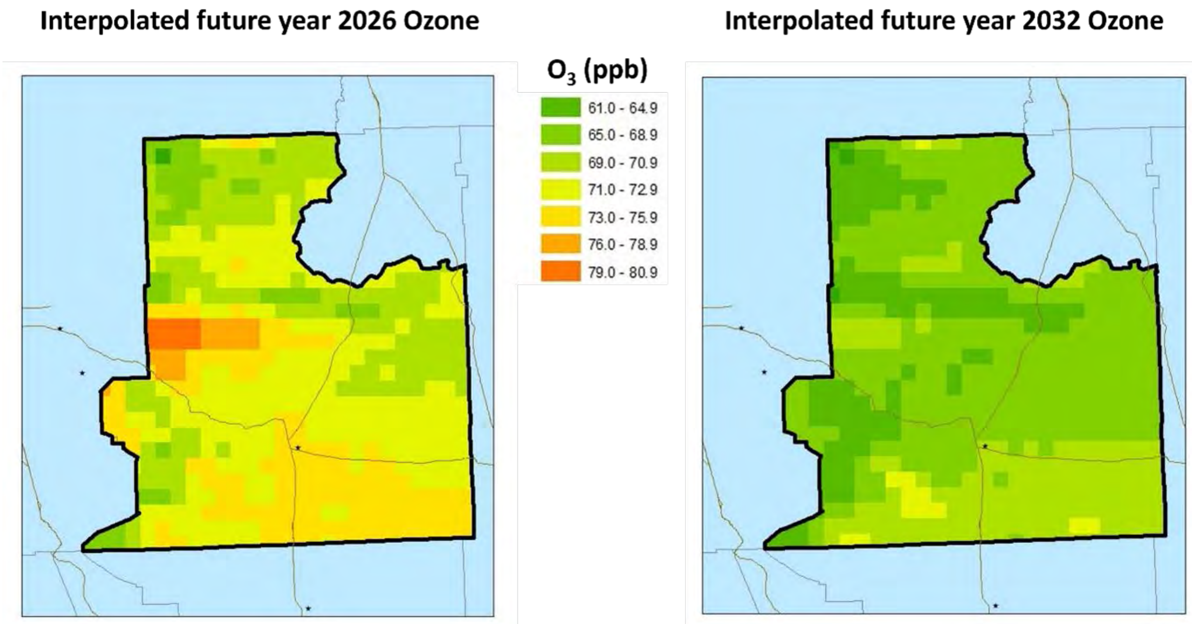


Figure 21. Spatial distribution of the future 2026 DVs (left) and 2032 DVs (right) based on the unmonitored area analysis in the EKNA, with fire days excluded in DVs calculation for EKNA and SJV sites.

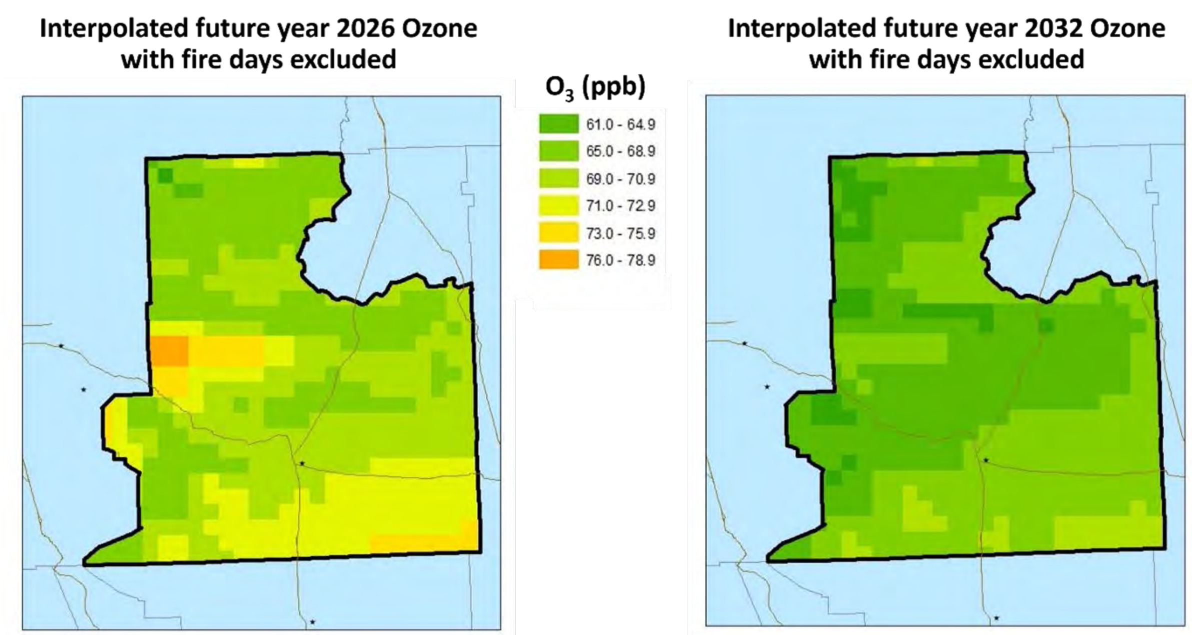
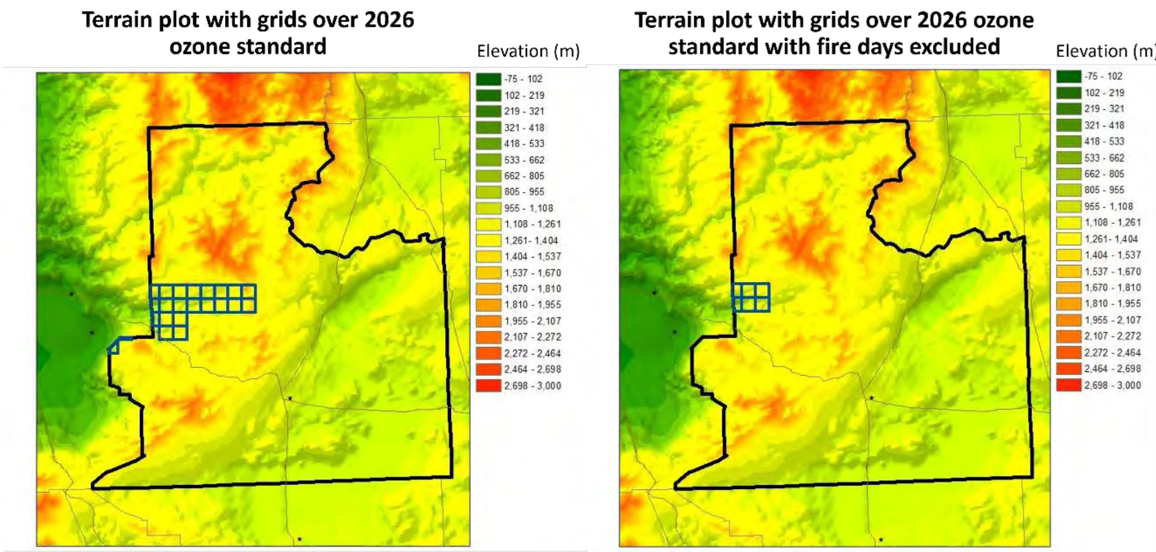


Figure 22. Terrain plots of EKNA and surrounding regions, with mark of grids that have interpolated 2026 Ozone concentration above standard (75 ppb) based on the unmonitored area analysis in the EKNA. Blue bordered grids in the figures represent the area that have interpolated 2026 ozone concentration above standard (75 ppb), with fire days included (left) and excluded (right) in DVs calculation for EKNA and SJV sites.



References

Angevine, W. M., L. Eddington, K. Durkee, C. Fairall, L. Bianco, and J. Brioude. 2012. "Meteorological model evaluation for CalNex 2010." *Monthly Weather Review* (140): 3885-3906.

Atsuyuki, O., B. Boots, K. Sugihara, and S. N. Chiu. 2009. *Spatial tessellations: concepts and applications of Voronoi diagrams.* Second. John Wiley & Sons.

Baker, K. R., C. Misenis, M. D. Obland, R. A. Ferrare, A. J. Scarino, and J. T. Kelly. 2013. "Evaluation of surface and upper air fine scale WRF meteorological modeling of the May and June 2010 CalNex period in California." *Atmospheric Environment* (80): 299-309.

Bao, J.W., S.A. Michelson, P.O.G. Persson, I.V. Djalalova, and J.M. Wilczak. 2008. "Observed and WRF-simulated low-level winds in a high-ozone episode during the Central California ozone study." *Journal of Applied Meteorology and Climatology* 47: 2372-2394.

Beaver, S., and A. Palazoglu. 2009. "Influence of synoptic and mesoscale meteorology on ozone pollution potential for San Joaquin Valley of California." *Atmospheric Environment* 43 (10).

Blanchard, C.L., S. Tanenbaum, E.M. Fujita, D. Campbell, and J. Wilkinson. 2008. *Understanding Relationships between Changes in Ambient Ozone and Precursor Concentrations and Changes in VOC and NOx Emissions from 1990 to 2004 in Central California.* Report prepared for the California Air Resources Board, Envair, DRI and Alpine Geophysics.

Buchholz, R. R., Emmons, L. K., Tilmes, S., & The CESM2 Development Team. 2019. "CESM2.1/CAM-chem Instantaneous Output for Boundary Conditions." UCAR/NCAR - Atmospheric Chemistry Observations and Modeling Laboratory. https://doi.org/10.5065/NMP7-EP60.

Cai, C., J. C. Avise, A. Kaduwela, J. DaMassa, C. Warneke, J. B. Gilman, W. Kuster, et al. 2019. "Simulating the Weekly Cycle of NOx-VOC-HOx-O3Photochemical System in the South Coast ofCalifornia During CalNex-2010 Campaign." *Journal of Geophysical Research: Atmospheres* 3532–3555.

Cai, C., S. Kulkarni, Z. Zhao, A. Kaduwela, J. C. Avise, and J. A. DaMassa. 2016. "Simulating Reactive Nitrogen, Carbon Monoxide, and Ozone in California During ARCTAS-CARB 2008 with High Wildfire Activity." *Atmospheric Environment* 28-44.

CARB. 1990. *Assessment and Mitigation of the Impacts of Transported Pollutants on Ozone Concentrations within California, Staff Report prepared by the Technical Support Division and the Office of Air Quality Planning and Liaison of the California Air Resources Board.* available at https://www.arb.ca.gov/aqd/transport/assessments/1990.pdf.

CARB. 2020. *2017 Baseline Inventory and Vehicle Miles Traveled Offset Demonstration for the 2015 70 ppb 8-hour Ozone Standard available at* *https://ww2.arb.ca.gov/resources/documents/2017-baseline-inventory-and-vehicle-miles-traveled-offset-demonstration-2015-70.* Accessed Jan 2022.

CARB. 2018. "2018 Western Nevada County Planning Area Ozone Attainment Plan available at https://ww3.arb.ca.gov/planning/sip/planarea/wnc/carb_staff_report.pdf." Staff Report. Accessed Jan 2022.

Carter, W.P.L. 2010b. "Development of a condensed SAPRC-07 chemical mechanism." *Atmospheric Environment* 5336-5345.

Carter, W.P.L. 2010a. "Development of the SAPRC-07 chemical mechanism." *Atmospheric Environment* 5324-5335.

Chen, J., D. Yin, Z. Zhao, A. P. Kaduwela, J. C. Avise, J. A. DaMassa, A. Beyersdorf, and S. Burton et al. 2020. "Modeling air quality in the San Joaquin Valley of California during the 2013 DISCOVER-AQ field campaign." *Atmospheric Environment* (5): 100067.

Deligiorgi, D., and K. Philippopoulos. 2011. "Spatial Interpolation Methodologies in Urban Air Pollution Modeling: Application for the Greater Area of Metropolitan Athens, Greece." In *Advanced Air Pollution*. doi:10.5772/17734.

EasternKern. 2017. "2017 Ozone Attainment Plan, available at: http://www.kernair.org/Documents/Announcements/Attainment/2017%20Ozone%20Plan_EKAPCD_Adopted_7-27-17.pdf."

EKAPCD. 2003. "East Kern County Ozone Attainment Demonstration, Maintenance Plan, and Redesignation Request." available at https://www.arb.ca.gov/planning/sip/planarea/easternkern/2003kernplan.pdf.

Emery, C., Liu, Z., Russell, A. M., Odman, T., Yarwood, G., Kumar, N. 2017. "Recommendations on statistics and benchmarks to assess photochemical model performance." *Journal of the Air & Waste Management Association* 582-598.

Emmons, L. K., R. H. Schwantes, J. J. Orlando, G. Tyndall, D. Kinnison, and J.-F. Lamarque et al. 2020. "The Chemistry Mechanism in the Community Earth System Model version 2 (CESM2)." *Journal of Advances in Modeling Earth Systems.* https://doi.org/10.1029/2019MS001882.

EPA, U.S. 2017. "Ozone Designations - 2015 Standards accessible at https://www.epa.gov/sites/default/files/2018-05/documents/ca_tsd_combined_final_0.pdf." Accessed Jan 2022. https://www.epa.gov/sites/default/files/2018-05/documents/ca_tsd_combined_final_0.pdf.

Fast, J. D., W. I. Gustafson Jr, L. K. Berg, W. J. Shaw, M. Pekour, and M. Shrivastava et al. 2012. "Transport and mixing patterns over Central California during the carbonaceous aerosol and radiative effects study (CARES)." *Atmospheric Chemistry and Physics* (12): 1759-1783.

Fosberg, M.A., and M.J. Schroeder. 1966. "Marine air penetration in Central California." *Journal of Applied Meteorology* (5): 573-589.

Fujita, E. M., R. E. Keislar, D. L. Freeman, J. Watson, A. J. Ranzieri, S. Tanrikulu, and K. Magliano. 1999. *Field study plan for the Central California Ozone Study.*

He, H., X-Z. Liang, and D. J. Wuebbles. 2018. "Effects of emissions change, climate change and long-range transport on regional modeling of future U.S. particulate matter pollution and speciation." *Atmospheric Environment*, 166-176. doi:https://doi.org/10.1016/j.atmosenv.2018.02.020.

Heuss, J. M., D. F. Kahlbaum, and G. T. Wolff. 2003. "Weekday/Weekend Ozone Differences: What Can We Learn from Them?" *Journal of the Air & Waste Management Association* 53 (7): 772-788.

Hu, J., C. J. Howard, F. Mitloehner, P. G. Green, and M. J. Kleeman. 2012. "Mobile Source and Livestock Feed Contributions to Regional Ozone Formation in Central California." *Environmental Science and Technology* (46): 2781-2789.

Imperial. 2017. " Imperial County 2017 State Implementation Plan for the 2008 8-Hour Ozone Standard, available at: https://ww3.arb.ca.gov/planning/sip/planarea/imperial/2017o3sip_final.pdf ."

Imperial. 2018. " Imperial County 2018 Annual Particulate Matter Less than 2.5 Microns in Diameter State Implementation Plan, available at: https://ww3.arb.ca.gov/planning/sip/planarea/imperial/final_2018_ic_pm25_sip.pdf ."

Jin, L., N. J. Brown, R. A. Harley, J-W. Bao, S. A. Michelson, and J. M. Wilczak. 2010. "Seasonal versus episodic performance evaluation for an Eulerian photochemical air quality model." *Journal of Geophysical Research: Atmospheres* 115, D09302.

Jin, L., S. Tonse, D. S. Cohan, X Mao, R. A. Harley, and N. J. Brown. 2008. "Sensitivity analysis of ozone formation and transport for a central California air pollution episode." *Environmental Science and Technology* 3683-3689.

Kelly, J. T., K. R. Baker, J. B. Nowak, J. G. Murphy, Z. M. Milos, T. C. VandenBoer, R. A. Ellis, et al. 2014. "Fine-scale simulation of ammonium and nitrate over the South Coast Air Basin and San Joaquin Valley of California during CalNex-2010." *Journal of Geophysical Research* (119): 3600-3614. doi:doi:10.1002/2013JD021290.

Kelly, J.T., J. Avise, C. Cai, and A. Kaduwela. 2010. "Simulating particle size distributions over California and impact on lung deposition fraction." *Aerosol Science and Technology* 148-162.

Kelly, J.T., K.R Baker, J.B. Nowak, and J.G Murphy et al. 2014. "Fine-scale simulation of ammonium and nitrate over the South Coast Air Basin and San Joaquin Valley of California during CalNex-2010." *Journal of Geophysical Research: Atmosphere* 3600–3614.

Kulkarni, S., A. P. Kaduwela, J. C. Avise, J. A. DaMassa, and D. Chau. 2014. "An extended approach to calculate the ozone relative response factors used in the attainment demonstration for the National Ambient Air Quality Standards." *Journal of the Air and Waste Management Association* 1204-1213.

Lamarque, J.-F., L. K. Emmons, P. G. Hess, D. E. Kinnison, S. Tilmes, F. Vitt, C. L. Heald, et al. 2012. "CAM-chem: description and evaluation of interactive atmospheric chemistry in the Community Earth System Model." *Geoscientific Model Development* 369-411.

Lehrman, D. 2001. *Characterization of the 2000 Measurement Period.* Interim Report prepared for California Air Resources Board, Technical and Business Systems, Inc.,.

Lehrman, D., D. Bush, B. Knuth, D. Fairley, and C. Blanchard. 2004. *Characterization of the CCOS 2000 measurement period.* Final Report prepared for California Air Resources Board, Technical and Business Systems, Inc.

Lin, M., A. M. Fiore, O. R. Cooper, L. W. Horowitz, A. O. Langford, H. Levy II, B. J. Johnson, V. Naik, and S. J. Oltmans. 2012. "Springtime high surface ozone events over the western United States: Quantifying the role of stratospheric." *Journal of Geophysical Research* D00V22, doi:10.1029/2012JD018151.

Livingstone, P.L., K. Magliano, K. Gurer, P.D. Allen, K.M. Zhang, Q. Ying, and , B.S. Jackson et al. 2009. "Simulating PM concentration during a winter episode in a subtropical valley: Sensitivity simulations and evaluation methods." *Atmospheric Environment* 5971-5977.

Pun, B. K., J. F. Loius, and C. Seigneur. 2008. *A conceptual model of ozone formation in the San Joaquin Valley.* CP049-1-98, Atmospheric and Environmental Research Inc., San Ramon, CA.

Pun, B.K., R.T.F. Balmori, and C. Seigneur. 2009. "Modeling wintertime particulate matter formation in central California." *Atmospheric Environment* 402-409.

Pusede, S. E., and R. C. Cohen. 2012. "On the observed response of ozone to NOx and VOC reactivity reductions in San Joaquin Valley California 1995–present." *Atmospheric Chemistry and Physics* 8323-8339.

Pusede, S. E., D. R. Gentner, P. J. Wooldridge, E. C. Browne, A. W. Rollins, K. E. Min, A. R. Russell, et al. 2014. "On the temperature dependence of organic reactivity, nitrogen oxides, ozone production, and the impact of emission controls in San Joaquin Valley, California." *Atmospheric Chemistry and Physics* 3373-3395.

Sacramento. 2017. "Sacramento Regional 2008 NAAQS 8-Hour Ozone Attainment And Reasonalbe Further Progress Plan, available at http://www.airquality.org/ProgramCoordination/Documents/Sac%20Regional%202008%20NAAQS%20Attainment%20and%20RFP%20Plan.pdf."

Seinfeld, J. H., and S. N. Pandis. 1998. *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change.* Edited by 1. New York: J. Wiley.

Sen, Zekai. 2016. "2.8.1 Delaney, Varoni, and Thiessen Polygons." In *Spatial Modeling Principles in Earth Sciences*, 57. Springer.

Shahrokhishahraki, N., P. J. Rayner, J. D. Silver, S. Thomas, and R. Schofield. 2022. "High-resolution modeling of gaseous air pollutants over Tehran and validation with surface and satellite data." *Atmospheric Environment*. doi:https://doi.org/10.1016/j.atmosenv.2021.118881.

Shearer, S. M., Harley, R. A., Jin, L., Brown, N. J. 2012. "Comparison of SAPRC99 and SAPRC07 mechanisms in photochemical modeling for central California." *Atmospheric Environment* 205-216.

Sillman, S. 1999. "The relation between ozone, NOx and hydrocarbons in urban and polluted rural environments." *Atmospheric Environment* 33 (12): 1821-1845.

Simon, H., K. R. Baker, and S. Phillips. 2012. "Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012." *Atmospheric Environment* (61): 124-139.

SJV. 2018. " 2018 PM2.5 Plan for the San Joaquin Valley, available at: http://valleyair.org/pmplans/ ."

SJV. 2008. "2008 PM2.5 Plan, available at: http://www.valleyair.org/Air_Quality_Plans/AQ_Proposed_PM25_2008.htm."

SJV. 2012. "2012 PM2.5 Plan, available at: http://www.valleyair.org/Air_Quality_Plans/PM25Plans2012.htm ."

SJV. 2013. "2013 Plan for the Revoked 1-Hour Ozone Standard, available at: http://valleyair.org/Air_Quality_Plans/Ozone-OneHourPlan-2013.htm ."

SJV. 2016a. "2016 Moderate Area Plan for the 2012 PM2.5 Standard, available at: http://www.valleyair.org/Air_Quality_Plans/docs/PM25-2016/2016-Plan.pdf ."

SJV. 2016b. "2016 Plan for the 2008 8-Hour Ozone Standard, available at: http://valleyair.org/Air_Quality_Plans/Ozone-Plan-2016.htm ."

Skamarock, W. C., J. B. Klemp, J. Dudhia, D. O. Gill, D. M. Barker, M. G. Duda, X.-Y. Huang, W. Wang, and J. G. Powers. 2008. ""Description ofthe Advanced Research WRF version 4,Rep. NCAR/TN-475++STR,Natl. Cent. for Atmos. Res., ."." Boulder, Colo.

SouthCoast. 2012. "Final 2012 Air Quality Management Plan, available at: http://www.aqmd.gov/home/air-quality/clean-air-plans/air-quality-mgt-plan/final-2012-air-quality-management-plan ."

SouthCoast. 2016. "Final 2016 Air Quality Management Plan, available at: http://www.aqmd.gov/docs/default-source/clean-air-plans/air-quality-management-plans/2016-air-quality-management-plan/final-2016-aqmp/cover-and-opening.pdf?sfvrsn=6."

Tonse, S. R., N. J. Brown, R. A. Harley, and L. Jin. 2008. "A process-analysis based study of the ozone weekend effect." *Atmospheric Environment* 7728-7736.

U.S. EPA. 2018. *Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze.* 11 29. https://www.epa.gov/scram/sip-modeling-guidance-documents.

U.S.EPA. 1993. "NOx Substitution Guidance, available at https://www3.epa.gov/ttn/naaqs/aqmguide/collection/cp2/19931201_oaqps_nox_substitution_guidance.pdf."

Ventura. 2016. "Final 2016 Ventura County Air Quality Management Plan, available at: http://www.vcapcd.org/pubs/Planning/AQMP/2016/Final/Final-2016-Ventura-County-AQMP.pdf ."

Vijayaraghavan, K., P. Karamchadania, and C. Seigneur. 2006. "Plume-in-grid modeling of summer air pollution in Central California." *Atmospheric Environment* 5097-5109.

Wang, P., P. Wang, K. Chen, J. Du, and H Zhang. 2022. "Ground-level ozone simulation using ensemble WRF/Chem predictions over the Southeast United States." *Chemosphere.* doi:https://doi.org/10.1016/j.chemosphere.2021.132428.

WesternMojave. 2016. "2016 8-Hour Ozone SIP: Western Mojave Desert Nonattainment Area, available at: https://ww3.arb.ca.gov/planning/sip/planarea/mojavesedsip.htm#2016."

WesternNevada. 2018. "Western Nevada County 8-hour Ozone Attainment Plan, available at: https://ww3.arb.ca.gov/planning/sip/planarea/wncsip.htm."

Yan, F., Y. Gao, M. Ma, C. Liu, X. Ji, F. Zhao, X. Yao, and H. Gao. 2021. "Revealing the modulation of boundary conditions and governing processes on ozone formation over northern China in June 2017." *Environmental Pollution* 272. doi:https://doi.org/10.1016/j.envpol.2020.115999.

Yienger, J. J., and H. Levy II. 1995. "Empirical model of global soil-biogenic NOχ emissions." *Journal of Geophysical Research: Atmospheres* 11447-11464.

Zhang, Y., P. Liu, X. Liu, B. Pun, C. Seigneur, M.Z. Jacobson, and W. Wang. 2010. "Fine scale modeling of wintertime aerosol mass, number, and size distributions in Central California." *Journal of Geophysical Research* D15207, doi:10.1029/2009JD012950.

Zhu, S., Horne, J. R., Kinnon, M. M., Samuelsen, G. S., Dabdub, D. 2019. "Comprehensively assessing the drivers of future air quality in California." *Environment International* 386-398.

IV. Supplemental Materials

Supplemental Materials List of Figures

Figure S 1. Time series of average temperature, relative humidity, wind speed, and direction of all sites in April 2018.

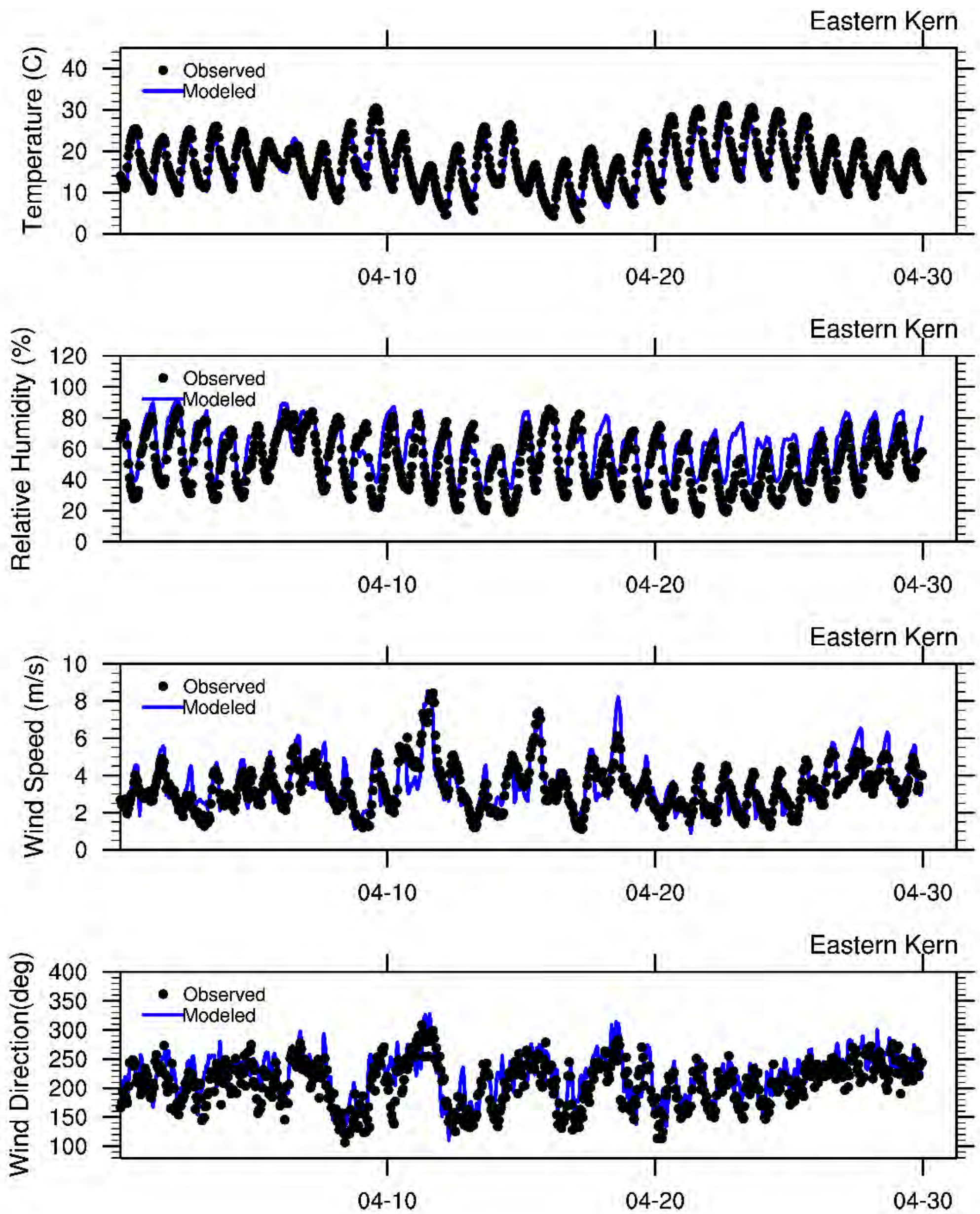


Figure S 2. Time series of average temperature, relative humidity, wind speed, and direction of all sites in May 2018.

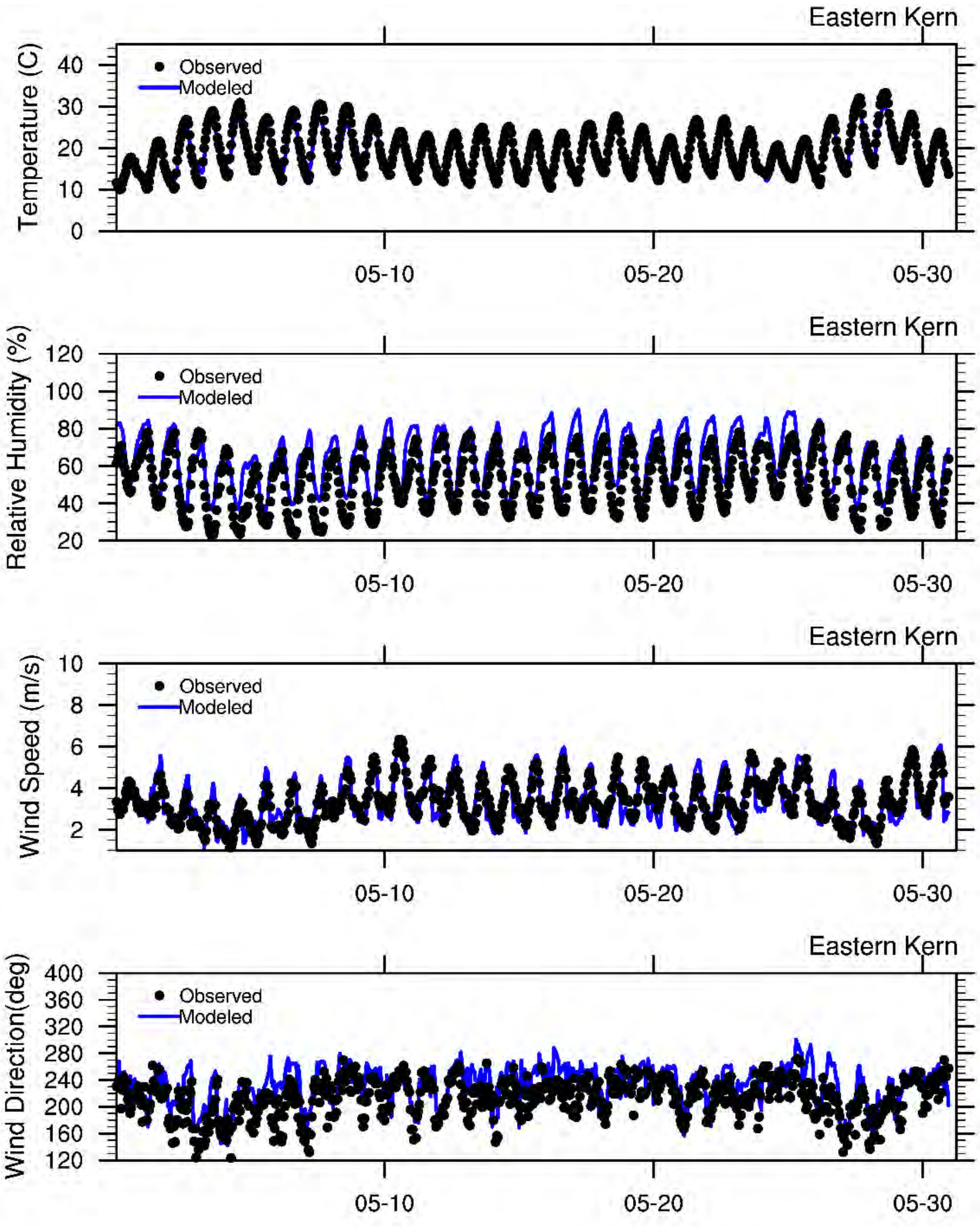


Figure S 3. Time series of average temperature, relative humidity, wind speed, and direction of all sites in June 2018.

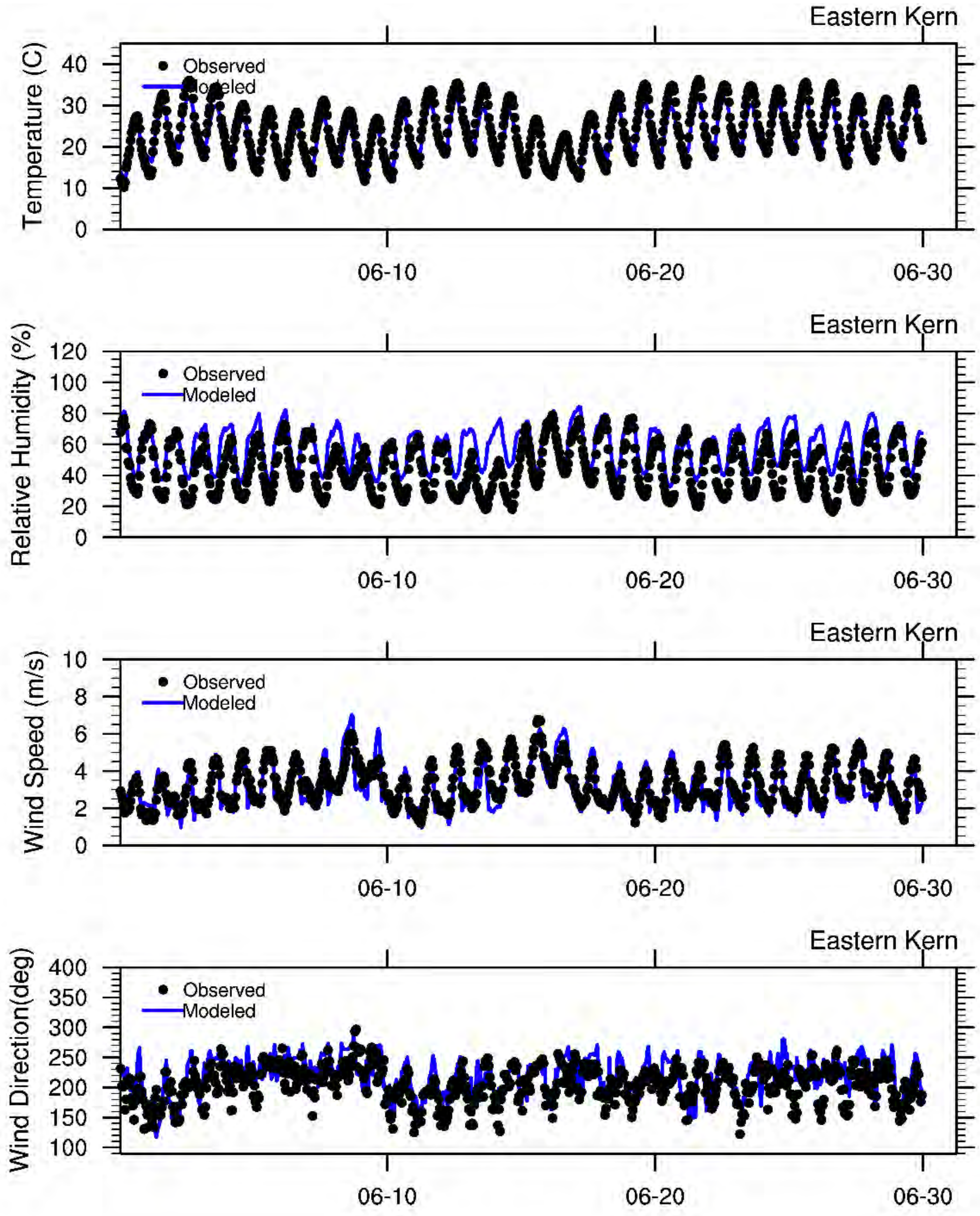


Figure S 4. Time series of average temperature, relative humidity, wind speed, and direction of all sites in July 2018.

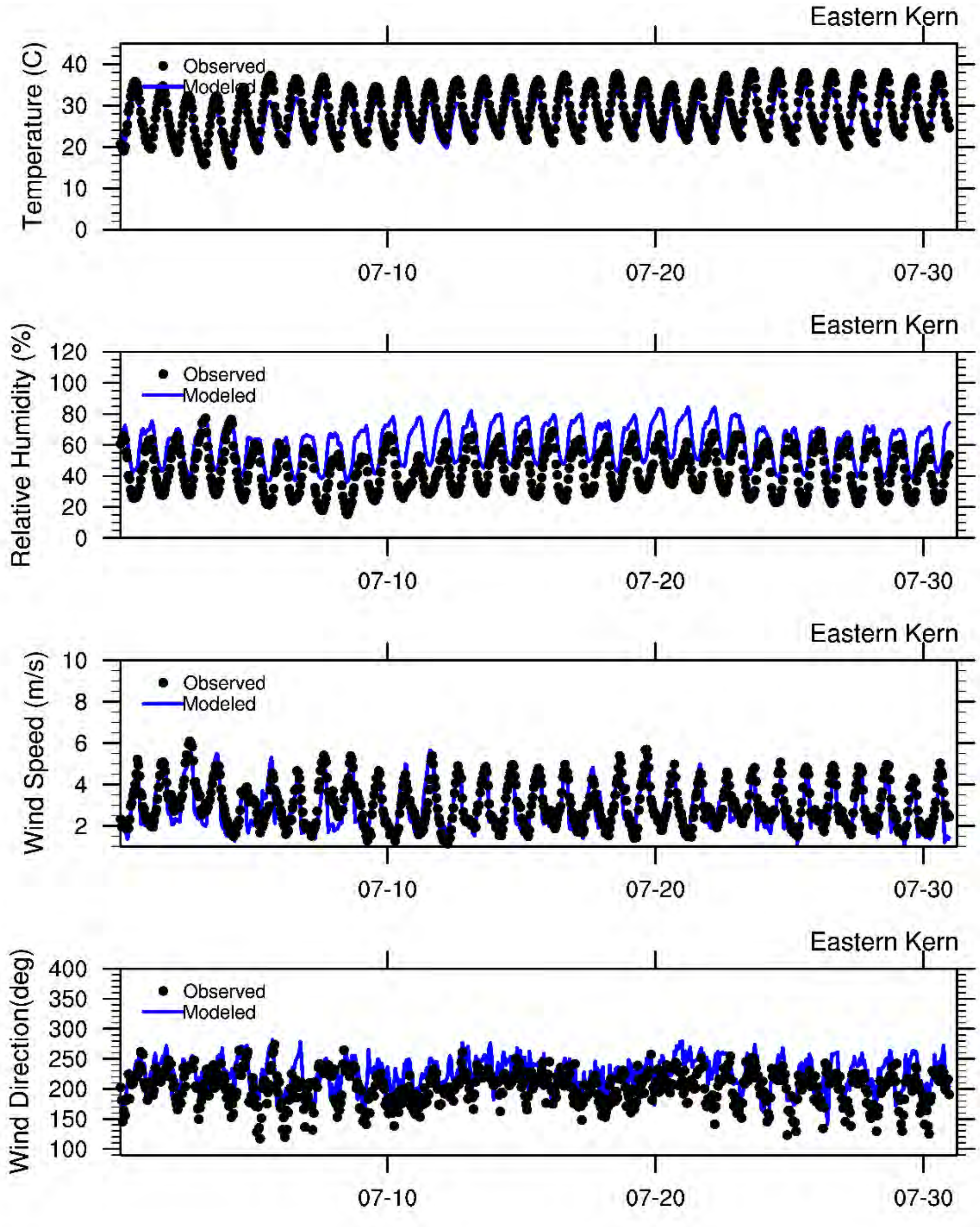


Figure S 5. Time series of average temperature, relative humidity, wind speed, and direction of all sites in August 2018.

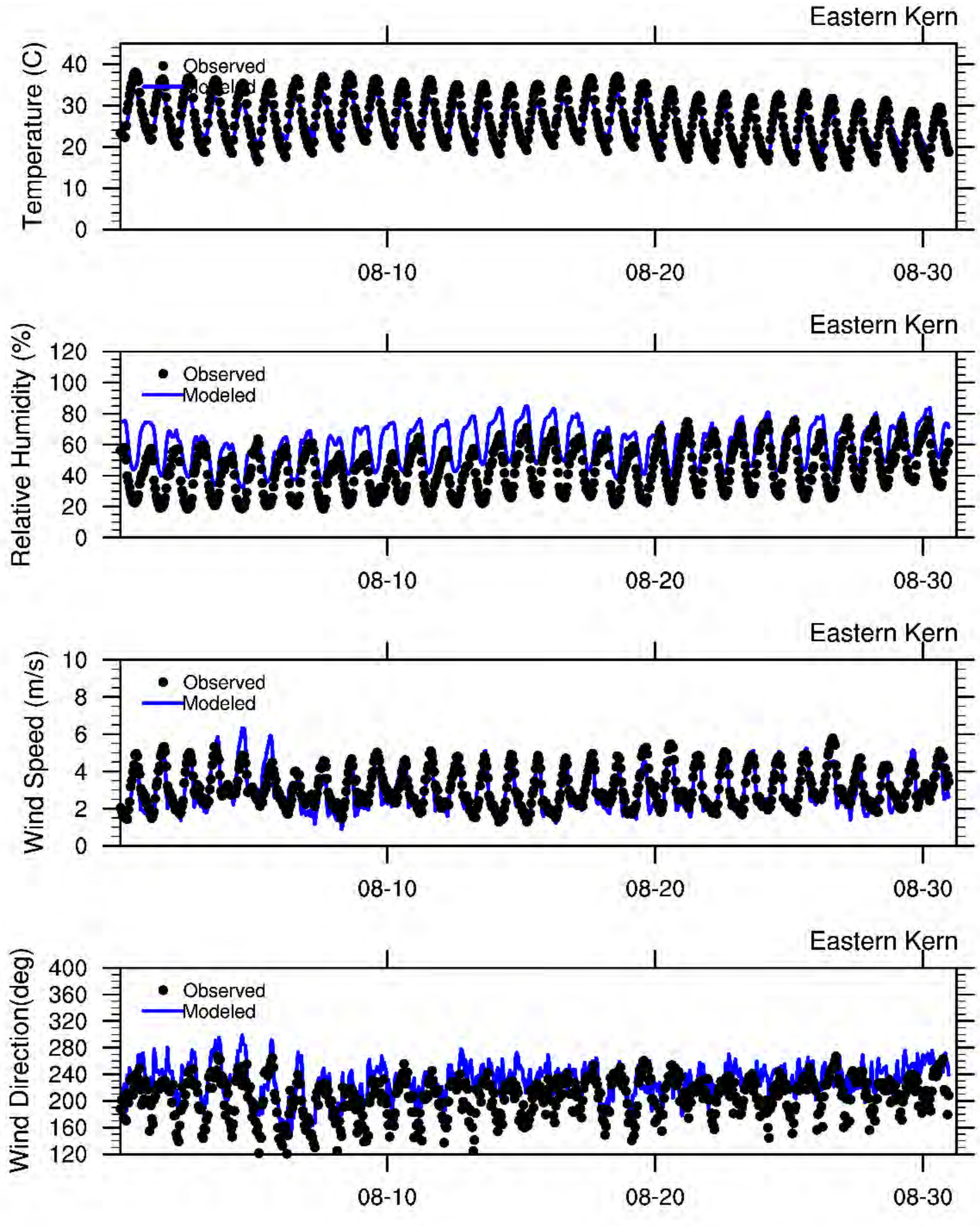


Figure S 6. Time series of average temperature, relative humidity, wind speed, and direction of all sites in September 2018.

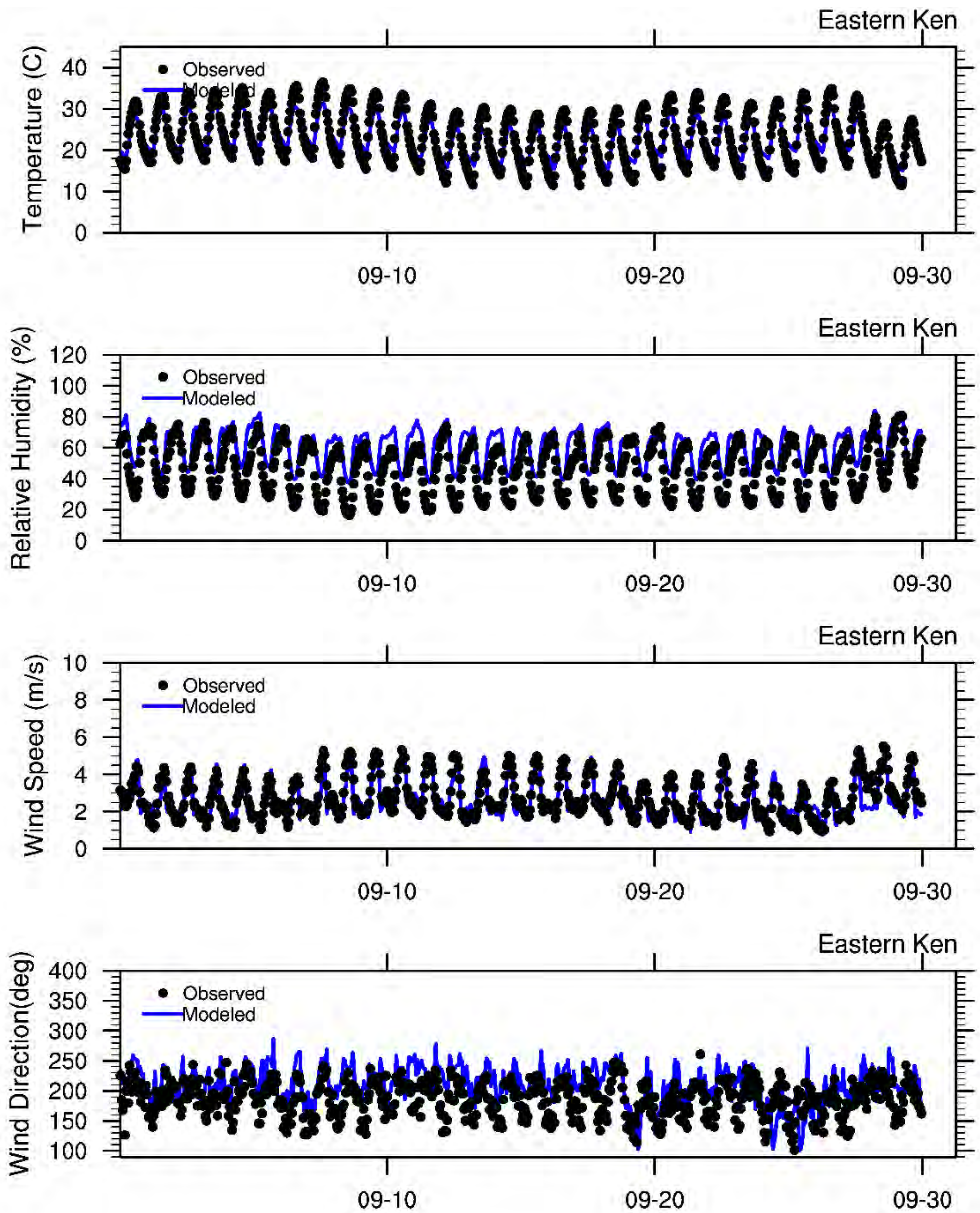


Figure S 7. Time series of average temperature, relative humidity, wind speed, and direction, and temperature of all sites in October 2018.

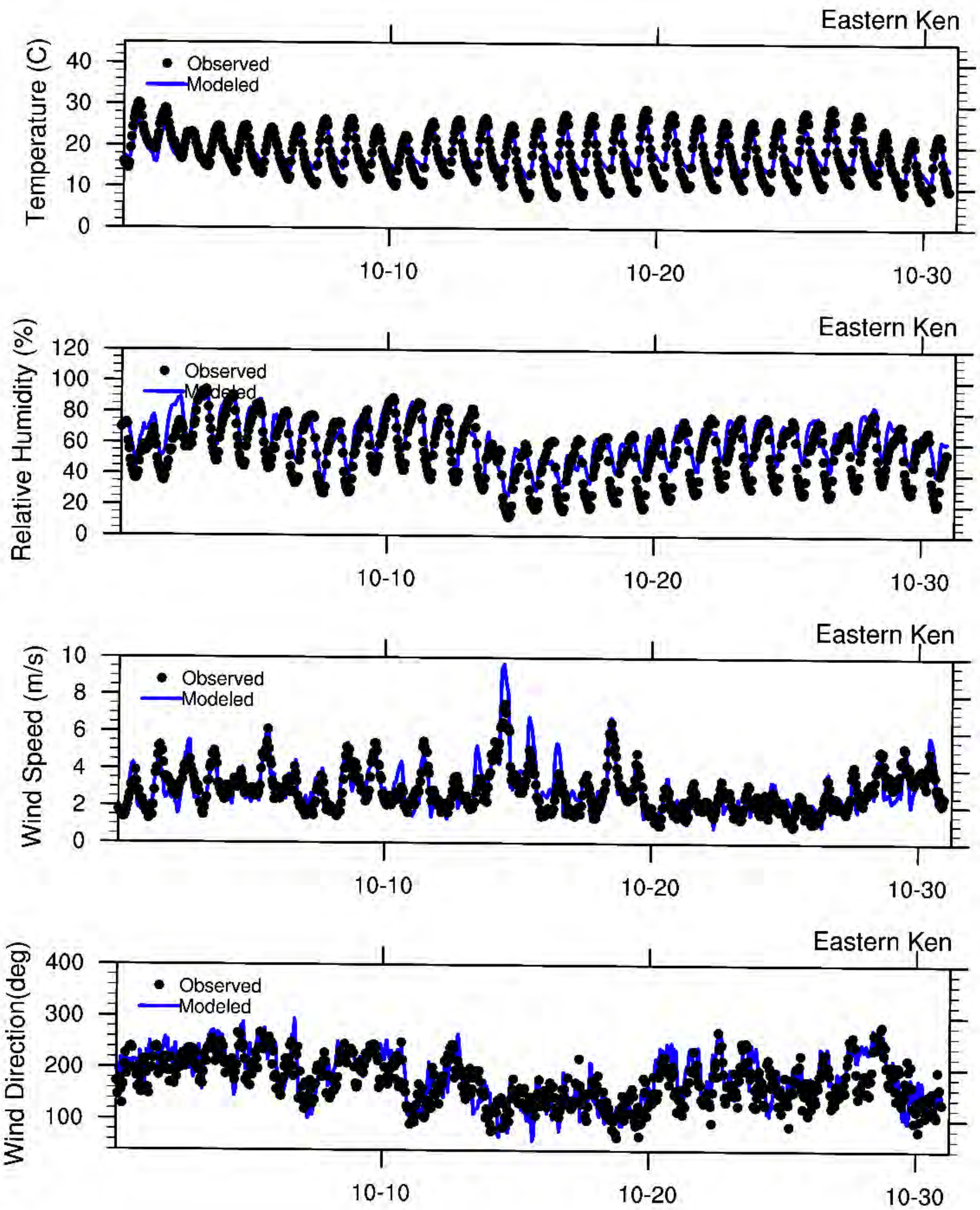


Figure S 8. Observed and modeled ozone frequency distribution at the Mojave-923PooleSt site for the ozone season (April – October 2018)

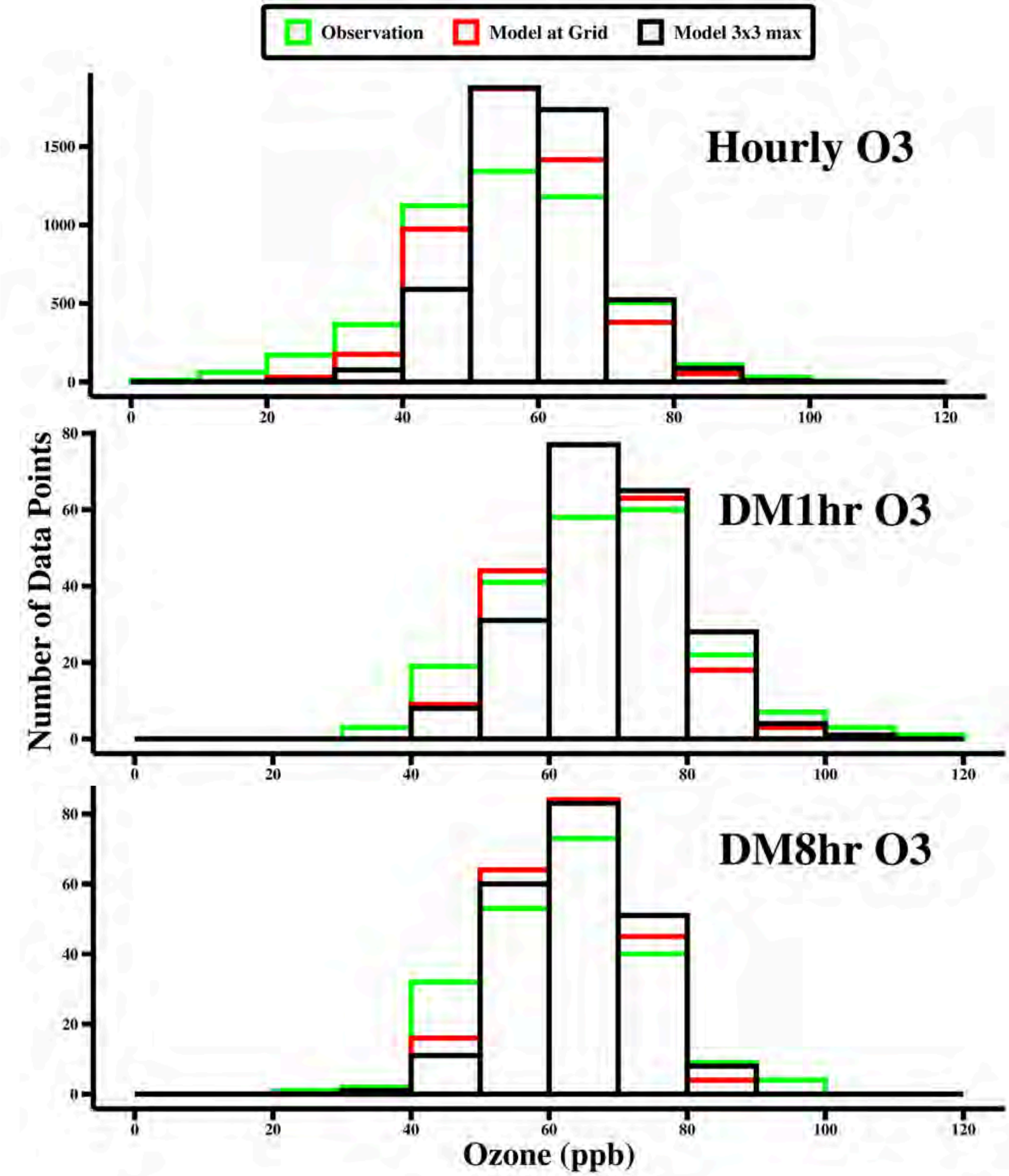


Figure S 9. Observed and modeled ozone scatter plots at the Mojave-923 PooleSt site for the ozone season (April – October 2018)

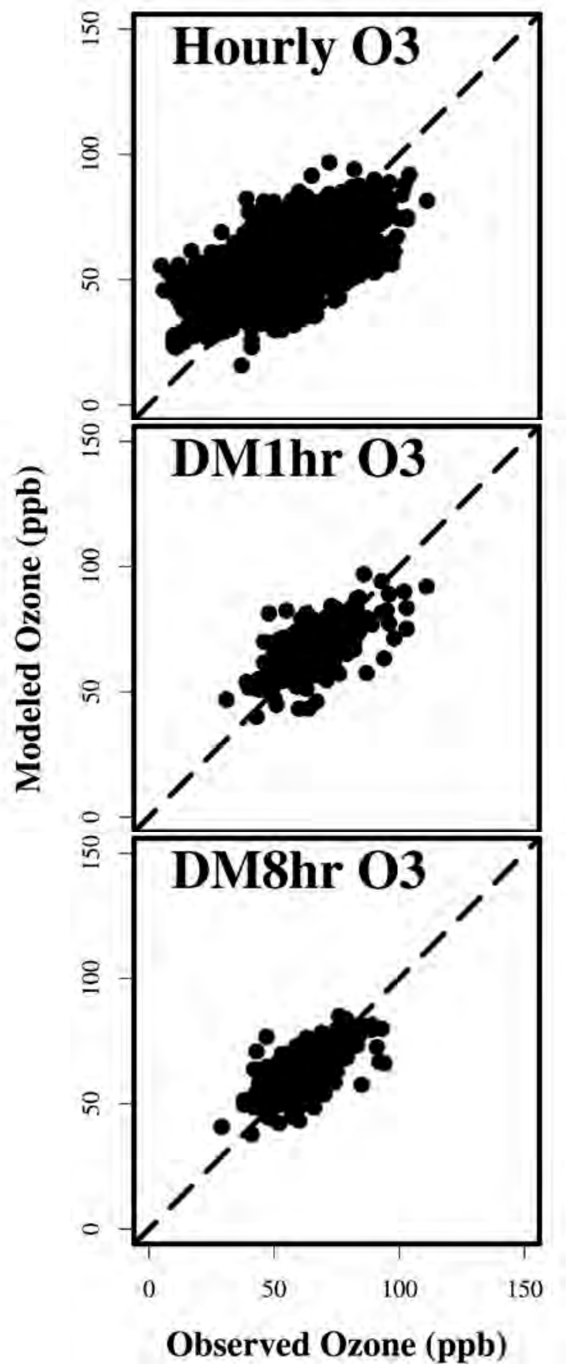


Figure S 10. Time-series of hourly ozone at Mojave-923 PooleSt for the ozone season (April – October 2018)

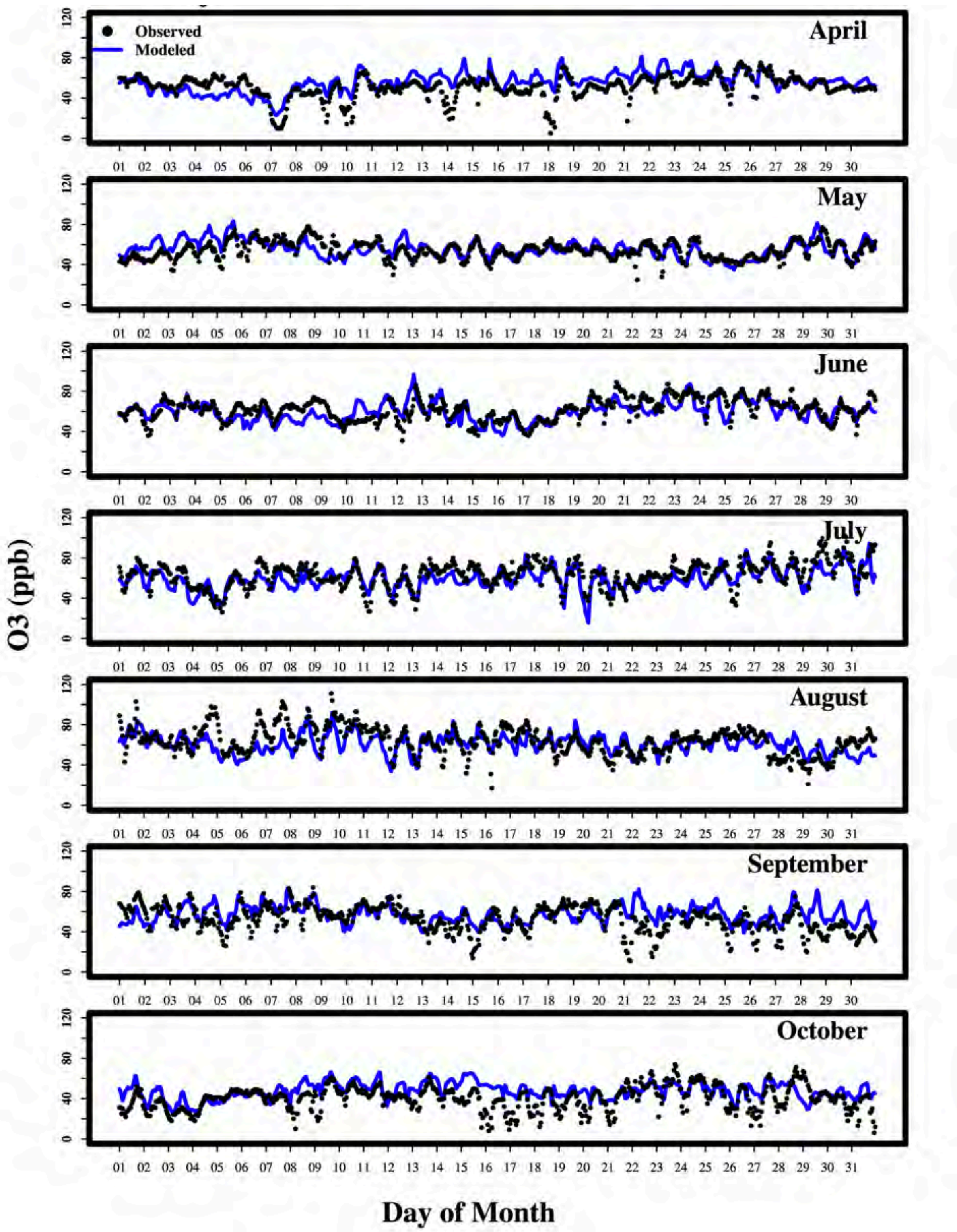


Figure S 13. Time-series of maximum daily average 1-hour ozone at the Mojave-923PooleSt site for the ozone season (April – October 2018)

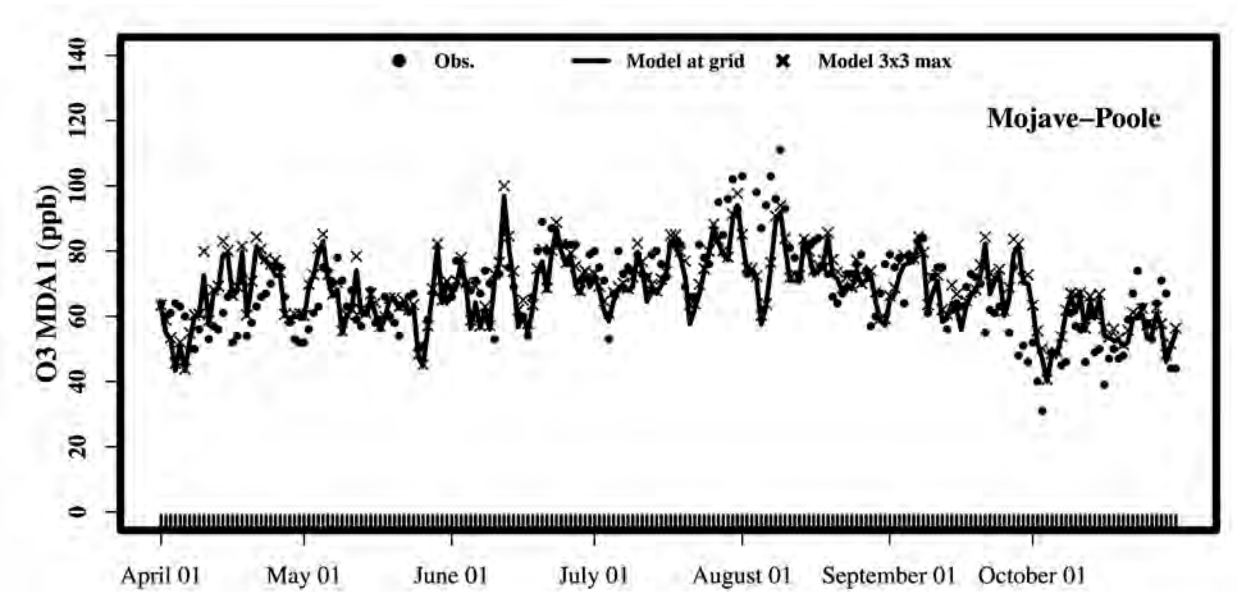


Figure S 14. Time-series of maximum daily average 8-hour ozone at the Mojave-923PooleSt site for the ozone season (April – October 2018)

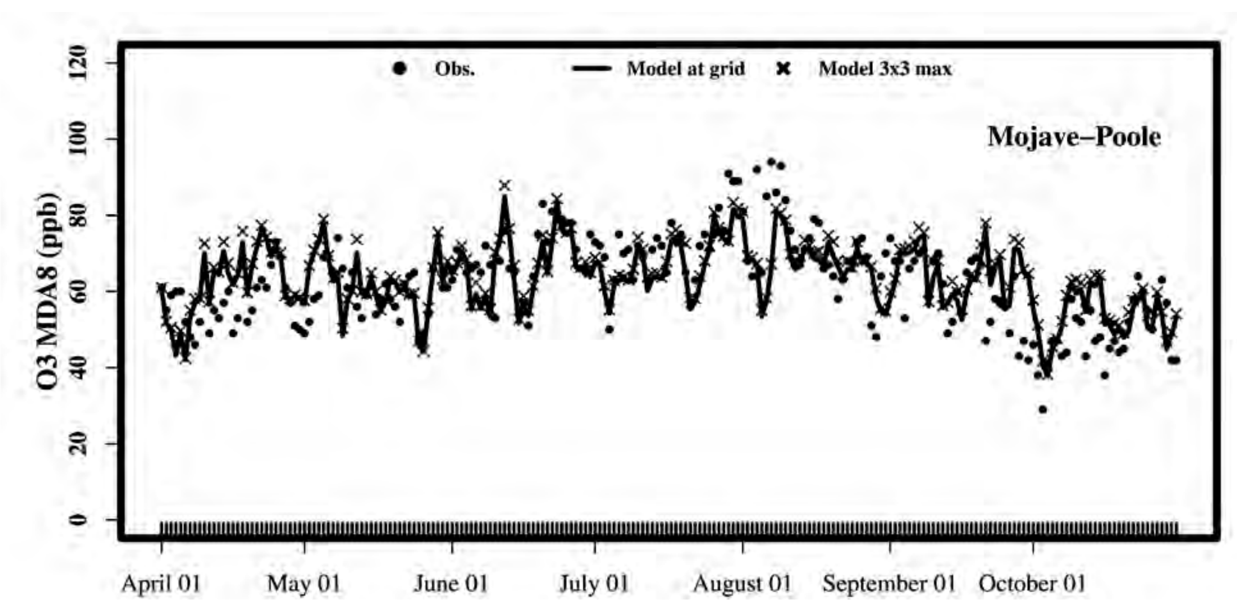


Figure S 15. Time-series of hourly NO_2 at the Shafter site in San Joaquin Valley for the ozone season (April-October 2018)

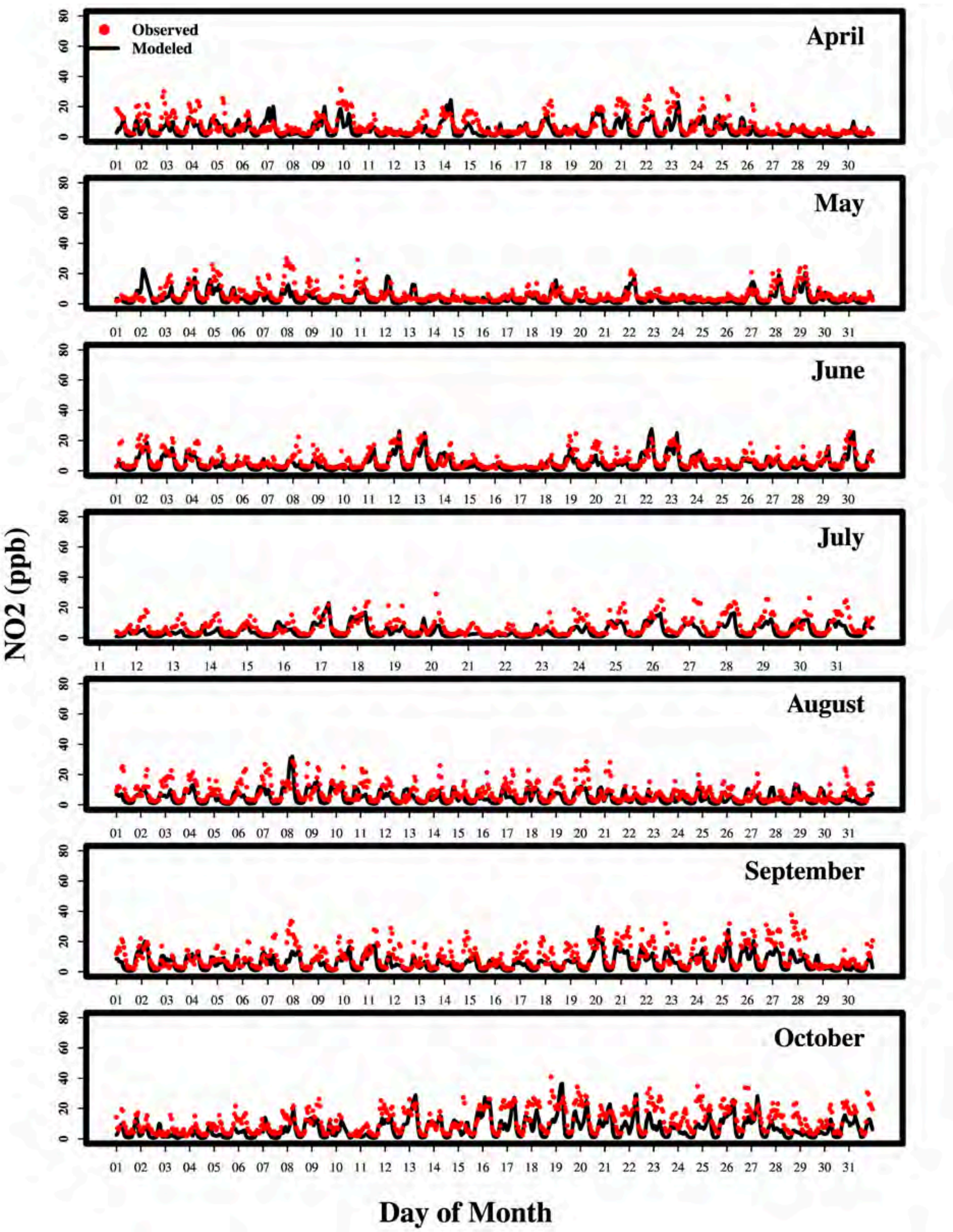


Figure S 18. Time-series of hourly NO_2 at the Santa Clarita site in South Coast for the ozone season (April-October 2018)

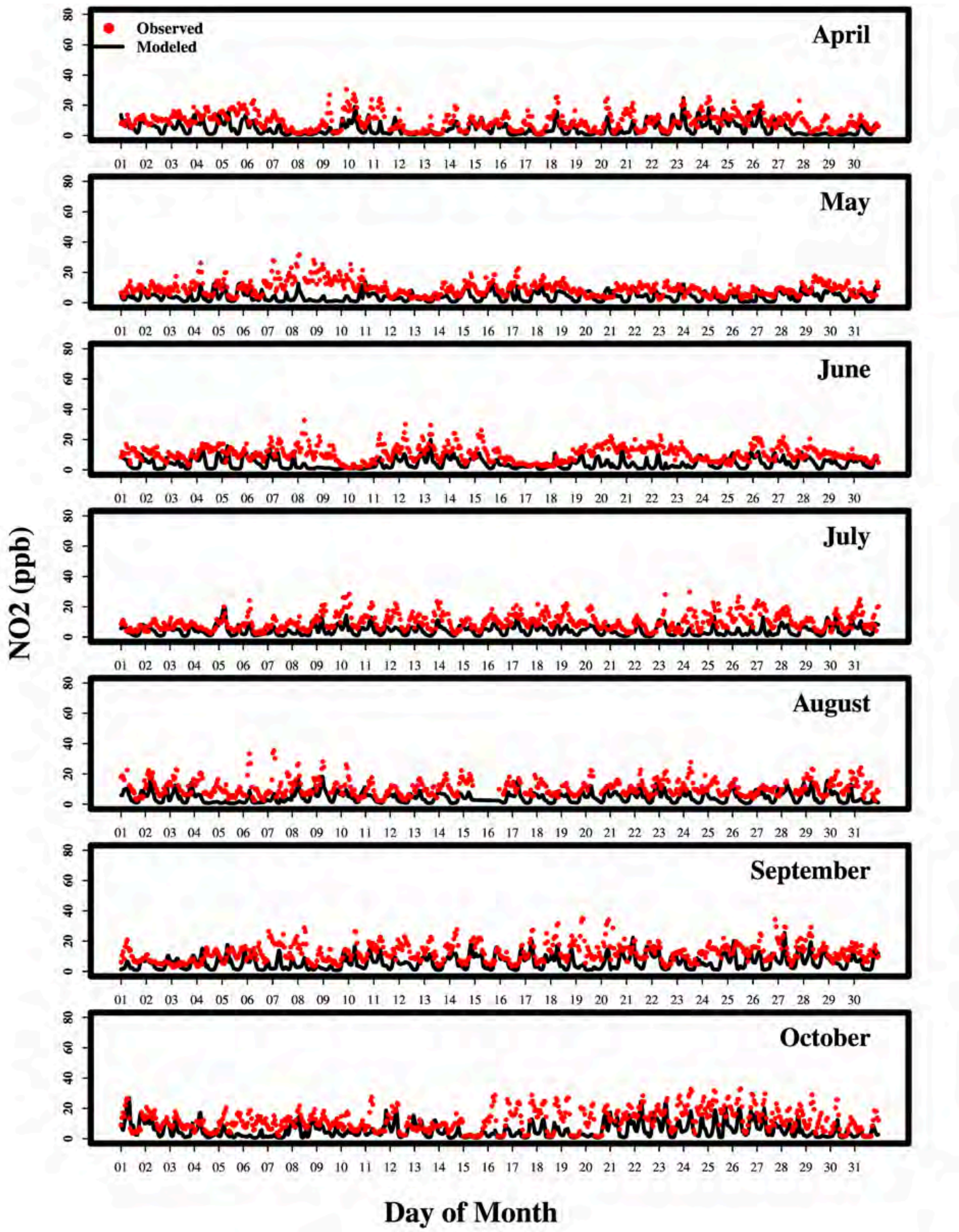


Table S 1. **List of fire days in East Kern County and SJV between year 2016 – 2019.**

East Kern 2018	**SJV 2016**	**SJV 2017**	**SJV 2018**	**SJV 2019**
2018-07-29	2016-06-30	2017-05-23	2018-07-17	2019-08-07
2018-07-30	2016-07-01	2017-05-24	2018-07-18	2019-08-15
2018-07-31	2016-07-02	2017-06-07	2018-07-24	
2018-08-04	2016-07-25	2017-06-22	2018-07-27	
2018-08-06	2016-07-26	2017-06-23	2018-07-29	
2018-08-07	2016-07-27	2017-06-25	2018-07-30	
2018-08-08	2016-07-28	2017-07-05	2018-07-31	
2018-08-09	2016-07-29	2017-07-06	2018-08-01	
2018-08-10	2016-07-30	2017-07-07	2018-08-04	
	2016-08-02	2017-07-10	2018-08-06	
	2016-08-04	2017-07-15	2018-08-07	
	2016-08-11	2017-07-23	2018-08-08	
	2016-08-12	2017-08-01	2018-08-09	
	2016-08-13	2017-08-02	2018-08-10	
	2016-08-16	2017-08-23	2018-08-16	
	2016-08-17	2017-08-25	2018-08-25	
	2016-08-18	2017-08-26		
	2016-08-19	2017-08-27		
	2016-08-20	2017-08-28		
	2016-08-29	2017-08-29		
	2016-08-30	2017-08-30		
	2016-08-31	2017-08-31		
	2016-09-07	2017-09-01		
	2016-09-08	2017-09-02		
	2016-09-18	2017-09-03		

APPENDIX N
EKAPCD RACT SIP
2008 Ozone NAAQS

BEFORE THE AIR POLLUTION CONTROL BOARD
EASTERN KERN AIR POLLUTION CONTROL DISTRICT

In the matter of:

RESOLUTION APPROVING EASTERN KERN AIR POLLUTION CONTROL DISTRICT REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT) STATE IMPLEMENTATION PLAN (SIP) FOR THE 2008 OZONE NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Resolution No. 2017-001-05

I, Louise Roman, SECRETARY TO THE AIR POLLUTION CONTROL BOARD OF THE EASTERN KERN AIR POLLUTION CONTROL DISTRICT, certify that the following Resolution, proposed by Director Gleason and seconded by Director Parris, was duly passed and adopted by said Board at an official meeting on this 11th day of May, 2017, by the following vote:

AYES: Grimes, Parris, Scrivner, and Gleason

NOES: None

ABSENT: Breeden

(District Seal)

Louise Roman
Secretary of the Air Pollution Control Board of the Eastern Kern Air Pollution Control District

By Louise Roman

RESOLUTION

1

Section 1. RECITALS:

(a) The Eastern Kern Air Pollution Control District ("District") is authorized by Health and Safety Code section 40702 to make and enforce all necessary and proper orders, rules and regulations to accomplish the purposes of Division 26 of the Health and Safety Code; and

(b) A portion of Eastern Kern has been designated as a "Moderate" nonattainment area due to exceeding the 2008, 8-Hour Ozone National Ambient Air Quality Standards (NAAQS) (70 FR 71612, November 29, 2005); and

(c) Subsections 182(b)(2), (c), (d), and (f) of the Federal Clean Air Act (FCAA) (42 U.S.C. §751la(b)(2), (c), (d),(f)) require states and districts located in ozone nonattainment areas classified as moderate or above to implement Reasonably Available Control Technology (RACT), for all source categories for which the U.S. Environmental Protection Agency (EPA) has published a Control Techniques Guidelines (CTG) document prior to the area's date of attainment, and for all non-CTG major sources; and

(d) A non-CTG major source is a permitted facility located in the District's nonattainment area that collectively exceeds the major source threshold of 50 tons per year (tpy) of either Volatile Organic Compounds (VOC) or Oxides of Nitrogen (NOx); and

(e) The Board of Directors have determined, in the RACT SIP, that the District has adopted rules meeting RACT, which cover all existing applicable CTG source categories and identified all District rules applicable to non-CTG major sources; and

(f) The RACT SIP for the 2008 Ozone NAAQS identifies three District NOx rules applicable to non-CTG major sources with deficiencies that will be formally amended to fulfill RACT requirements; and

(g) States and districts may comply with requirements of subsections 182(b)(2), (c), (d), and (f) of the FCAA (42 U.S.C. §751la(b)(2), (c), (d), (f)) by adopting a Negative Declaration for each CTG source category with no applicable source operating within the District's nonattainment area.; and

(h) The District has reviewed its permit records, emissions inventory database, and consulted with permitting and enforcement staff in determining there are no sources subject to the published CTGs identified in Table 1; and

(i) The Board of Directors have determined it is necessary to adopt Negative Declarations for the following published CTGs listed in Table 1:

Table 1 Negative Declarations

EPA Report #	CTG Source Category	Title	District Source
EPA-450-2-77-008, 1977/05	Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks	Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks	None
EPA-450/2-77-025, 1977/10	Petroleum Refineries	Control of Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds	N/A
EPA-450/2-77-026, 1977/10	Tank Trucks Gasoline Loading Terminals	Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals	N/A
EPA-450/2-77-032, 1977/12	Surface Coating of Metal Furniture	Control of VOC Emissions from Existing Stationary Sources – Volume III: Surface Coating of Metal Furniture	N/A
EPA-450/2-77-033, 1977/12	Surface Coating for Insulation of Magnet Wire	Control of Volatile Organic Emissions from Existing Stationary Sources – Volume IV: Surface Coating of Insulation of Magnet Wire	N/A
EPA-450/2-77-034, 1977/12	Surface Coating of Large Appliances	Control of VOC Emissions from Existing Stationary Sources – Volume V: Surface Coating of Large Appliances	N/A
EPA-450/2-77-035, 1977/12	Bulk Gasoline Plants	Control of VOC Emissions from Bulk Gasoline Plants	N/A
EPA-450/2-77-036, 1977/12	Storage of Petroleum Liquids in Fixed-Roof Tanks	Control of VOC Emissions from Storage of Petroleum Liquids in Fixed-Roof Tanks	N/A
EPA-450/2-77-037, 1977/12	Cutback Asphalt from Paving Operation	Control of VOC Emissions from Use of Cutback Asphalt	N/A
EPA-450/2-78-032, 1978/06	Surface Coating of Flat Wood Paneling	Control of VOC Emissions from Existing Stationary Sources – Volume VII: Factory Surface Coating of Flat Wood Paneling	N/A
EPA-450/2-78-036, 1978/06	Leaks from Petroleum Refinery Equipment	Control of VOC Leaks from Petroleum Refinery Equipment	N/A
EPA-450/2-78-029, 1978/12	Synthesized Pharmaceutical Products	Control of Volatile Organic Emissions from Manufacture of Synthesized Pharmaceutical Products	N/A
EPA-450/2-78-030, 1978/12	Manufacture of Pneumatic Rubber Tire	Control of Volatile Organic Emissions from Manufacture of Pneumatic Rubber Tires	N/A

EPA Report #	CTG Source Category	Title	District Source
EPA-450/2-78-033, 1978/12	Graphic Arts	Control of VOC Emissions from Existing Stationary Sources – Volume VIII: Graphic Arts-Rotogravure and Flexography	N/A
EPA-450/2-78-047, 1978/12	Storage of Petroleum Liquids in External Floating Roof Tanks	Control of VOC Emissions from Petroleum Liquid Storage in External Floating Roof Tanks	N/A
EPA-450/3-82-009, 1982/09	Large Petroleum Dry Cleaners	Control of VOC Emissions from Large Petroleum Dry Cleaners	N/A
EPA-450/3-83-008, 1983/11	Polymers and Resins Manufacturing Industry	Control of VOC Emissions from Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins	N/A
EPA-450/3-83-007, 1983/12	Equipment Leaks from Natural Gas/Gasoline Processing Plants	Control of VOC Equipment Leaks from Natural Gas/Gasoline Processing Plants	N/A
EPA-450/3-83-006, 1984/03	Equipment Leaks from Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment	Control of VOC Leaks from Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment	N/A
EPA-450/3-84-015, 1984/12	Synthetic Organic Chemical Manufacturing Industry	Control of VOC Emissions from Air Oxidation Processes in Synthetic Organic Chemical Manufacturing Industry	N/A
EPA-450/4-91-031, 1993/08	Synthetic Organic Chemical Manufacturing Industry	Control of VOC Emissions from Reactor Processes and Distillation Operations in Synthetic Organic Chemical Manufacturing Industry	N/A
61 FR 44050 8/27/1996, 1996/08	Shipbuilding and Ship Repair Operations	Control Techniques Guidelines for Shipbuilding and Ship Repair Operations (Surface Coating)	N/A
EPA-453/R-06-001, 2006/09	Industrial Cleaning Solvents	Control Techniques Guidelines for Industrial Cleaning Solvents	N/A
EPA-453/R-06-002, 2006/09	Offset Lithographic and Letterpress Printing	Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing	N/A
EPA-453/R-06-003, 2006/09	Flexible Package Printing	Control Techniques Guidelines for Flexible Package Printing	N/A
EPA-453/R-06-004, 2006/09	Flat Wood Paneling Coatings	Control Techniques Guidelines for Flat Wood Paneling Coatings	N/A
EPA-453/R-07-003, 2007/09	Paper, Film, and Foil Coatings	Control Techniques Guidelines for Paper, Film, and Foil Coatings	N/A
EPA-453/R-07-005, 2007/09	Large Appliance Coatings	Control Techniques Guidelines for Large Appliance Coatings	N/A
EPA-453/R-07-005, 2007/09	Metal Furniture Coatings	Control Techniques Guidelines for Metal Furniture Coatings	N/A

EPA Report #	CTG Source Category	Title	District Source
EPA-453/R-08-004, 2008/09	Fiberglass Boat Manufacturing	Control Techniques Guidelines for Fiberglass Boat Manufacturing Materials	N/A
EPA-453/R-08-005, 2008/09	Miscellaneous Industrial Adhesives	Control Techniques Guidelines for Miscellaneous Industrial Adhesives	N/A
EPA-453/R-08-006, 2008/09	Automobile and Light-Duty Truck Assembly Coatings	Control Techniques Guidelines for Automobile and Light-Duty Truck Assembly Coatings	N/A
EPA-453/B-16-001, 2016/10	Oil and Natural Gas Industry	Control Techniques Guidelines for the Oil and Natural Gas Industry	N/A

(j) Negative Declaration findings are exempt from the California Environmental Quality Act (CEQA) pursuant to (1) CEQA Guideline section 1506l(b)(3) (Cal. Code Regs., tit. 14, §1506l(b)(2)) as the action does not have the potential of causing a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, and thus does not constitute a "project" under California Public Resources Code section 21065; and (2) CEQA Guideline sections 1506l(b)(2) and 15308 (Cal. Code Regs., tit. 14, §§15061(b)(2), 15308)) as it involves authorized actions taken by regulatory agencies for the protection of the environment under CEQA.

(k) A notice of a public hearing on May 11, 2017, at the hour of 2:00 p.m. at the Tehachapi Police Department Communications Room 220 West "C" Street, Tehachapi, CA, to consider adoption of the District's RACT SIP, was duly given; and

(l) The matter was heard at the time and place so specified, evidence was received and all persons desiring to be heard in said matter were given an opportunity to be heard; and

Section 2. IT IS RESOLVED by the Board as follows:

1. This Board hereby approves and adopts this Resolution thereby approving the Reasonably Available Control Technology (RACT) State Implementation Plan (SIP) for the 2008 Ozone NAAQS.

2. All notices required to be given by law have been duly given in accordance with Health and Safety Code section 40725, and the Board has allowed public comment, both oral and written, in accordance with Health and Safety Code section 40726

3. This Board finds that this action poses no significant impact on the environment and is exempt from CEQA under CEQA Guidelines sections 15061(b)(2) and 15308.

4. District staff is directed to prepare a Notice of Exemption for this project, and the Secretary of this Board is hereby directed to file the Notice of Exemption with the Kern County Clerk.

5. The Secretary of this Board is directed to cause a certified copy of this Resolution to be forwarded to the Air Pollution Control Officer (APCO) for said District and to the County Counsel of Kern County.

6. The APCO for said District is hereby authorized and directed to submit this resolution and all necessary supporting documents to the California Air Resources Board for submittal to EPA as a revision to the California State Implementation Plan.

7. The Board authorizes the APCO for said District to include in the submittal or subsequent documentation any technical corrections, clarifications, or additions that may be needed to secure EPA approval, provided such changes do not alter the substantive requirements of the approved rule.

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APPENDIX O
EKAPCD RACT SIP
2015 OZONE NAAQS

BEFORE THE AIR POLLUTION CONTROL BOARD
EASTERN KERN AIR POLLUTION CONTROL DISTRICT

In the matter of: RESOLUTION APPROVING EASTERN KERN AIR POLLUTION CONTROL DISTRICT REASONABLY AVAILABLE CONTROL TECHNOLOGY (RACT) STATE IMPLEMENTATION PLAN (SIP) FOR THE 2015 OZONE NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)	)	Resolution No. 2020-001-09

I, Katharine Lantz, SECRETARY TO THE AIR POLLUTION CONTROL BOARD OF THE EASTERN KERN AIR POLLUTION CONTROL DISTRICT, certify that the following Resolution, proposed by Director Parris and seconded by Director Mower, was duly passed and adopted by said Board at an official meeting on this 3rd Day of September, 2020, by the following vote:

AYES:	Parris, Mower, Scrivner
NOES:	None
ABSENT:	Davies, Gleason

(District Seal)

EASTERN KERN AIR POLLUTION DISTRICT
BOARD OF DIRECTORS

KATHARINE LANTZ
Secretary to the Air Pollution Control Board of the Eastern Kern Air Pollution Control District

By K Lantz

RESOLUTION

Section 1. RECITALS:

(a) The Eastern Kern Air Pollution Control District ("District") is authorized by Health and Safety Code section 40702 to make and enforce all necessary and proper orders, rules and regulations to accomplish the purposes of Division 26 of the Health and Safety Code; and

(b) A portion of Eastern Kern has been designated as a "Moderate" nonattainment area due to exceeding the 2015, 8-Hour Ozone National Ambient Air Quality Standards (NAAQS) (83 FR 25786, June 4, 2018); and

(c) Subsections 182(b)(2), (c), (d), and (f) of the Federal Clean Air Act (FCAA) (42 U.S.C. §751la(b)(2), (c), (d),(f)) require states and districts located in ozone nonattainment areas classified as moderate or above to implement Reasonably Available Control Technology (RACT), for all source categories for which the U.S. Environmental Protection Agency (EPA) has published a Control Techniques Guidelines (CTG) document prior to the area's date of attainment, and for all non-CTG major sources; and

(d) The Board of Directors have determined, in the RACT SIP, that the District has adopted rules meeting RACT, which cover all existing applicable CTG source categories and identified all District rules applicable to major non-CTG sources; and

(e) A major non-CTG source is a permitted facility located in the District's nonattainment area that collectively exceeds the major source threshold of 50 tons per year (tpy) of either Oxides of Nitrogen (NOx) or Volatile Organic Compounds (VOC); and

(f) States and districts may comply with requirements of subsections 182(b)(2), (c), (d), and (f) of the FCAA (42 U.S.C. §751la(b)(2), (c), (d), (f)) by adopting a Negative Declaration for each CTG source category with no applicable source operating within the District's nonattainment area; and

(g) The Board of Directors have determined that there is no existing, or anticipated major non-CTG source of VOCs in the nonattainment area; and

(h) The Board of Directors adopts a Negative Declaration for major non-CTG sources of VOCs in the nonattainment area; and

(i) The District has reviewed its permit records, emissions inventory database, and consulted with permitting and enforcement staff in determining that there are no sources subject to the published CTGs identified in Table 1; and

(j) The Board of Directors have determined it is necessary to adopt Negative Declarations for the following published CTGs listed in Table 1.

Table 1 Negative Declarations

<table>
<tr><th>EPA Report #</th><th>CTG Source Category</th><th>Title</th><th>District Source</th></tr>
<tr><td>EPA-450-2-77-008, 1977/05</td><td>Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks</td><td>Control of Volatile Organic Emissions from Existing Stationary Sources – Volume II: Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks</td><td>None</td></tr>
<tr><td>EPA-450/2-77-025, 1977/10</td><td>Petroleum Refineries</td><td>Control of Refinery Vacuum Producing Systems, Wastewater Separators, and Process Unit Turnarounds</td><td>N/A</td></tr>
<tr><td>EPA-450/2-77-026, 1977/10</td><td>Tank Trucks Gasoline Loading Terminals</td><td>Control of Hydrocarbons from Tank Truck Gasoline Loading Terminals</td><td>N/A</td></tr>
<tr><td>EPA-450/2-77-032, 1977/12</td><td>Surface Coating of Metal Furniture</td><td>Control of VOC Emissions from Existing Stationary Sources – Volume III: Surface Coating of Metal Furniture</td><td>N/A</td></tr>
<tr><td>EPA-450/2-77-033, 1977/12</td><td>Surface Coating for Insulation of Magnet Wire</td><td>Control of Volatile Organic Emissions from Existing Stationary Sources – Volume IV: Surface Coating of Insulation of Magnet Wire</td><td>N/A</td></tr>
<tr><td>EPA-450/2-77-034, 1977/12</td><td>Surface Coating of Large Appliances</td><td>Control of VOC Emissions from Existing Stationary Sources – Volume V: Surface Coating of Large Appliances</td><td>N/A</td></tr>
<tr><td>EPA-450/2-77-035, 1977/12</td><td>Bulk Gasoline Plants</td><td>Control of VOC Emissions from Bulk Gasoline Plants</td><td>N/A</td></tr>
<tr><td>EPA-450/2-77-036, 1977/12</td><td>Storage of Petroleum Liquids in Fixed-Roof Tanks</td><td>Control of VOC Emissions from Storage of Petroleum Liquids in Fixed-Roof Tanks</td><td>N/A</td></tr>
<tr><td>EPA-450/2-77-037, 1977/12</td><td>Cutback Asphalt from Paving Operation</td><td>Control of VOC Emissions from Use of Cutback Asphalt</td><td>N/A</td></tr>
<tr><td>EPA-453/R-08-003, 2008/09</td><td>Miscellaneous Metal and Plastic Parts Coatings – Motor Vehicle Materials</td><td>Motor Vehicle Materials used at facilities that are not automobile or light-duty truck assembly coating facilities (Table 6).
<table>
<tr><th>Coating Category</th><th>lbs VOC/gal Coating</th></tr>
<tr><td>Motor vehicle cavity wax</td><td>5.4</td></tr>
<tr><td>Motor vehicle sealer</td><td>5.4</td></tr>
<tr><td>Motor vehicle deadener</td><td>5.4</td></tr>
<tr><td>Motor vehicle gasket/gasket sealing material</td><td>1.7</td></tr>
<tr><td>Motor vehicle underbody coating</td><td>5.4</td></tr>
<tr><td>Motor vehicle trunk interior coating</td><td>5.4</td></tr>
<tr><td>Motor vehicle bedliner</td><td>1.7</td></tr>
<tr><td>Motor vehicle lubricating wax/compound</td><td>5.8</td></tr>
</table></td><td>N/A</td></tr>
</table>

EPA Report #	CTG Source Category	Title	District Source
EPA-450/2-78-032, 1978/06	Surface Coating of Flat Wood Paneling	Control of VOC Emissions from Existing Stationary Sources – Volume VII: Factory Surface Coating of Flat Wood Paneling	N/A
EPA-450/2-78-036, 1978/06	Leaks from Petroleum Refinery Equipment	Control of VOC Leaks from Petroleum Refinery Equipment	N/A
EPA-450/2-78-029, 1978/12	Synthesized Pharmaceutical Products	Control of Volatile Organic Emissions from Manufacture of Synthesized Pharmaceutical Products	N/A
EPA-450/2-78-030, 1978/12	Manufacture of Pneumatic Rubber Tire	Control of Volatile Organic Emissions from Manufacture of Pneumatic Rubber Tires	N/A
EPA-450/2-78-033, 1978/12	Graphic Arts	Control of VOC Emissions from Existing Stationary Sources – Volume VIII: Graphic Arts-Rotogravure and Flexography	N/A
EPA-450/2-78-047, 1978/12	Storage of Petroleum Liquids in External Floating Roof Tanks	Control of VOC Emissions from Petroleum Liquid Storage in External Floating Roof Tanks	N/A
EPA-450/3-82-009, 1982/09	Large Petroleum Dry Cleaners	Control of VOC Emissions from Large Petroleum Dry Cleaners	N/A
EPA-450/3-83-008, 1983/11	Polymers and Resins Manufacturing Industry	Control of VOC Emissions from Manufacture of High-Density Polyethylene, Polypropylene, and Polystyrene Resins	N/A
EPA-450/3-83-007, 1983/12	Equipment Leaks from Natural Gas/Gasoline Processing Plants	Control of VOC Equipment Leaks from Natural Gas/Gasoline Processing Plants	N/A
EPA-450/3-83-006, 1984/03	Equipment Leaks from Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment	Control of VOC Leaks from Synthetic Organic Chemical Polymer and Resin Manufacturing Equipment	N/A
EPA-450/3-84-015, 1984/12	Synthetic Organic Chemical Manufacturing Industry	Control of VOC Emissions from Air Oxidation Processes in Synthetic Organic Chemical Manufacturing Industry	N/A
EPA-450/4-91-031, 1993/08	Synthetic Organic Chemical Manufacturing Industry	Control of VOC Emissions from Reactor Processes and Distillation Operations in Synthetic Organic Chemical Manufacturing Industry	N/A
61 FR 44050 8/27/1996, 1996/08	Shipbuilding and Ship Repair Operations	Control Techniques Guidelines for Shipbuilding and Ship Repair Operations (Surface Coating)	N/A
EPA-453/R-06-001, 2006/09	Industrial Cleaning Solvents	Control Techniques Guidelines for Industrial Cleaning Solvents	N/A
EPA-453/R-06-002, 2006/09	Offset Lithographic and Letterpress Printing	Control Techniques Guidelines for Offset Lithographic Printing and Letterpress Printing	N/A

EPA Report #	CTG Source Category	Title	District Source
EPA-453/R-06-003, 2006/09	Flexible Package Printing	Control Techniques Guidelines for Flexible Package Printing	N/A
EPA-453/R-06-004, 2006/09	Flat Wood Paneling Coatings	Control Techniques Guidelines for Flat Wood Paneling Coatings	N/A
EPA-453/R-07-003, 2007/09	Paper, Film, and Foil Coatings	Control Techniques Guidelines for Paper, Film, and Foil Coatings	N/A
EPA-453/R-07-005, 2007/09	Large Appliance Coatings	Control Techniques Guidelines for Large Appliance Coatings	N/A
EPA-453/R-07-005, 2007/09	Metal Furniture Coatings	Control Techniques Guidelines for Metal Furniture Coatings	N/A
EPA-453/R-08-004, 2008/09	Fiberglass Boat Manufacturing	Control Techniques Guidelines for Fiberglass Boat Manufacturing Materials	N/A
EPA-453/R-08-005, 2008/09	Miscellaneous Industrial Adhesives	Control Techniques Guidelines for Miscellaneous Industrial Adhesives	N/A
EPA-453/R-08-006, 2008/09	Automobile and Light-Duty Truck Assembly Coatings	Control Techniques Guidelines for Automobile and Light-Duty Truck Assembly Coatings	N/A
EPA-453/B-16-001, 2016/10	Oil and Natural Gas Industry	Control Techniques Guidelines for the Oil and Natural Gas Industry	N/A

(k) Negative Declaration findings are exempt from the California Environmental Quality Act (CEQA) pursuant to (1) CEQA Guideline section 1506l(b)(3) (Cal. Code Regs., tit. 14, §1506l(b)(2)) as the action does not have the potential of causing a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, and thus does not constitute a "project" under California Public Resources Code section 21065; and (2) CEQA Guideline sections 1506l(b)(2) and 15308 (Cal. Code Regs., tit. 14, §§15061(b)(2), 15308)) as it involves authorized actions taken by regulatory agencies for the protection of the environment under CEQA.

(l) A notice of a public hearing on September 3, 2020, at the hour of 2:00 p.m. at the District Field office located at 20406 Brian Way, Suite 4A in Tehachapi, CA 93561, to consider adoption of the District's RACT SIP, was duly given; and

(m) The matter was heard at the time and place so specified, evidence was received and all persons desiring to be heard in said matter were given an opportunity to be heard; and

Section 2. IT IS RESOLVED by the Board as follows:

1. This Board hereby approves and adopts this Resolution thereby approving the Reasonably Available Control Technology (RACT) State Implementation Plan (SIP) for the 2015, 8-Hour Ozone NAAQS.

2. All notices required to be given by law have been duly given in accordance with Health and Safety Code section 40725, and the Board has allowed public comment, both oral and written, in accordance with Health and Safety Code section 40726

3. This Board finds that this action poses no significant impact on the environment and is exempt from CEQA under CEQA Guidelines sections 15061(b)(2) and 15308.

4. District staff is directed to prepare a Notice of Exemption for this project, and the Secretary of this Board is hereby directed to file the Notice of Exemption with the Kern County Clerk.

5. The Secretary of this Board is directed to cause a certified copy of this Resolution to be forwarded to the Air Pollution Control Officer (APCO) for said District and to the County Counsel of Kern County.

6. The APCO for said District is hereby authorized and directed to submit this resolution and all necessary supporting documents to the California Air Resources Board for submittal to EPA as a revision to the California State Implementation Plan.

7. The Board authorizes the APCO for said District to include in the submittal or subsequent documentation any technical corrections, clarifications, or additions that may be needed to secure EPA approval, provided such changes do not alter the substantive requirements of the approved rule.

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