CARB Chico, CA/Butte County PM2.5 Second Maintenance Plan
Emissions Inventory Write-Up
CEPAM 2026 PM2.5 Plans v1.00

(March 2026)

Contents

Emissions Inventory Background

The Clean Air Act (Act) identifies specific requirements that states must submit to U.S. EPA as part of their State Implementation Plan (SIP) to attain and maintain the National Ambient Air Quality Standards (NAAQS). Section 175(A)[*] of the Act and the United States Environmental Protection Agency (U.S. EPA) guidance sets the general framework for maintenance plans. These requirements include the development of an emission inventory. This document describes the emission inventory included in the Chico, CA/Butte County PM2.5 Second Maintenance Plan (Plan).

Emissions Inventory Overview

Emissions inventories are estimates of the amount and type of pollutants emitted into the atmosphere by facilities, mobile sources, and areawide 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.

The California Air Resources Board (CARB) in conjunction with Butte County Air Quality Management District (District) have developed a comprehensive emissions inventory consistent with the requirements set forth in Section 172(C)[†] of the Act. 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 areawide sources are based on the most recent approved models and methodologies.

CARB also reviewed the growth profiles for point and areawide 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.

U.S. EPA requires that the emission inventory for a PM2.5 Plan contain emissions data for directly emitted PM2.5 and its precursors: oxides of nitrogen (NOx), sulfur oxides (SOx), volatile organic compounds (VOC), and ammonia (NH3)[‡]. 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 U.S. EPA's list of VOCs.

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[*] Section 175 (A) of the Act. *https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart1-sec7505a.htm*

[†] Section 172(C)(3) of the Act. *https://www.govinfo.gov/content/pkg/USCODE-2013-title42/html/USCODE-2013-title42-chap85-subchapI-partD-subpart1-sec7502.htm*

Inventory Base Year

The attainment base year inventory for the maintenance demonstration should reflect emissions during one of the three years for which monitoring data showed compliance with the standard[§]. Since this Plan is showing maintenance using the 2024 design values, which includes the years 2022, 2023 and 2024, CARB selected the base year 2023, as it is also the most recent triennial inventory year conducted for the National Emissions Inventory (NEI).

Forecasted Inventories

In addition to base year emissions, emissions projections are needed for a variety of reasons, including redesignation maintenance plans, the attainment projected inventory for a nonattainment area (NAA), and air quality modeling for attainment plans. The future years included in this Plan are 2028, 2035, and 2038.

For stationary and areawide sources, forecasted inventories are a projection of the base year inventory that reflects expected growth trends for each source category and emission reductions due to adopted control measures. CARB develops emission forecasts by applying growth and control profiles to the base year inventory. The stationary and areawide source emissions inventory for the Plan is modeled by the California Emission Projection Analysis Model (CEPAM), 2026 PM2.5 Plans, Version 1.00.

Growth profiles for point and areawide 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 EMFAC2021 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 model. CEPAM integrates the emission projections derived from these mobile source models to develop a comprehensive forecasted emissions inventory. As with stationary sources, the mobile source models include control algorithms that account for adopted regulatory actions.

[§] *40 CFR 51.1008(a)(1)(i). https://www.ecfr.gov/current/title-40/part-51/section-51.1008#p-51.1008(a)(1)(i)*

Temporal Resolution

Planning inventories typically include annual as well as seasonal (summer and winter) emission estimates. Annual emission inventories represent the total emissions over an entire year (tons per year), or the daily emissions produced on an average day (tons per day) basis. Seasonal inventories account for temporal activity variations throughout the year, as determined by category-specific temporal profiles. Since PM2.5 concentrations tend to be highest during the winter months, the emission inventory used in this Plan is based on the winter season (November through April).

Geographic Scope

The inventory presented in this plan includes emissions for the Chico, CA/Butte County (partial) PM2.5 Planning Area (Planning Area).. Since the Butte County portion is split into a region not defined by county, air basin, or district boundaries, the emissions had to be spatially allocated for the portion in the Planning Area. The county level emissions were allocated to the nonattainment area using the approach described below.

Stationary Point Sources:
Emissions from stationary point sources were designated as being inside or outside the nonattainment area based on a district assessment of latitude and longitude coordinates.

Beginning with this plan, CARB is using a new approach to spatially allocate emissions for stationary aggregated, areawide, off-road mobile, and natural source categories for sub-county nonattainment areas with geographical boundaries that do not align with CARB's standard county/air basin/district definitions. This change better aligns geographical representation of planning inventories with the approaches used by CARB in their air quality modeling.

The inventory presented in this plan includes emissions for the Planning Area. Since the Planning Area represents only part of Butte County, the portion of county emissions associated with the Planning Area had to be determined. This was done using a variation of the approach that is used for spatial surrogate fraction calculations for air quality modeling. Surrogate fractions are the fraction of a region's emissions associated with each model grid cell. These are calculated based on the portion of underlying geographic weighting data in each grid cell (e.g., coordinates representing restaurants for charbroiling-related emissions). A similar process was used for calculating the fraction of emissions associated with the sub-county Planning Area, except that the Planning Area boundary was the intersecting boundary used, instead of the typical model grid cells used for air quality modeling. This process resulted in fractions of emissions inside the Planning Area region. These Planning Area region fractions were multiplied by the county-level emission totals to yield emissions inside the Planning Area region. The underlying weighting data differed by source and sector but were consistent with CARB's air quality modeling inventories and the most recent available spatial surrogate snapshot 20260127, along with their respective assignments file last updated on 2026-03-13. This assignments file cross-references inventory categories to spatial surrogate assignments. The methodology document describing weighting data used and spatial surrogates-related files are available on CARB's

Air Quality Modeling Spatial Repository (CARB, 2026a, b)[1] with the latest updates available upon request. The final data product from this spatial analysis was the production of a fraction dataset for the Planning Area sub-area defined at the Emission Inventory Code (EIC) level.

Special Treatment Sectors

Natural Sources

Surrogates are not typically used to spatially allocate biogenic sources in CARB's air quality modeling. Most biogenic source emissions are provided directly by the Model of Emissions of Gases and Aerosols from Nature (MEGAN). For purposes of calculating emissions fractions within the Planning Area, MEGAN gridded 1km model output for year 2017 was used as weighting data.

Coordinates of prescribed fires used to construct CARB's 2023 inventory weighted by the sum of smoldering and flaming PM 2.5 emissions were used as weighting data to calculate the sub-county Planning Area fractions for the prescribed fire sector.

Wildfire boundaries data (2023) weighted by the sum of smoldering and flaming PM 2.5 emissions were used as weighting data to calculate the sub-county Planning Area fractions for the wildfire sector.

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 multiple stages of the Plan's 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 District staff, who 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. On-road mobile categories are direct outputs of CARB's EMFAC model. For off-road mobile categories, the inventory for this plan is based on a suite of category specific off-road 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.

Emission Inventory Components

A summary of the components that make up the Chico, CA/Butte County PM2.5 Second Maintenance Plan emissions inventory is presented in the following sections. These include mobile (on- and off-road) sources, stationary point sources, areawide sources, and natural sources.

Mobile Source Emissions

CARB develops the emission inventory for 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.

On-Road Mobile Source Emissions

EMFAC2021 and Its Approval by U.S. EPA

EMFAC is California's federally approved on-road mobile source emissions inventory model. It supports CARB's regulatory and air quality planning efforts and fulfills requirements under the federal Clean Air Act. On November 15, 2022, U.S. EPA approved EMFAC2021 v1.0.2 for use in SIP development and conformity analyses, which reflected CARB's latest understanding of California's on-road vehicle emissions, activities, and the benefits of regulations adopted prior to March 31, 2021. The model accounts for the effects of regulations approved by the Board as of the release of EMFAC2021 v1.0.2 on January 15, 2021. Please note that EMFAC2021 with the adjustment factors that EPA approved on November 21, 2025 is the latest approved method for modeling emissions in California, per 40 CFR 93.111 (see section "EMFAC Off-Model Adjustment Factors to Remove Emissions Benefits of Advanced Clean Trucks, Zero-Emission Airport Shuttle, Warranty Phase 1, and Heavy-Duty Omnibus Regulations" for more information).

Emissions from on-road mobile sources, including passenger vehicles, buses, and trucks, were estimated using the EMFAC2021 v1.0.2 model by applying model emission factors to transportation activity data provided by local MPOs based on the 2022 Regional Transportation Plan. The model incorporates California-specific data on vehicle fleets and travel activity. For light-duty vehicles, population data was drawn from 2019 California Department of Motor Vehicles (DMV) data, with updated emission rates based on test data and the inclusion of plug-in hybrid electric vehicles. For heavy-duty vehicles, model year–specific emission factors based on new test data were used, along with population estimates from DMV data for in-state trucks and International Registration Plan (IRP) data for out-of-state vehicles. The model uses a socio-econometric regression approach to forecast new vehicle sales and future fleet mix. It also reflects emissions benefits of CARB's rulemakings including the Advanced Clean Trucks, Heavy-Duty Omnibus regulations, the Truck and Bus Rule, and previously adopted rules for other on-road diesel fleets.

Additional information on the EMFAC2021 model is available at: *https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-road-documentation*

EMFAC Off-Model Adjustment Factors to Remove Emissions Benefits of Advanced Clean Trucks, Zero-Emission Airport Shuttle, Warranty Phase 1, and Heavy-Duty Omnibus Regulations

On June 12, 2025, three Congressional Resolutions purported to disapprove U.S. EPA's decisions to grant California waivers for several regulations in the EMFAC2021 v1.0.2 baseline, including Advanced Clean Trucks (ACT), Zero-Emission Airport Shuttle, Heavy-Duty Vehicle and Engine Emission Warranty and Maintenance Provisions (Warranty Phase 1), and Heavy-Duty Omnibus (Omnibus) regulations. While these illegal actions are being contested, CARB staff developed adjustment factors to remove these regulations from EMFAC2021 v1.0.2 solely for the purposes of State Implementation Plan (SIP) development and conformity determinations, including regional emissions analysis for transportation plan and transportation improvement program conformity determinations, as well as hot-spot analysis for project-level conformity determinations.

To remove the impact of ACT, Zero-Emission Airport Shuttle, Warranty Phase 1, and Omnibus regulations on criteria pollutant emissions, CARB staff used the methodology implemented in EMFAC2021 v1.0.2. Using the "Annual" setting, the model was run for calendar years 2022 through 2050 to estimate emissions under two scenarios: (1) a "Remove Regulations" scenario, which excludes the emissions benefits of these regulations; and (2) an "Include Regulations" scenario, which reflects the benefits of these regulations along with all other adopted regulations at the time the model was finalized. These adjustment factors, provided in the form of multipliers applied to emissions outputs from the EMFAC2021 model, were approved by U.S. EPA on November 21, 2025. In the CEPAM planning projection inventory used for the Butte PM2.5 Plan, we executed scenario (1) by removing the benefits of the aforementioned regulations. These off-model adjustment factors that remove the emission benefits of these regulations were applied to the EMFAC2021 baseline emission outputs using the CEPAM external adjustment module.

EMFAC Off-Model Adjustment Factors to Account for Emissions Benefits of Clean Truck Check

On December 9, 2021, CARB adopted the Clean Truck Check Program (CTC), also known as the Heavy-Duty Inspection and Maintenance Program (HD I/M), to control tailpipe emissions of oxides of nitrogen (NOx) and total direct-vehicle particulate matter (PM) effectively from non-gasoline on-road heavy-duty vehicles with a gross vehicle weight rating (GVWR) greater than 14,000 pounds. The CTC regulation was approved by the Office of Administrative Law (OAL) on October 5, 2022, and implementation began on January 1, 2023. Starting from calendar year 2023, the program drastically reduces NOx and PM2.5 emissions by enforcing periodic testing and inspections for heavy-duty trucks operating in California.

In January 2026, U.S. EPA took final action to partially approve and partially disapprove the inclusion of CARB's CTC in the California SIP. The disapproval applies only to portions of the regulation affecting out-of-state vehicles and does not impact CARB's authority to implement and enforce the program for trucks registered in the state of California.

Since CTC was adopted after the release of EMFAC2021, its emissions benefits are not included in EMFAC2021. Therefore, CARB staff used the methodology implemented in the latest U.S. EPA-approved version of the EMFAC model, EMFAC2021 v1.0.2 with the November 2025 adjustment factors, to assess the NOx and PM emissions benefits of CTC.

Using the "Annual" setting, the model was run for calendar years 2023 through 2050 to estimate emissions under two scenarios: (1) an "Adjusted Baseline" scenario where emissions are estimated without accounting for the benefits of CTC. This scenario was achieved by applying EMFAC2021 off-model adjustment factors to the output of the public version of the EMFAC2021 v1.0.2 model to remove the benefits of ACT, Omnibus, Warranty Phase 1, and Zero-Emission Airport Shuttle; and (2) an "Include Regulations" scenario where the "Adjusted Baseline" scenario was updated off-model to reflect emissions reductions from CTC only for in-state vehicle categories. The in-state emissions reductions were estimated based on a modeled decrease in high-emitting vehicles operating on the road due to CTC requirements (e.g., periodic vehicle testing). Emissions for out-of-state vehicle categories (e.g., T6 out-of-state, Class 4-7, T7 non-neighboring out-of-state Class 8, T7 neighboring out-of-state Class 8) were kept the same as the "Adjusted Baseline" scenario.

These adjustment factors, provided in the form of multipliers, were applied to emissions outputs from the EMFAC2021 model with the November 2025 adjustment factors to account for the impact of partial SIP approval of the HD I/M program. These off-model adjustment factors account only for emissions reductions associated with in-state vehicle categories subject to CTC. Please note that these adjustment factors are pending EPA approval (expected April 2026). These off-model adjustment factors for "partial" implementation of HD I/M were applied to the EMFAC2021 baseline outputs using the CEPAM external adjustment module.

Off-Road Mobile Source Emissions

Emissions from off-road sources are estimated using a suite of category-specific models. In the case where a new model was not available, the OFFROAD2007 model was used. Many of the newer models were 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.

Aircraft

CAI2024 uses activity data from the U.S. Federal Aviation Administration's (FAA) 2023 Terminal Area Forecast (TAF) and the Bureau of Transportation Statistics (BTS) from 2024 to project the growth of most metropolitan and international airports in California. Detailed activity data was acquired from FlightAware for 857 aviation facilities in California, separated by airframe and engine, and utilized to run FAA Aviation Environmental Design Tool version 3e (AEDT). AEDT's emission factors are based on data from the Base of Aircraft Data version 3 (BADA 3) which consists of performance data maintained by the European Organization for the Safety of Air Navigation (EUROCONTROL).

This combination of these data sources allowed a comprehensive modeling of the landing and take-off (LTO) aircraft emissions from all active aviation facilities encompassing a broad spectrum of aircraft types in California, including Air Carriers, Air Taxis, General Aviation, and Helicopters (also known as Rotorcraft). Additionally, CAI2024 includes the emissions inventory for Military and Agricultural (Crop Dusters also known as Aerial Applicators) aircraft. Since the release of CAI2024, the inventory has been updated to break-out APU emissions and correct the SFO allocation to San Mateo County.

Additional information is available at:
(CAI2024) California Aircraft Emissions Inventory

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

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

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. Most 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

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

Locomotives

All locomotive inventories were updated in 2020 and include linehaul (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, and Santa Fe Railway (BNSF) for linehaul and switcher operations. Data for other categories was supplied by the locomotive owners. Emission factors for all categories were based on U.S. 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

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 for population and activity based on the DOORS registration program. Activity was updated based on a 2021 survey of registered equipment owners, but emission factors were updated based on the 2025 off-road diesel emission factor update. The inventory reflects the In-Use Off-Road Equipment Regulations, as amended in 2011.

Additional information on the methodology is available at:
https://ww2.arb.ca.gov/sites/default/files/2025-09/2025%20In-Use%20Off-Road%20Inventory%20Update%20-%202025%20ADA%20FINAL.pdf

Transportation Refrigeration Units - Diesel

The Transportation Refrigeration Units (TRU) inventory was updated in 2025 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 U.S. EPA as of 2024, as well as testing data. The inventory reflects the TRU ATCM and 2021 amendments. Forecasting was based on historical trends in reporting, projections of population and agricultural production.

Additional information is available at:
https://ww2.arb.ca.gov/sites/default/files/2025-07/2025TRUInventory.pdf

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 2023 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 U.S. EPA's latest guidance for gasoline and propane engines. The inventory reflects the LSI regulation requirements and 2016 amendments, but does not reflect zero emission requirements.

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/sites/default/files/barcu/regact/2024/zeforklifts/appd.pdf

Forestry Equipment

The new 2025 forestry diesel equipment emissions 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. Updates include emission factors from the 2025 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/2025-09/2025%20Forestry%20Inventory%20Update%20-%202025%20ADA%20FINAL.pdf

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

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 2025 using a 2024 survey of California farmers and rental facilities, and the 2022 U.S. Department of Agriculture (USDA) agricultural census. Emission factors are based on the 2025 off-road diesel emission factor update. The inventory reflects incentive programs

for agricultural equipment that were implemented earlier than August 2024. Agricultural growth rates were developed using historical data from the County Agricultural Commissioners' reports.

Additional information will be available in May, 2026, at:
https://ww2.arb.ca.gov/our-work/programs/msei/road-categories/road-diesel-models-and-documentation

Stationary Sources Overview

The stationary source inventory is composed of point sources, stationary aggregated sources, and area-wide sources. The data elements in the inventory are consistent with the data elements required by U.S. EPA's Air Emissions Reporting Requirements (AERR)[**]. The inventory reflects actual emissions from industrial point sources reported to the District by the facility operators through calendar year 2023.

Estimation methods for point sources include source testing, direct measurement by continuous emissions monitoring systems, or engineering calculations.

As mentioned above, the stationary source inventory is classified into three components: point sources (individual facilities), stationary aggregated sources and area-wide sources. The emission estimates for point sources and stationary aggregated sources are closely interrelated. These components of the CEIDARS emissions inventory are evolving, and the associated reporting process is currently in transition. Historically, reporting of point sources has generally been limited to those emitting greater than or equal to 10 tons per year of any criteria pollutant. While some air districts have voluntarily reported facilities below this threshold, such reporting was not previously required. Under the Criteria and Toxics Reporting (CTR) program and the AB 2588 Air Toxics "Hot Spots" Emission Inventory Criteria and Guidelines (EICG) regulation guidance, air districts are now required to report point sources at significantly lower emission levels.

Complementing the stationary point source inventory is the stationary aggregated source inventory. This inventory represents a compilation of smaller emission sources across a county, air basin, or district, and is treated as "area sources" estimated using top-down methodologies applied at a regional scale. Examples include non-agricultural internal combustion engines, auto body refinishing operations, gasoline service stations, and dry cleaning facilities.

Because emissions within a given source category are often represented as a combination of reported point sources and estimated aggregated sources, a reconciliation process is required within CEIDARS.

[**] AERR, 40 CFR part 51, subpart A. *https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-51/subpart-A*

This process subtracts the point source emissions from the corresponding area source totals to prevent double counting within the regional inventory.

With the implementation of CTR and EICG requirements, an increasing number of smaller facilities are now reported as point sources. A key driver of this shift is the need to better characterize emission sources and their proximity to communities that experience disproportionate air pollution burdens. As more facilities are captured in the point source inventory, the corresponding stationary aggregated emissions decrease through the reconciliation process.

Over time, as point source reporting becomes more comprehensive and granular, the reliance on area source methodologies may diminish. However, the program is currently in a transitional phase, and area source methodologies remain necessary to ensure complete emissions coverage. The long-term role of these methodologies will become clearer after several years of CTR and EICG implementation.

In the interim, as smaller facilities continue to be incorporated into the point source inventory, the reconciliation process will continue to be applied wherever an associated area source methodology exists for a given category. Once it is determined that a source category or process is fully represented within the point source inventory, CARB will be positioned to evaluate whether the corresponding unreconciled area source estimates can be removed from the inventory altogether.

Stationary Aggregated Sources

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

Stationary Nonagricultural Internal Combustion 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

Agricultural Internal Combustion Diesel Irrigation Pumps

This category includes emissions from the operation of diesel-fueled stationary and mobile agricultural irrigation pumps. The 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*

Laundering

This category includes emissions from perchloroethylene (perc) dry cleaning establishments. The 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

Degreasing

This category includes emissions from solvents in degreasing operations in the manufacturing and maintenance industries. The 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/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

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

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

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

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 tanks; 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

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 U.S. 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

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 are based on engineering calculations. Emissions for these categories are estimated by both CARB and the District.

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

Consumer Products and Aerosol Coatings

The Consumer Product (CP) 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, 2024. This Butte plan includes the impact of the 2021 consumer product regulation that targets a subgroup of CP as well as aerosol coatings (see Table 2).

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

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*

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 2023 calendar year. Agricultural pesticide emission forecasts for years 2024 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*

Residential Wood Combustion

This update incorporates new device fractions from EPA's 2023 Wagon Wheel BETA, improved estimates of both primary and supplemental wood heating, updated emission factors, and revised burn rates. Supplemental heating use is now inferred by comparing American Housing Survey counts of primary wood-heated households with total estimated device use, filling a key gap in the earlier approach. Emission factors have been refreshed using the latest Northeast States for Coordinated Air Use Management (NESCAUM) test data compiled in the 2023 Wagon Wheel. Burn rates, previously based on outdated surveys, were updated using recent data from woodsmoke reduction programs in parts of California, while values for remaining regions were estimated through a regression model incorporating factors such as population density and heating degree days. In addition to the revised Wagon Wheel methodological approach, CARB has redefined the emission inventory code (EIC) landscape to delineate catalyzed and noncatalyzed woodstoves and fireplace inserts. In this update there is no change to the monthly temporal activity profiles, so the seasonality aspect of the inventory remains the same. Butte County Rule 207 is accounted for in the emission projections for this plan (see Table 2).

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Residential Natural Gas Combustion

CARB staff updated the methodology to reflect 2017 fuel use from the California Energy Consumption Database. Residential natural gas consumption by county was obtained from the 2019 California Energy Commission (CEC) California Energy Consumption Database. The heat content of natural gas reflects the 2017 values per the Energy Information Administration (EIA) State Energy Consumption, Price, and Expenditure Estimates. The emissions estimates reflect the most recent emissions factors from U.S. 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

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 U.S. 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 – State Energy Data System (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

Farming Operations

Tilling and Harvesting

Farming operation dust refers to particulate matter (PM) emissions generated during agricultural land preparation activities such as tilling, and during harvest operations including crop picking and initial post-harvest handling (e.g., packing house activities). Estimating emissions for this category requires crop-specific harvested acreage and crop calendars that describe land preparation and harvest timing for each crop. PM emissions are calculated by multiplying harvested acreage by crop-specific emission factors, which are derived from operation types and crop calendar information.

To better characterize crop-specific dust emissions, this update retires the previously used aggregated EICs and replaces them with crop-specific EICs. We now have 21 crop-specific EICs for tilling dust and

21 crop-specific EICs for harvest operations, for a total of 42 farming-operation-dust EICs. These EICs were developed based on the 2016 crop calendar and reviewed with air district experts.

In addition to the EIC updates, we also updated activity data. The 2022 California Department of Food and Agriculture (CDFA) harvested acreage data now replaces the 2012 dataset previously used. We also implemented major improvements to spatial allocation. In the current methodology, emissions for counties spanning multiple air basins were apportioned using land area or population. In this update, we instead allocate county-level harvested acreage to each air basin based on the true spatial distribution of crops, using multiple years of cropland data layers averaged together and overlaying them with CARB's COABDIS boundary shapefile. This substantially improves spatial accuracy.

Temporal profiles for both land preparation and harvest operations remain unchanged, as there are no updates to the crop calendar. Likewise, there are no updates to control assumptions unless districts provide new information for this category.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Livestock

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.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Dairy Cattle

Dairy cattle populations have been updated to reflect dairy facility reporting of head count by animal subtype for calendar year 2023 which affects all dairy emissions. All dairy emissions include VOCs, NH3, PM10, PM2.5, and PM for all dairy cattle in accordance with the new methodology document.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Manure Land Application – Dairy cattle

For dairy cropland manure application specifically, ammonia emissions are now being accounted for using a previously published emission factor along with the latest dairy population numbers.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Dairy Silage

For dairy silage emissions specifically, VOCs are the only pollutant that has been quantified, and this updated methodology uses SJVAPCD's silage pile and bunker feed VOC emissions factors as well as observations of onsite dairy silage storage via Google Earth images. When combined with the dairy facility head counts previously mentioned, this enables dairy silage VOC emissions to be estimated statewide, including assigning zero silage VOC emissions to dairies that do not appear to use or store silage onsite.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Construction and Demolition

The Building Dust category includes particulate matter (PM) emissions from building construction activities. For this update, we made substantial changes to EICs, variables, data sources, and methodology to better estimate emissions from building construction dust. Previously, the inventory included five EICs for building construction dust. In this update, we are retiring the building construction dust EIC associated with governmental buildings; all government-related construction emissions are now classified under the institutional category, consistent with U.S. EPA's approach.

For construction activity data, we are using 2023 and 2022 Construction Industry Research Board (CIRB) Building Permit data. For the acre-basis conversion, which translates building permit units into the acres disturbed by construction activities, we apply unit-to-acre factors for single-family and two-family homes, and dollar-to-acre factors for apartments and non-residential buildings. Project duration estimates are updated using 2023 data from the U.S. Census Bureau. We also added a soil moisture adjustment factor for this update, applying information from the 2024 EPA Wagon Wheel Tool. Emission factors used to estimate emissions are also derived from the 2024 EPA Wagon Wheel Tool. Temporal profiles for building construction remain unchanged, as working hours and construction schedules are relatively consistent over time. There are currently no updates to control factors unless new information is provided by the districts.

Additional information on this methodology can be found at:
https://ww2.arb.ca.gov/area-source-methodologies-major-category

Paved Road Dust

Paved road dust emissions for 2023 were estimated in 2025 using a CARB methodology consistent with the current U.S. EPA method (AP-42). Data from CARB's EMFAC2021 model, the District, and the Valley MPOs were used to estimate region specific vehicle miles traveled (VMT). VMT were distributed using 2022 travel fractions calculated using California Department of Transportation (Caltrans) Highway

Performance Monitoring System (HPMS) data for each of the four road types: freeway, major, collector, and local. Emissions were grown using EMFAC2021 default VMT activity.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Unpaved Road Dust – Farm Roads

Fugitive dust from unpaved farm roads refers to particulate matter (PM) emissions generated from vehicle travel on unpaved agricultural roads. This category specifically focuses on emissions caused by the mechanical disturbance of roadway surfaces. Activity data required for this category includes harvested acreage, crop calendars, and crop-specific VMT factors. The crop-specific VMT factor represents the level of agricultural traffic on farm roads (expressed as VMT per acre per year) and is used to estimate annual VMT for each crop. PM emissions from unpaved farm roads are estimated by first calculating the activity data for each crop and road type. The resulting VMT values are then multiplied by emission factors (pounds of PM per VMT) to generate county-level emissions, which are subsequently allocated to air basins and air districts.

For this update, we are using 2022 CDFA harvested acreage data in place of the previously used 2012 dataset. We have also updated the spatial allocation approach. Consistent with the farming operations category, the county-to-air-basin-to-air-district allocation is now based on crop distributions and actual geographic locations rather than general proportional methods. Temporal profiles for unpaved farm roads remain unchanged because there are no updates to the crop calendar. There are currently no updates to control assumptions unless additional information is provided by air districts.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Unpaved Nonfarm Road Dust

Fugitive dust from unpaved non-farm roads refers to particulate matter (PM) emissions generated by vehicles traveling on unpaved roads not associated with agricultural operations. These roads include city and county roads, forest roads, park roads, and other non-farm unpaved routes. For this update, we transitioned to a completely new data source for obtaining unpaved road miles and corresponding VMT: REPLICA's big-data platform. REPLICA specializes in mobility and transportation analytics for urban planning. Using REPLICA data, we were able to identify the geographic locations of unpaved roads, determine their lengths, and obtain traffic activity levels for each segment. As a result, all unpaved roads included in this update are actual mapped unpaved roads rather than scaled estimates from paved roads, and the previous assumption of 10 passes per day is no longer needed. These changes are reflected in both the activity data and methodology.

Previously, the category included five EICs for unpaved non-farm road dust. With the new methodology and unified data source, all unpaved road information can be obtained from a single

dataset—REPLICA—eliminating the need to collect data by individual road types. Consequently, we retired all road-type-specific EICs except for the city and county road EIC, which must be retained for motor vehicle emissions budget purposes. The updated structure now includes two EICs: one for city and county unpaved roads and one for all other unpaved non-farm roads. We also updated the spatial allocation approach. As with other categories in this update, REPLICA GIS data is combined with CARB's county/air-basin/air-district (COABDIS) boundary shapefile to allocate unpaved road segments and VMT across air basin and air district boundaries. This replaces the previous spatial allocation method based on land area or population. Temporal profiled for this category has been updated with the most recent precipitation data. There are currently no updates to control assumptions unless additional information is provided by air districts.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Fugitive Windblown Dust from Open Areas and Non-pasture Agriculture Lands

Fugitive windblown dust emissions were estimated using CARB's 1997 methodology. The methodology is based on 1993 harvested crop acreage and a wind erosion equation that incorporates climate, soil, and vegetative cover attributes. Emissions for agricultural lands were grown based on projections of acreage from FMMP, 2016. No growth is assumed for non-agricultural lands.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Windblown Dust from Unpaved Roads and Associated Areas

Emissions for this source category were estimated based on a 1997 CARB methodology reflecting unpaved road mileage and local parameters that affect wind erosion. The estimates assume no growth.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Fires (Isolated Structures & Vehicle Fire Incidents Not Associated with Wildfire)

Emissions from structural and vehicle fires were estimated based on an updated CARB methodology using individual fire incidents reported by firefighters into the National Fire Incident Reporting System (NFIRS) database. Estimates for structural fires are calculated using the reported square footage of each structure that is burned. The square footage burned is converted to combustible material using fuel loading factors from Holder et al. 2023 and consumption factors from NFIRS. The fuel loading factors account for both the structure itself (frame, walls, doors, etc.) and the contents (such as furniture). Emission factors from Holder et al. are used to estimate emissions from the consumed material. Estimates for vehicle fires are calculated for each reported vehicle burned using the consumption factors reported in NFIRS and fuel loading factors from Holder et al. 2023. These factors

provide the amount of combustible material for each vehicle. Emissions factors from Holder et al. 2023 are used to estimate air pollutants from the consumed material of each vehicle burned. Structural fire emissions growth is based on DOF housing unit forecasts, and vehicle fire emissions growth is based on EMFAC vehicle population forecasts.

Additional information on this methodology is available at:
Fires | California Air Resources Board

Managed Burning – Forest Management and Range Improvement (Collectively Known as Prescribed Fire)

The prescribed fire category provides emission estimates for planned and carefully managed fire ignited in natural vegetation to reduce wildfire risk, restore ecosystem health, and support landscapes that depend on periodic burning. In CEPAM, the inventory is broken out into two sub-categories: forest management (forest- and woodland-dominated landscapes) and rangeland improvement (primarily grasslands).

For the 2023 inventory, activity data from multiple reporting systems were integrated together and reconciled to build a comprehensive and non-duplicative record of prescribed fire activity statewide: Prescribed Fire Information Reporting System (PFIRS), prescribed fire records maintained by local air districts and compiled by the California Air Pollution Control Officers Association (CAPCOA), state/federal land management agencies' own databases (via the Wildfire and Forest Resilience Task Force's Interagency Treatment Tracking System), and satellite-based Visible Infrared Imaging Radiometer Suite (VIIRS) active fire product. CARB staff developed a multi-stage decision framework to evaluate data completeness, resolve spatial and temporal inconsistencies in activity records, and avoid potential double-/triple-counting between overlapping datasets.

CARB staff characterizes fuel loading information for each prescribed burn by sampling Fuel Characteristic Classification System (FCCS) fuel beds using multiple spatial frameworks. Fuel consumption assumptions are derived from the First Order Fire Effects Model (FOFEM) framework. The inventory incorporates multiple prescribed fire emissions estimation pathways, including broadcast burns, pile burns, and air curtain incinerator (ACI) operations. The inventory applies an expanded set of emission factors that explicitly include smoldering-phase emissions, enabling more complete accounting of particulate matter and trace gas production.

For inventory years prior to 2023, burn project perimeters and ignition dates or date ranges were provided by the California Department of Forestry and Fire Protection's (CAL FIRE) Fire History Geodatabase. Prescribed burning emissions were estimated using the FOFEM (version 6.7) and a custom geoprocessing tool (Emission Estimation System, EES) developed for CARB by researchers at UC Berkeley.

Future year estimates are based on a 10-year average, held flat in the forecast.

Additional information on this methodology is available at:
Fires | California Air Resources Board

Managed Burning & Disposal – Agricultural Burning

The Agricultural Burning Managed Burning and Disposal category includes the open burning of agricultural residues (such as crop stubble and orchard pruning), weed abatement (such as ditch and

canal bank burning), and other materials. 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. Growth for agricultural burning is based on CARB projections of FMMP farmland acres, 2016. 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

Residential Backyard Burning (Non-agricultural Open Burning)

The residential backyard burning methodology estimates emissions from the open burning of household-generated materials—specifically yard waste since burning trash is prohibited. CARB staff lead district wide working group to develop the methodology and ended in early 2025. The methodology applies a bottom-up framework that combines the following activity indicators: population, forested acreage, and average leaf and brush generation. Emissions factors are provided by the EPA Wagon Wheel compendium that are separated by leaf and brush. While CARB staff used existing temporal profiles to populate this methodology, several districts requested updated profiles to reflect local burning restrictions.

Additional information on this methodology is available at:
Fires | California Air Resources Board

Commercial Cooking

The commercial cooking methodology estimates emissions from food preparation at restaurants and other commercial establishments, focusing on major equipment types such as charbroilers, fryers, and griddles, which are the primary sources of emissions. Activity is based on the amount of food cooked, using the 2001 *Charbroiling Activity Estimation Report* by Dr. Michel Potepan[2] and restaurant count data from Dun & Bradstreet. Emission factors are taken from the 1997 study by Joseph Norbeck[3] and applied to the activity estimates to calculate pollutant emissions.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Domestic Ammonia

The domestic ammonia (NH_3) methodology estimates emissions from a suite of diffuse, non-agricultural area sources—such as human respiration and perspiration, household ammonia use, and pet waste—that are not captured in other inventory categories but collectively contribute to statewide totals. It applies a bottom-up framework that combines population-based and activity-based indicators with literature-derived emission factors to quantify emissions, with particular attention to volatilization processes that govern NH_3 release. The methodology relies on surrogate data and generalized assumptions where direct measurement is not feasible. Although uncertainties remain due to

variability in human behavior and environmental conditions, pet ownership and pet waste ammonia volatilization, the approach provides a practical, policy-relevant estimate that can be updated as improved data and science become available.

CARB is in the process of publishing this new methodology document and it will be available soon at the web link below:
Area Source Methodologies by Major Category | California Air Resources Board

Natural Sources

Biogenic Vegetation (ROG) and Soil (NOx)

Biogenic emissions were generated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN3.0) biogenics emissions model. 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 Moderate Resolution Imaging Spectroradiometer (MODIS) Terra/Aqua combined product (MCD15A2H) for 2017[††].[4] 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[‡‡]. 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[§§].[5] Hourly meteorology for MEGAN was provided by the 4 km WRF simulation described above, and all stress factor adjustments were turned off.

MEGAN implemented the parameterized scheme Yiener-Levy (YL95) to estimate soil NOx.[6] Main features include separate exponential temperature dependence for wet soils and linear dependence for dry soils. An optimal temperature above which flux becomes temperature independent, scalar adjustments to account for both "pulsing" and canopy reduction, synoptic-scale temperature and precipitation forcing, an explicit linear dependence of emission on fertilizer rate.

Wildfires – Vegetations

This wildfire category provides emission estimates for vegetations burned in wildfires. Starting with 2026 edition inventory (covering 2015-2024 activity), the vegetation wildfire emission inventory has day-by-day wildfire emissions and fuel consumption information. CARB staff models daily fire perimeters using VIIRS active fire product in conjunction with the CAL FIRE's Fire History Geodatabase. For each day's fire perimeter, fuel information is based on FCCS fuelbeds and stacked with fuel moisture rasters. Using these data as inputs, FOFEM produces estimates of flaming emissions,

[††] *https://earthdata.nasa.gov/*
[‡‡] *https://archive.usgs.gov/archive/sites/landcover.usgs.gov/green_veg.html*
[§§] *https://www.itreetools.org/tools/i-tree-eco*

smoldering emissions, and fuel consumption. Where VIIRS data are available, smoldering emissions are empirically allocated over time for each day using VIIRS fire radiative power data.

Future year estimates are based on a 10-year average, held flat in the forecast.

Additional information on this methodology is available at:
https://ww2.arb.ca.gov/wildfire-emissions

Point and Areawide Source Emissions Forecasting

Emission forecasts (2021 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 below in Table 1. The emissions inventory also reflects emission reductions from point and areawide sources subject to District rules and CARB regulations. The rules and regulations reflected in the inventory are listed below in Table 1.

Table 1: Growth Surrogates for Point and Areawide Sources

Source Category	Subcategory	Growth Surrogate
Electric Utilities	Natural Gas	California Energy Commission (CEC) Integrated Energy Policy Report forecast, 2019
	Other Fuels	Energy Information Administration (EIA) Annual Energy Outlook, 2019
Cogeneration	All	CEC forecast, 2019
Oil and Gas Production (Combustion)	All	CalGEM statewide total oil production. Assumed 2.9% annual decline reflecting CalGEM historical trend, 2000 through 2016
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
	Natural Gas	CEC forecast, 2019
	Others	REMI economic forecast, version 2.4.5; EIA forecast, 2018
Service and Commercial	Natural Gas	CEC forecast, 2019
	Other Fuels	EIA forecast, 2018
Other (Fuel Combustion)	Diesel	Modeled estimate, 2003
	Other than diesel	EIA forecast, 2018

Source Category	Subcategory	Growth Surrogate
Waste Disposal	All	DOF population forecast, 2024
Laundering	Dry Cleaning	DOF population forecast, 2024
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
Printing	All	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
Petroleum Marketing	Natural Gas Transmission	CEC forecast, 2019
	Gas Dispensing Facilities and Cargo Tanks	Fuel use from CARB EMFAC2021 model
	Other Point Sources	REMI economic forecast, version 2.4.5
Chemical	All	REMI economic forecast, version 2.4.5
Food & Agriculture	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
Wood and Paper		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, 2024
	Aerosol Coatings	No growth

Source Category	Subcategory	Growth Surrogate
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	Tilling and Harvesting	CARB projection of farmland acres per FMMP, 2016
	Dairy / Feedlots	No growth
	Other Livestock	CARB projection of livestock population per Census of Agriculture, 2012
Construction and Demolition	Building Construction	REMI economic forecast, version 2.4.5
	Road Construction	REMI economic forecast, version 2.4.5
Paved Road Dust	All	EMFAC2021 VMT
Unpaved Road Dust	City and County Roads, U.S. Forest, B.L.M	No Growth
	Farm Roads	FMMP Acreage, 2016
Fugitive Windblown Dust	Agricultural Lands (Non-Pasture	FMMP Acreage, 2016 FMMP Grazing, 2016
Fires	Structural	DOF households forecast, 2020
	Automobile	DOF population forecast, 2024

Source Category	Subcategory	Growth Surrogate
Managed Burning and Disposal	Agricultural Burning, Pruning & Field Crops	FMMP farmland acreage projection, 2016
	Non-Agricultural Open Burning	No Growth
	Unspecified Waste Burning	DOF population forecast, 2024
	Forest Management and Range Improvement	10-year average, held flat
	Others	No growth
Cooking	All	DOF population forecast, 2024
Natural Sources:	Biogenics Vegetation	Held flat in the projection
	Soil NOx	Held flat in the projection. Soil NOx is being presented as a line item in the plan
	Wildfires	10-year average, held flat

Table 2: District and CARB Control Rules and Regulations Included in the Inventory for Stationary Sources

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
BUT_AQMD	207	Wood Burning Devices Control Rule	Wood burning devices
CARB	ARB_R003 & ARB_R003_A	Consumer Product Regulations & Amendments	Consumer products
CARB	ARB_R007	Aerosol Coating Regulations	Aerosol coatings

Agency	Rule/Reg No.	Rule Title	Source Categories Impacted
CARB	CP_2021REG	CARB 2021 Consumer Products Regulation	Selected CP categories and aerosol coatings
CARB	GDF_HOSREG	Gasoline Dispensing Facility Hose Emission Regulation	Petroleum marketing - gasoline dispensing facility hoses
CARB	ORVR	Fueling emissions from ORVR vehicles	Petroleum marketing - fueling emissions from ORVR vehicles
CARB	AG_IC_ENG	AG IC Engine Emission Scalars	Agricultural IC Engines
CARB	NONAGICENG	Non-Ag IC Engine Emission Scalars	Non-agricultural IC Engines

External Adjustments

External adjustments were made in CEPAM to account for unaccounted regulatory emission reduction benefits. The external adjustments reflected in the CEPAM2026 PM2.5 Plans v1.00 Butte 2006 24-Hour 35 ug PM2.5 Maintenance Plan inventory are listed below in Table 3.

Table 3: External Adjustment IDs and Descriptions

Adjustment ID	Adjustment Description
DEL_ACTOMN	Undo ACT Omnibus Warranty Combined Adjustment Factors
PART_HD_IM	Partial HD IM Regulation for application to the EMFAC2021 baseline
NonAg_ICE	Update non-ag internal combustion engines to reflect 2003 ATCM and 2010 rule amend

Condensable Particulate Matter

Background

Condensable particulate matter (PM) is material that is vapor phase at stack conditions, but which condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid PM immediately after discharge from the stack. Condensable PM is a component of primary PM, which is the sum of condensable and filterable PM. Filterable PM comprises particles that are directly emitted by a source as a solid or liquid [aerosol] at stack or release conditions. All condensable PM is assumed to be smaller than 2.5 microns (µm) in diameter.

The AERR requires states to report annual emissions of filterable and condensable components of PM2.5 and PM10, "as applicable," for large sources every inventory year and for all sources every third inventory year, beginning with 2011.[***] Subsequent emissions inventory guidance[†††] from the U.S. EPA clarifies the meaning of the phrase "as applicable" by providing a list of source types for which condensable PM is expected by the AERR. These stationary point and nonpoint combustion sources, including commercial cooking, fuel combustion at electric generating utilities, industrial processes like cement or chemical manufacturing, are expected to generate condensable PM. The condensable PM from stationary and areawide sources in this inventory is calculated using the methodology outlined below. Condensable PM is not required to be calculated for mobile sources.

Methodology

For the current inventory, the District has collected data on primary PM only, containing both filterable and condensable components without distinguishing between the two. Consequently, to be able to report emissions of the condensable component of PM2.5 separately as required by the AERR, primary PM2.5 is augmented to condensable PM using recommended fractions from U.S. EPA, which are published within their Emissions Inventory System (EIS) Gateway[‡‡‡]. Because these factors are assigned to Source Classification Codes (SCC), CARB Emission Inventory Codes (EICs) are crosswalked to SCC codes. These factors are then directly applied to primary PM2.5 from CEPAM2026 version 1.00 for years 2028, 2035, and 2038.

[***] 40 CFR §51.15(a)(1) and §51.30(b)(1)

[†††] U.S. EPA. Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. May 2017. *https://www.epa.gov/sites/production/files/2017-07/documents/ei_guidance_may_2017_final_rev.pdf*

[‡‡‡] EIS Gateway downloaded on 08/20.2022. *https://www.epa.gov/air-emissions-inventories/emissions-inventory-system-eis-gateway*

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