ANNUAL REPORT ON VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990-2024

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California Environmental Protection Agency
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Environmental Monitoring Branch
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Executive Summary

This report fulfills the requirements of Title 3 California Code of Regulations (3 CCR) section 6881, requiring the Director of the California Department of Pesticide Regulation (DPR) to issue an annual report on volatile organic compound (VOC) emissions from pesticides for the Sacramento Metro, San Joaquin Valley, South Coast, Southeast Desert, and Ventura ozone nonattainment areas (NAAs). It includes emissions data for May 1-October 31 of each year between 1990 and 2024, with an emphasis on the most recent five years of data.

In 2024, all five ozone NAAs were in compliance with the State Implementation Plan (SIP) goals.

- Sacramento Metro NAA: Emissions in 2024 remain in compliance with the SIP goal of 2.2 tons per day (tpd) and were 52% lower than the 1990 base year. Emissions decreased by 0.046 tpd, from 1.378 tpd in 2023 to 1.332 tpd in 2024.

- San Joaquin Valley NAA: Emissions in 2024 remain in compliance with the SIP goal of 18.1 tpd and were 24% lower than the 1990 base year. Emissions increased by 0.558 tpd, from 15.049 tpd in 2023 to 15.607 tpd in 2024.

  The prohibition of certain uses of high-VOC nonfumigant products in the San Joaquin Valley NAA went into effect in 2015. Once prohibitions are triggered, DPR regulations require prohibitions to continue each year until at least two consecutive years of total hypothetical emissions are less than the trigger level. In 2024, the total hypothetical emissions were 16.858 tpd, an increase of 0.74 tpd from the previous year, yet remained 0.382 tpd below the trigger level of 17.2 tpd.[1] Since the winter of 2022, drought conditions have been alleviated, marking 2024 as the second consecutive year in which hypothetical emissions remained below the trigger level under typical agricultural practices and pesticide use in the San Joaquin Valley NAA.

  Although hypothetical emissions remained below the trigger level, total emissions in 2024 increased compared to 2023. The continued increases in total emissions are driven by a continued increase in nonfumigant emissions. Offsetting this nonfumigant increase are decreases in emissions from fumigants, particularly the decline in the 1,3-D emissions resulting from the adoption of new application methods with low emission ratings (ERs). These new application methods require 24” injection and were introduced as part of the newly implemented 1,3-D nonoccupational bystander regulation (effective January 1, 2024). The new fumigation methods were widely adopted in 2024 and comprised 78% of all 1,3-D field fumigation emissions and 79% of all 1,3-D field fumigation use in the San Joaquin Valley NAA. Without the adoption and widespread use of these low-emission fumigation methods, the 2024 total emissions would have been 15.79 tpd and total hypothetical emissions would have reached 17.04 tpd.

  In light of these two trends considered together, DPR determines that the nonfumigant prohibitions should remain in effect through 2026 to ensure total hypothetical emissions stay below the trigger level of 17.2 tpd and remain in compliance with the SIP goal of 18.1 tpd.

[1] See the text under Table A3-5 in Appendix 3 for the calculation of 2024 total hypothetical emissions.

The increase in nonfumigant emissions is attributed to an increase in the use of a wide variety of alternative nonfumigants to chlorpyrifos, since its ban in 2021. DPR will assess the impact of the availability of new low-emission alternatives as part of next year's assessment of nonfumigant regulations.

- Southeast Desert NAA: Emissions in 2024 remain in compliance with the SIP goal of 0.92 tpd and were 76% lower than the 1990 base year. Emissions decreased by 0.246 tpd, from 0.526 tpd in 2023 to 0.280 tpd in 2024.
- Ventura NAA: Emissions in 2024 remain in compliance with the SIP goal of 3.0 tpd and were 69% lower than the 1990 base year. Emissions decreased by 0.087 tpd, from 1.251 tpd in 2023 to 1.163 tpd in 2024.
- South Coast NAA: Emissions in 2024 remain in compliance with the SIP goal of 8.7 tpd and were 90% lower than the 1990 base year. Emissions decreased by 0.115 tpd, from 1.173 tpd in 2023 to 1.059 tpd in 2024.

3 CCR section 6881(b) requires a 45-day public comment period of the draft report.

Abbreviations

AI	Active Ingredient
AMAF	Application Method Adjustment Factor
APCD	Air Pollution Control District
CARB	California Air Resources Board
CDPR	Department of Pesticide Regulation
EC	Emulsifiable Concentrate
EP	Emission Potential
ER	Emission Rating
FFM	Field Fumigation Methods
GIS	Geographic Information System
MUF	Method Use Fraction
NAA	Nonattainment Area
PUR	Pesticide Use Report
SIP	State Implementation Plan
TGA	Thermogravimetric Analysis
TIF	Totally Impermeable Film
tpd	Tons Per Day
VOC	Volatile Organic Compound

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Introduction

Volatile Organic Compounds

Under the federal Clean Air Act, the United States Environmental Protection Agency (USEPA) develops National Ambient Air Quality Standards to limit the concentration of airborne pollutants and designates areas that do not attain the standards, called nonattainment areas (NAAs). In partnership with USEPA, states develop State Implementation Plans (SIPs) specifying how they plan to attain and maintain standards for these federal NAAs. The California Air Resources Board (CARB) coordinates the development of California's SIP, which includes measures for attaining ground-level ozone standards. Ground-level ozone, also known as smog, forms from the chemical interaction of nitrogen oxides, volatile organic compounds (VOCs), and sunlight. Because pesticides are a known source of atmospheric VOC emissions, the California Department of Pesticide Regulation (DPR) maintains a VOC emissions inventory ("inventory") for specific uses of pesticide products and compares emissions to emissions-reduction targets ("SIP goals") for five ozone NAAs.

SIP Goals

DPR compares the results of its inventory to emissions reduction targets in the SIP, referred to hereafter as "SIP goals." The SIP requires 20% reductions in emissions relative to 1990 in four NAAs (Sacramento Metro, South Coast, Southeast Desert, and Ventura) and reduction to 18.1 tpd in the San Joaquin Valley NAA (USEPA 1997). Prior to USEPA approval of DPR's SIP amendment in 2012, the SIP goal for the San Joaquin Valley NAA was a 12% reduction relative to 1990 (USEPA 2012). The superseding SIP goal of 18.1 tpd is equivalent to the 12% reduction, calculated using a specific methodology. The same methodology must be used to calculate future emissions to ensure a legitimate comparison to SIP goals. Emission estimates for pesticide application methods that were used in 1990 cannot be modified, absent a SIP revision. Similarly, nonfumigant emission potentials (EPs) of formulations that were used in the base year cannot be changed, absent a SIP revision.

Compliance with the SIP goals is made possible by regulations that are part of the SIP. These regulations describe the information that must be included in the annual inventory report and provide enforcement mechanisms to limit emissions from fumigants and nonfumigants.

Regulatory Background

Annual Inventory Report

In 2008, DPR adopted Title 3 California Code of Regulations (3 CCR) section 6452.4 requiring an annual inventory report that includes the following information:

- Total agricultural and structural emissions for the previous years;
- Evaluation of whether emissions are in compliance with regulatory benchmarks (equivalent to the SIP goals) in 3 CCR section 6452.2;[2]
- Fumigant emission limits for the upcoming year pursuant to 3 CCR section 6452.2;
- Emission ratings (ERs), also known as application method adjustment factors (AMAFs), for each fumigation method.

Section 6452.4 also required a 45-day public comment period for the draft report.

In 2013, DPR amended the 2008 regulations, moving the requirements for the annual report from 3 CCR section 6452.4 to section 6881 and adding the following report elements:

- Prohibitions on use of high-VOC nonfumigant products pursuant to 3 CCR section 6452.2(f), and if applicable, determination of whether prohibitions remain in effect pursuant to 3 CCR section 6884(c);
- A list of nonfumigant products that are designated as low-VOC pursuant to 3 CCR section 6880; and
- A list of actively registered nonfumigant products that are designated as high-VOC pursuant to 3 CCR section 6880.

This report contains all of the information specified above, including: 1) unadjusted emission estimates for 1990-2024; 2) adjusted emissions estimates for 1990 and 2004-2024; 3) whether 2024 emissions exceed levels that trigger fumigant limits or nonfumigant prohibitions; and 4) the status of previously enacted fumigant emissions limits and nonfumigant prohibitions.

Fumigants

The 2008 regulations that describe the content of the annual inventory report also included measures to limit emissions from fumigant applications. During the ozone season, fumigation methods with known application method adjustment factors (AMAFs)—the proportion of applied fumigant mass that contributes to VOC emissions under field conditions—are required within the five NAAs, and "low-

[2] The first report for which these two terms are equivalent is "ANNUAL REPORT ON VOLATILE ORGANIC COUMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990 – 2008" (2010). These terms previously represented different numbers due to a now-overturned court order.

emission" fumigant application methods are required within the San Joaquin Valley, Southeast Desert, and Ventura NAAs. Permissible and prohibited fumigant application methods are listed in Appendix 1B.

3 CCR section 6452 describes the interim and rulemaking processes that DPR uses to evaluate and approve new low-emission fumigant application methods. In April 2013, DPR granted interim approval allowing the use of the USEPA-approved totally impermeable film (TIF) tarp method for certain fumigants. The regulation that granted permanent approval for TIF tarp methods became effective on April 1, 2016. The continued increase in adoption of low-emission application methods and products by growers, registrants, and others significantly contributes to SIP compliance and reducing emissions.

If emissions equal or exceed a "trigger level" (equal to 95% of the SIP goal) for an NAA, DPR will ensure compliance with the SIP goal by establishing a fumigant limit equal to the difference between the SIP goal and calculated nonfumigant emissions, enforced by DPR and County Agricultural Commissioners (CACs) through grower allowances or other methods.[3]

Potential Emissions Reductions and Proposed SIP Commitment

DPR has enacted regulations to reduce non-occupational bystander exposure to 1,3-D by introducing application methods with lower 1,3-D emissions or using other measures to reduce exposure. HYDRUS (a soil-water transport software) simulations were also used to reevaluate the ERs of existing methods, which resulted in both increases and decreases of these ERs in 2024. ERs are percentages used to estimate emissions resulting from the different methods of fumigation. While this regulation was not intended to address any mandatory state implementation plan (SIP) element or other Clean Air Act requirement, it resulted in reducing VOC emissions from the use of 1,3-D.

To illustrate the impacts of 1,3-D non-occupational bystander regulation across each NAA, the current adjusted fumigant emissions totals for each NAA are compared to their pre-2024 emissions in Table 1. The pre-2024 emissions are what the emissions would have been if the new low-emission 1,3-D fumigation methods were not made available. For fumigation methods at a 24" depth (1224-1227, collectively referred to as the 1220 series) this includes assigning ERs from their analogous previously used 18" injection methods. Table 1 illustrates that those NAAs that adopted the 1220 series methods the most, Sacramento Metro and San Joaquin Valley, had the greatest percent decrease in emissions (10.8% and 8.5 % respectively). The Southeast Desert NAA had no recorded 1,3-D field fumigations and thus had no change. The Ventura NAA had no recorded usage of the 1220 series methods, but reductions were a result of the updated HYDRUS ERs. Conversely, the slight increase in fumigant emissions within the South Coast NAA was also a result of the updated HYDRUS ERs.

Table 1 1. Comparison of 2024 total adjusted fumigant emissions pre and post 2024 1,3-D regulations. Historical and updated FFM codes and ERs are available in Appendix 1 of this report. Appendix 1B contains the pre-2024 emission ratings, and Appendix 1C contains the updated 2024 emissions rating as well as the 1220 series methods.

Nonattainment Area	2024 Fumigant emissions using post-2024 ERs (tpd)	2024 Fumigant emissions using pre-2024 ERs (tpd)

[3] The percentage(s) of the SIP goals that constitute the trigger level has historically changed as a result of subsequent regulations, court orders, and SIP revisions. The current value of 95% is included in the discussion of the 2008 regulations for simplicity.

Sacramento Metro	0.058	0.065
San Joaquin Valley	1.949	2.130
Southeast Desert	0.025	0.025
Ventura	0.776	0.804
South Coast	0.112	0.111

The San Joaquin Valley NAA has historically recorded the highest fumigant emissions among all NAAs. A significant shift occurred in 2024 with the widespread adoption of the 1220 series 24-inch injection fumigation methods, driven by the 1,3-D regulation for non-occupational bystanders. This transition from the previous 18-inch injection methods led to a 25% reduction in 1,3-D emissions compared to what they would have been without the adoption of the 1220 series. As a result, total emissions from all fumigants in the San Joaquin Valley NAA decreased by 8.5% (0.181 tons per day), relative to projected levels had the 1220 series methods not been implemented. Table 2 compares pre-2024 emissions to the actual post-2024 emissions for 1,3-D, for the San Joaquin Valley NAA, aggregated by FFM code. For the purposes of this table, applications in 2024 that used the 1220 series were assumed to have used method 1206 for pre-2024 emissions, and the reductions reflect applicators shifting to the lower-emission methods in 2024. In contrast, emissions from pre-existing fumigation methods in Table 2 (1206, 1242, and 1247) either increased, decreased or remained the same due to HYDRUS updated ERs. Going forward, if more applications transition to the 1220 series of methods in place of the 18" methods, emissions are expected to decrease further.

Table 2. Comparison of emissions pre and post 2024 1,3-D regulations aggregated by the field fumigation method (FFM code) used in the SJV NAA during the ozone season.

Field Fumigation Method	2024 Emissions using post-2024 ERs (tpd)	2024 Emissions using pre-2024 ERs (tpd)
1206	0.118	0.108
1224	0.306	0.419
1225	0.002	0.003
1226	0.220	0.300
1227	0.007	0.010

1242	0.036	0.033
1247	0.0002	0.0002

Nonfumigants

Because a majority of emissions in the San Joaquin Valley NAA historically stemmed from nonfumigant use, the 2013 regulations replaced the San Joaquin Valley NAA's fumigant limit with prohibitions on certain uses of nonfumigant products designated as high-VOC.

Designation of High-VOC Nonfumigant Products

3 CCR section 6880 establishes EP thresholds for regulatory classification of nonfumigant products containing abamectin, chlorpyrifos, gibberellins, and/or oxyfluorfen:

Table 3. EP thresholds established in 3 CCR section 6880.

Primary AI	EP Threshold
ABAMECTIN	35%
CHLORPYRIFOS	25%
GIBBERELLINS	25%
OXYFLUORFEN	15%

DPR classifies products containing any of the four pesticides listed above into three groups:

- **High-VOC product:** (1) contains any of the four pesticides as a primary AI; (2) is labeled for agricultural use; and (3) the EP is greater than the threshold.
- **Low-VOC product:** (1) contains any of the four pesticides as a primary AI; (2) is labeled for agricultural use; and (3) the EP is equal to or less than the threshold.
- **Excluded product:** (1) contains any of the four pesticides, but not as a primary AI; or (2) is labeled for non-agricultural use only.

If a product contains multiple AIs, the primary AI(s) are those present at the highest percentage in a product. Products with a primary AI not listed in Table 3 (including products with multiple primary AIs) are excluded.

Products labeled only for non-agricultural uses are also excluded. Non-agricultural uses include: a) home use; b) use in structural pest control; c) industrial or institutional use; d) control of an animal pest under the written prescription of a veterinarian; or e) vector control. All other uses are considered agricultural.

Appendix 4 lists the currently registered products designated as high-VOC or low-VOC.

Prohibitions on High-VOC Nonfumigant Products

When emissions in the San Joaquin Valley NAA exceed the trigger level, applications of high-VOC products to alfalfa, almonds, citrus, cotton, grapes, pistachios, or walnuts are prohibited in the San Joaquin Valley NAA between May 1 and October 31,[4] with the following exceptions:[5]

- Use of chlorpyrifos products to control aphids on cotton[6].
- Use of gibberellins products when applied at an application rate of 16 grams of AI per acre or less.
- Use of oxyfluorfen products when applied at an application rate of 0.125 (1/8) pounds of AI per acre or less.
- Uses for which USEPA has issued an emergency exemption from registration under Section 18 of the Federal Insecticide, Fungicide, and Rodenticide Act.
- Uses registered as a Special Local Need under Section 24(c) of the Federal Insecticide, Fungicide, and Rodenticide Act.
- Applications made by or under the direction of the US Department of Agriculture, the California Department of Food and Agriculture, or CACs to control, suppress, or eradicate pests.
- Applications using precision spray technology meeting the criteria of the California Office of the Natural Resources Conservation Service's Environmental Quality Incentives Program.

Property operators must obtain a written recommendation from a licensed pest control adviser before application.[7] In turn, pest control advisers cannot make a recommendation that violates any active high-VOC prohibitions. If an exception to a prohibition applies, the exception must be identified in the written recommendation.[8]

When prohibitions for high-VOC nonfumigant products are in effect, those prohibitions must remain in effect until the total hypothetical VOC emissions detailed in the annual inventory report (see the report section "Emissions Relative to SIP Goals and Trigger Levels") are less than the trigger level for at least two consecutive years.[9]

[4] 3 CCR section 6884(a)
[5] 3 CCR section 6884(b)
[6] Chlorpyrifos sales were fully banned in California on Dec 31st 2020, and this exemption is no longer allowed.
[7] 3 CCR section 6883
[8] 3 CCR section 6558
[9] 3 CCR section 6884(c)

Emission Calculation

Input Data

The pesticide use report (PUR) dataset is one of two primary inputs to the inventory. The inventory includes all pesticide applications that are made for agricultural and commercial structural use, as defined by law, in five ozone NAAs, during the peak ozone period in California (May 1-October 31).[10] The inventory excludes applications outside of these NAAs, months, and uses.[11] DPR updates its inventory annually when PUR data from the previous year becomes available. Data was queried from the PUR database on December 6th, 2025. The key PUR data fields used to calculate emissions are shown in Table 4.

EP data form the other primary input of the inventory. The EP is the mass fraction of a pesticide product that contributes to atmospheric VOC emissions. For the period covered by this report, the data for each year consists of EP values for approximately 5,307 products.

Other inputs to the inventory include geospatial data, due to the inventory's focus on specific NAAs within California. The boundaries of these NAAs and a listing of counties that fall within the boundaries are shown in Figure 1 and Table 5, respectively.

Table 4. Key information included in PURs that form the basis of DPR's VOC emissions inventory.

Information	Production Agriculture Reports	Non-production Agriculture and Non-agricultural Reports
Product Applied	Yes	Yes
Crop/Site Treated	Yes	Yes
Amount Applied	Yes - each application	Monthly Total
Date Applied	Date and Time	Month
Application Method	Yes	No
Acres/Units Treated	Yes	Monthly Total
Location of Application	Township/Range/Section	County
Fumigant Method Code	Yes*	No

* Field fumigant use reports only

[10] Production agricultural use covers applications to approximately 400 commodities/crops. Non-production agricultural use includes applications to approximately 20 sites such as cemeteries, golf courses, parks, and rights-of-way. Structural use includes all applications by structural pest control businesses, regardless of site treated.

[11] The excluded uses are home use, industrial use, institutional use, applications made for vector control purposes, and veterinary use.

Table 5. A listing of counties wholly or partially within the five ozone NAAs in California.

NAA	Counties within the NAA
Sacramento Metro	All of Sacramento, Yolo. Parts of Sutter, Solano, Placer, El Dorado.
San Joaquin Valley	All of Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare. Western Part of Kern.
Southeast Desert	Parts of Los Angeles, San Bernardino, Riverside.
Ventura	All of Ventura.
South Coast	All of Orange. Western Parts of Los Angeles, San Bernardino, Riverside.

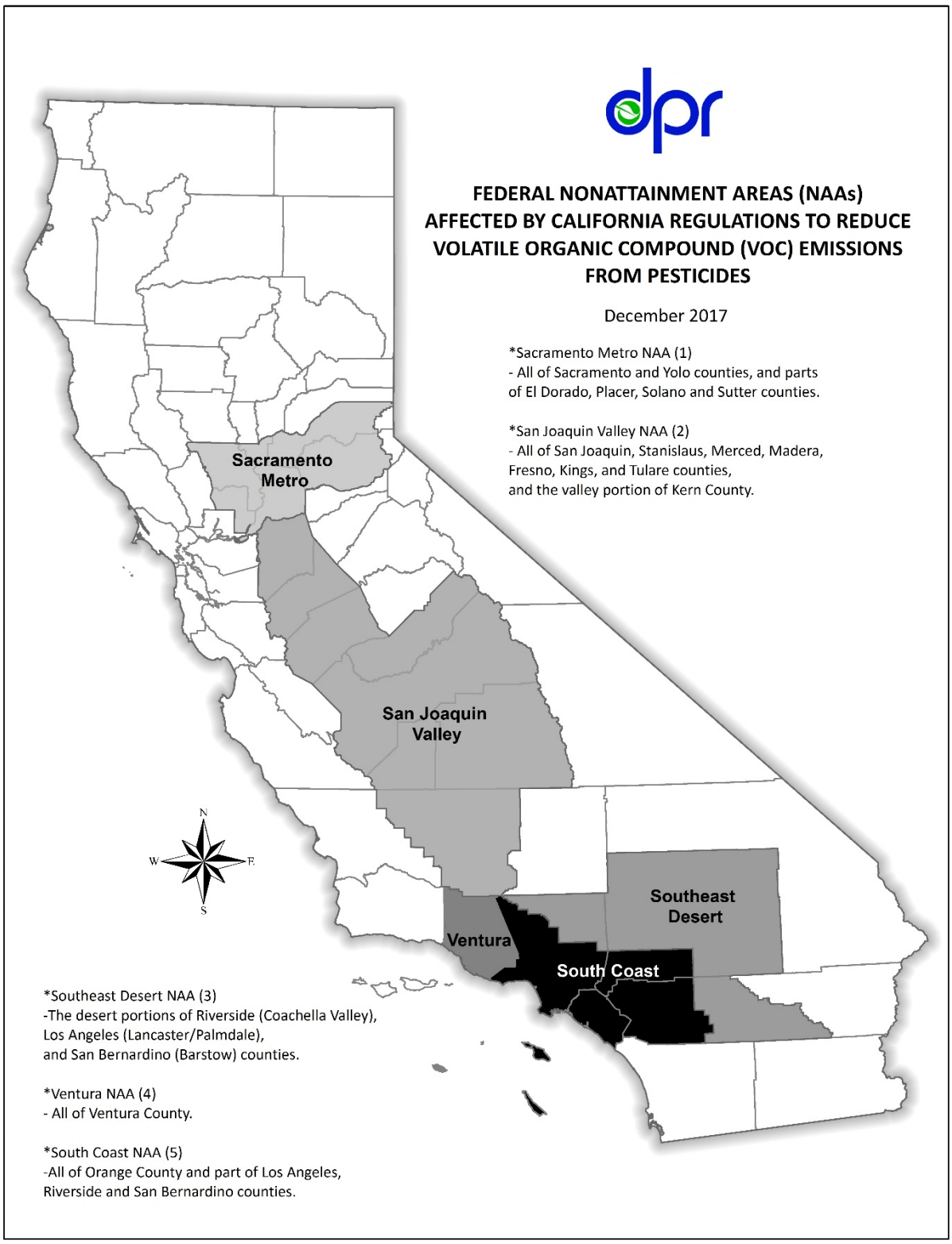

Figure 1. Federal ozone NAAs affected by California regulations to reduce VOC emissions from pesticides.

Data Revisions

DPR continually evaluates data to the inventory for reliability. DPR thoroughly evaluates registrant-submitted thermogravimetric analysis (TGA) data to determine EPs for new and existing products. Previous inventories have shown that changes in a widely used product's EP can significantly influence the inventory. Table 6 contains products whose EP values changed significantly as a result of recent TGA submissions. Products where EP updates are greater than or equal to 1% change are considered to have been changed significantly. As of 2024, EP changes to products listed in Table 6 did not have significant effect on the overall emissions.

Changes to a product's EP can occur when an EP determined by alternative methods is replaced by an EP derived from TGA data. Products lacking TGA data are assigned default EP values based on the type of product formulation. Updates to DPR's Product/Label database may reflect changes in the product formulation and thus alter its default EP. Changes to default EP values are not included in Table 6.

DPR also evaluates the inventory data for past errors in TGA-based EP values (e.g., approval of deficient TGA data or erroneous bridging of one product's EP to another "substantially similar" product). If any such errors are discovered by DPR, DPR can request that the registrant provide new TGA data for a product, after which a new EP can be determined.

Table 6. Nonfumigant products with substantially changed EP values between the 2023 and 2024 annual inventories. The estimated difference in emissions in 2024 for the San Joaquin Valley NAA resulting from changes in product EP. Products without use in 2024 are omitted.

Product	Registration Number	2024 Method	2024 EP	2023 EP	2024 Applied Mass (tpd)	Change in Emissions (tpd)
DIBROM 8 EMULSIVE	5481-479-AA	TGA/derived	29.98	29.67	0.606	0.002
FALGRO 4L	62097-2-AA-82917	TGA	94.62	93.80	<0.001	<0.001
ERASER A/P	53883-266-AA	TGA	22.91	22.19	0.009	<0.001
MEDALLION SC	100-1448-AA	TGA	7.71	7.51	<0.001	<0.001

Emission Calculation Procedure

Prior to 2008, DPR reported an unadjusted inventory that assumed the entire volatile portion of a fumigant product eventually volatilizes, contributing to atmospheric VOC loadings. In the unadjusted inventory, VOC emissions from the application of a fumigant or nonfumigant product equals the applied product mass multiplied by the EP (Spurlock 2006).

emissions = lbs of product used * EP

In 1994 under the CAA and Montreal Protocol, the phaseout of methyl bromide began, prompting research into fumigation methods that reduce emissions. Several dozen field studies published at the time showed that actual emissions from soil-applied fumigants vary by application method and are generally less than 100% (Majewski et al. 1995, Wang et al. 1997, Williams e al. 1999, Yagi et al. 1993).

DPR has developed an adjustment procedure to account for the effect of application methods on reducing fumigant emissions.[12]

In the adjusted inventory, the emissions from an applied fumigant product are the sum of the emissions from each fumigant AI within the product.[13] The emissions from each AI equals the applied product mass multiplied by the EP—generally the percent of the AI in the product—and an AMAF, which has been determined from field study data and is specific to a given combination of AI and application method (Barry et al. 2007).

emission = lbs of product used * EP * AMAF

The 2008 regulations facilitated adjusted calculations by requiring that each field fumigant application made within the ozone NAAs during the ozone season report the application method. In 2024, DPR found no issues with the quality of data from the 947 field fumigations reporting an FFM code. For any such records, DPR uses a conservative approach by assuming that the application method with the highest ER allowed by the regulations for that fumigant was used (Table 7), creating a complete dataset from which adjusted emissions can be calculated. Appendix 1C contains current FFMs and corresponding ERs. For reference, Appendix 1B contains the pre-2024 FFM codes and ERs.

As of January 1, 2024, DPR has implemented a new 1,3-D non-occupational bystander regulation, which updated ERs for existing FFM codes as well as the addition of new FFM codes. The newly enacted regulation continues the requirement that all 1,3-D PUR records report an FFM code. In addition to the regulations, DPR reevaluated the assignment of default ERs to account for the highest allowed ER in a given NAA. The result is a two-tiered default ER system, which is outlined in Table 7. To further illustrate the changes to the default ERs, the pre-2024 default ERs remain available in the inventory (Table 8).

Table 7. New Default ERs and FFM codes assigned to fumigant applications with a missing or invalid FFM code. For products that contain a combination of chloropicrin and either 1,3-D or methyl bromide, chloropicrin is never considered to be the primary AI for purposes of selecting a default application method. For some AIs, multiple FFM codes may be associated with the same maximum combination of ERs, but only one is displayed below. These have replaced the ERs listed in Table 8 and are reflected in the emissions totals in the 2024 inventory report.

Nonattainment Area	FFM Code	Primary AI	ER	Secondary AI	ER
San Joaquin Valley, Southeast Desert, and Ventura	1103	Chloropicrin	44%		
Sacramento Metro and South Coast	1102	Chloropicrin	64%		

[12] Nonfumigant product emissions are calculated using the unadjusted inventory procedure, due to a lack of data to support adjusted calculations.

[13] In addition to the emissions derived from fumigant AIs, inert ingredients for products that contain chloropicrin, methyl bromide, and 1,3-dichloropropene are assumed to be volatile and are included in the inventory calculations. For the highest use products containing metam-sodium, metam-potassium, sodium tetrathiocarbonate, and dazomet, analysis of their confidential statements of formula determined that the composition of inerts is non-volatile and so does not contribute to the EP of these products.

All NAAs	1501	Dazomet	17%		
San Joaquin Valley, Southeast Desert, and Ventura	1103	Methyl Bromide	48%	Chloropicrin	44%
Sacramento Metro and South Coast	1106	Methyl Bromide	100%	Chloropicrin	64%
San Joaquin Valley, Southeast Desert, and Ventura	1204	1,3-Dichloropropene	35%	Chloropicrin	43%
Sacramento Metro and South Coast	1209	1,3-Dichloropropene	52%	Chloropicrin	12%
San Joaquin Valley, Southeast Desert, and Ventura	1402	Metam-Sodium/Potassium N-Methyldithiocarbamate	28%		
Sacramento Metro and South Coast	1413	Metam-Sodium/Potassium N-Methyldithiocarbamate	100%		
All NAAs	1601	Sodium Tetrathiocarbamate	10%		

Table 8. Pre-2024 default ERs assigned to fumigant applications with missing or invalid FFM codes. These codes are no longer used as of January 1, 2024.

Active Ingredient	Default ER
Methyl Bromide with or without Chloropicrin	48%
1,3-Dichloropropene with or without Chloropicrin	44%
Chloropicrin Only	44%
Metam-Sodium or Potassium N-Methyldithiocarbamate	28%
Dazomet	17%
Sodium Tetrathiocarbonate	10%

Prior to 2008, fumigant applications did not report FFM codes. DPR developed an alternative procedure to adjust the total emissions—across all applications in a given year and NAA—of each fumigant AI, rather than the emission of an AI from a single application of a fumigant product. This procedure relies on Method Use Fractions (MUFs), which are the fraction of a fumigant AI's total applied mass that uses a specific fumigation method. MUF values are specific to combinations of fumigant AI, application method, NAA, and year, reflecting differences in fumigant use patterns across time and space. Total adjusted emissions from all applications of an AI made using a specific fumigation method equals the product of total AI mass, MUF, and AMAF. This can also be calculated by multiplying MUF and AMAF for all of an AI's methods, summing the results, then multiplying the sum by total AI mass. Summation of all the fumigant AIs' emissions yields total adjusted emissions from fumigant products.

Appendix 1A contains MUFs and AMAFs for 2008 and earlier years. For 2008, MUFs were derived from information available in the PUR database. For 2007 and earlier years, surrogate data were used to estimate MUFs. The type of surrogate data differed for different AIs. For 1,3-dichloropropene, the MUFs were determined from use data collected by the registrant in support of DPR's township application caps. For metam-sodium and metam-potassium, grower/applicator surveys were conducted to determine types of applications for different crops and areas. Methyl bromide and chloropicrin MUFs were based on expert opinion and regulatory history. Finally, MUFs for dazomet and sodium tetrathiocarbonate equal one because the AMAFs for each of these two fumigants are constant, independent of application method (Barry et al. 2007).

Non-production agriculture and non-agricultural pesticide applications are reported to DPR as "monthly summary data" with no geographic location information beyond the county of application (Table 5). These applications include commercial structural, landscape maintenance, rights-of-way, and commodity fumigations. In cases where two or more air basins, one of which may be in an NAA, are present within a single county, these applications must be proportionally allocated. DPR allocates these monthly summary applications using surrogate data that are assumed to have similar geographic distributions. In 2012, the surrogate data were updated to provide the most accurate estimated geographic distribution of emissions, reflecting changes in California's population and transportation infrastructure. US Census data for the 2010 decennial census together with TIGER/Line shapefiles for roads, rail roads, and linear hydrography were used as surrogates for commercial structural, landscape maintenance, and rights-of-way applications. Commodity fumigation data were provided by California CACs (Neal and Spurlock 2012).

Emissions are aggregated from individual PUR records at various levels: by year, NAA, primary AI, commodity or application site, and emissions category as defined by CARB. The primary AI is defined as the AI present at the highest percentage in a pesticide product. If a product contains 20% of AI "A" and 10% of AI "B", all calculated emissions from that product are assigned to the primary AI "A". CARB defines four emission categories: methyl bromide emissions from agricultural applications, non-methyl bromide emissions from agricultural applications, methyl bromide emissions from structural applications, and non-methyl bromide emissions from structural applications.

Emissions are reported as US tons per day (tpd) throughout this report.

Results

Emissions Relative to SIP Goals and Trigger Levels

Restrictions are triggered if emissions in an NAA exceed its trigger level (95% of its SIP goal). For the Sacramento Metro, Southeast Desert, South Coast, and Ventura NAAs the restrictions are a fumigant emissions limit. If emissions exceed the trigger level for the San Joaquin Valley NAA, certain uses of high-VOC products are prohibited until at least two consecutive years of total hypothetical emissions are less than the trigger level. More information about the calculation of total hypothetical emissions can be found in Appendix 3. For all five NAAs, restrictions are triggered for the upcoming ozone season based on the most recent inventory. For example, the 2024 inventory is used to determine if restrictions will go into effect on May 1, 2026.

As shown in Table 9, 2024 emissions in all five NAAs were less than their trigger levels and SIP goals.

Table 9. SIP goals, trigger levels and 2024 emissions.

NAA	SIP Goal (tpd)	Trigger Level (95% of SIP Goal) (tpd)	2024 Emissions (tpd)
Sacramento Metro	2.20	2.090	1.332
San Joaquin Valley	18.10	17.195	15.607
Southeast Desert	0.92	0.874	0.280
Ventura	3.00	2.850	1.163
South Coast	8.70	8.265	1.059

Emissions reported in the 2013 annual inventory report for the San Joaquin Valley NAA exceeded the SIP goal by 0.183 tpd. In the 2014 annual inventory report, revised emissions calculations for 2013 yielded 19.518 tpd (1.418 tpd above the SIP Goal). This increase was largely due to revised TGA-based EP values for fenpyroximate and hexythiazox products with emulsifiable concentrate formulations. Therefore, DPR enacted prohibitions on high-VOC nonfumigant products from May 1 through October 31 of 2015 and 2016.

In 2024, the total hypothetical emissions were 16.858 tpd, an increase of 0.74 tpd from the previous year, yet remained 0.377 tpd below the trigger level of 17.2 tpd.[14] This marks the fourth consecutive year since 2020 in which hypothetical emissions have remained in compliance.

Under 3 CCR section 6884(c), at least two consecutive years of hypothetical emissions below the trigger level are required for the Director of DPR to consider repealing the nonfumigant prohibition. However, the decision to repeal or continue the prohibition remains at the Director's discretion, and the regulation does not mandate repeal.

[14] See the text under Table A3-5 in Appendix 3 for the calculation of 2024 total hypothetical emissions.

Severe drought conditions significantly impacted the agricultural sector from 2020 to 2022. As a result, the prohibitions remained in place due to uncertainty over whether the low hypothetical emissions were a temporary consequence of drought conditions or reflected emissions under typical agricultural practices. Since the winter of 2022, drought conditions have been alleviated, marking 2024 as the second consecutive year in which hypothetical emissions remained below the trigger level under typical agricultural practices and pesticide use in the San Joaquin Valley NAA.

Although hypothetical emissions remained below the trigger level, total emissions in 2024 increased compared to 2023. The continued increases in total emissions are driven by a continued increase in nonfumigant emissions. Offsetting this nonfumigant increase are decreases in emissions from fumigants, particularly the decline in the 1,3-D emissions resulting from the adoption of new application methods with low emission ratings (ERs). These new application methods require 24" injection and were introduced as part of the newly implemented 1,3-D nonoccupational bystander regulation (effective January 1, 2024). The new fumigation methods were widely adopted in 2024 and comprised 78% of all 1,3-D field fumigation emissions and 79% of all 1,3-D field fumigation use in the San Joaquin Valley NAA. Without the adoption and widespread use of these low-emission fumigation methods, the 2024 total emissions would have been 15.79 tpd and total hypothetical emissions would have reached 17.04 tpd.

In light of these two trends considered together, DPR determines that the nonfumigant prohibitions should remain in effect through 2026 to ensure total hypothetical emissions stay below the trigger level of 17.2 tpd and remain in compliance with the SIP goal of 18.1 tpd.

The increase in nonfumigant emissions is attributed to an increase in the use of a wide variety of alternative nonfumigants to chlorpyrifos, since its ban in 2021. DPR will assess the impact of the availability of new low-emission alternatives as part of next year's assessment of nonfumigant regulations.

In 2024, all five ozone NAAs were in compliance with the SIP goals.

- Sacramento Metro NAA: Emissions in 2024 remain in compliance with the SIP goal of 2.2 tpd and were 52% lower than the 1990 base year. Emissions decreased by 0.046 tpd, from 1.378 tpd in 2023 to 1.332 tpd in 2024.
- San Joaquin Valley NAA: Emissions in 2024 remain in compliance with the SIP goal of 18.1 tpd and were 24% lower than the 1990 base year. Emissions increased by 0.558 tpd, from 15.049 tpd in 2023 to 15.607 tpd in2024.
- Southeast Desert NAA: Emissions in 2024 remain in compliance with the SIP goal of 0.92 tpd and were 76% lower than the 1990 base year. Emissions decreased by 0.246 tpd, from 0.526 tpd in 2023 to 0.280 tpd in 2024.
- Ventura NAA: Emissions in 2024 remain in compliance with the SIP goal of 3.0 tpd and were 69% lower than the 1990 base year. Emissions decreased by 0.087 tpd, from 1.251 tpd in 2023 to 1.163 tpd in 2024.
- South Coast NAA: Emissions in 2024 remain in compliance with the SIP goal of 8.7 tpd and were 90% lower than the 1990 base year. Emissions decreased by 0.115tpd, from 1.173 tpd in 2023 to 1.059 tpd in 2024.

Total emissions for all available years of data are shown in Figures 2 and 3. Appendix 2 lists these data in table form, as well as additional emissions data discussed below.[15]

Pesticide use varies from year to year due to weather, drought, pest problems, economics, and types of crops planted. Increases and decreases in pesticide use in the span of a few years do not necessarily indicate a trend. Such variances are and will continue to be a normal occurrence. A more detailed explanation of pesticide use patterns is given in DPR's annual summary of PURs, which is available at https://www.cdpr.ca.gov/pesticide-use-in-california/pesticide-use-reporting/.

[15] Table A2-1-1 is interpreted as Appendix 2, NAA 1, Table 1. Tables in Appendix 3 are similar, though they are not specific to an NAA. E.g., Table A3-1 is interpreted as Appendix 3, Table 1. These formats are standard throughout this report.

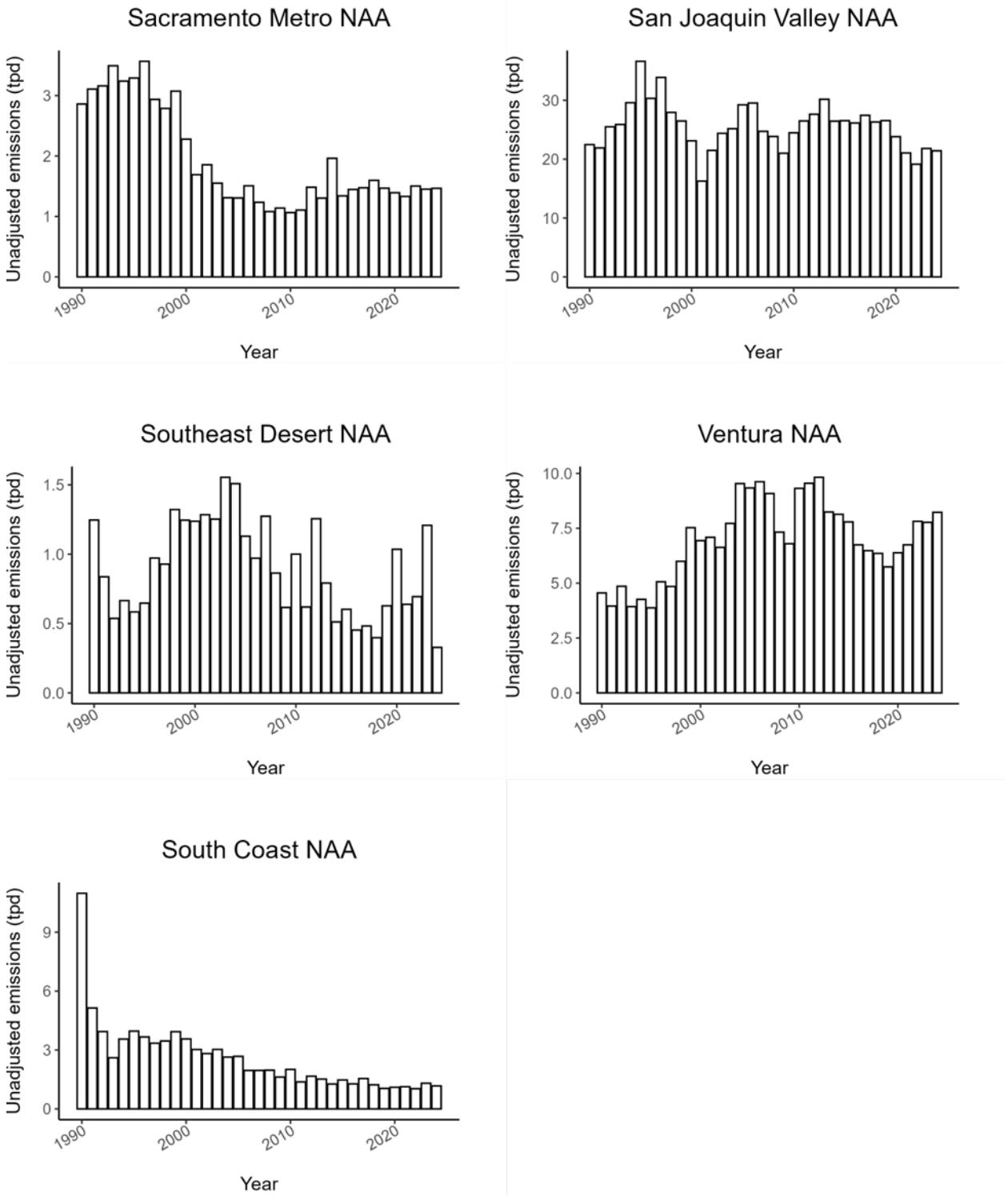

Figure 2. Total unadjusted emissions in each NAA from 1990 to 2024.

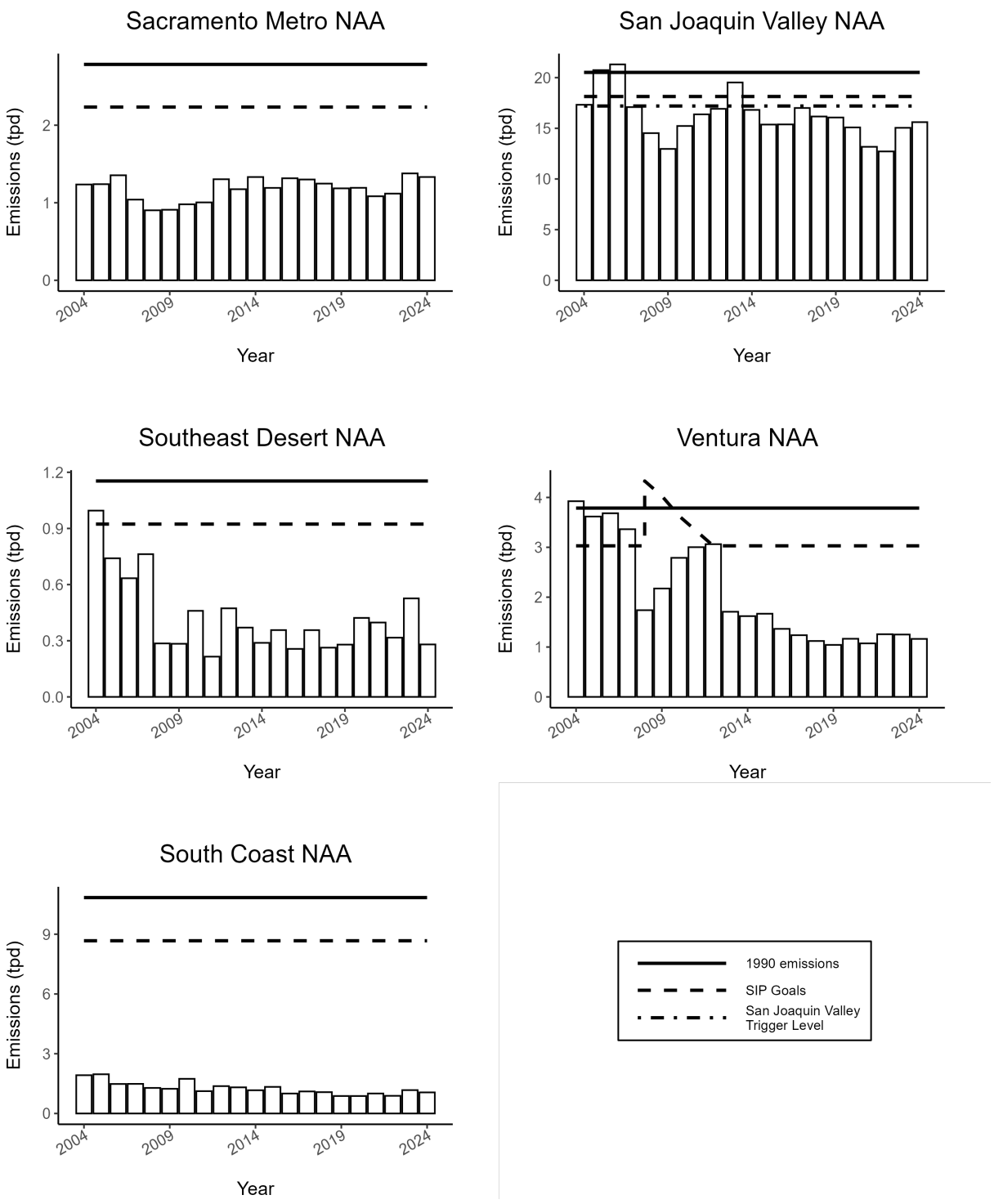

Figure 3. Total adjusted emissions in each NAA from the earliest available year of adjusted emissions data (2004) to 2024, in comparison to 1990 emissions, the SIP goals, and the San Joaquin Valley NAA trigger level. The 2007 SIP revision temporarily increased Ventura's SIP goal above 4 tpd in 2008, then gradually reduced the goal each year until 2012. Since 2012, the goal for Ventura remains 3 tpd.

Sacramento Metro NAA

In the Sacramento Metro NAA, 2024 emissions from pesticides decreased 0.046 tpd between 2023 and 2024, from 1.378 to 1.332 tpd. Emissions were 36% (0.758 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.1 tpd.

Fumigant emissions increased 56% (0.021 tpd), from 0.037 to 0.058 tpd. There were five fumigant product formulations responsible for all fumigant applications. The pressurized gas (dry) formulation was the highest emitting formulation at 0.031 tpd, an increase of 0.006 tpd from 2023. There were five fumigant primary AIs, not counting inert ingredients. 1,3-Dichloropropene was the highest emitter of fumigant emissions at 0.021 tpd, an increase of 0.015 tpd from 2023. There were 10 commodities treated by fumigant products. Uncultivated agricultural areas were responsible for the highest fumigant emissions at 0.036 tpd, an increase in 0.035 tpd from 2023.

Nonfumigant emissions increased 5% (0.067 tpd), from 1.341 to 1.274 tpd. There were 19 nonfumigant product formulations. The emulsifiable concentrate was the highest emitting formulation at 0.570 tpd, a decrease of 0.032 tpd from 2023. There were 364 nonfumigant primary AIs. The top 10 AIs accounted for 53% of nonfumigant emissions and propanil was the highest emitter at 0.144 tpd and increase of 0.019 tpd from 2023. There were 113 commodities treated by nonfumigant products. The top 10 commodities accounted for 89% of nonfumigant emissions and rice was responsible for the highest emissions at 0.308 tpd a decrease of 0.03 tpd from 2023.

Table A2-1-10 shows unadjusted emissions using the CARB California Emissions Inventory Development and Reporting System (CEIDARS) classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 15% (0.007 tpd), from 0.045 tpd in 2023 to 0.038 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased <1% (0.005 tpd), from 1.216 tpd to 1.211 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products increased 13% (0.025 tpd), from 0.191 tpd to 0.216 tpd.

San Joaquin Valley NAA

In the San Joaquin Valley NAA, 2024 emissions from pesticides increased 0.558 tpd between 2023 and 2024, from 15.049 to 15.607 tpd. Emissions were 9% (1.588 tpd) below the regulatory trigger level (95% of the SIP goal) of 17.2 tpd.

Fumigant emissions decreased 28% (0.742 tpd), from 2.691 to 1.949 tpd. There were four fumigant product formulations responsible for all fumigant applications. Liquid concentrate was the highest emitting formulation at 1.086 tpd, a decrease of 0.615 tpd from 2023. There were five fumigant primary AIs, not counting inert ingredients. 1,3-Dichloropropene was the highest emitter of fumigant emissions at 0.685 tpd, a decrease of 0.527 tpd from 2023. There were 10 commodities treated by fumigant products. Almonds were responsible for the highest fumigant emissions at 0.486 tpd, a decrease in 0.172 tpd from 2023.

Nonfumigant emissions increased 11% (1.300 tpd), from 12.358 to 13.658 tpd. There were 19 nonfumigant product formulations. The emulsifiable concentrate was the highest emitting formulation at 6.756 tpd, an increase of 0.877 tpd from 2023. There were 445 nonfumigant primary AIs. The top 10 AIs accounted for 50% of nonfumigant emissions and glufosinate-ammonium was the highest emitter at 1.474 tpd, an increase of 0.269 tpd from 2023. There were 164 commodities treated by nonfumigant products. The top 10 commodities accounted for 86% of nonfumigant emissions and almonds were responsible for the highest emissions at 4.588 tpd, an increase of 0.530 tpd from 2023.

Table A2-2-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 19% (0.192 tpd), from 1.005 tpd in 2023 to 0.812 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased <1% (0.147 tpd), from 20.547 tpd to 20.400 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products decreased 21% (0.054 tpd), from 0.257 tpd to 0.204 tpd.

Southeast Desert NAA

In the Southeast Desert NAA, 2024 emissions from pesticides decreased 0.246 tpd between 2023 and 2024, from 0.526 to 0.280 tpd. Emissions were 68% (0.594 tpd) below the regulatory trigger level (95% of the SIP goal) of 0.87 tpd.

Fumigant emissions decreased 91% (0.262 tpd), from 0.287 to 0.025 tpd. There were four fumigant product formulations responsible for all fumigant applications. Emulsifiable concentrate was the highest emitting formulation at 0.02 tpd, a decrease of 0.014 tpd from 2023. There were two fumigant primary AIs, not counting inert ingredients. Metam-sodium was the highest emitter of fumigant emissions at 0.025 tpd, a decrease of 0.015 tpd from 2023. There were 2 commodities treated by fumigant products. Peppers were responsible for the highest fumigant emissions at 0.02 tpd, a decrease in 0.003 tpd from 2023.

Nonfumigant emissions increased 7% (0.017 tpd), from 0.239 to 0.255 tpd. There were 19 nonfumigant product formulations. The emulsifiable concentrate was the highest emitting formulation at 0.124 tpd, an increase of 0.027 tpd from 2023. There were 345 nonfumigant primary AIs. The top 10 AIs accounted for 58% of nonfumigant emissions and caprylic acid was the highest emitted at 0.033 tpd, an increase of 0.014 tpd from 2023. There were 95 commodities treated by nonfumigant products. The top 10 commodities accounted for 81% of nonfumigant emissions and structural pest control was responsible for the highest emissions at 0.051 tpd, a decrease of 0.014 tpd from 2023.

Table A2-3-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased >99% (0.074 tpd), from 0.074 tpd in 2023 to 0.000 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 74% (0.792 tpd), from 1.068 tpd to 0.277 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products decreased 21% (0.014 tpd), from 0.065 tpd to 0.051 tpd.

Ventura NAA

In the Ventura NAA, 2024 emissions from pesticides decreased 0.087 tpd between 2023 and 2024, from 1.251 to 1.163 tpd. Emissions were 59% (1.687 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.85 tpd.

Fumigant emissions decreased 8% (0.070 tpd), from 0.846 to 0.776 tpd. There were five fumigant product formulations responsible for all fumigant applications. Pressurized gas (dry) was the highest emitting formulation at 0.398 tpd, a decrease of 0.072 tpd from 2023. There were five fumigant primary AIs, not counting inert ingredients. Chloropicrin was the highest emitter of fumigant emissions at 0.379 tpd, an increase of 0.028 tpd from 2023. There were 8 commodities treated by fumigant products. Strawberries were responsible for the highest fumigant emissions at 0.754 tpd, a decrease in 0.07 tpd from 2023.

Nonfumigant emissions decreased 4% (0.018 tpd), from 0.405 to 0.387 tpd. There were 18 nonfumigant product formulations. The emulsifiable concentrate was the highest emitting formulation at 0.142 tpd, an increase of 0.004 tpd from 2023. There were 328 nonfumigant primary AIs. The top 10 AIs accounted for 40% of nonfumigant emissions and mineral oil was the highest emitted at 0.044 tpd, an increase of 0.008 tpd from 2023. There were 97 commodities treated by nonfumigant products. The top 10 commodities accounted for 81% of nonfumigant emissions and strawberries were responsible for the highest emissions at 0.075 tpd, an increase of 0.016 tpd from 2023.

Table A2-4-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide increased 25% (0.002 tpd), from 0.006 tpd in 2023 to 0.008 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 6% (0.456 tpd), from 7.735 tpd to 8.194 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products increased 4% (<0.001 tpd), from 0.026 tpd to 0.027 tpd.

South Coast NAA

In the South Coast NAA, 2024 emissions from pesticides decreased 0.115 tpd between 2023 and 2024, from 1.173 to 1.059 tpd. Emissions were 87% (7.206 tpd) below the regulatory trigger level (95% of the SIP goal) of 8.3 tpd.

Fumigant emissions increased by less than 1% (<0.001 tpd), from 0.111 to 0.112 tpd. There were six fumigant product formulations responsible for all fumigant applications. Pressurized gas (dry) was the highest emitting formulation at 0.072 tpd, an increase of 0.023 tpd from 2023. There were five fumigant primary AIs, not counting inert ingredients. Methyl bromide was the highest emitter of fumigant emissions at 0.072 tpd, an increase of 0.023 tpd from 2023. There were 6 commodities treated by fumigant products. Fumigations were responsible for the highest fumigant emissions at 0.047 tpd, an increase in 0.013 tpd from 2023.

Nonfumigant emissions decreased 11% (0.109 tpd), from 1.063 to 0.947 tpd. There were 19 nonfumigant product formulations. The emulsifiable concentrate was the highest emitting formulation at 0.266 tpd, an increase of 0.006 tpd from 2023. There were 370 nonfumigant primary AIs. The top 10 AIs accounted for 61% of nonfumigant emissions and piperonyl butoxide was the highest emitted at 0.156 tpd, an increase of 0.021 tpd from 2023. There were 99 commodities treated by nonfumigant products. The top 10 commodities accounted for 95% of nonfumigant emissions and structural pest control was responsible for the highest emissions at 0.684 tpd, a decrease of 0.072 tpd from 2023.

Table A2-5-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide increased 48% (0.023 tpd), from 0.048 tpd in 2023 to 0.072 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 17% (0.087 tpd), from 0.502 tpd to 0.415 tpd. Emissions from structural applications of methyl bromide continued to be below a reportable level. Unadjusted emissions from structural applications of non-methyl bromide products decreased 10% (0.072 tpd), from 0.757 tpd to 0.684 tpd.

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