ANNUAL REPORT ON VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990–2022

June 2024

California Environmental Protection Agency
Department of Pesticide Regulation
Environmental Monitoring Branch
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Air 24-01

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 2022, with an emphasis on the most recent five years of data.

In 2022, all five ozone NAAs were in compliance with the State Implementation Plan (SIP) goals.

- Sacramento Metro NAA: Emissions in 2022 remain in compliance with the SIP goal of 2.2 tpd and were 60% lower than the 1990 base year. Emissions increased by 2% (0.026 tons per day (tpd)), from 1.090 tpd in 2021 to 1.116 tpd.

- San Joaquin Valley NAA: Emissions in 2022 remain in compliance with the SIP goal of 18.1 tpd and were 38% lower than the 1990 base year. Emissions decreased by 3% (-0.436 tpd), from 13.107 tpd in 2021 to 12.671 tpd. Prohibition of certain uses of high-VOC nonfumigant products went into effect in 2015. Once prohibition is triggered, DPR regulations require prohibition to continue each year until at least two consecutive years of total hypothetical emissions are less than the trigger level. The 2021 report determined that total hypothetical emissions had been less than the trigger level since 2020, enabling DPR to decide whether or not to lift the prohibitions. DPR determined that prohibition should continue through 2023, in order to monitor whether this decrease was a long-term trend, or a temporary decrease due to exceptional drought conditions. According to the National Integrated Drought Information System, 2020 to 2022 were the driest years on record in California. A wet winter in 2022 subsequently alleviated drought conditions. Once 2023 pesticide use data is available, it will be possible to observe whether total hypothetical emissions increase in tandem with water availability. Until then, DPR is maintaining the prohibitions of certain high-VOC nonfumigants in 2024. The nonfumigant prohibitions that went into effect in 2015 remain active in 2024 in the San Joaquin Valley NAA. Subsequent reports will continue to evaluate whether to lift prohibitions consistent with the DPR's obligations to keep emissions below the trigger level in the San Joaquin Valley NAA.

- Southeast Desert NAA: Emissions in 2022 remain in compliance with the SIP goal of 0.92 tpd and were 73% lower than the 1990 base year. Emissions decreased by 21% (-0.084 tpd), from 0.395 tpd in 2021 to 0.311 tpd.

- Ventura NAA: Emissions in 2022 remain in compliance with the SIP goal of 3.0 tpd and were 65% lower than the 1990 base year. Emissions increased by 16% (0.184 tpd), from 1.151 tpd in 2021 to 1.335 tpd.

- South Coast NAA: Emissions in 2022 remain in compliance with the SIP goal of 8.7 tpd and were 92% lower than the 1990 base year. Emissions decreased by 10% (-0.102 tpd), from 0.995 tpd in 2021 to 0.893 tpd.

3 CCR section 6881(b) requires a 45-day public comment period of the draft report. No comments were received during the comment period ending on June 20, 2024.

Abbreviations

AI	Active Ingredient
AMAF	Application Method Adjustment Factor
CARB	California Air Resources Board
DPR	Department of Pesticide Regulation
EP	Emission Potential
FFM	Field Fumigation Methods
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

Personnel

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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;[1]
- Fumigant emission limits for the upcoming year pursuant to 3 CCR section 6452.2;
- Emission ratings, also known as application method adjustment factors (AMAFs), for each fumigation method.

Section 6452.4 also required a 45-day public comment period of 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 1990-2022; 2) adjusted emissions estimates for 1990 and 2004-2022; 3) whether 2022 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-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.

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

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 use of the USEPA-approved totally impermeable film (TIF) tarp method for certain fumigants. The regulation that gave 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.[2]

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 1. 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.

[2] 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.

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 5 (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,[3] with the following exceptions:[4]

- Use of chlorpyrifos products to control aphids on cotton.
- 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.[5] 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.[6]

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.[7]

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[3] 3 CCR section 6884(a)
[4] 3 CCR section 6884(b)
[5] 3 CCR section 6883
[6] 3 CCR section 6558
[7] 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).[8] The inventory excludes applications outside of these NAAs, months, and uses.[9] DPR updates its inventory annually when PUR data from the previous year becomes available. Data were queried from the PUR database on November 27, 2023. The key PUR data fields used to calculate emissions are shown in Table 2.

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 consist of EP values for approximately 5,598 products.

Other inputs to the inventory include geospatial data, due to their 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 3, respectively.

Table 2. Key information included in PURs that forms 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

[8] 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.
[9] The excluded uses are home use, industrial use, institutional use, applications made for vector control purposes, and veterinary use.

Table 3. 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.

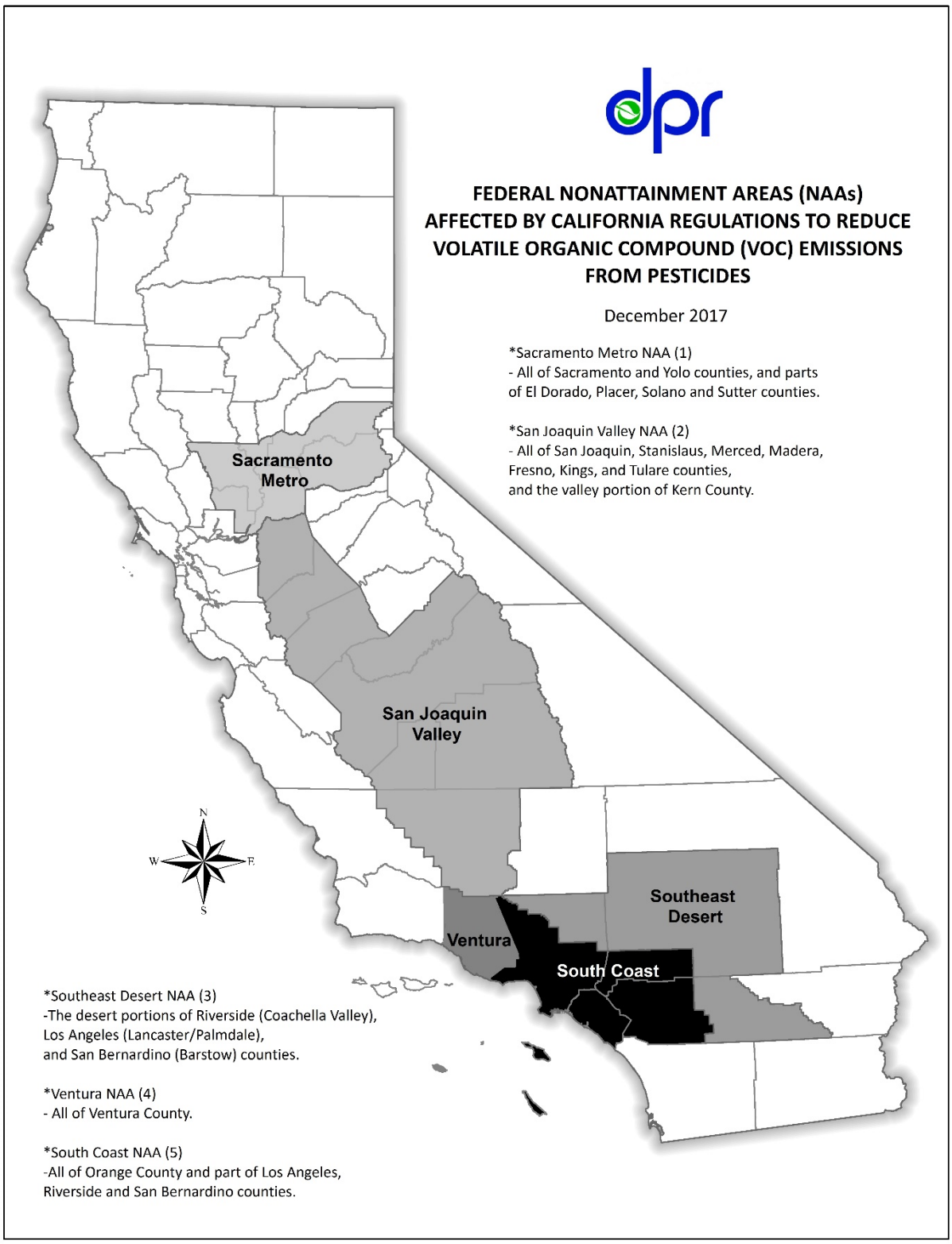

Figure 1. Federal ozone NAAs affected by California regulations to reduce VOC emissions from pesticides.

Data Revisions

DPR continually evaluates input 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 4 contains products whose EP values changed significantly as a result of recent TGA submissions.

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 4.

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 4. Nonfumigant products with substantially changed EP values between the 2021 and 2022 annual inventories, and the estimated change in emissions in 2022 for the San Joaquin Valley NAA resulting from changes in EP for products. Products without use in 2022 are omitted.

Product	Registration Number	2022 Method	2021 Method	2022 EP	2021 EP	2022 Applied Mass (tpd)	Change in Emissions (tpd)
WILLOWOOD ABAMECTIN 0.7SC	87290-36-AA	TGA	TGA	6.30	4.62	0.005	<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

Several dozen field studies have shown that actual emissions from soil-applied fumigants such as methyl bromide 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 method on reducing fumigant emissions.[10]

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

In the adjusted inventory, the emissions from an applied fumigant product are the sum of the emissions from each fumigant AI within the product.[11] 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 2022, only five of the 1,073 field fumigant applications did not report an accurate field fumigation method (FFM) code. These missing records originated in the Sacramento Metro, San Joaquin Valley, and Ventura NAAs. For any such records, DPR uses a conservative approach by assuming that the application method with the highest AMAF allowed by the regulations for that fumigant was used (Table 5), creating a complete dataset from which adjusted emissions can be calculated. Appendix 1b contains current FFMs and corresponding AMAFs.

Table 5. Default AMAFs (highest allowed by the regulations) assigned to fumigant applications with missing or invalid FFM codes.

Active Ingredient	Default AMAF
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.

[11] 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.

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 3). 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 2022 inventory is used to determine if restrictions will go into effect on May 1, 2024.

As shown in Table 6, 2022 emissions in all five NAAs were less than their trigger levels and SIP goals.

Table 6. SIP goals, trigger levels and 2022 emissions.

NAA	SIP Goal (tpd)	Trigger Level (95% of SIP Goal) (tpd)	2022 Emissions (tpd)
Sacramento Metro	2.20	2.090	1.116
San Joaquin Valley	18.10	17.195	12.671
Southeast Desert	0.92	0.874	0.311
Ventura	3.00	2.850	1.335
South Coast	8.70	8.265	0.893

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. When nonfumigant prohibitions are in effect, those prohibitions must remain in effect until the total hypothetical emissions detailed in the annual inventory report are less than the trigger level for at least two consecutive years.

The total hypothetical emission since 2020 have been less than the trigger level of 17.2 tpd, and in 2021 the regulatory requirement preventing DPR from lifting the nonfumigant prohibitions was satisfied. 3 CCR section 6884(c) requires at least two such consecutive years but does not mandate repeal of the nonfumigant prohibitions. The total hypothetical emissions for 2022 are equal to 13.989 tpd, which is 18.6% (-3.206 tpd) less than the trigger level of 17.2 tpd.[12] The agricultural sector was impacted by drought during this period. When drought conditions alleviate, pesticide use and total hypothetical

[12] See the text under Table A3-5 in Appendix 3 for the calculation of 2020 total hypothetical emissions.

emissions could return to pre-2020 levels that exceeded the trigger level. DPR is therefore leaving prohibitions in place in 2024.

Emissions in the Ozone NAAs

In 2022, all five ozone NAAs were in compliance with the SIP goals.

- Sacramento Metro NAA: Emissions in 2022 remain in compliance with the SIP goal of 2.2 tpd and were 60% lower than the 1990 base year. Emissions increased by 2% (0.026 tpd), from 1.090 tpd in 2021 to 1.116 tpd.
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- South Coast NAA: Emissions in 2022 remain in compliance with the SIP goal of 8.7 tpd and were 92% lower than the 1990 base year. Emissions decreased by 10% (-0.102 tpd), from 0.995 tpd in 2021 to 0.893 tpd.

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.[13]

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 http://www.DPR.ca.gov/docs/pur/purmain.htm.

[13] 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.

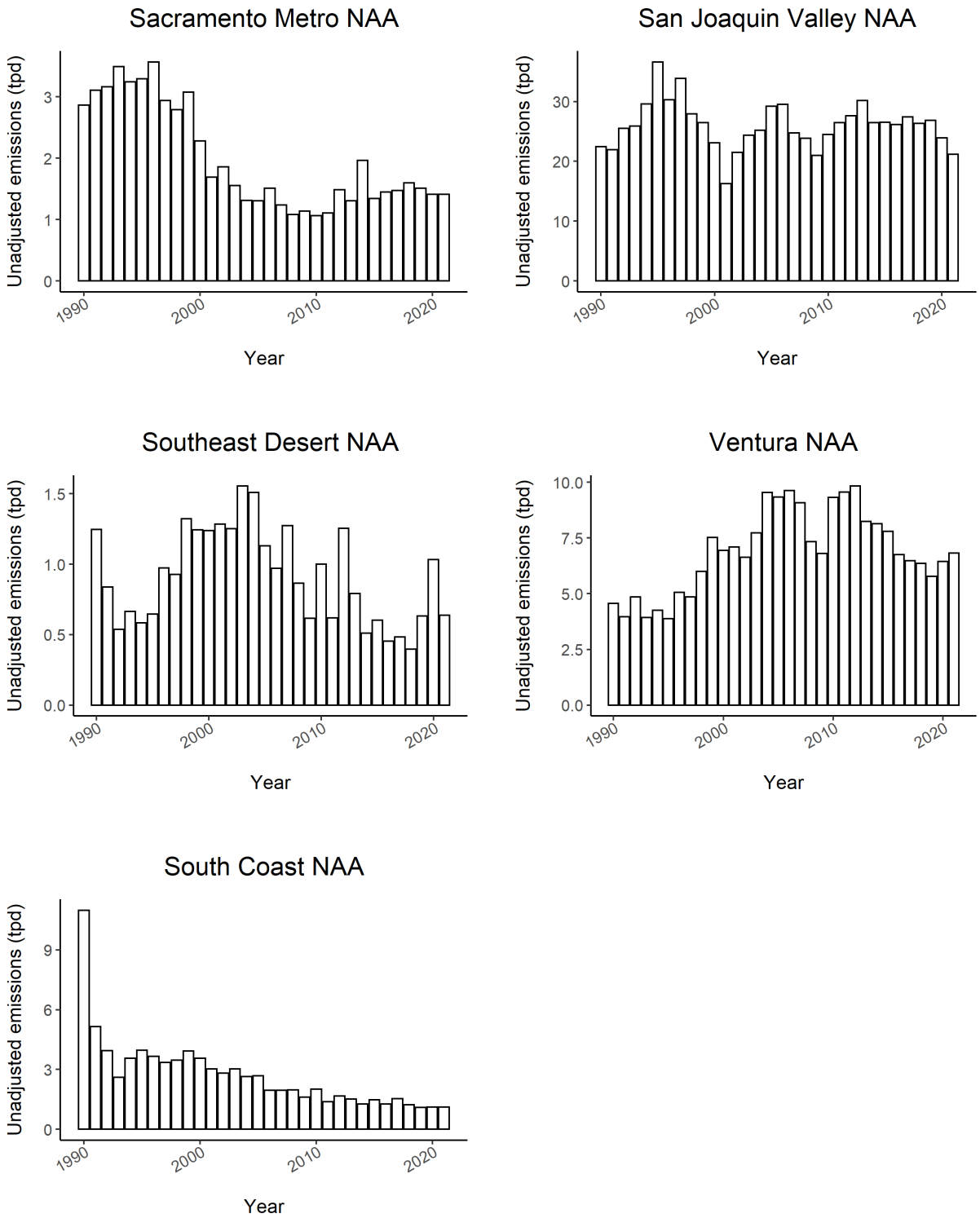

Figure 2. Total unadjusted emissions in each NAA from 1990 to 2022.

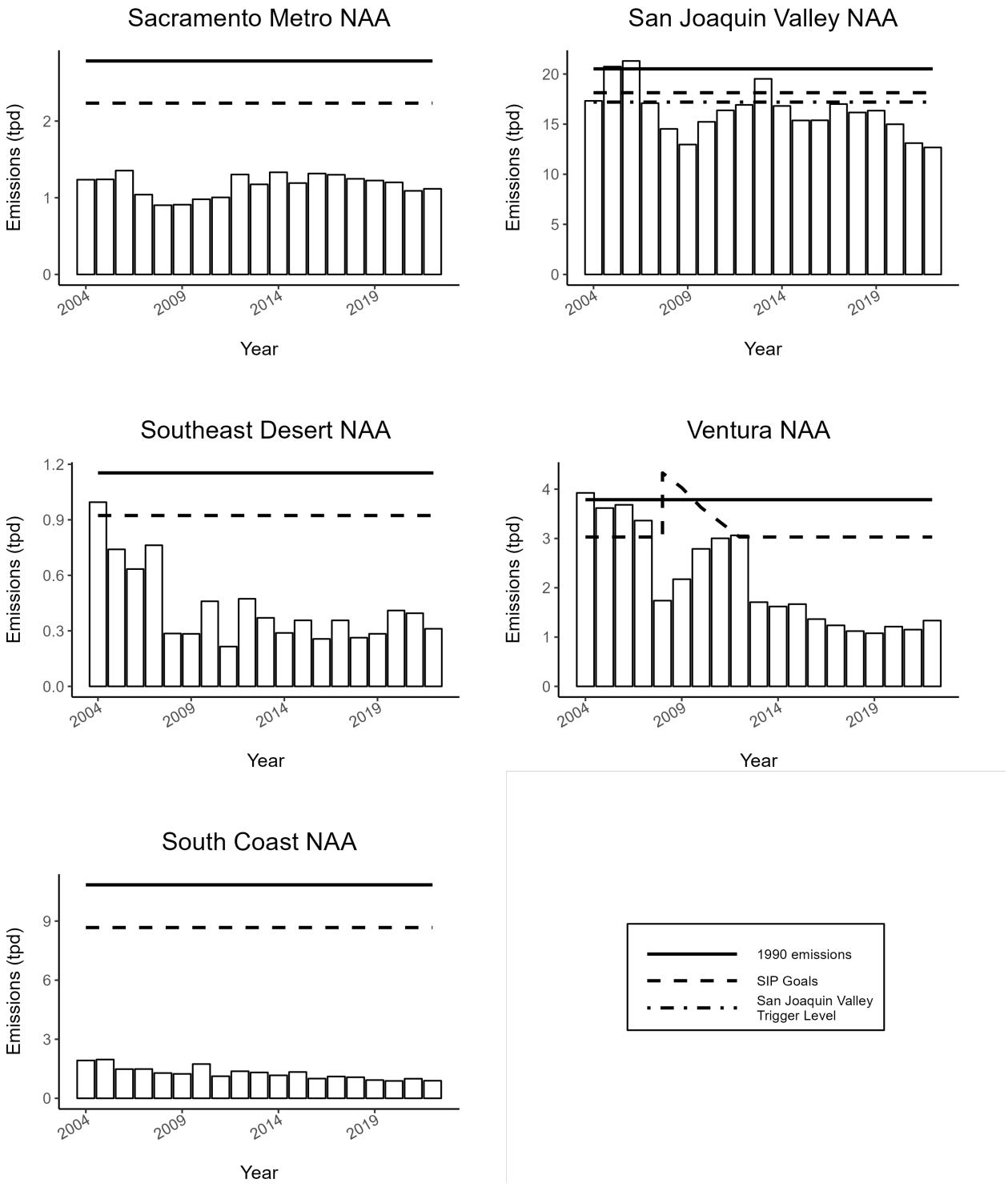

Figure 3. Total adjusted emissions in each NAA from the earliest available year of adjusted emissions data (2004) to 2022, in comparison to 1990 emissions, the SIP goals, and the San Joaquin Valley NAA trigger level. The 2007 SIP revision temporarily increased Ventura's SIP goal above 4 tpd in 2008, 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, 2022 emissions from pesticides increased 2% (0.026 tpd) between 2021 and 2022, from 1.090 to 1.116 tpd. This is the lowest emissions estimate since 2021. Emissions were 47% (-0.974 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.1 tpd.

Fumigant emissions increased 67% (0.078 tpd), from 0.116 to 0.194 tpd. There were five fumigant product formulations. The liquid concentrate and pressurized gas formulations accounted for 96% of fumigant emissions and 96% of the increase in fumigant emissions. There were five fumigant primary AIs, not counting inert ingredients. 1,3-dichloropropene and chloropicrin accounted for 79% of fumigant emissions and 92% of the increase in fumigant emissions. There were nine commodities treated by fumigant products. Cherry and walnut (English walnut, Persian walnut) accounted for 58% of fumigant emissions and 103% of the increase in fumigant emissions.

Nonfumigant emissions decreased 5% (-0.051 tpd), from 0.974 to 0.923 tpd. There were 18 nonfumigant product formulations. The emulsifiable concentrate, liquid concentrate, granular/flake, and flowable concentrate formulations accounted for 84% of nonfumigant emissions and 104% of the decrease in nonfumigant emissions. There were 374 nonfumigant primary AIs. The top 10 AIs accounted for 49% of nonfumigant emissions and 16% of the decrease in nonfumigant emissions. There were 107 commodities treated by nonfumigant products. The top 10 commodities accounted for 86% of nonfumigant emissions and 80% of the decrease in nonfumigant emissions.

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 8% (-0.004 tpd), from 0.052 tpd in 2021 to 0.047 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 18% (0.205 tpd), from 1.155 tpd to 1.360 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 18% (-0.026 tpd), from 0.145 tpd to 0.119 tpd.

San Joaquin Valley NAA

In the San Joaquin Valley NAA, 2022 emissions from pesticides decreased 3% (-0.436 tpd) between 2021 and 2022, from 13.107 to 12.671 tpd. This is the lowest emissions estimate since 2004. Emissions were 26% (-4.524 tpd) below the regulatory trigger level (95% of the SIP goal) of 17.2 tpd.

Fumigant emissions decreased 25% (-0.787 tpd), from 3.118 to 2.331 tpd. There were five fumigant product formulations. The liquid concentrate and pressurized gas formulations accounted for 96% of fumigant emissions and 58% of the decrease in fumigant emissions. There were five fumigant primary AIs, not counting inert ingredients. 1,3-dichloropropene, methyl bromide, and potassium n-methyldithiocarbamate accounted for 79% of fumigant emissions and 75% of the decrease in fumigant emissions. There were 42 commodities treated by fumigant products. Almond, carrots (general), soil application, preplant-outdoor (seedbeds, etc.), nursery-outdoor container/field grown plants, and nursery-outdoor grown transplant/propagative material accounted for 67% of fumigant emissions and 89% of the decrease in fumigant emissions.

Nonfumigant emissions increased 4% (0.351 tpd), from 9.989 to 10.340 tpd. There were 18 nonfumigant product formulations. The emulsifiable concentrate, liquid concentrate, and granular/flake formulations accounted for 74% of nonfumigant emissions and 110% of the increase in nonfumigant emissions. There were 436 nonfumigant primary AIs. The top 10 AIs accounted for 50% of nonfumigant emissions. Emissions from the top 10 AIs decreased by 0.021 tpd. There were 167 commodities treated by nonfumigant products. The top 10 commodities accounted for 82% of nonfumigant emissions and 141% of the increase in nonfumigant emissions.

Table A2-2-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide increased 5% (0.043 tpd), from 0.839 tpd in 2021 to 0.882 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 10% (-2.104 tpd), from 20.172 tpd to 18.068 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 71% (0.120 tpd), from 0.170 tpd to 0.291 tpd.

Southeast Desert NAA

In the Southeast Desert NAA, 2022 emissions from pesticides decreased 21% (-0.084 tpd) between 2021 and 2022, from 0.395 to 0.311 tpd. This is the lowest emissions estimate since 2019. Emissions were 64% (-0.563 tpd) below the regulatory trigger level (95% of the SIP goal) of 0.87 tpd.

Fumigant emissions decreased 48% (-0.080 tpd), from 0.168 to 0.088 tpd. There were six fumigant product formulations. The emulsifiable concentrate formulations accounted for 89% of fumigant emissions and 65% of the decrease in fumigant emissions. There were five fumigant primary AIs, not counting inert ingredients. Metam-sodium accounted for 83% of fumigant emissions and 83% of the decrease in fumigant emissions. There were 8 commodities treated by fumigant products. Peppers (bell, chili, etc.), strawberry (all or unspecified), and lemon accounted for 85% of fumigant emissions and 71% of the decrease in fumigant emissions.

Nonfumigant emissions decreased 2% (-0.004 tpd), from 0.228 to 0.224 tpd. There were 18 nonfumigant product formulations. The emulsifiable concentrate and liquid concentrate formulations accounted for 60% of nonfumigant emissions and 542% of the decrease in nonfumigant emissions. There were 361 nonfumigant primary AIs. The top 10 AIs accounted for 54% of nonfumigant emissions. Emissions from the top 10 AIs increased by 0.006 tpd. There were 94 commodities treated by nonfumigant products. The top 10 commodities accounted for 82% of nonfumigant emissions. The top 10 commodities also increased by 0.006 tpd.

Table A2-3-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased >99% (-0.045 tpd), from 0.045 tpd in 2021 to 0.000 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 17% (0.095 tpd), from 0.545 tpd to 0.640 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 2% (<0.001 tpd), from 0.047 tpd to 0.048 tpd.

Ventura NAA

In the Ventura NAA, 2022 emissions from pesticides increased 16% (0.184 tpd) between 2021 and 2022, from 1.151 to 1.335 tpd. This is the lowest emissions estimate since 2021. Emissions were 53% (-1.515 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.85 tpd.

Fumigant emissions increased 17% (0.133 tpd), from 0.783 to 0.916 tpd. There were four fumigant product formulations. The pressurized gas and emulsifiable concentrate formulations accounted for 80% of fumigant emissions and 378% of the increase in fumigant emissions. There were five fumigant primary AIs, not counting inert ingredients. Chloropicrin and inerts accounted for 68% of fumigant emissions and 64% of the increase in fumigant emissions. There were 7 commodities treated by fumigant products. Strawberry (all or unspecified) accounted for 96% of fumigant emissions and 85% of the increase in fumigant emissions.

Nonfumigant emissions increased 14% (0.051 tpd), from 0.368 to 0.419 tpd. There were 18 nonfumigant product formulations. The emulsifiable concentrate, liquid concentrate, and oil formulations accounted for 83% of nonfumigant emissions and 110% of the increase in nonfumigant emissions. There were 319 nonfumigant primary AIs. The top 10 AIs accounted for 49% of nonfumigant emissions and 63% of the increase in nonfumigant emissions. There were 105 commodities treated by nonfumigant products. The top 10 commodities accounted for 81% of nonfumigant emissions and 69% of the increase in nonfumigant emissions.

Table A2-4-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide increased 24% (0.001 tpd), from 0.006 tpd in 2021 to 0.007 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 16% (1.069 tpd), from 6.804 tpd to 7.873 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% (-0.002 tpd), from 0.016 tpd to 0.015 tpd.

South Coast NAA

In the South Coast NAA, 2022 emissions from pesticides decreased 10% (-0.102 tpd) between 2021 and 2022, from 0.995 to 0.893 tpd. This is the lowest emissions estimate since 2020. Emissions were 89% (-7.372 tpd) below the regulatory trigger level (95% of the SIP goal) of 8.3 tpd.

Fumigant emissions decreased 22% (-0.026 tpd), from 0.119 to 0.093 tpd. There were seven fumigant product formulations. The pressurized gas, liquid concentrate, and solution/liquid (ready-to-use) formulations accounted for 97% of fumigant emissions and 83% of the decrease in fumigant emissions. There were five fumigant primary AIs, not counting inert ingredients. Methyl bromide and metam-sodium accounted for 81% of fumigant emissions and 101% of the decrease in fumigant emissions. There were 8 commodities treated by fumigant products. Fumigation (other), rights of way, and strawberry (all or unspecified) accounted for 90% of fumigant emissions and 61% of the decrease in fumigant emissions.

Nonfumigant emissions decreased 9% (-0.076 tpd), from 0.877 to 0.800 tpd. There were 18 nonfumigant product formulations. The pressurized liquid/sprays/foggers, emulsifiable concentrate, liquid concentrate, flowable concentrate, and granular/flake formulations accounted for 80% of nonfumigant emissions and 114% of the decrease in nonfumigant emissions. There were 386 nonfumigant primary AIs. The top 10 AIs accounted for 58% of nonfumigant emissions and 70% of the decrease in nonfumigant emissions. There were 84 commodities treated by nonfumigant products. The top 10 commodities accounted for 97% of nonfumigant emissions and 95% of the decrease in nonfumigant emissions.

Table A2-5-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 6% (-0.003 tpd), from 0.052 tpd in 2021 to 0.049 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 14% (-0.078 tpd), from 0.540 tpd to 0.461 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 1% (-0.007 tpd), from 0.533 tpd to 0.526 tpd.

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