ANNUAL REPORT ON VOLATILE ORGANIC COMPOUND EMISSIONS FROM PESTICIDES: EMISSIONS FOR 1990-2021

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California Environmental Protection Agency
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Air 23-04

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 (CDPR) 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 2021, with an emphasis on the most recent five years of data.

In 2021, all five ozone NAAs were in compliance with the State Implementation Plan (SIP) goals.

- Sacramento Metro NAA: Emissions in 2021 remain in compliance with the SIP goal of 2.2 tpd and were 59% lower than the 1990 base year. Emissions decreased by 4% (-0.049 tons per day (tpd)), from 1.201 tpd in 2020 to 1.152 tpd.

- San Joaquin Valley NAA: Emissions in 2021 remain in compliance with the SIP goal of 18.1 tpd and were 36% lower than the 1990 base year. Emissions decreased by 13% (-1.922 tpd), from 14.988 tpd in 2020 to 13.066 tpd. Prohibition of certain uses of high-VOC nonfumigant products went into effect in 2015 and must continue until at least two consecutive years of hypothetical emissions are less than the trigger level. The hypothetical emissions for 2020 and 2021 are less than the trigger level; however, pesticide use decreased in those drought-impacted years and likely contributed to the reduction in hypothetical emissions below the trigger level. If the drought conditions that were present during these years alleviate, pesticide use and hypothetical emissions could increase and exceed the trigger level. Accordingly, CDPR is maintaining the prohibitions of certain high-VOC nonfumigants in 2023. The nonfumigant prohibitions that went into effect in 2015 remain active in 2023 in the San Joaquin Valley NAA.

- Southeast Desert NAA: Emissions in 2021 remain in compliance with the SIP goal of 0.92 tpd and were 66% lower than the 1990 base year. Emissions decreased by 4% (-0.015 tpd), from 0.410 tpd in 2020 to 0.395 tpd.

- Ventura NAA: Emissions in 2021 remain in compliance with the SIP goal of 3.0 tpd and were 70% lower than the 1990 base year. Emissions decreased by 5% (-0.061 tpd), from 1.212 tpd in 2020 to 1.151 tpd.

- South Coast NAA: Emissions in 2021 remain in compliance with the SIP goal of 8.7 tpd and were 91% lower than the 1990 base year. Emissions increased by 12% (0.110 tpd), from 0.883 tpd in 2020 to 0.992 tpd.

3 CCR section 6881(b) requires a 45-day public comment period of the draft report. Comments received during the comment period ending on September 5, 2023 are included in Appendix 5.

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

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 (CDPR) 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

CDPR 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 CDPR'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, CDPR 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;
- 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 of the draft report.

In 2013, CDPR 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 1990-2021; 2) adjusted emissions estimates for 1990 and 2004-2021; 3) whether 2021 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.

3 CCR section 6452 describes the interim and rulemaking processes that CDPR uses to evaluate and approve new low-emission fumigant application methods. In April 2013, CDPR 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, CDPR 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 CDPR and County Agricultural Commissioners (CACs) through grower allowances or other methods.[1]

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%

CDPR 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 5 (including products with multiple primary AIs) are excluded.

[1] 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.

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,[2] with the following exceptions:[3]

- 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.[4] 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.[5]

When prohibitions for high-VOC nonfumigant products are in effect, those prohibitions must remain in effect until the hypothetical VOC emissions detailed in the annual inventory report (see the section Emissions Relative to SIP Goals and Trigger Levels) are less than the trigger level for at least two consecutive years.[6]

[2] 3 CCR section 6884(a)
[3] 3 CCR section 6884(b)
[4] 3 CCR section 6883
[5] 3 CCR section 6558
[6] 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).[7] The inventory excludes applications outside of these NAAs, months, and uses.[8] CDPR updates its inventory annually when PUR data from the previous year becomes available. For the period covered by this report, the data for each year consists of approximately 2.1 million pesticide use records. 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 consists of EP values for approximately 5,570 products.

Other inputs to the inventory include geospatial data, due to its 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 form the basis of CDPR'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

[7] 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.

[8] 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.

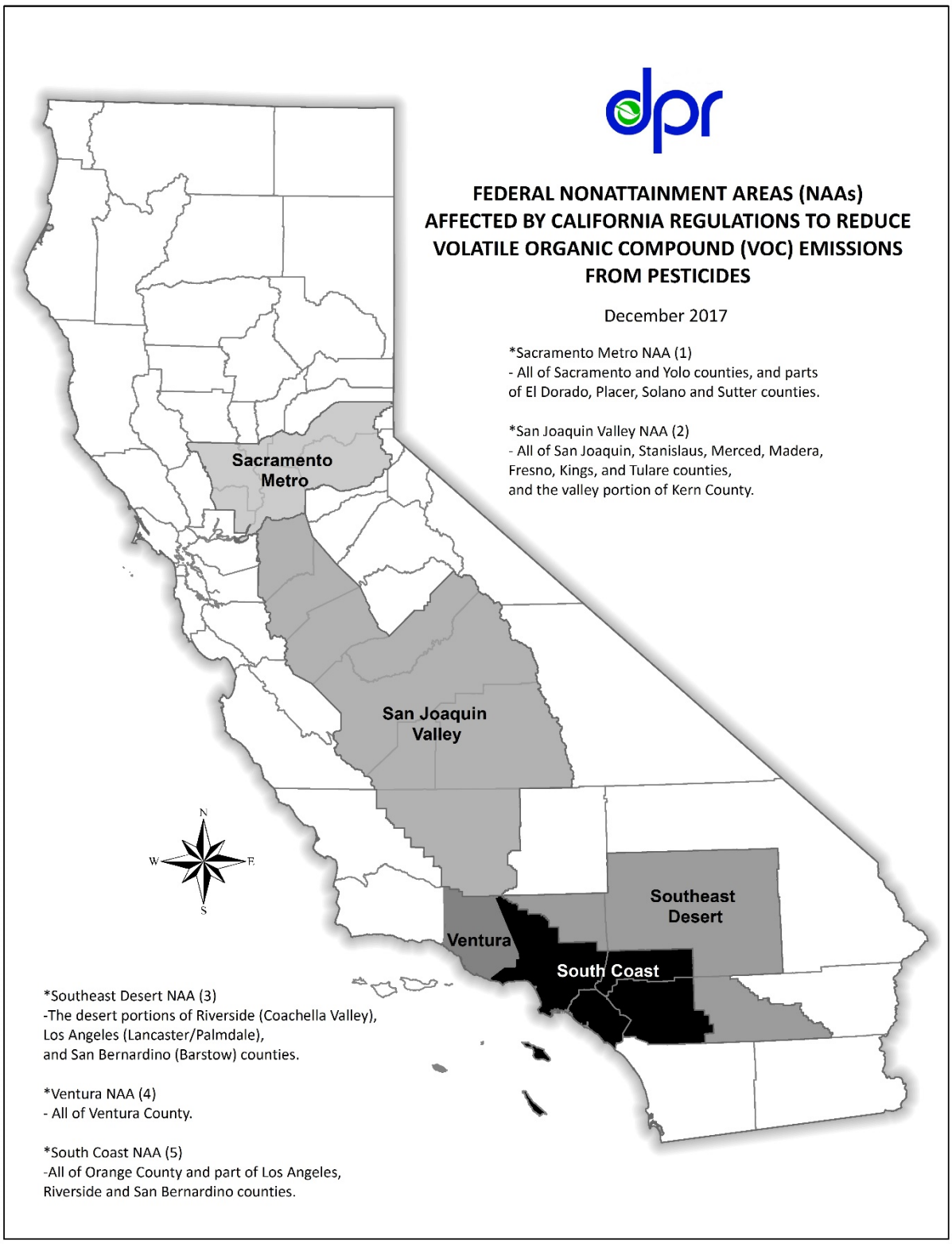

Figure 1: Federal ozone NAAs affected by California regulations to reduce VOC emissions from pesticides.

Data Revisions

CDPR continually evaluates input data to the inventory for reliability. CDPR 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 CDPR'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.

CDPR 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 CDPR, CDPR 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 2020 and 2021 annual inventories, and the estimated change in emissions in 2021 for the San Joaquin Valley NAA resulting from changes in EP for products. Products without use in 2021 are omitted.

Product	Registration Number	2021 Method	2020 Method	2021 EP	2020 EP	2021 Applied Mass (tpd)	Change in Emissions (tpd)
EMBED	62719-634-AA	Derived	Default median	0.04	5.71	0.003	>-0.001
GOVEE	89167-90-AA-89391	Derived	Default median	73.09	5.71	0.006	0.004

Emission Calculation Procedure

Prior to 2008, CDPR 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). CDPR has developed an adjustment procedure to account for the effect of application method on reducing fumigant emissions.[9]

[9] 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.[10] The emission 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 2021, only six of the 1,696 field fumigant applications did not report an accurate field fumigation method (FFM) code. These missing records originated in the Sacramento Metro, San Joaquin Valley, Ventura, and South Coast NAAs. For any such records, CDPR 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. CDPR 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.

[10] 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 CDPR'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 CDPR 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. CDPR 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 hypothetical emissions are less than the trigger level. More information about the calculation of 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 2021 inventory is used to determine if restrictions will go into effect on May 1, 2023.

As shown in Table 6, 2021 emissions in all five NAAs were less than their trigger levels and SIP goals.

Table 6: SIP goals, trigger levels and 2021 emissions.

NAA	SIP Goal (tpd)	Trigger Level (95% of SIP Goal) (tpd)	2021 Emissions (tpd)
Sacramento Metro	2.20	2.090	1.152
San Joaquin Valley	18.10	17.195	13.066
Southeast Desert	0.92	0.874	0.395
Ventura	3.00	2.850	1.151
South Coast	8.70	8.265	0.992

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 (EC) formulations. Therefore, CDPR 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 hypothetical emissions detailed in the annual inventory report are less than the trigger level for at least two consecutive years.

The total hypothetical emissions for 2020 were 16.587 tpd, and the total hypothetical emissions for 2021 were 14.400 tpd.[11] Both years' total hypothetical emissions are less than the trigger level of 17.2 tpd. This marks the first time that the minimum requirement for potential repeal of the nonfumigant prohibitions has been satisfied. 3 CCR 6884(c) requires at least two such consecutive years but does not mandate repeal of the nonfumigant prohibitions. The agricultural sector was impacted by drought during this period, and pesticide use dropped statewide by over 10% in 2021.[12] When drought

[11] See the text under Table A3-5 in Appendix 3 for the calculation of 2020 total hypothetical emissions.
[12] Personal communication with Kimberly Steinmann.

conditions alleviate, pesticide use and emissions could return to pre-2020 levels that exceeded the hypothetical emissions. CDPR is therefore leaving prohibitions in place in 2023.

Emissions in the Ozone NAAs

In 2021, all five ozone NAAs were in compliance with the SIP goals.

- Sacramento Metro NAA: Emissions in 2021 remain in compliance with the SIP goal of 2.2 tpd and were 59% lower than the 1990 base year. Emissions decreased by 4% (-0.049 tpd), from 1.201 tpd in 2020 to 1.152 tpd.
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- South Coast NAA: Emissions in 2021 remain in compliance with the SIP goal of 8.7 tpd and were 91% lower than the 1990 base year. Emissions increased by 12% (0.110 tpd), from 0.883 tpd in 2020 to 0.992 tpd.

Total emissions for all available years of data are shown in Figures 2 and 3. Appendix 2 lists this 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 CDPR's annual summary of PURs, which is available at http://www.cdpr.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.

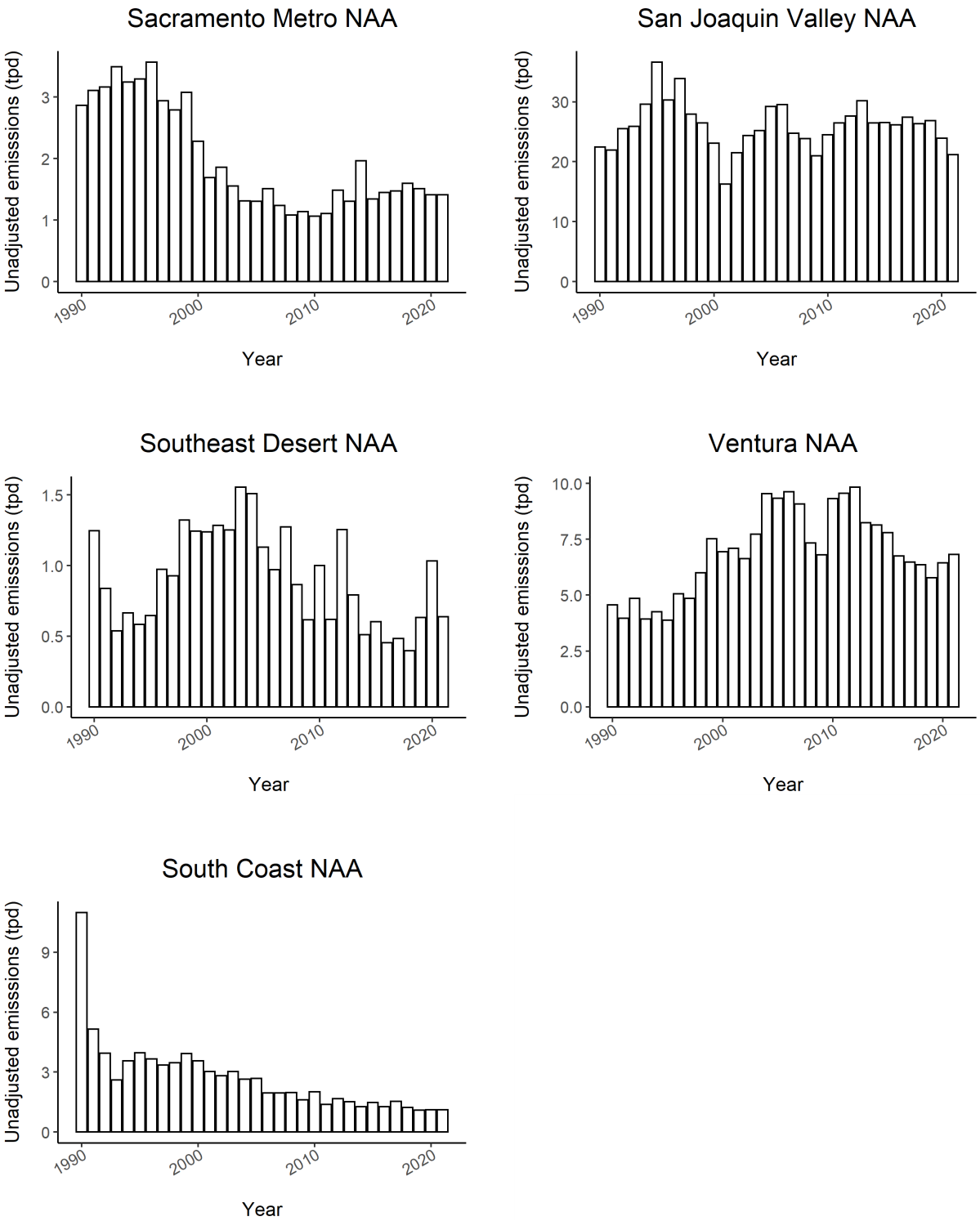

Figure 2: Total unadjusted emissions in each NAA from 1990 to 2021.

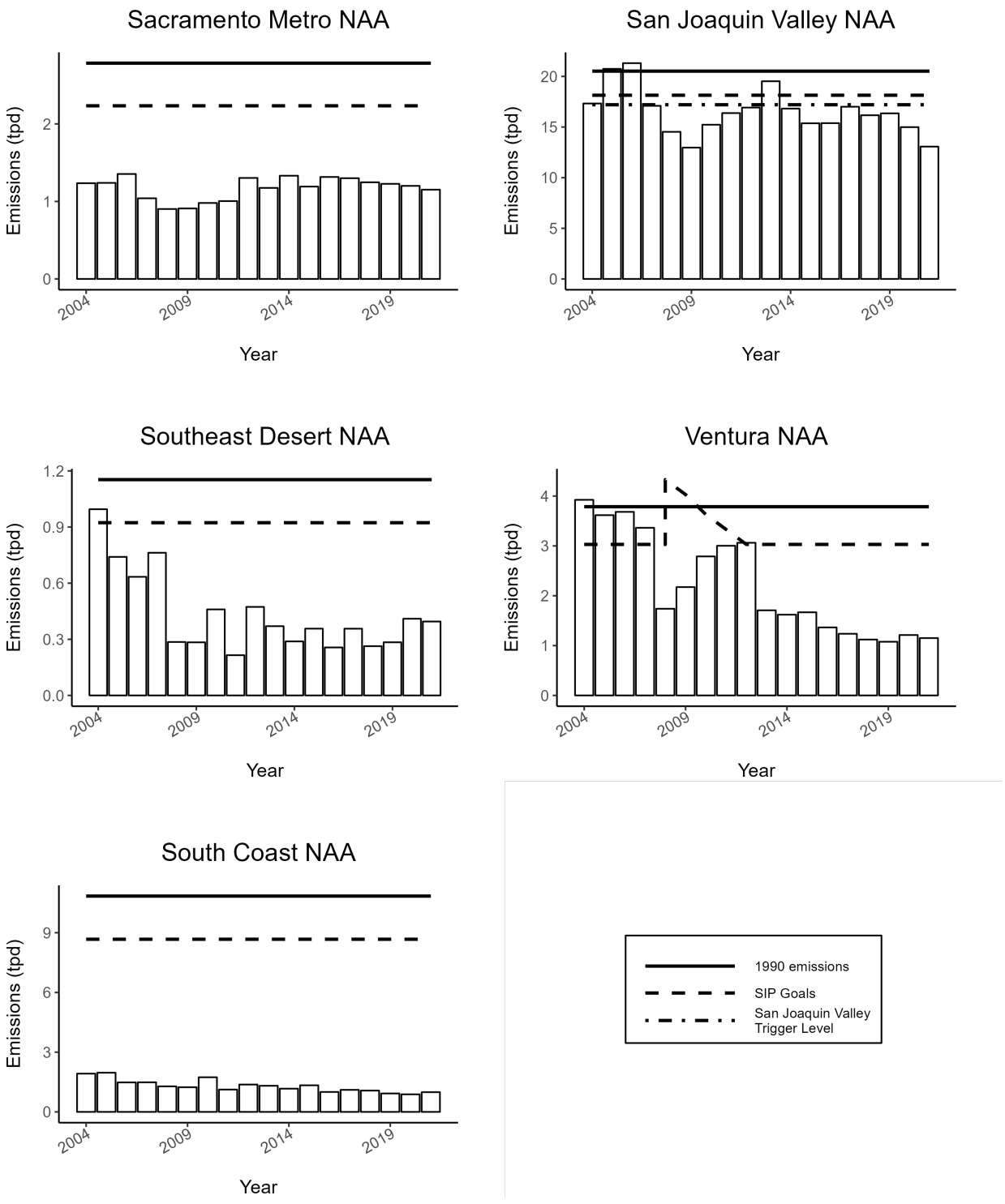

Figure 3: Total adjusted emissions in each NAA from the earliest available year of adjusted emissions data (2004) to 2021, in comparison to 1990 emissions, the SIP goals, and the San Joaquin Valley NAA trigger level. The 2007 SIP revision temporarily increased Ventura's SIP goal above 4 tpd in 2008, 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, 2021 emissions from pesticides decreased 4% (-0.049 tpd) between 2020 and 2021, from 1.201 to 1.152 tpd. This is the lowest emissions have estimated since 2011. Emissions were 45% (-0.938 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.1 tpd.

Fumigant emissions decreased 9% (-0.011 tpd), from 0.127 to 0.116 tpd. Fumigants represented 10% of emissions and 22% of the decrease in emissions. There were six fumigant product formulations used in the Sacramento Metro NAA. Two formulations had notable changes in fumigant emissions. Liquid concentrates increased by 0.017 tpd, while pressurized liquid/sprays/foggers decreased by 0.026 tpd. These formulations respectively accounted for 73% and 22% of fumigant emissions. Two AIs constituted the majority of fumigant emissions: 1,3-dichloropropene (65%) and methyl bromide (17%). There was a 0.013 tpd increase in 1,3-dichloropropene emissions and a decrease in chloropicrin emissions of 0.026 tpd. There were 18 commodities treated by fumigant products, including wine grapes (34% of fumigant emissions), walnuts (27%), and outdoor preplant soil applications (23%).

Emissions from nonfumigant products decreased 4% (-0.038 tpd), from 1.074 to 1.036 tpd. Nonfumigants represented 90% of emissions and 78% of the decrease in emissions. There were 18 nonfumigant product formulations used in the Sacramento NAA. Three formulations had notable changes in nonfumigant emissions. Emulsifiable concentrates increased by 0.092 tpd, while liquid concentrates and granular/flake formulations respectively decreased by 0.068 and 0.062 tpd. These formulations respectively accounted for 47%, 17%, and 13% of nonfumigant emissions. There were 145 commodities treated by nonfumigant products. This included structural pest control (20% of nonfumigant emissions), rice (19%), and almonds (14%). There were 488 nonfumigant primary AIs. The top 10 nonfumigant AIs accounted for 53% of nonfumigant emissions and an increase of 0.0125 tpd.

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 increased 19% (0.008 tpd), from 0.043 tpd in 2020 to 0.052 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 8% (-0.095 tpd), from 1.249 tpd to 1.154 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 79% (0.091 tpd), from 0.116 tpd to 0.207 tpd.

San Joaquin Valley NAA

In the San Joaquin Valley NAA, 2021 emissions from pesticides decreased 13% (-1.922 tpd) between 2020 and 2021, from 14.988 to 13.066 tpd. This is the lowest emissions have been since 2009. Emissions were 24% (-4.129 tpd) below the regulatory trigger level (95% of the SIP goal) of 17.2 tpd.

Fumigant emissions decreased 20% (-0.784 tpd), from 3.902 to 3.117 tpd. Fumigants represented 24% of emissions and 41% of the decrease in emissions. There were eight fumigant product formulations used in the San Joaquin Valley NAA. Two formulations had notable changes in fumigant emissions. Liquid concentrates and pressurized liquid/sprays/foggers respectively decreased by 0.645 and 0.141 tpd. These formulations respectively accounted for 70% and 10% of fumigant emissions. Four AIs constituted the majority of fumigant emissions: 1,3-dichloropropene (44%), potassium n-methyldithiocarbamate (19%), methyl bromide (15%), and chloropicrin (10%). There was a 0.469 tpd decrease in 1,3-dichloropropene emissions and a decrease in chloropicrin emissions of 0.152 tpd. There were 88 commodities treated by fumigant products, including almonds (34% of fumigant emissions) and carrots (17%).

Emissions from nonfumigant products decreased 10% (-1.138 tpd), from 11.086 to 9.948 tpd. Nonfumigants represented 76% of emissions and 59% of the decrease in emissions. There were 18 nonfumigant product formulations used in the San Joaquin Valley NAA. Two formulations had notable changes in nonfumigant emissions. Emulsifiable concentrates and liquid concentrates respectively decreased by 0.485 and 0.550 tpd. These formulations respectively accounted for 45% and 23% of nonfumigant emissions. There were 210 commodities treated by nonfumigant products. This included almonds (35% of nonfumigant emissions) and pistachios (13%). There were 582 nonfumigant primary AIs. The top 10 AIs accounted for 52% of nonfumigant emissions and a decrease of 0.570 tpd.

Table A2-2-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide increased <1% (0.006 tpd), from 0.833 tpd in 2020 to 0.839 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 12% (-2.807 tpd), from 22.939 tpd to 20.132 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 by less than 1% (<0.001 tpd), from 0.169 tpd to 0.170 tpd.

Southeast Desert NAA

In the Southeast Desert NAA, 2021 emissions from pesticides decreased 4% (-0.015 tpd) between 2020 and 2021, from 0.410 to 0.395 tpd. Emissions were 55% (-0.479 tpd) below the regulatory trigger level (95% of the SIP goal) of 0.87 tpd.

Fumigant emissions decreased 5% (-0.009 tpd), from 0.177 to 0.168 tpd. Fumigants represented 42% of emissions and 62% of the decrease in emissions. There were nine fumigant product formulations used in the Southeast Desert NAA. Three formulations had notable changes in fumigant emissions. Emulsifiable concentrates and pressurized gases respectively increased by 0.050 and 0.022 tpd, while liquid concentrates decreased by 0.081 tpd. These formulations respectively accounted for 78%, 13%, and 6% of fumigant emissions. One AI constituted the majority of fumigant emissions: metam-sodium (83%). There was a 0.057 tpd increase in metam-sodium emissions, a 0.021 tpd increase in methyl bromide emissions, and a decrease in 1,3-dichloropropene emissions from 0.082 to 0.00 tpd. (Aside from 2020, there is no reported use of 1,3-dichloropropene between 2017 and 2021.) There were 25 commodities treated by fumigant products, including peppers (75% of fumigant emissions) and ornamental turf (13%).

Emissions from nonfumigant products decreased 2% (-0.006 tpd), from 0.233 to 0.227 tpd. Nonfumigants represented 58% of emissions and 38% of the decrease in emissions. There were 18 nonfumigant product formulations used in the Southeast Desert NAA. There were notable changes in emissions across many nonfumigant formulations. In particular, emulsifiable concentrates increased by 0.017 tpd, while liquid concentrates decreased by 0.14 tpd. These formulations respectively accounted for 50% and 18% of nonfumigant emissions. There were 133 commodities treated by nonfumigant products. This included structural pest control (21% of nonfumigant emissions), dates (12%), landscape maintenance (11%), and lemons (10%). There were 482 nonfumigant primary AIs. The top 10 AIs accounted for 53% of nonfumigant emissions and an increase of 0.017 tpd.

Table A2-3-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide increased from 0.000 tpd in 2020 to 0.045 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 45% (-0.446 tpd), from 0.991 tpd to 0.545 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 10% (0.004 tpd), from 0.043 tpd to 0.047 tpd.

Ventura NAA

In the Ventura NAA, 2021 emissions from pesticides decreased 5% (-0.061 tpd) between 2020 and 2021, from 1.212 to 1.151 tpd. Emissions were 60% (-1.699 tpd) below the regulatory trigger level (95% of the SIP goal) of 2.85 tpd.

Fumigant emissions decreased 1% (-0.011 tpd), from 0.794 to 0.783 tpd. Fumigants represented 68% of emissions and 18% of the decrease in emissions. There were seven fumigant product formulations used in the Ventura NAA. Five fumigant product formulations had notable changes in emissions, but these changes did not result in a significant change in fumigant emissions. Three of these formulations accounted for the majority of fumigant emissions. Pressurized liquid/sprays/foggers, emulsifiable concentrates, and liquid concentrates respectively accounted for 52%, 27%, and 18% of fumigant emissions. Three AIs constituted the majority of fumigant emissions: chloropicrin (40%), 1,3-dichloropropene (19%), and potassium n-methyldithiocarbamate (10%). There was a 0.032 tpd increase in potassium n-methyldithiocarbamate emissions, and a 0.025 tpd increase in 1,3-dichloropropene emissions. Inert fumigant product ingredients also contributed significantly to fumigant emissions (29%); in contrast, in the other four NAAs inerts constituted between 0.5% and 6% of emissions. There were 19 commodities treated by fumigant products, including strawberries (98% of fumigant emissions).

Emissions from nonfumigant products decreased 12% (-0.050 tpd), from 0.418 to 0.368 tpd. Nonfumigants represented 32% of emissions and 82% of the decrease in emissions. There were 18 nonfumigant product formulations used in the Ventura NAA. Three formulations had notable changes in nonfumigant emissions. Emulsifiable concentrates, liquid concentrates, and oils respectively decreased by 0.009, 0.018, and 0.024 tpd. These formulations respectively accounted for 14%, 18%, and 6% of nonfumigant emissions. There were 139 commodities treated by nonfumigant products. This included strawberries (24% of nonfumigant emissions) and lemons (21%). There were 413 nonfumigant primary AIs. The top 10 AIs accounted for 50% of nonfumigant emissions and a decrease of 0.018 tpd.

Table A2-4-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 24% (-0.002 tpd), from 0.007 tpd in 2020 to 0.006 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products increased 6% (0.378 tpd), from 6.426 tpd to 6.804 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 13% (-0.002 tpd), from 0.019 tpd to 0.016 tpd.

South Coast NAA

In the South Coast NAA, 2021 emissions from pesticides increased 12% (0.110 tpd) between 2020 and 2021, from 0.883 to 0.992 tpd. Emissions were 88% (-7.273 tpd) below the regulatory trigger level (95% of the SIP goal) of 8.3 tpd.

Fumigant emissions increased 3% (0.004 tpd), from 0.115 to 0.119 tpd. Fumigants represented 12% of emissions and 4% of the increase in emissions. There were nine fumigant product formulations used in the South Coast NAA. Two formulations had notable changes in fumigant emissions. Ready-to-use solution/liquid formulations increased by 0.021 tpd, while pressurized gases decreased by 0.016 tpd. These formulations respectively accounted for 18% and 53% of fumigant emissions. The majority of fumigant emissions are evenly split between two AIs: methyl bromide (43%) and metam-sodium (42%). There was a 0.023 tpd increase in metam-sodium and decreases in the other AIs and inert ingredients. There were 14 commodities treated by fumigant products, including rights of way (41% of fumigant emissions).

Emissions from nonfumigant products increased 14% (0.106 tpd), from 0.768 to 0.873 tpd. Nonfumigants represented 88% of emissions and 96% of the increase in emissions. There were 18 nonfumigant product formulations used in the South Coast NAA. Two formulations drove the increase in nonfumigant emissions. Emulsifiable concentrates and flowable concentrates respectively increased by 0.034 and 0.082 tpd. These formulations respectively accounted for 30% and 18% of nonfumigant emissions. There were 518 nonfumigant primary AIs. The top 10 AIs accounted for 61% of nonfumigant emissions and an increase of 0.145 tpd. There were 149 commodities treated by nonfumigant products. This included structural pest control (61% of nonfumigant emissions) and landscape maintenance (28%).

Table A2-5-10 shows unadjusted emissions using the CARB CEIDARS classifications. Unadjusted emissions from agricultural applications of methyl bromide decreased 10% (-0.006 tpd), from 0.057 tpd in 2020 to 0.052 tpd. Unadjusted emissions from agricultural applications of non-methyl bromide products decreased 12% (-0.076 tpd), from 0.616 tpd to 0.540 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 22% (0.095 tpd), from 0.435 tpd to 0.530 tpd.

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