
Chapter 5

Toxic Air Contaminant Emissions, Air Quality, and Health Risk

Introduction

This chapter presents a summary of the emissions and air quality data available for selected toxic air contaminants, or TACs. The Health and Safety Code defines a TAC as an air pollutant which may cause or contribute to an increase in mortality or serious illness, or which may pose a present or potential hazard to human health. There are almost 200 compounds that have been designated as TACs in California. Some of these TACs are groups of compounds which contain many individual substances (e.g., copper compounds, polycyclic aromatic compounds). The summary information includes available data for the ten TACs posing the greatest known health risk in California, based primarily on ambient air quality data. These TACs are acet-aldehyde, benzene, 1,3-butadiene, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel particulate matter (diesel PM). Besides the ten selected TACs, dioxins are also considered to pose substantial health risk, and a brief discussion on dioxins is presented in this introduction.

Chapter 5 is organized in three major sections. The introduction provides an overview of emission and air quality information on TACs. The second section provides summaries of statewide emissions, annual average concentrations (calculated as an average of the monthly means), and estimated health risks for the ten selected TACs. The third section provides similar information for California's five most populous air basins: the South Coast, the San Francisco Bay Area, the San Joaquin Valley, the San Diego, and the Sacramento Valley air basins. Tables of concentration and health risk data for the ten TACs at the state, air basin, and site levels are presented in Appendix C.

It is important to note that the summarized data reflect a spatial average, and ambient concentrations and health risks for individual locations may be higher or lower. In addition, the information presented here reflect the ten TACs that pose the most substantial health risk, based on data collected only at sites operated by ARB. There may be

other TACs that may pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern. Additional information on interpreting air quality data for TACs can be found in Chapter 1.

Sources of Toxic Air Contaminant Emissions in California. Similar to the criteria pollutants, TACs are emitted from stationary sources, area-wide sources, and mobile sources. The stationary source emissions inventory was developed by the ARB in cooperation with affected industries and the air pollution control and air quality management districts (districts) as part of AB 2588, the Air Toxics Hot Spots Information and Assessment Act of 1987 (Hot Spots Program). The ARB developed the emission estimates for area-wide sources and mobile sources.

Emissions of the selected TACs are reported on a statewide basis and for the ten highest-emitting counties in California. Emissions are also included for the five most populous air basins. In general, the inventory base year is 2008. Note, however, that the stationary source emissions inventory uses the best available information for the emission source, although the data may not have been specifically collected for 2008.

Air Quality Monitoring for Toxic Air Contaminants. The ARB maintains a statewide air quality monitoring network for TACs. The network was originally designed to measure selected substances in the ambient air to determine if levels were sufficiently high to be of concern. As a result of this monitoring, the ARB has determined atmospheric concentrations for over 60 individual substances. As shown in Figure 5-1, the ARB currently maintains a network of 17 air quality monitoring stations, measuring ambient concentrations of 64 substances.

TAC samples are generally collected once every 12 days, throughout the year. This results in 20,000 to 35,000 individual TAC measure-

ments annually. The TAC data are typically sampled, analyzed, and reported as 24-hour averages. These 24-hour averages provide the basis for the annual average concentrations. The annual average concentrations are then used to support statewide risk assessment.

The TAC air quality trends included in this chapter are based on ambient data collected during 1990 through 2007 except for diesel PM which currently has no widely accepted monitoring method. The ARB has made some estimates of ambient diesel PM concentrations in 1998 based on receptor modeling techniques. These estimates are currently being reviewed to reflect control measures that are outlined in the Diesel Reduction Plan.

To minimize the influences of extreme weather on the trends, three-year statewide average concentrations were used to assess changes in individual TACs over time. The trend is determined by comparing the resulting averages from the beginning and end of the monitoring periods. For about half of the ten TACs, the baseline average concentration is for 1990-1992, and the current average concentration is for 2005-2007. However, acetaldehyde and formaldehyde data collected prior to 1996 are underestimated, so their respective baseline average concentration is for 1996-1998. For hexavalent chromium and *para*-dichlorobenzene, monitoring data were available starting in 1992 and 1991, respectively, so their baseline averages are for 1992-1994 and 1991-1993. The analysis of *para*-dichlorobenzene was discontinued in March 2007 due to the high percentage of values below the limit of detection; therefore, the current average concentration is for 2004-2006. Carbon tetrachloride data from February 2004 through 2007 are not available because of a problem with the laboratory standard. Therefore, carbon tetrachloride's baseline average is for 1990-1991 (1992 average was invalid), and the current average concentration is for 2001-2003.

Statewide Health Risk and Community Health. In the Almanac, health risk is presented on a pollutant-by-pollutant basis as well as on a cumulative basis with a focus on cancer risk. The risk for an individual TAC is calculated by multiplying its unit risk factor with its annual average concentration. The unit risk factor is expressed as

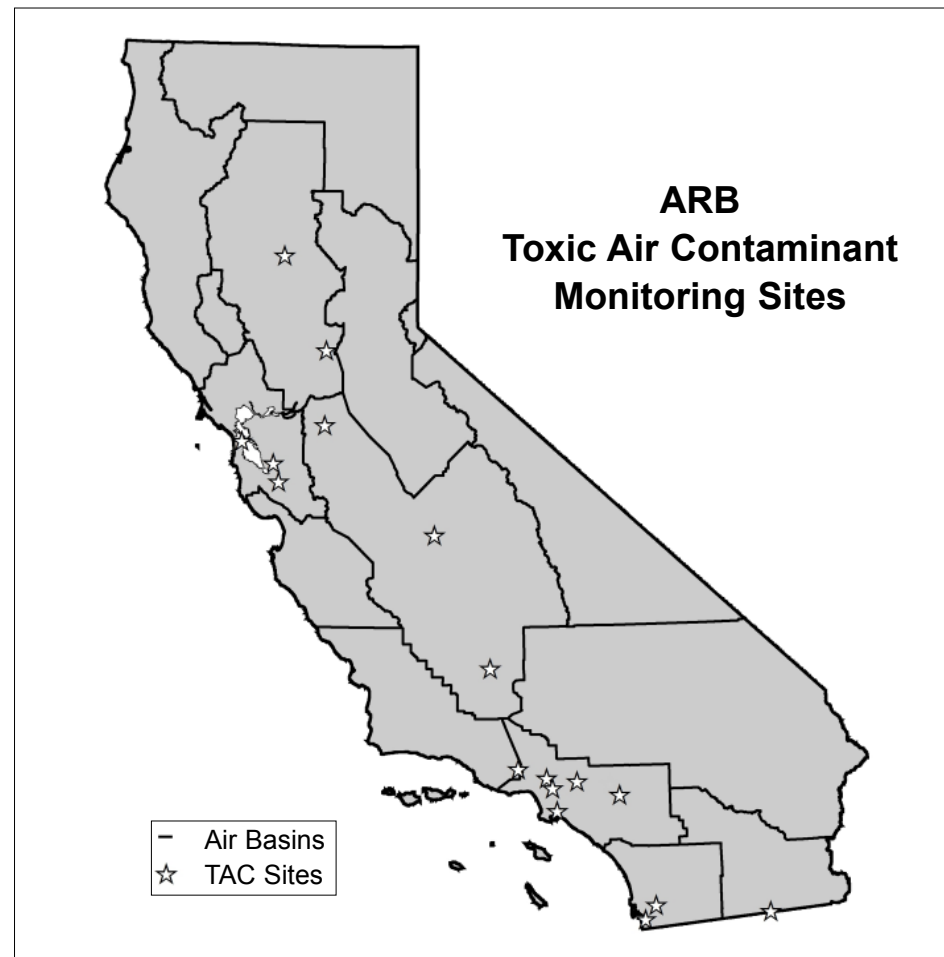


Figure 5-1

the probability, or risk, of contracting cancer as a result of constant exposure to an ambient concentration of one microgram per cubic meter for 70 years. It reflects only the inhalation pathway. The risk is expressed as the risk of contracting cancer (or excess cancer cases) per million people exposed over a 70-year period. Table 5-1 lists the unit risk factor and limit of detection (LOD) for each of the ten TACs presented in this almanac. The LOD is the lowest concentration of a substance that can be reliably measured, and measurements below the LOD are assumed to be one-half of the LOD.

The TAC monitoring network is designed to provide air quality data in support of general population exposures. Therefore, the data do not provide information on localized impacts, often referred to as near-source or neighborhood exposures. Localized impacts may involve exposure to different TACs with higher or lower concentrations than those represented by the regional ambient air monitoring data.

The ARB participated in several studies to address localized impacts and community health issues. For example, during October 1999, ARB initiated a monitoring and evaluation study in the Barrio Logan and Logan Heights neighborhoods of San Diego. In addition, ARB has conducted monitoring in five other communities in support of the community health program as required by the Children's Environmental Health Protection Program (Senate Bill 25, 1999 or SB 25). Efforts such as these supplement our existing statewide TAC monitoring network, which was designed for regional rather than neighborhood assessments. Information on these and other studies is available at www.arb.ca.gov/ch/programs/sb25/sb25.htm.

Monitoring for Dioxins. Dioxins and furans, collectively referred to as dioxins, are a group of chemicals with similar structures and chemical properties. When found in the environment, dioxins are usually a mixture of these chemicals. Dioxins are byproducts of various industrial and combustion activities, and they can be emitted from vehicles, waste incineration, chemical manufacturing plants, and forest fires. Once released into the environment, dioxins are highly persistent and can accumulate in the tissues of animals and humans.

Dioxins enter the body through direct inhalation or can accumulate in the body from eating dioxins-contaminated vegetation or animals that have eaten such vegetation. Many studies have shown that dioxins can cause cancer and other health problems including birth defects and liver damage.

The ARB has identified dioxins as a TAC, and the U.S. EPA has listed them as hazardous air pollutants. In 1990, the ARB adopted a control measure to reduce emissions of dioxins from medical waste incinera-

Toxic Air Contaminant Unit Risk Factors		
Toxic Air Contaminant	Unit Risk/Million People ¹	Detection Limit (ppb)
Acetaldehyde	2.7	0.10
Benzene	29	0.05
1,3-Butadiene	170	0.04
Carbon Tetrachloride	42	0.02
Chromium, Hexavalent	150,000	0.06 ²
<i>para</i> -Dichlorobenzene	11	0.30
Formaldehyde	6	0.10
Methylene Chloride	1	0.10
Perchloroethylene	5.9	0.01
Diesel Particulate Matter	300 ³	N/A

1 The unit risk represents the number of excess cancer cases per million people per microgram per cubic meter TAC concentration over a 70-year, lifetime exposure.

2 The hexavalent chromium detection limit units are in nanograms per cubic meter.

3 A diesel particulate matter unit risk value of 300 is used as a reasonable estimate in the "Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles" (ARB, October 2000).

Table 5-1

tors by 99 percent. At the time, medical waste incinerators were one of the largest known air sources of dioxins in California. As a result of the control measure, the number of medical incinerators in the State dropped sharply, from about 150 to less than 10. Since 1990, the ARB has adopted additional control measures to reduce dioxins including limits on residential waste burning and onboard incineration on cruise and oceangoing ships.

In order to provide information on ambient levels of dioxins and dioxin-like compounds, the ARB has developed the California Ambient Dioxin Air Monitoring Program (CADAMP). This program is modeled, in part, after the U.S. EPA's National Dioxin Air Monitoring Network (NDAMN) to ensure the data from the two networks can be used interchangeably. The two networks use the same sampling and analytical techniques; however, CADAMP focuses on dioxins sampling in urban areas while NDAMN emphasizes rural

areas nationwide. Ten sampling sites were deployed in CADAMP, five in the San Francisco Bay Area, four in the South Coast Air Basin, and one in Sacramento. Several of the CADAMP sites are also part of the ARB's Children's Environmental Health Protection Program (SB 25). The monitoring period was from December 2001 to August 2006. The dioxin monitoring data can be found at www.arb.ca.gov/pub/dioxin/cadamp.php. General information on ARB's dioxins program is available at www.arb.ca.gov/toxics/dioxins/dioxins.htm.

2008 Statewide TAC Emissions

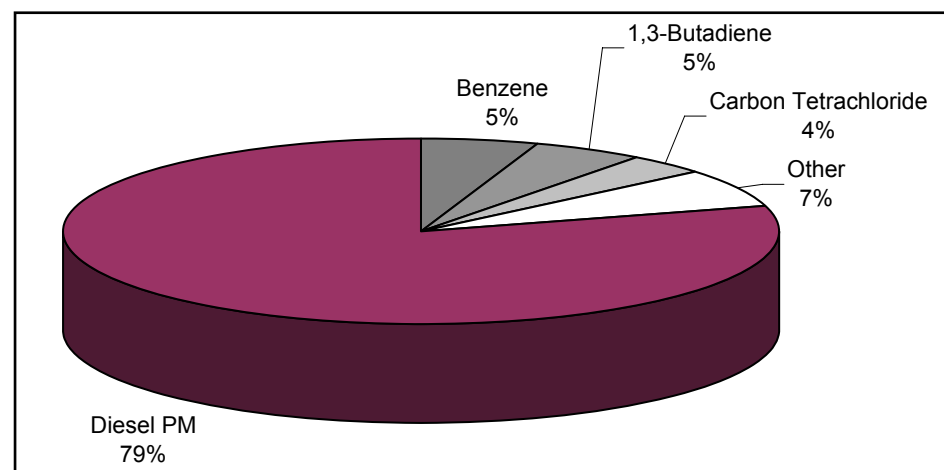
TAC	tons/year
Acetaldehyde	9,103
Benzene	10,794
1,3-Butadiene	3,754
Carbon Tetrachloride	4.04
Chromium, Hexavalent	0.61
para-Dichlorobenzene	1,508
Formaldehyde	20,951
Methylene Chloride	6,436
Perchloroethylene	4,982
Diesel PM	35,884

Table 5-2

Statewide TAC Emissions and Ambient Health Risks. Table 5-2 provides a summary of the 2008 Statewide emissions for the top 10 TACs. Figure 5-2 provides a graphical presentation of the Statewide ambient health risks for 2007. Data for Diesel PM reflect 2000 and for carbon tetrachloride reflect 2003.

Additional Information. Additional emissions and air quality data for the ten TACs in this almanac, as well as many other TACs, may be found by accessing the ARB website at www.arb.ca.gov/html/ds.htm. The web data are updated periodically, as new information becomes available. More detailed information on the health effects of these compounds, as well as other TACs, can be found in an ARB report entitled: "Update to the Toxic Air Contaminant List" dated December 1999. This report can be obtained by accessing the newer ARB website at www.arb.ca.gov/toxics/id/id.htm.

2007 Statewide Health Risks¹



¹ Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; "Other" only includes acetaldehyde, formaldehyde, para-dichlorobenzene, hexavalent chromium, perchloroethylene, and methylene chloride. This pie chart is based upon ambient monitoring for the top 10 TACs. The statewide number of excess cancer cases per million people over a 70-year, lifetime exposure is 680 for the year 2007.

Figure 5-2

Acetaldehyde

2008 Statewide Emission Inventory

Acetaldehyde is a federal hazardous air pollutant (HAP). The ARB identified acetaldehyde as a TAC in April 1993 under AB 2728. This bill required the ARB to identify all federal HAPs as TACs. In California, acetaldehyde is identified as a carcinogen. This compound also causes chronic non-cancer toxicity in the respiratory system.

Acetaldehyde is both directly emitted into the atmosphere and formed in the atmosphere as a result of photochemical oxidation. Sources of acetaldehyde include emissions from combustion processes such as exhaust from mobile sources and fuel combustion from stationary internal combustion engines, boilers, and process heaters. In California, photochemical oxidation is the largest source of acetaldehyde concentrations in the ambient air. Approximately 30 percent of the statewide acetaldehyde emissions can be attributed to on-road motor vehicles, with an additional 50 percent attributed to other mobile sources such as construction and mining equipment, aircraft, recreational boats, and agricultural equipment. Area-wide sources of emissions, which contribute 18 percent of the statewide acetaldehyde emissions, include the burning of wood in residential fireplaces and wood stoves. Stationary sources contribute two percent of the statewide acetaldehyde emissions. The primary stationary sources are from fuel combustion from the petroleum industry.

Acetaldehyde		
Emissions Source	tons/year	Percent State
Stationary Sources	208	2%
Area-wide Sources	1624	18%
On-Road Mobile	2692	30%
Gasoline Vehicles	745	8%
Diesel Vehicles	1947	22%
Other Mobile	4489	50%
Gasoline Fuel	854	9%
Diesel Fuel	3197	35%
Other Fuel	529	6%
Natural Sources	0	0%
Total Statewide	9103	100%

Table 5-3

2008 Top Ten Counties - Acetaldehyde

The top ten counties account for approximately 47 percent of the statewide acetaldehyde emissions. The South Coast Air Basin has three of the top ten counties: South Coast portion of Los Angeles County (13 percent of the emissions of acetaldehyde statewide), Orange County (four percent), and South Coast portion of San Bernardino County (three percent). Collectively, approximately 20 percent of statewide acetaldehyde emissions occur in the South Coast Air Basin. San Diego County accounts for approximately six percent. The six other counties in the top ten for acetaldehyde emissions are: Kern (San Joaquin Valley portion), San Bernardino (Mojave Desert portion), Fresno, Santa Clara, Alameda, and San Joaquin. These six counties account for approximately 21 percent of statewide acetaldehyde emissions.

Acetaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1174	13%
San Diego	San Diego	524	6%
Orange	South Coast	376	4%
Kern	San Joaquin Valley	360	4%
San Bernardino	Mojave Desert	349	4%
Fresno	San Joaquin Valley	320	4%
Santa Clara	San Francisco Bay Area	268	3%
Alameda	San Francisco Bay Area	264	3%
San Joaquin	San Joaquin Valley	258	3%
San Bernardino	South Coast	258	3%

Table 5-4

Acetaldehyde

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of acetaldehyde in its statewide air toxics monitoring network. Figure 5-3 presents a trend graph of acetaldehyde for the years 1990 through 2007. The graph shows a general decrease in acetaldehyde levels from 1990-1998 with some year-to-year fluctuations. There was a sharp drop in acetaldehyde levels during 1995 and a corresponding increase the following year. Levels between 1998 and 2007 have shown little variation, except for a slight increase in 2005.

Although concentration and health risk data are available from 1990 to 2007, the data prior to 1996 are lower than expected because the ARB collected ambient samples using a method that underestimated the actual concentrations. A method change in 1996 corrected this bias; however, the ARB was unable to develop a correction factor for the earlier data. The data prior to 1996 are included here because it is certain that at least the reported amount was present. However, the data prior to 1996 are not directly comparable to data collected during the later years.

To minimize the influences of weather on trends, three-year average statewide concentrations are used to assess the change over time. Although acetaldehyde data were collected beginning in 1990, as noted above, data prior to 1996 were unreliable. Therefore, the period 1996-1998 was used as the baseline average for comparison to 2005-2007. The result shows a seven percent decrease in acetaldehyde concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2007, there were an estimated five excess cancer cases per million people due to exposure to acetaldehyde. On an individual basis, the health risks from acetaldehyde are much lower than they are for some of the

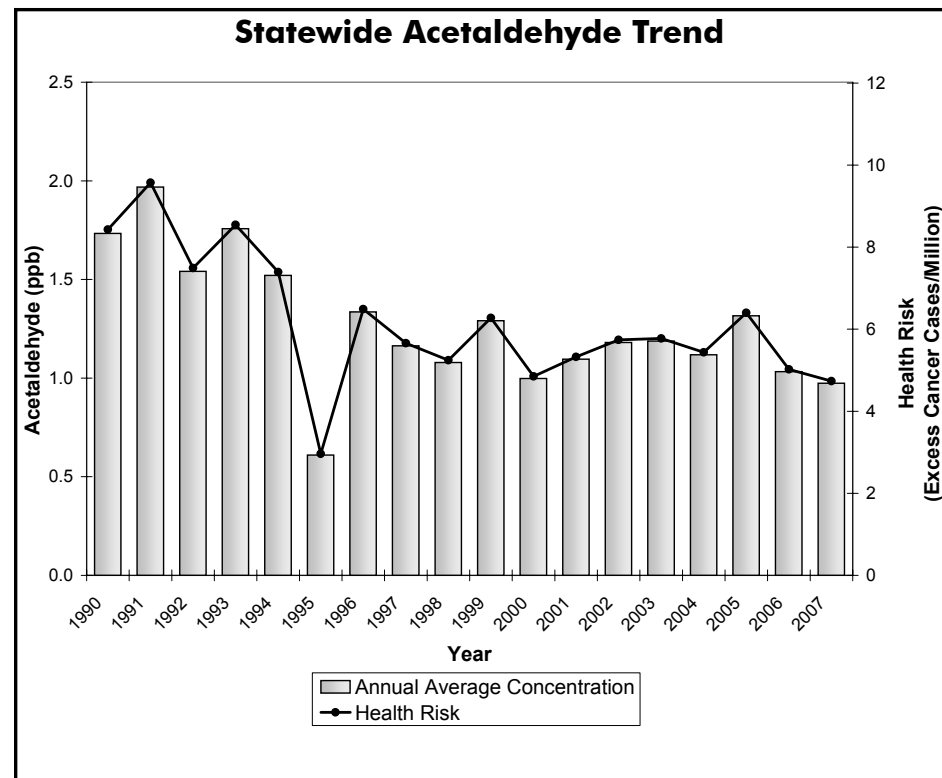


Figure 5-3

other TACs. Among the ten compounds presented in this almanac, the health risk from acetaldehyde ranks eighth.

It is important to note that the health risk due to acetaldehyde is not spread evenly throughout the State. This is common for almost all pollutants. The data reflect statewide averages, and do not consider local impacts. Therefore, some Californians may be exposed to near-source, or “hot spot” concentrations of acetaldehyde which are above the statewide annual average concentration. “Hot spot” exposure may increase the potential cancer risk to individuals living near large combustion sources. Information collected under AB 2588 (the Hot

Spots Program) will be used to help determine the priority and need for control of sources of acetaldehyde.

Another factor to consider is that the statewide averages reflect ambient outdoor concentrations. In general, acetaldehyde concentrations are higher indoors than outdoors, due in part to the abundance of combustion sources, such as cigarettes, fireplaces, and woodstoves.

Acetaldehyde is directly emitted from combustion sources and also occurs in the environment as a result of the photochemical oxidation of reactive organic gases (ROG). Over the years, stringent emission standards for newer vehicles have resulted in steady declines in directly emitted acetaldehyde due to vehicular emissions. However, its secondary formation can be hard to quantify, and can contribute to fluctuations in ambient levels of acetaldehyde.

Benzene

2008 Statewide Emission Inventory

Benzene is highly carcinogenic and occurs throughout California. The ARB identified benzene as a TAC in January 1985 under California's TAC program (AB 1807). In addition to being a carcinogen, benzene also has non-cancer health impacts. Brief inhalation exposure to high concentrations can cause central nervous system depression. Acute effects include central nervous system symptoms of nausea, tremors, drowsiness, dizziness, headache, intoxication, and unconsciousness.

Current estimates show that approximately 87 percent of the benzene emitted in California comes from motor vehicles, including evaporative leakage and unburned fuel exhaust. The predominant sources of total benzene emissions in the atmosphere are gasoline fugitive emissions and gasoline motor vehicle exhaust. Approximately 47 percent of the statewide benzene emissions can be attributed to on-road motor vehicles, with an additional 40 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and lawn and garden equipment. Currently, the benzene content of gasoline is less than one percent. Some of the benzene in the fuel is emitted from vehicles as unburned fuel. Benzene is also formed as a partial combustion product of larger aromatic fuel components. Industry-related stationary sources contribute twelve percent and area-wide sources contribute one percent of the statewide benzene emissions. The primary stationary sources of reported benzene emissions are crude petroleum and natural gas mining, petroleum refining, and electric generation. The primary area-wide sources include residential combustion of various types such as cooking and water heating. The primary natural sources are petroleum seeps that form where oil or natural gas emerge from subsurface sources to the ground or water surface.

Benzene		
Emissions Source	tons/year	Percent State
Stationary Sources	1284	12%
Area-wide Sources	117	1%
On-Road Mobile	5024	47%
Gasoline Vehicles	4494	42%
Diesel Vehicles	530	5%
Other Mobile	4232	40%
Gasoline Fuel	3127	29%
Diesel Fuel	870	8%
Other Fuel	326	3%
Natural Sources	46	<1%
Total Statewide	10794	100%

Table 5-5

2008 Top Ten Counties - Benzene

The top ten counties account for approximately 54 percent of the statewide benzene emissions. The South Coast Air Basin has four of the top ten counties emitting benzene, representing 28 percent of statewide benzene emissions. San Diego contributes seven percent. Two counties in the San Francisco Air Basin contribute approximately six percent: Santa Clara County (three percent) and Alameda County (three percent). The three other counties in the top ten for benzene emissions are: Kern (San Joaquin portion), San Bernardino (Mojave Desert portion), and Sacramento. These counties account for approximately 13 percent of statewide benzene emissions.

Benzene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1761	16%
San Diego	San Diego	770	7%
Kern	San Joaquin Valley	645	6%
Orange	South Coast	597	6%
San Bernardino	Mojave Desert	397	4%
Santa Clara	San Francisco Bay Area	357	3%
San Bernardino	South Coast	346	3%
Alameda	San Francisco Bay Area	328	3%
Riverside	South Coast	302	3%
Sacramento	Sacramento Valley	292	3%

Table 5-6

Benzene

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of benzene in its statewide air toxics monitoring network. Figure 5-4 shows the annual average statewide benzene concentrations and the associated health risk from benzene alone. Ambient levels have shown generally steady improvement since 1990. To examine the trend in benzene while minimizing the influences of weather, the statewide average benzene concentration for 1990-1992 was compared to that for 2005-2007. The result is an 80 percent decrease in both concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration level over a 70-year lifetime. From these data, it is apparent that benzene poses a substantial health risk. Based on the statewide averages, benzene ranks second highest among the ten TACs presented in this almanac. During 2007, there was an estimated risk of 35 excess cancer cases per million people due to exposure to benzene. However, as with all air pollutants, the health risk is not spread evenly throughout the State. In general, ambient benzene concentrations and associated health risks tend to be higher in the more urbanized areas.

It is important to note that the ambient benzene concentrations have been corrected to provide a consistent long-term data record. Prior to 1999, the ARB analyzed samples using a single-point calibration of the gas chromatograph analyzers. While this method was approved by the U.S. EPA, it resulted in low concentrations being under-reported. Beginning January 1, 1999, new and more sophisticated computer software allowed the ARB to switch to a 3-point calibration of the analyzers. This improved measurement technique more accurately characterizes the ambient benzene levels, especially at low concentrations. However, concentrations measured using the 3-point calibration method are higher than those measured with the single-point calibration method. A year long study showed that the two measurement methods were highly correlated, and the ARB was able to develop

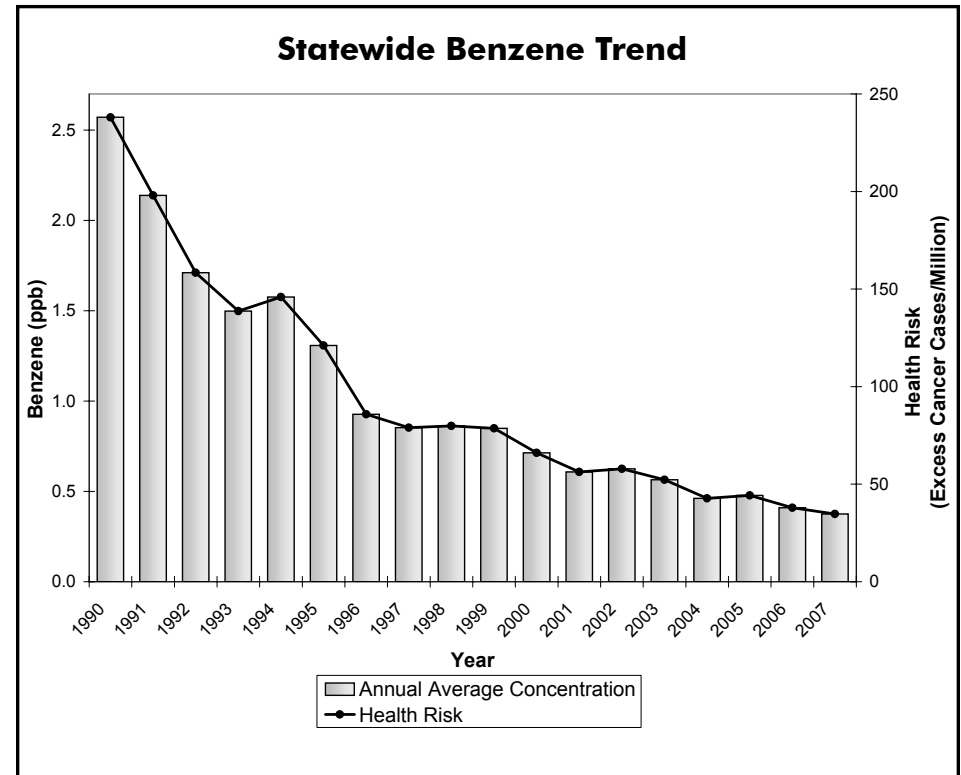


Figure 5-4

a predictive relationship between the two. To avoid discontinuity in the trend data, the pre-1999 benzene data shown in Figure 5-4 have been adjusted according to these predictive equations, and they now reflect the results that would have been produced using the 3-point calibration method. Information about the specific study process and adjustment equations can be found on the “Laboratory Standard Operating Procedures for Ambient Air” page on the ARB website at www.arb.ca.gov/aaqm/sop/summary/summary.htm.

The ARB started to use a gas chromatography/mass spectrometry (GC/MS) based method to analyze benzene in 2001 to fulfill a lower detection limit requirement for the SB 25 and Neighborhood Assessment Programs. The new method is also in line with the new U.S. EPA Urban Air Toxic Program being developed nationally. Measurements do not change substantially by using the GC/MS method, so no adjustment is needed to prior years' data.

Although the health risk from benzene is still substantial, emissions have been reduced significantly over the last decade, and will be reduced further in California through a progression of regulatory measures and control technologies. The Low Emission Vehicle (LEV) regulations have resulted in a significant reduction in exhaust and evaporative hydrocarbon emissions, including benzene. As the fleet turns over and new LEV technology vehicles are introduced into the fleet, emission reductions will continue. In 1996, the California Phase II Reformulated Gasoline Program was implemented statewide. Fuel reformulation has led to a substantial decrease in the level of benzene from gasoline and vehicle exhaust emissions. Since motor vehicles continue to be the major source of benzene in the State, future efforts to improve fuel formulations, reduce vehicle exhaust emissions, and promote less polluting modes of transportation will likely continue to help reduce benzene emissions.

1,3-Butadiene

2008 Statewide Emission Inventory

The ARB identified 1,3-butadiene as a TAC in 1992. In California, 1,3-butadiene has been identified as a carcinogen. In addition, 1,3-butadiene vapors are mildly irritating to the eyes and mucous membranes and cause neurological effects at very high levels.

Most of the emissions of 1,3-butadiene are from incomplete combustion of gasoline and diesel fuels. Mobile sources account for approximately 53 percent of the total statewide emissions. Vehicles that are not equipped with functioning exhaust catalysts emit greater amounts of 1,3-butadiene than vehicles with functioning catalysts. Approximately 26 percent of the statewide 1,3-butadiene emissions can be attributed to on-road motor vehicles, with an additional 27 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and aircraft. Area-wide sources such as agricultural waste burning, open burning associated with forest management, and woodstoves and fireplaces contribute approximately 21 percent. Stationary sources contribute less than one percent of the statewide 1,3-butadiene emissions. The primary stationary sources with reported 1,3-butadiene emissions include petroleum refining, manufacturing of synthetics and man-made materials, and oil and gas extraction. The primary natural sources of 1,3-butadiene emissions are wildfires.

1,3-Butadiene		
Emissions Source	tons/year	Percent State
Stationary Sources	19	1%
Area-wide Sources	794	21%
On-Road Mobile	993	26%
Gasoline Vehicles	943	25%
Diesel Vehicles	50	1%
Other Mobile	1009	27%
Gasoline Fuel	723	19%
Diesel Fuel	83	2%
Other Fuel	206	5%
Natural Sources	937	25%
Total Statewide	3754	100%

Table 5-7

2008 Top Ten Counties - 1,3-Butadiene Emissions

The top ten counties account for approximately 40 percent of the statewide 1,3-butadiene emissions. Emission sources in the South Coast Air Basin contribute approximately 16 percent of the statewide total: Los Angeles County (10 percent), Orange County (three percent), and South Coast portion of San Bernardino County (three percent). San Diego County accounts for approximately six percent. Two counties in the San Joaquin Valley Air Basin contribute seven percent of the 1,3-butadiene: Tulare County (four percent) and Fresno County (three percent). The other counties in the top ten account for 11 percent: San Bernardino (Mojave Desert portion), Siskiyou, Tuolumne and Plumas.

1,3-Butadiene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	369	10%
San Diego	San Diego	233	6%
Tulare	San Joaquin Valley	158	4%
Orange	South Coast	119	3%
Fresno	San Joaquin Valley	113	3%
San Bernardino	Mojave Desert	111	3%
Siskiyou	Northeast Plateau	110	3%
San Bernardino	South Coast	108	3%
Tuolumne	Mountain Counties	106	3%
Plumas	Mountain Counties	91	2%

Table 5-8

1,3-Butadiene

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of 1,3-butadiene in its statewide air toxics monitoring network. Figure 5-5 shows the annual average statewide 1,3-butadiene concentrations and the associated health risk from this TAC alone since 1990. The data show a general downward trend, with some variability. To examine the trend in 1,3-butadiene while minimizing the influences of weather, the statewide average 1,3-butadiene concentration for 1990-1992 was compared to that for 2005-2007. The result is a 74 percent decrease in both concentration and health risk. Despite this substantial drop, the health risk from this compound remains relatively high. In 2007, there was an estimated risk of 34 excess cancer cases per million people due to exposure to 1,3-butadiene. Of the ten compounds presented in this almanac, the average statewide health risk from 1,3-butadiene ranks third. Again, it is important to note that the data shown here reflect statewide averages. They do not consider local impacts, which may be higher or lower.

Similar to benzene, the ARB analyzed 1,3-butadiene samples using a single-point calibration of the gas chromatograph analyzers prior to 1999. While this method was approved by the U.S. EPA, it resulted in low concentrations being under-reported. Beginning January 1, 1999, new and more sophisticated computer software allowed the ARB to switch to a 3-point calibration of the analyzers. This improved measurement technique more accurately characterizes the ambient 1,3-butadiene, especially at low concentrations. However, concentrations measured using the 3-point calibration method are higher than those measured with the single-point calibration method. A year-long ARB study showed that the two measurement methods were highly correlated, and the ARB was able to develop a predictive relationship between them. To avoid discontinuity in the trend data, the pre-1999 1,3-butadiene data shown in Figure 5-5 have been adjusted according to these predictive equations and now

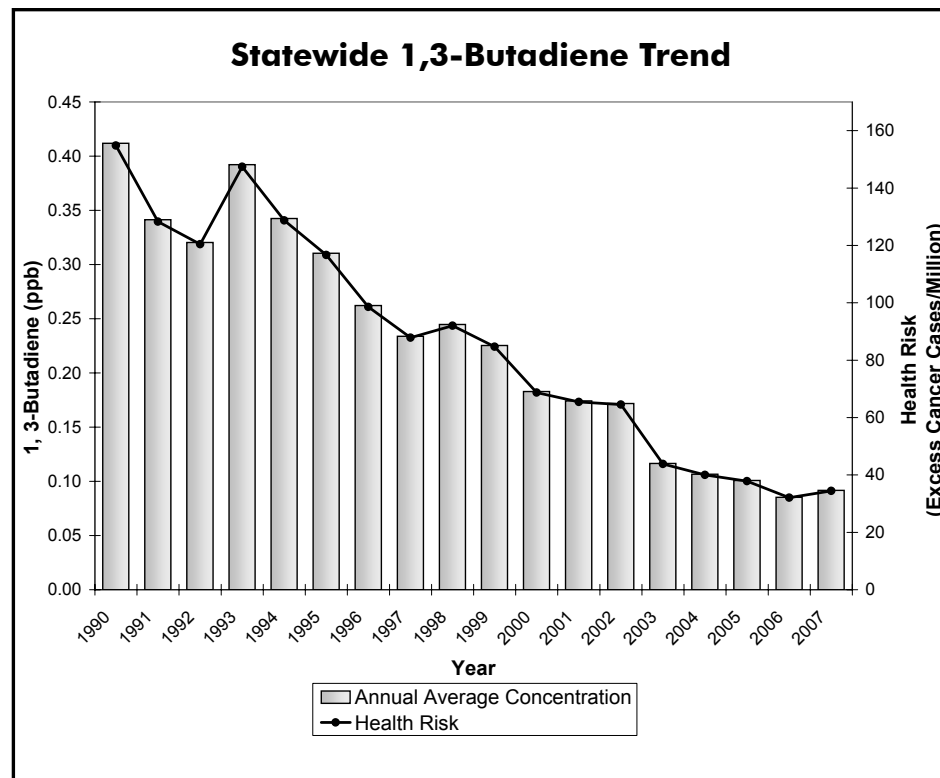


Figure 5-5

reflect the results that would have been produced using the 3-point calibration method. Information about the specific study process and adjustment equations can be found on the “Laboratory Standard Operating Procedures for Ambient Air” page on the ARB website at www.arb.ca.gov/aaqm/sop/summary/summary.htm.

Similar to benzene, the ARB started to use a GC/MS based method to analyze 1,3-butadiene in 2001. This change in method fulfilled a lower detection limit requirement for the SB 25 and Neighborhood Assessment Programs. The new method is also in line with the new

U.S. EPA Urban Air Toxic Program being developed nationally. Measurements do not change substantially by using the GC/MS method, so no adjustment is needed to prior years' data.

In California, the majority of 1,3-butadiene emissions are from incomplete combustion of gasoline and diesel fuels. The ARB adopted LEV/Clean Fuels regulations in 1990 and the Phase II reformulated gasoline regulations were implemented in 1996. The LEV regulations are expected to continue to reduce 1,3-butadiene emissions from cars and light-duty trucks as the fleet turns over and new LEVs are introduced into the fleet.

Carbon Tetrachloride

2008 Statewide Emission Inventory

The ARB identified carbon tetrachloride as a TAC in 1987 under California's TAC program (AB 1807). In California, carbon tetrachloride has been identified as a carcinogen. Carbon tetrachloride is also a central nervous system depressant and mild eye and respiratory tract irritant.

The primary stationary sources reporting emissions of carbon tetrachloride include chemical and allied product manufacturers and petroleum refineries. In the past, carbon tetrachloride was used for dry cleaning and as a grain-fumigant. Usage for these purposes is no longer allowed in the United States. Carbon tetrachloride has not been registered for pesticidal use in California since 1987. Also, the use of carbon tetrachloride in products to be used indoors has been discontinued in the United States. The statewide emissions of carbon tetrachloride are small (about 4.04 tons per year), and background concentrations account for most of the health risk.

Carbon Tetrachloride		
Emissions Source	tons/year	Percent State
Stationary Sources	4.04	100%
Area-wide Sources	0	0%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	4.04	100%

Table 5-9

2008 Top Ten Counties - Carbon Tetrachloride

The top two counties account for 85 percent of the statewide carbon tetrachloride emissions. Contra Costa County (San Francisco Bay Area Air Basin) accounts for approximately 52 percent, and Orange County accounts for approximately 33 percent of the emissions of carbon tetrachloride statewide. Although the percentages for these counties are high, the emissions are very small (one ton or less per year in each county). The eight other counties in the top ten contribute approximately 13 percent of statewide carbon tetrachloride emissions.

Carbon Tetrachloride			
County	Air Basin	tons/year	Percent
Contra Costa	San Francisco Bay Area	2.12	52%
Orange	South Coast	1.33	33%
Los Angeles	South Coast	0.11	3%
Riverside	South Coast	0.09	2%
San Diego	San Diego	0.09	2%
San Bernardino	Mojave Desert	0.07	2%
San Bernardino	South Coast	0.06	2%
Ventura	South Central Coast	0.05	1%
Sacramento	Sacramento Valley	0.05	1%
Kern	Mojave Desert	0.01	<1%

Table 5-10

Carbon Tetrachloride

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of carbon tetrachloride in its statewide air toxics monitoring network. Figure 5-6 shows the annual average statewide concentrations and the associated health risk from carbon tetrachloride alone. There are several years of incomplete data for carbon tetrachloride. The annual average concentration is available only if there is a full year of data. Based on the available data, the ambient concentrations and health risk dropped between 1990 and 1996, and then there was a substantial increase in values for 1998, followed by levels which stayed fairly constant between 2000 and 2003. Carbon tetrachloride data from February 2004 through 2007 are not available because of a problem with the laboratory standard.

To examine the trend in carbon tetrachloride while minimizing the influences of weather, the statewide average carbon tetrachloride concentration for 1990-1991 (1992 average was invalid) was compared to that for 2001-2003. The result is a 30 percent decrease in both concentration and health risk. Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. In 2003, there was an estimated risk of 25 excess cancer cases per million people due to exposure to carbon tetrachloride. The health risk of this TAC ranks fourth among the ten compounds presented in this almanac.

Unlike many of the other TACs, carbon tetrachloride is emitted primarily by sources other than motor vehicles, and there are virtually no emissions within California. However, because carbon tetrachloride persists in the atmosphere for many years (the estimated atmospheric lifetime is 50 years), background concentrations still pose a health risk.

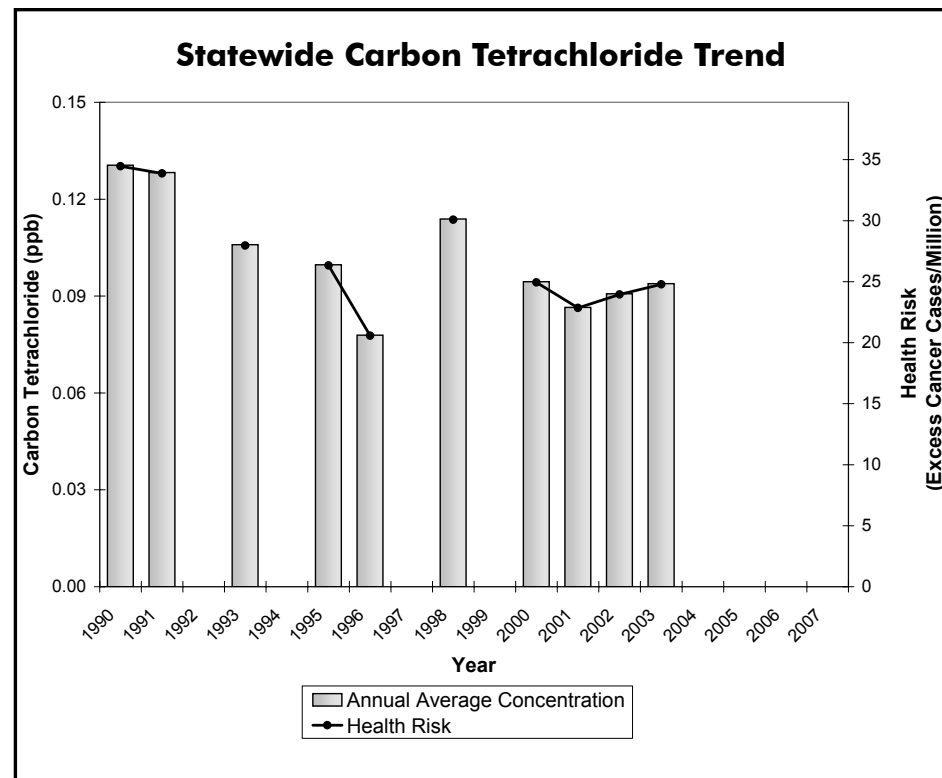


Figure 5-6

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Chromium, Hexavalent

2008 Statewide Emission Inventory

Hexavalent chromium was identified as a TAC in 1986 under California's TAC program (AB 1807, Tanner, 1983). In California, hexavalent chromium has been identified as a carcinogen. There is epidemiological evidence that exposure to inhaled hexavalent chromium may result in lung cancer. The principal acute effects of hexavalent chromium are renal toxicity, gastrointestinal hemorrhage, and intravascular hemolysis.

Chrome plating is no longer the primary source of hexavalent chromium emissions in the State. Hexavalent chromium emissions from plating have declined significantly from previous editions of the almanac due to many platers switching to the use of trivalent chromium in place of hexavalent chromium. Chromic acid anodizing is another industrial metal finishing process which uses hexavalent chromium. A third source of hexavalent chromium emissions is the firebrick lining of glass furnaces. In California, stationary sources are estimated to emit about 0.28 ton per year of hexavalent chromium. Emissions from these sources were obtained from facilities under the Air Toxics Hot Spots Act of 1987. This act required facilities to estimate toxics emissions, including hexavalent chromium. Approximately 0.16 tons of hexavalent chromium are emitted by gasoline motor vehicles. Other mobile sources such as trains and ships contribute approximately 0.15 tons of hexavalent chromium annually.

Chromium, Hexavalent		
Emissions Source	tons/year	Percent State
Stationary Sources	0.28	46%
Area-wide Sources	0.01	2%
On-Road Mobile	0.17	27%
Gasoline Vehicles	0.16	26%
Diesel Vehicles	0.01	1%
Other Mobile	0.15	25%
Gasoline Fuel	0.14	24%
Diesel Fuel	< .01	1%
Other Fuel	< .01	<1%
Natural Sources	0	0%
Total Statewide	0.61	100%

Table 5-11

2008 Top Ten Counties - Chromium, Hexavalent

Five counties account for approximately 45 percent of the statewide hexavalent chromium emissions: South Coast portion of Los Angeles (17 percent), San Diego County (11 percent), Fresno (seven percent), Orange (five percent), and San Joaquin (five percent). The five other counties in the top ten for hexavalent chromium emissions are: Kern (San Joaquin Valley portion), Mono, Mojave Desert portion of San Bernardino, South Coast portion of San Bernardino, and Mendocino. These five counties account for approximately 18 percent of statewide hexavalent chromium emissions.

Chromium, Hexavalent			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	0.10	17%
San Diego	San Diego	0.06	11%
Fresno	San Joaquin Valley	0.04	7%
Orange	South Coast	0.03	5%
San Joaquin	San Joaquin Valley	0.03	5%
Kern	San Joaquin Valley	0.03	4%
Mono	Great Basin Valleys	0.02	4%
San Bernardino	Mojave Desert	0.02	4%
San Bernardino	South Coast	0.02	3%
Mendocino	North Coast	0.02	3%

Table 5-12

Chromium, Hexavalent

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of hexavalent chromium in its statewide air toxics monitoring network. Chromium exists primarily in hexavalent and trivalent forms. Hexavalent chromium has been identified as a TAC and has been found to be much more reactive and much more toxic than trivalent chromium.

Fuel combustion from mobile sources is the largest source of hexavalent chromium emissions. Combustion from stationary sources is also a large source of emissions. Examples of other sources of hexavalent chromium emissions include chrome plating, chromic acid anodizing, and thermal spraying. In the past, compounds containing hexavalent chromium, such as sodium dichromate or lead chromate, were added to cooling tower water to control corrosion in the towers and associated heat exchangers. Hexavalent chromium was also used in motor vehicle and mobile equipment coatings.

The statewide annual average concentrations and associated health risks are shown in Figure 5-7. Both show a general downward trend, with the exception of 1995, 2000-2001, and 2005. The high 1995 value is driven in part by an extremely high annual average for the Burbank site in the South Coast Air Basin. However, a number of other sites also had higher concentrations in 1995 than in other years.

To examine the trend in hexavalent chromium while minimizing the influences of weather, the average hexavalent chromium concentration for 1992-1994 was compared to that for 2005-2007. The result is a 66 percent decrease in both concentration and health risk. Health risk is based on the annual average concentration and represents the estimated risk of excess cancer cases per million people exposed over a 70-year lifetime at the specified concentration level. In 2007, there were an estimated 10 excess cancer cases per million people due to exposure to hexavalent chromium. Based on data for the ten TACs

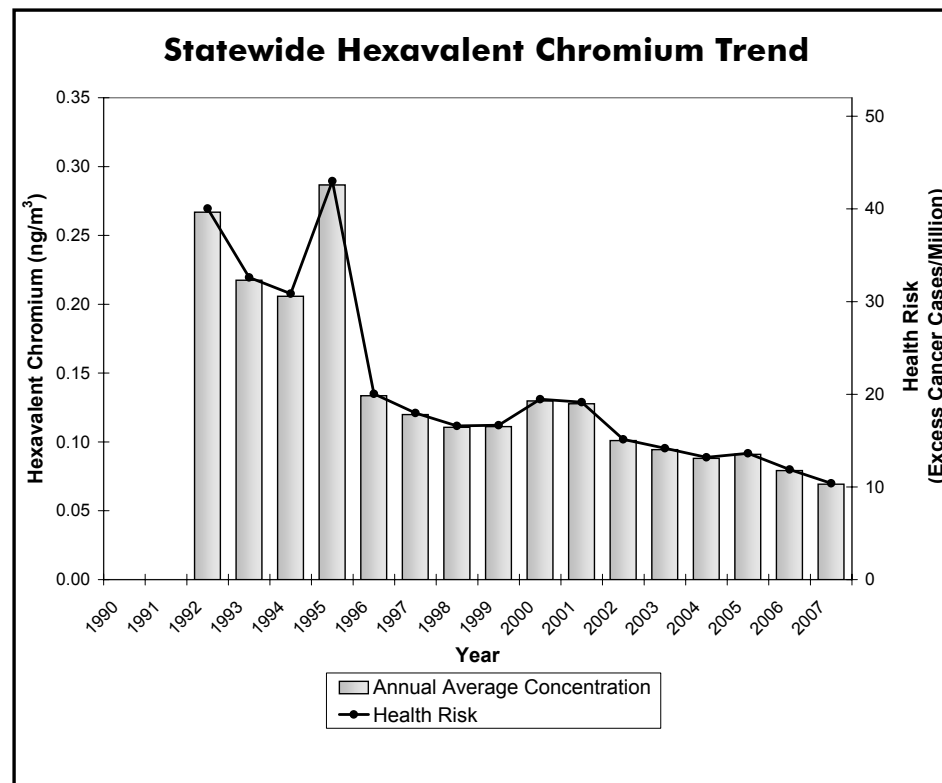


Figure 5-7

presented in this almanac, hexavalent chromium ranks sixth in terms of ambient health risk. It is important to note that since hexavalent chromium exposure and health impacts usually occur on a neighborhood scale, actual health risk can be higher in some areas than the statewide average, and lower in other areas.

ARB has adopted several control measures to reduce emissions or prohibit use of this very potent TAC. In 1988, ARB adopted the chrome plating Airborne Toxics Control Measure (ATCM). This ATCM reduced hexavalent chromium emissions from chrome plating and chromic acid anodizing operations by well over 90 percent,

with the largest facilities reducing emissions by over 99 percent. This ATCM was amended in 2006 to further reduce emissions from all chrome plating and anodizing operations. In 1989, ARB adopted a measure that prohibited the use of hexavalent chromium compounds in cooling towers. ARB has also adopted a measure to prohibit use of hexavalent chromium in motor vehicle and mobile equipment coatings, and a measure that substantially reduces hexavalent chromium emissions from thermal spraying operations.

Statewide annual averages and health risk estimates for hexavalent chromium are available for 1992 through 2007. Prior to 1992, a different measurement method was used. With this method, some of the hexavalent chromium was transformed into trivalent chromium on the collection filter. As a result, the hexavalent chromium concentrations were unreliable, and these data are not included in this almanac. Since 1992, the method to analyze hexavalent chromium has been improved to prevent the transformation from occurring.

The significant reduction in hexavalent chromium coincided with the complete implementation of the chrome plating and the chromate-treated cooling tower control measures. The measures were so effective that they resulted in a very high percentage of the measured values being below the LOD. From 1998 through 2001, the lowest level that could reliably be measured was 0.2 nanograms per cubic meter (ng/m^3). In calculating an annual average, values below $0.2 \text{ ng}/\text{m}^3$ are assumed equal to $0.1 \text{ ng}/\text{m}^3$, which is half the LOD. This approach applies to all other TACs when their measurements are below their respective LODs. Starting on January 1, 2002, hexavalent chromium is being analyzed by compositing quarterly samples by site. Although the new method decreases the number of samples, it increases the sensitivity of the instrument by lowering the lowest concentration that can be reliably measured from $0.2 \text{ ng}/\text{m}^3$ to $0.06 \text{ ng}/\text{m}^3$. Using the new method, measurements will sometimes fall below the LOD, and the half detection limit approach is applied to those measurements.

*para-Dichlorobenzene***2008 Statewide Emission Inventory**

The ARB identified *para*-dichlorobenzene as a TAC in April 1993 under AB 2728. This bill required the ARB to identify, by regulation, all federal hazardous air pollutants as TACs. In California, *para*-dichlorobenzene has been identified as a carcinogen. In addition to the carcinogenic impact, long-term inhalation exposure may affect the liver, skin, and central nervous system in humans.

The primary area-wide sources that have reported emissions of *para*-dichlorobenzene include consumer products such as non-aerosol insect repellants and solid/gel air fresheners. These sources contribute nearly all of the statewide *para*-dichlorobenzene emissions.

para-Dichlorobenzene		
Emissions Source	tons/year	Percent State
Stationary Sources	7	<1%
Area-wide Sources	1501	100%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	1508	100%

Table 5-13

2008 Top Ten Counties - *para*-Dichlorobenzene

The top ten counties account for approximately 68 percent of the statewide *para*-dichlorobenzene emissions. The South Coast Air Basin has four of the top ten counties, representing 42 percent of statewide *para*-dichlorobenzene emissions. San Diego County contributes approximately eight percent. Three counties in the San Francisco Bay Area Air Basin contribute approximately 12 percent: Santa Clara County (five percent), Alameda County (four percent), and Contra Costa County (three percent). The other two counties in the top ten are: Sacramento (four percent) and Fresno (two percent).

para-Dichlorobenzene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	388	26%
Orange	South Coast	124	8%
San Diego	San Diego	122	8%
Santa Clara	San Francisco Bay Area	72	5%
Riverside	South Coast	63	4%
San Bernardino	South Coast	62	4%
Alameda	San Francisco Bay Area	62	4%
Sacramento	Sacramento Valley	56	4%
Contra Costa	San Francisco Bay Area	41	3%
Fresno	San Joaquin Valley	37	2%

Table 5-14

para-Dichlorobenzene

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of *para*-dichlorobenzene in its statewide air toxics monitoring network. Statewide annual average concentrations and health risk estimates are available for 1991 through 2006, with the exception of 1998 and 1999. No summary data are available for these years because of problems with laboratory equipment and associated data reliability. The trend graph for *para*-dichlorobenzene, shown in Figure 5-8, shows values fairly constant throughout 1991 to 1997, with slightly lower values in 1994 and 1996. Following a drop in 2000, there was an upturn in 2001 through 2002, and *para*-dichlorobenzene levels have shown a slight decrease between 2002 and 2006. The analysis of *para*-dichlorobenzene was discontinued in March 2007 due to the high percentage of values below the limit of detection.

The increase in *para*-dichlorobenzene in 2001 and subsequent years was likely due to a mechanism that ARB's Monitoring and Laboratory Division used for estimating very low concentrations. In 2001, the lowest level of *para*-dichlorobenzene that could be reliably measured was changed from 0.2 to 0.3 parts per billion (ppb). This change resulted in a higher percentage of *para*-dichlorobenzene samples not detectable because most samples were less than 0.3 ppb.

In calculating an annual average, values below 0.3 ppb are assumed equal to 0.15 ppb, which is one-half of the LOD. This approach applies to all other TACs when their measurements are below the LOD. It is a good estimate for some TACs, however, it is uncertain for *para*-dichlorobenzene due to the large number of samples that were lower than the LOD.

To examine the trend in *para*-dichlorobenzene, the statewide average concentration for 1991-1993 was compared to that for 2004-2006. The result is a 10 percent increase in both the concentration and health risk. Health risk is based on the annual average concentration

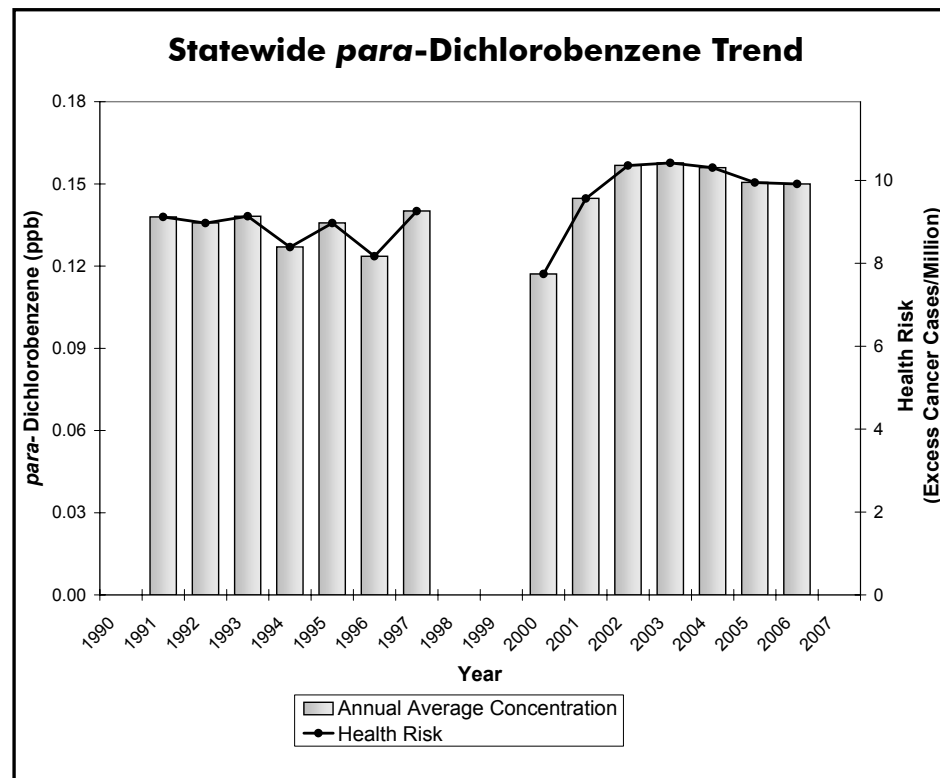


Figure 5-8

and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2006, there was an estimated risk of 10 excess cancer cases per million people from exposure to this compound alone. Based on this, *para*-dichlorobenzene ranks seventh out of the ten compounds presented in this almanac. However, it is important to note that annual average concentration and health risk for *para*-dichlorobenzene are heavily influenced by its LOD.

The ARB adopted an ATCM in 2004 to prohibit the use of *para*-dichlorobenzene in solid air fresheners and toilet/urinal care

products. The ATCM required the phase-out of *para*-dichlorobenzene from these products by December 31, 2005, with a complete ban on the sale of the products by December 31, 2006. An emission reduction of 2.72 tons per day of *para*-dichlorobenzene was expected. Besides reducing emissions and improving air quality inside buildings and the surrounding area, the ATCM is also expected to reduce *para*-dichlorobenzene emissions from water treatment facilities processing wastewater from toilets and urinals, and therefore reduce the ambient concentration of *para*-dichlorobenzene.

Formaldehyde

2008 Statewide Emission Inventory

The ARB identified formaldehyde as a TAC in 1992 under California's TAC program (AB 1807, Tanner, 1983). In California, formaldehyde has been identified as a carcinogen. Chronic exposure is associated with respiratory symptoms and eye, nose, and throat irritation.

Formaldehyde is both directly emitted into the atmosphere and formed in the atmosphere as a result of photochemical oxidation. Photochemical oxidation is the largest source of formaldehyde concentrations in California ambient air. Directly emitted formaldehyde is a product of incomplete combustion. One of the primary sources of directly-emitted formaldehyde is vehicular exhaust. Formaldehyde is used in resins, can be found in many consumer products as an anti-microbial agent, and is also used in fumigants and soil disinfectants. About 82 percent of direct formaldehyde emissions are estimated to come from the combustion of fossil fuels from mobile sources. Approximately 31 percent of the total statewide formaldehyde emissions can be attributed to on-road motor vehicles, with an additional 51 percent attributed to other mobile sources such as aircraft, recreational boats, and construction and mining equipment. Stationary sources contribute approximately nine percent and area-wide sources contribute approximately nine percent of the statewide formaldehyde emissions in California. The primary area-wide sources of formaldehyde emissions include wood burning in residential fireplaces and wood stoves.

Formaldehyde		
Emissions Source	tons/year	Percent State
Stationary Sources	1886	9%
Area-wide Sources	1964	9%
On-Road Mobile	6373	31%
Gasoline Vehicles	2478	12%
Diesel Vehicles	3896	19%
Other Mobile	10543	51%
Gasoline Fuel	2613	12%
Diesel Fuel	6398	31%
Other Fuel	1716	8%
Natural Sources	0	0%
Total Statewide	20951	100%

Table 5-15

2008 Top Ten Counties - Formaldehyde

The top ten counties account for approximately 50 percent of the statewide formaldehyde emissions. The South Coast Air Basin has three of the top ten counties emitting formaldehyde, representing 22 percent of statewide formaldehyde emissions. The seven other counties in the top ten for formaldehyde emissions are: Kern (San Joaquin Valley portion), San Diego, San Bernardino (Mojave Desert portion), Fresno, Santa Clara, Alameda, and San Joaquin. These seven counties account for approximately 28 percent of statewide formaldehyde emissions.

Formaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	2870	14%
Kern	San Joaquin Valley	1301	6%
San Diego	San Diego	1282	6%
Orange	South Coast	947	5%
San Bernardino	Mojave Desert	799	4%
Fresno	San Joaquin Valley	688	3%
Santa Clara	San Francisco Bay Area	629	3%
San Bernardino	South Coast	604	3%
Alameda	San Francisco Bay Area	599	3%
San Joaquin	San Joaquin Valley	565	3%

Table 5-16

Formaldehyde

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of formaldehyde in its statewide air toxics monitoring network. Its statewide annual average concentrations and associated health risk are available for 1990 through 2007. However, values prior to 1996 are uncertain because the data were based on a method that underestimated the actual concentrations. A method change in 1996 corrected this problem, but a correction factor could not be developed for the earlier data. While the data prior to the method change are included here for completeness, they are not directly comparable to data collected during the later years. The trend graph for formaldehyde, shown in Figure 5-9, shows a great deal of variability through 2005, and a slight decrease since then.

To examine the trend in formaldehyde using available data while minimizing the influences of weather, the statewide average concentration for 1996-1998 was compared to that for 2005-2007 (since formaldehyde data prior to 1996 are not reliable). There is a nine percent decrease in both concentration and health risk. Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2007, there was an estimated risk of 19 excess cancer cases per million people from exposure to formaldehyde alone. Based on data for all ten TACs presented in this almanac, formaldehyde ranks fifth in terms of health risk.

Although formaldehyde is emitted by both stationary and mobile sources, mobile sources are, by far, the largest contributors. The ARB adopted the Low Emissions/Clean Fuels Regulations in 1990, and these regulations are expected to continue to reduce formaldehyde emissions from cars and light-duty trucks. Formaldehyde, similar to acetaldehyde, can also be formed in the environment due to reactions of pollutants in the air. This secondary contribution is hard to quantify and can also contribute to fluctuations observed in the ambient levels of formaldehyde.

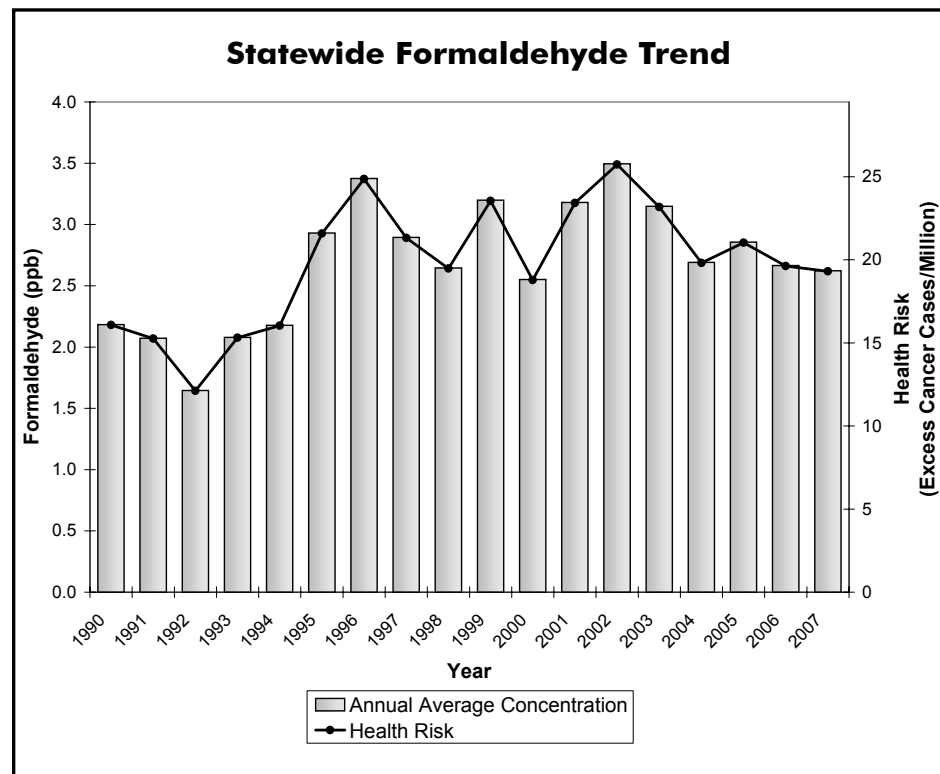


Figure 5-9

Formaldehyde also poses a problem for indoor air quality, and its concentrations indoors are generally higher than outdoor levels. This is because many building materials, consumer products, and fabrics emit formaldehyde. As a result, indoor formaldehyde levels are expected to remain higher than outdoor levels because of new materials brought into homes, as a consequence of remodeling or purchasing new furnishings. Other indoor combustion sources such as wood and gas stoves, kerosene heaters, and cigarettes also contribute to indoor formaldehyde levels, although intermittently.

On April 26, 2007, the ARB adopted an ATCM to reduce formaldehyde emissions from three composite wood products: hardwood

plywood, particleboard, and medium density fiberboard. Composite wood is a general term for wood-based panels made from wood pieces, particles or fibers bonded together with a resin. Based on the average emissions of existing composite wood products, the adopted ATCM would reduce emissions of formaldehyde by about 20 percent in Phase 1 (2009) or about 180 tons per year. In Phase 2 (2011-2012), a 57 percent reduction in formaldehyde emissions or 500 tons per year would be achieved. Because the ATCM would reduce indoor formaldehyde exposures, substantial benefits would be realized by buyers of new homes as well as those with existing homes due to reduced emissions from remodeling projects and new furniture. The Phase 1 standards would reduce the number of formaldehyde-related childhood exposure cancer cases by 3 to 9, and the lifetime exposure cancer cases by 12 to 35 per million. In Phase 2, childhood exposure cancer cases would be reduced by 9 to 26, and lifetime exposure cancer cases by 35 to 97 per million.

Methylene Chloride

2008 Statewide Emission Inventory

The ARB identified methylene chloride as a TAC in 1987 under California's TAC program. In California, methylene chloride has been identified as a carcinogen. In addition, chronic exposure can lead to bone marrow, hepatic, and renal toxicity.

Methylene chloride is used as a solvent, a blowing and cleaning agent in the manufacture of polyurethane foam and plastic fabrication, and as a solvent in paint stripping operations. Paint removers account for the largest use of methylene chloride in California, where methylene chloride is the main ingredient in many paint stripping formulations. Plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers are stationary sources reporting emissions of methylene chloride. These sources contribute approximately 48 percent of the statewide methylene chloride emissions. Area-wide sources contribute approximately 52 percent.

Methylene Chloride		
Emissions Source	tons/year	Percent State
Stationary Sources	3077	48%
Area-wide Sources	3359	52%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	6436	100%

Table 5-17

2008 Top Ten Counties - Methylene Chloride

The top ten counties account for approximately 75 percent of the statewide methylene chloride emissions. The South Coast Air Basin has four of the top ten counties emitting methylene chloride, representing 55 percent of statewide methylene chloride emissions. Two counties in the San Francisco Bay Area Air Basin contribute approximately seven percent: Santa Clara County (four percent) and Alameda County (three percent). The four other counties in the top ten for methylene chloride emissions are: San Diego, Sacramento, Ventura, and Fresno. Together, these four counties account for approximately 13 percent of statewide methylene chloride emissions.

Methylene Chloride			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	2039	32%
Orange	South Coast	965	15%
San Diego	San Diego	359	6%
San Bernardino	South Coast	278	4%
Santa Clara	San Francisco Bay Area	251	4%
Riverside	South Coast	234	4%
Alameda	San Francisco Bay Area	201	3%
Sacramento	Sacramento Valley	175	3%
Ventura	South Central Coast	157	2%
Fresno	San Joaquin Valley	126	2%

Table 5-18

Methylene Chloride

Statewide Air Quality and Health Risk

The ARB routinely monitors for outdoor levels of methylene chloride in its statewide air toxics monitoring network. The trend graph in Figure 5-10 shows an overall downward trend with some variability, particularly during the early years. The drop in 2001 was substantial, and a flat trend between 2002 and 2007 with the exception of the lower 2006 measurements. To examine the trend in methylene chloride while minimizing the influences of weather, the statewide average methylene chloride concentration for 1990-1992 was compared to that for 2005-2007. The result is a 77 percent decrease in both concentration and health risk.

Health risk is based on the annual average concentration and represents the estimated number of excess cancer cases per million people exposed to the specified concentration for 70 years. During 2007, there was an estimated risk from exposure to methylene chloride of one excess cancer case per million people. Of the ten compounds presented in this almanac, methylene chloride presents the lowest health risk, on a statewide basis. However, any level of risk is a concern from a public health standpoint.

In California, paint removers account for the largest use of methylene chloride, which is the primary ingredient in paint stripping formulations used for industrial, commercial, military, and domestic applications. The use of methylene chloride in consumer and automotive products has been significantly reduced through aggressive regulations adopted by the ARB. These regulations have reduced ambient concentrations and health risks.

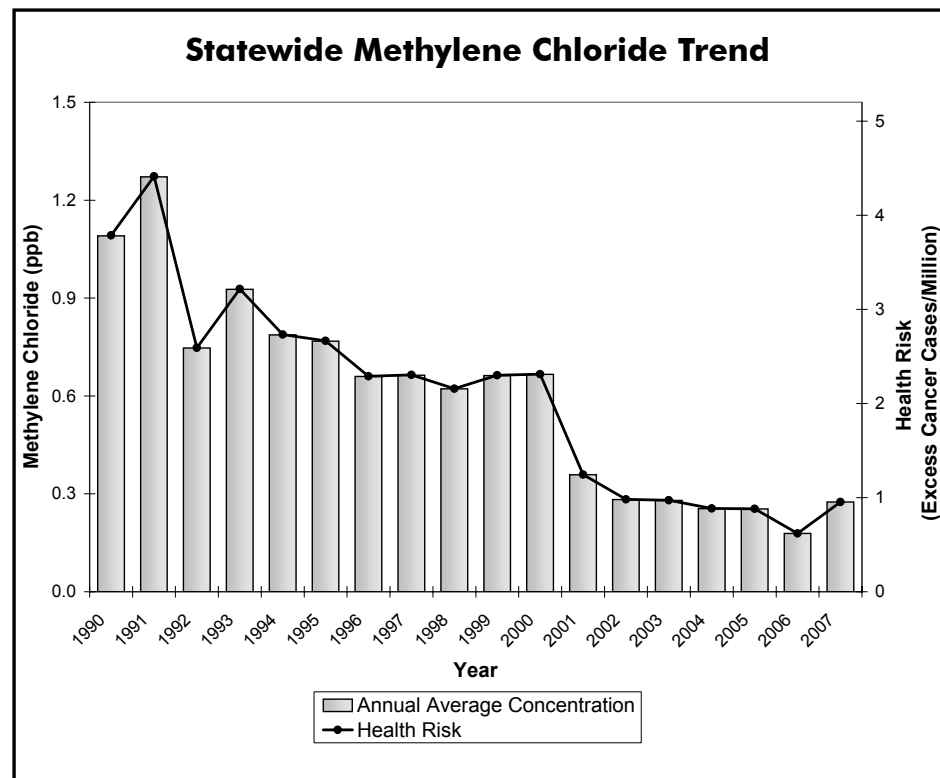


Figure 5-10

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Perchloroethylene

2008 Statewide Emission Inventory

The ARB identified perchloroethylene as a TAC in 1991 under California's TAC program (AB 1807, Tanner, 1983). In California, perchloroethylene has been identified as a carcinogen. Perchloroethylene vapors are irritating to the eyes and respiratory tract. Following chronic exposure, workers have shown signs of liver toxicity, as well as kidney dysfunction and neurological effects.

Perchloroethylene is used as a solvent, primarily in dry cleaning operations. Perchloroethylene is also used in degreasing operations, paints and coatings, adhesives, aerosols, specialty chemical production, printing inks, silicones, rug shampoos, and laboratory solvents. In California, the stationary sources that have reported emissions of perchloroethylene are dry cleaning plants, aircraft part and equipment manufacturers, and fabricated metal product manufacturers. These stationary sources account for 57 percent of the statewide emissions of perchloroethylene. Area-wide sources contribute approximately 43 percent. The primary area-wide sources include consumer products such as automotive brake cleaners and tire sealants and inflators.

Perchloroethylene		
Emissions Source	tons/year	Percent State
Stationary Sources	2826	57%
Area-wide Sources	2156	43%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Gasoline Fuel	0	0%
Diesel Fuel	0	0%
Other Fuel	0	0%
Natural Sources	0	0%
Total Statewide	4982	100%

Table 5-19

2008 Top Ten Counties - Perchloroethylene

The top ten counties account for approximately 69 percent of the statewide perchloroethylene emissions. The South Coast Air Basin has four of the top ten counties emitting perchloroethylene, representing 44 percent of statewide perchloroethylene emissions. San Diego County contributes approximately eight percent. The five other counties in the top ten for perchloroethylene emissions are: Sacramento, Santa Clara, Alameda, Fresno, and San Joaquin. These five counties account for approximately 17 percent of statewide perchloroethylene emissions.

Perchloroethylene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1276	26%
Orange	South Coast	433	9%
San Diego	San Diego	422	8%
San Bernardino	South Coast	226	5%
Riverside	South Coast	216	4%
Sacramento	Sacramento Valley	192	4%
Santa Clara	San Francisco Bay Area	191	4%
Alameda	San Francisco Bay Area	184	4%
Fresno	San Joaquin Valley	170	3%
San Joaquin	San Joaquin Valley	117	2%

Table 5-20

Perchloroethylene

Statewide Air Quality and Health Risk

The ARB routinely monitors outdoor levels of perchloroethylene in its statewide air toxics monitoring network. Although the trend graph for perchloroethylene in Figure 5-11 shows some variability during the early 1990s, there is an overall downward trend. To examine the trend in perchloroethylene over the monitoring period of record and to minimize the influences of weather, the statewide perchloroethylene concentration for 1990-1992 was compared to that for 2005-2007. The result is an 84 percent decrease in both concentration and health risk. For 1999, complete and representative data are not available.

In Figure 5-11, health risk is based on the annual average concentration and represents the estimated risk of excess cancer cases per million people exposed over a 70-year lifetime at the specified concentration level. During 2006, there was an estimated risk of one excess cancer case per million people from exposure to perchloroethylene. Based on this, perchloroethylene ranks ninth out of the ten compounds presented in this almanac.

When the ARB identified perchloroethylene as a TAC in October 1991, it was estimated that 60 percent of perchloroethylene came from dry cleaning operations. Examination of industry practices suggested the potential for significant reductions of emissions. The ARB focused control efforts on that industry and adopted a control measure governing the use of perchloroethylene in dry cleaning operations in 1993 (dry cleaning ATCM). In 2007, the ARB amended the Dry Cleaning ATCM which will virtually eliminate the potential health risk due to perchloroethylene emissions from dry cleaning machines. The amended dry cleaning ATCM will over time phase out the use of perchloroethylene in dry cleaning machines and related equipment by January 1, 2023. Additionally, while perchloroethylene dry cleaning machines remain in use, the ARB will continue to provide training for dry cleaners on improved practices and methods for reducing emissions.

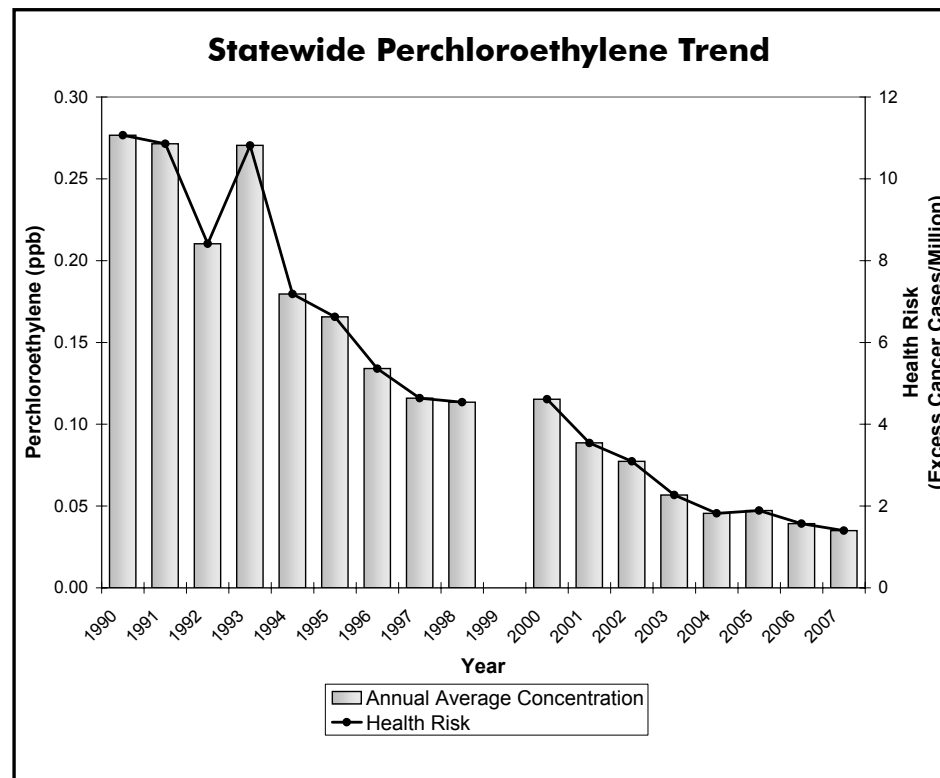


Figure 5-11

The ARB has also developed control measures that prohibit the use of perchloroethylene in automotive and many consumer products, including aerosol coatings and adhesives.

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Diesel Particulate Matter

2008 Statewide Emission Inventory

The ARB identified the PM emissions from diesel-fueled engines as a TAC in August 1998 under California's TAC program. In California, diesel engine exhaust has been identified as a carcinogen. Most researchers believe that diesel exhaust particles contribute the majority of the risk because the particles in the exhaust carry many harmful organics and metals.

Diesel PM is emitted from both mobile and stationary sources. In California, on-road diesel-fueled vehicles contribute approximately 38 percent of the statewide total, with an additional 60 percent attributed to other mobile sources such as construction and mining equipment, agricultural equipment, and transport refrigeration units. Stationary sources, contributing about one percent of emissions, include shipyards, warehouses, heavy equipment repair yards, and oil and gas production operations. Emissions from these sources are from diesel-fueled internal combustion engines. Stationary sources that report diesel PM emissions also include heavy construction (except highway), manufacturers of asphalt paving materials and blocks, and electrical generation.

Readers may note that the stationary source diesel PM emission estimates differ from those presented in previous editions of the almanac and in the ARB's October 2000 report entitled: "*Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*" (Diesel Risk Reduction Plan or Plan). This is because they incorporate more recent data and have been calculated with updated methodologies developed for new regulations. These regulations are those that were recommended in the Diesel Risk Reduction Plan. The on-road mobile source emissions cited in the Diesel Risk Reduction Plan are based on an earlier version of EMFAC2001 (EMFAC1.99(f) 6/26/00), whereas the current estimates are based on EMFAC2007. The other mobile inventory includes revised estimates for ship diesel PM emissions. In 2005, ARB staff improved the methodology for esti-

Diesel PM		
Emissions Source	tons/year	Percent State
Stationary Sources	531	1%
Area-wide Sources	0	0%
On-Road Mobile	13670	38%
Gasoline Vehicles	0	0%
Diesel Vehicles	13670	38%
Other Mobile	21683	60%
Gasoline Fuel	0	0%
Diesel Fuel	14877	41%
Other Fuel	6805	19%
Natural Sources	0	0%
Total Statewide	35884	100%

Table 5-21

imating ship emissions by developing a consistent statewide methodology that incorporates more recent data on ship activities and emission factors. This inventory continues to be refined; the current estimate is 4 percent less than the previous almanac and 115 percent greater than the inventory developed before the methodology was revised.

2008 Top Ten Counties - Diesel Particulate Matter

The top ten counties account for approximately 60 percent of the statewide diesel PM emissions. The South Coast Air Basin has four of the top ten counties emitting diesel particulate matter which represents 29 percent of statewide diesel PM emissions. Three counties in the San Joaquin Air Basin contribute 13 percent: Kern (six percent), Fresno (four percent), and San Joaquin (three percent). San Diego contributes six percent, San Bernardino (Mojave Desert portion) contributes five percent, and Alameda contributes four percent.

Diesel PM			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	5163	18%
Kern	San Joaquin Valley	1640	6%
San Diego	San Diego	1607	6%
San Bernardino	Mojave Desert	1450	5%
Orange	South Coast	1394	5%
Fresno	San Joaquin Valley	1159	4%
Alameda	San Francisco Bay Area	1033	4%
San Joaquin	San Joaquin Valley	993	3%
San Bernardino	South Coast	887	3%
Riverside	South Coast	856	3%

Table 5-22

Diesel Particulate Matter

Statewide Air Quality and Health Risk

The exhaust from diesel-fueled engines is a complex mixture of gases, vapors, and particles, many of which are known human carcinogens. More than 40 diesel exhaust components are listed by the State and federal government as TACs or hazardous air pollutants, respectively. Most researchers believe that diesel exhaust particles contribute the majority of the risk because the particles in the exhaust carry many harmful organics and metals.

Unlike the other TACs presented in this almanac, the ARB does not monitor outdoor diesel PM because there is no routine method for monitoring ambient concentrations. However, the ARB made a preliminary estimation of diesel PM concentrations for the State's 15 air basins and for the State as a whole using a PM-based exposure method. The method uses the ARB emission inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies with chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate statewide outdoor concentrations of diesel PM. The ARB subsequently updated the original statewide estimates based on the ratio between the previous estimate for 1990 and the most recent diesel PM emission inventory for the year 1990. The details of the methodology are described in Appendix VI to the ARB Diesel Risk Reduction Plan.

The updated statewide population-weighted average diesel PM concentrations and health risk for various years are shown in Figure 5-12. The average statewide concentration for 1990 was estimated at 3.0 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). This is associated with a health risk of 900 excess cancer cases per million people exposed over a 70-year lifetime. The estimates for 2000 show a 40 percent drop from 1990, with a concentration of 1.8 $\mu\text{g}/\text{m}^3$ and an associated health risk of 540 excess cancer cases per million people. In addition, the ARB estimated population-weighted concentrations of 1.5 $\mu\text{g}/\text{m}^3$ for 2010 and 1.2 $\mu\text{g}/\text{m}^3$ for 2020 without implementing the

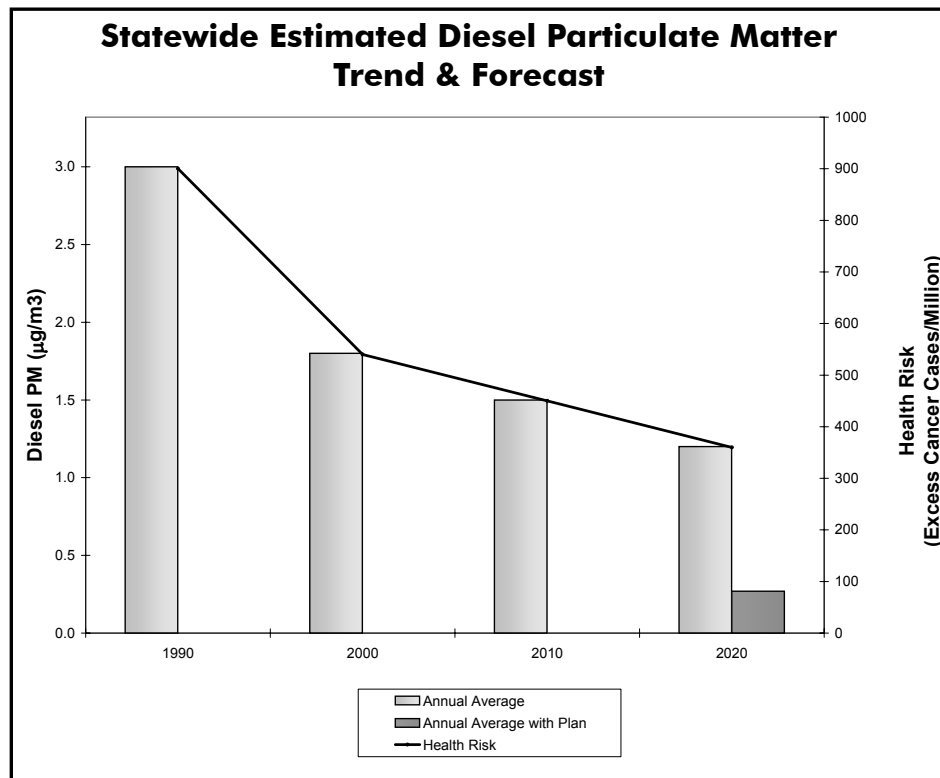


Figure 5-12

Diesel Risk Reduction Plan. Two estimates are given for 2020: one reflecting the estimated ambient concentrations (1.2 $\mu\text{g}/\text{m}^3$) without implementing the Diesel Risk Reduction Plan and one reflecting the estimated ambient concentrations (0.27 $\mu\text{g}/\text{m}^3$) with implementation of control measures in the Diesel Risk Reduction Plan. These future year estimates are based on linear extrapolations from the 1990 emissions inventory and linear rollback techniques. It is important to note that the estimated risk from diesel PM is higher than the risk from all other TACs combined, and this TAC poses the most significant risk to California's citizens. In fact, the ARB estimates that 79 percent of

the known statewide cancer risk from the top 10 outdoor air toxics is attributable to diesel PM.

The Diesel Risk Reduction Plan provides a mechanism for combating the diesel PM problem. Without implementing the Plan, concentrations in 2010 and 2020 are estimated to drop by only about 17 percent and 33 percent, respectively, from the estimated year 2000 level. However, the goal of the Plan is to reduce concentrations by 85 percent by 2020. The key elements of the Plan are to clean up existing engines through engine retrofit emission control devices, to adopt stringent standards for new diesel engines, and to lower the sulfur content of diesel fuel to protect new, and very effective, advanced technology emission control devices on diesel engines. When fully implemented, the Diesel Risk Reduction Plan will significantly reduce emissions from both old and new diesel-fueled motor vehicles and from stationary sources that burn diesel fuel. In addition to these strategies, the ARB continues to promote the use of alternative fuels and electrification. As a result of these actions, diesel PM concentrations and associated health risks should continue to decline.

South Coast Air Basin

2008 Emission Inventory by Compound

Acetaldehyde

Approximately 94 percent of the emissions of acetaldehyde are from mobile sources.

South Coast - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	27	1%	<1%
Area-wide Sources	91	5%	1%
On-Road Mobile	706	35%	8%
Gasoline Vehicles	250	12%	3%
Diesel Vehicles	455	22%	5%
Other Mobile	1199	59%	13%
Gasoline Fuel	242	12%	3%
Diesel Fuel	957	47%	11%
Other Fuel	< 1	<1%	<1%
Natural Sources	0	0%	0%
Total	2023	100%	22%
Total Statewide	9103		

Table 5-23

Benzene

The primary sources of benzene emissions in the South Coast Air Basin are mobile sources (approximately 94 percent).

South Coast - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	134	4%	1%
Area-wide Sources	45	2%	<1%
On-Road Mobile	1662	55%	15%
Gasoline Vehicles	1539	51%	14%
Diesel Vehicles	124	4%	1%
Other Mobile	1164	39%	11%
Gasoline Fuel	902	30%	8%
Diesel Fuel	260	9%	2%
Other Fuel	2	<1%	<1%
Natural Sources	0	0%	0%
Total	3006	100%	28%
Total Statewide	10794		

Table 5-24

1,3-Butadiene

Approximately 83 percent of the emissions of 1,3-butadiene are from mobile sources.

South Coast - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	5	1%	<1%
Area-wide Sources	43	6%	1%
On-Road Mobile	333	49%	9%
Gasoline Vehicles	321	48%	9%
Diesel Vehicles	12	2%	<1%
Other Mobile	230	34%	6%
Gasoline Fuel	205	30%	5%
Diesel Fuel	25	4%	1%
Other Fuel	< 1	<1%	<1%
Natural Sources	62	9%	2%
Total	673	100%	18%
Total Statewide	3754		

Table 5-25

Carbon Tetrachloride

Stationary sources, such as chemical manufacturers and petroleum refineries, account for all of the emissions of carbon tetrachloride.

South Coast - Carbon Tetrachloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1.59	100%	39%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	1.59	100%	39%
Total Statewide	4.04		

Table 5-26

Chromium, Hexavalent

On-road mobile sources account for 40 percent of the hexavalent chromium emissions. Approximately 31 percent of the hexavalent chromium emissions are from stationary sources such as chrome platers, aircraft and parts manufacturing, and fabricated metal product manufacturing.

South Coast - Chromium, Hexavalent			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.05	31%	8%
Area-wide Sources	< .01	1%	<1%
On-Road Mobile	0.07	40%	11%
Gasoline Vehicles	0.06	39%	11%
Diesel Vehicles	< .01	1%	<1%
Other Mobile	0.05	28%	8%
Gasoline Fuel	0.04	27%	7%
Diesel Fuel	< .01	1%	<1%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.16	100%	27%
Total Statewide	0.61		

Table 5-27

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

South Coast - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< 1	<1%	<1%
Area-wide Sources	637	100%	42%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	638	100%	42%
Total Statewide	1508		

Table 5-28

Formaldehyde

Approximately 90 percent of the formaldehyde emissions are from mobile sources.

South Coast - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	318	6%	2%
Area-wide Sources	188	4%	1%
On-Road Mobile	1753	36%	8%
Gasoline Vehicles	842	17%	4%
Diesel Vehicles	911	19%	4%
Other Mobile	2665	54%	13%
Gasoline Fuel	742	15%	4%
Diesel Fuel	1915	39%	9%
Other Fuel	8	<1%	<1%
Natural Sources	0	0%	0%
Total	4924	100%	24%
Total Statewide	20951		

Table 5-29

Methylene Chloride

Approximately 60 percent of the emissions of methylene chloride are from stationary sources such as plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers.

South Coast - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	2122	60%	33%
Area-wide Sources	1394	40%	22%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	3516	100%	55%
Total Statewide	6436		

Table 5-30

Perchloroethylene

Approximately 58 percent of the emissions of perchloroethylene are from dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

South Coast - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1238	58%	25%
Area-wide Sources	912	42%	18%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	2150	100%	43%
Total Statewide	4982		

Table 5-31

Diesel Particulate Matter

Approximately 98 percent of the emissions of diesel PM are from mobile sources.

South Coast - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	176	2%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	3345	40%	9%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	3345	40%	9%
Other Mobile	4778	58%	13%
Gasoline Fuel	0	0%	0%
Diesel Fuel	4446	54%	12%
Other Fuel	332	4%	1%
Natural Sources	0	0%	0%
Total	8300	100%	23%
Total Statewide	35884		

Table 5-32

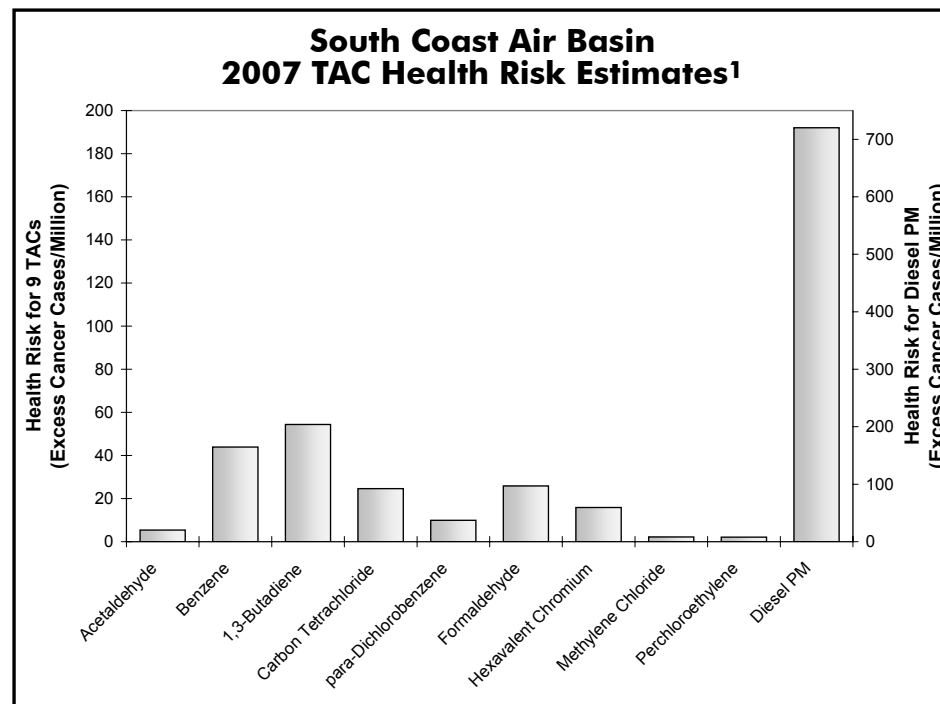
South Coast Air Basin

Air Quality and Health Risk

From 1990 through 2007, the ARB monitored outdoor concentrations for various TACs at seven sites in the South Coast Air Basin. Data are available for most of the years at sites located in Burbank, Los Angeles, North Long Beach, and Riverside. Measurements for 1990 through 1997 are also available from a site at Upland. In addition, there are data for 1998 at a site in Fontana. During December 1999, monitoring activities for most of the TACs at Fontana were relocated to Azusa. Annual average concentration and associated health risk are not available for the year during which the site was moved because neither site had a full year of data. This almanac focuses on the top ten TACs based on available data. There may be other TACs that may pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the South Coast Air Basin, are provided in Table 5-33. Data for individual sites are provided in Appendix C. Figure 5-13 shows individual health risk from the ten TACs for the South Coast Air Basin. As indicated on the graph, the health risk data reflect the year of 2007 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated and monitoring data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted ambient monitoring measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission



¹ Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2006

Figure 5-13

inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.

Diesel PM poses the greatest health risk among the ten TACs. In the South Coast Air Basin, the estimated health risk from diesel PM was 720 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 33

percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2005-2007. The health risks of 1,3-butadiene and benzene have been reduced by 73 percent and 82 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 65 percent and 87 percent, respectively.

Carbon tetrachloride data show a 33 percent decrease comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2007 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2005-2007. Acetaldehyde and formaldehyde show a 24 percent and 15 percent reduction, respectively.

Para-dichlorobenzene data show a 13 percent decrease comparing periods between 1991-1993 and 2004-2006. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The analysis of *para*-dichlorobenzene was discontinued in March 2007 due to the high percentage of values below the limit of detection (LOD).

Hexavalent chromium data show a 60 percent decrease comparing periods between 1992-1994 and 2005-2007. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. Similar

to *para*-dichlorobenzene, it also had a high number of samples below its LOD. To better assess the hexavalent chromium measurements below the LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter and will not be repeated here.

Overall, in the South Coast Air Basin, all TACs have shown improvement since 1990, but their health risks are still higher than the statewide levels. It is important to note that there may be other compounds that pose a significant health risk but are not monitored. Reductions in ambient TAC concentrations and health risks should continue, as new rules and regulations are implemented to control TACs.

In addition to the routine monitoring, a special study was conducted at two sites located in the Boyle Heights and Wilmington areas of Los Angeles between February 2001 and May 2002 (Boyle Heights) and between May 2001 and July 2002 (Wilmington). Monitoring included both TACs and criteria air pollutants. Limited monitoring of a few pollutants was conducted at two satellite sites in Boyle Heights from March 2001 through October 2001, and at one satellite site in Wilmington from November 2001 through May 2002. The Boyle Heights and Wilmington communities are both located near major freeways. The Wilmington community is also located near oil refineries and port facilities. Although not included in this almanac, data from Boyle Heights, Wilmington, and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at www.arb.ca.gov/ch/programs/sb25/sb25.htm.

South Coast Air Basin

Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																			
TAC	Conc.1/Risk ²	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Acetaldehyde	Annual Avg	2.46	3	2.46	2.67	2.3	0.97	2.08	1.77	1.54	1.63	1.26	1.47	1.41	1.47	1.46	1.79	1.17	1.11
	Health Risk	12	15	12	13	11	5	10	9	7	8	6	7	7	7	7	9	6	5
Benzene	Annual Avg	3.42	2.91	2.61	2.17	2.4	1.89	1.45	1.34	1.25	1.2	0.97	0.86	0.769	0.745	0.589	0.634	0.504	0.474
	Health Risk	317	269	242	201	222	175	134	124	116	111	90	80	71	69	55	59	47	44
1,3-Butadiene	Annual Avg	0.532	0.452	0.498	0.565	0.497	0.459	0.39	0.378	0.354	0.328	0.251	0.251	0.211	0.147	0.143	0.137	0.111	0.145
	Health Risk	200	170	187	212	187	173	146	142	133	123	94	94	79	55	54	51	42	54
Carbon Tetrachloride	Annual Avg	0.136	0.134		0.105		0.102	0.079		0.114		0.096	0.086	0.092	0.093				
	Health Risk	36	35		28		27	21		30		25	23	24	25				
Chromium, Hexavalent	Annual Avg			0.39	0.29	0.29	0.46	0.18	0.17	0.15	0.14	0.18		0.179	0.158	0.126	0.139	0.139	0.106
	Health Risk			59	43	43	69	27	25	22	22	27		27	24	19	21	21	16
<i>para</i> -Dichlorobenzene	Annual Avg		0.17	0.19	0.17	0.13	0.17	0.11	0.13			0.13	0.15	0.16	0.17	0.16	0.15	0.15	
	Health Risk		11	13	11	8	11	7	9			9	10	11	11	11	10	10	
Formaldehyde	Annual Avg	2.92	3.08	2.22	3.22	3.14	3.57	5.06	4.47	3.79	4.06	3.13	4.13	4.16	3.83	3.76	4.21	3.58	3.51
	Health Risk	22	23	16	24	23	26	37	33	28	30	23	30	31	28	28	31	26	26
Methylene Chloride	Annual Avg	1.86	1.51	0.9	1.23	1.1	1.28	0.95	1.14	0.85	0.92	0.83	0.63	0.57	0.59	0.57	0.57	0.32	0.62
	Health Risk	6	5	3	4	4	4	3	4	3	3	3	2	2	2	2	2	1	2
Perchloroethylene	Annual Avg	0.576	0.547	0.412	0.448	0.393	0.364	0.32	0.274	0.259		0.207	0.176	0.146	0.105	0.082	0.08	0.062	0.053
	Health Risk	23	22	16	18	16	15	13	11	10		8	7	6	4	3	3	2	2
<i>Diesel PM</i> ³	Annual Avg	(3.6)					(2.7)					(2.4)							
	Health Risk	(1080)					(810)					(720)							
Average Basin Risk	w/o Diesel PM	616	550	548	554	514	505	398	357	349	297	285	253	258	225	179	186	155	149
	w/ Diesel PM	(1696)					(1315)					(1005)							

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, Interpreting the Emission and Air Quality Statistics.

3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-33

San Francisco Bay Area Air Basin

2008 Emission Inventory by Compound

Acetaldehyde

Approximately 79 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion and agricultural burning contribute approximately 20 percent.

San Francisco Bay Area - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	9	1%	<1%
Area-wide Sources	276	20%	3%
On-Road Mobile	307	23%	3%
Gasoline Vehicles	138	10%	2%
Diesel Vehicles	169	13%	2%
Other Mobile	758	56%	8%
Gasoline Fuel	101	7%	1%
Diesel Fuel	535	40%	6%
Other Fuel	123	9%	1%
Natural Sources	0	0%	0%
Total	1350	100%	15%
Total Statewide	9103		

Table 5-34

Benzene

Mobile sources are the primary sources of benzene emissions in the San Francisco Bay Area Air Basin (approximately 90 percent).

San Francisco Bay Area - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	137	8%	1%
Area-wide Sources	33	2%	<1%
On-Road Mobile	880	54%	8%
Gasoline Vehicles	834	51%	8%
Diesel Vehicles	46	3%	<1%
Other Mobile	583	36%	5%
Gasoline Fuel	375	23%	3%
Diesel Fuel	146	9%	1%
Other Fuel	63	4%	1%
Natural Sources	0	0%	0%
Total	1634	100%	15%
Total Statewide	10794		

Table 5-35

1,3-Butadiene

Most of the emissions of 1,3-butadiene are from mobile sources.

San Francisco Bay Area - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1	<1%	<1%
Area-wide Sources	71	17%	2%
On-Road Mobile	177	43%	5%
Gasoline Vehicles	173	42%	5%
Diesel Vehicles	4	1%	<1%
Other Mobile	147	35%	4%
Gasoline Fuel	85	20%	2%
Diesel Fuel	14	3%	<1%
Other Fuel	48	12%	1%
Natural Sources	19	4%	<1%
Total	415	100%	11%
Total Statewide	3754		

Table 5-36

Carbon Tetrachloride

Stationary sources, such as chemical and petroleum refineries, account for all of the emissions of carbon tetrachloride.

San Francisco Bay Area - Carbon Tetrachloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	2.13	100%	53%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	2.13	100%	53%
Total Statewide	4.04		

Table 5-37

Chromium, Hexavalent

Approximately 38 percent of the hexavalent chromium emissions are from other mobile sources. On-road mobile sources account for approximately 51 percent of hexavalent chromium emissions. Stationary sources such as electrical generation and fabricated metal product manufacturing contribute approximately nine percent.

San Francisco Bay Area - Chromium, Hexavalent			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< .01	9%	1%
Area-wide Sources	< .01	1%	<1%
On-Road Mobile	0.03	51%	5%
Gasoline Vehicles	0.03	50%	4%
Diesel Vehicles	< .01	1%	<1%
Other Mobile	0.02	38%	3%
Gasoline Fuel	0.02	36%	3%
Diesel Fuel	< .01	2%	<1%
Other Fuel	< .01	<1%	<1%
Natural Sources	0	0%	0%
Total	0.05	100%	9%
Total Statewide	0.61		

Table 5-38

para-Dichlorobenzene

Emissions of *para*-dichlorobenzene are essentially all from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Francisco Bay Area - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1	<1%	<1%
Area-wide Sources	282	100%	19%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	284	100%	19%
Total Statewide	1508		

Table 5-39

Formaldehyde

Approximately 82 percent of the formaldehyde emissions are from mobile sources.

San Francisco Bay Area - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	217	7%	1%
Area-wide Sources	354	11%	2%
On-Road Mobile	792	25%	4%
Gasoline Vehicles	453	14%	2%
Diesel Vehicles	339	11%	2%
Other Mobile	1776	57%	8%
Gasoline Fuel	308	10%	1%
Diesel Fuel	1071	34%	5%
Other Fuel	397	13%	2%
Natural Sources	0	0%	0%
Total	3138	100%	15%
Total Statewide	20951		

Table 5-40

Methylene Chloride

Approximately 70 percent of the emissions of methylene chloride are from area-wide sources.

San Francisco Bay Area - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	269	30%	4%
Area-wide Sources	637	70%	10%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	906	100%	14%
Total Statewide	6436		

Table 5-41

Perchloroethylene

Approximately 51 percent of the emissions of perchloroethylene are from such area-wide sources as automotive brake cleaners and other consumer products.

San Francisco Bay Area - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	383	49%	8%
Area-wide Sources	405	51%	8%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	788	100%	16%
Total Statewide	4982		

Table 5-42

Diesel Particulate Matter

Emissions of diesel PM are primarily from mobile sources.

San Francisco Bay Area - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	62	1%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	1222	29%	3%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1222	29%	3%
Other Mobile	2867	69%	8%
Gasoline Fuel	0	0%	0%
Diesel Fuel	2529	61%	7%
Other Fuel	337	8%	1%
Natural Sources	0	0%	0%
Total	4151	100%	12%
Total Statewide	35884		

Table 5-43

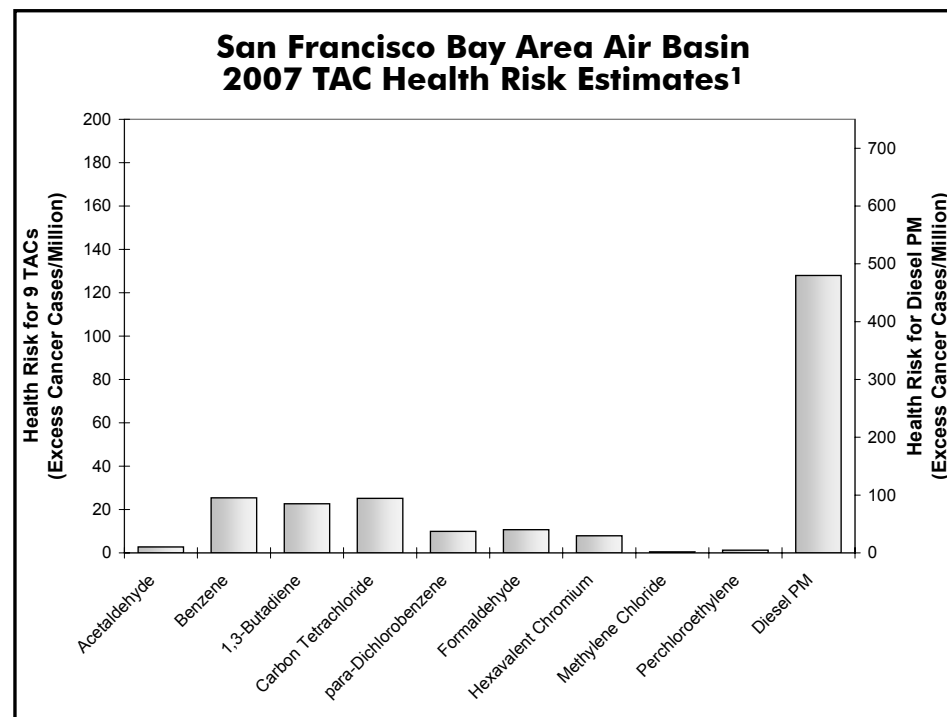
San Francisco Bay Area Air Basin

Air Quality and Health Risk

From 1990 through 2007, the ARB monitored outdoor concentration for various TACs at six sites in the San Francisco Bay Area Air Basin. Data for the entire time period are available from sites located in Fremont and San Francisco. The San Jose-Fourth Street site has measurements from 1990 through 2001; this site was relocated to San Jose-Jackson Street in mid-2002. Data are also available from a site at Concord from 1990 through 1999. In addition, there was a monitor at Richmond from 1990 through April 1997. This site was relocated to San Pablo and began sampling there in May 1997. At the end of February 2000, TAC monitoring was discontinued at the Concord and San Pablo sites, and additional data from these sites will not be available. Annual average concentration and associated health risk are unavailable for the year during a site move because neither site has a full year of data. This almanac focuses on the top ten TACs based on available data. There may be other TACs that may pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the San Francisco Bay Area Air Basin, are provided in Table 5-44. Data for individual sites are provided in Appendix C. Figure 5-14 shows individual health risk from the ten TACs for the San Francisco Bay Area Air Basin. As indicated on the graph, the health risk data reflect the year of 2007 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not cur-



¹ Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2006.

Figure 5-14

rently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.

Diesel PM poses the greatest health risk among the ten TACs. In the San Francisco Bay Area Air Basin, the estimated health risk from

diesel PM was 480 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 36 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2005-2007. The health risks of 1,3-butadiene and benzene have been reduced by 78 percent and 83 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 90 percent and 86 percent, respectively.

Carbon tetrachloride data show a 29 percent decrease when comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2007 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2005-2007. Acetaldehyde and formaldehyde show a 13 percent and a 30 percent reduction, respectively.

Para-dichlorobenzene data show a 31 percent increase when comparing periods between 1991-1993 and 2004-2006. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The analysis of *para*-dichlorobenzene was discontinued in March 2007 due to the high percentage of values below the limit of detection (LOD).

Hexavalent chromium data show a 68 percent decrease when comparing periods between 1992-1994 and 2005-2007. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. To better assess the hexavalent chromium measurements below its LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter and will not be repeated here.

In addition to the routine monitoring, a special study was conducted at two sites, located in the Crockett and Fruitvale/Oakland areas of the San Francisco Bay Area Air Basin between October 2001 and May 2003 (Crockett) and between November 2001 and April 2003 (Fruitvale). Monitoring included both TACs and criteria air pollutants. The Crockett community is located near high-risk facilities, including mobile source emissions. Oil refineries and major oil storage facilities are located in nearby cities to Crockett. Crockett is also the location of a major food processing operation and a heavy-rail transfer facility. The Fruitvale community lies between two major freeways that are a significant source of vehicular emissions. The Fruitvale area is also downwind of several industrial operations that are sources of pollution. Although not included in this almanac, data from Crockett, Fruitvale, and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at www.arb.ca.gov/ch/programs/sb25/sb25.htm.

San Francisco Bay Area Air Basin

Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																			
TAC	Conc.1/Risk ²	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Acetaldehyde	Annual Avg	1.3	1.4	1.03	1.31	1.17	0.42	0.83	0.73	0.65	0.76	0.68	0.73	0.63	0.74	0.74	0.71	0.66	0.56
	Health Risk	6	7	5	6	6	2	4	4	3	4	3	4	3	4	4	3	3	3
Benzene	Annual Avg	2.18	1.82	1.49	1.49	1.4	1.26	0.71	0.61	0.71	0.6	0.56	0.425	0.454	0.439	0.372	0.314	0.326	0.274
	Health Risk	202	169	138	138	129	116	66	56	66	55	52	39	42	41	34	29	30	25
1,3-Butadiene	Annual Avg	0.359	0.287	0.275	0.367	0.287	0.277	0.218	0.187	0.217	0.17	0.149	0.133	0.137	0.098	0.09	0.075	0.069	0.06
	Health Risk	135	108	103	138	108	104	82	70	82	64	56	50	51	37	34	28	26	23
Carbon Tetrachloride	Annual Avg	0.128	0.125		0.108		0.1	0.078				0.094	0.087	0.089	0.095				
	Health Risk	34	33		29		26	21				25	23	24	25				
Chromium, Hexavalent	Annual Avg			0.23	0.2	0.19	0.25	0.13	0.12	0.1	0.1	0.12		0.074	0.096	0.094	0.08	0.063	0.053
	Health Risk			34	29	29	37	19	17	15	15	18		11	14	14	12	9	8
<i>para</i> -Dichlorobenzene	Annual Avg		0.12	0.12	0.12	0.11	0.13	0.14	0.12			0.11	0.14	0.15	0.15	0.17	0.15	0.15	
	Health Risk		8	8	8	7	8	9	8			7	9	10	10	11	10	10	
Formaldehyde	Annual Avg	1.87	1.73	1.43	1.56	1.66	2.06	2.62	1.85	1.76	2.09	1.77	2.32	2.57	2.22	1.71	1.32	1.59	1.45
	Health Risk	14	13	11	11	12	15	19	14	13	15	13	17	19	16	13	10	12	11
Methylene Chloride	Annual Avg	1.04	2.32	0.65	0.72	0.59	0.6	0.58	0.55			0.53	0.27	0.22	0.22	0.14	0.13	0.16	0.13
	Health Risk	4	8	2	2	2	2	2	2			2	<1	<1	<1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.204	0.232	0.169	0.128	0.082	0.094	0.067	0.071			0.078	0.059	0.052	0.039	0.035	0.029	0.027	0.031
	Health Risk	8	9	7	5	3	4	3	3			3	2	2	2	1	1	1	1
<i>Diesel PM</i> ³	Annual Avg	(2.5)					(1.9)					(1.6)							
	Health Risk	(750)					(570)					(480)							
Average Basin Risk	w/o Diesel PM	403	355	308	366	296	314	225	174	179	153	179	144	162	149	111	93	91	71
	w/ Diesel PM	(1153)					(884)					(659)							

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics*.

3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-44

San Joaquin Valley Air Basin

2008 Emission Inventory by Compound

Acetaldehyde

Approximately 85 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion account for approximately 10 percent.

San Joaquin Valley - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	72	5%	1%
Area-wide Sources	164	10%	2%
On-Road Mobile	639	40%	7%
Gasoline Vehicles	81	5%	1%
Diesel Vehicles	558	35%	6%
Other Mobile	727	45%	8%
Gasoline Fuel	76	5%	1%
Diesel Fuel	525	33%	6%
Other Fuel	127	8%	1%
Natural Sources	0	0%	0%
Total	1603	100%	18%
Total Statewide	9103		

Table 5-45

Benzene

The primary sources of benzene emissions in the San Joaquin Valley Air Basin are mobile sources (approximately 67 percent) and stationary sources (approximately 32 percent).

San Joaquin Valley - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	543	32%	5%
Area-wide Sources	13	1%	<1%
On-Road Mobile	633	38%	6%
Gasoline Vehicles	481	29%	4%
Diesel Vehicles	152	9%	1%
Other Mobile	490	29%	5%
Gasoline Fuel	279	17%	3%
Diesel Fuel	143	9%	1%
Other Fuel	67	4%	1%
Natural Sources	< 1	<1%	<1%
Total	1680	100%	16%
Total Statewide	10794		

Table 5-46

1,3-Butadiene

Approximately 48 percent of the emissions of 1,3-butadiene are from mobile sources.

San Joaquin Valley - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	3	1%	<1%
Area-wide Sources	137	27%	4%
On-Road Mobile	116	23%	3%
Gasoline Vehicles	101	20%	3%
Diesel Vehicles	14	3%	<1%
Other Mobile	128	25%	3%
Gasoline Fuel	64	12%	2%
Diesel Fuel	14	3%	<1%
Other Fuel	50	10%	1%
Natural Sources	131	25%	3%
Total	515	100%	14%
Total Statewide	3754		

Table 5-47

Carbon Tetrachloride

There are no major sources of carbon tetrachloride in the San Joaquin Valley.

San Joaquin Valley - Carbon Tetrachloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< .01	100%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	< .01	100%	<1%
Total Statewide	4.04		

Table 5-48

Chromium, Hexavalent

Approximately 75 percent of the hexavalent chromium emissions are from stationary sources.

San Joaquin Valley - Chromium, Hexavalent			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.09	75%	15%
Area-wide Sources	< .01	<1%	<1%
On-Road Mobile	0.02	14%	3%
Gasoline Vehicles	0.02	13%	3%
Diesel Vehicles	< .01	2%	<1%
Other Mobile	0.01	11%	2%
Gasoline Fuel	0.01	10%	2%
Diesel Fuel	< .01	1%	<1%
Other Fuel	< .01	<1%	<1%
Natural Sources	0	0%	0%
Total	0.12	100%	20%
Total Statewide	0.61		

Table 5-49

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Joaquin Valley - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	5	3%	<1%
Area-wide Sources	151	97%	10%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	156	100%	10%
Total Statewide	1508		

Table 5-50

Formaldehyde

Approximately 76 percent of the formaldehyde emissions are from mobile sources.

San Joaquin Valley - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	795	20%	4%
Area-wide Sources	196	5%	1%
On-Road Mobile	1385	34%	7%
Gasoline Vehicles	268	7%	1%
Diesel Vehicles	1117	27%	5%
Other Mobile	1689	42%	8%
Gasoline Fuel	232	6%	1%
Diesel Fuel	1051	26%	5%
Other Fuel	406	10%	2%
Natural Sources	0	0%	0%
Total	4065	100%	19%
Total Statewide	20951		

Table 5-51

Methylene Chloride

Approximately 80 percent of the emissions of methylene chloride are from paint removers/strippers, automotive brake cleaners, and other consumer products.

San Joaquin Valley - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	85	20%	1%
Area-wide Sources	337	80%	5%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	423	100%	7%
Total Statewide	6436		

Table 5-52

Perchloroethylene

Approximately 65 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

San Joaquin Valley - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	399	65%	8%
Area-wide Sources	218	35%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	617	100%	12%
Total Statewide	4982		

Table 5-53

Diesel Particulate Matter

Approximately 99 percent of the diesel PM emissions are from mobile sources.

San Joaquin Valley - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	32	1%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	3718	61%	10%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	3718	61%	10%
Other Mobile	2323	38%	6%
Gasoline Fuel	0	0%	0%
Diesel Fuel	2313	38%	6%
Other Fuel	11	<1%	<1%
Natural Sources	0	0%	0%
Total	6073	100%	17%
Total Statewide	35884		

Table 5-54

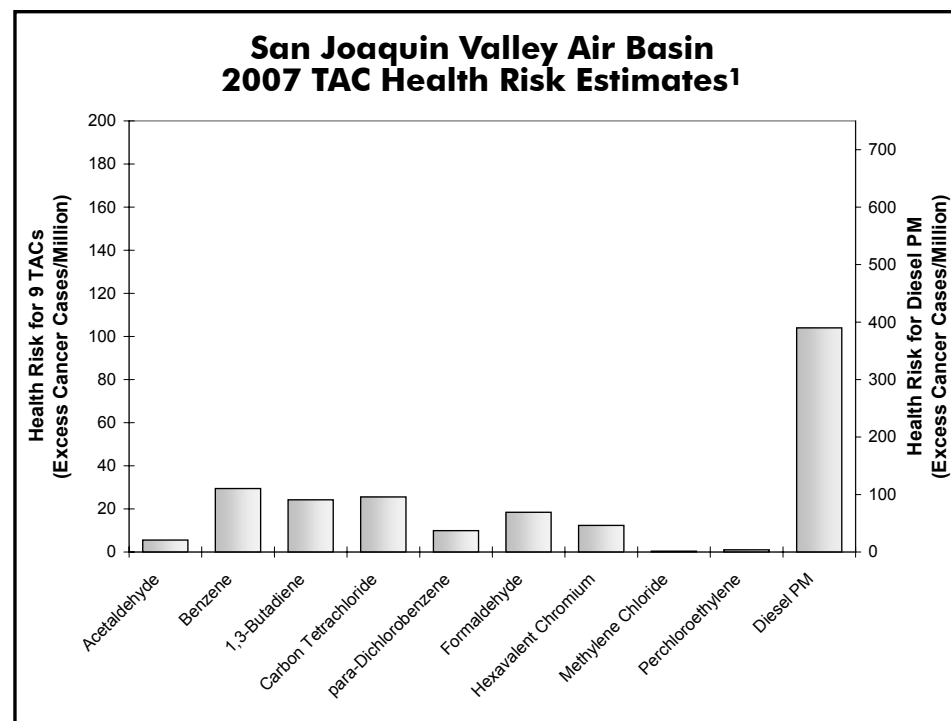
San Joaquin Valley Air Basin

Air Quality and Health Risk

From 1990 through 2007, the ARB monitored outdoor concentrations for various TACs at six sites in the San Joaquin Valley Air Basin. Data for all years are available only for the Stockton site. Data are available for 1991 through 2007 at the Fresno-First Street site, for 1990 through 1993 at the Bakersfield-Chester Avenue site, and for 1995 through 2003 at the Bakersfield-5558 California Avenue site. Data are also available at the Modesto-14th Street site from 1990 through 1999. In addition, limited TAC data are available at the Modesto-I Street site from 1991 to 1997. This almanac focuses on the top ten TACs based on available data. There may be other TACs that may pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the San Joaquin Valley Air Basin, are provided in Table 5-55. Data for individual sites are provided in Appendix C. Figure 5-15 shows individual health risk from the ten TACs for the San Joaquin Valley Air Basin. As indicated on the graph, the health risk data reflect the year of 2007 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used,



¹ Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2006.

Figure 5-15

along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.

Diesel PM poses the greatest health risk among the ten TACs. In the San Joaquin Valley Air Basin, the estimated health risk from diesel PM was 390 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 50 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2005-2007. The health risks of 1,3-butadiene and benzene have been reduced by 79 percent and 82 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 83 percent and 75 percent, respectively.

Carbon tetrachloride data show a 29 percent decrease when comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2007 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2005-2007. Acetaldehyde shows a three percent increase while formaldehyde had a nine percent decrease.

Para-dichlorobenzene data show a 29 percent increase when comparing periods between 1991-1993 and 2004-2006. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The analysis of *para*-dichlorobenzene was discontinued in March 2007 due to the high percentage of values below the limit of detection (LOD).

Hexavalent chromium data show a 67 percent decrease when comparing periods between 1992-1994 and 2005-2007. The significant reduction in hexavalent chromium in years after 1995 was attributed

to implementation of a series of successful control measures. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. To better assess the hexavalent chromium measurements below the LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter and will not be repeated here.

In addition to the routine monitoring, a special study was conducted at a site located in the Fresno area of the San Joaquin Valley Air Basin between June 2002 and August 2003. Monitoring included both TACs and criteria air pollutants. This Fresno community is located in a residential neighborhood near sources of motor vehicle pollution. There are a large number of children living in the community. Although not included in the almanac, data from Fresno and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at www.arb.ca.gov/ch/communities/studies/fresno/fresno.htm.

San Joaquin Valley Air Basin

Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																			
TAC	Conc.1/Risk ²	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Acetaldehyde	Annual Avg	1.94	1.84	1.38	1.73	1.29	0.54	1.28	1.19	1.3	1.56	1.09	1.15	1.24	1.34	1.14	1.42	1.33	1.15
	Health Risk	9	9	7	8	6	3	6	6	6	8	5	6	6	7	6	7	6	6
Benzene	Annual Avg	2.45	2.11	1.36	1.32	1.33	1.16	0.73	0.71	0.76	0.69	0.63	0.538	0.552	0.463	0.372	0.374	0.362	0.318
	Health Risk	227	196	126	122	123	107	68	66	71	64	58	50	51	43	34	35	34	29
1,3-Butadiene	Annual Avg	0.409	0.36	0.236	0.339	0.323	0.264	0.222	0.195	0.233	0.177	0.158	0.15	0.146	0.095	0.08	0.082	0.069	0.065
	Health Risk	154	135	89	127	121	99	83	73	88	67	59	56	55	36	30	31	26	24
Carbon Tetrachloride	Annual Avg	0.128	0.129		0.109		0.098	0.077		0.114		0.096	0.086	0.091	0.097				
	Health Risk	34	34		29		26	20		30		25	23	24	26				
Chromium, Hexavalent	Annual Avg			0.23	0.21	0.19	0.28	0.13	0.11	0.1	0.1	0.12		0.086	0.078	0.083	0.076	0.05	0.083
	Health Risk			34	31	29	42	20	16	15	15	18		13	12	13	11	8	12
<i>para</i> -Dichlorobenzene	Annual Avg		0.11	0.11	0.13	0.11	0.11	0.1	0.13			0.11	0.13	0.15	0.15	0.15	0.15	0.15	
	Health Risk		7	7	9	7	8	7	9			7	9	10	10	10	10	10	
Formaldehyde	Annual Avg	2.45	1.81	1.46	1.67	1.8	2.1	2.96	2.77	2.86	3.44	2.61	3.08	3.13	3.02	2.27	2.52	2.78	2.51
	Health Risk	18	13	11	12	13	15	22	20	21	25	19	23	23	22	17	19	20	18
Methylene Chloride	Annual Avg	0.76	0.59	0.55	0.76	0.59	0.61	0.54	0.53	0.52	0.5	0.53	0.27	0.16	0.14	0.11	0.12	0.11	0.1
	Health Risk	3	2	2	3	2	2	2	2	2	2	2	<1	<1	<1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.126	0.133	0.104	0.473	0.067	0.068	0.068	0.056	0.039		0.076	0.052	0.039	0.033	0.027	0.032	0.032	0.026
	Health Risk	5	5	4	19	3	3	3	2	2		3	2	2	1	1	1	1	1
<i>Diesel PM</i> ³	Annual Avg	(2.6)					(1.7)					(1.3)							
	Health Risk	(780)					(510)					(390)							
Average Basin Risk	w/o Diesel PM	450	401	280	360	304	305	231	194	235	181	196	169	184	157	111	114	105	90
	w/ Diesel PM	(1230)					(815)					(586)							

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics*.

3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-55

San Diego Air Basin

2008 Emission Inventory by Compound

Acetaldehyde

Approximately 90 percent of the emissions of acetaldehyde are from mobile sources.

San Diego - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	8	1%	<1%
Area-wide Sources	45	9%	<1%
On-Road Mobile	154	29%	2%
Gasoline Vehicles	66	13%	1%
Diesel Vehicles	88	17%	1%
Other Mobile	318	61%	3%
Gasoline Fuel	61	12%	1%
Diesel Fuel	192	37%	2%
Other Fuel	64	12%	1%
Natural Sources	0	0%	0%
Total	524	100%	6%
Total Statewide	9103		

Table 5-56

Benzene

The primary sources of benzene emissions in the San Diego Air Basin are mobile sources (approximately 94 percent).

San Diego - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	42	5%	<1%
Area-wide Sources	4	<1%	<1%
On-Road Mobile	415	54%	4%
Gasoline Vehicles	391	51%	4%
Diesel Vehicles	24	3%	<1%
Other Mobile	310	40%	3%
Gasoline Fuel	227	29%	2%
Diesel Fuel	52	7%	<1%
Other Fuel	31	4%	<1%
Natural Sources	0	0%	0%
Total	770	100%	7%
Total Statewide	10794		

Table 5-57

1,3-Butadiene

Approximately 71 percent of the emissions of 1,3-butadiene are from mobile sources, and 22 percent from natural sources.

San Diego - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1	1%	<1%
Area-wide Sources	13	6%	<1%
On-Road Mobile	85	36%	2%
Gasoline Vehicles	83	35%	2%
Diesel Vehicles	2	1%	<1%
Other Mobile	82	35%	2%
Gasoline Fuel	52	22%	1%
Diesel Fuel	5	2%	<1%
Other Fuel	25	11%	1%
Natural Sources	52	22%	1%
Total	233	100%	6%
Total Statewide	3754		

Table 5-58

Carbon Tetrachloride

Stationary sources such as chemical and allied product manufacturers account for all of the emissions of carbon tetrachloride.

San Diego - Carbon Tetrachloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.09	100%	2%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.09	100%	2%
Total Statewide	4.04		

Table 5-59

Chromium, Hexavalent

Approximately 54 percent of the hexavalent chromium emissions are from stationary sources. Mobile sources account for approximately 44 percent.

San Diego - Chromium, Hexavalent			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.03	54%	6%
Area-wide Sources	< .01	2%	<1%
On-Road Mobile	0.02	27%	3%
Gasoline Vehicles	0.02	26%	3%
Diesel Vehicles	< .01	1%	<1%
Other Mobile	0.01	17%	2%
Gasoline Fuel	0.01	17%	2%
Diesel Fuel	< .01	1%	<1%
Other Fuel	< .01	<1%	<1%
Natural Sources	0	0%	0%
Total	0.06	100%	10%
Total Statewide	0.61		

Table 5-60

para-Dichlorobenzene

All of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

San Diego - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0	0%	0%
Area-wide Sources	122	100%	8%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	122	100%	8%
Total Statewide	1508		

Table 5-61

Formaldehyde

Approximately 92 percent of the formaldehyde emissions are from mobile sources.

San Diego - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	49	4%	<1%
Area-wide Sources	56	4%	<1%
On-Road Mobile	397	31%	2%
Gasoline Vehicles	221	17%	1%
Diesel Vehicles	176	14%	1%
Other Mobile	779	61%	4%
Gasoline Fuel	187	15%	1%
Diesel Fuel	385	30%	2%
Other Fuel	208	16%	1%
Natural Sources	0	0%	0%
Total	1282	100%	6%
Total Statewide	20951		

Table 5-62

Methylene Chloride

Area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products account for approximately 84 percent of the emissions of methylene chloride.

San Diego - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	57	16%	1%
Area-wide Sources	301	84%	5%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	359	100%	6%
Total Statewide	6436		

Table 5-63

Perchloroethylene

Approximately 58 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

San Diego - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	245	58%	5%
Area-wide Sources	177	42%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	422	100%	8%
Total Statewide	4982		

Table 5-64

Diesel Particulate Matter

Approximately 96 percent of the emissions of diesel PM are from mobile sources.

San Diego - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	56	4%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	645	40%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	645	40%	2%
Other Mobile	905	56%	3%
Gasoline Fuel	0	0%	0%
Diesel Fuel	896	56%	2%
Other Fuel	9	1%	<1%
Natural Sources	0	0%	0%
Total	1607	100%	4%
Total Statewide	35884		

Table 5-65

San Diego Air Basin

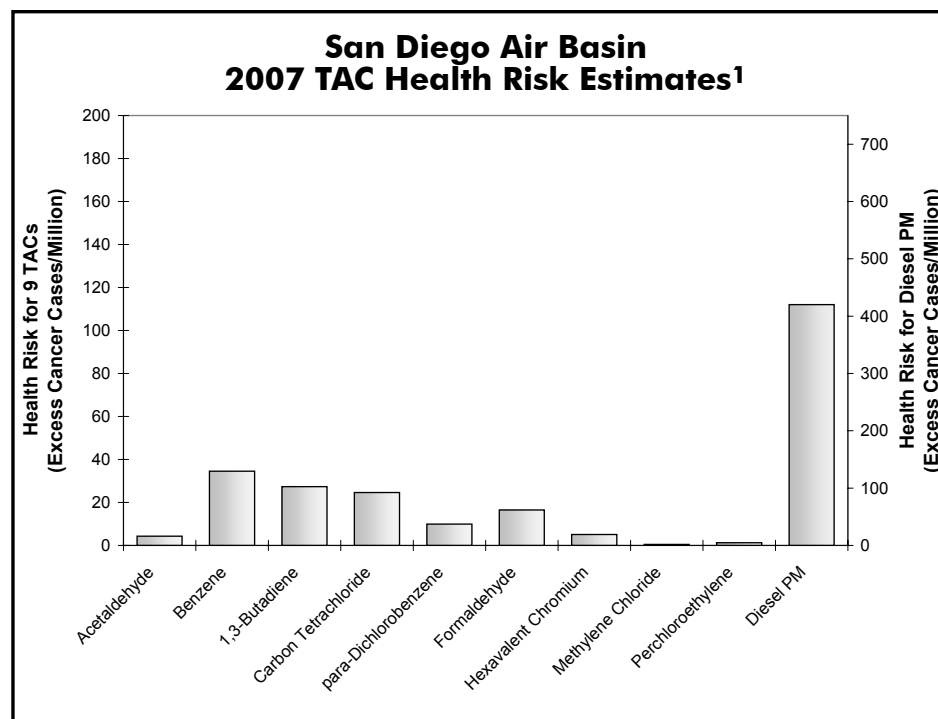
Air Quality and Health Risk

During 1990 through 2007, the ARB monitored outdoor concentrations for various TACs at two sites in the San Diego Air Basin. The sites are located in Chula Vista and El Cajon. This almanac focuses on the top ten TACs based on available data. There may be other TACs that may pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the San Diego Air Basin, are provided in Table 5-66. Data for individual sites are provided in Appendix C. Figure 5-16 shows individual health risk from the ten TACs for the San Diego Air Basin. As indicated on the graph, the health risk data reflect the year of 2007 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based exposure method. The method uses the ARB emission inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.

Diesel PM poses the greatest health risk among the ten TACs. In the San Diego Air Basin, the estimated health risk from diesel PM was



¹ Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2006.

Figure 5-16

420 excess cancer cases per million people in 2000. Although the health risk is higher than the statewide average, it represents a 52 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2005-2007. The health risks of 1,3-butadiene and benzene have been reduced by 75 percent and 79 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 85 percent and 87 percent, respectively.

Carbon tetrachloride data show a 30 percent decrease when comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2007 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2005-2007. Acetaldehyde data show a 5 percent reduction and formaldehyde data show a 10 percent reduction.

Para-dichlorobenzene data show a 32 percent increase when comparing periods between 1991-1993 and 2004-2006. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The analysis of *para*-dichlorobenzene was discontinued in March 2007 due to the high percentage of values below the limit of detection (LOD).

Hexavalent chromium data show a 78 percent decrease when comparing periods between 1992-1994 and 2005-2007. The significant reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. To better assess hexavalent chromium measurements below its LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method has been discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter.

In addition to routine monitoring, a special study was conducted at a site located in the Logan Heights/Barrio Logan area of San Diego during the period of October 1999 through February 2001. Monitoring

included both TACs and criteria air pollutants. The Barrio Logan community is located in a large urban area near major freeways, industrial sources, and neighborhood sources such as gas stations, dry cleaners, and automotive repair facilities. Although not included in this almanac, data from Barrio Logan and other community monitoring studies are being used in support of the ARB's Community Health Program. Copies of the full reports are available at www.arb.ca.gov/ch/programs/sb25/sb25.htm.

San Diego Air Basin

Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																			
TAC	Conc.1/Risk ²	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Acetaldehyde	Annual Avg	1.33	1.5	1.22	1.41	1.48	0.64	1.03	1	0.86	1.04	0.84	0.95	0.97	0.89	0.89	1.01	0.85	0.88
	Health Risk	6	7	6	7	7	3	5	5	4	5	4	5	5	4	4	5	4	4
Benzene	Annual Avg	2.25	1.7	1.48	1.16	1.39	0.98	0.76	0.76	0.76	0.86	0.65	0.505	0.491	0.483	0.371	0.404	0.362	0.373
	Health Risk	208	158	137	107	129	90	71	70	70	79	60	47	45	45	34	37	34	35
1,3-Butadiene	Annual Avg	0.333	0.257	0.258	0.312	0.307	0.242	0.208	0.198	0.196	0.22	0.159	0.136	0.12	0.089	0.074	0.073	0.068	0.073
	Health Risk	125	97	97	117	115	91	78	75	74	83	60	51	45	33	28	27	26	27
Carbon Tetrachloride	Annual Avg	0.132	0.127		0.103		0.099	0.077				0.094	0.086	0.092	0.093				
	Health Risk	35	34		27		26	20				25	23	24	25				
Chromium, Hexavalent	Annual Avg			0.24	0.19	0.16	0.18	0.11	0.11	0.1	0.1	0.1		0.045	0.05	0.03	0.043	0.05	0.034
	Health Risk			36	28	23	27	16	16	15	15	15		7	8	5	6	8	5
<i>para</i> -Dichlorobenzene	Annual Avg		0.1	0.11	0.13	0.15	0.12	0.11	0.13				0.15	0.15	0.15	0.15	0.15	0.15	
	Health Risk		7	8	8	10	8	7	8				10	10	10	10	10	10	
Formaldehyde	Annual Avg	1.64	1.53	1.26	1.76	2.25	2.13	2.62	2.62	2.27	2.67	2.23	2.59	2.99	2.68	2.19	2.42	2.08	2.24
	Health Risk	12	11	9	13	17	16	19	19	17	20	16	19	22	20	16	18	15	16
Methylene Chloride	Annual Avg	0.59	0.83	1.34	1.13	0.73	0.63	0.59	0.57		0.53	0.76	0.17	0.16	0.16	0.13	0.14	0.14	0.14
	Health Risk	2	3	5	4	3	2	2	2		2	3	<1	<1	<1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.282	0.269	0.263	0.2	0.207	0.249	0.147	0.125			0.089	0.061	0.06	0.047	0.037	0.041	0.037	0.03
	Health Risk	11	11	11	8	8	10	6	5			4	2	2	2	1	2	1	1
<i>Diesel PM</i> ³	Annual Avg	(2.9)					(1.9)					(1.4)							
	Health Risk	(870)					(570)					(420)							
Average Basin Risk	w/o Diesel PM	399	328	309	319	312	273	224	200	180	204	187	157	160	147	98	105	98	88
	w/ Diesel PM	(1269)					(843)					(607)							

1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.

2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics*.

3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-66

Sacramento Valley Air Basin

2008 Emission Inventory by Compound

Acetaldehyde

Approximately 66 percent of the emissions of acetaldehyde are from mobile sources. Another 31 percent are from area-wide sources, including the burning of wood in residential fireplaces and wood stoves.

Sacramento Valley - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	27	3%	<1%
Area-wide Sources	304	31%	3%
On-Road Mobile	249	25%	3%
Gasoline Vehicles	63	6%	1%
Diesel Vehicles	185	19%	2%
Other Mobile	407	41%	4%
Gasoline Fuel	74	7%	1%
Diesel Fuel	289	29%	3%
Other Fuel	44	4%	<1%
Natural Sources	0	0%	0%
Total	986	100%	11%
Total Statewide	9103		

Table 5-67

Benzene

The primary sources of benzene emissions in the Sacramento Valley Air Basin are mobile sources (approximately 84 percent).

Sacramento Valley - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	147	15%	1%
Area-wide Sources	8	1%	<1%
On-Road Mobile	432	45%	4%
Gasoline Vehicles	382	40%	4%
Diesel Vehicles	50	5%	<1%
Other Mobile	369	39%	3%
Gasoline Fuel	271	28%	3%
Diesel Fuel	79	8%	1%
Other Fuel	19	2%	<1%
Natural Sources	0	0%	0%
Total	957	100%	9%
Total Statewide	10794		

Table 5-68

1,3-Butadiene

Approximately 39 percent of the emissions of 1,3-butadiene are from mobile sources.

Sacramento Valley - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< 1	<1%	<1%
Area-wide Sources	122	28%	3%
On-Road Mobile	85	19%	2%
Gasoline Vehicles	80	18%	2%
Diesel Vehicles	5	1%	<1%
Other Mobile	87	20%	2%
Gasoline Fuel	62	14%	2%
Diesel Fuel	7	2%	<1%
Other Fuel	17	4%	<1%
Natural Sources	143	33%	4%
Total	437	100%	12%
Total Statewide	3754		

Table 5-69

Carbon Tetrachloride

Stationary sources such as chemical and allied product manufacturers account for all of the emissions of carbon tetrachloride.

Sacramento Valley - Carbon Tetrachloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.05	100%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	0.05	100%	1%
Total Statewide	4.04		

Table 5-70

Chromium, Hexavalent

Approximately 73 percent of the hexavalent chromium emissions are from mobile sources.

Sacramento Valley - Chromium, Hexavalent			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< .01	24%	1%
Area-wide Sources	< .01	3%	<1%
On-Road Mobile	0.01	32%	2%
Gasoline Vehicles	0.01	30%	2%
Diesel Vehicles	< .01	2%	<1%
Other Mobile	0.02	41%	3%
Gasoline Fuel	0.01	39%	2%
Diesel Fuel	< .01	2%	<1%
Other Fuel	< .01	<1%	<1%
Natural Sources	0	0%	0%
Total	0.04	100%	6%
Total Statewide	0.61		

Table 5-71

para-Dichlorobenzene

Most of the emissions of *para*-dichlorobenzene are from consumer products (non-aerosol insect repellants and solid/gel air fresheners).

Sacramento Valley - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< 1	<1%	<1%
Area-wide Sources	108	100%	7%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	108	100%	7%
Total Statewide	1508		

Table 5-72

Formaldehyde

Approximately 74 percent of the formaldehyde emissions are from mobile sources, and 17 percent are from area-wide sources.

Sacramento Valley - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	177	9%	1%
Area-wide Sources	343	17%	2%
On-Road Mobile	578	28%	3%
Gasoline Vehicles	208	10%	1%
Diesel Vehicles	371	18%	2%
Other Mobile	947	46%	5%
Gasoline Fuel	226	11%	1%
Diesel Fuel	578	28%	3%
Other Fuel	143	7%	1%
Natural Sources	0	0%	0%
Total	2045	100%	10%
Total Statewide	20951		

Table 5-73

Methylene Chloride

Approximately 68 percent of the emissions of methylene chloride are from area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products.

Sacramento Valley - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	112	32%	2%
Area-wide Sources	241	68%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	352	100%	5%
Total Statewide	6436		

Table 5-74

Perchloroethylene

Approximately 56 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Sacramento Valley - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	200	56%	4%
Area-wide Sources	155	44%	3%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Gasoline Fuel	0	0%	0%
Diesel Fuel	0	0%	0%
Other Fuel	0	0%	0%
Natural Sources	0	0%	0%
Total	355	100%	7%
Total Statewide	4982		

Table 5-75

Diesel Particulate Matter

Approximately 98 percent of the emissions of diesel PM are from mobile sources.

Sacramento Valley - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	39	2%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	1246	48%	3%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1246	48%	3%
Other Mobile	1304	50%	4%
Gasoline Fuel	0	0%	0%
Diesel Fuel	1302	50%	4%
Other Fuel	2	<1%	<1%
Natural Sources	0	0%	0%
Total	2590	100%	7%
Total Statewide	35884		

Table 5-76

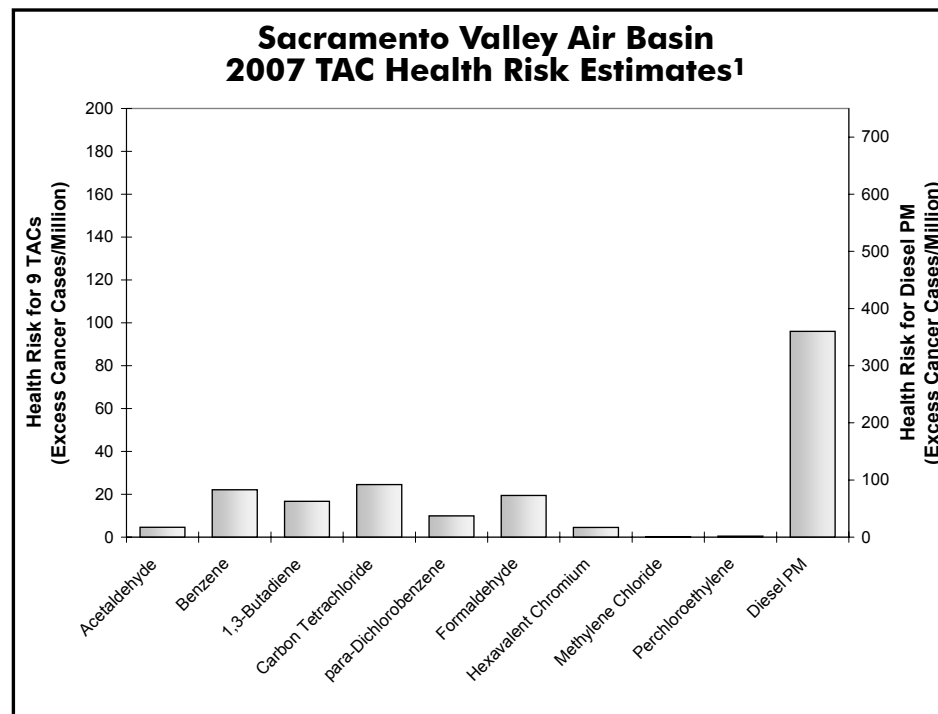
Sacramento Valley Air Basin

Air Quality and Health Risk

Unlike the other air basins described in this almanac, TAC monitoring in the Sacramento Valley Air Basin has not been continuous at any site. TAC concentrations were monitored at the Chico-Salem Street site during 1990 through the middle of 1992. The site was then moved to Chico-Manzanita Avenue. While there was monitoring in the Chico area for 1992, an annual average is not included here because neither site has a full year of data. Similarly, TAC concentrations were monitored at the Citrus Heights site during 1990 through part of 1993, when the site was relocated to Roseville. Again, annual average concentration and associated health risk are not available for the year during which the site was moved because neither site has a full year of data. This almanac focuses on the top ten TACs based on available data. There may be other TACs that may pose a substantial risk, but for which sufficient data are not available, or which have not been identified as a concern.

Annual average concentrations and associated health risks for the top ten TACs individually as well as cumulatively for the Sacramento Valley Air Basin, are provided in Table 5-77. Data for individual sites are provided in Appendix C. Figure 5-17 shows individual health risk from the ten TACs for the Sacramento Valley Air Basin. As indicated on the graph, the health risk data reflect the year of 2007 except those for diesel PM which reflects the year 2000 and for carbon tetrachloride which reflects the year 2003, the most recent years for which estimated data are available. The health risks shown here are based on an annual average concentration for all sites in the air basin. The risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources.

Unlike the other nine TACs, diesel PM does not have ambient monitoring data because an accepted measurement method does not currently exist. However, the ARB has made preliminary concentration estimates for the State and its 15 air basins using a PM-based expo-



¹ Data for Diesel PM reflect 2000; carbon tetrachloride reflect 2003; all other TACs reflect 2006.
Figure 5-17

sure method. The method uses the ARB emission inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies on chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate outdoor concentrations of diesel PM. The existing diesel PM estimates are currently being reviewed to reflect control measures that were outlined in the ARB Diesel Risk Reduction Plan.

Diesel PM poses the greatest health risk among the ten TACs. In the Sacramento Valley Air Basin, the estimated health risk from diesel PM was 360 excess cancer cases per million people in 2000. Although

the health risk is higher than the statewide average, it represents a 52 percent drop between 1990 and 2000.

Trends and health risks for the nine other TACs are based on monitoring data. To examine their trends while minimizing the annual variation due to meteorology and sampling schedule, the air basin average concentration for the 1990-1992 time period was compared to that for 2005-2007. The health risks of 1,3-butadiene and benzene have been reduced by 82 percent and 84 percent, respectively. Methylene chloride and perchloroethylene also show substantial reductions of 88 percent and 77 percent, respectively.

Carbon tetrachloride data show a 27 percent decrease when comparing periods between 1990-1991 (1992 average was not valid) and 2001-2003. Carbon tetrachloride data from mid-February 2004 through 2007 were invalidated.

Although acetaldehyde and formaldehyde data were collected beginning in 1990, concentration and health risk values prior to 1996 were uncertain because the method used to collect these samples underestimated the actual concentrations. The bias was corrected by a method change in 1996; however, the ARB was unable to develop a correction factor for the earlier data. Therefore, the data for years prior to 1996 are not directly comparable to data collected during the later years. The 1996-1998 time period is used instead to compare with that for 2005-2007. Acetaldehyde data show a one percent increase and formaldehyde data show a four percent decrease.

Para-dichlorobenzene data show a 10 percent increase when comparing periods between 1992-1994 and 2004-2006. Note that *para*-dichlorobenzene has a high number of samples that can not be reliably measured, so its trend is biased by these measurements. The analysis of *para*-dichlorobenzene was discontinued in March 2007 due to the high percentage of values below the limit of detection (LOD).

Hexavalent chromium data show a 71 percent decrease when comparing periods between 1992-1994 and 2005-2007. The significant

reduction in hexavalent chromium in years after 1995 was attributed to implementation of a series of successful control measures. Similar to *para*-dichlorobenzene, it also had a high number of samples below its LOD. To better assess the hexavalent chromium measurements below its LOD, the ARB's Monitoring and Laboratory division used a different approach to analyze hexavalent chromium samples in 2001. The method is discussed in the Hexavalent Chromium Statewide Air Quality and Health Risk section in this chapter.

Sacramento Valley Air Basin

Annual Average Concentrations and Health Risks

Annual Average Concentrations and Health Risks																			
TAC	Conc.1/Risk ²	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Acetaldehyde	Annual Avg	1.29			1.37	1.04	0.39	1.03	1.05	0.92	1.23	0.83	0.74	1.14	1.04	1.09	1.15	0.92	0.95
	Health Risk	6			7	5	2	5	5	4	6	4	4	6	5	5	6	4	5
Benzene	Annual Avg	2.02	1.88	1.35	1	1.02	0.8	0.56	0.55	0.5	0.56	0.45	0.422	0.443	0.406	0.406	0.335	0.268	0.239
	Health Risk	187	174	125	92	95	74	51	51	47	52	42	39	41	38	38	31	25	22
1,3-Butadiene	Annual Avg	0.378	0.332	0.283	0.288	0.221	0.186	0.176	0.16	0.154	0.128	0.119	0.125	0.116	0.094	0.093	0.08	0.051	0.045
	Health Risk	142	125	106	108	83	70	66	60	58	48	45	47	44	35	35	30	19	17
Carbon Tetrachloride	Annual Avg	0.123	0.123		0.109		0.099	0.078				0.094	0.088	0.09	0.093				
	Health Risk	33	32		29		26	21				25	23	24	25				
Chromium, Hexavalent	Annual Avg			0.17	0.14	0.13	0.18	0.11	0.1	0.1	0.1	0.1	0.1	0.053	0.05	0.068	0.058	0.041	0.03
	Health Risk			26	21	19	26	16	15	15	15	15	15	8	8	10	9	6	5
<i>para</i> -Dichlorobenzene	Annual Avg			0.11	0.1	0.2	0.14	0.11	0.14			0.1	0.13	0.15	0.15	0.15	0.15	0.15	
	Health Risk			7	7	14	9	7	10			7	9	10	10	10	10	10	
Formaldehyde	Annual Avg	1.57			1.77	1.75	1.91	2.76	2.92	2.52	3.61	2.51	2.41	3.79	3.53	2.76	2.68	2.54	2.64
	Health Risk	12			13	13	14	20	22	19	27	18	18	28	26	20	20	19	19
Methylene Chloride	Annual Avg	0.65	0.56	0.55	0.98	0.66	0.53	0.54	0.52		0.6	0.57	0.29	0.08	0.08	0.07	0.08	0.07	0.07
	Health Risk	2	2	2	3	2	2	2	2		2	2	1	<1	<1	<1	<1	<1	<1
Perchloroethylene	Annual Avg	0.071	0.074	0.063	0.052	0.165	0.049	0.055	0.052			0.058	0.027	0.025	0.018	0.015	0.021	0.015	0.012
	Health Risk	3	3	3	2	7	2	2	2			2	1	1	<1	<1	<1	<1	<1
<i>Diesel PM</i> ³	Annual Avg	(2.5)					(1.6)					(1.2)							
	Health Risk	(750)					(480)					(360)							
Average Basin Risk	w/o Diesel PM	385	336	269	282	238	225	190	167	143	150	160	157	162	147	118	106	83	68
	w/ Diesel PM	(1135)					(705)					(520)							

- 1 Concentrations for Hexavalent chromium are expressed as ng/m3 and concentrations for diesel PM are expressed as ug/m3. Concentrations for all other TACs are expressed as parts per billion.
- 2 Health Risk represents the number of excess cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration. It reflects only those compounds listed in this table and only those with data for that year. There may be other significant compounds for which we do not monitor or have health risk information. Additional information about interpreting the toxic air contaminant air quality trends can be found in Chapter 1, *Interpreting the Emission and Air Quality Statistics*.
- 3 Diesel PM estimates are based on receptor modeling techniques, and the estimates are available only for selected years. Currently, the estimates are being reviewed.

Table 5-77

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