
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 in serious illness, or which may pose a present or potential hazard to human health. The summary information includes available data for the ten TACs posing the greatest health risk in California, based primarily on ambient air quality data. These TACs are acetaldehyde, benzene, 1,3-butadiene, carbon tetrachloride, chromium (hexavalent), *para*-dichlorobenzene, formaldehyde, methylene chloride, perchloroethylene, and diesel particulate matter (diesel PM). Information is summarized for the State as a whole and for each of the five most populated air basins. It is important to note that the summarized data reflect a spatial average, and the ambient concentrations and health risks for individual locations may be higher or lower.

This section provides some general background information on toxic air contaminants, their emissions, and air quality. The following section provides information on a statewide level. The information includes summaries of statewide emissions,

statewide annual average concentrations (calculated as a mean of the monthly means) and statewide average health risks for the ten selected TACs. The final sections of this chapter provide similar information for California's five most populated air basins: the South Coast Air Basin, the San Francisco Bay Area Air Basin, the San Joaquin Valley Air Basin, the San Diego Air Basin, and the Sacramento Valley Air Basin (concentration and health risk data for individual sites within these air basins are found in Appendix C). It is important to note that the ambient concentration and health risk information reflect data collected only at sites operated by the ARB.

It is important to note that the information presented in this chapter reflects only the ten TACs for which available data indicate the most substantial health risk. There may be other TACs that pose a substantial risk, but for which data are not available (dioxins, for example), or which have not been identified as a concern. Furthermore, additional information about interpreting the toxic air contaminant air quality data can be found in Chapter 1.

Sources of Toxic Air Contaminant Emissions in California.

Similar to the criteria pollutants, toxic air contaminants are emitted from stationary sources, area-wide sources, and mobile sources. The ARB developed the stationary source emissions inventory in cooperation with affected industries and the air pollution control and air quality management districts (districts) as part of Assembly Bill 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 highest-emitting ten counties in California. Emissions are also included for the five most populated air basins. In general, the inventory base year is 2002. Note, however, that the stationary source emissions inventory represents the best available information for the emission source, although the data may not have been specifically collected for 2002.

Air Quality Monitoring for Toxic Air Contaminants. The ARB maintains a statewide air quality monitoring network for toxic air contaminants. The network was originally designed to measure selected substances in ambient air to determine if the levels were sufficiently high to be of concern. As a result of this monitoring, the ARB has determined atmospheric concentrations of



Figure 5-1

over 60 individual TACs. As shown in Figure 5-1, the ARB currently maintains a network of 18 air quality monitoring stations, measuring ambient concentrations of 58 TACs. The number of sites is smaller than in previous years and reflects the closure of several sites during 2000. By closing these sites, additional resources were made available to support monitoring for the ARB community health program. The sites selected for closure generally showed “average” concentrations, thereby having a small overall impact on the statewide annual averages. Other factors considered in selecting sites included the total number of sites in the area and the continuity of the data record.

TAC samples are generally collected once every 12 days, throughout the year. This results in 20,000 to 35,000 separate TAC measurements 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. These annual average concentrations are then used to support statewide risk assessment.

The TAC monitoring network is currently designed to provide air quality data on general population exposures. Therefore, the data do not provide information on localized impacts, often referred to as near-source or neighborhood exposures. The ARB

is currently participating in several studies to address localized impacts and community health issues. For example, during October 1999, the ARB initiated a monitoring and evaluation study in the Barrio Logan and Logan Heights neighborhoods of San Diego. In addition, the ARB is conducting monitoring in five other communities in support of the children’s health program. Efforts such as these will supplement our existing statewide TAC monitoring network, which was designed for regional rather than neighborhood assessments. Information from these and other studies may be incorporated in subsequent editions of this almanac.

The ambient TAC air quality trends included in this chapter are based on ambient data collected during 1990 through 2001. At this time, there are no available ambient air quality data for diesel particulate matter. However, the ARB has made some estimates of ambient diesel particulate matter concentrations, based on receptor modeling techniques. These estimates are included for comparison.

Statewide Health Risk and Community Health. In this almanac, health risk is presented on a pollutant-by-pollutant basis and on a cumulative basis, with a focus on cancer risk. Because the monitoring data represent general population

exposures, the risk estimates represent general population impacts. Localized impacts may involve exposure to different toxic air contaminants or higher concentrations than those represented by the ambient air monitoring data. The next challenge is to better characterize community health risks by focusing on localized impacts. In addition, the focus of this almanac is only on cancer risks. In contrast to cancer risks, non-cancer risks may be more significant on a localized basis than on a general population exposure basis.

The cancer risk estimates presented in this almanac are calculated using an annual average concentration multiplied by a unit risk factor. The unit risk factor is expressed as the probability, or chance, of contracting cancer as a result of constant exposure to an ambient concentration of 1 microgram per cubic meter over a 70-year lifetime. The potential impacts for cancer are expressed as the chance of contracting cancer (or excess cancer cases) per million people exposed over a 70-year period. Table 5-1 lists the unit risk factor for each of the ten TACs presented in this almanac. The factors reflect only the inhalation pathway.

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/ae&m.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 many other TACs, can be found in an ARB report entitled: "Toxic Air Contaminant Identification List - Summaries," dated September 1997. This report can be obtained from the ARB Public Information Office or by accessing the ARB website.

Toxic Air Contaminant Unit Risk Factors	
Toxic Air Contaminant	Unit Risk/Million People*
Acetaldehyde	2.7
Benzene	29
1,3-Butadiene	170
Carbon Tetrachloride	42
Chromium (Hexavalent)	150,000
para-Dichlorobenzene	11
Formaldehyde	6
Methylene Chloride	1
Perchloroethylene	5.9
Diesel Particulate Matter	300**

* The Unit Risk represents the number of excess cancers per million people per microgram per cubic meter TAC concentration over a 70-year, lifetime exposure.

** 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

Acetaldehyde

2002 Statewide Emission Inventory

Acetaldehyde is a federal hazardous air pollutant (HAP). The ARB identified acetaldehyde as a TAC in April 1993 under Assembly Bill 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 24 percent of the statewide acetaldehyde emissions can be attributed to on-road motor vehicles, with an additional 51 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 22 percent of the

Acetaldehyde		
Emissions Source	tons/year	Percent
Stationary Sources	207	3%
Area-wide Sources	1664	22%
On-Road Mobile	1848	24%
Gasoline Vehicles	898	12%
Diesel Vehicles	950	13%
Other Mobile	3824	51%
Natural Sources	0	0%
Total Statewide	7543	100%

Table 5-2

statewide acetaldehyde emissions, include the burning of wood in residential fireplaces and wood stoves. Stationary sources contribute 3 percent of the statewide acetaldehyde emissions. The primary stationary sources are manufacturers of miscellaneous food and kindred products and crude oil and natural gas extraction. The emissions from these sources are from fuel combustion.

2002 Top Ten Counties - Acetaldehyde

The top ten counties account for approximately 46 percent of the statewide acetaldehyde emissions. The South Coast Air Basin has four of the top ten counties: South Coast portion of Los Angeles County (12 percent of the emissions of acetaldehyde statewide), Orange County (4 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (2 percent). Collectively, approximately 21 percent of statewide acetaldehyde emissions occur in the South Coast Air Basin. San Diego County accounts for approximately 7 percent. The five other counties in the top ten for acetaldehyde emissions are Alameda, Kern, Santa Clara, Fresno, and Sacramento. These five counties account for approximately 18 percent of statewide acetaldehyde emissions.

Acetaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	923	12%
San Diego	San Diego	526	7%
Orange	South Coast	327	4%
Kern	San Joaquin Valley	283	4%
Alameda	San Francisco Bay Area	280	4%
Santa Clara	San Francisco Bay Area	268	4%
Fresno	San Joaquin Valley	254	3%
Sacramento	Sacramento Valley	221	3%
San Bernardino	South Coast	196	3%
Riverside	South Coast	187	2%

Table 5-3

Acetaldehyde

Air Quality and Health Risk

The ARB routinely monitors acetaldehyde concentrations in the ambient air at its network of toxic monitoring sites. The trend graph for acetaldehyde, shown in Figure 5-2, shows a lot of variability. However, there is a general drop in ambient concentrations and health risk during 1990 through 1995. Values show a substantial increase during 1996, and then a variable trend, with an overall decrease, through 2001. Although data are shown for all years during 1990 through 2001, the values prior to 1996 are uncertain because the ARB analyzed ambient samples using a method that underestimated the actual concentrations. A method change in 1996 corrected this bias. However, the ARB was not able to develop a correction factor for the earlier data. Although the concentrations and health risk values for years prior to 1996 are lower than expected, they are included here for completeness.

Based on the statewide annual averages for the six years with consistent data, 1996 through 2001, acetaldehyde concentrations and associated health risk decreased by about 18 percent. On an individual basis, the health risks from acetaldehyde

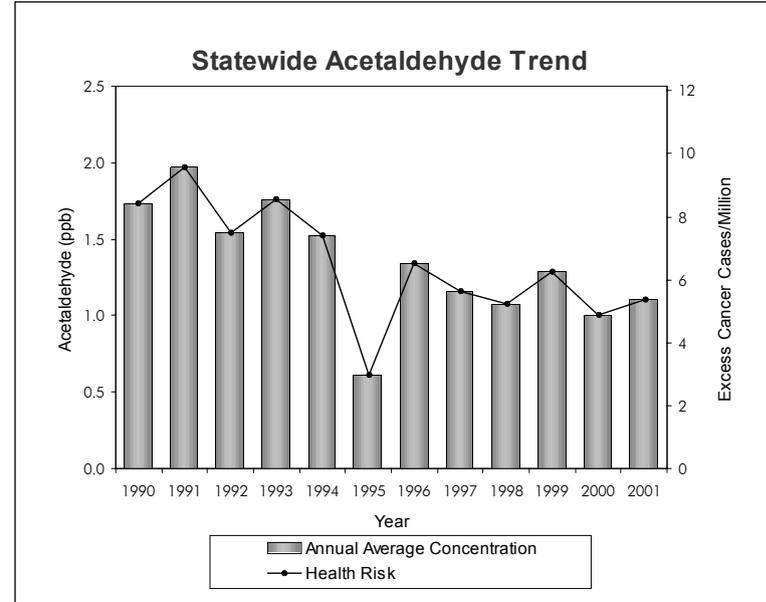


Figure 5-2

alone are much lower than they are for some of the other toxic air contaminants. In fact, considering the ten compounds presented in this almanac, the health risk from acetaldehyde alone ranks eighth out of ten. During 2001, there was an estimated chance of 5 excess cancer cases per million people. However, as with all air pollutants, the health risk is not spread evenly throughout the State, and it is important to remember that the data reflect statewide averages. They 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 concentrations. "Hot spot" exposure may increase the potential cancer risk to individuals living near large combustion sources. Information collected under the Assembly Bill 2588 air toxics "hot spots" emission reporting program will be used during the risk management phase to help determine the priority and need for control of sources of acetaldehyde. Another thing to consider is the fact 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 and also occurs as a result of the photochemical oxidation of reactive organic gases (ROG).

Over the years, the emission standards for new vehicles have resulted in steady declines in vehicular ROG emissions, including acetaldehyde, and NO_x emissions. Further reductions in ROG and NO_x are expected to result in a decline in secondary acetaldehyde due to vehicular emissions. Declines are expected to continue because of the adopted low emission vehicle (LEV) emission standards. Additionally, the primary directly emitted acetaldehyde, also a reactive organic gas, is expected to decline.

Benzene

2002 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 (Assembly Bill 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 85 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 54 percent of the statewide benzene emissions can be attributed to on-road motor vehicles, with an additional 31 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and lawn and garden equipment. Currently, the benzene content of gaso-

Benzene		
Emissions Source	tons/year	Percent
Stationary Sources	1963	14%
Area-wide Sources	97	1%
On-Road Mobile	7517	54%
Gasoline Vehicles	7258	52%
Diesel Vehicles	259	2%
Other Mobile	4292	31%
Natural Sources	43	0%
Total Statewide	13912	100%

Table 5-4

line is less than 1 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 14 percent and area-wide sources contribute 1 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 the application of agricultural and structural pesticides. The primary natural sources are petroleum seeps that form where oil or natural gas emerge from subsurface sources to the ground or water surface.

2002 Top Ten Counties - Benzene

The top ten counties account for approximately 56 percent of the statewide benzene emissions. The South Coast Air Basin has four of the top ten counties emitting benzene: South Coast portion of Los Angeles County (19 percent of the emissions of benzene statewide), Orange County (6 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 31 percent of statewide benzene emissions occur in the South Coast Air Basin. Three counties in the San Francisco Air Basin contribute approximately 10 percent: Alameda County (3 percent), Contra Costa (3 percent) and Santa Clara County (4 percent). The three other counties in the top ten for benzene emissions are San Diego, Kern, and Sacramento. These three counties account for approximately 16 percent of statewide benzene emissions.

Benzene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	2628	19%
San Diego	San Diego	947	7%
Orange	South Coast	883	6%
Kern	San Joaquin Valley	821	6%
Santa Clara	San Francisco Bay Area	545	4%
Alameda	San Francisco Bay Area	438	3%
San Bernardino	South Coast	431	3%
Riverside	South Coast	403	3%
Sacramento	Sacramento Valley	372	3%
Contra Costa	San Francisco Bay Area	353	3%

Table 5-5

Benzene

Air Quality and Health Risk

The ARB has routinely monitored benzene concentrations in the ambient air for more than a decade. Based on the statewide annual averages, the 2001 statewide ambient benzene concentration was about 76 percent lower than the peak in 1990. Figure 5-3 shows the annual average statewide benzene concentrations and the associated health risk from benzene alone. 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. In fact, based on the statewide averages, benzene ranks third highest among the ten TACs presented in this almanac. During 2001, there was an estimated chance of 56 excess cancer cases per million people from benzene. However, as with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower. In general, ambient benzene concentrations and associated health risks tend to be higher in the more urbanized areas.

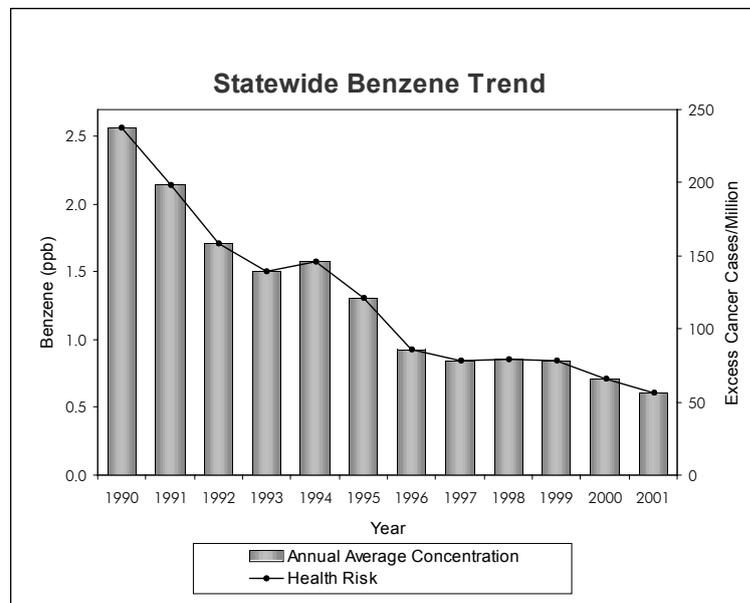


Figure 5-3

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. Environmental Protection Agency, 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, 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 a predictive relationship between the two. To avoid discontinuity in the trend data, the pre-1999 benzene data shown in Figure 5-3 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 is available from the ARB Monitoring and Laboratory Division.

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. 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.

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1,3-Butadiene

2002 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 85 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 49 percent of the statewide 1,3-butadiene emissions can be attributed to on-road motor vehicles, with an additional 36 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and aircraft. Area-wide sources such as agricultural waste burning and open burning associated with forest management contribute approximately 12 percent. Stationary sources contribute less than 1 percent of the statewide 1,3-butadiene emissions. The primary stationary sources with reported 1,3-butadiene emissions include petroleum refining,

1,3-Butadiene		
Emissions Source	tons/year	Percent
Stationary Sources	14	0%
Area-wide Sources	371	12%
On-Road Mobile	1560	49%
Gasoline Vehicles	1535	48%
Diesel Vehicles	25	1%
Other Mobile	1151	36%
Natural Sources	83	3%
Total Statewide	3180	100%

Table 5-6

manufacturing of synthetics and man-made materials, and oil and gas extraction. The primary natural sources are wildfires.

2002 Top Ten Counties - 1,3-Butadiene Emissions

The top ten counties account for approximately 49 percent of the statewide 1,3-butadiene emissions. Four counties in the South Coast Air Basin contribute approximately 28 percent: South Coast portion of Los Angeles County (16 percent), Orange County (5 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (3 percent). San Diego County accounts for approximately 7 percent. The San Joaquin Valley Air Basin has three of the top ten counties emitting 1,3-butadiene: Tulare County (3 percent), Fresno County (3 percent) and Kern County (3 percent). The other counties in the top ten for 1,3-butadiene emissions are Santa Clara, and Alameda.

1,3-Butadiene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	509	16%
San Diego	San Diego	224	7%
Orange	South Coast	159	5%
Tulare	San Joaquin Valley	109	3%
Santa Clara	San Francisco Bay Area	107	3%
San Bernardino	South Coast	97	3%
Alameda	San Francisco Bay Area	90	3%
Kern	San Joaquin Valley	90	3%
Fresno	San Joaquin Valley	87	3%
Riverside	South Coast	84	3%

Table 5-7

1,3-Butadiene

Air Quality and Health Risk

The ARB routinely monitors for 1,3-butadiene at its statewide air toxics monitoring network. Figure 5-4 shows the annual average statewide 1,3-butadiene concentrations and the associated health risk from this TAC alone. The data show a general downward trend, with some variability. Ambient concentrations show a drop of about 58 percent from 1990 to 2001. There has been an equivalent drop in the health risk. Despite this substantial drop, the health risk from this compound remains relatively high. Of the ten compounds presented in this almanac, the average statewide health risk from 1,3-butadiene ranks second. Again, it is important to remember 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

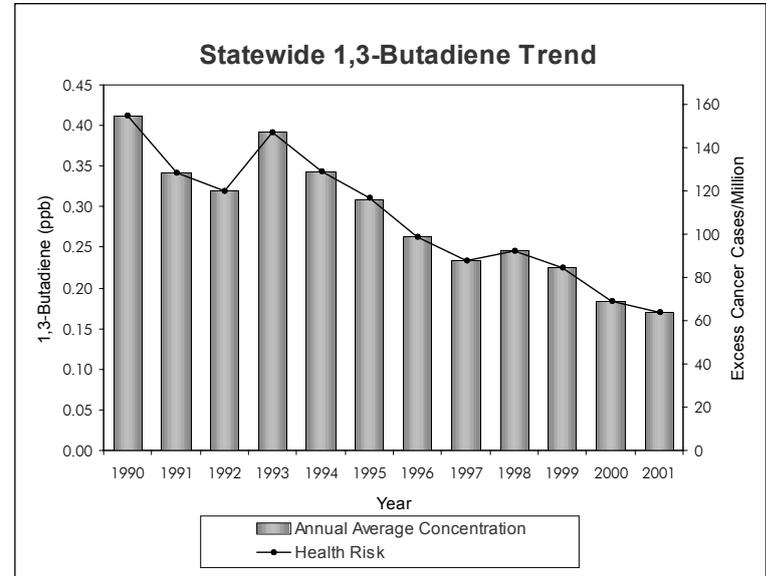


Figure 5-4

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 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 5-4 have been adjusted according to these predictive equations and now reflect the results that would have been produced using the 3-point calibration method. Information about the specific study process and adjustment equations is available from the ARB Monitoring and Laboratory Division.

In California, the majority of 1,3-butadiene emissions are from incomplete combustion of gasoline and diesel fuels. The ARB adopted the Low Emission Vehicles/Clean Fuels regulations in 1990 and the Phase 2 reformulated gasoline regulations in 1991. These regulations are expected to continue to reduce 1,3-butadiene emissions from cars and light-duty trucks.

Carbon Tetrachloride

2002 Statewide Emission Inventory

The ARB identified carbon tetrachloride as a Toxic Air Contaminant 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 3.48 tons per year), and background concentrations account for most of the health risk.

Carbon Tetrachloride		
Emissions Source	tons/year	Percent
Stationary Sources	3.48	100%
Area-wide Sources	0	0%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	3.48	100%

Table 5-8

2002 Top Ten Counties - Carbon Tetrachloride

The top two counties account for 90 percent of the statewide carbon tetrachloride emissions. Los Angeles County (South Coast Air Basin portion) accounts for approximately 53 percent, and Contra Costa County, located in the San Francisco Bay Area Air Basin, accounts for approximately 37 percent of the emissions of carbon tetrachloride statewide. Although the percentages for these two counties are high, the emissions are very small (2 tons or less per year in each county). The eight other counties in the top ten contribute approximately 10 percent of statewide carbon tetrachloride emissions.

Carbon Tetrachloride			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1.83	53%
Contra Costa	San Francisco Bay Area	1.31	37%
San Diego	San Diego	0.09	3%
Orange	South Coast	0.08	2%
Sacramento	Sacramento Valley	0.06	2%
Ventura	South Central Coast	0.05	2%
Riverside	South Coast	0.02	1%
San Bernardino	South Coast	<0.01	<1%
Fresno	San Joaquin Valley	<0.01	<1%
El Dorado	Lake Tahoe	<0.01	<1%

Table 5-9

Carbon Tetrachloride

Air Quality and Health Risk

The ARB routinely monitors carbon tetrachloride concentrations in the ambient air. Based on data from sites in the TAC monitoring network, the year 2001 statewide average carbon tetrachloride concentration and the associated health risk were about 34 percent lower than the peak in 1990. Figure 5-5 shows the annual average statewide concentrations and the associated health risk from carbon tetrachloride alone. During 2001, there was an estimated risk of 23 excess cancer cases per million people. This ranks fourth among the ten compounds presented in this almanac. As with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower. As with a number of other TACs, there are several years of incomplete data for carbon tetrachloride. Based on the data that are available, the ambient concentrations and health risk dropped between 1990 and 1996, and then there was a substantial increase in values for 1998. Although values dropped again in 2000 and 2001, the values for 2001 are still about 12 percent higher than the values for 1996. Data are not sufficient to determine if the higher

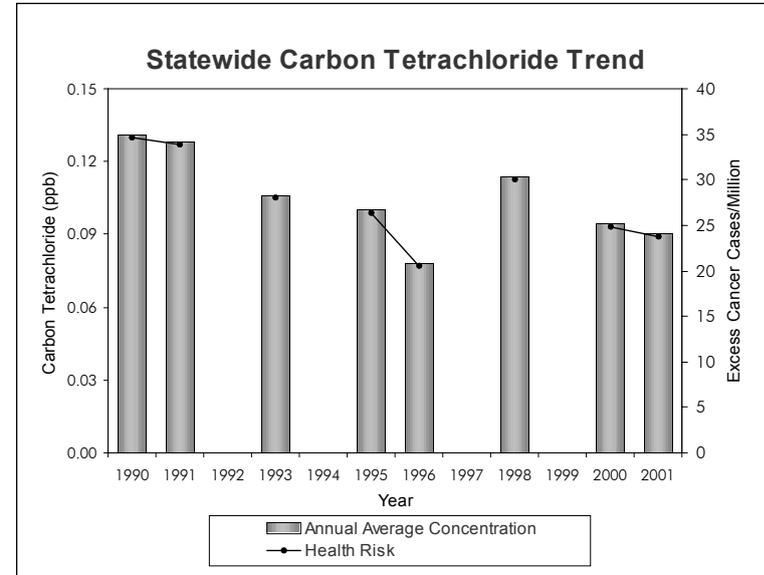


Figure 5-5

values during the end years are anomalous or if a trend towards higher values will continue. It is, however, important to remember that the data have not been adjusted for variations in meteorology, and the increased values may be due in part to meteorological fluctuations rather than changes in emissions.

Unlike many of the other TACs, carbon tetrachloride is emitted primarily by sources other than motor vehicles. Many of these sources are being controlled. However, because carbon tetrachloride persists in the atmosphere for many years (estimated atmospheric lifetime is 50 years), background concentrations account for most of the health risk, and local controls have limited impact.

Chromium (Hexavalent)

2002 Statewide Emission Inventory

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

Chrome plating is a primary source of chromium (hexavalent) emissions in the State. Chromic acid anodizing is another industrial metal finishing process which uses chromium (hexavalent). A third source of chromium (hexavalent) emissions is the firebrick lining of glass furnaces. In California, stationary sources are estimated to emit approximately 1.5 tons annually of chromium (hexavalent). Emissions from these sources were obtained from facilities under the Air Toxics Hot Spots Act of 1987. This act required facilities to estimate toxics and potential toxics emissions, including chromium (hexavalent). Area-wide sources include oil and gas production, specifically the burning of residual and distillate oils. Approximately 0.12 tons

Chromium (Hexavalent)		
Emissions Source	tons/year	Percent
Stationary Sources	1.52	60%
Area-wide Sources	0	0%
On-Road Mobile	0.12	5%
Gasoline Vehicles	0.12	5%
Diesel Vehicles	<0.01	0%
Other Mobile	0.92	36%
Natural Sources	<0.01	0%
Total Statewide	2.56	100%

Table 5-10

of chromium (hexavalent) are emitted by gasoline motor vehicles. Other mobile sources such as trains and ships contribute approximately 1 ton of chromium (hexavalent) annually.

2002 Top Ten Counties - Chromium (Hexavalent)

Four counties account for approximately 63 percent of the statewide chromium (hexavalent) emissions: South Coast portion of Los Angeles County (17 percent of the emissions of chromium (hexavalent) statewide), Mojave Desert portion of Kern County (12 percent), San Diego County (11 percent), and San Francisco Bay Area portion of Solano County (8 percent). Collectively, approximately 19 percent of statewide chromium (hexavalent) emissions occur in the South Coast Air Basin. Two counties in the San Joaquin Valley Air Basin contribute approximately 3 percent: Fresno County (3 percent) and Madera County (3 percent). The remaining four counties in the top ten for chromium (hexavalent) emissions are Tuolumne County, Orange County, Solano County (San Francisco Bay Area Air Basin portion), and San Bernardino (Mojave Desert Air Basin portion).

Chromium (Hexavalent)			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	0.45	17%
Kern	Mojave Desert	0.30	12%
San Diego	San Diego	0.29	11%
Solano	San Francisco Bay Area	0.20	8%
Tuolumne	Mountain Counties	0.09	4%
Fresno	San Joaquin Valley	0.08	3%
Madera	San Joaquin Valley	0.08	3%
Orange	South Coast	0.06	2%
Alameda	San Francisco Bay Area	0.06	2%
San Bernardino	Mojave Desert	0.05	2%

Table 5-11

Chromium (Hexavalent)

Air Quality and Health Risk

Chromium (hexavalent) is the only one of the top ten toxic air contaminants that is a metal, not a gas. Statewide annual averages and health risk estimates are available for 1992 through 2001. Prior to 1992, a different measurement method was used. With this method, some of the chromium (hexavalent) was transformed into chromium (trivalent) on the collection filter. As a result, the chromium (hexavalent) concentrations were underestimated, and these data are not included in this almanac. Since 1992, a new and more accurate method has been used.

The annual average statewide concentrations and health risk values are shown in Figure 5-6. Both show a general downward trend, with the exception of 1995. 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. While the reasons for these high values are uncertain, some of the variation may be attributable to meteorology. Based on statewide data, the 2001 annual average chromium (hexavalent) concentration and the associated health

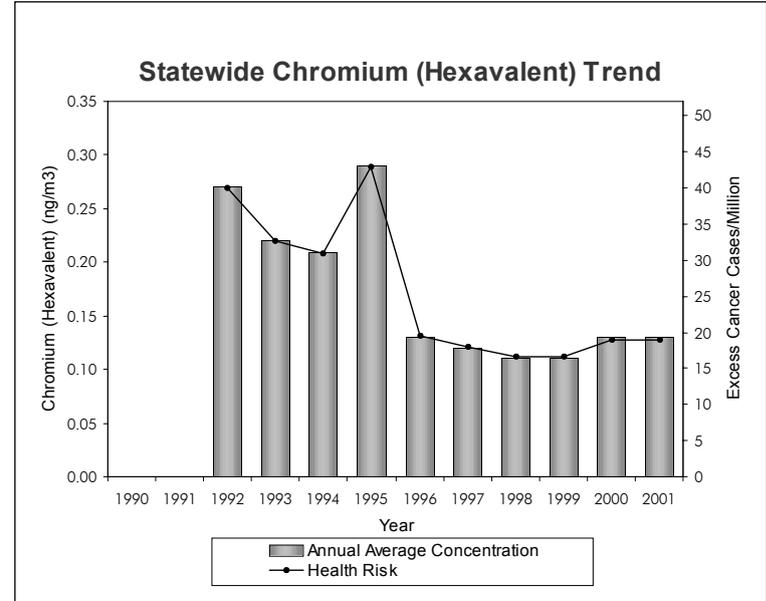


Figure 5-6

risk were 52 percent lower than they were in 1992. During 2001, there was an estimated risk of 19 excess cancer cases per million people, from chromium (hexavalent) alone. While the values for 2000 and 2001 are slightly higher than the values for 1997 through 1999, remember that the data have not been adjusted for meteorological fluctuations. Based on data for all ten TACs presented in this almanac, chromium (hexavalent) ranks sixth in terms of health risk. As with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower.

It is important to note that many of the chromium (hexavalent) measurements are below the Limit of Detection (LOD), which is the lowest concentration that can be reliably measured. The LOD for chromium (hexavalent) is 0.2 nanograms per cubic meter (ng/m^3). During 1998 through 2001, a very high percentage of the measured values were below the LOD. In calculating an annual average, values below the LOD are assumed to equal one-half the LOD. For chromium (hexavalent), one-half the LOD is $0.1 \text{ ng}/\text{m}^3$.

In 1988, the ARB adopted an airborne toxic control measure to control emissions of chromium (hexavalent) from chrome plat-

ing and chromic acid anodizing operations. The control measure contains both an interim requirement (95 percent control) and a technology-forcing requirement (99.8 percent control). In the past, compounds containing chromium (hexavalent), such as sodium dichromate or lead chromate, were added to cooling tower water to control corrosion in the towers and associated heat exchangers. The ARB adopted a statewide airborne toxic control measure in 1989 that prohibits the use of chromium (hexavalent) in cooling towers. Implementation of these control measures has helped reduce ambient concentrations and associated health risks from chromium (hexavalent).

At its September 2001 Board Hearing, the ARB approved an air toxic control measure banning the use of both chromium (hexavalent) and cadmium in motor vehicle and mobile equipment coatings. The measure becomes effective January 1, 2003, and allows a sell-through period to deplete existing inventories. Statewide, ARB estimates that 99 percent of auto body repair and refinishing facilities already use chromium-free and cadmium-free coatings. This rule will ensure additional reductions in chromium (hexavalent) exposures near those facilities that do not use chromium-free and cadmium-free coatings.

para-Dichlorobenzene 2002 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 approximately 99 percent of the statewide *para*-dichlorobenzene emissions. Stationary sources contribute approximately 1 percent. The primary stationary sources include plating and polishing of fabricated metal products, crude petroleum and natural gas extraction, and sanitary services.

para-DiChlorobenzene		
Emissions Source	tons/year	Percent
Stationary Sources	16	1%
Area-wide Sources	1807	99%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	1822	100%

Table 5-12

2002 Top Ten Counties - *para*-Dichlorobenzene

The top ten counties account for approximately 69 percent of the statewide *para*-dichlorobenzene emissions. The South Coast Air Basin has four of the top ten counties: South Coast portion of Los Angeles County (27 percent of the emissions of *para*-dichlorobenzene statewide), Orange County (8 percent), South Coast portion of San Bernardino County (4 percent), and South Coast portion of Riverside County (4 percent). Collectively, approximately 43 percent of statewide *para*-dichlorobenzene emissions occur in the South Coast Air Basin. San Diego County contributes approximately 8 percent. Three counties in the San Francisco Bay Area Air Basin contribute approximately 12 percent: Santa Clara County (5 percent), Alameda County (4 percent), and Contra Costa County (3 percent). The two other counties in the top ten for *para*-dichlorobenzene emissions are Sacramento and Fresno.

para-DiChlorobenzene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	489	27%
San Diego	San Diego	154	8%
Orange	South Coast	153	8%
Santa Clara	San Francisco Bay Area	91	5%
Alameda	San Francisco Bay Area	76	4%
San Bernardino	South Coast	70	4%
Riverside	South Coast	66	4%
Sacramento	Sacramento Valley	65	4%
Contra Costa	San Francisco Bay Area	49	3%
Fresno	San Joaquin Valley	44	2%

Table 5-13

para-Dichlorobenzene

Air Quality and Health Risk

The ARB routinely monitors for *para*-dichlorobenzene, and statewide annual average concentrations and health risk estimates are available for the years 1991 through 1997, 2000, and 2001. No summary data are available for 1998 and 1999 because of problems with laboratory equipment and associated data reliability.

Para-dichlorobenzene values have remained fairly constant over the trend period, showing very little change. The variations that are present are probably caused by year-to-year variations in meteorology rather than substantial changes in emissions. Figure 5-7 shows the annual average statewide *para*-dichlorobenzene concentrations and the associated health risk from *para*-dichlorobenzene alone. As with all air pollutants, the health risk is not spread evenly throughout the State. In some areas, the health risk is higher than the statewide average, while in other areas the health risk is lower. During 2001, there was an estimated risk of 10 excess cancer cases per million people, from this compound alone. Based on this, *para*-dichlorobenzene ranks seventh out of the ten compounds presented in this almanac.

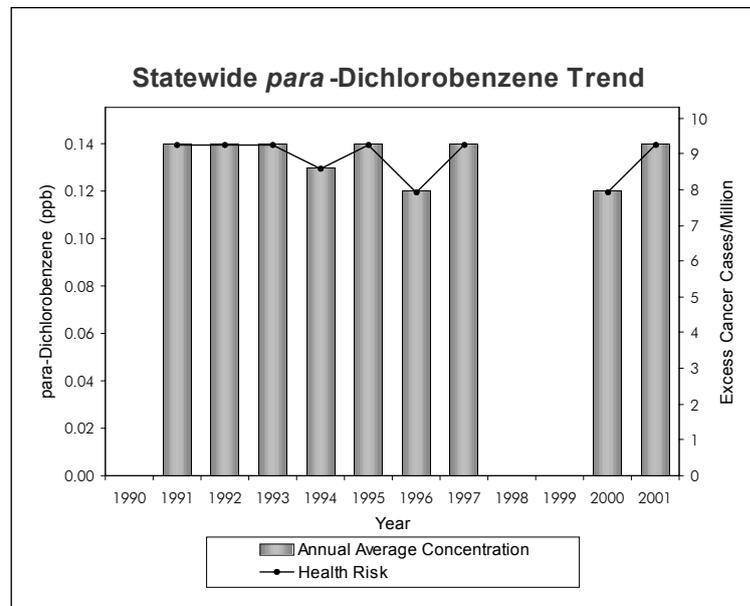


Figure 5-7

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Formaldehyde

2002 Statewide Emission Inventory

The ARB identified formaldehyde as a TAC in 1992 under California's TAC program (AB 1807). 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. 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 antimicrobial agent, and is also used in fumigants and soil disinfectants. About 78 percent of direct formaldehyde emissions are estimated to come from the combustion of fossil fuels from mobile sources. Approximately 29 percent of the total statewide formaldehyde emissions can be attributed to on-road motor vehicles, with an additional 48 percent attributed to other mobile sources such as aircraft,

Formaldehyde		
Emissions Source	tons/year	Percent
Stationary Sources	2871	14%
Area-wide Sources	1976	9%
On-Road Mobile	6035	29%
Gasoline Vehicles	4133	20%
Diesel Vehicles	1901	9%
Other Mobile	10150	48%
Natural Sources	0	0%
Total Statewide	21033	100%

Table 5-14

recreational boats, and construction and mining equipment. Area-wide sources contribute approximately 9 percent and stationary sources contribute approximately 14 percent of the statewide formaldehyde emissions. The primary area-wide sources in California of formaldehyde emissions include the wood burning in residential fireplaces and wood stoves.

2002 Top Ten Counties - Formaldehyde

The top ten counties account for approximately 51 percent of the statewide formaldehyde emissions. The South Coast Air Basin has four of the top ten counties emitting formaldehyde: South Coast portion of Los Angeles County (15 percent of the emissions of formaldehyde statewide), Orange County (5 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 26 percent of statewide formaldehyde emissions occur in the South Coast Air Basin. The six other counties in the top ten for formaldehyde emissions are San Diego, Kern, Santa Clara, Alameda, Fresno, and Santa Barbara. These six counties account for approximately 26 percent of statewide formaldehyde emissions.

Formaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	3173	15%
Kern	San Joaquin Valley	1530	7%
San Diego	San Diego	1362	6%
Orange	South Coast	1019	5%
Santa Clara	San Francisco Bay Area	720	3%
Alameda	San Francisco Bay Area	631	3%
Fresno	San Joaquin Valley	599	3%
Santa Barbara	South Central Coast	597	3%
Riverside	South Coast	567	3%
San Bernardino	South Coast	561	3%

Table 5-15

Formaldehyde

Air Quality and Health Risk

The ARB routinely monitors formaldehyde concentrations in the ambient air. While the trend graph for formaldehyde shows a great deal of variability, there is a general drop in ambient concentrations and health risk (excess cancer cases) during 1990 through 1992. Following this, there is a general increase until 1996 and then a general decrease, with much variability, from 1996 to 2001. Because of the variability in the data, it will be several more years before we can determine the overall nature of the trend.

Although data are shown for all years during the trend period, the values prior to 1996 are uncertain. The data analyzed prior to 1996 were based on a method that underestimated the actual concentrations. A method change in 1996 corrected this problem. However, 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. Since 1996, the statewide annual average concentrations and health risk have declined about 6 percent. While formaldehyde is emitted by

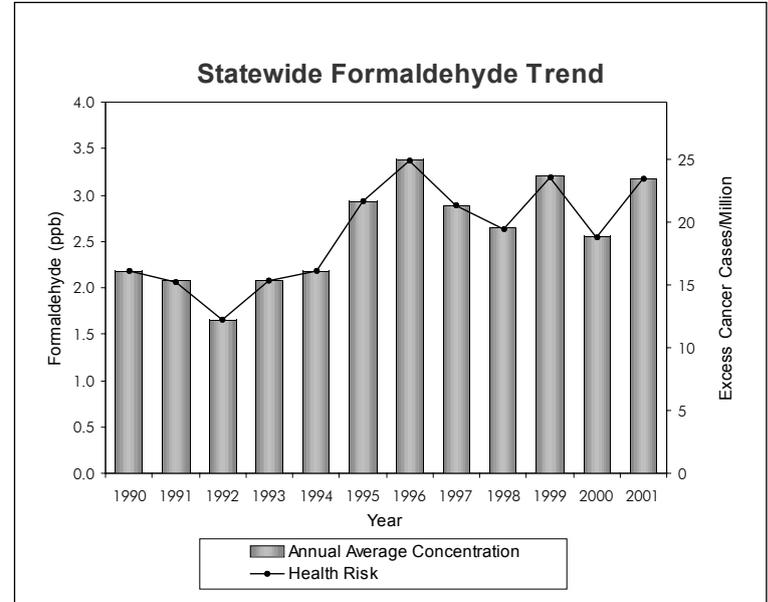


Figure 5-8

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. With these reductions should come lower ambient outdoor concentrations and a lowered health risk from formaldehyde exposure.

While ambient outdoor formaldehyde concentrations are expected to decline, formaldehyde concentrations indoors are generally higher. 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.

Methylene Chloride

2002 Statewide Emission Inventory

The ARB identified methylene chloride as a Toxic Air Contaminant (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. Although methylene chloride is used in some aerosol consumer products (e.g., aerosol paints and automotive products), most consumer product manufacturers have voluntarily phased out its use. 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 52 percent of the statewide methylene chloride emissions. Area-wide sources contribute approximately 48 percent.

Methylene Chloride		
Emissions Source	tons/year	Percent
Stationary Sources	4042	52%
Area-wide Sources	3697	48%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	7739	100%

Table 5-16

The primary area-wide sources include consumer products such as paint removers and strippers and automotive brake cleaners.

2002 Top Ten Counties - Methylene Chloride

The top ten counties account for approximately 77 percent of the statewide methylene chloride emissions. The South Coast Air Basin has four of the top ten counties emitting methylene chloride: South Coast portion of Los Angeles County (33 percent of the emissions of methylene chloride statewide), Orange County (13 percent), South Coast portion of San Bernardino County (6 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 55 percent of statewide methylene chloride emissions occur in the South Coast Air Basin. Two counties in the San Francisco Bay Area Air Basin contribute approximately 9 percent: Santa Clara County (6 percent), and Alameda County (3 percent). The four other counties in the top ten for methylene chloride emissions are San Diego, Sacramento, Fresno and Ventura. Together, these three counties account for approximately 11 percent of statewide methylene chloride emissions.

Methylene Chloride			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	2580	33%
Orange	South Coast	1021	13%
Santa Clara	San Francisco Bay Area	458	6%
San Bernardino	South Coast	456	6%
San Diego	San Diego	393	5%
Alameda	San Francisco Bay Area	265	3%
Riverside	South Coast	253	3%
Sacramento	Sacramento Valley	182	2%
Ventura	South Central Coast	169	2%
Fresno	San Joaquin Valley	150	2%

Table 5-17

Methylene Chloride

Air Quality and Health Risk

The ARB routinely monitors methylene chloride in the ambient air. The trend graph in Figure 5-9 shows some variability, particularly during the early years. However, there is an overall downward trend. The statewide annual average concentrations and health risk have dropped nearly 67 percent since 1990. 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. During 2001, there was an estimated risk of 1 excess cancer case per million people.

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. Because methylene chloride is also a constituent in many consumer products, including aerosol paints and automotive products, short-term indoor concentrations may be several orders of magnitude higher than the ambient outdoor concentrations. Many manufacturers of consumer products are voluntarily phasing-out their use of methylene chloride. In addition, in the case of aerosol

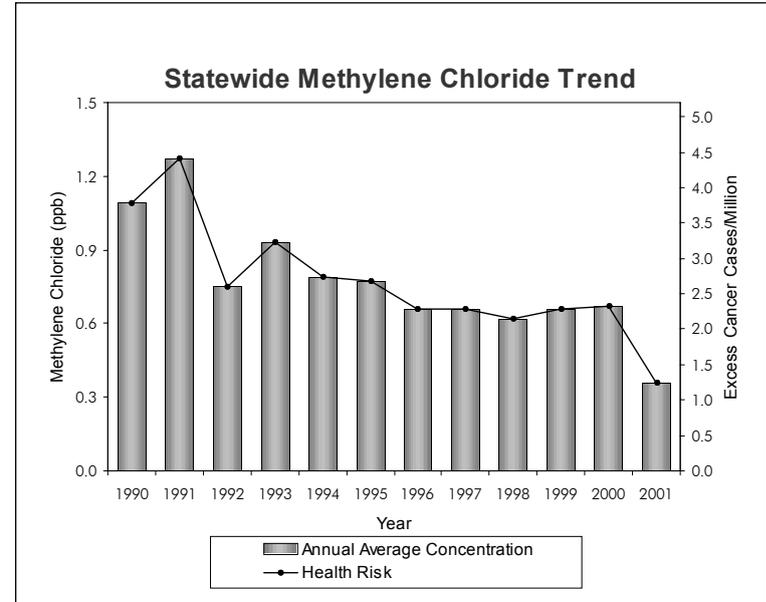


Figure 5-9

paints, use will be restricted by a provision in the ARB's "Regulation for Reducing Volatile Organic Compound (VOC) Emissions from Aerosol Coating Products," adopted in March 1995. These regulations should help to further reduce ambient outdoor concentrations and health risks.

Perchloroethylene

2002 Statewide Emission Inventory

The ARB identified perchloroethylene as a Toxic Air Contaminant (TAC) in 1991 under California's TAC program (AB 1807). 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 64 percent of the statewide emissions of perchloroethylene. Area-wide sources contribute approximately 36 percent. The primary area-wide sources include consumer products such as automotive brake cleaners and tire sealants and inflators.

Perchloroethylene		
Emissions Source	tons/yr	Percent
Stationary Sources	3828	64%
Area-wide Sources	2199	36%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	6027	100%

Table 5-18

2002 Top Ten Counties - Perchloroethylene

The top ten counties account for approximately 71 percent of the statewide perchloroethylene emissions. The South Coast Air Basin has four of the top ten counties emitting perchloroethylene: South Coast portion of Los Angeles County (30 percent of the emissions of perchloroethylene statewide), Orange County (10 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 46 percent of statewide perchloroethylene emissions occur in the South Coast Air Basin. San Diego County contributes approximately 10 percent. The five other counties in the top ten for perchloroethylene emissions are Santa Clara, Sacramento, Alameda, Fresno and San Francisco. These five counties account for approximately 14 percent of statewide perchloroethylene emissions.

Perchloroethylene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1783	30%
Orange	South Coast	625	10%
San Diego	San Diego	624	10%
Santa Clara	San Francisco Bay Area	226	4%
San Bernardino	South Coast	199	3%
Sacramento	Sacramento Valley	197	3%
Alameda	San Francisco Bay Area	191	3%
Riverside	South Coast	173	3%
Fresno	San Joaquin Valley	136	2%
San Francisco	San Francisco Bay Area	114	2%

Table 5-19

Perchloroethylene

Air Quality and Health Risk

The ARB routinely monitors perchloroethylene concentrations in the ambient air. The trend graph for perchloroethylene shows some variability, probably caused by year-to-year changes in meteorology. However, there is an overall downward trend. Since 1990, the statewide annual average concentrations and health risk have dropped about 68 percent. Figure 5-10 shows the annual average statewide perchloroethylene concentrations and the associated health risk for 1990 through 1998 and for 2000 through 2001, the years for which complete and representative data are available. 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 2001, there was an estimated chance of 4 excess cancer cases per million people.

When the ARB identified perchloroethylene as a TAC in October 1991, the ARB estimated that 60 percent of perchloroethylene came from dry cleaning operations. Examination of industry practices suggested the potential for

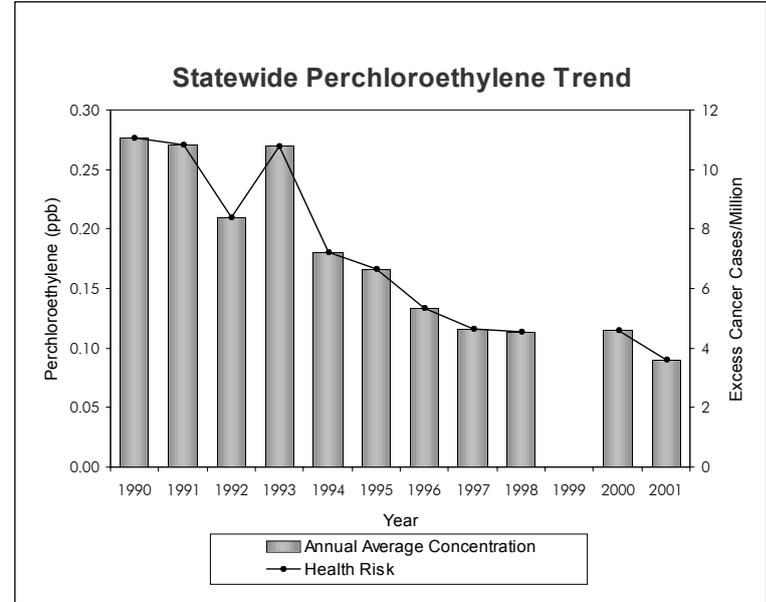


Figure 5-10

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 October 1993. The final deadline for compliance was 1998. In addition to requiring emission controls, the ARB has worked with the industry to provide training for industry personnel on improved practices and methods for reducing emissions. In the near future, the most significant factor affecting emissions will most likely be a continued reduction as more dry cleaning operations modify or replace older equipment. In the long-term, increasing population in California may lead to increased demand for services and products using perchloroethylene. Barring future control measures, this could eventually lead to increased emissions.

Diesel Particulate Matter

2002 Statewide Emission Inventory

The ARB identified the particulate matter (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.

Diesel PM is emitted from both mobile and stationary sources. In California, on-road diesel-fueled vehicles contribute approximately 23 percent of statewide total, with an additional 67 percent attributed to other mobile sources such as construction and mining equipment, agricultural equipment, and transport refrigeration units. Stationary sources, contributing about 10 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 diesel PM emission estimates differ from those presented in the ARB's October 2000 report enti-

Diesel PM		
Emissions Source	tons/year	Percent
Stationary Sources	2492	10%
Area-wide Sources	0	0%
On-Road Mobile	6023	23%
Gasoline Vehicles	0	0%
Diesel Vehicles	6023	23%
Other Mobile	17163	67%
Natural Sources	0	0%
Total Statewide	25678	100%

Table 5-20

tled: "*Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*" (Diesel Risk Reduction Plan). This is because they incorporate more recent data. More specifically, the on-road mobile source emissions cited in the Diesel Risk Reduction Plan are based on an earlier version of EMFAC 2001 (EMFAC 1.99(f) 6/26/00) and the other mobile inventory includes revised estimates for ship diesel PM emissions. We will continue to refine estimates of diesel PM emissions as we develop the regulations identified in the Diesel Risk Reduction Plan. Even with these differences, the statewide emission estimates for diesel PM compare favorably.

2002 Top Ten Counties - Diesel Particulate Matter

The top ten counties account for approximately 57 percent of the statewide diesel particulate matter emissions. The South Coast Air Basin has three of the top ten counties emitting diesel particulate matter: South Coast portion of Los Angeles County (18 percent of the emissions of diesel particulate matter statewide), Orange County (7 percent), and South Coast portion of Riverside County (4 percent). Collectively, approximately 29 percent of statewide diesel particulate matter emissions occur in the South Coast Air Basin. San Diego County contributes approximately 7 percent, and Fresno County contributes approximately 5 percent. Three counties in the San Francisco Bay Area Air Basin contribute 11 percent: Alameda (4 percent), Santa Clara (4 percent), and San Francisco (3 percent). The San Joaquin Valley portion of Kern County and Sacramento County contribute the remainder.

Diesel PM			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	4563	18%
Orange	South Coast	1822	7%
San Diego	San Diego	1800	7%
Fresno	San Joaquin Valley	1157	5%
Alameda	San Francisco Bay Area	976	4%
Santa Clara	San Francisco Bay Area	971	4%
Riverside	South Coast	907	4%
Kern	San Joaquin Valley	898	3%
San Francisco	San Francisco Bay Area	848	3%
Sacramento	Sacramento Valley	784	3%

Table 5-21

Diesel Particulate Matter

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 governments as toxic air contaminants or hazardous air pollutants. Most researchers believe that diesel particulate matter contributes the majority of the risk from exposure to diesel exhaust because the particles carry many of the harmful organics and metals present in exhaust.

Unlike the other toxic air contaminants presented in this almanac, the Air Resources Board does not monitor diesel particulate matter because there is no routine method for monitoring ambient concentrations. However, the ARB made a preliminary estimation of diesel particulate matter concentrations for the State's fifteen air basins and for the State as a whole using a particulate matter-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 particulate matter. The ARB

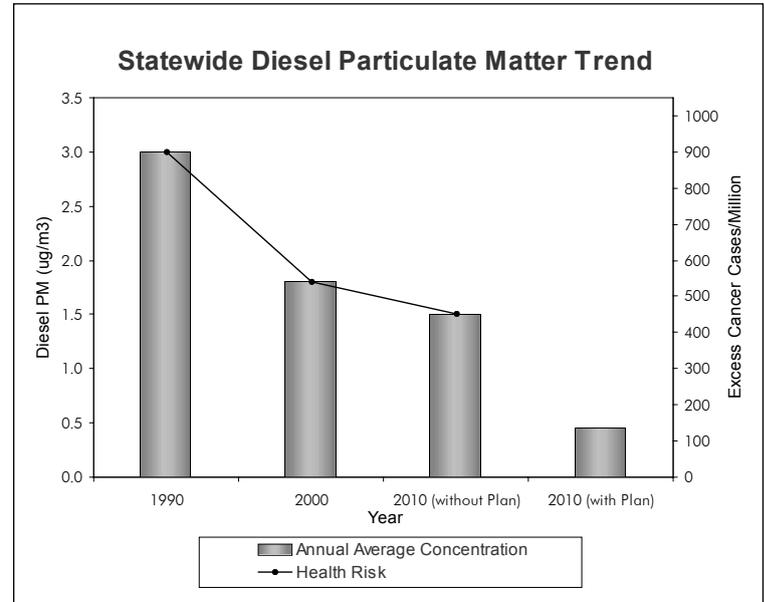


Figure 5-11

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 report entitled: *“Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles,”* (Risk Reduction Plan or Plan) dated October 2000.

The updated statewide population-weighted average diesel PM concentrations and health risk for various years are shown in Figure 5-11. 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. In addition to the 1990 estimate, the ARB estimated population-weighted concentrations for 2000 and 2010. Two estimates are given for 2010: one reflecting the estimated ambient concentrations without implementing the Risk Reduction Plan and one reflecting the estimated ambient concentrations with implementation of control measures in the Risk Reduction Plan. These future year estimates are based on linear extrapolations from the 1990 emissions inventory and linear rollback techniques. 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. It is

important to note that the estimated risk from diesel PM is higher than the risk from all other toxic air contaminants combined, and this TAC poses the most significant risk to California's citizens. In fact, the ARB estimates that 70 percent of the known statewide cancer risk from outdoor air toxics is attributable to diesel particulate matter.

The Risk Reduction Plan provides a mechanism for combating the diesel PM problem. Without implementing the Plan, concentrations in 2010 are estimated to drop by only about 17 percent from the estimated year 2000 level. However, implementing control measures in the Plan serves to reduce concentrations by 75 percent over the same timeframe. The key elements of the Plan are to clean existing engines by up to 85 percent through engine retrofits, to adopt stringent new standards that will reduce diesel particulate matter by over 90 percent, 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 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 particulate matter concentrations and associated health risk should continue to decline.

South Coast Air Basin 2002 Emission Inventory by Compound

Acetaldehyde

Approximately 93 percent of the emissions of acetaldehyde are from mobile sources.

South Coast - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	19	1%	0%
Area-wide Sources	84	5%	1%
On-Road Mobile	623	38%	8%
Gasoline Vehicles	319	20%	4%
Diesel Vehicles	304	19%	4%
Other Mobile	906	55%	12%
Natural Sources	0	0%	0%
Total	1633	100%	22%
Total Statewide	7543		

Table 5-22

Benzene

The primary sources of benzene emissions in the South Coast Air Basin are mobile sources (approximately 87 percent).

South Coast - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	508	12%	4%
Area-wide Sources	43	1%	0%
On-Road Mobile	2689	62%	19%
Gasoline Vehicles	2607	60%	19%
Diesel Vehicles	83	2%	1%
Other Mobile	1104	25%	8%
Natural Sources	0	0%	0%
Total	4344	100%	31%
Total Statewide	13912		

Table 5-23

1,3-Butadiene

Approximately 93 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	4	0%	0%
Area-wide Sources	39	5%	1%
On-Road Mobile	554	65%	17%
Gasoline Vehicles	546	64%	17%
Diesel Vehicles	8	1%	0%
Other Mobile	237	28%	7%
Natural Sources	17	2%	1%
Total	852	100%	27%
Total Statewide	3180		

Table 5-24

Carbon Tetrachloride

Stationary sources such as chemical and allied product 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	1.95	100%	56%
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%
Natural Sources	0	0%	0%
Total	1.95	100%	56%
Total Statewide	3.48		

Table 5-25

Chromium (Hexavalent)

Approximately 85 percent of the chromium (hexavalent) emissions are from stationary sources such as electrical generation, aircraft and parts manufacturing, and fabricated metal product manufacturing.

South Coast - Chromium (Hexavalent)			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.48	85%	31%
Area-wide Sources	0	0%	0%
On-Road Mobile	0.05	8%	2%
Gasoline Vehicles	0.05	8%	2%
Diesel Vehicles	<0.01	0%	0%
Other Mobile	0.04	6%	2%
Natural Sources	<0.01	0%	0%
Total	0.57	100%	22%
Total Statewide	2.56		

Table 5-26

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	9	1%	0%
Area-wide Sources	769	99%	42%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	778	100%	43%
Total Statewide	1822		

Table 5-27

Formaldehyde

Approximately 81 percent of the formaldehyde emissions are from mobile sources.

Methylene Chloride

Approximately 64 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 - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	808	15%	4%
Area-wide Sources	175	3%	1%
On-Road Mobile	2086	39%	10%
Gasoline Vehicles	1478	28%	7%
Diesel Vehicles	608	11%	3%
Other Mobile	2252	42%	11%
Natural Sources	0	0%	0%
Total	5321	100%	25%
Total Statewide	21033		

Table 5-28

South Coast - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	2745	64%	35%
Area-wide Sources	1565	36%	20%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	4310	100%	56%
Total Statewide	7739		

Table 5-29

Perchloroethylene

Approximately 66 percent of the emissions of perchloroethylene are from dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

Diesel Particulate Matter

Approximately 93 percent of emissions of diesel particulate matter are from mobile sources.

South Coast - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1844	66%	31%
Area-wide Sources	936	34%	16%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	2780	100%	46%
Total Statewide	6027		

South Coast - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	538	7%	2%
Area-wide Sources	0	0%	0%
On-Road Mobile	2026	25%	8%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	2026	25%	8%
Other Mobile	5470	68%	21%
Natural Sources	0	0%	0%
Total	8034	100%	31%
Total Statewide	25678		

Table 5-30

Table 5-31

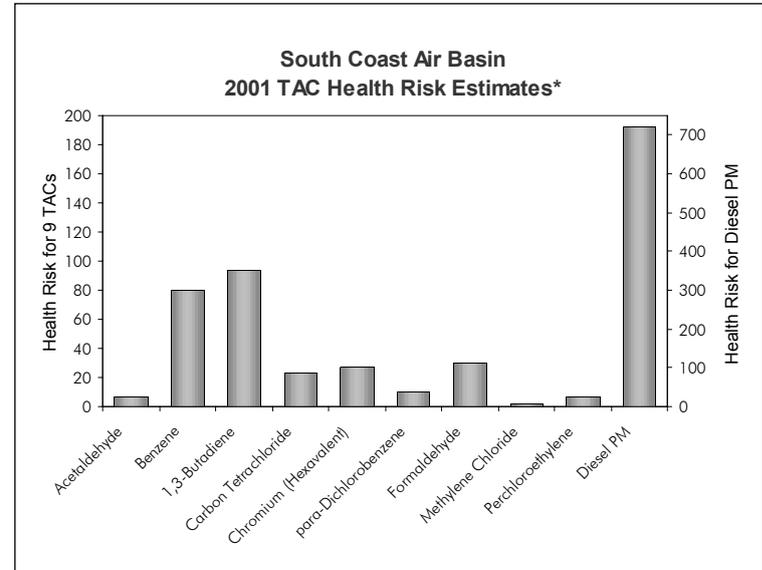
South Coast Air Basin

Air Quality and Health Risk

From 1990 through 2001, the ARB monitored ambient toxics concentrations 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 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, and this site is now part of the statewide ambient TAC monitoring network.

Figure 5-12 shows the estimated annual average health risks for the nine TACs with measured ambient data. As indicated on the graph, the health risk numbers for eight of the nine TACs reflect the year 2001, the most recent year for which complete and representative data are available. Also included are estimates of health risk for chromium (hexavalent) and diesel particulate matter which reflect the year 2000.

Based on the estimate of health risk for diesel particulate matter, this TAC presents the most significant risk of the ten TACs.



* Data for Chromium (Hexavalent) and Diesel PM reflect 2000; data for all other TACs reflect 2001.

Figure 5-12

The estimated health risk is 720 excess cancer cases per million people. This is higher than the average statewide health risk for diesel PM.

Although much smaller by comparison, 1,3-butadiene and benzene also pose substantial health risks as shown in Figure 5-12 and Table 5-32. However, it is important to remember that the health risks shown here are based on an annual average concentration (calculated as a mean of the monthly means) for all sites in the air basin. The health risk at individual locations may be higher or lower than the average for the air basin, depending on the impact of nearby sources. While the average health risks for several of the TACs are high, there have been substantial reductions in concentrations and associated health risks since 1990. Benzene shows the largest reduction (about 75 percent) while perchloroethylene, methylene chloride, chromium (hexavalent), and 1,3-butadiene all show reductions of more than 50 percent. The estimates for diesel particulate matter show a 33 percent decrease between 1990 and the year 2000. The reductions for all six of these TACs are similar to the average statewide reductions. However, it is important to note that although the percent reductions are similar, the annual averages and associated health risks for almost all the TACs are higher for the South Coast Air Basin than they are statewide. Furthermore, there

may be other compounds that pose a significant risk but are not monitored. Reductions in ambient TAC concentrations and health risks should continue, as new rules and regulations are implemented to control toxic air contaminants.

South Coast Air Basin

Annual Average Concentrations and Health Risks

South Coast Air Basin Toxic Air Contaminants - Annual Average Concentrations and Health Risks													
TAC*	Conc./ Risk	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Acetaldehyde	Annual Avg	2.46	3.00	2.46	2.67	2.30	0.97	2.08	1.77	1.54	1.63	1.26	1.47
	Health Risk	12	15	12	13	11	5	10	9	7	8	6	7
Benzene	Annual Avg	3.42	2.91	2.61	2.17	2.40	1.89	1.45	1.34	1.25	1.20	0.97	0.86
	Health Risk	317	269	242	201	222	175	134	124	116	111	90	80
1,3-Butadiene	Annual Avg	0.53	0.45	0.50	0.57	0.50	0.46	0.39	0.38	0.35	0.33	0.25	0.25
	Health Risk	200	170	187	212	187	173	146	142	133	123	94	94
Carbon Tetrachloride	Annual Avg	0.14	0.13		0.11		0.10	0.08		0.11		0.10	0.09
	Health Risk	36	35		28		27	21		30		25	23
Chromium (Hexavalent)	Annual Avg			0.39	0.29	0.29	0.46	0.18	0.17	0.15	0.14	0.18	
	Health Risk			59	43	43	69	27	25	22	22	27	
<i>para</i> -Dichlorobenzene	Annual Avg		0.17	0.19	0.17	0.13	0.17	0.11	0.13			0.13	0.15
	Health Risk		11	13	11	8	11	7	9			9	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
	Health Risk	22	23	16	24	23	26	37	33	28	30	23	30
Methylene Chloride	Annual Avg	1.86	1.51	0.90	1.23	1.10	1.28	0.95	1.14	0.85	0.92	0.83	0.63
	Health Risk	6	5	3	4	4	4	3	4	3	3	3	2
Perchloroethylene	Annual Avg	0.58	0.55	0.41	0.45	0.39	0.36	0.32	0.27	0.26		0.21	0.18
	Health Risk	23	22	16	18	16	15	13	11	10		8	7
Diesel Particulate Matter**	Annual Avg	(3.6)					(2.7)					(2.4)	
	Health Risk	(1080)					(810)					(720)	
Average Basin Risk***	Without Diesel PM	616	550	548	554	514	505	398	357	349	297	285	253
	With Diesel PM	(1696)					(1315)					(1005)	

* Concentrations for Chromium (Hexavalent) 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.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** 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*.

Table 5-32

San Francisco Bay Area Air Basin 2002 Emission Inventory by Compound

Acetaldehyde

Approximately 78 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	28	2%	0%
Area-wide Sources	279	20%	4%
On-Road Mobile	356	26%	5%
Gasoline Vehicles	172	12%	2%
Diesel Vehicles	183	13%	2%
Other Mobile	727	52%	10%
Natural Sources	0	0%	0%
Total	1390	100%	18%
Total Statewide	7543		

Table 5-33

Benzene

Mobile sources are the primary sources of benzene emissions in the San Francisco Bay Area Air Basin (approximately 91 percent).

San Francisco Bay Area - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	202	9%	1%
Area-wide Sources	17	1%	0%
On-Road Mobile	1468	64%	11%
Gasoline Vehicles	1418	62%	10%
Diesel Vehicles	50	2%	0%
Other Mobile	615	27%	4%
Natural Sources	0	0%	0%
Total	2302	100%	17%
Total Statewide	13912		

Table 5-34

1,3-Butadiene

Essentially all 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	4	1%	0%
Area-wide Sources	2	0%	0%
On-Road Mobile	306	61%	10%
Gasoline Vehicles	301	60%	9%
Diesel Vehicles	5	1%	0%
Other Mobile	191	38%	6%
Natural Sources	1	0%	0%
Total	504	100%	16%
Total Statewide	3180		

Table 5-35

Carbon Tetrachloride

Stationary sources such as chemical and allied product manufacturers 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	1.31	100%	38%
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%
Natural Sources	0	0%	0%
Total	1.31	100%	38%
Total Statewide	3.48		

Table 5-36

Chromium (Hexavalent)

Approximately 65 percent of the chromium (hexavalent) emissions are from other mobile sources. Stationary sources such as electrical generation and fabricated metal product manufacturing contribute approximately 29 percent.

San Francisco Bay Area - Chromium (Hexavalent)			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.11	29%	4%
Area-wide Sources	0	0%	0%
On-Road Mobile	0.02	6%	1%
Gasoline Vehicles	0.02	6%	1%
Diesel Vehicles	<0.01	0%	0%
Other Mobile	0.25	65%	10%
Natural Sources	<0.01	0%	0%
Total	0.39	100%	15%
Total Statewide	2.56		

Table 5-37

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	0%	0%
Area-wide Sources	350	100%	19%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	351	100%	19%
Total Statewide	1822		

Table 5-38

Formaldehyde

Approximately 85 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	173	5%	1%
Area-wide Sources	336	9%	2%
On-Road Mobile	1160	32%	6%
Gasoline Vehicles	793	22%	4%
Diesel Vehicles	367	10%	2%
Other Mobile	1912	53%	9%
Natural Sources	0	0%	0%
Total	3580	100%	17%
Total Statewide	21033		

Table 5-39

Methylene Chloride

Approximately 55 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	587	45%	8%
Area-wide Sources	715	55%	9%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	1302	100%	17%
Total Statewide	7739		

Table 5-40

Perchloroethylene

Approximately 51 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Diesel Particulate Matter

Emissions of diesel particulate matter are primarily all from mobile sources.

San Francisco Bay Area - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	445	51%	7%
Area-wide Sources	426	49%	7%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	870	100%	14%
Total Statewide	6027		

Table 5-41

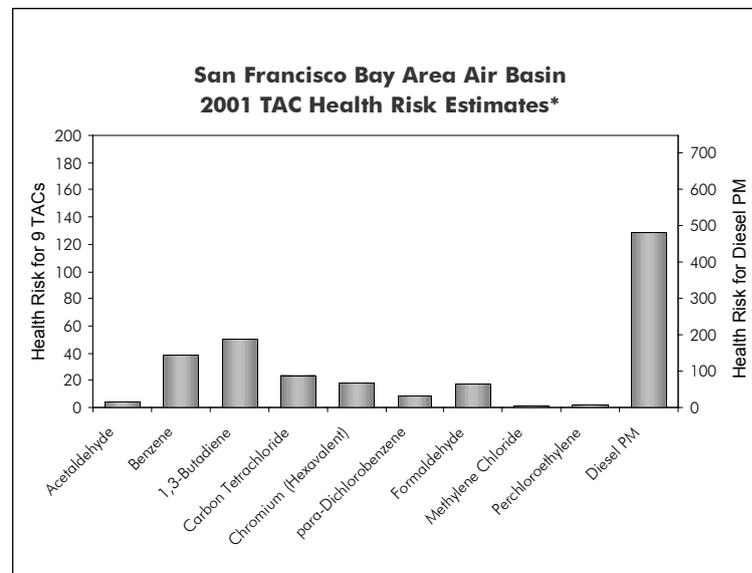
San Francisco Bay Area - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	315	7%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	1165	25%	5%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1165	25%	5%
Other Mobile	3255	69%	13%
Natural Sources	0	0%	0%
Total	4735	100%	18%
Total Statewide	25678		

Table 5-42

San Francisco Bay Area Air Basin Air Quality and Health Risk

Over the last twelve years, the ARB has monitored ambient TAC concentrations at six sites in the San Francisco Bay Area Air Basin. Data for the entire time period are available from sites located in Fremont, San Francisco, and San Jose. Data are also available from a site in 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.

Figure 5-13 and Table 5-43 show the estimated annual average health risks for the San Francisco Bay Area Air Basin. The health risk estimates for eight of the TACs that are measured in the ambient air reflect 2001, the most recent year with complete and representative data. In contrast, the health risk estimates for chromium (hexavalent) and diesel particulate matter reflect the year 2000. Of the ten TACs considered in this almanac, diesel particulate matter poses the greatest health risk



* Data for Chromium (Hexavalent) and Diesel PM reflect 2000; data for all other TACs reflect 2001.

Figure 5-13

in this air basin, 480 excess cancer cases per million people exposed over a 70-year lifetime. This is lower than the estimated statewide value for the same year.

Two other TACs, 1,3-butadiene and benzene, also pose substantial health risks. Again, however, it is important to remember that the health risks shown here are based on an average concentration for the entire air basin, and the health risk at individual locations may be higher or lower. Of those TACs included in Figure 5-13, benzene, methylene chloride, perchloroethylene, and 1,3-butadiene all show reductions of 63 percent or more. In most cases, both the average TAC concentration and the average health risk for the San Francisco Bay Area Air Basin are lower than the statewide averages and generally, are much lower than those for the South Coast Air Basin. However, it is important to note that there may be other compounds that pose a significant risk but are not monitored. Nearly all the compounds show some reduction over the time period, and the reduction for several compounds is fairly substantial. These reductions should continue as additional control measures are implemented.

San Francisco Bay Area Air Basin Annual Average Concentrations and Health Risks

San Francisco Bay Area Air Basin Toxic Air Contaminants - Annual Average Concentrations and Health Risks													
TAC*	Conc./ Risk	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Acetaldehyde	Annual Avg	1.30	1.40	1.03	1.31	1.17	0.42	0.83	0.73	0.65	0.76	0.68	0.73
	Health Risk	6	7	5	6	6	2	4	4	3	4	3	4
Benzene	Annual Avg	2.18	1.82	1.49	1.49	1.40	1.26	0.71	0.61	0.71	0.60	0.56	0.43
	Health Risk	202	169	138	138	129	116	66	56	66	55	52	39
1,3-Butadiene	Annual Avg	0.36	0.29	0.28	0.37	0.29	0.28	0.22	0.19	0.22	0.17	0.15	0.13
	Health Risk	135	108	103	138	108	104	82	70	82	64	56	50
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08				0.09	0.09
	Health Risk	34	33		29		26	21				25	23
Chromium (Hexavalent)	Annual Avg			0.23	0.20	0.19	0.25	0.13	0.12	0.10	0.10	0.12	
	Health Risk			34	29	29	37	19	17	15	15	18	
<i>para</i> -Dichlorobenzene	Annual Avg		0.12	0.12	0.12	0.11	0.13	0.14	0.12			0.11	0.14
	Health Risk		8	8	8	7	8	9	8			7	9
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
	Health Risk	14	13	11	11	12	15	19	14	13	15	13	17
Methylene Chloride	Annual Avg	1.04	2.32	0.65	0.72	0.59	0.60	0.58	0.55			0.53	0.27
	Health Risk	4	8	2	2	2	2	2	2			2	1
Perchloroethylene	Annual Avg	0.20	0.23	0.17	0.13	0.08	0.09	0.07	0.07			0.08	0.06
	Health Risk	8	9	7	5	3	4	3	3			3	2
<i>Diesel Particulate Matter</i> **	Annual Avg	(2.5)					(1.9)					(1.6)	
	Health Risk	(750)					(570)					(480)	
Average Basin Risk ***	Without Diesel PM	403	355	308	366	296	314	225	174	179	153	179	145
	<i>With Diesel PM</i>	(1153)					(884)					(659)	

* Concentrations for Chromium (Hexavalent) 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.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** 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*.

Table 5-43

San Joaquin Valley Air Basin 2002 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 account for approximately 16 percent.

San Joaquin Valley - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	71	6%	1%
Area-wide Sources	192	16%	3%
On-Road Mobile	270	22%	4%
Gasoline Vehicles	101	8%	1%
Diesel Vehicles	168	14%	2%
Other Mobile	703	57%	9%
Natural Sources	0	0%	0%
Total	1236	100%	16%
Total Statewide	7543		

Table 5-44

Benzene

The primary sources of benzene emissions in the San Joaquin Valley Air Basin are mobile sources (approximately 67 percent) and stationary sources (approximately 33 percent).

San Joaquin Valley - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	663	33%	5%
Area-wide Sources	13	1%	0%
On-Road Mobile	843	42%	6%
Gasoline Vehicles	797	39%	6%
Diesel Vehicles	46	2%	0%
Other Mobile	508	25%	4%
Natural Sources	< 1	0%	0%
Total	2027	100%	15%
Total Statewide	13912		

Table 5-45

1,3-Butadiene

Approximately 70 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%	0%
Area-wide Sources	134	27%	4%
On-Road Mobile	175	35%	5%
Gasoline Vehicles	170	34%	5%
Diesel Vehicles	4	1%	0%
Other Mobile	173	35%	5%
Natural Sources	10	2%	0%
Total	495	100%	16%
Total Statewide	3180		

Table 5-46

Carbon Tetrachloride

Emissions of carbon tetrachloride are all from stationary sources such as chemical and allied product manufacturers.

San Joaquin Valley - Carbon Tetrachloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< .01	100%	0%
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%
Natural Sources	0	0%	0%
Total	< .01	100%	0%
Total Statewide	3.48		

Table 5-47

Chromium (Hexavalent)

Approximately 82 percent of the chromium (hexavalent) emissions are from stationary sources such as electrical generation, aircraft and parts manufacturing, and fabricated metal product manufacturing.

San Joaquin Valley - Chromium (Hexavalent)			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.29	82%	11%
Area-wide Sources	0	0%	0%
On-Road Mobile	0.01	4%	1%
Gasoline Vehicles	0.01	4%	1%
Diesel Vehicles	<0.01	0%	0%
Other Mobile	0.05	14%	2%
Natural Sources	<0.01	0%	0%
Total	0.36	100%	14%
Total Statewide	2.56		

Table 5-48

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%	0%
Area-wide Sources	175	97%	10%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	180	100%	10%
Total Statewide	1822		

Table 5-49

Formaldehyde

Approximately 68 percent of the formaldehyde emissions are from mobile sources.

San Joaquin Valley - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1007	26%	5%
Area-wide Sources	226	6%	1%
On-Road Mobile	804	21%	4%
Gasoline Vehicles	467	12%	2%
Diesel Vehicles	337	9%	2%
Other Mobile	1834	47%	9%
Natural Sources	0	0%	0%
Total	3872	100%	18%
Total Statewide	21033		

Table 5-50

Methylene Chloride

Approximately 71 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	148	29%	2%
Area-wide Sources	360	71%	5%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	508	100%	7%
Total Statewide	7739		

Table 5-51

Perchloroethylene

Approximately 59 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Diesel Particulate Matter

Emissions of diesel particulate matter are from mobile sources (approximately 79 percent) and stationary sources (approximately 21 percent).

San Joaquin Valley - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	310	59%	5%
Area-wide Sources	213	41%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	523	100%	9%
Total Statewide	6027		

San Joaquin Valley - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	966	21%	4%
Area-wide Sources	0	0%	0%
On-Road Mobile	988	21%	4%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	988	21%	4%
Other Mobile	2714	58%	11%
Natural Sources	0	0%	0%
Total	4668	100%	18%
Total Statewide	25678		

Table 5-52

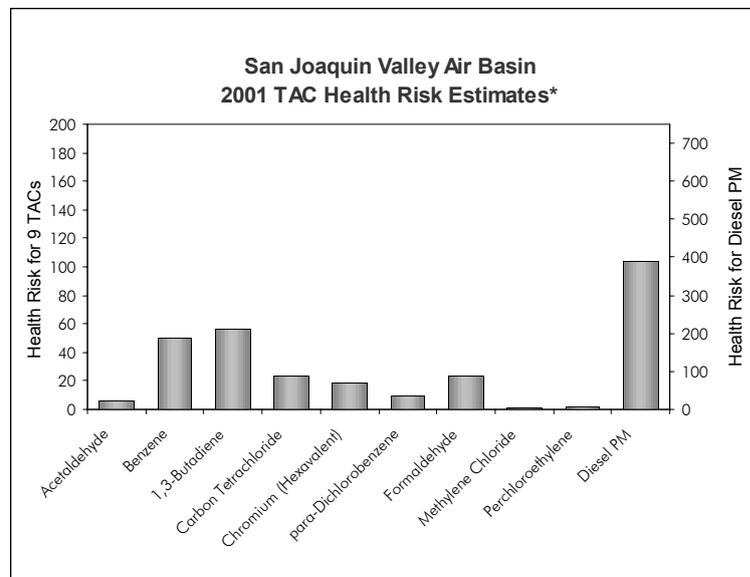
Table 5-53

San Joaquin Valley Air Basin

Air Quality and Health Risk

During the past twelve years, the ARB monitored ambient TAC concentrations at five sites in the San Joaquin Valley Air Basin. Data for all years are available for sites in Fresno and Stockton. Data are available for 1990 through 1993 at the Bakersfield-Chester Avenue site and for 1995 through 2001 at the Bakersfield-5558 California Avenue site. Complete and representative data are also available for a site in Modesto (14th Street) from 1990 through 1999. In addition, a limited amount of TAC data are available from a second site in Modesto during 1991 to 1997.

Figure 5-14 and Table 5-54 show the estimated average health risks for all the sites in the San Joaquin Valley Air Basin. As indicated on the figure, health risk numbers for eight of the TACs with measured data reflect the year 2001. The health risk for chromium (hexavalent) and for diesel particulate matter reflect the year 2000. As in all other areas of the State, the health risk for diesel PM overwhelms the other nine TACs. Based on receptor modeling techniques, the diesel PM health risk for 2000 is estimated at 390 excess cancer cases per one million people exposed over a 70-year lifetime. While this value



* Data for Chromium (Hexavalent) and Diesel PM reflect 2000; data for all other TACs reflect 2001.

Figure 5-14

is lower than the estimated statewide health risk, it is similar to values estimated for other urbanized areas of the State such as the San Francisco Bay Area Air Basin and the Sacramento Valley Air Basin.

Similar to most other areas of the State, Figure 5-14 and Table 5-54 show that of the nine remaining TACs, 1,3-butadiene and benzene pose the greatest health risk, on average, in the San Joaquin Valley Air Basin. Overall, the average concentrations and health risks from all the TACs except *para*-dichlorobenzene and formaldehyde have been reduced since 1990. Benzene, methylene chloride, 1,3-butadiene, and perchloroethylene all show more than a 60 percent reduction, and diesel PM shows a reduction equal to 50 percent. In contrast, formaldehyde concentrations and health risks show an increase of about 26 percent. This apparent increase may be related to the change in the analysis method for this TAC rather than increases in emissions. Again, as in all other areas of California, it is important to remember that there may be local source impacts, and these may be higher than the air basin averages. Furthermore, there may be other TACs that pose a significant risk in the San Joaquin Valley Air Basin but are not monitored.

San Joaquin Valley Air Basin Annual Average Concentrations and Health Risks

San Joaquin Valley Air Basin Toxic Air Contaminants - Annual Average Concentrations and Health Risks													
TAC*	Conc./ Risk	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Acetaldehyde	Annual Avg	1.94	1.84	1.38	1.73	1.29	0.54	1.28	1.19	1.30	1.56	1.09	1.15
	Health Risk	9	9	7	8	6	3	6	6	6	8	5	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	0.54
	Health Risk	227	196	126	122	123	107	68	66	71	64	58	50
1,3-Butadiene	Annual Avg	0.41	0.36	0.24	0.34	0.32	0.26	0.22	0.20	0.23	0.18	0.16	0.15
	Health Risk	154	135	89	127	121	99	83	73	88	67	59	56
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08		0.11		0.10	0.09
	Health Risk	34	34		29		26	20		30		25	23
Chromium (Hexavalent)	Annual Avg			0.23	0.21	0.19	0.28	0.13	0.11	0.10	0.10	0.12	
	Health Risk			34	31	29	42	20	16	15	15	18	
<i>para</i> -Dichlorobenzene	Annual Avg		0.11	0.11	0.13	0.11	0.11	0.10	0.13			0.11	0.13
	Health Risk		7	7	9	7	8	7	9			7	9
Formaldehyde	Annual Avg	2.45	1.81	1.46	1.67	1.80	2.10	2.96	2.77	2.86	3.44	2.61	3.08
	Health Risk	18	13	11	12	13	15	22	20	21	25	19	23
Methylene Chloride	Annual Avg	0.76	0.59	0.55	0.76	0.59	0.61	0.54	0.53	0.52	0.50	0.53	0.27
	Health Risk	3	2	2	3	2	2	2	2	2	2	2	1
Perchloroethylene	Annual Avg	0.13	0.13	0.10	0.47	0.07	0.07	0.07	0.06	0.04		0.08	0.05
	Health Risk	5	5	4	19	3	3	3	2	2		3	2
<i>Diesel Particulate Matter</i> **	Annual Avg	(2.6)					(1.7)					(1.3)	
	Health Risk	(780)					(510)					(390)	
Average Basin Risk ***	Without Diesel PM	450	401	280	360	304	305	231	194	235	181	196	170
	<i>With Diesel PM</i>	(1230)					(815)					(586)	

* Concentrations for Chromium (Hexavalent) 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.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** 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*.

Table 5-54

San Diego Air Basin 2002 Emission Inventory by Compound

Acetaldehyde

Approximately 79 percent of the emissions of acetaldehyde are from mobile sources.

San Diego - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	4	1%	0%
Area-wide Sources	103	20%	1%
On-Road Mobile	148	28%	2%
Gasoline Vehicles	73	14%	1%
Diesel Vehicles	75	14%	1%
Other Mobile	271	51%	4%
Natural Sources	0	0%	0%
Total	526	100%	7%
Total Statewide	7543		

Table 5-55

Benzene

The primary sources of benzene emissions in the San Diego Air Basin are mobile sources (approximately 97 percent).

San Diego - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	30	3%	0%
Area-wide Sources	3	0%	0%
On-Road Mobile	611	65%	4%
Gasoline Vehicles	591	62%	4%
Diesel Vehicles	20	2%	0%
Other Mobile	302	32%	2%
Natural Sources	0	0%	0%
Total	947	100%	7%
Total Statewide	13912		

Table 5-56

1,3-Butadiene

Approximately 95 percent of the emissions of 1,3-butadiene are from mobile sources.

San Diego - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< 1	0%	0%
Area-wide Sources	4	2%	0%
On-Road Mobile	127	57%	4%
Gasoline Vehicles	125	56%	4%
Diesel Vehicles	2	1%	0%
Other Mobile	85	38%	3%
Natural Sources	8	4%	0%
Total	224	100%	7%
Total Statewide	3180		

Table 5-57

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%	3%
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%
Natural Sources	0	0%	0%
Total	0.09	100%	3%
Total Statewide	3.48		

Table 5-58

Chromium (Hexavalent)

Approximately 62 percent of the chromium (hexavalent) emissions are from other mobile sources. Stationary sources account for approximately 34 percent.

para-Dichlorobenzene

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

San Diego - Chromium (Hexavalent)			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.10	34%	4%
Area-wide Sources	0	0%	0%
On-Road Mobile	0.01	4%	0%
Gasoline Vehicles	0.01	4%	0%
Diesel Vehicles	<0.01	0%	0%
Other Mobile	0.18	62%	7%
Natural Sources	<0.01	0%	0%
Total	0.29	100%	11%
Total Statewide	2.56		

Table 5-59

San Diego - <i>para</i> -DiChlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0	0%	0%
Area-wide Sources	154	100%	8%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	154	100%	8%
Total Statewide	1822		

Table 5-60

Formaldehyde

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

San Diego - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	21	2%	0%
Area-wide Sources	118	9%	1%
On-Road Mobile	492	36%	2%
Gasoline Vehicles	342	25%	2%
Diesel Vehicles	150	11%	1%
Other Mobile	731	54%	3%
Natural Sources	0	0%	0%
Total	1362	100%	6%
Total Statewide	21033		

Table 5-61

Methylene Chloride

Area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products account for approximately 81 percent of the emissions of methylene chloride.

San Diego - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	76	19%	1%
Area-wide Sources	317	81%	4%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	393	100%	5%
Total Statewide	7739		

Table 5-62

Perchloroethylene

Approximately 70 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	436	70%	7%
Area-wide Sources	188	30%	3%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	624	100%	10%
Total Statewide	6027		

Table 5-63

Diesel Particulate Matter

Approximately 95 percent of the emissions of diesel particulate matter are from mobile sources.

San Diego - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	98	5%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	468	26%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	468	26%	2%
Other Mobile	1235	69%	5%
Natural Sources	0	0%	0%
Total	1800	100%	7%
Total Statewide	25678		

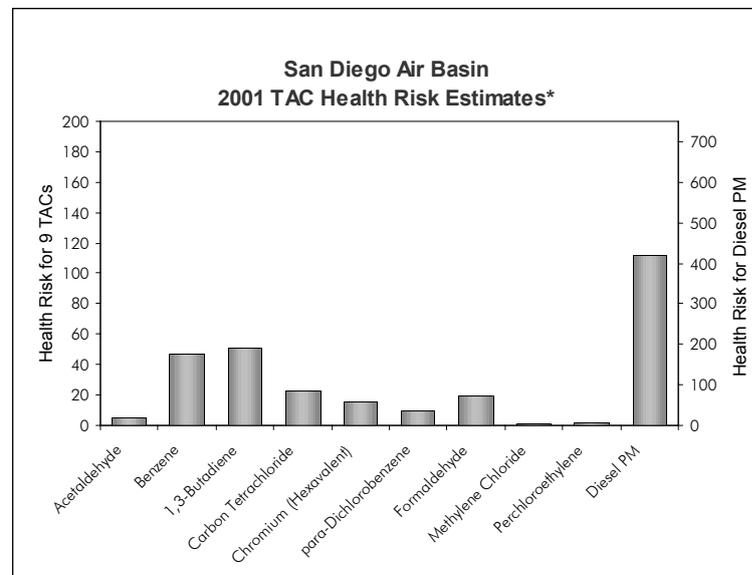
Table 5-64

San Diego Air Basin

Air Quality and Health Risk

During 1990 through 2001, the ARB monitored ambient TAC concentrations at two sites in the San Diego Air Basin. The sites are located in Chula Vista and El Cajon. One additional special study site, located in the Logan Heights/Barrio Logan area of San Diego, operated between October 1999 and February 2001. 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 the Barrio Logan and other community monitoring studies are being used in support of the ARB Community Health Program.

Figure 5-15 and Table 5-65 show the estimated average health risks for the two San Diego sites in the ambient TAC network. Because of incomplete data, the concentration and health risk estimates for chromium (hexavalent) reflect 2000. The health risk estimates for the remaining eight TACs measured in ambient air reflect the year 2001. The estimated health risk for diesel PM also reflects data for the year 2000 and is 420 excess



* Data for Chromium (Hexavalent) and Diesel PM reflect 2000; data for all other TACs reflect 2001.

Figure 5-15

cancer cases per million people. While the health risk from diesel PM is lower than the estimated statewide value, it is comparable to the annual averages estimated for other urbanized areas such as the Sacramento Valley and San Joaquin Valley Air Basins. Furthermore, diesel particulate matter represents the most substantial health risk in the San Diego Air Basin.

Similar to most other areas, Figure 5-15 and Table 5-65 show that aside from diesel particulate matter, benzene and 1,3-butadiene pose the greatest health risks, on average, in the San Diego Air Basin. However, it is important to remember that the health risks shown here are based on an average concentration for the entire air basin, and the health risk at individual locations may be higher or lower, depending on the impact of local sources. Overall, the total average health risk from all the TACs combined have been reduced over the trend period. In contrast to the overall reduction, the health risk for *para*-dichlorobenzene shows an increase from 1990 to 2001. Furthermore, although it appears that formaldehyde concentrations and health risk have increased, remember that the analysis method used before 1996 underestimated ambient concentrations, and the data have not been corrected. Based on data analyzed since 1996, formaldehyde concentrations and health risk have decreased. Of the ten TACs included in Figure 5-15,

perchloroethylene, benzene, methylene chloride, 1,3-butadiene, chromium (hexavalent), and diesel PM show the greatest reductions in concentration: 79 percent, 78 percent, 71 percent, 58 percent, 58 percent, and 52 percent, respectively. Again, as in all other areas of California, it is important to remember that there may be other compounds that pose a significant risk in the San Diego Air Basin but are not monitored. Being near a source of toxics emissions can also increase the health risk.

San Diego Air Basin Annual Average Concentrations and Health Risks

San Diego Air Basin Toxic Air Contaminants - Annual Average Concentrations and Health Risks													
TAC*	Conc./ Risk	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Acetaldehyde	Annual Avg	1.33	1.50	1.22	1.41	1.48	0.64	1.03	1.00	0.86	1.04	0.84	0.95
	Health Risk	6	7	6	7	7	3	5	5	4	5	4	5
Benzene	Annual Avg	2.25	1.70	1.48	1.16	1.39	0.98	0.76	0.76	0.76	0.86	0.65	0.50
	Health Risk	208	158	137	107	129	90	71	70	70	79	60	47
1,3-Butadiene	Annual Avg	0.333	0.257	0.258	0.312	0.307	0.242	0.208	0.198	0.196	0.220	0.159	0.136
	Health Risk	125	97	97	117	115	91	78	75	74	83	60	51
Carbon Tetrachloride	Annual Avg	0.132	0.127		0.103		0.099	0.077				0.094	0.086
	Health Risk	35	34		27		26	20				25	23
Chromium (Hexavalent)	Annual Avg			0.24	0.19	0.16	0.18	0.11	0.11	0.10	0.10	0.10	
	Health Risk			36	28	23	27	16	16	15	15	15	
<i>para</i> -Dichlorobenzene	Annual Avg		0.10	0.11	0.13	0.15	0.12	0.11	0.13				0.15
	Health Risk		7	8	8	10	8	7	8				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
	Health Risk	12	11	9	13	17	16	19	19	17	20	16	19
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
	Health Risk	2	3	5	4	3	2	2	2		2	3	1
Perchloroethylene	Annual Avg	0.282	0.269	0.263	0.200	0.207	0.249	0.147	0.125			0.089	0.061
	Health Risk	11	11	11	8	8	10	6	5			4	2
<i>Diesel Particulate Matter</i> **	Annual Avg	(2.9)					(1.9)					(1.4)	
	Health Risk	(870)					(570)					(420)	
Average Basin Risk***	Without Diesel PM	399	328	309	319	312	273	224	200	180	204	187	158
	<i>With Diesel PM</i>	(1269)					(843)					(607)	

* Concentrations for Chromium (Hexavalent) 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.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** 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*.

Table 5-65

Sacramento Valley Air Basin

2002 Emission Inventory by Compound

Acetaldehyde

Approximately 60 percent of the emissions of acetaldehyde are from mobile sources. Another 36 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	32	4%	0%
Area-wide Sources	288	36%	4%
On-Road Mobile	154	19%	2%
Gasoline Vehicles	69	8%	1%
Diesel Vehicles	85	11%	1%
Other Mobile	335	41%	4%
Natural Sources	0	0%	0%
Total	808	100%	11%
Total Statewide	7543		

Table 5-66

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	175	15%	1%
Area-wide Sources	8	1%	0%
On-Road Mobile	580	49%	4%
Gasoline Vehicles	557	47%	4%
Diesel Vehicles	23	2%	0%
Other Mobile	415	35%	3%
Natural Sources	0	0%	0%
Total	1177	100%	8%
Total Statewide	13912		

Table 5-67

1,3-Butadiene

Approximately 76 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	0%	0%
Area-wide Sources	58	20%	2%
On-Road Mobile	120	41%	4%
Gasoline Vehicles	117	41%	4%
Diesel Vehicles	2	1%	0%
Other Mobile	102	35%	3%
Natural Sources	8	3%	0%
Total	289	100%	9%
Total Statewide	3180		

Table 5-68

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	0.06	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%
Natural Sources	0	0%	0%
Total	0.06	100%	2%
Total Statewide	3.48		

Table 5-69

Chromium (Hexavalent)

Approximately 83 percent of the chromium (hexavalent) emissions are from stationary sources such as electrical generation, aircraft and parts manufacturing, and fabricated metal product manufacturing.

Sacramento Valley - Chromium (Hexavalent)			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.16	83%	6%
Area-wide Sources	0	0%	0%
On-Road Mobile	<0.01	4%	0%
Gasoline Vehicles	<0.01	4%	0%
Diesel Vehicles	<0.01	0%	0%
Other Mobile	0.03	13%	1%
Natural Sources	<0.01	0%	0%
Total	0.19	100%	7%
Total Statewide	2.56		

Table 5-70

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	0%	0%
Area-wide Sources	124	100%	7%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	124	100%	7%
Total Statewide	1822		

Table 5-71

Formaldehyde

Approximately 71 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	248	13%	1%
Area-wide Sources	325	17%	2%
On-Road Mobile	479	25%	2%
Gasoline Vehicles	309	16%	1%
Diesel Vehicles	170	9%	1%
Other Mobile	878	46%	4%
Natural Sources	0	0%	0%
Total	1930	100%	9%
Total Statewide	21033		

Table 5-72

Methylene Chloride

Approximately 71 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	102	29%	1%
Area-wide Sources	256	71%	3%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	358	100%	5%
Total Statewide	7739		

Table 5-73

Perchloroethylene

Approximately 60 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Diesel Particulate Matter

Approximately 88 percent emissions of diesel particulate matter are from mobile sources.

Sacramento Valley - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	223	60%	4%
Area-wide Sources	151	40%	3%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	374	100%	6%
Total Statewide	6027		

Table 5-74

Sacramento Valley - Diesel PM			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	285	12%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	556	23%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	556	23%	2%
Other Mobile	1576	65%	6%
Natural Sources	0	0%	0%
Total	2417	100%	9%
Total Statewide	25678		

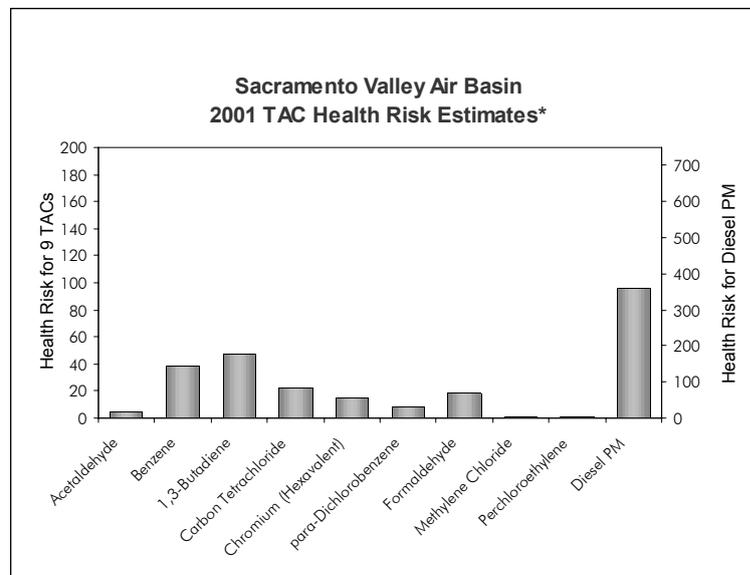
Table 5-75

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 during all of 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, no data are available for the year during which the site was moved because neither site has a full year of data.

Figure 5-16 is based on all data collected in the Sacramento Valley Air Basin and shows the estimated annual average health risks for this area. As shown in the graph, the health risk estimates for the nine TACs measured by the ambient network reflect 2001, the most recent year for which complete and representative data are available. The estimate for diesel PM reflects the year 2000. Like all other air basins,



* Data for Diesel PM reflects 2000; data for all other TACs reflect 2001.

Figure 5-16

diesel particulate matter poses the greatest health risk among the ten TACs considered in this almanac. Based on receptor modeling techniques, the ARB estimated a year 2000 health risk of 360 excess cancer cases per million people. This is about half the estimated statewide health risk. The estimated health risk for the Sacramento Valley is similar to that for the San Joaquin Valley. However, it is lower than the concentrations estimated for other urban areas including the San Francisco Bay Area Air Basin and the San Diego Air Basin.

In the absence of diesel particulate matter, Figure 5-16 and Table 5-76 show that benzene and 1,3-butadiene pose the greatest health risk, on average, in the Sacramento Valley Air Basin. However, these compounds also show the largest reductions since 1990, 79 percent and 66 percent, respectively. It is important to remember that the health risks shown here are based on an average concentration for only two areas in the air basin, and the health risk at other locations may be higher or lower. Overall, the average concentrations and health risks from all the TACs except *para*-dichlorobenzene and formaldehyde have been reduced since 1990. The annual average concentration and health risk for formaldehyde are more than 50 percent higher in 2001 than in 1990. The increase may be attributed in part to the method change implemented in 1996. While

the pre-1996 data are included for completeness, a more reasonable approach is to compare the 1996 data with the 2001 data. When doing this, formaldehyde shows a decrease on the order of 13 percent. More years of data are needed to determine if this decrease will continue. Finally, as in all areas of the State, it is important to note that there may be other compounds that are not monitored, but which may pose a substantial health risk in the Sacramento Valley Air Basin.

Sacramento Valley Air Basin

Annual Average Concentrations and Health Risks

Sacramento Valley Air Basin Toxic Air Contaminants - Annual Average Concentrations and Health Risks													
TAC*	Conc./ Risk	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Acetaldehyde	Annual Avg	1.29			1.37	1.04	0.39	1.03	1.05	0.92	1.23	0.83	0.74
	Health Risk	6			7	5	2	5	5	4	6	4	4
Benzene	Annual Avg	2.02	1.88	1.35	1.00	1.02	0.80	0.56	0.55	0.50	0.56	0.45	0.42
	Health Risk	187	174	125	92	95	74	51	51	47	52	42	39
1,3-Butadiene	Annual Avg	0.378	0.332	0.283	0.288	0.221	0.186	0.176	0.160	0.154	0.128	0.119	0.125
	Health Risk	142	125	106	108	83	70	66	60	58	48	45	47
Carbon Tetrachloride	Annual Avg	0.123	0.123		0.109		0.099	0.078				0.094	0.088
	Health Risk	33	32		29		26	21				25	23
Chromium (Hexavalent)	Annual Avg			0.17	0.14	0.13	0.18	0.11	0.10	0.10	0.10	0.10	0.10
	Health Risk			26	21	19	26	16	15	15	15	15	15
<i>para</i> -Dichlorobenzene	Annual Avg			0.11	0.10	0.20	0.14	0.11	0.14			0.10	0.13
	Health Risk			7	7	14	9	7	10			7	9
Formaldehyde	Annual Avg	1.57			1.77	1.75	1.91	2.76	2.92	2.52	3.61	2.51	2.41
	Health Risk	12			13	13	14	20	22	19	27	18	18
Methylene Chloride	Annual Avg	0.65	0.56	0.55	0.98	0.66	0.53	0.54	0.52		0.60	0.57	0.29
	Health Risk	2	2	2	3	2	2	2	2		2	2	1
Perchloroethylene	Annual Avg	0.071	0.074	0.063	0.052	0.165	0.049	0.055	0.052			0.058	0.027
	Health Risk	3	3	3	2	7	2	2	2			2	1
Diesel Particulate Matter**	Annual Avg	(2.5)					(1.6)					(1.2)	
	Health Risk	(750)					(480)					(360)	
Average Basin Risk***	Without Diesel PM	385	336	269	282	238	225	190	167	143	150	160	157
	With Diesel PM	(1135)					(705)					(520)	

* Concentrations for Chromium (Hexavalent) 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.

** Diesel PM concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years.

*** 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*.

Table 5-76

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