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 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. 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 2001. 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 2001.

Air Quality Monitoring for Toxic Air Contaminants. The ARB maintains a statwide 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

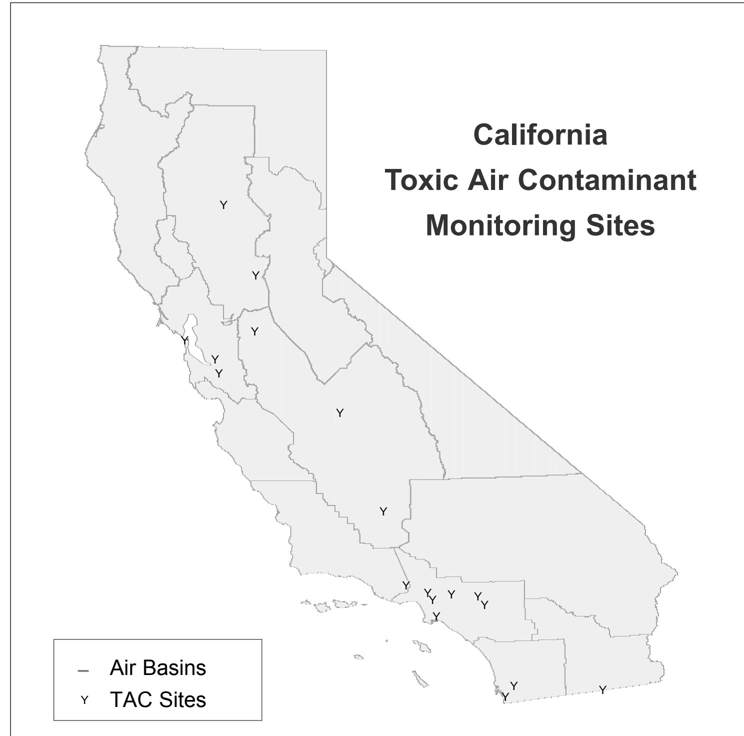

Figure 5-1

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 2000. 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 air monitoring data. The next challenge is to better characterize community health risks by focusing on localized impacts. Future editions of the almanac will include this type of information, as it becomes available. In addition, the focus of this almanac is only on cancer risks. Future editions may include data for non-cancer risks, which 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/aqe&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*" (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

2001 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		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	253	3%
Area-wide Sources	2007	24%
On-Road Mobile	2073	25%
Gasoline Vehicles	1178	14%
Diesel Vehicles	895	11%
Other Mobile	3905	47%
Natural Sources	0	0%
Total Statewide	***8239***	***100%***

Table 5-2

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 25 percent of the statewide acetaldehyde emissions can be attributed to on-road motor vehicles, with an additional 47 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 24 percent of the 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 mining. The emissions from these sources are from fuel combustion.

2001 Top Ten Counties - Acetaldehyde

The top ten counties account for approximately 49 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 (14 percent of the emissions of acetaldehyde 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 25 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 17 percent of statewide acetaldehyde emissions.

Acetaldehyde			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	1166	14%
San Diego	San Diego	567	7%
Orange	South Coast	422	5%
Alameda	San Francisco Bay Area	311	4%
Kern	San Joaquin Valley	290	4%
Santa Clara	San Francisco Bay Area	278	3%
Fresno	San Joaquin Valley	269	3%
San Bernardino	South Coast	253	3%
Sacramento	Sacramento Valley	241	3%
Riverside	South Coast	221	3%

Figure 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 2000. Although data are shown for all years during 1990 through 2000, 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.

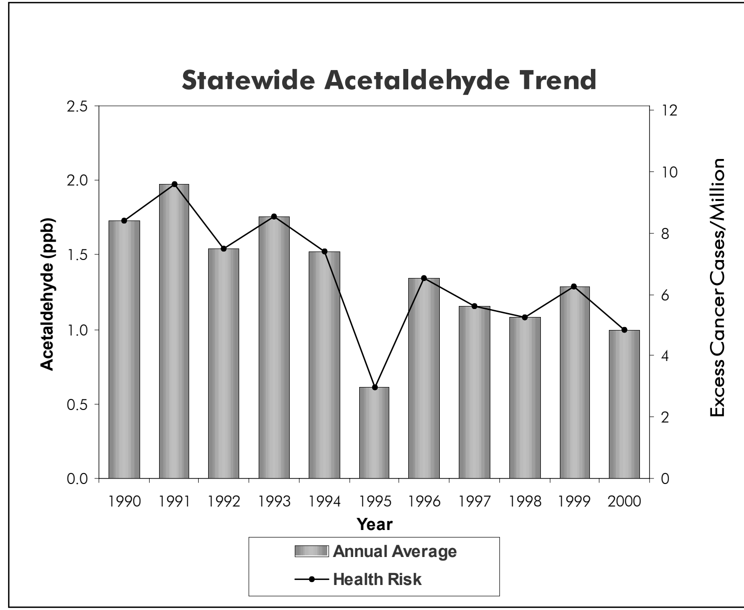

Figure 5-2

Based on the statewide annual averages for the five years with consistent data, 1996 through 2000, acetaldehyde concentrations and associated health risk decreased by about 25 percent. On an individual basis, the health risks from acetaldehyde 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 2000, 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

2001 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 61 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 61 percent of the statewide benzene emissions can be attributed to on-road motor vehicles, with an additional 21 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and lawn and garden equipment. Currently, the benzene content of gasoline is less than 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 6 percent and area-wide sources contribute 12 percent of the statewide benzene emissions. The primary stationary sources of reported benzene emissions are crude petroleum and natural gas mining,

Benzene		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	1319	6%
Area-wide Sources	2672	12%
On-Road Mobile	13453	61%
Gasoline Vehicles	13209	60%
Diesel Vehicles	244	1%
Other Mobile	4534	21%
Natural Sources	43	0%
Total Statewide	***22022***	***100%***

Table 5-4

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.

2001 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 (18 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 30 percent of statewide benzene emissions occur in the South Coast Air Basin. Two counties in the San Joaquin Valley Air Basin contribute approximately 9 percent: Kern County (5 percent) and Fresno County (4 percent). The four other counties in the top ten for benzene emissions are: San Diego, Santa Clara, Alameda, and Sacramento. These four counties account for approximately 17 percent of statewide benzene emissions.

Benzene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	3928	18%
San Diego	San Diego	1471	7%
Orange	South Coast	1307	6%
Kern	San Joaquin Valley	1158	5%
Fresno	San Joaquin Valley	971	4%
Santa Clara	San Francisco Bay Area	859	4%
Alameda	San Francisco Bay Area	677	3%
Sacramento	Sacramento Valley	669	3%
San Bernardino	South Coast	646	3%
Riverside	South Coast	562	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 2000 statewide ambient benzene concentration was about 72 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 2000, there was an estimated chance of 66 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.

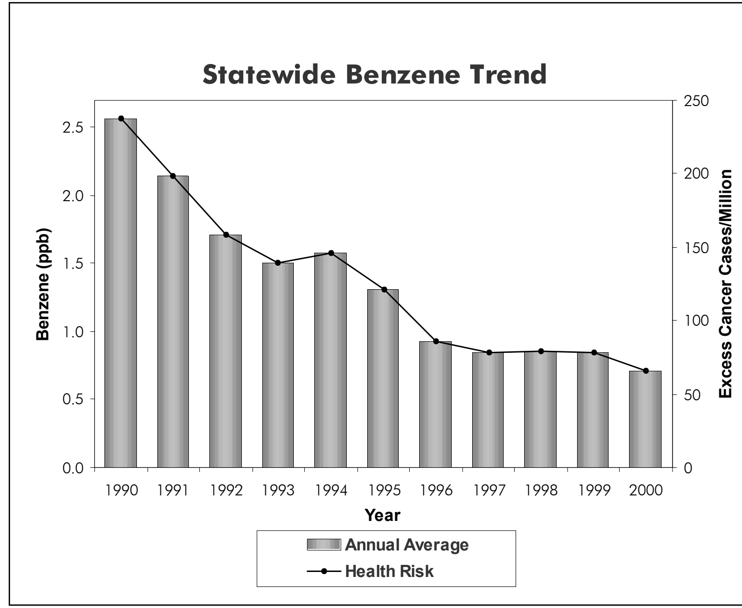

Figure 5-3

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 they 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

2001 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 87 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 54 percent of the statewide 1,3-butadiene emissions can be attributed to on-road motor vehicles, with an additional 33 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 10 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, manufacturing of synthetics and man-made materials, and oil and gas extraction. The primary natural sources are wildfires.

1,3-Butadiene		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	16	<1%
Area-wide Sources	385	10%
On-Road Mobile	1994	54%
Gasoline Vehicles	1971	54%
Diesel Vehicles	23	1%
Other Mobile	1201	33%
Natural Sources	83	2%
Total Statewide	***3678***	***100%***

Table 5-6

2001 Top Ten Counties -
1,3-Butadiene Emissions

The top ten counties account for approximately 50 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 (17 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 two of the top ten counties emitting 1,3-butadiene: Tulare County (3 percent) and Kern County (3 percent). The other counties in the top ten for 1,3-butadiene emissions are: Santa Clara, Alameda, and Sacramento.

1,3-Butadiene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	630	17%
San Diego	San Diego	264	7%
Orange	South Coast	192	5%
Santa Clara	San Francisco Bay Area	127	3%
Tulare	San Joaquin Valley	116	3%
San Bernardino	South Coast	114	3%
Kern	San Joaquin Valley	104	3%
Alameda	San Francisco Bay Area	102	3%
Sacramento	Sacramento Valley	100	3%
Riverside	South Coast	100	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 56 percent from 1990 to 2000. 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.

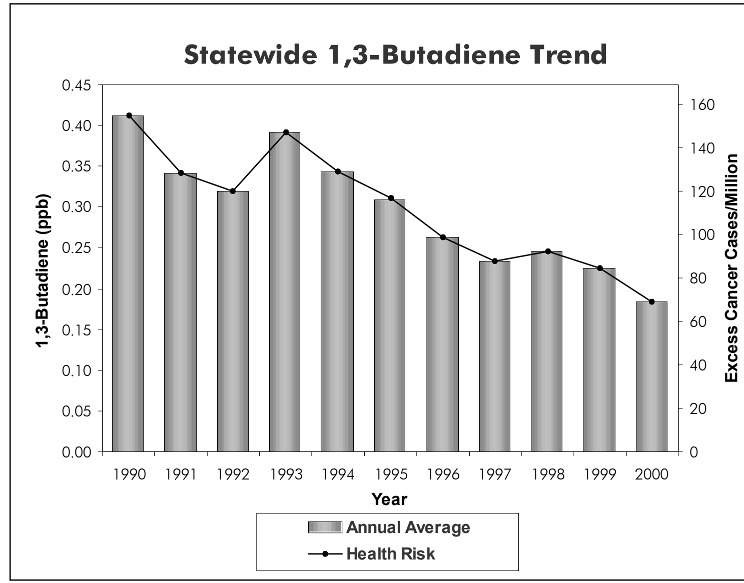

Figure 5-4

Similar to benzene, the ARB analyzed 1,3-butadiene samples using a single-point calibration of the gas chromatograph analyzers prior to 1999. While this method was approved by the U.S. EPA, it resulted in low concentrations being under-reported. Beginning January 1, 1999, new and more sophisticated computer software allowed the ARB to switch to a 3-point calibration of the analyzers. This improved measurement technique more accurately characterizes the ambient 1,3-butadiene, especially at low concentrations. However, concentrations measured using the 3-point calibration method are higher than those measured with the single-point calibration method. A year-long 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

2001 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 4 tons per year), and background concentrations account for most of the health risk.

Carbon Tetrachloride		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	3.67	100%
Area-wide Sources	0.00	0%
On-Road Mobile	0.00	0%
Gasoline Vehicles	0.00	0%
Diesel Vehicles	0.00	0%
Other Mobile	0.00	0%
Natural Sources	0.00	0%
Total Statewide	***3.67***	***100%***

Table 5-8

2001 Top Ten Counties - Carbon Tetrachloride

The top two counties account for approximately 90 percent of the statewide carbon tetrachloride emissions. Los Angeles County (South Coast Air Basin portion) accounts for approximately 50 percent, and Contra Costa County, located in the San Francisco Bay Area Air Basin, accounts for approximately 40 percent of the emissions of carbon tetrachloride statewide. Although the percentages for these two counties are high, the emissions are very small (about 2 tons per year in each county). The eight other counties in the top ten contribute approximately 9 percent of statewide carbon tetrachloride emissions.

Carbon Tetrachloride			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1.83	50%
Contra Costa	San Francisco Bay Area	1.46	40%
Orange	South Coast	0.08	2%
Santa Barbara	South Central Coast	0.07	2%
Sacramento	Sacramento Valley	0.06	2%
Alameda	San Francisco Bay Area	0.03	1%
Riverside	South Coast	0.02	<1%
Ventura	South Central Coast	0.02	<1%
Sonoma	San Francisco Bay Area	0.02	<1%
Kern	Mojave Desert	0.02	<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 2000 statewide average carbon tetrachloride concentration and the associated health risk were 28 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 2000, there was an estimated risk of 25 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 then a substantial increase in values for 1998. Although values dropped again in 2000, the values for the year 2000 are still about 20 percent higher than the values for 1996. Data are not sufficient to determine if the higher values during

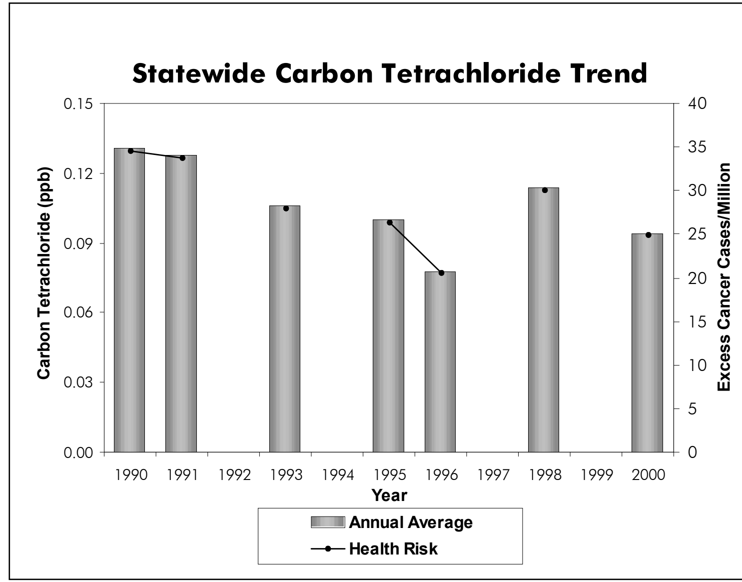

Figure 5-5

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)

2001 Statewide Emission Inventory

Chromium (hexavalent) was identified as a Toxic Air Contaminant 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 ton 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. There is no evidence showing chromium (hexavalent) in gasoline or diesel used in on-road motor vehicles. Therefore, we do not expect any chromium (hexavalent) emissions from this category. However, other mobile sources such as trains and ships contribute approximately 1 ton of chromium (hexavalent) annually.

Chromium (Hexavalent)		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	1.29	59%
Area-wide Sources	0.01	<1%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0.89	41%
Natural Sources	<.01	<1%
Total Statewide	***2.20***	***100%***

Table 5-10

2001 Top Ten Counties - Chromium (Hexavalent)

Four counties account for approximately 55 percent of the statewide chromium (hexavalent) emissions: South Coast portion of Los Angeles County (22 percent of the emissions of chromium (hexavalent) statewide), Mojave Desert portion of Kern County (14 percent), San Diego County (10 percent), and San Francisco Bay Area portion of Solano County (9 percent). Collectively, approximately 30 percent of statewide chromium (hexavalent) emissions occur in the South Coast Air Basin. Three counties in the San Joaquin Valley Air Basin contribute approximately 14 percent: Fresno County (8 percent), San Joaquin County (4 percent), and San Joaquin Valley portion of Kern County (2 percent). The remaining three counties in the top ten for chromium (hexavalent) emissions are: Riverside (South Coast Air Basin portion), San Bernardino (Mojave Desert portion) and Orange County.

Chromium (Hexavalent)			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	0.49	22%
Kern	Mojave Desert	0.31	14%
San Diego	San Diego	0.22	10%
Solano	San Francisco Bay Area	0.20	9%
Fresno	San Joaquin Valley	0.17	8%
Riverside	South Coast	0.12	6%
San Joaquin	San Joaquin Valley	0.09	4%
San Bernardino	Mojave Desert	0.08	3%
Orange	South Coast	0.05	2%
Kern	San Joaquin Valley	0.04	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 2000. 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 2000 annual average chromium

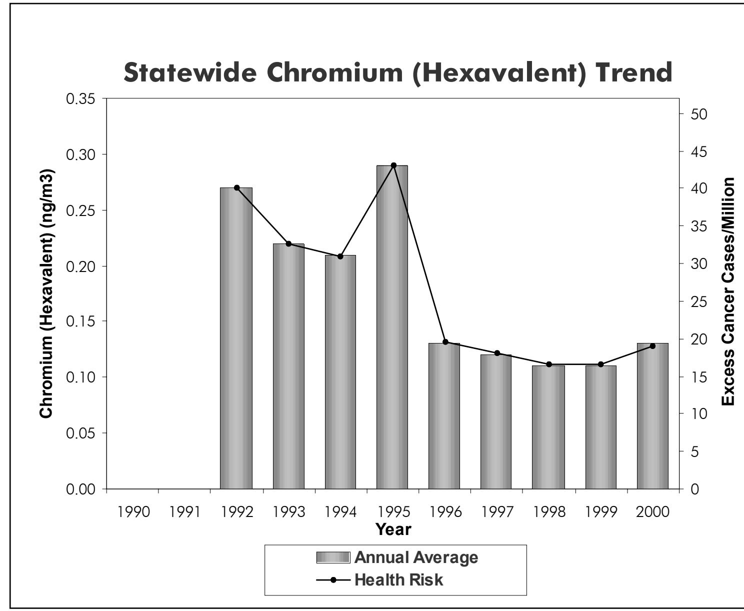

Figure 5-6

(hexavalent) concentration and the associated health risk were 52 percent lower than they were in 1992. During 2000, there was an estimated risk of 19 excess cancer cases per million people, from chromium (hexavalent) alone. While this is higher than the value for 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 fifth 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 measured concentrations for chromium (hexavalent) 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 2000, an average of 93 percent of the values during each year 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 ng/m^3.

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

para-Dichlorobenzene
2001 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	15	1%
Area-wide Sources	1783	99%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	***1799***	***100%***

Table 5-12

2001 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 (9 percent), South Coast portion of San Bernardino County (4 percent), and South Coast portion of Riverside County (4 percent). Collectively, approximately 44 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	483	27%
Orange	South Coast	155	9%
San Diego	San Diego	150	8%
Santa Clara	San Francisco Bay Area	89	5%
Alameda	San Francisco Bay Area	74	4%
San Bernardino	South Coast	69	4%
Riverside	South Coast	64	4%
Sacramento	Sacramento Valley	62	3%
Contra Costa	San Francisco Bay Area	49	3%
Fresno	San Joaquin Valley	43	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 1991 through 1997 and for the year 2000. These 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 2000, there was an estimated risk of 8 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.

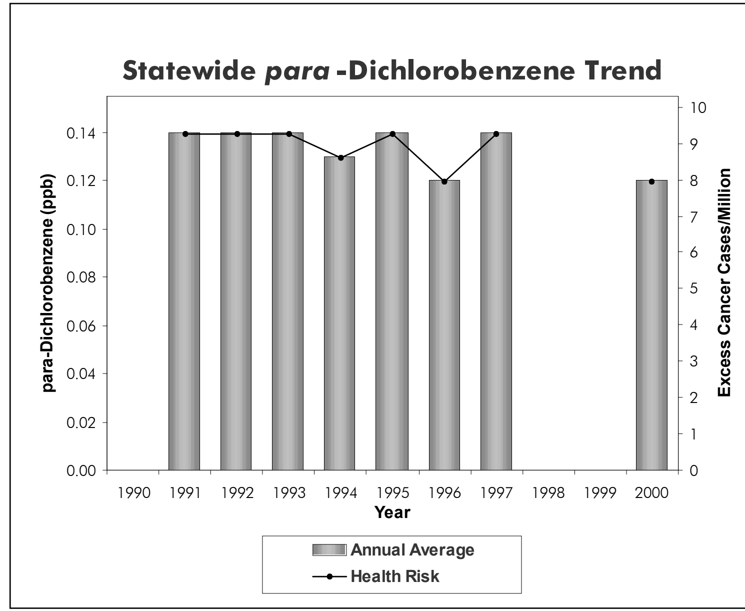

Figure 5-7

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Formaldehyde

2001 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 81 percent of direct formaldehyde emissions are estimated to come from the combustion of fossil fuels from mobile sources. Approximately 33 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, recreational boats, and construction and mining equipment. Area-wide sources contribute approximately 11 percent and stationary sources contribute approximately 8 percent of the statewide formaldehyde emissions. The primary area-wide sources in California that report formaldehyde emissions include the burning of wood in residential fireplaces and wood stoves.

Formaldehyde		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	1828	8%
Area-wide Sources	2347	11%
On-Road Mobile	7199	33%
Gasoline Vehicles	5408	25%
Diesel Vehicles	1792	8%
Other Mobile	10396	48%
Natural Sources	0	0%
Total Statewide	***21771***	***100%***

Table 5-14

2001 Top Ten Counties - Formaldehyde

The top ten counties account for approximately 52 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 (16 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 27 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 Sacramento. These six counties account for approximately 25 percent of statewide formaldehyde emissions.

Formaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	3394	16%
San Diego	San Diego	1542	7%
Kern	San Joaquin Valley	1221	6%
Orange	South Coast	1125	5%
Santa Clara	San Francisco Bay Area	737	3%
Alameda	San Francisco Bay Area	657	3%
Fresno	San Joaquin Valley	647	3%
San Bernardino	South Coast	639	3%
Sacramento	Sacramento Valley	597	3%
Riverside	South Coast	574	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 from 1996 to 2000. 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 25 percent. While formaldehyde is emitted by both stationary and mobile sources, mobile sources are, by far,

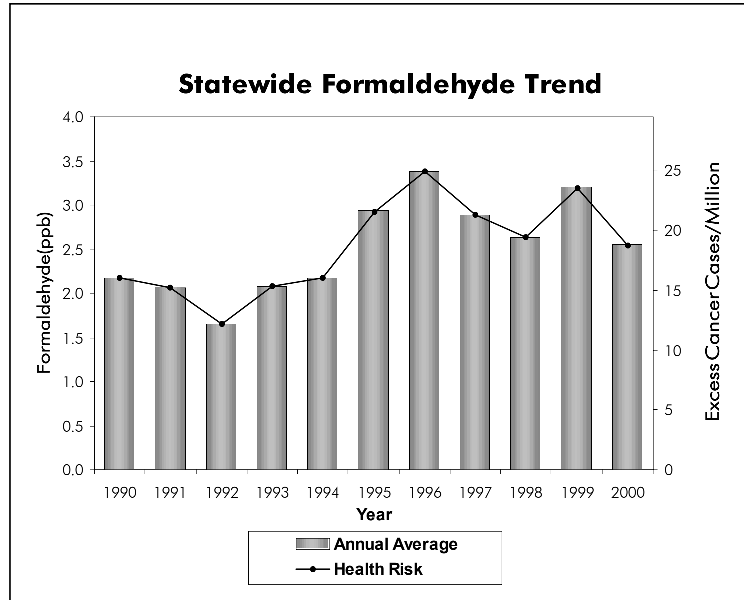


Figure 5-8

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 the home, 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

2001 Statewide Emission Inventory

The ARB identified methylene chloride as a Toxic Air Contaminant 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 55 percent of the statewide methylene chloride emissions. Area-wide sources contribute approximately 45 percent.

Methylene Chloride		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	4455	55%
Area-wide Sources	3668	45%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	***8124***	***100%***

Table 5-16

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

2001 Top Ten Counties - Methylene Chloride

The top ten counties account for approximately 80 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 (32 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 54 percent of statewide methylene chloride emissions occur in the South Coast Air Basin. Three counties in the San Francisco Bay Area Air Basin contribute approximately 17 percent: Santa Clara County (11 percent), Alameda County (4 percent), and San Mateo County (2 percent). The three other counties in the top ten for methylene chloride emissions are: San Diego, Sacramento, and Ventura. Together, these three counties account for approximately 9 percent of statewide methylene chloride emissions.

Methylene Chloride			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	2562	32%
Orange	South Coast	1009	13%
Santa Clara	San Francisco Bay Area	855	11%
San Bernardino	South Coast	462	6%
San Diego	San Diego	378	5%
Alameda	San Francisco Bay Area	312	4%
Riverside	South Coast	248	3%
Sacramento	Sacramento Valley	178	2%
Ventura	South Central Coast	170	2%
San Mateo	San Francisco Bay Area	149	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, probably caused by year-to-year changes in meteorology. However, there is an overall downward trend. While the statewide annual average concentrations and health risk have dropped 39 percent since 1990, there has been essentially no change during the last five years. 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 2000, there was an estimated risk of 2 excess cancer cases per million people.

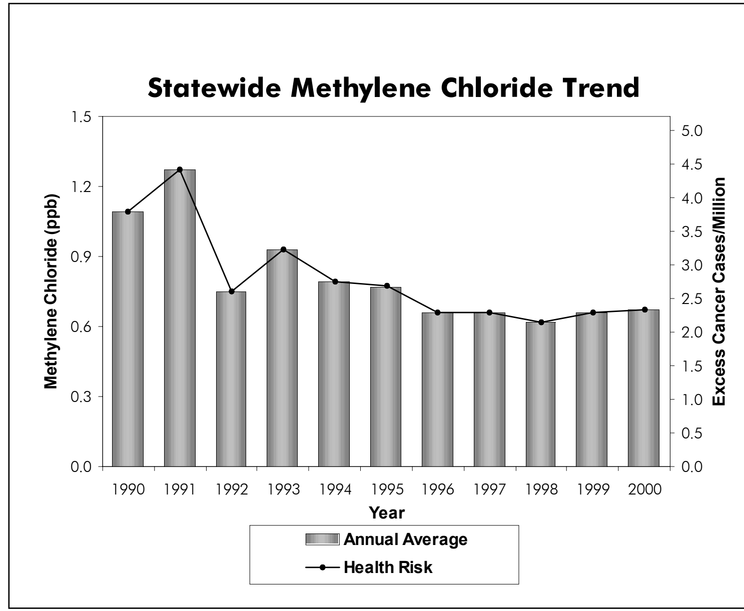


Figure 5-9

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 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

2001 Statewide Emission Inventory

The ARB identified perchloroethylene as a Toxic Air Contaminant 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 82 percent of the statewide emissions of perchloroethylene. Area-wide sources contribute approximately 18 percent. The primary area-wide sources include consumer products such as automotive brake cleaners and tire sealants and inflators.

Perchloroethylene		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	9860	82%
Area-wide Sources	2170	18%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	***12030***	***100%***

Table 5-18

2001 Top Ten Counties - Perchloroethylene

The top ten counties account for approximately 74 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 (26 percent of the emissions of perchloroethylene statewide), Orange County (13 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (2 percent). Collectively, approximately 44 percent of statewide perchloroethylene emissions occur in the South Coast Air Basin. San Diego County contributes approximately 14 percent. The five other counties in the top ten for perchloroethylene emissions are: Alameda, Sacramento, Santa Clara, San Francisco, and San Mateo. These five counties account for approximately 16 percent of statewide perchloroethylene emissions.

Perchloroethylene			
County	**Air Basin**	**tons/year**	**Percent**
Los Angeles	South Coast	3088	26%
San Diego	San Diego	1668	14%
Orange	South Coast	1537	13%
Alameda	San Francisco Bay Area	467	4%
Sacramento	Sacramento Valley	461	4%
Santa Clara	San Francisco Bay Area	422	4%
San Bernardino	South Coast	399	3%
San Francisco	San Francisco Bay Area	284	2%
Riverside	South Coast	274	2%
San Mateo	San Francisco Bay Area	258	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 58 percent. Figure 5-10 shows the annual average statewide perchloroethylene concentrations and the associated health risk for 1990 through 1998 and for 2000, 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 2000, there was an estimated chance of 5 excess cancer cases per million people.

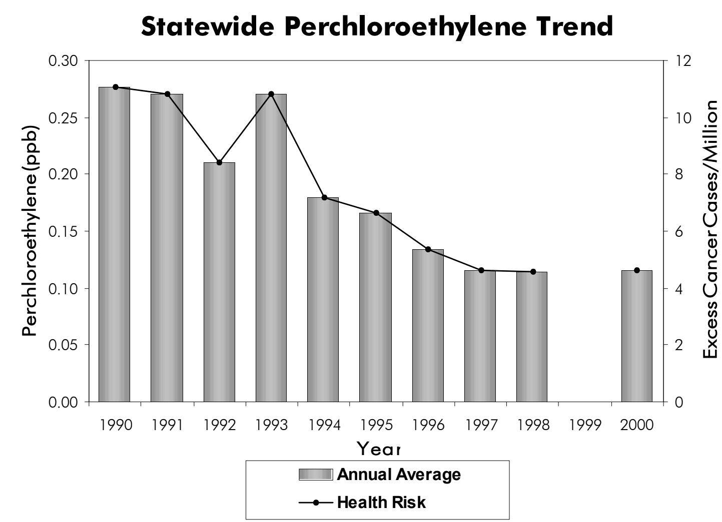


Figure 5-10

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 there was a potential for significant reductions of emissions. The ARB focused control efforts on that industry and adopted a control measure governing the use of perchloroethylene in dry cleaning operations in 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

2001 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 25 percent of statewide total, with an additional 73 percent attributed to other mobile sources such as construction and mining equipment, agricultural equipment, and transport refrigeration units. Stationary sources, contributing about 2 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 entitled: "*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.

Diesel Particulate Matter		
Emissions Source	**tons/year**	**Percent**
Stationary Sources	558	2%
Area-wide Sources	0	0%
On-Road Mobile	6012	25%
Gasoline Vehicles	0	0%
Diesel Vehicles	6012	25%
Other Mobile	17939	73%
Natural Sources	0	0%
Total Statewide	***24509***	***100%***

Table 5-20

2001 Top Ten Counties - Diesel Particulate Matter

The top ten counties account for approximately 55 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 (17 percent of the emissions of diesel particulate matter statewide), Orange County (7 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 27 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 4 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). Sacramento County and the Mojave Desert portion of San Bernardino County contribute the remainder.

Diesel Particulate Matter			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	4338	17%
San Diego	San Diego	1731	7%
Orange	South Coast	1693	7%
Fresno	San Joaquin Valley	950	4%
Alameda	San Francisco Bay Area	938	4%
Santa Clara	San Francisco Bay Area	908	4%
San Francisco	San Francisco Bay Area	821	3%
Riverside	South Coast	817	3%
Sacramento	Sacramento Valley	807	3%
San Bernardino	Mojave Desert	726	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.

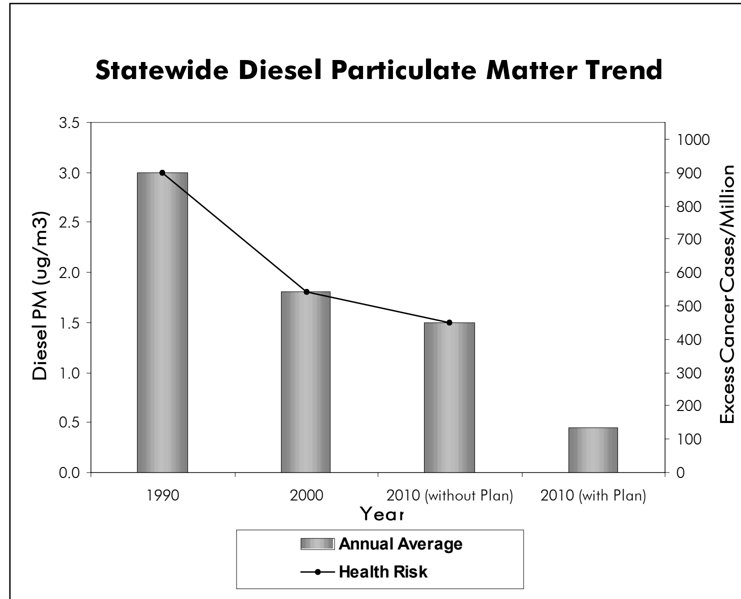


Figure 5-11

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 PM_{10} database, ambient PM_{10} 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 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 ($\mu g/m^3$). 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 $\mu g/m^3$ 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

2001 Emission Inventory by Compound

Acetaldehyde

Approximately 80 percent of the emissions of acetaldehyde are from mobile sources.

South Coast - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	39	2%	0%
Area-wide Sources	369	18%	4%
On-Road Mobile	728	35%	9%
Gasoline Vehicles	422	20%	5%
Diesel Vehicles	306	15%	4%
Other Mobile	925	45%	11%
Natural Sources	0	0%	0%
Total	***2061***	***100%***	***25%***
Total Statewide	**8239**		

Table 5-22

Benzene

The primary sources of benzene emissions in the South Coast Air Basin are mobile sources (approximately 95 percent).

South Coast - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	241	4%	1%
Area-wide Sources	137	2%	1%
On-Road Mobile	4866	76%	22%
Gasoline Vehicles	4783	74%	22%
Diesel Vehicles	83	1%	0%
Other Mobile	1198	19%	5%
Natural Sources	0	0%	0%
Total	***6442***	***100%***	***29%***
Total Statewide	**22022**		

Table 5-23

1,3-Butadiene

Approximately 94 percent of the emissions of 1,3-butadiene are from mobile sources.

South Coast - 1,3-Butadiene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	5	0%	0%
Area-wide Sources	39	4%	1%
On-Road Mobile	715	69%	19%
Gasoline Vehicles	707	68%	19%
Diesel Vehicles	8	1%	<1%
Other Mobile	260	25%	7%
Natural Sources	17	2%	<1%
Total	***1036***	***100%***	***28%***
Total Statewide	**3678**		

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%**	**53%**
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	***1.95***	***100%***	***53%***
Total Statewide	**3.67**		

Table 5-25

Chromium (Hexavalent)

Approximately 95 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	0.65	95%	29%
Area-wide Sources	<.01	<1%	<1%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.03	5%	2%
Natural Sources	<.01	<1%	<1%
Total	***0.68***	***100%***	***31%***
Total Statewide	**2.20**		

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 - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	9	1%	<1%
Area-wide Sources	762	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	***771***	***100%***	***43%***
Total Statewide	**1799**		

Table 5-27

Formaldehyde

Approximately 86 percent of the formaldehyde emissions are from mobile sources.

South Coast - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	349	6%	2%
Area-wide Sources	482	8%	2%
On-Road Mobile	2568	45%	12%
Gasoline Vehicles	1954	34%	9%
Diesel Vehicles	613	11%	3%
Other Mobile	2334	41%	11%
Natural Sources	0	0%	0%
Total	***5732***	***100%***	***26%***
Total Statewide	**21771**		

Table 5-28

Methylene Chloride

Approximately 63 percent of the emissions of methylene chloride are from stationary sources such as plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers.

South Coast - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	2711	63%	33%
Area-wide Sources	1570	37%	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	***4281***	***100%***	***53%***
Total Statewide	**8124**		

Table 5-29

Perchloroethylene

Approximately 82 percent of the emissions of perchloroethylene are from dry cleaning plants, manufacturers of aircraft parts and fabricated metal parts, and other stationary sources.

South Coast - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	4371	82%	36%
Area-wide Sources	928	18%	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	***5299***	***100%***	***44%***
Total Statewide	**12030**		

Table 5-30

Diesel Particulate Matter

Emissions of diesel particulate matter are essentially all from mobile sources (approximately 99 percent).

South Coast - Diesel Particulate Matter			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	95	1%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	2178	29%	9%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	2178	29%	9%
Other Mobile	5339	70%	22%
Natural Sources	0	0%	0%
Total	***7611***	***100%***	***31%***
Total Statewide	**24509**		

Table 5-31

South Coast Air Basin

Air Quality and Health Risk

During 1990 to 2000, the ARB monitored ambient toxics concentrations at five sites in the South Coast Air Basin. The sites are located in Burbank, Los Angeles, North Long Beach, Riverside, and 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 these nine TACs reflect the year 2000, which is the most recent year for which complete and representative data are available. Also included is an estimate of the health risk from diesel particulate matter for 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. The estimated health risk is 720 excess cancer cases per million people. This is higher than the average statewide health risk for diesel PM.

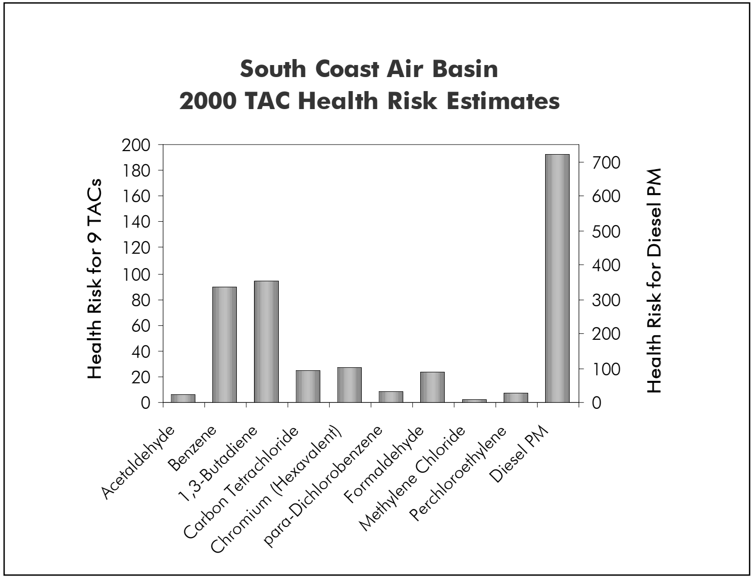


Figure 5-12

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 72 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 these six 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**
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
	Health Risk	12	15	12	13	11	5	10	9	7	8	6
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
	Health Risk	317	269	242	201	222	175	134	124	116	111	90
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
	Health Risk	200	170	187	212	187	173	146	142	133	123	94
Carbon Tetrachloride	Annual Avg	0.14	0.13		0.11		0.10	0.08		0.11		0.10
	Health Risk	36	35		28		27	21		30		25
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
para-Dichlorobenzene	Annual Avg		0.17	0.19	0.17	0.13	0.17	0.11	0.13			0.13
	Health Risk		11	13	11	8	11	7	9			9
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
	Health Risk	22	23	16	24	23	26	37	33	28	30	23
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
	Health Risk	6	5	3	4	4	4	3	4	3	3	3
Perchloroethylene	Annual Avg	0.58	0.55	0.41	0.45	0.39	0.36	0.32	0.27	0.26		0.21
	Health Risk	23	22	16	18	16	15	13	11	10		8
*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
	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

2001 Emission Inventory by Compound

Acetaldehyde

Approximately 77 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion and agricultural burning contribute approximately 19 percent.

San Francisco Bay Area - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	53	4%	1%
Area-wide Sources	281	19%	3%
On-Road Mobile	377	26%	5%
Gasoline Vehicles	215	15%	3%
Diesel Vehicles	162	11%	2%
Other Mobile	748	51%	9%
Natural Sources	0	0%	0%
Total	***1459***	***100%***	***18%***
Total Statewide	**8239**		

Table 5-33

Benzene

Mobile sources are the primary sources of benzene emissions in the San Francisco Bay Area Air Basin (approximately 92 percent).

San Francisco Bay Area - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	207	6%	1%
Area-wide Sources	87	2%	0%
On-Road Mobile	2560	73%	12%
Gasoline Vehicles	2516	72%	12%
Diesel Vehicles	44	1%	0%
Other Mobile	656	19%	3%
Natural Sources	0	0%	0%
Total	***3512***	***100%***	***16%***
Total Statewide	**22022**		

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	6	1%	0%
Area-wide Sources	1	0%	0%
On-Road Mobile	368	64%	10%
Gasoline Vehicles	364	63%	10%
Diesel Vehicles	4	1%	0%
Other Mobile	198	34%	5%
Natural Sources	1	0%	0%
Total	***575***	***100%***	***16%***
Total Statewide	**3678**		

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	1.53	100%	42%
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	***1.53***	***100%***	***42%***
Total Statewide	**3.67**		

Table 5-36

Chromium (Hexavalent)

Approximately 96 percent of the chromium (hexavalent) emissions are from other mobile sources. Stationary sources such as electrical generation and fabricated metal product manufacturing contribute approximately 4 percent.

San Francisco Bay Area - Chromium (Hexavalent)			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	<.01	4%	<1%
Area-wide Sources	<.01	<1%	<1%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.24	96%	11%
Natural Sources	<.01	0%	<1%
Total	***0.25***	***100%***	***12%***
Total Statewide	**2.20**		

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 - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	<1	0%	0%
Area-wide Sources	343	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	***344***	***100%***	***19%***
Total Statewide	**1799**		

Table 5-38

Formaldehyde

Approximately 87 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	154	4%	1%
Area-wide Sources	337	9%	2%
On-Road Mobile	1300	35%	6%
Gasoline Vehicles	976	26%	4%
Diesel Vehicles	324	9%	1%
Other Mobile	1959	52%	9%
Natural Sources	0	0%	0%
Total	***3750***	***100%***	***17%***
Total Statewide	**21771**		

Table 5-39

Methylene Chloride

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

San Francisco Bay Area - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	1040	60%	13%
Area-wide Sources	697	40%	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	***1737***	***100%***	***21%***
Total Statewide	**8124**		

Table 5-40

Perchloroethylene

Approximately 78 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

San Francisco Bay Area - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	1494	78%	12%
Area-wide Sources	418	22%	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	***1912***	***100%***	***16%***
Total Statewide	**12030**		

Table 5-41

Diesel Particulate Matter

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

San Francisco Bay Area - Diesel Particulate Matter			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	50	1%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	1109	25%	5%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1109	25%	5%
Other Mobile	3340	75%	14%
Natural Sources	0	0%	0%
Total	***4499***	***100%***	***18%***
Total Statewide	**24509**		

Table 5-42

San Francisco Bay Area Air Basin

Air Quality and Health Risk

Over the last eleven years, the ARB has monitored ambient TAC concentrations at four sites in the San Francisco Bay Area Air Basin. The sites are located in Concord, Fremont, San Francisco, and San Jose. 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 the nine TACs that are measured in the ambient air reflect the most recent year with complete and representative data -- 2000. In addition, an estimated health risk for diesel particulate matter is given for the year 2000. Of the ten TACs considered in this almanac, diesel particulate matter poses the greatest health risk 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 that year.

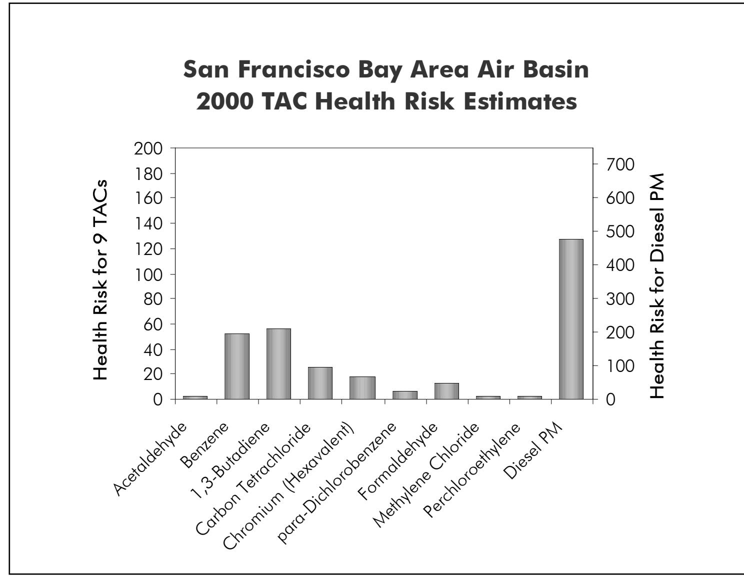


Figure 5-13

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. Since 1990, the annual average concentrations and health risks from all the TACs have decreased. Of those TACs included in Figure 5-13, benzene, perchloroethylene, 1,3-butadiene, and acetaldehyde all show reductions of 50 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. All compounds show some reduction over the time period, and the reduction for several compounds is fairly substantial. We expect these reductions will 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**
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
	Health Risk	6	7	5	6	6	2	4	4	3	4	3
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
	Health Risk	202	169	138	138	129	116	66	56	66	55	52
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
	Health Risk	135	108	103	138	108	104	82	70	82	64	56
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08				0.09
	Health Risk	34	33		29		26	21				25
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
para-Dichlorobenzene	Annual Avg		0.12	0.12	0.12	0.11	0.13	0.14	0.12			0.11
	Health Risk		8	8	8	7	8	9	8			7
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
	Health Risk	14	13	11	11	12	15	19	14	13	15	13
Methylene Chloride	Annual Avg	1.04	2.32	0.65	0.72	0.59	0.60	0.58	0.55			0.53
	Health Risk	4	8	2	2	2	2	2	2			2
Perchloroethylene	Annual Avg	0.20	0.23	0.17	0.13	0.08	0.09	0.07	0.07			0.08
	Health Risk	8	9	7	5	3	4	3	3			3
*Diesel Particulate Matter***	*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
	With Diesel PM	***(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

2001 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 account for approximately 15 percent.

San Joaquin Valley - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	85	7%	1%
Area-wide Sources	198	15%	2%
On-Road Mobile	296	23%	4%
Gasoline Vehicles	139	11%	2%
Diesel Vehicles	157	12%	2%
Other Mobile	713	55%	9%
Natural Sources	0	0%	0%
Total	***1292***	***100%***	***16%***
Total Statewide	**8239**		

Table 5-44

Benzene

The primary sources of benzene emissions in the San Joaquin Valley Air Basin are mobile sources (approximately 51 percent) and area-wide sources (approximately 37 percent).

San Joaquin Valley - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	456	12%	2%
Area-wide Sources	1447	37%	7%
On-Road Mobile	1513	38%	7%
Gasoline Vehicles	1470	37%	7%
Diesel Vehicles	43	1%	0%
Other Mobile	528	13%	2%
Natural Sources	<1	0%	0%
Total	***3945***	***100%***	***18%***
Total Statewide	**22022**		

Table 5-45

1,3-Butadiene

Approximately 73 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	136	24%	4%
On-Road Mobile	234	42%	6%
Gasoline Vehicles	230	41%	6%
Diesel Vehicles	4	1%	0%
Other Mobile	175	31%	5%
Natural Sources	10	2%	0%
Total	***559***	***100%***	***15%***
Total Statewide	**3678**		

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	**3.67**		

Table 5-47

Chromium (Hexavalent)

Approximately 86 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	0.31	86%	14%
Area-wide Sources	<.01	<1%	<1%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.05	14%	2%
Natural Sources	<.01	<1%	<1%
Total	***0.36***	***100%***	***16%***
Total Statewide	**2.20**		

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 - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	5	3%	0%
Area-wide Sources	172	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	***177***	***100%***	***10%***
Total Statewide	**1799**		

Table 5-49

Formaldehyde

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

San Joaquin Valley - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	685	18%	3%
Area-wide Sources	233	6%	1%
On-Road Mobile	955	26%	4%
Gasoline Vehicles	640	17%	3%
Diesel Vehicles	315	8%	1%
Other Mobile	1854	50%	9%
Natural Sources	0	0%	0%
Total	***3727***	***100%***	***17%***
Total Statewide	**21771**		

Table 5-50

Methylene Chloride

Approximately 72 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	142	28%	2%
Area-wide Sources	356	72%	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	***497***	***100%***	***6%***
Total Statewide	**8124**		

Table 5-51

Perchloroethylene

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

San Joaquin Valley - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	293	58%	2%
Area-wide Sources	209	42%	2%
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	***502***	***100%***	***4%***
Total Statewide	**12030**		

Table 5-52

Diesel Particulate Matter

Emissions of diesel particulate matter are from mobile sources (approximately 92 percent) and stationary sources (approximately 5 percent).

San Joaquin Valley - Diesel Particulate Matter			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	204	5%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	960	24%	4%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	960	24%	4%
Other Mobile	2769	68%	11%
Natural Sources	0	0%	0%
Total	***3933***	***100%***	***16%***
Total Statewide	**24509**		

Table 5-53

San Joaquin Valley Air Basin

Air Quality and Health Risk

During 1990 through 2000, the ARB monitored ambient TAC concentrations at four sites in the San Joaquin Valley Air Basin. The sites are located in Bakersfield, Fresno, Stockton, and Modesto. In addition, complete and representative data for a limited number of TACs are available from a second site in Modesto during 1991 to 1997. At the end of February 2000, TAC monitoring was discontinued at the primary Modesto site, and additional data will not be available. 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 TACs with measured data reflect the year 2000. The estimate given for diesel particulate matter also reflects 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 is lower than the estimated statewide health risk, it is similar to values estimated for other urbanized areas of the State such as

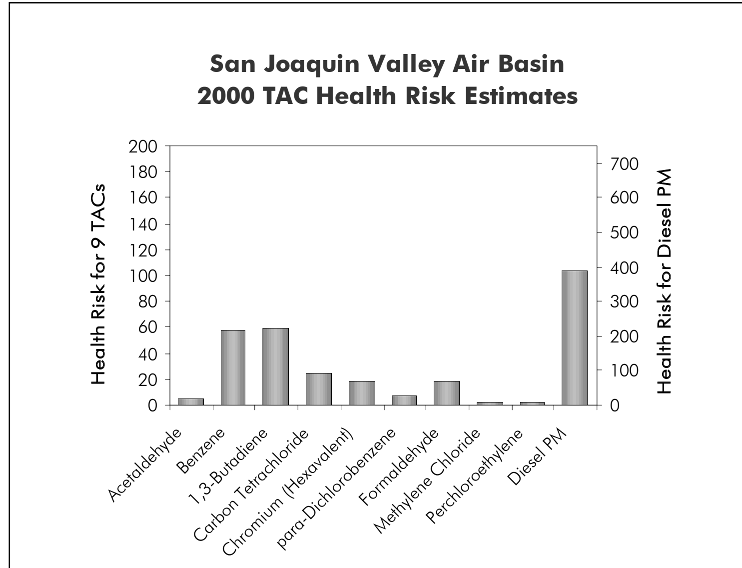


Figure 5-14

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 and 1,3-butadiene both show more than a 60 percent reduction, and diesel PM shows a reduction equal to 50 percent. Average concentrations and health risks for *para*-dichlorobenzene show no change from 1990 to 2000. In contrast, formaldehyde concentrations and health risks show an increase of 7 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**
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
	Health Risk	9	9	7	8	6	3	6	6	6	8	5
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
	Health Risk	227	196	126	122	123	107	68	66	71	64	58
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
	Health Risk	154	135	89	127	121	99	83	73	88	67	59
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08		0.11		0.10
	Health Risk	34	34		29		26	20		30		25
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
para-Dichlorobenzene	Annual Avg		0.11	0.11	0.13	0.11	0.11	0.10	0.13			0.11
	Health Risk		7	7	9	7	8	7	9			7
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
	Health Risk	18	13	11	12	13	15	22	20	21	25	19
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
	Health Risk	3	2	2	3	2	2	2	2	2	2	2
Perchloroethylene	Annual Avg	0.13	0.13	0.10	0.47	0.07	0.07	0.07	0.06	0.04		0.08
	Health Risk	5	5	4	19	3	3	3	2	2		3
*Diesel Particulate Matter***	*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
	With Diesel PM	***(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

2001 Emission Inventory by Compound

Acetaldehyde

Approximately 77 percent of the emissions of acetaldehyde are from mobile sources.

San Diego - Acetaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	23	4%	0%
Area-wide Sources	106	19%	1%
On-Road Mobile	161	28%	2%
Gasoline Vehicles	94	17%	1%
Diesel Vehicles	67	12%	1%
Other Mobile	277	49%	3%
Natural Sources	0	0%	0%
Total	***567***	***100%***	***7%***
Total Statewide	**8239**		

Table 5-55

Benzene

The primary sources of benzene emissions in the San Diego Air Basin are mobile sources (approximately 95 percent).

San Diego - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	50	3%	0%
Area-wide Sources	33	2%	0%
On-Road Mobile	1067	73%	5%
Gasoline Vehicles	1049	71%	5%
Diesel Vehicles	18	1%	0%
Other Mobile	321	22%	1%
Natural Sources	0	0%	0%
Total	***1471***	***100%***	***7%***
Total Statewide	**22022**		

Table 5-56

1,3-Butadiene

Approximately 85 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%	<1%
Area-wide Sources	4	1%	<1%
On-Road Mobile	162	61%	4%
Gasoline Vehicles	160	61%	4%
Diesel Vehicles	2	1%	<1%
Other Mobile	89	34%	2%
Natural Sources	8	3%	0%
Total	***264***	***100%***	***7%***
Total Statewide	**3678**		

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	<.01	100%	<1%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	***<.01***	***100%***	***<1%***
Total Statewide	**3.67**		

Table 5-58

Chromium (Hexavalent)

Approximately 80 percent of the chromium (hexavalent) emissions are from other mobile sources. Stationary sources account for approximately 20 percent.

San Diego - Chromium (Hexavalent)			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0.04	20%	2%
Area-wide Sources	<.01	1%	<1%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.18	80%	8%
Natural Sources	<.01	0%	<1%
Total	***0.22***	***100%***	***10%***
Total Statewide	**2.20**		

Table 5-59

para-Dichlorobenzene

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

San Diego - *para*-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	0	0%	0%
Area-wide Sources	150	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	***150***	***100%***	***8%***
Total Statewide	**1799**		

Table 5-60

Formaldehyde

Approximately 86 percent of the formaldehyde emissions are from mobile sources.

San Diego - Formaldehyde			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	92	6%	0%
Area-wide Sources	121	8%	1%
On-Road Mobile	575	37%	3%
Gasoline Vehicles	441	29%	2%
Diesel Vehicles	134	9%	1%
Other Mobile	753	49%	3%
Natural Sources	0	0%	0%
Total	***1542***	***100%***	***7%***
Total Statewide	**21771**		

Table 5-61

Methylene Chloride

Area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products account for approximately 82 percent of the emissions of methylene chloride.

San Diego - Methylene Chloride			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	68	18%	1%
Area-wide Sources	310	82%	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	***378***	***100%***	***5%***
Total Statewide	**8124**		

Table 5-62

Perchloroethylene

Approximately 89 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	1486	89%	12%
Area-wide Sources	182	11%	2%
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	***1668***	***100%***	***14%***
Total Statewide	**12030**		

Table 5-63

Diesel Particulate Matter

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

San Diego - Diesel Particulate Matter			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	20	1%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	436	26%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	436	26%	2%
Other Mobile	1237	73%	5%
Natural Sources	0	0%	0%
Total	***1693***	***100%***	***7%***
Total Statewide	**24509**		

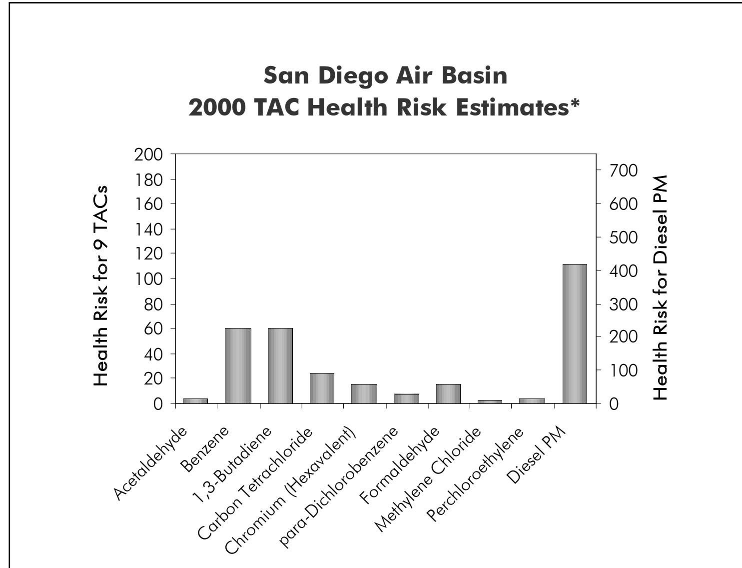
Table 5-64

San Diego Air Basin

Air Quality and Health Risk

During 1990 through 2000, 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 *para*-dichlorobenzene reflect 1997. The health risk estimates for the remaining nine TACs reflect the year 2000. The estimated health risk for diesel PM is 420 excess cancer cases per million people. While the health risk from



* Data for *para*-dichlobenzene reflect 1997; data for all other TACs reflect 2000.

Figure 5-15

diesel PM is lower than the estimated statewide value, it is comparable to the annual average 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 risks for *para*-dichlorobenzene and methylene chloride show little change during 1990 to 2000. 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 during the last five years, formaldehyde concentrations and health risk have decreased. Of the ten TACs included in Figure 5-15, benzene, perchloroethylene, chromium (hexavalent), diesel PM, and 1,3-butadiene show the greatest reductions: 71 percent, 68 percent, 58 percent, 52 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 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**
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
	Health Risk	6	7	6	7	7	3	5	5	4	5	4
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
	Health Risk	208	158	137	107	129	90	71	70	70	79	60
1,3-Butadiene	Annual Avg	0.33	0.26	0.26	0.31	0.31	0.24	0.21	0.20	0.20	0.22	0.16
	Health Risk	125	97	97	117	115	91	78	75	74	83	60
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.10		0.10	0.08				0.09
	Health Risk	35	34		27		26	20				25
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
para-Dichlorobenzene	Annual Avg		0.10	0.11	0.13	0.15	0.12	0.11	0.13			
	Health Risk		7	8	8	10	8	7	8			
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
	Health Risk	12	11	9	13	17	16	19	19	17	20	16
Methylene Chloride	Annual Avg	0.59	0.83	1.34	1.13	0.73	0.63	0.59	0.57		0.53	0.76
	Health Risk	2	3	5	4	3	2	2	2		2	3
Perchloroethylene	Annual Avg	0.28	0.27	0.26	0.20	0.21	0.25	0.15	0.13			0.09
	Health Risk	11	11	11	8	8	10	6	5			4
*Diesel Particulate Matter***	*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
	With Diesel PM	***(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

2001 Emission Inventory by Compound

Acetaldehyde

Approximately 63 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	13	2%	0%
Area-wide Sources	297	36%	4%
On-Road Mobile	174	21%	2%
Gasoline Vehicles	93	11%	1%
Diesel Vehicles	81	10%	1%
Other Mobile	344	42%	4%
Natural Sources	0	0%	0%
Total	***828***	***100%***	***10%***
Total Statewide	**8239**		

Table 5-66

Benzene

The primary sources of benzene emissions in the Sacramento Valley Air Basin are mobile sources (approximately 76 percent).

Sacramento Valley - Benzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	148	7%	1%
Area-wide Sources	354	18%	2%
On-Road Mobile	1085	54%	5%
Gasoline Vehicles	1063	53%	5%
Diesel Vehicles	22	1%	0%
Other Mobile	436	22%	2%
Natural Sources	0	0%	0%
Total	***2023***	***100%***	***9%***
Total Statewide	**22022**		

Table 5-67

1,3-Butadiene

Approximately 77 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	73	21%	2%
On-Road Mobile	159	46%	4%
Gasoline Vehicles	157	45%	4%
Diesel Vehicles	2	1%	0%
Other Mobile	106	31%	3%
Natural Sources	8	2%	0%
Total	***346***	***100%***	***9%***
Total Statewide	**3678**		

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	**3.67**		

Table 5-69

Chromium (Hexavalent)

Approximately 70 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	0.06	70%	3%
Area-wide Sources	<.01	2%	<1%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.02	28%	1%
Natural Sources	<.01	<1%	<1%
Total	***0.09***	***100%***	***4%***
Total Statewide	**2.20**		

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 - para-Dichlorobenzene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	<1	0%	0%
Area-wide Sources	121	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	***121***	***100%***	***7%***
Total Statewide	**1799**		

Table 5-71

Formaldehyde

Approximately 75 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	161	8%	1%
Area-wide Sources	335	17%	2%
On-Road Mobile	583	29%	3%
Gasoline Vehicles	421	21%	2%
Diesel Vehicles	161	8%	1%
Other Mobile	904	46%	4%
Natural Sources	0	0%	0%
Total	***1982***	***100%***	***9%***
Total Statewide	**21771**		

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	100	29%	1%
Area-wide Sources	251	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	***352***	***100%***	***4%***
Total Statewide	**8124**		

Table 5-73

Perchloroethylene

Approximately 85 percent of the emissions of perchloroethylene are from stationary sources such as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Sacramento Valley - Perchloroethylene			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	832	85%	7%
Area-wide Sources	148	15%	1%
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	***979***	***100%***	***8%***
Total Statewide	**12030**		

Table 5-74

Diesel Particulate Matter

Essentially all of the emissions of diesel particulate matter are from mobile sources.

Sacramento Valley - Diesel Particulate Matter			
Emissions Source	**tons/year**	**Percent Air Basin**	**Percent State**
Stationary Sources	87	4%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	554	25%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	554	25%	2%
Other Mobile	1594	71%	7%
Natural Sources	0	0%	0%
Total	***2234***	***100%***	***9%***
Total Statewide	**24509**		

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.

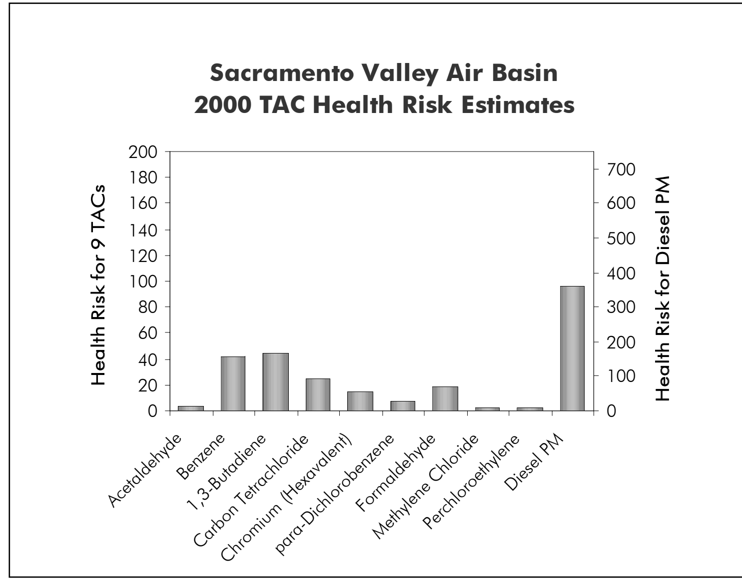


Figure 5-16

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 2000, the most recent year for which complete and representative data are available. The estimate for diesel PM also reflects 2000. Like all other air basins, 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, 78 percent and 69 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 formaldehyde have been reduced since 1990. The annual average concentration and health risk for formaldehyde are more than 50 percent higher in 2000 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 2000 data. When doing this, formaldehyde shows a decrease on the order of 9 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**
Acetaldehyde	Annual Avg	1.29			1.37	1.04	0.39	1.03	1.05	0.92	1.23	0.83
	Health Risk	6			7	5	2	5	5	4	6	4
Benzene	Annual Avg	2.02	1.88	1.35	1.00	1.02	0.80	0.56	0.55	0.5	0.56	0.45
	Health Risk	187	174	125	92	95	74	51	51	47	52	42
1,3-Butadiene	Annual Avg	0.38	0.33	0.28	0.29	0.22	0.19	0.18	0.16	0.15	0.13	0.12
	Health Risk	142	125	106	108	83	70	66	60	58	48	45
Carbon Tetrachloride	Annual Avg	0.12	0.12		0.11		0.10	0.08				0.09
	Health Risk	33	32		29		26	21				25
Chromium (Hexavalent)	Annual Avg			0.17	0.14	0.13	0.18	0.11	0.10	0.10	0.10	0.10
	Health Risk			26	21	19	26	16	15	15	15	15
para-Dichlorobenzene	Annual Avg			0.11	0.10	0.20	0.14	0.11	0.14			0.10
	Health Risk			7	7	14	9	7	10			7
Formaldehyde	Annual Avg	1.57			1.77	1.75	1.91	2.76	2.92	2.52	3.61	2.51
	Health Risk	12			13	13	14	20	22	19	27	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
	Health Risk	2	2	2	3	2	2	2	2		2	2
Perchloroethylene	Annual Avg	0.07	0.07	0.06	0.05	0.17	0.05	0.06	0.05			0.06
	Health Risk	3	3	3	2	7	2	2	2			2
*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
	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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