
CHAPTER 6

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 estimated concentrations of diesel particulate matter (diesel PM). Information is summarized for the State as a whole and for each of the five most populated air basins.

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 B).

It is important to note that the information presented in this chapter reflects only the ten TACs for which available data indicate the most substantial health risk. There may be other TACs that pose a substantial risk, but for which data are not available (dioxins, for example), or which have not been identified as a concern. Furthermore, the information reflects spatially averaged concentrations. The ambient concentrations and health risks for individual locations may be higher or lower. 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 year is 2000. 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 2000.

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

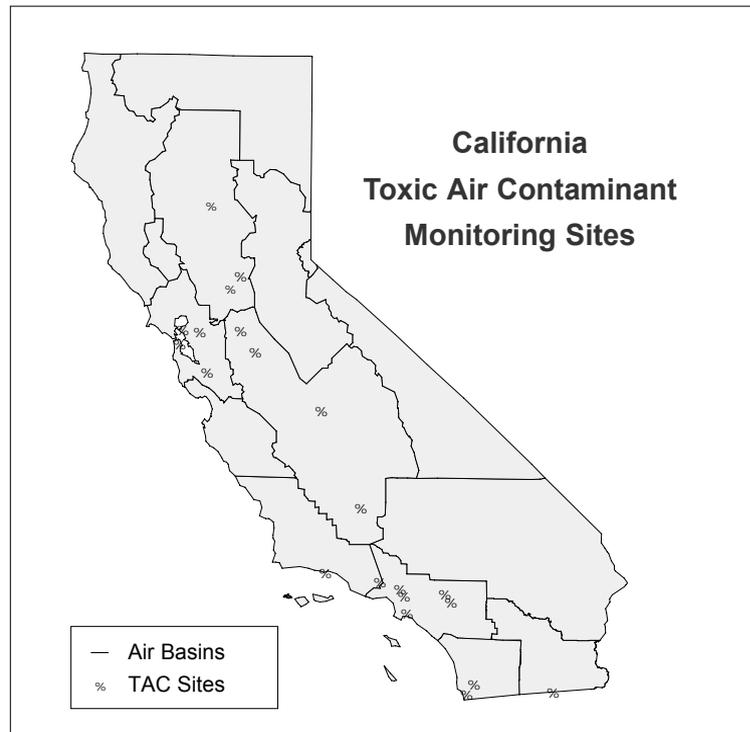


Figure 6-1

monitoring, the ARB has determined atmospheric concentrations of over 60 individual TACs. As shown in Figure 6-1, the ARB currently maintains a network of 21 air quality monitoring stations, measuring ambient concentrations of 58 TACs. 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 12-month monitoring and evaluation study in the Barrio Logan and Logan Heights neighborhoods of San Diego. This pilot effort is serving as the foundation for ARB's community health program. Efforts such as this will supplement our existing statewide TAC monitoring network, which was designed for regional rather than neighbor-

hood assessments. Information from this and other studies will 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 1999. 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 will 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 6-1 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 included in this almanac, as well as many other TACs may be found by accessing the ARB website at www.arb.ca.gov. Data on the web are updated periodically, as information becomes available. More detailed information on the health effects of these compounds, as well as many other toxic air contaminants, 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/Million People*
Acetaldehyde	2.7
Benzene	29
1,3-Butadiene	170
Carbon Tetrachloride	42
Chromium (Hexavalent)	150,000
<i>para</i> -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 "*Proposed Risk Reduction Plan for Diesel-Fueled Engines and Vehicles*" (ARB, July 13, 2000).

Table 6-1

Acetaldehyde

2000 Statewide Emission Inventory

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

Acetaldehyde is both directly emitted into the atmosphere and formed in the atmosphere as a result of photochemical oxidation. Sources of acetaldehyde include emissions from combustion processes such as exhaust from mobile sources and fuel combustion from stationary internal combustion engines, boilers, and process heaters. In California, photochemical oxidation is the largest source of acetaldehyde concentrations in the ambient air. Approximately 27 percent of the statewide acetaldehyde emissions can be attributed to on-road motor vehicles, with an additional 50 percent attributed to other mobile sources such as construction and mining equipment, aircraft, recreational boats, and agricultural equipment. Area-wide sources of emissions, which contribute 20 percent of the

Acetaldehyde		
Emissions Source	tons/year	Percent
Stationary Sources	243	3%
Area-wide Sources	1939	20%
On-Road Mobile	2575	27%
Gasoline Vehicles	1449	15%
Diesel Vehicles	1125	12%
Other Mobile	4812	50%
Natural Sources	0	0%
Total Statewide	9568	100%

Table 6-2

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

2000 Top Ten Counties - Acetaldehyde

The top ten counties account for approximately 52 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 (17 percent of the emissions of acetaldehyde 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 29 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, Fresno, Kern, Sacramento, and Santa Clara. These five counties account for approximately 16 percent of statewide acetaldehyde emissions.

Acetaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1624	17%
San Diego	San Diego	675	7%
Orange	South Coast	549	6%
Alameda	San Francisco Bay Area	363	4%
San Bernardino	South Coast	315	3%
Fresno	San Joaquin Valley	307	3%
Kern	San Joaquin Valley	305	3%
Sacramento	Sacramento Valley	301	3%
Santa Clara	San Francisco Bay Area	300	3%
Riverside	South Coast	261	3%

Figure 6-3

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 6-2, 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 fairly flat trend over the last four years. Although data are shown for all years during the trend period, the values prior to 1996 are uncertain because the ARB analyzed ambient samples using a method that underestimated the actual concentrations. A method change in 1996 corrected this bias. However, the ARB was not able to develop a correction factor for the earlier data. Although the concentrations and health risk values for years prior to 1996 are lower than expected, they are included here for completeness.

Based on the statewide annual averages for the four years with consistent data, 1996 through 1999, acetaldehyde concentrations and associated health risk decreased by about 14 percent. On an individual basis, the health risks from acetaldehyde

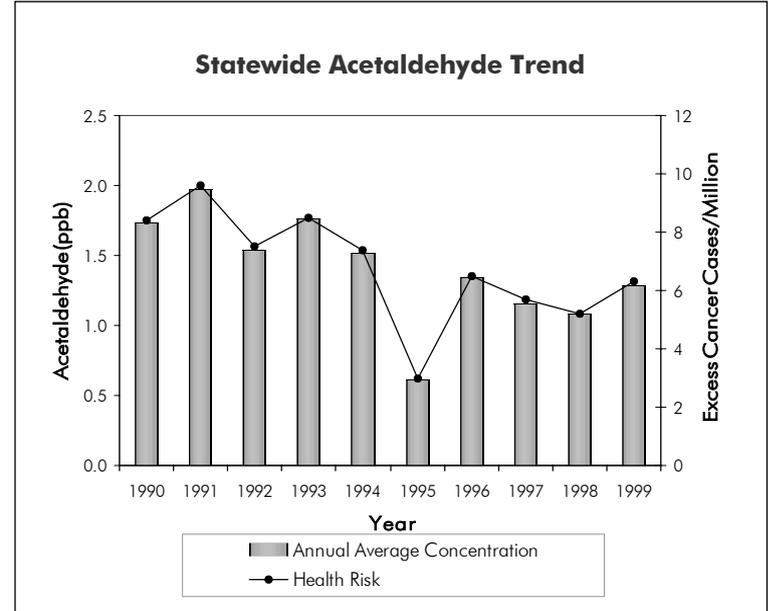


Figure 6-2

alone are much lower than they are for some of the other toxic air contaminants. In fact, considering the ten compounds presented in this almanac, the health risk from acetaldehyde alone ranks eighth out of ten. During 1999, there was an estimated chance of 6 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 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 recently adopted low emission vehicle (LEV) emission standards. Additionally, the primary directly emitted acetaldehyde, also a reactive organic gas, is expected to decline.

Benzene

2000 Statewide Emission Inventory

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

Current estimates show that approximately 85 percent of the benzene emitted in California comes from motor vehicles, including evaporative leakage and unburned fuel exhaust. The predominant sources of total benzene emissions in the atmosphere are gasoline fugitive emissions and gasoline motor vehicle exhaust. Approximately 50 percent of the statewide benzene emissions can be attributed to on-road motor vehicles, with an additional 35 percent attributed to other mobile sources such as recreational boats, off-road recreational vehicles, and lawn and garden equipment. Currently, the benzene content of gaso-

Benzene		
Emissions Source	tons/year	Percent
Stationary Sources	1805	6%
Area-wide Sources	2505	8%
On-Road Mobile	15538	50%
Gasoline Vehicles	15232	49%
Diesel Vehicles	306	1%
Other Mobile	10887	35%
Natural Sources	43	< 1%
Total Statewide	30778	100%

Table 6-4

line is about 1 percent. Because of its anti-knock properties, a mixture of benzene-rich aromatics is added to gasoline as a replacement for alkyl lead compounds. 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 8 percent of the statewide benzene emissions. The primary stationary

sources of reported benzene emissions are crude petroleum and natural gas mining, petroleum refining, and electric generation. The primary area-wide sources include the application of agricultural and structural pesticides. The primary natural sources are petroleum seeps that form where oil or natural gas emerge from subsurface sources to the ground or water surface.

2000 Top Ten Counties - Benzene

The top ten counties account for approximately 55 percent of the statewide benzene emissions. The South Coast Air Basin has four of the top ten counties emitting benzene: South Coast portion of Los Angeles County (19 percent of the emissions of benzene statewide), Orange County (7 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (2 percent). Collectively, approximately 31 percent of statewide benzene emissions occur in the South Coast Air Basin. Two counties in the San Joaquin Valley Air Basin contribute approximately 8 percent: Kern County (4 percent) and Fresno County (4 percent). The four other counties in the top ten for benzene emissions are: San Diego, Santa Clara, Sacramento, and Alameda. These four counties account for approximately 16 percent of statewide benzene emissions.

Benzene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	5914	19%
San Diego	San Diego	2267	7%
Orange	South Coast	2004	7%
Kern	San Joaquin Valley	1323	4%
Fresno	San Joaquin Valley	1102	4%
San Bernardino	South Coast	1037	3%
Santa Clara	San Francisco Bay Area	1015	3%
Sacramento	Sacramento Valley	925	3%
Alameda	San Francisco Bay Area	890	3%
Riverside	South Coast	757	2%

Table 6-5

Benzene

Air Quality and Health Risk

The ARB has routinely monitored benzene concentrations in the ambient air for more than a decade. 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 data shown in Figure 6-3 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

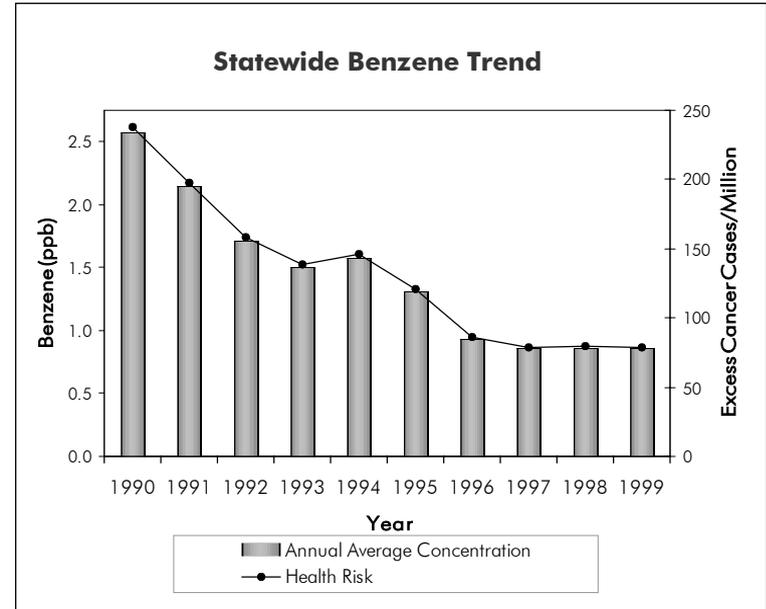


Figure 6-3

study process and adjustment equations is available from the ARB Monitoring and Laboratory Division.

Based on the statewide annual averages, the 1999 statewide ambient benzene concentration was about 67 percent lower than the peak in 1990. Figure 6-3 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 1999, there was an estimated chance of 79 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.

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

2000 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 91 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 46 percent of the statewide 1,3-butadiene emissions can be attributed to on-road motor vehicles, with an additional 45 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 7 percent. Stationary sources contribute less than 1 percent of the statewide 1,3-butadiene emissions. The primary stationary sources with reported 1,3-butadiene emissions include petroleum refining,

1,3-Butadiene		
Emissions Source	tons/year	Percent
Stationary Sources	13	<1%
Area-wide Sources	390	7%
On-Road Mobile	2449	46%
Gasoline Vehicles	2420	45%
Diesel Vehicles	29	1%
Other Mobile	2401	45%
Natural Sources	87	2%
Total Statewide	5340	100%

Table 6-6

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

2000 Top Ten Counties - 1,3-Butadiene Emissions

The top ten counties account for approximately 52 percent of the statewide 1,3-butadiene emissions. Four counties in the South Coast Air Basin contribute approximately 30 percent: South Coast portion of Los Angeles County (19 percent), Orange County (6 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (2 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 Fresno County (3 percent). The other counties in the top ten for 1,3-butadiene emissions are: Sacramento, Santa Clara, and Alameda.

1,3-Butadiene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	1032	19%
San Diego	San Diego	400	7%
Orange	South Coast	327	6%
San Bernardino	South Coast	180	3%
Tulare	San Joaquin Valley	155	3%
Sacramento	Sacramento Valley	153	3%
Santa Clara	San Francisco Bay Area	150	3%
Alameda	San Francisco Bay Area	141	3%
Fresno	San Joaquin Valley	136	3%
Riverside	South Coast	129	2%

Table 6-7

1,3-Butadiene

Air Quality and Health Risk

The ARB routinely monitors for 1,3-butadiene at its statewide air toxics monitoring network. 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 6-4 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

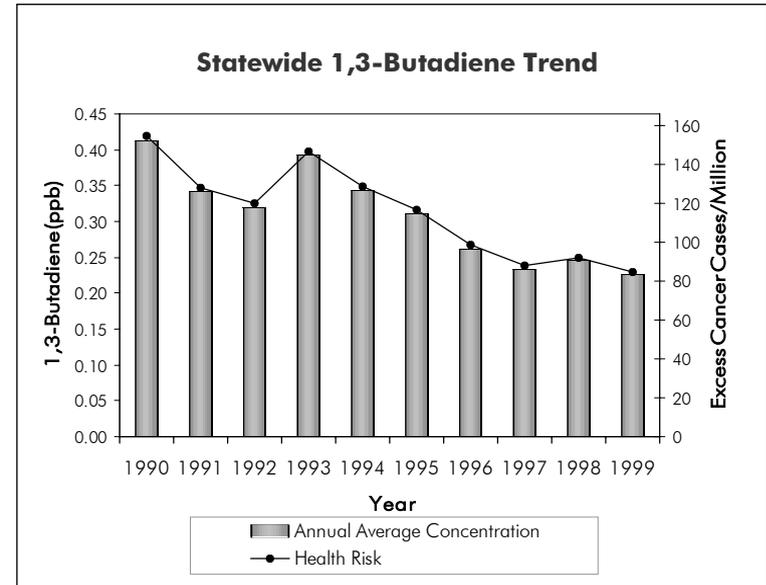


Figure 6-4

and adjustment equations is available from the ARB Monitoring and Laboratory Division.

Figure 6-4 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 45 percent from 1990 to 1999. 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.

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 reduce 1,3-butadiene emissions from cars and light-duty trucks.

Carbon Tetrachloride

2000 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	4.39	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	4.39	100%

Table 6-8

2000 Top Ten Counties - Carbon Tetrachloride

The top ten counties account for approximately 99 percent of the statewide carbon tetrachloride emissions. Contra Costa County, in the San Francisco Bay Area Air Basin, accounts for approximately 50 percent of the emissions of carbon tetrachloride statewide. Los Angeles County (South Coast Air Basin portion) accounts for approximately 42 percent. 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 7 percent of statewide carbon tetrachloride emissions.

Carbon Tetrachloride			
County	Air Basin	tons/year	Percent
Contra Costa	San Francisco Bay Area	2.18	50%
Los Angeles	South Coast	1.84	42%
Orange	South Coast	0.09	2%
Santa Barbara	South Central Coast	0.07	2%
Sacramento	Sacramento Valley	0.06	1%
Ventura	South Central Coast	0.05	1%
Riverside	South Coast	0.02	1%
San Diego	San Diego	0.02	0%
Fresno	San Joaquin Valley	0.01	0%
Santa Clara	San Francisco Bay Area	0.01	0%

Table 6-9

Carbon Tetrachloride

Air Quality and Health Risk

The ARB routinely monitors carbon tetrachloride concentrations in the ambient air. Based on data from the 21 sites in the TAC monitoring network, the 1998 statewide average carbon tetrachloride concentration and the associated health risk were 13 percent lower than the peak in 1990. Figure 6-5 shows the annual average statewide concentrations and the associated health risk from carbon tetrachloride alone. During 1998, there was an estimated risk of 30 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. However, the values for 1998 are nearly 50 percent higher than the values for 1996. Data are not sufficient to determine if this is an anomaly, or if the upward trend will continue. However, it is important to remember that the data have not been adjust-

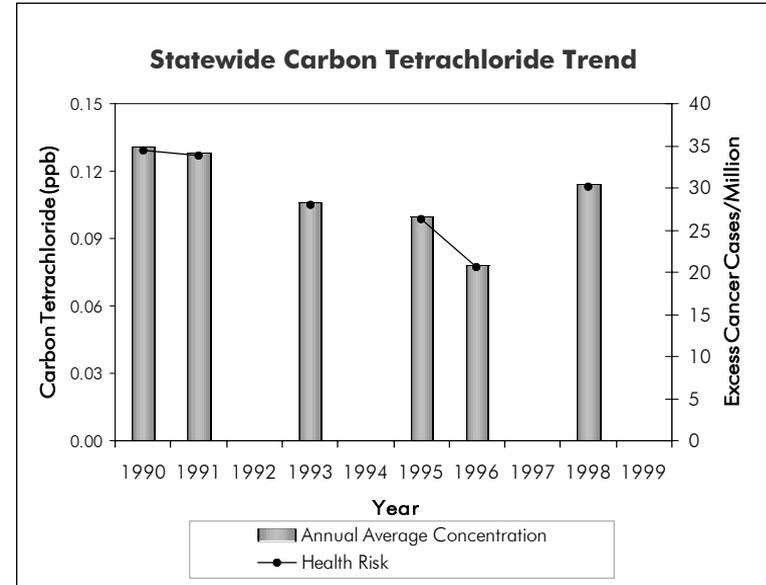


Figure 6-5

ed 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, which should lead to lower overall ambient carbon tetrachloride concentrations.

Chromium (Hexavalent)

2000 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 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 contribute approximately 61 percent of statewide emissions of chromium (hexavalent) while other mobile sources such as jet aircraft and ships contribute approximately 38 percent. Stationary sources that report chromium (hexavalent) emissions include electrical generation, aircraft and parts manufacturing, fabricated metal product manufacturing, and stone, clay, and glass production. The application of various types of industrial surface coatings also contributes to chromium (hexavalent) emissions.

Chromium (Hexavalent)		
Emissions Source	tons/year	Percent
Stationary Sources	1.49	61%
Area-wide Sources	0.04	2%
On-Road Mobile	0.00	0%
Gasoline Vehicles	0.00	0%
Diesel Vehicles	0.00	0%
Other Mobile	0.93	38%
Natural Sources	< .01	0%
Total Statewide	2.46	100%

Table 6-10

2000 Top Ten Counties - Chromium (Hexavalent)

The top ten counties account for approximately 72 percent of the statewide chromium (hexavalent) emissions. The South Coast Air Basin has four of the top ten counties emitting chromium (hexavalent): South Coast portion of Los Angeles County (22 percent of the emissions of chromium (hexavalent) statewide), South Coast portion of Riverside County (7 percent), Orange County (3 percent), and South Coast portion of San Bernardino County (3 percent). Collectively, approximately 35 percent of statewide chromium (hexavalent) emissions occur in the South Coast Air Basin. Two counties in the Mojave Desert Air Basin contribute approximately 15 percent: Mojave Desert portion of Kern County (12 percent) and Mojave Desert portion of San Bernardino County (3 percent). The four other counties in the top ten for chromium (hexavalent) emissions are: San Diego, Solano (San Francisco Bay Area Air Basin portion), San Joaquin, and Fresno. These four counties account for approximately 22 percent of the statewide chromium (hexavalent) emissions.

Chromium (Hexavalent)			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	0.54	22%
Kern	Mojave Desert	0.31	12%
San Diego	San Diego	0.22	9%
Solano	San Francisco Bay Area	0.18	7%
Riverside	South Coast	0.18	7%
San Joaquin	San Joaquin Valley	0.08	3%
Orange	South Coast	0.07	3%
San Bernardino	South Coast	0.07	3%
San Bernardino	Mojave Desert	0.07	3%
Fresno	San Joaquin Valley	0.06	3%

Table 6-11

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 1998. 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 6-6. Both show a general downward trend from 1992 to 1998, 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 1998 annual average chromium (hexavalent) concentration and the associated health risk were 59 percent lower than they were

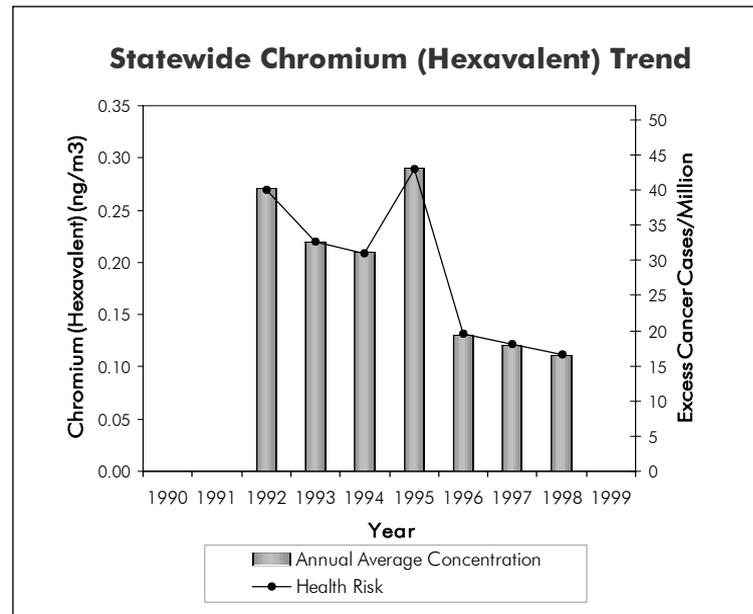


Figure 6-6

in 1992. During 1998, there was an estimated risk of 17 excess cancer cases per million people, from chromium (hexavalent) alone. Based on this, chromium (hexavalent) ranks sixth out of 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.

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).

para-Dichlorobenzene

2000 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.

<i>para</i> -Dichlorobenzene		
Emissions Source	tons/year	Percent
Stationary Sources	15	1%
Area-wide Sources	1539	99%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	1553	100%

Table 6-12

2000 Top Ten Counties - *para*-Dichlorobenzene

The top ten counties account for approximately 72 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 (28 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 45 percent of statewide *para*-dichlorobenzene emissions occur in the South Coast Air Basin. San Diego County contributes approximately 9 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.

<i>para</i> -Dichlorobenzene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	434	28%
Orange	South Coast	135	9%
San Diego	San Diego	133	9%
Santa Clara	San Francisco Bay Area	79	5%
Alameda	San Francisco Bay Area	66	4%
San Bernardino	South Coast	61	4%
Riverside	South Coast	56	4%
Sacramento	Sacramento Valley	55	4%
Contra Costa	San Francisco Bay Area	43	3%
Fresno	San Joaquin Valley	38	2%

Table 6-13

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. 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 6-7 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 1997, there was an estimated risk of 9 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.

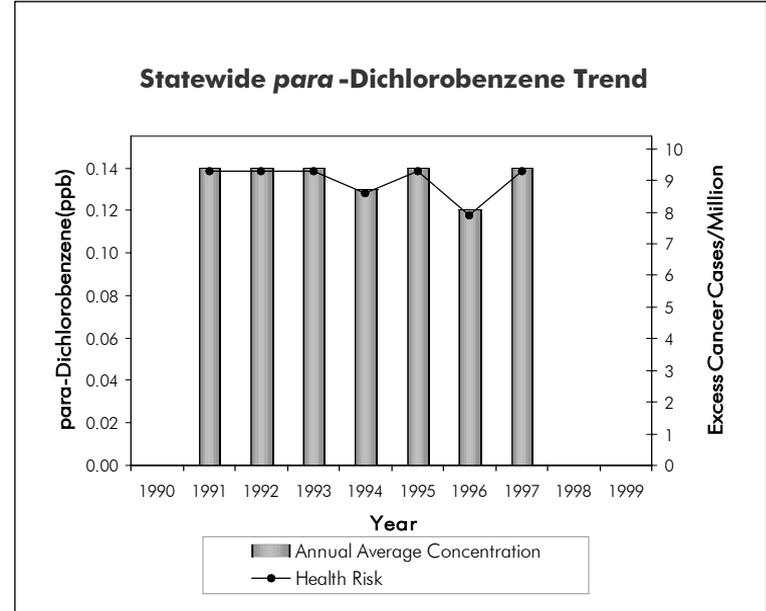


Figure 6-7

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Formaldehyde

2000 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 85 percent of direct formaldehyde emissions are estimated to come from the combustion of fossil fuels from mobile sources. Approximately 35 percent of the total statewide formaldehyde emissions can be attributed to on-road motor vehicles, with an additional 50 percent attributed to other mobile sources such as aircraft,

Formaldehyde		
Emissions Source	tons/year	Percent
Stationary Sources	1579	6%
Area-wide Sources	2277	9%
On-Road Mobile	9188	35%
Gasoline Vehicles	6937	26%
Diesel Vehicles	2252	9%
Other Mobile	13285	50%
Natural Sources	0	0%
Total Statewide	26329	100%

Table 6-14

recreational boats, and construction and mining equipment. Area-wide sources contribute approximately 9 percent and stationary sources contribute approximately 6 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.

2000 Top Ten Counties - Formaldehyde

The top ten counties account for approximately 55 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 (19 percent of the emissions of formaldehyde statewide), Orange County (6 percent), South Coast portion of San Bernardino County (3 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 31 percent of statewide 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, Sacramento, and Fresno. These six counties account for approximately 24 percent of statewide formaldehyde emissions.

Formaldehyde			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	4999	19%
San Diego	San Diego	1941	7%
Orange	South Coast	1568	6%
Kern	San Joaquin Valley	1232	5%
San Bernardino	South Coast	850	3%
Santa Clara	San Francisco Bay Area	815	3%
Alameda	San Francisco Bay Area	798	3%
Sacramento	Sacramento Valley	797	3%
Fresno	San Joaquin Valley	774	3%
Riverside	South Coast	699	3%

Table 6-15

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 during 1990 through 1992. Following this, there is a general increase until 1996 and then a decrease from 1996 to 1998. The subsequent increase in 1999 brought values close to what they were during 1996, however, we will need several more years of data before we can determine whether this signals a change in the overall 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 only about 4 percent. Although the health risk from

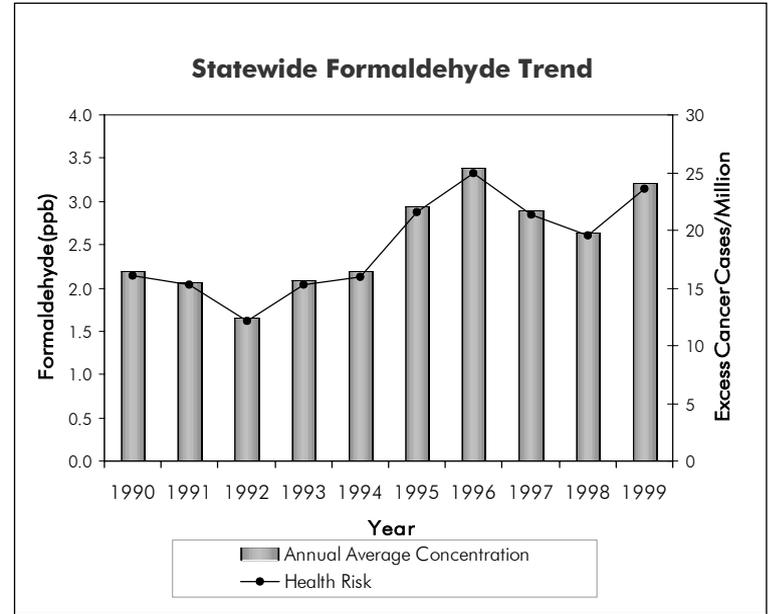


Figure 6-8

formaldehyde is still considerable, ambient concentrations and associated health risks have shown a small drop over the last four years. While formaldehyde is emitted by both stationary and mobile sources, mobile sources are, by far, the largest contributors. The ARB has adopted the Low Emissions/Clean Fuels Regulations in 1990, and these regulations are expected 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

2000 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 61 percent of the statewide methylene chloride emissions. Area-wide sources contribute approximately 39 percent.

Methylene Chloride		
Emissions Source	tons/year	Percent
Stationary Sources	4984	61%
Area-wide Sources	3182	39%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	8166	100%

Table 6-16

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

2000 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 (33 percent of the emissions of methylene chloride statewide), Orange County (12 percent), South Coast portion of San Bernardino County (5 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 53 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 18 percent: Santa Clara County (12 percent), Alameda County (4 percent), and Contra Costa County (2 percent). The three other counties in the top ten for methylene chloride emissions are: San Diego, Ventura, and Sacramento. 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	2675	33%
Santa Clara	San Francisco Bay Area	978	12%
Orange	South Coast	976	12%
San Bernardino	South Coast	436	5%
San Diego	San Diego	372	5%
Alameda	San Francisco Bay Area	366	4%
Riverside	South Coast	230	3%
Ventura	South Central Coast	173	2%
Contra Costa	San Francisco Bay Area	173	2%
Sacramento	Sacramento Valley	170	2%

Table 6-17

Methylene Chloride

Air Quality and Health Risk

The ARB routinely monitors methylene chloride in the ambient air. The trend graph in Figure 6-9 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 four years. Of the ten compounds presented in this almanac, methylene chloride presents one of the lower health risks, on a statewide basis. However, any level of risk is a concern from a public health standpoint. During 1999, there was an estimated risk of 2 excess cancer cases per million people, and methylene chloride ranks last among the ten toxic air contaminants considered here.

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 ambi-

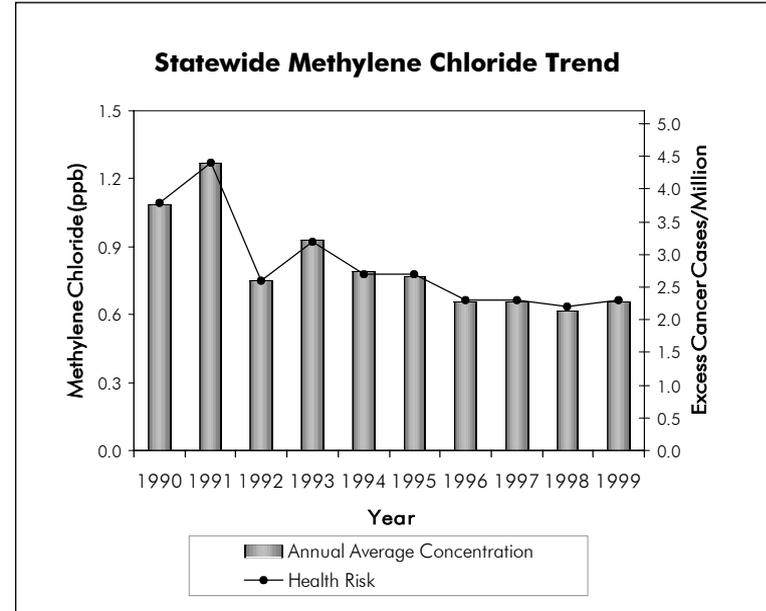


Figure 6-9

ent 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, "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

2000 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	9405	82%
Area-wide Sources	2026	18%
On-Road Mobile	0	0%
Gasoline Vehicles	0	0%
Diesel Vehicles	0	0%
Other Mobile	0	0%
Natural Sources	0	0%
Total Statewide	11431	100%

Table 6-18

2000 Top Ten Counties - Perchloroethylene

The top ten counties account for approximately 77 percent of the statewide perchloroethylene emissions. The South Coast Air Basin has four of the top ten counties emitting perchloroethylene: South Coast portion of Los Angeles County (30 percent of the emissions of perchloroethylene statewide), Orange County (14 percent), South Coast portion of San Bernardino County (4 percent), and South Coast portion of Riverside County (3 percent). Collectively, approximately 51 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, Santa Clara, Sacramento, San Francisco, and Monterey. These five counties account for approximately 12 percent of statewide perchloroethylene emissions.

Perchloroethylene			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	3431	30%
San Diego	San Diego	1631	14%
Orange	South Coast	1552	14%
San Bernardino	South Coast	462	4%
Alameda	San Francisco Bay Area	371	3%
Riverside	South Coast	336	3%
Santa Clara	San Francisco Bay Area	322	3%
Sacramento	Sacramento Valley	258	2%
San Francisco	San Francisco Bay Area	226	2%
Monterey	North Central Coast	221	2%

Table 6-19

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 59 percent. Figure 6-10 shows the annual average statewide perchloroethylene concentrations and the associated health risk for 1980 through 1998, 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 1998, there was a chance of 5 excess cancer cases per million people.

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

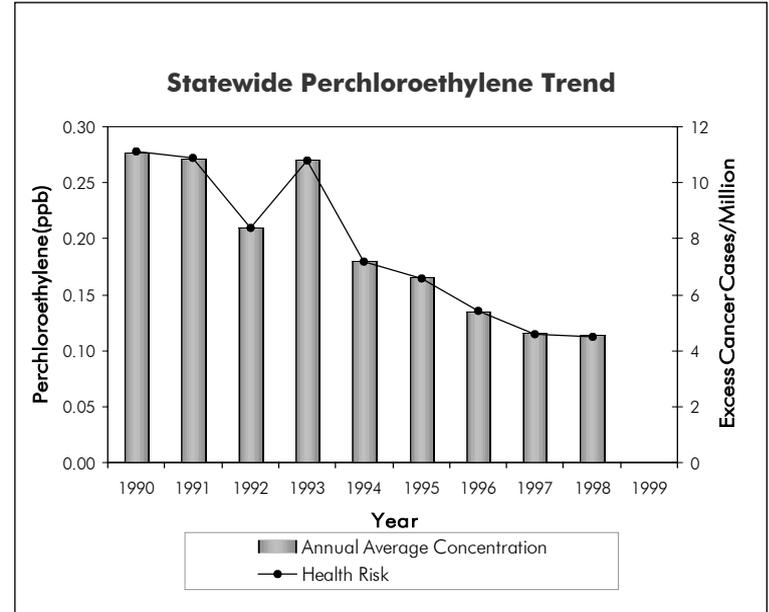


Figure 6-10

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

2000 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 emissions are emitted from both mobile and stationary sources. In California, on-road diesel-fueled vehicles contribute approximately 26 percent of statewide diesel PM emissions, with an additional 72 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 recent ARB report, "*Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*" (Diesel Risk Reduction Plan, October 2000) because they incorporate more recent data. Specifically, the on-road

Diesel Particulate Matter		
Emissions Source	tons/year	Percent
Stationary Sources	558	2%
Area-wide Sources	0	0%
On-Road Mobile	6489	26%
Gasoline Vehicles	0	0%
Diesel Vehicles	6489	26%
Other Mobile	17761	72%
Natural Sources	0	0%
Total Statewide	24808	100%

Table 6-20

mobile source emissions cited in the Diesel Risk Reduction Plan are based on an earlier version of EMFAC 2000 (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 emissions for diesel PM compare favorably.

For stationary sources, this almanac uses the estimates prepared for the Diesel Risk Reduction Plan. These estimates differ somewhat from those currently presented on the ARB web site. As discussed above, we will review the methodology for estimating stationary source emissions and include revised estimates as appropriate.

2000 Top Ten Counties - Diesel Particulate Matter

The top ten counties account for approximately 57 percent of the statewide diesel particulate matter emissions. The South Coast Air Basin has four of the top ten counties emitting diesel particulate matter: South Coast portion of Los Angeles County (19 percent of the emissions of diesel particulate matter statewide), Orange County (7 percent), South Coast portion of Riverside County (3 percent), and South Coast portion of San Bernardino County (3 percent). Collectively, approximately 32 percent of statewide diesel particulate matter emissions occur in the South Coast Air Basin. San Diego County contributes approximately 7 percent. Two counties in the San Joaquin Valley Air Basin contribute approximately 7 percent: Fresno County (4 percent) and San Joaquin Valley portion of Kern County (3 percent). The other three counties in the top ten for diesel particulate matter emissions are: Alameda, Santa Clara, and Sacramento.

Diesel Particulate Matter			
County	Air Basin	tons/year	Percent
Los Angeles	South Coast	4639	19%
San Diego	San Diego	1748	7%
Orange	South Coast	1763	7%
Fresno	San Joaquin Valley	1071	4%
Alameda	San Francisco Bay Area	947	4%
Riverside	South Coast	865	3%
Santa Clara	San Francisco Bay Area	873	4%
Kern	San Joaquin Valley	693	3%
Sacramento	Sacramento Valley	793	3%
San Bernardino	South Coast	757	3%

Table 6-21

Diesel Particulate Matter

Air Quality and Health Risk

The exhaust from diesel-fueled engines is a complex mixture of gases, vapors, and particles, many of which are known human carcinogens. More than 40 diesel exhaust components are listed by the State and federal governments as toxic air contaminants or hazardous air pollutants. Most researchers believe that diesel particulate matter contributes the majority of the risk from exposure to diesel exhaust because the particles carry many of the harmful organics and metals present in exhaust.

Unlike the other toxic air contaminants presented in this almanac, the Air Resources Board does not routinely monitor diesel particulate matter concentrations. However, the ARB made a preliminary estimation of diesel particulate matter concentrations for the State's fifteen air basins using a particulate matter-based exposure method. The method uses the ARB emission inventory's PM₁₀ database, ambient PM₁₀ monitoring data, and the results from several studies with chemical speciation of ambient data. These data were used, along with receptor modeling techniques, to estimate statewide outdoor concentrations of diesel particulate matter. The statewide popula-

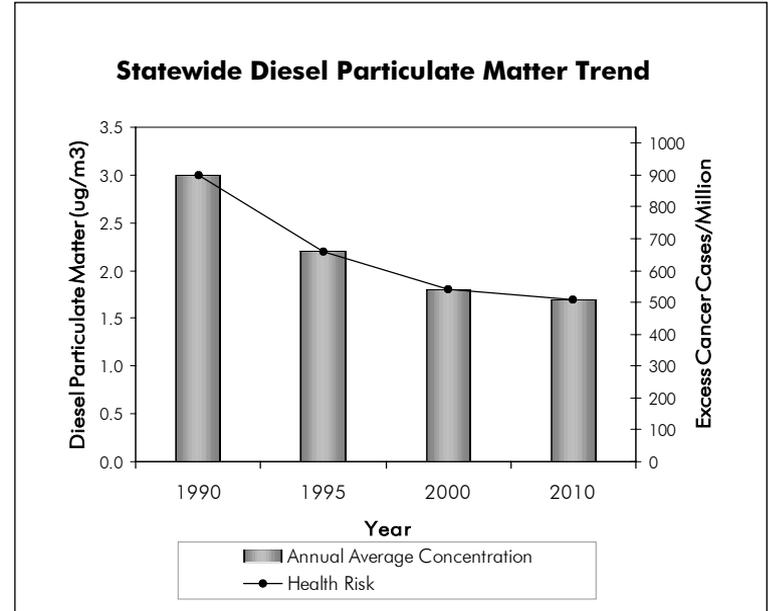


Figure 6-11

tion-weighted average diesel particulate matter concentrations and health risk for various years are shown in Figure 6-11. The average statewide concentration for 1990 was estimated at 3.0 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). This is associated with 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 1995, 2000, and 2010 based on linear extrapolations from the 1990 emissions inventory and linear rollback techniques. It is important to note that the estimated risk from diesel particulate matter 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.

To combat the problem, the ARB has developed a statewide plan to reduce diesel particulate matter concentrations. 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

diesel risk reduction plan will significantly reduce emissions from both old and new diesel-fueled motor vehicles and from stationary sources that burn diesel fuel. In addition to these strategies, the ARB continues to promote the use of alternative fuels and electrification. As a result of these actions, diesel particulate matter concentrations and associated health risk should continue to decline.

South Coast Air Basin 2000 Emission Inventory by Compound

Acetaldehyde

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

South Coast - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	26	1%	0%
Area-wide Sources	363	13%	4%
On-Road Mobile	1010	37%	11%
Gasoline Vehicles	585	21%	6%
Diesel Vehicles	425	15%	4%
Other Mobile	1351	49%	14%
Natural Sources	0	0%	0%
Total	2749	100%	29%
Total Statewide	9568		

Table 6-22

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	374	4%	1%
Area-wide Sources	139	1%	0%
On-Road Mobile	6110	63%	20%
Gasoline Vehicles	5994	62%	19%
Diesel Vehicles	116	1%	0%
Other Mobile	3090	32%	10%
Natural Sources	0	0%	0%
Total	9712	100%	32%
Total Statewide	30778		

Table 6-23

1,3-Butadiene

Approximately 97 percent of the emissions of 1,3-butadiene are from mobile sources.

South Coast - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	4	0%	0%
Area-wide Sources	20	1%	0%
On-Road Mobile	990	59%	19%
Gasoline Vehicles	979	59%	18%
Diesel Vehicles	11	1%	0%
Other Mobile	637	38%	12%
Natural Sources	17	1%	0%
Total	1669	100%	31%
Total Statewide	5340		

Table 6-24

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	1.96	100%	45%
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	1.96	100%	45%
Total Statewide	4.39		

Table 6-25

Chromium (Hexavalent)

Approximately 82 percent of the hexavalent chromium 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	0.7065	82%	29%
Area-wide Sources	0.0010	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.1573	18%	6%
Natural Sources	0.0002	0%	0%
Total	0.8650	100%	35%
Total Statewide	2.4651		

Table 6-26

para-Dichlorobenzene

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

South Coast - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	9	1%	1%
Area-wide Sources	677	99%	44%
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	686	100%	44%
Total Statewide	1553		

Table 6-27

Formaldehyde

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

Methylene Chloride

Approximately 68 percent of the emissions of methylene chloride are from stationary sources such as plastic product manufacturers, manufacturers of synthetics, and aircraft and parts manufacturers.

South Coast - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	321	4%	1%
Area-wide Sources	472	6%	2%
On-Road Mobile	3687	45%	14%
Gasoline Vehicles	2836	35%	11%
Diesel Vehicles	851	10%	3%
Other Mobile	3637	45%	14%
Natural Sources	0	0%	0%
Total	8116	100%	31%
Total Statewide	26329		

Table 6-28

South Coast - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	2917	68%	36%
Area-wide Sources	1400	32%	17%
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	4317	100%	53%
Total Statewide	8166		

Table 6-29

Perchloroethylene

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

Diesel Particulate Matter

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

South Coast - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	4891	85%	43%
Area-wide Sources	891	15%	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	5782	100%	51%
Total Statewide	11431		

Table 6-30

South Coast - Diesel Particulate Matter			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	60	1%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	2485	31%	10%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	2485	31%	10%
Other Mobile	5479	68%	22%
Natural Sources	0	0%	0%
Total	8024	100%	32%
Total Statewide	24808		

Table 6-31

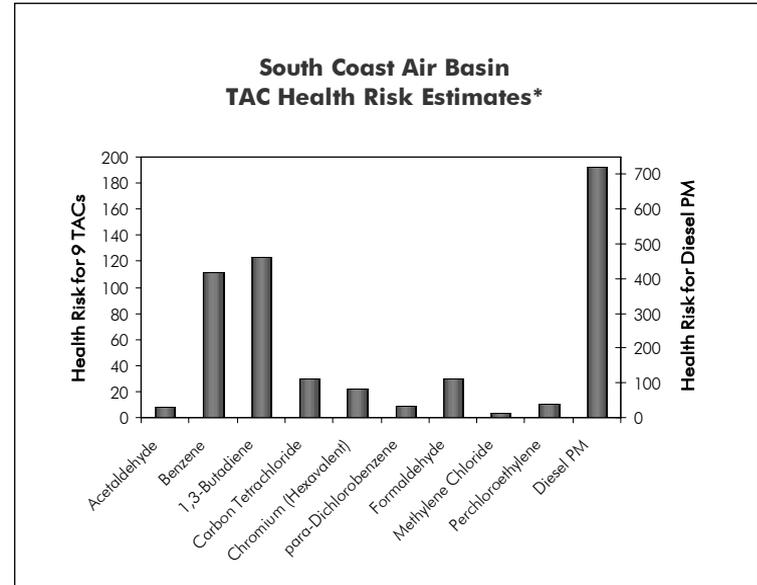
South Coast Air Basin

Air Quality and Health Risk

Over the last decade, the ARB has 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. Figure 6-12 shows the estimated annual average health risks for the nine TACs with measured ambient data. As indicated on the graph, health risk numbers reflect the most recent year for which complete and representative data are available -- 1997, 1998, or 1999. 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.

Although much smaller by comparison, 1,3-butadiene and benzene also pose substantial health risks as shown in Figure 6-12 and Table 6-32. However, it is important to remember that the



* *para*-Dichlorobenzene = 1997; Carbon Tetrachloride, Chromium (Hexavalent), and Perchloroethylene = 1998; Diesel PM = 2000; All other TACs = 1999.

Figure 6-12

health risks shown here are based on an annual average concentration 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 65 percent) while 1,3-butadiene shows a 39 percent reduction. The estimates for diesel particulate matter show a 33 percent decrease between 1990 and the year 2000. The reductions for these three 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
Acetaldehyde	Annual Avg	2.46	3.00	2.46	2.67	2.30	0.97	2.08	1.77	1.54	1.63
	Health Risk	12	15	12	13	11	5	10	9	8	8
Benzene	Annual Avg	3.42	2.91	2.61	2.17	2.40	1.89	1.45	1.34	1.25	1.20
	Health Risk	317	269	242	201	222	175	134	124	116	111
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
	Health Risk	200	170	187	212	187	173	146	142	133	123
Carbon Tetrachloride	Annual Avg	0.14	0.13		0.11		0.10	0.08		0.11	
	Health Risk	36	35		28		27	21		30	
Chromium (Hexavalent)	Annual Avg			0.39	0.29	0.29	0.46	0.18	0.17	0.15	
	Health Risk			59	43	43	69	27	25	22	
<i>para</i> -Dichlorobenzene	Annual Avg		0.17	0.19	0.17	0.13	0.17	0.11	0.13		
	Health Risk		11	13	12	8	11	7	9		
Formaldehyde	Annual Avg	2.92	3.08	2.22	3.22	3.14	3.57	5.06	4.47	3.79	4.06
	Health Risk	22	23	16	24	23	26	37	33	28	30
Methylene Chloride	Annual Avg	1.86	1.51	0.90	1.23	1.10	1.28	0.95	1.14	0.85	0.92
	Health Risk	7	5	3	4	4	5	3	4	3	3
Perchloroethylene	Annual Avg	0.58	0.55	0.41	0.45	0.39	0.36	0.32	0.27	0.26	
	Health Risk	23	22	17	18	16	15	13	11	10	
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	356	350	275
	With Diesel PM	(1696)					(1315)				(995)

* 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. Estimated concentration for 1999 reflects the year 2000.

*** 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 6-32

San Francisco Bay Area Air Basin

2000 Emission Inventory by Compound

Acetaldehyde

Approximately 78 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion and agricultural burning contribute approximately 17 percent.

San Francisco Bay Area - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	64	4%	1%
Area-wide Sources	282	17%	3%
On-Road Mobile	388	24%	4%
Gasoline Vehicles	221	14%	2%
Diesel Vehicles	167	10%	2%
Other Mobile	877	54%	9%
Natural Sources	0	0%	0%
Total	1611	100%	17%
Total Statewide	9568		

Table 6-33

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	248	6%	1%
Area-wide Sources	94	2%	0%
On-Road Mobile	2712	60%	9%
Gasoline Vehicles	2667	59%	9%
Diesel Vehicles	45	1%	0%
Other Mobile	1448	32%	5%
Natural Sources	0	0%	0%
Total	4501	100%	15%
Total Statewide	30778		

Table 6-34

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	3	0%	0%
Area-wide Sources	< 1	0%	0%
On-Road Mobile	377	52%	7%
Gasoline Vehicles	373	52%	7%
Diesel Vehicles	4	1%	0%
Other Mobile	340	47%	6%
Natural Sources	2	0%	0%
Total	723	100%	14%
Total Statewide	5340		

Table 6-35

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	2.20	100%	50%
Area-wide Sources	0	0%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0.00	0%	0%
Diesel Vehicles	0.00	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	2.20	100%	50%
Total Statewide	4.39		

Table 6-36

Chromium (Hexavalent)

Approximately 86 percent of the hexavalent chromium emissions are from other mobile sources. Stationary sources such as electrical generation and fabricated metal product manufacturing also contribute approximately 13 percent.

San Francisco Bay Area - Chromium (Hexavalent)			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.0299	13%	1%
Area-wide Sources	0.0025	1%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.2059	86%	8%
Natural Sources	< .0001	0%	0%
Total	0.2383	100%	10%
Total Statewide	2.4651		

Table 6-37

para-Dichlorobenzene

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

San Francisco Bay Area - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< 1	0%	0%
Area-wide Sources	307	100%	20%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0	0%	0%
Natural Sources	0	0%	0%
Total	308	100%	20%
Total Statewide	1553		

Table 6-38

Formaldehyde

Approximately 89 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	137	3%	1%
Area-wide Sources	352	8%	1%
On-Road Mobile	1372	33%	5%
Gasoline Vehicles	1038	25%	4%
Diesel Vehicles	334	8%	1%
Other Mobile	2347	56%	9%
Natural Sources	0	0%	0%
Total	4208	100%	16%
Total Statewide	26329		

Table 6-39

Methylene Chloride

Approximately 68 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	1340	68%	16%
Area-wide Sources	635	32%	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	1975	100%	24%
Total Statewide	8166		

Table 6-40

Perchloroethylene

Approximately 73 percent of the emissions of perchloroethylene are from such stationary sources as dry cleaning plants and manufacturers of aircraft parts and fabricated metal parts.

Diesel Particulate Matter

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

San Francisco Bay Area - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1074	73%	9%
Area-wide Sources	404	27%	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	1478	100%	13%
Total Statewide	11431		

Table 6-41

San Francisco Bay Area - Diesel Particulate Matter			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	1	0%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	1067	25%	4%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1067	25%	4%
Other Mobile	3153	75%	13%
Natural Sources	0	0%	0%
Total	4221	100%	17%
Total Statewide	24808		

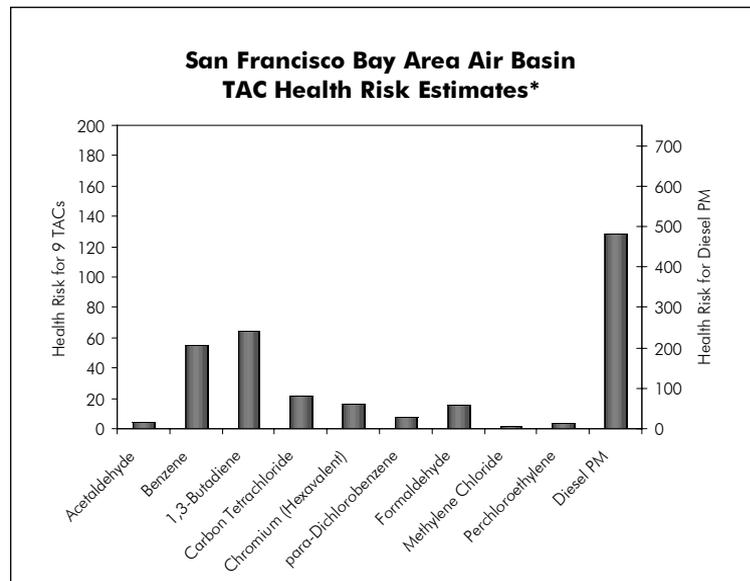
Table 6-42

San Francisco Bay Area Air Basin

Air Quality and Health Risk

Over the last decade, 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. Figure 6-13 and Table 6-43 show the estimated annual average health risks for the San Francisco Bay Area Air Basin. Because of gaps in the data, 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 -- 1996, 1997, 1998, or 1999. 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.

Two other TACS, 1,3-butadiene and benzene, also pose substantial health risks. Again, however, it is important to remem-



* Carbon Tetrachloride = 1996; *para*-Dichlorobenzene, Methylene chloride, and Perchloroethylene = 1997; Chromium (Hexavalent) = 1998; Diesel PM = 2000; All other TACs = 1999.

Figure 6-13

ber 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, average concentrations and health risks from all the TACs except formaldehyde have been reduced (note that because of a change in analysis method, formaldehyde concentrations prior to 1996 are uncertain, and this uncertainty impacts the resulting trend). Of those TACs included in Figure 6-13, benzene, perchloroethylene, 1,3-butadiene, chromium (hexavalent), and methylene chloride all show reductions of 50 percent or more. In contrast, *para*-dichlorobenzene concentrations have remained fairly constant since 1990, and there has not been a noticeable change in the overall average concentrations and health risks. In all 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 fairly substantial reductions over the time period. 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
Acetaldehyde	Annual Avg	1.30	1.40	1.03	1.31	1.17	0.42	0.83	0.73	0.65	0.76
	Health Risk	6	7	5	6	6	2	4	4	3	4
Benzene	Annual Avg	2.18	1.82	1.49	1.49	1.40	1.26	0.71	0.61	0.71	0.60
	Health Risk	202	169	138	138	129	116	66	57	66	55
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
	Health Risk	135	108	103	138	108	104	82	70	82	64
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08			
	Health Risk	34	33		29		27	21			
Chromium (Hexavalent)	Annual Avg			0.23	0.20	0.19	0.25	0.13	0.12	0.10	
	Health Risk			34	30	29	37	19	17	16	
<i>para</i> -Dichlorobenzene	Annual Avg		0.12	0.12	0.12	0.11	0.13	0.14	0.12		
	Health Risk		8	8	8	7	8	9	8		
Formaldehyde	Annual Avg	1.87	1.73	1.43	1.56	1.66	2.06	2.62	1.85	1.76	2.09
	Health Risk	14	13	11	12	12	15	19	14	13	15
Methylene Chloride	Annual Avg	1.04	2.32	0.65	0.72	0.59	0.60	0.58	0.55		
	Health Risk	4	8	2	3	2	2	2	2		
Perchloroethylene	Annual Avg	0.20	0.23	0.17	0.13	0.08	0.09	0.07	0.07		
	Health Risk	8	9	7	5	3	4	3	3		
<i>Diesel Particulate Matter</i> **	Annual Avg	(2.5)					(1.9)				(1.6)
	Health Risk	(750)					(570)				(480)
Average Basin Risk***	Without Diesel PM	403	355	308	368	296	315	224	174	179	139
	With Diesel PM	(1153)					(885)				(619)

* 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. Estimated concentration for 1999 reflects the year 2000.

*** 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 6-43

San Joaquin Valley Air Basin

2000 Emission Inventory by Compound

Acetaldehyde

Approximately 81 percent of the emissions of acetaldehyde are from mobile sources. Area-wide sources such as residential wood combustion account for approximately 13 percent.

San Joaquin Valley - Acetaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	84	6%	1%
Area-wide Sources	193	13%	2%
On-Road Mobile	370	25%	4%
Gasoline Vehicles	179	12%	2%
Diesel Vehicles	191	13%	2%
Other Mobile	816	56%	9%
Natural Sources	0	0%	0%
Total	1463	100%	15%
Total Statewide	9568		

Table 6-44

Benzene

The primary sources of benzene emissions in the San Joaquin Valley Air Basin are mobile sources (approximately 60 percent) and area-wide sources (approximately 26 percent).

San Joaquin Valley - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	655	14%	2%
Area-wide Sources	1269	26%	4%
On-Road Mobile	1811	37%	6%
Gasoline Vehicles	1759	36%	6%
Diesel Vehicles	52	1%	0%
Other Mobile	1115	23%	4%
Natural Sources	< 1	0%	0%
Total	4851	100%	16%
Total Statewide	30778		

Table 6-45

1,3-Butadiene

Approximately 77 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	0%	0%
Area-wide Sources	161	21%	3%
On-Road Mobile	302	40%	6%
Gasoline Vehicles	297	39%	6%
Diesel Vehicles	5	1%	0%
Other Mobile	286	37%	5%
Natural Sources	10	1%	0%
Total	763	100%	14%
Total Statewide	5340		

Table 6-46

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	0.02	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	0.02	100%	0%
Total Statewide	4.39		

Table 6-47

Chromium (Hexavalent)

Approximately 84 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	0.2712	84%	11%
Area-wide Sources	0.0117	4%	0%
On-Road Mobile	0.0000	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.0398	12%	2%
Natural Sources	< .0001	0%	0%
Total	0.3227	100%	13%
Total Statewide	2.4651		

Table 6-48

para-Dichlorobenzene

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

San Joaquin Valley - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	5	3%	0%
Area-wide Sources	150	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	154	100%	10%
Total Statewide	1553		

Table 6-49

Formaldehyde

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

Methylene Chloride

Approximately 66 percent of the emissions of methylene chloride are from paint removers/strippers, automotive brake cleaners, and other consumer products.

San Joaquin Valley - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	641	15%	2%
Area-wide Sources	227	5%	1%
On-Road Mobile	1239	29%	5%
Gasoline Vehicles	857	20%	3%
Diesel Vehicles	382	9%	1%
Other Mobile	2159	51%	8%
Natural Sources	0	0%	0%
Total	4266	100%	16%
Total Statewide	26329		

Table 6-50

San Joaquin Valley - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	159	34%	2%
Area-wide Sources	309	66%	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	468	100%	6%
Total Statewide	8166		

Table 6-51

Perchloroethylene

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

Diesel Particulate Matter

Emissions of diesel particulate matter are from mobile sources (approximately 91 percent) and stationary sources (approximately 9 percent).

San Joaquin Valley - Perchloroethylene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	284	59%	2%
Area-wide Sources	197	41%	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	481	100%	4%
Total Statewide	11431		

Table 6-52

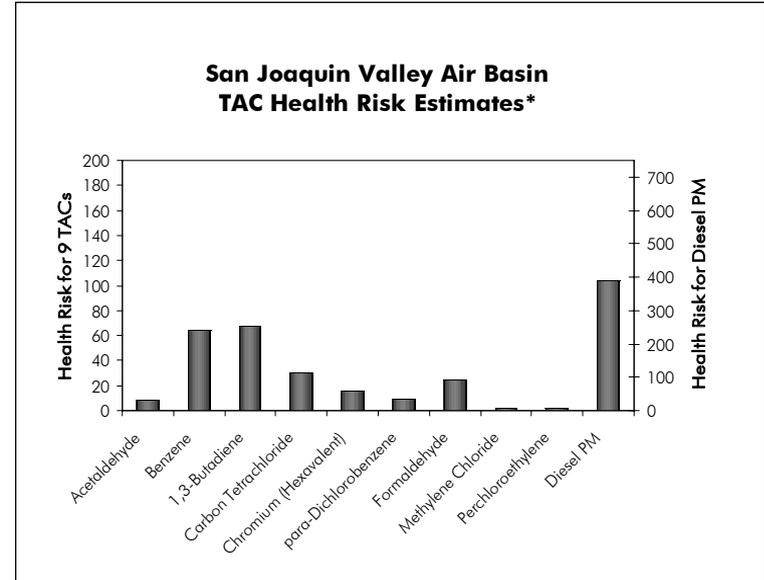
San Joaquin Valley - Diesel Particulate Matter			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	370	9%	1%
Area-wide Sources	0	0%	0%
On-Road Mobile	1004	24%	4%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	1004	24%	4%
Other Mobile	2764	67%	11%
Natural Sources	0	0%	0%
Total	4139	100%	17%
Total Statewide	24808		

Table 6-53

San Joaquin Valley Air Basin

Air Quality and Health Risk

During 1990 through 1999, 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. Figure 6-14 and Table 6-54 show the estimated average health risks for all the sites in the San Joaquin Valley Air Basin. As indicated in the figure, health risk numbers for TACs with measured data reflect the most recent year for which complete and representative data are available-1997, 1998, or 1999, while the estimate given for diesel particulate matter reflects the year 2000. As in all other areas of the State, the health risk for diesel PM overwhelms the other nine TACs. The 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 unbanized areas of the State such as the San Francisco Bay Area Air Basin and the Sacramento Valley Air Basin.



* *para*-Dichlorobenzene = 1997; Carbon Tetrachloride, Chromium (Hexavalent), and Perchloroethylene = 1998; Diesel PM = 2000; All other TACs = 1999.

Figure 6-14

Similar to most other areas of the State, Figure 6-14 and Table 6-54 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, perchloroethylene, 1,3-butadiene, and chromium (hexavalent) each show more than a 50 percent reduction, and diesel PM shows a reduction equal to 50 percent. In contrast, average concentrations and health risks for *para*-dichlorobenzene have increased. The values for formaldehyde have also increased, however, the increase may be related to the change in the analysis method for this TAC rather than increases in emissions. While the concentrations and health risks for these two TACs are higher during their end years, the total average air basin health risk for all ten TACs together dropped 52 percent over the trend period (based on the earliest and the most recent years of complete and representative data for each of the ten TACs). 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
Acetaldehyde	Annual Avg	1.94	1.84	1.38	1.73	1.29	0.54	1.28	1.19	1.30	1.56
	Health Risk	9	9	7	8	6	3	6	6	6	8
Benzene	Annual Avg	2.45	2.11	1.36	1.32	1.33	1.16	0.73	0.71	0.76	0.69
	Health Risk	227	196	126	122	123	107	68	66	71	64
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
	Health Risk	154	135	89	127	121	99	83	73	88	67
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.11		0.10	0.08		0.11	
	Health Risk	34	34		29		26	20		30	
Chromium (Hexavalent)	Annual Avg			0.23	0.21	0.19	0.28	0.13	0.11	0.10	
	Health Risk			34	31	29	42	20	16	16	
<i>para</i> -Dichlorobenzene	Annual Avg		0.11	0.11	0.13	0.11	0.11	0.10	0.13		
	Health Risk		8	7	9	7	8	7	9		
Formaldehyde	Annual Avg	2.45	1.81	1.46	1.67	1.80	2.10	2.96	2.77	2.86	3.44
	Health Risk	18	13	11	12	13	16	22	20	21	25
Methylene Chloride	Annual Avg	0.76	0.59	0.55	0.76	0.59	0.61	0.54	0.53	0.52	0.50
	Health Risk	3	2	2	3	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	
	Health Risk	5	5	4	19	3	3	3	2	2	
Diesel Particulate Matter**	Annual Avg	(2.6)					(1.7)				(1.3)
	Health Risk	(780)					(510)				(390)
Average Basin Risk***	Without Diesel PM	450	402	279	360	305	304	231	195	235	165
	With Diesel PM	(1230)					(814)				(555)

* 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. Estimated concentration for 1999 reflects the year 2000.

*** 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 6-54

San Diego Air Basin

2000 Emission Inventory by Compound

Acetaldehyde

Approximately 82 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	3%	0%
Area-wide Sources	103	15%	1%
On-Road Mobile	200	30%	2%
Gasoline Vehicles	116	17%	1%
Diesel Vehicles	84	12%	1%
Other Mobile	348	52%	4%
Natural Sources	0	0%	0%
Total	675	100%	7%
Total Statewide	9568		

Table 6-55

Benzene

The primary sources of benzene emissions in the San Diego Air Basin are mobile sources (approximately 93 percent).

San Diego - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	137	6%	0%
Area-wide Sources	36	2%	0%
On-Road Mobile	1264	56%	4%
Gasoline Vehicles	1241	55%	4%
Diesel Vehicles	23	1%	0%
Other Mobile	830	37%	3%
Natural Sources	0	0%	0%
Total	2267	100%	7%
Total Statewide	30778		

Table 6-56

1,3-Butadiene

Approximately 97 percent of the emissions of 1,3-butadiene are from mobile sources.

San Diego - 1,3-Butadiene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< 1	0%	0%
Area-wide Sources	4	1%	0%
On-Road Mobile	201	50%	4%
Gasoline Vehicles	199	50%	4%
Diesel Vehicles	2	1%	0%
Other Mobile	187	47%	3%
Natural Sources	8	2%	0%
Total	400	100%	7%
Total Statewide	5340		

Table 6-57

Carbon Tetrachloride

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

San Diego - Carbon Tetrachloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.02	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	0.02	100%	0%
Total Statewide	4.39		

Table 6-58

Chromium (Hexavalent)

Approximately 74 percent of the chromium (hexavalent) emissions are from other mobile sources. Stationary sources account for approximately 25 percent.

para-Dichlorobenzene

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

San Diego - Chromium (Hexavalent)			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0.0552	25%	2%
Area-wide Sources	0.0015	1%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.1618	74%	7%
Natural Sources	< .0001	0%	0%
Total	0.2184	100%	9%
Total Statewide	2.4651		

Table 6-59

San Diego - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	0	0%	0%
Area-wide Sources	133	100%	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	133	100%	9%
Total Statewide	1553		

Table 6-60

Formaldehyde

Approximately 89 percent of the formaldehyde emissions are from mobile sources.

San Diego - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	96	5%	0%
Area-wide Sources	118	6%	0%
On-Road Mobile	737	38%	3%
Gasoline Vehicles	568	29%	2%
Diesel Vehicles	169	9%	1%
Other Mobile	989	51%	4%
Natural Sources	0	0%	0%
Total	1941	100%	7%
Total Statewide	26329		

Table 6-61

Methylene Chloride

Area-wide sources such as paint removers/strippers, automotive brake cleaners, and other consumer products account for approximately 74 percent of the emissions of methylene chloride.

San Diego - Methylene Chloride			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	97	26%	1%
Area-wide Sources	275	74%	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	372	100%	5%
Total Statewide	8166		

Table 6-62

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	1455	89%	13%
Area-wide Sources	175	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	1631	100%	14%
Total Statewide	11431		

Table 6-63

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	68	4%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	462	26%	2%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	462	26%	2%
Other Mobile	1218	70%	5%
Natural Sources	0	0%	0%
Total	1748	100%	7%
Total Statewide	24808		

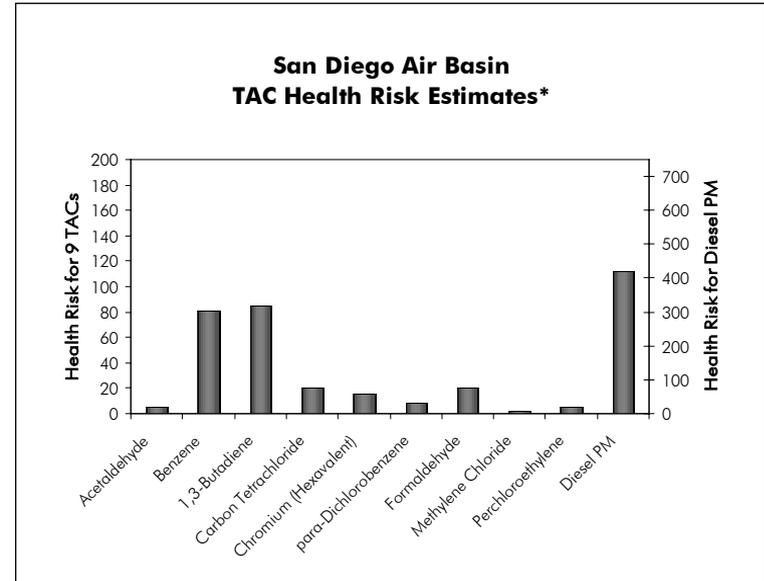
Table 6-64

San Diego Air Basin

Air Quality and Health Risk

During 1990 through 1999, 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. Figure 6-15 and Table 6-65 show the estimated average health risks for the two sites. Because of incomplete data, the concentration and health risk estimates for the nine TACS with measured data reflect varying years from 1997 to 1999. The health risk estimate for diesel particulate matter reflects the year 2000. The estimated health risk for diesel PM is 420 excess cancer cases per million people. While the health risk from diesel PM is lower than the estimated statewide value, it is comparable to the annual average estimated for other urbanized areas such as the Sacramento Valley and San Joaquin Valley Air Basins. Regardless of how it compares with the other areas, diesel particulate matter represents the most substantial health risk in the San Diego Air Basin.

Similar to most other areas, Figure 6-15 and Table 6-65 show that aside from diesel particulate matter, 1,3-butadiene and benzene pose the greatest health risks, on average, in the



* Carbon Tetrachloride = 1996; *para*-Dichlorobenzene, Methylene chloride and Perchloroethylene = 1997; Diesel PM = 2000; All other TACs = 1998.

Figure 6-15

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, *para*-dichlorobenzene shows a small increase and methylene chloride shows no improvement. 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. Formaldehyde concentrations and health risk have remained relatively constant over the last four years. Of the ten TACs included in Figure 6-15, benzene, chromium (hexavalent), perchloroethylene, and diesel PM show the greatest reductions—61 percent, 59 percent, 55 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. Near-source 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
Acetaldehyde	Annual Avg	1.33	1.50	1.22	1.41	1.48	0.64	1.03	1.00	0.86	1.03
	Health Risk	7	7	6	7	7	3	5	5	4	5
Benzene	Annual Avg	2.25	1.70	1.48	1.16	1.39	0.98	0.76	0.76	0.76	0.87
	Health Risk	208	158	137	107	129	90	71	70	70	81
1,3-Butadiene	Annual Avg	0.33	0.26	0.26	0.31	0.31	0.24	0.21	0.20	0.20	0.23
	Health Risk	125	97	97	117	115	91	78	75	74	85
Carbon Tetrachloride	Annual Avg	0.13	0.13		0.10		0.10	0.08			
	Health Risk	35	34		27		26	20			
Chromium (Hexavalent)	Annual Avg			0.24	0.19	0.16	0.18	0.11	0.11	0.10	
	Health Risk			37	28	23	27	16	16	15	
<i>para</i> -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	2.66
	Health Risk	12	11	9	13	17	16	19	19	17	20
Methylene Chloride	Annual Avg	0.59	0.83	1.34	1.13	0.73	0.63	0.59	0.57		0.53
	Health Risk	2	3	5	4	3	2	2	2		2
Perchloroethylene	Annual Avg	0.28	0.27	0.26	0.20	0.21	0.25	0.15	0.13		
	Health Risk	11	11	11	8	8	10	6	5		
<i>Diesel Particulate Matter</i> **	Annual Avg	(2.9)					(1.9)				(1.4)
	Health Risk	(870)					(570)				(420)
Average Basin Risk***	Without Diesel PM	400	327	308	319	312	273	224	200	180	192
	With Diesel PM	(1270)					(843)				(612)

* 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. Estimated concentration for 1999 reflects the year 2000.

*** 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 6-65

Sacramento Valley Air Basin

2000 Emission Inventory by Compound

Acetaldehyde

Approximately 69 percent of the emissions of acetaldehyde are from mobile sources. Another 29 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	1%	0%
Area-wide Sources	290	29%	3%
On-Road Mobile	230	23%	2%
Gasoline Vehicles	120	12%	1%
Diesel Vehicles	110	11%	1%
Other Mobile	461	46%	5%
Natural Sources	0	0%	0%
Total	995	100%	10%
Total Statewide	9568		

Table 6-66

Benzene

The primary sources of benzene emissions in the Sacramento Valley Air Basin are mobile sources (approximately 81 percent).

Sacramento Valley - Benzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	171	6%	1%
Area-wide Sources	409	14%	1%
On-Road Mobile	1286	43%	4%
Gasoline Vehicles	1256	42%	4%
Diesel Vehicles	30	1%	0%
Other Mobile	1132	38%	4%
Natural Sources	0	0%	0%
Total	2998	100%	10%
Total Statewide	30778		

Table 6-67

1,3-Butadiene

Approximately 85 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	14%	1%
On-Road Mobile	203	39%	4%
Gasoline Vehicles	200	38%	4%
Diesel Vehicles	3	1%	0%
Other Mobile	241	46%	5%
Natural Sources	8	2%	0%
Total	524	100%	10%
Total Statewide	5340		

Table 6-68

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%	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	0.06	100%	1%
Total Statewide	4.39		

Table 6-69

Chromium (Hexavalent)

Approximately 79 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	0.1021	79%	4%
Area-wide Sources	0.0079	6%	0%
On-Road Mobile	0	0%	0%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	0	0%	0%
Other Mobile	0.0187	15%	1%
Natural Sources	< .0001	0%	0%
Total	0.1288	100%	5%
Total Statewide	2.4651		

Table 6-70

para-Dichlorobenzene

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

Sacramento Valley - <i>para</i> -Dichlorobenzene			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	< 1	0%	0%
Area-wide Sources	107	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	107	100%	7%
Total Statewide	1553		

Table 6-71

Formaldehyde

Approximately 81 percent of the formaldehyde emissions are from mobile sources, and 13 percent are from area-wide sources.

Sacramento Valley - Formaldehyde			
Emissions Source	tons/year	Percent Air Basin	Percent State
Stationary Sources	166	7%	1%
Area-wide Sources	325	13%	1%
On-Road Mobile	785	31%	3%
Gasoline Vehicles	566	22%	2%
Diesel Vehicles	220	9%	1%
Other Mobile	1271	50%	5%
Natural Sources	0	0%	0%
Total	2548	100%	10%
Total Statewide	26329		

Table 6-72

Methylene Chloride

Approximately 63 percent of the emissions of methylene chloride are from 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	130	37%	2%
Area-wide Sources	220	63%	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	351	100%	4%
Total Statewide	8166		

Table 6-73

Perchloroethylene

Approximately 81 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	607	81%	5%
Area-wide Sources	140	19%	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	747	100%	7%
Total Statewide	11431		

Table 6-74

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	1	0%	0%
Area-wide Sources	0	0%	0%
On-Road Mobile	624	28%	3%
Gasoline Vehicles	0	0%	0%
Diesel Vehicles	624	28%	3%
Other Mobile	1626	72%	7%
Natural Sources	0	0%	0%
Total	2251	100%	9%
Total Statewide	24808		

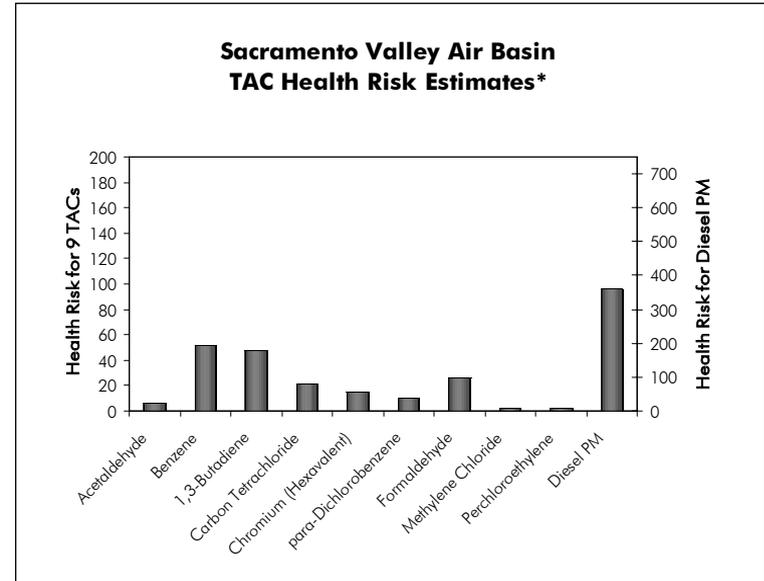
Table 6-75

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 6-16 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 figure, the health risk estimates for each TAC reflect the most recent year for which complete and representative data are available. Like all other air basins, diesel particulate matter poses the greatest health risk among the ten TACs considered in this almanac. Based on



* Carbon Tetrachloride = 1996; Perchloroethylene and *para*-Dichlorobenzene = 1997; Chromium (Hexavalent) = 1998; Diesel PM = 2000; All other TACs = 1999.

Figure 6-16

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 6-16 and Table 6-76 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, 72 percent and 66 percent, respectively. It is important to remember that the health risks shown here are based on an average concentration for only two areas in the air basin, and the health risk at individual locations may be higher or lower. Overall, the average concentrations and health risks from all the TACs except *para*-dichlorobenzene and formaldehyde have been reduced since 1990. Although the ambient concentrations and health risks have risen substantially for formaldehyde, 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 1999 data. When doing this,

formaldehyde shows a more modest increase. More years of data are needed to determine if this increase 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
Acetaldehyde	Annual Avg	1.29			1.37	1.04	0.39	1.03	1.05	0.92	1.23
	Health Risk	6			7	5	2	5	5	5	6
Benzene	Annual Avg	2.02	1.88	1.35	1.00	1.02	0.80	0.56	0.55	0.50	0.56
	Health Risk	187	174	125	93	95	74	51	51	47	52
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
	Health Risk	142	125	106	108	83	70	66	60	58	48
Carbon Tetrachloride	Annual Avg	0.12	0.12		0.11		0.10	0.08			
	Health Risk	33	33		29		26	21			
Chromium (Hexavalent)	Annual Avg			0.17	0.14	0.13	0.18	0.11	0.10	0.10	
	Health Risk			26	21	19	26	16	15	15	
<i>para</i> -Dichlorobenzene	Annual Avg			0.11	0.10	0.20	0.14	0.11	0.14		
	Health Risk			7	7	14	9	7	10		
Formaldehyde	Annual Avg	1.57			1.77	1.75	1.91	2.76	2.92	2.52	3.61
	Health Risk	12			13	13	14	20	22	19	27
Methylene Chloride	Annual Avg	0.65	0.56	0.55	0.98	0.66	0.53	0.54	0.52		0.60
	Health Risk	2	2	2	3	2	2	2	2		2
Perchloroethylene	Annual Avg	0.07	0.07	0.06	0.05	0.17	0.05	0.06	0.05		
	Health Risk	3	3	3	2	7	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	166	143	134
	With Diesel PM	(1135)					(705)				(494)

* 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. Estimated concentration for 1999 reflects the year 2000.

*** 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*.

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