# Chapter 3

## Statewide Trends and Forecasts -- Criteria Pollutants

# *Introduction*
## Emission Trends and Forecasts

The most current emissions data available are from 2008. Any data prior to this year are derived from historical emissions data where available, and backcasted emissions based on historical socio-economic growth and control information. Future year data are forecasted from the 2008 base year and control measures reported through September 2006. Forecasts take into account emissions data, projected growth rates, and future adopted control measures to calculate emissions in future years.

On a statewide basis, emissions of $NO_x$ increased between 1975 and 1980, decreased slightly in 1985, and are forecasted to decline between 1990 and 2020. Emissions of ROG decrease steadily between 1975 and 2020. In addition to being ozone precursors, both $NO_x$ and ROG are secondary contributors to $PM_{10}$ and $PM_{2.5}$. Direct $PM_{10}$ emissions show an increase from 1975 to 1990, a slight decrease in 1995, hold relatively constant from 1995 to 2010, and then a slow increase after 2010. Direct $PM_{2.5}$ emissions decreased from 1975 to 1985, increased from 1985 to 1990, decreased slightly between 1990 and 1995, held relatively constant from 1995 to 2015, and are predicted to increase after 2015.

Emissions of CO have decreased since 1985 and are forecasted to continue declining. The recent decreases in $NO_x$, ROG, and CO are occurring even with increases in population and VMT.

Statewide $SO_x$ emissions decreased sharply from 1975 through 1985, decreased steadily through 1995, and remained relatively constant through 2010. On-shore $SO_x$ emissions are projected to increase moderately through 2020. Off-shore emissions are projected to increase substantially through 2020 due to increased shipping activity. In 2005, off-shore emissions represent approximately 38 percent of the statewide $SO_x$ emission inventory. By 2020, off-shore emissions are forecasted to comprise 52 percent of the statewide $SO_x$ emissions.

**Statewide Emissions (tons/day, annual average)**

| Pollutant | 1975 | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
|---|---|---|---|---|---|---|---|---|---|---|
| $NO_X$ | 4886 | 4898 | 4744 | 4940 | 4387 | 3972 | 3513 | 2981 | 2476 | 2173 |
| ROG | 7058 | 6566 | 5990 | 4733 | 3803 | 3141 | 2455 | 2127 | 1993 | 1950 |
| $PM_{10}$ | 1857 | 1889 | 1971 | 2215 | 2112 | 2174 | 2134 | 2139 | 2202 | 2275 |
| $PM_{2.5}$ | 713 | 687 | 685 | 751 | 686 | 693 | 686 | 682 | 690 | 707 |
| $SO_X$ | 1277 | 953 | 534 | 511 | 303 | 297 | 301 | 294 | 337 | 394 |
| CO | 42175 | 37958 | 35270 | 30084 | 22405 | 17203 | 13127 | 10543 | 9134 | 8369 |

Table 3-1

## Statewide Population and VMT

Airborne pollutants result in large part from human activities, and growth generally has a negative impact on air quality. California is fortunate in that it boasts the world's most progressive emission controls. These controls have resulted in significant air quality improvements, despite substantial growth.

During 1988 through 2007, statewide maximum 8-hour ozone values decreased 47 percent, and maximum 8-hour carbon monoxide values dropped 73 percent. These air quality improvements occurred at the same time the State's population increased 33 percent and the average daily VMT increased 46 percent. Ambient annual average $PM_{10}$ values in the non-desert areas also show improvement: a 23 percent decrease from 1989 to 2007. While the air quality improvements are impressive, additional emission controls will be needed to offset future growth.

## Percent Change in Air Quality and Growth

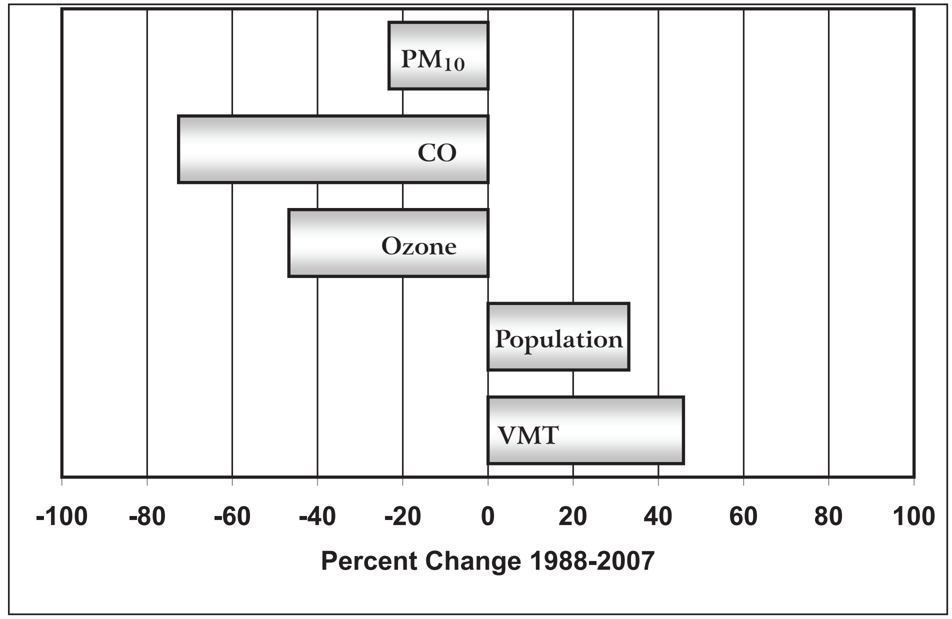


Figure 3-1

| Statewide Population and VMT Trends | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | 1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |
| Population | 23782000 | 26402401 | 29828496 | 31711849 | 34095209 | 36896218 | 39135677 | 41635800 | 44135923 |
| Avg. Daily VMT/1000 | 403567 | 538319 | 691049 | 733629 | 799848 | 955234 | 958079 | 1033400 | 1104522 |

Table 3-2

# *Ozone*

## Emission Trends and Forecasts - Ozone Precursors

### $NO_x$ Emission Trends and Forecasts

$NO_x$ emission standards for on-road motor vehicles were introduced in 1971 and followed in later years by the implementation of more stringent standards and the introduction of three-way catalysts. $NO_x$ emissions from on-road motor vehicles have declined by 23 percent from 1990 to 2000. $NO_x$ emissions are projected to decrease by 66 percent between 2000 and 2020. This has occurred as vehicles meeting more stringent emission standards enter the fleet, and all vehicles use cleaner burning gasoline and diesel fuel or alternative fuels.

NOx emissions from other mobile categories on the whole decreased from 1990 to 2020. The two largest NOx contributors in the other mobile category are off-road equipment and ships. The emissions from off-road equipment decrease significantly over the entire forecast period. However, the emissions from ships have increased to better reflect actual shipping activity resulting in a fairly constant $NO_x$ emission level for the trend and forecast period for the other mobile category as a whole. Stationary source $NO_x$ emissions dropped by 68 percent between 1980 and 2005. This decrease has been largely due to a switch from fuel oil to natural gas and the implementation of combustion controls such as low-$NO_x$ burners for boilers and catalytic converters for both external and internal combustion stationary sources. SIP and conformity inventory forecasts may differ from the forecasts presented in this almanac. For additional information on these forecasts, please refer to the ARB SIP web page at *www.arb.ca.gov/planning/sip/sip.htm.*

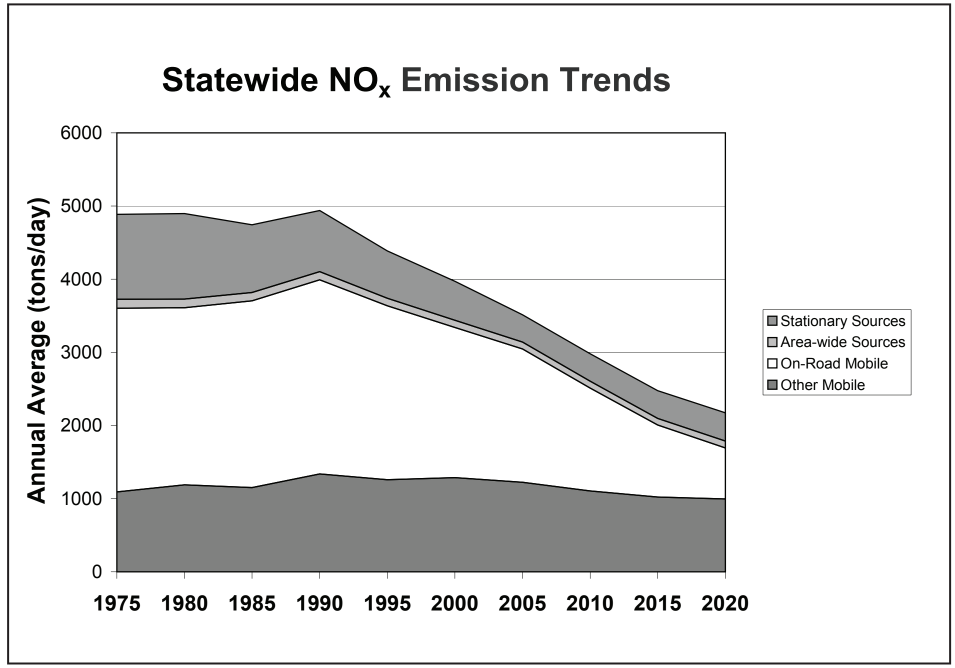


Figure 3-2

### ROG Emission Trends and Forecasts

ROG emissions in California are projected to decrease by over 72 percent between 1975 and 2020, largely as a result of the State's on-road motor vehicle emission control program. This includes the use of improved evaporative emission control systems, computerized fuel injection, engine management systems to meet increasingly stringent California emission standards, cleaner gasoline, and the Smog Check program. ROG emissions from other mobile sources are projected to decline between 1990 and 2020 as more stringent emission standards are adopted and implemented. Substantial reductions have also been obtained for area-wide sources through the vapor recovery program for service stations, bulk plants, and other fuel distribution operations. There are also on-going programs to reduce overall solvent ROG emissions from coatings, consumer products, cleaning and degreasing solvents, and other substances used within California. Again, SIP and conformity inventory forecasts may differ from the forecasts presented in this almanac. For additional information on these forecasts, please refer to the ARB SIP web page at *www.arb.ca.gov/planning/sip/sip.htm*.

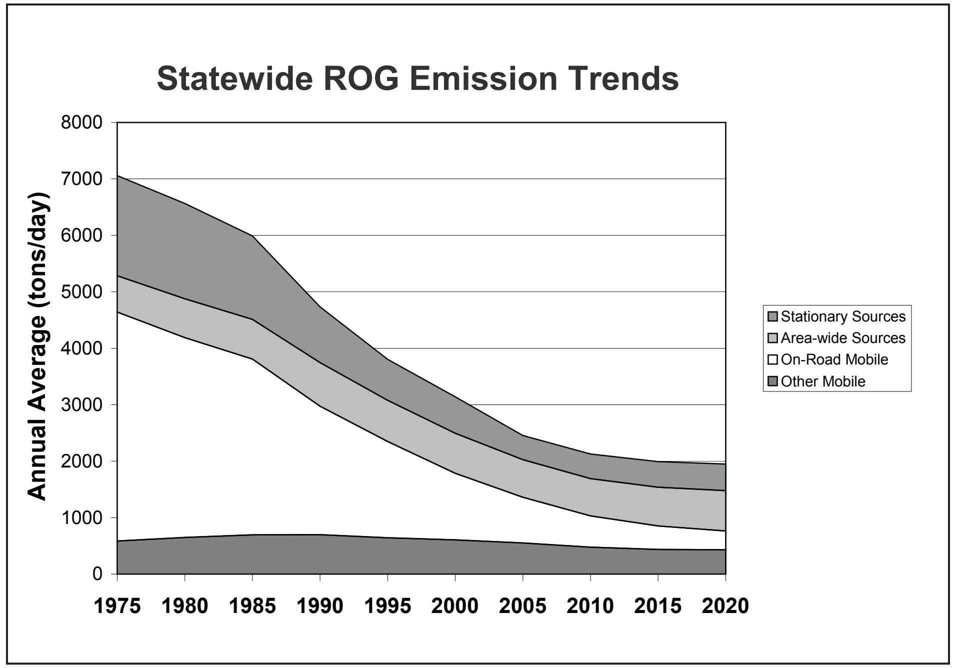


Figure 3-3

# Emission Trends and Forecasts - Ozone Precursors

| $NO_x$ Emission Trends (tons/day, annual average) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Source** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020** |
| ***All Sources*** | ***4886*** | ***4898*** | ***4744*** | ***4940*** | ***4387*** | ***3972*** | ***3513*** | ***2981*** | ***2476*** | ***2173*** |
| **Stationary Sources** | 1161 | 1170 | 926 | 837 | 647 | 533 | 372 | 376 | 378 | 387 |
| **Area-wide Sources** | 122 | 118 | 115 | 111 | 104 | 99 | 95 | 92 | 92 | 93 |
| **On-Road Mobile** | 2510 | 2421 | 2552 | 2654 | 2377 | 2053 | 1823 | 1407 | 984 | 699 |
| Gasoline Vehicles | 2197 | 2014 | 1958 | 1839 | 1574 | 1160 | 754 | 504 | 359 | 263 |
| Diesel Vehicles | 312 | 407 | 593 | 815 | 803 | 893 | 1069 | 904 | 625 | 435 |
| **Other Mobile** | 1093 | 1189 | 1152 | 1338 | 1258 | 1287 | 1223 | 1105 | 1022 | 995 |
| Gasoline Fuel | 51 | 57 | 62 | 72 | 70 | 69 | 75 | 68 | 64 | 64 |
| Diesel Fuel | 914 | 999 | 948 | 1091 | 984 | 968 | 861 | 740 | 602 | 497 |
| Other Fuel | 128 | 132 | 142 | 174 | 205 | 249 | 287 | 297 | 356 | 435 |

Table 3-3

| ROG Emission Trends (tons/day, annual average) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Source** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020** |
| ***All Sources*** | ***7058*** | ***6566*** | ***5990*** | ***4733*** | ***3803*** | ***3141*** | ***2455*** | ***2127*** | ***1993*** | ***1950*** |
| **Stationary Sources** | 1773 | 1688 | 1476 | 986 | 727 | 647 | 429 | 436 | 454 | 472 |
| **Area-wide Sources** | 645 | 689 | 704 | 773 | 727 | 710 | 666 | 659 | 685 | 713 |
| **On-Road Mobile** | 4054 | 3540 | 3116 | 2275 | 1706 | 1179 | 808 | 555 | 417 | 334 |
| Gasoline Vehicles | 4015 | 3487 | 3044 | 2184 | 1645 | 1120 | 743 | 497 | 373 | 302 |
| Diesel Vehicles | 39 | 53 | 72 | 91 | 62 | 59 | 65 | 58 | 44 | 33 |
| **Other Mobile** | 586 | 649 | 694 | 698 | 643 | 606 | 552 | 476 | 437 | 430 |
| Gasoline Fuel | 415 | 461 | 517 | 497 | 457 | 436 | 396 | 340 | 316 | 315 |
| Diesel Fuel | 121 | 135 | 126 | 147 | 138 | 129 | 114 | 91 | 71 | 59 |
| Other Fuel | 50 | 53 | 50 | 54 | 48 | 41 | 42 | 45 | 51 | 57 |

Table 3-4

## Statewide Air Quality - Ozone

Air quality as it relates to ozone has improved greatly in all areas of California over the last 20 years, despite significant growth. The statewide trend, which reflects values for the South Coast Air Basin, shows that the peak 8-hour and 1-hour indicators declined by over 42 percent and over 49 percent respectively from 1988 to 2007.

During 1988 to 2007, the statewide population grew by 33 percent and the number of vehicle miles traveled each day was up more than 46 percent. Motor vehicles are the largest source category of ozone precursor emissions, and reducing their emissions will continue to be the cornerstone of California's ozone control efforts. New vehicles must meet the ARB's low emission vehicle (LEV) standards, which equate to about 95 percent fewer smog-forming emissions than vehicles produced in the 1970s.

In recent years, increases in population and driving are partially offsetting the benefits of ARB's emission control programs. As part of the SIP, California will be implementing a comprehensive set of new programs. These programs will include new emission control standards as well as very innovative incentive programs to accelerate clean air technologies and reduce emissions from goods movement. These programs are now being developed and implemented at the National, State, and local levels.

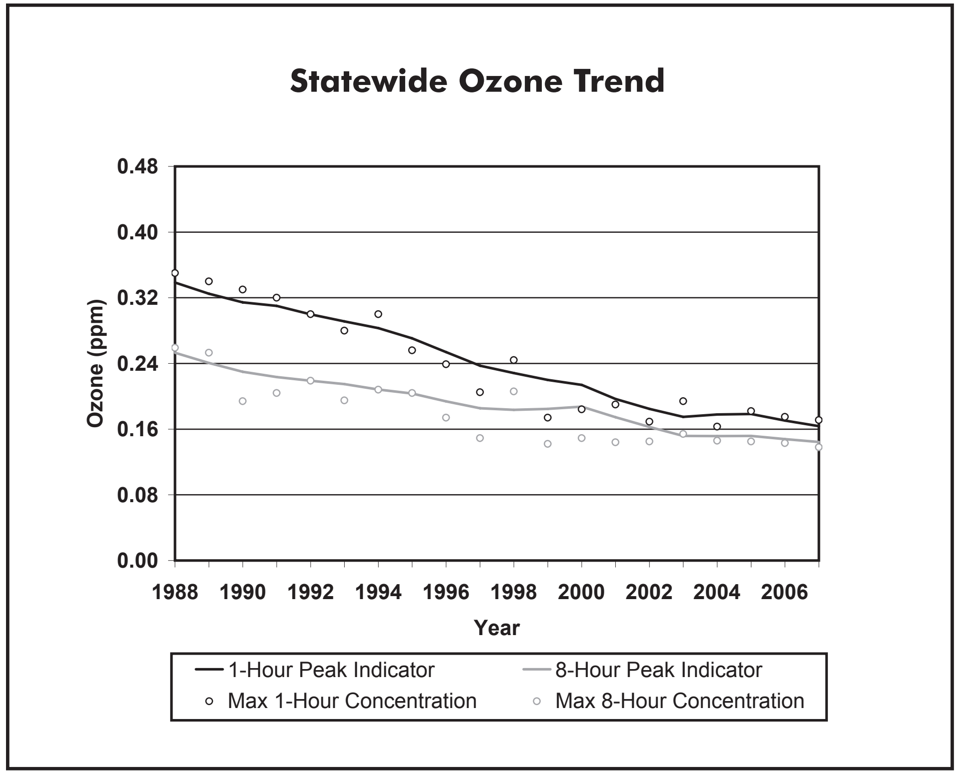


Figure 3-4

# Population-Weighted Exposures Over the State Ozone Standard

There are a number of ways to look at how ozone levels have changed over the years. Though simple indicators are most commonly used, complex indicators can offer additional insight concerning air quality. One such indicator is the population-weighted exposure indicator. As used here, an “exposure” occurs when a person experiences an 8-hour ozone concentration outdoors that is higher than 0.070 ppm, the level of the State 8-hour standard. The population-weighted exposure indicator considers both the level and the duration of ozone concentrations above the State standard. The annual exposure is the sum of all the daily 8-hour ozone exposures during the year and presents the result as an average per exposed person. For a more detailed discussion see Appendix B.

In Figure 3-5, the population-weighted exposures have been graphed from 1988 to 2007 in order to provide a visual representation of how the ozone exposures, in ppm-hours/person, are distributed over the years and how they compare with the increase in population. These values are meant to be a general representation of ozone exposure in the South Coast Air Basin. This graph gives a good indication of how ozone exposures have been steadily declining while the population has been increasing. For example, in Table 3-5 South Coast shows the highest exposure of all five air basins, however, the graph makes it clear that this exposure has been significantly declining and is now one fifth of what it was two decades ago.

The population-weighted exposures in Table 3-5 are listed for each year, from 1988 through 2007, for the five most populated areas of California. While these areas do not encompass all of California’s ozone nonattainment areas, they do include the urban areas where 86 percent of the State’s population lives.

This table also lists the percent of the total population represented in the exposure value. This reflects the percent of the total population in the area that was exposed to an ozone concentration above the level of the State 8-hour standard for at least one 8-hour period during the year. This method provides a reasonable approach for comparing exposures among various regions and for assessing trends in exposure reductions.

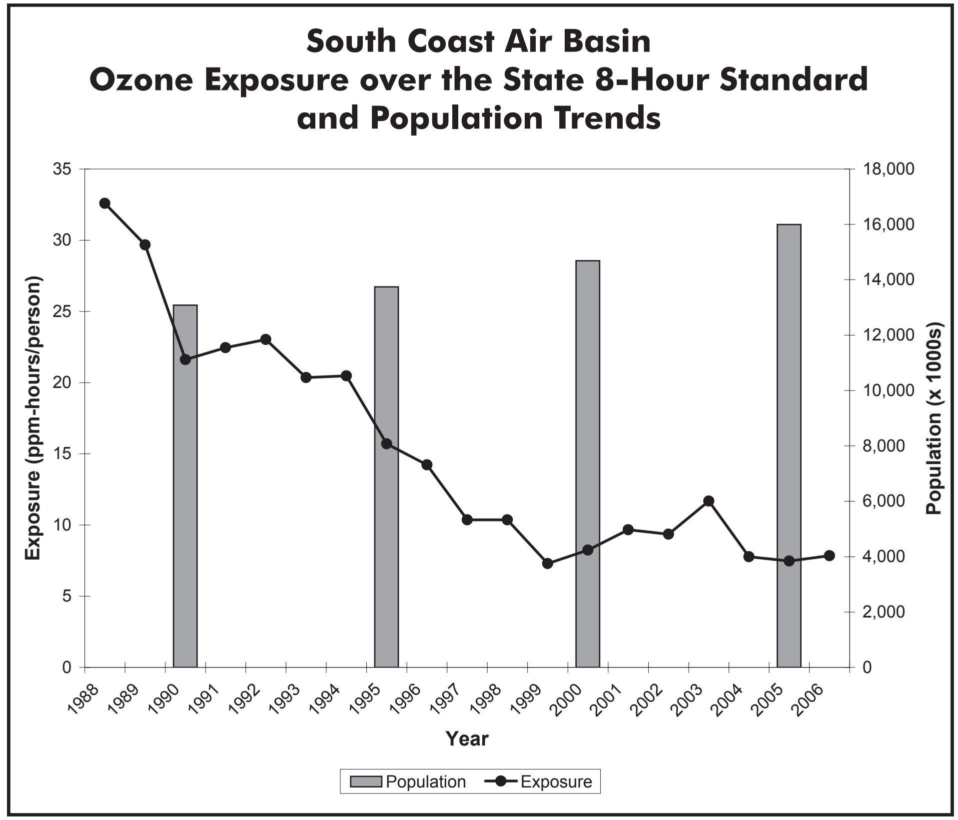


Figure 3-5

| Ozone Exposures Over the State 8-Hour Standard: Population-Weighted (ppm-hours / person) | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
| **South Coast Air Basin** | | | | | | | | | | | | | | | | | | | | |
| Exposure | 32.59 | 29.67 | 21.62 | 22.45 | 23.03 | 20.36 | 20.47 | 15.70 | 14.22 | 10.36 | 10.36 | 7.29 | 8.24 | 9.67 | 9.36 | 11.68 | 7.77 | 7.47 | 7.85 | 6.66 |
| % Pop. Represented * | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 98% | 98% | 99% | 92% | 95% | 97% | 97% | 81% | 97% | 100% | 98% | 84% | 100% |
| **San Francisco Bay Area Air Basin** | | | | | | | | | | | | | | | | | | | | |
| Exposure | 2.90 | 1.39 | 0.98 | 0.87 | 1.18 | 0.92 | 0.74 | 1.68 | 1.58 | 0.23 | 1.52 | 1.21 | 0.62 | 0.73 | 0.68 | 0.67 | 0.33 | 0.27 | 0.90 | 0.16 |
| % Pop. Represented | 90% | 59% | 41% | 41% | 51% | 66% | 36% | 88% | 60% | 68% | 42% | 64% | 18% | 34% | 36% | 68% | 42% | 41% | 44% | 9% |
| **San Joaquin Valley Air Basin** | | | | | | | | | | | | | | | | | | | | |
| Exposure | 18.83 | 13.76 | 10.86 | 12.23 | 11.65 | 12.50 | 11.02 | 11.52 | 13.96 | 9.50 | 11.70 | 12.02 | 11.49 | 12.18 | 12.86 | 12.17 | 7.50 | 6.32 | 8.22 | 5.18 |
| % Pop. Represented | 98% | 98% | 98% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% | 99% |
| **San Diego Air Basin** | | | | | | | | | | | | | | | | | | | | |
| Exposure | 10.88 | 10.97 | 9.63 | 7.54 | 6.25 | 5.31 | 5.19 | 4.59 | 3.49 | 1.96 | 3.58 | 2.76 | 2.85 | 2.41 | 1.77 | 2.12 | 1.64 | 1.39 | 2.38 | 1.40 |
| % Pop. Represented | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 98% | 94% | 90% | 100% | 86% | 54% | 100% | 42% | 73% | 99% |
| **Broader Sacramento Metropolitan Area** | | | | | | | | | | | | | | | | | | | | |
| Exposure | 8.19 | 4.54 | 4.88 | 5.64 | 5.49 | 2.77 | 4.41 | 4.82 | 5.15 | 2.09 | 4.23 | 4.58 | 3.19 | 3.51 | 4.68 | 3.72 | 2.28 | 2.88 | 3.94 | 1.51 |
| % Pop. Represented | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

* *% Population Represented* is the percent of the total population residing in an area exposed to an ozone concentration above the level of the State 8-hr standard for at least one 8-hour period during the year.

Table 3-5

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## Ozone Transport

Since 1989, the ARB staff has evaluated the impacts of the transport of ozone and ozone precursor emissions from upwind areas to the ozone concentrations in downwind areas. These analyses demonstrate that the air basin boundaries are not true boundaries of air masses. All urban areas are upwind contributors to their downwind neighbors with the exception of San Diego. Figure 3-6 shows the upwind areas that impact downwind areas throughout the State.

The ozone problem in the southern desert areas and some rural areas is significantly impacted by transported pollutants. National ozone air quality plans take into account the shared responsibility between upwind and downwind areas where transport can at times be signficant. Areas impacted by overwhelming transport, although designated nonattainment, are not required to adopt an air quality plan to meet State standards because local control strategies in these areas would not be effective in reducing ozone concentrations. However, these areas are subject to many statewide control strategies, such as cleaner fuels and LEVs. More detailed information about ozone transport is available on the web at *www.arb.ca.gov/aqd/transport/transport.htm*.

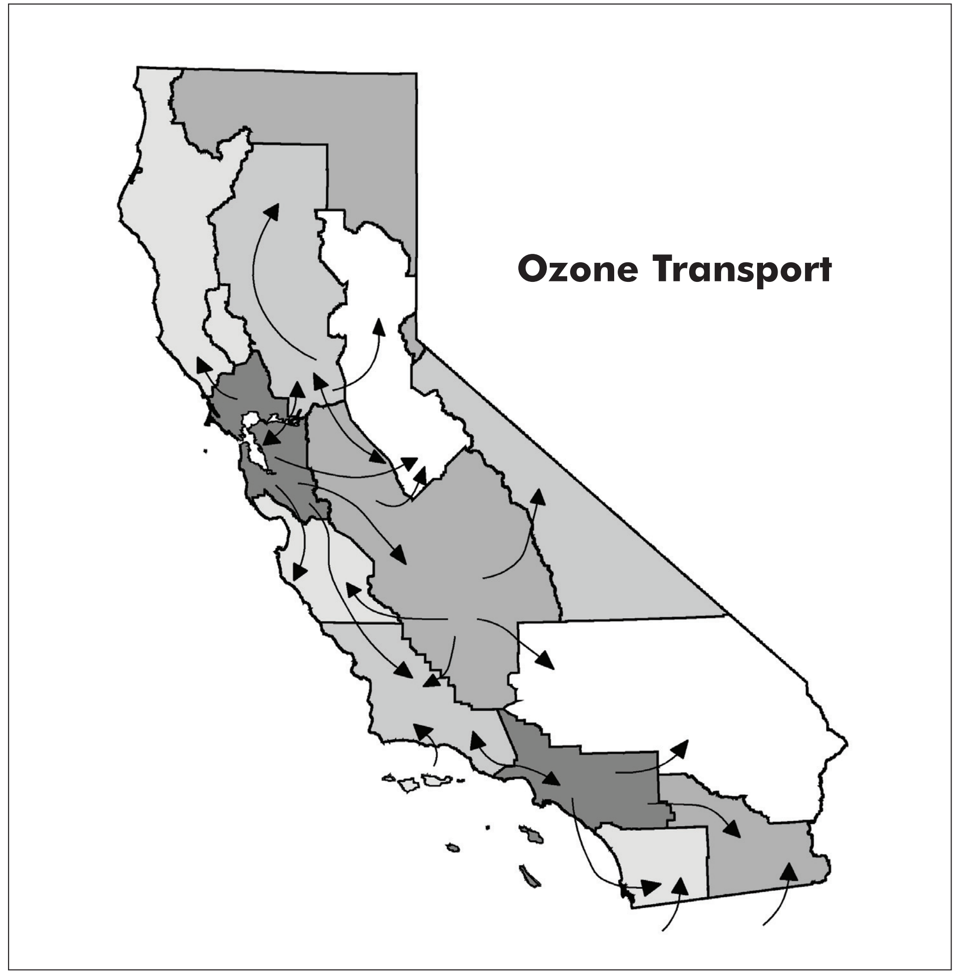


Figure 3-6

# *Directly Emitted Particulate Matter ($PM_{10}$)*

## Emission Trends and Forecasts - Directly Emitted $PM_{10}$

$PM_{10}$ emissions increase from 1975 to 1990, then decrease slightly in 1995, increase in 2000, decrease in 2005, and are projected to slowly increase after 2005. $PM_{10}$ emissions are dominated by area-wide sources. Emissions from paved road dust more than double between 1975 and 2000. Unpaved road dust emissions generally increase through the forecast period. Other area-wide sources include farming operations, construction and demolition, and fugitive wind blown dust from agricultural lands. Emissions from these categories have compensating effects resulting in a fairly constant statewide emission level; emissions increase slightly over the forecast period. The increase in emissions of unpaved and paved road dust are due to increases in VMT over these roads. Exhaust emissions from diesel mobile sources dropped by 38 percent from 1990 to 2000 due to more stringent emissions standards and the introduction of cleaner burning diesel fuel. $PM_{10}$ emissions from stationary sources are expected to increase slightly in the future due to industrial growth.

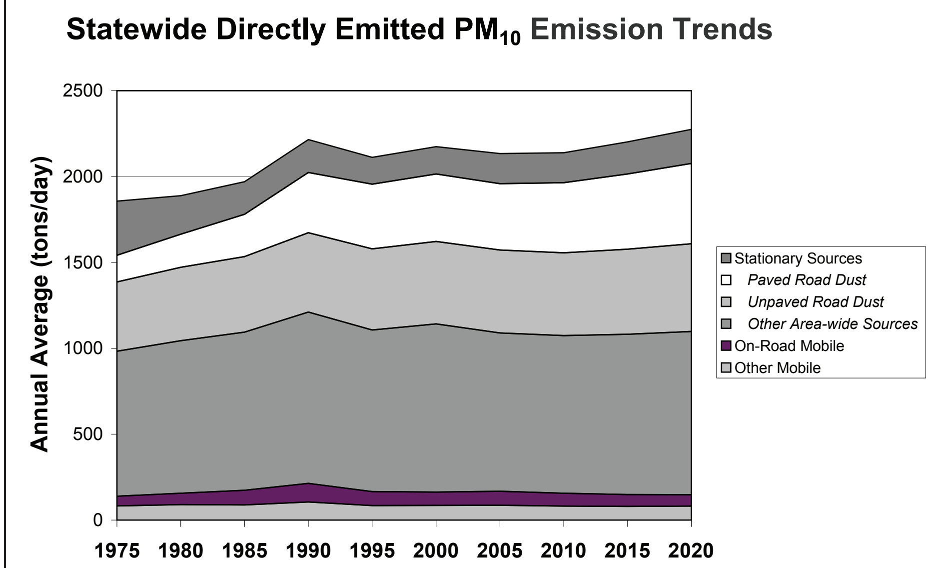


Figure 3-7

| Directly Emitted $PM_{10}$ Emission Trends (tons/day, annual average) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Source** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020** |
| ***All Sources*** | ***1857*** | ***1889*** | ***1971*** | ***2215*** | ***2112*** | ***2174*** | ***2134*** | ***2139*** | ***2202*** | ***2275*** |
| **Stationary Sources** | 315 | 224 | 190 | 192 | 157 | 159 | 175 | 174 | 187 | 198 |
| **Area-wide Sources** | 1403 | 1508 | 1607 | 1810 | 1790 | 1853 | 1791 | 1808 | 1867 | 1928 |
| Paved Road Dust | 156 | 192 | 246 | 350 | 376 | 393 | 386 | 408 | 438 | 467 |
| Unpaved Road Dust | 403 | 427 | 439 | 461 | 473 | 480 | 483 | 483 | 495 | 511 |
| Other Area-wide Sources | 844 | 888 | 921 | 998 | 941 | 979 | 922 | 918 | 933 | 950 |
| **On-Road Mobile** | 57 | 66 | 85 | 109 | 82 | 77 | 81 | 75 | 69 | 66 |
| Gasoline Vehicles | 23 | 20 | 22 | 27 | 29 | 33 | 39 | 42 | 47 | 51 |
| Diesel Vehicles | 34 | 46 | 63 | 82 | 53 | 44 | 42 | 33 | 23 | 15 |
| **Other Mobile** | 82 | 90 | 88 | 105 | 84 | 85 | 87 | 82 | 79 | 82 |
| Gasoline Fuel | 6 | 7 | 9 | 10 | 11 | 12 | 12 | 15 | 18 | 22 |
| Diesel Fuel | 58 | 64 | 60 | 70 | 52 | 50 | 46 | 38 | 27 | 18 |
| Other Fuel | 18 | 19 | 20 | 25 | 22 | 24 | 28 | 29 | 34 | 41 |

Table 3-6

# *Directly Emitted Particulate Matter ($PM_{2.5}$)*

## Emission Trends and Forecasts - Directly Emitted $PM_{2.5}$

$PM_{2.5}$ emissions decrease from 1975 to 1980 as a result of reduced stationary source emissions. Emissions increase slightly between 1980 and 1990, hold steady through 2010, and are projected to increase after 2010. $PM_{2.5}$ emissions are dominated by area-wide sources. Emissions from paved road dust more than double between 1975 and 2000. Unpaved road dust emissions increase through the forecast period. Other area-wide source emissions also increase slightly over the forecast period. The increase in emissions of unpaved and paved road dust are due to increases in VMT over these roads. Exhaust emissions from diesel mobile sources dropped by 38 percent from 1990 to 2000 due to more stringent emissions standards and the introduction of cleaner burning diesel fuel. $PM_{2.5}$ emissions from stationary sources are expected to increase slightly in the future due to industrial growth.

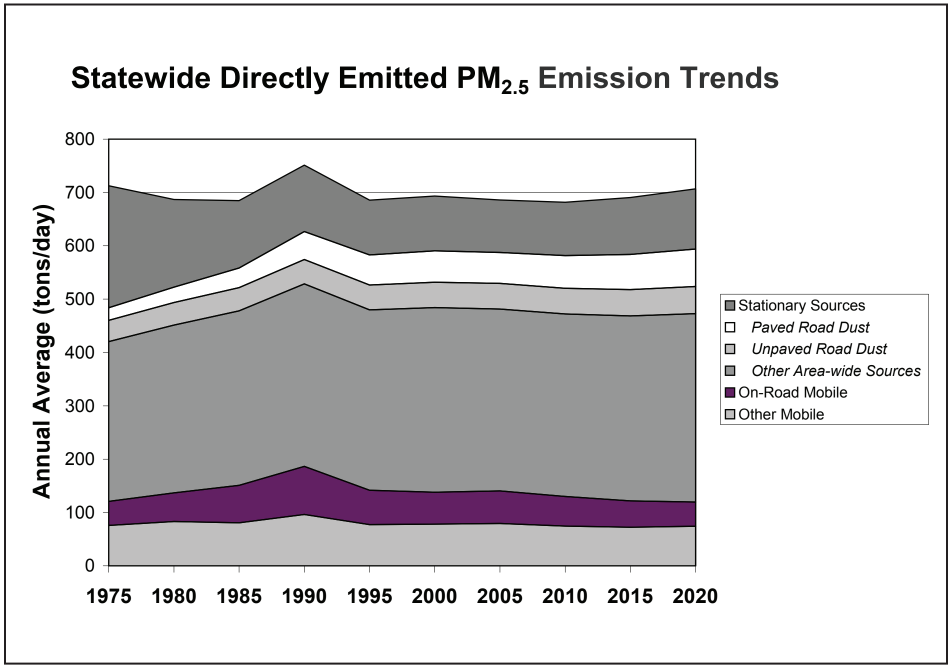


Figure 3-8

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| Directly Emitted $PM_{2.5}$ Emission Trends (tons/day, annual average) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Source** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020** |
| ***All Sources*** | ***713*** | ***687*** | ***685*** | ***751*** | ***686*** | ***693*** | ***686*** | ***682*** | ***690*** | ***707*** |
| **Stationary Sources** | 229 | 164 | 126 | 124 | 103 | 103 | 98 | 100 | 107 | 113 |
| **Area-wide Sources** | 363 | 386 | 408 | 440 | 441 | 453 | 447 | 452 | 462 | 475 |
| Paved Road Dust | 23 | 29 | 37 | 53 | 56 | 59 | 58 | 61 | 66 | 70 |
| Unpaved Road Dust | 40 | 42 | 44 | 46 | 47 | 47 | 48 | 48 | 49 | 51 |
| Other Area-wide Sources | 300 | 315 | 327 | 342 | 338 | 346 | 341 | 342 | 347 | 353 |
| **On-Road Mobile** | 45 | 54 | 70 | 90 | 65 | 60 | 61 | 55 | 49 | 45 |
| Gasoline Vehicles | 14 | 11 | 12 | 14 | 16 | 19 | 23 | 25 | 28 | 31 |
| Diesel Vehicles | 31 | 42 | 58 | 76 | 49 | 41 | 38 | 30 | 21 | 14 |
| **Other Mobile** | 76 | 83 | 81 | 96 | 77 | 78 | 79 | 75 | 72 | 74 |
| Gasoline Fuel | 4 | 5 | 7 | 8 | 8 | 9 | 9 | 11 | 14 | 17 |
| Diesel Fuel | 54 | 59 | 55 | 64 | 48 | 46 | 42 | 35 | 25 | 17 |
| Other Fuel | 18 | 18 | 19 | 24 | 22 | 24 | 28 | 29 | 34 | 40 |

Table 3-7

## Statewide Air Quality - $PM_{10}$

In contrast to ozone and carbon monoxide, $PM_{10}$ concentrations do not relate as well to growth in population or vehicle usage, and high $PM_{10}$ concentrations do not always occur in high population areas. Activities that contribute directly to high $PM_{10}$ include wood burning, agricultural activities, and driving on unpaved roads. In addition, emissions from stationary sources and motor vehicles form secondary particles that contribute to $PM_{10}$ in many areas. Figure 3-9 shows the statewide annual average for $PM_{10}$ concentrations for a non-desert area. The trend line reflects, for the most part, the South Coast Air Basin. The low value for the annual average in 1988 is due to the limited number of monitors with complete data for this year during the startup of the $PM_{10}$ monitoring network. The period between 1989 and 2007 provides a better indication of trends. Over this period, the three-year average of the annual average shows a decrease of more than 35 percent. However, there is a great deal of variability, especially during the late 1990's. Much of this variability may be due to meteorology rather than changes in emissions. Currently, over 99 percent of Californians live in air basins with concentrations that violate the State $PM_{10}$ standards during at least part of the year. As a result, PM is commanding greater attention.

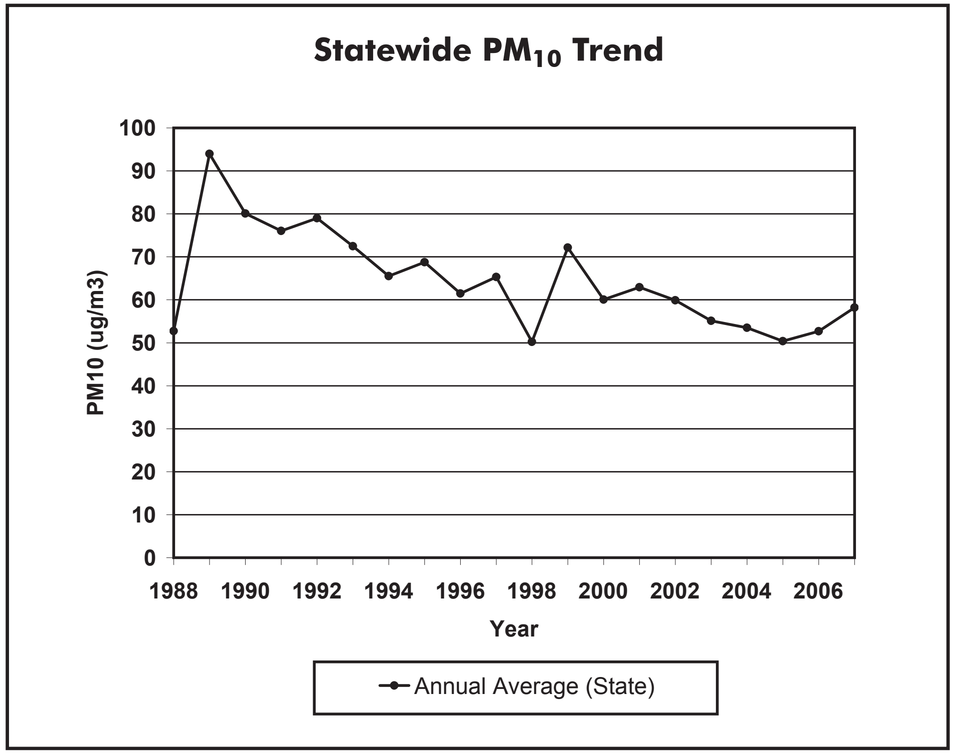

Figure 3-9

In 2003, the Legislature enacted Senate Bill 656 (SB 656) to reduce public exposure to $PM_{10}$ and $PM_{2.5}$. As a first step in the implementation of SB 656, in November 2004, the ARB approved an extensive list of the most readily available, feasible, cost-effective control measures that can be employed by air districts to reduce $PM_{10}$ and $PM_{2.5}$. Recently, air districts adopted implementation schedules for the subset of measures selected to address the nature and severity of their PM problem. The goal is to make progress towards attaining the State and national $PM_{10}$ and $PM_{2.5}$ standards.

## Statewide Air Quality - $PM_{2.5}$

Comprehensive monitoring for $PM_{2.5}$ began in 1999, therefore only limited data are available to evaluate statewide trends. Currently, most urban areas in the State, as well as several isolated sub-areas violate the State $PM_{2.5}$ annual average standard. Activities that contribute to high $PM_{2.5}$ concentrations include direct particulate emissions from mobile sources and burning, as well as the formation of $PM_{2.5}$ from the reactions of precursor gases.

Figure 3-10 shows the maximum statewide annual average $PM_{2.5}$ concentrations from 1999 through 2007 from the national perspective. The national annual average is also used in the air basin summaries in Chapter 4. The trend line reflects, for the most part, the South Coast Air Basin. Over the eight year period, the annual average shows a decrease of over 27 percent. Similar to $PM_{10}$, year-to-year changes in meteorology can mask the impacts of emission control programs.

As with $PM_{10}$, $PM_{2.5}$ represents one of the most serious health challenges in California. The measures adopted as part of SB 656 to reduce $PM_{10}$ and $PM_{2.5}$ (program description can be found on the ARB website at *www.arb.ca.gov/pm/pmmeasures/pmmeasures.htm*), as well as programs to reduce ozone and diesel PM will help in reducing public exposure to $PM_{2.5}$.

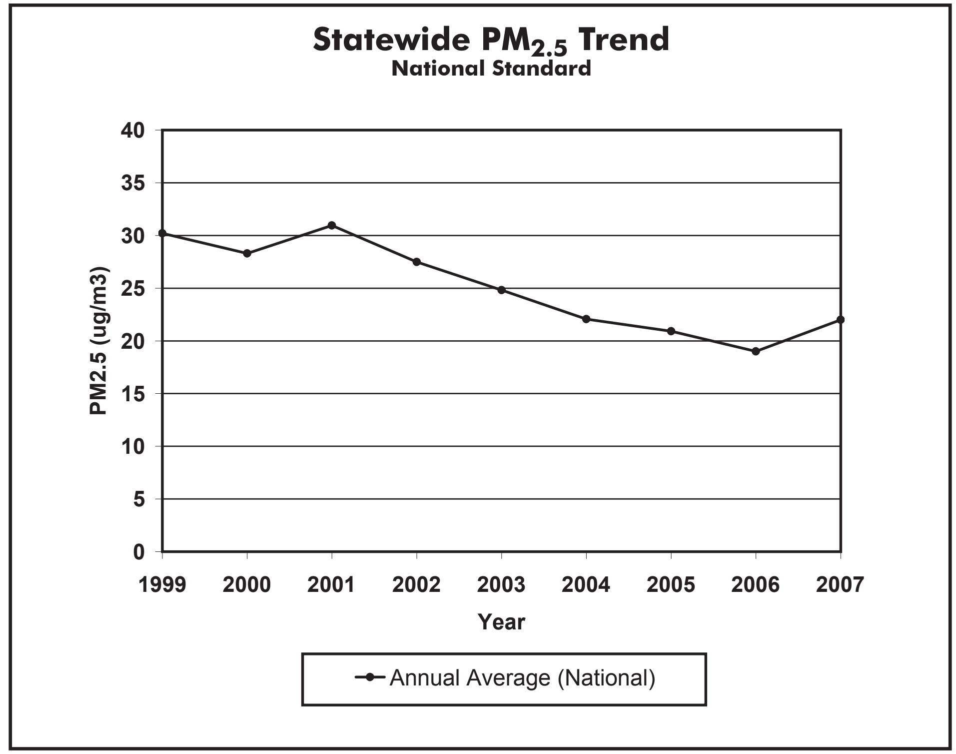


Figure 3-10

# *Carbon Monoxide (CO)*

## Emission Trends and Forecasts - Carbon Monoxide

Since 1975, even though VMT have continued to climb, the adoption of more stringent motor vehicle emissions standards has dropped statewide CO emissions from on-road motor vehicles by over 78 percent in 2005. With continued vehicle fleet turnover to cleaner vehicles, including super ultra low emitting vehicles (SULEVs) and zero emission vehicles (ZEVs), and the incorporation of cleaner burning fuels, CO emissions are forecast to continue decreasing through the year 2020. CO emissions from other mobile sources are also projected to decrease through 2010 as more stringent emissions standards are implemented with moderate increases expected after 2010. CO emissions from area-wide sources are expected to increase slightly due to increased waste burning and additional residential fuel combustion resulting from population increases.

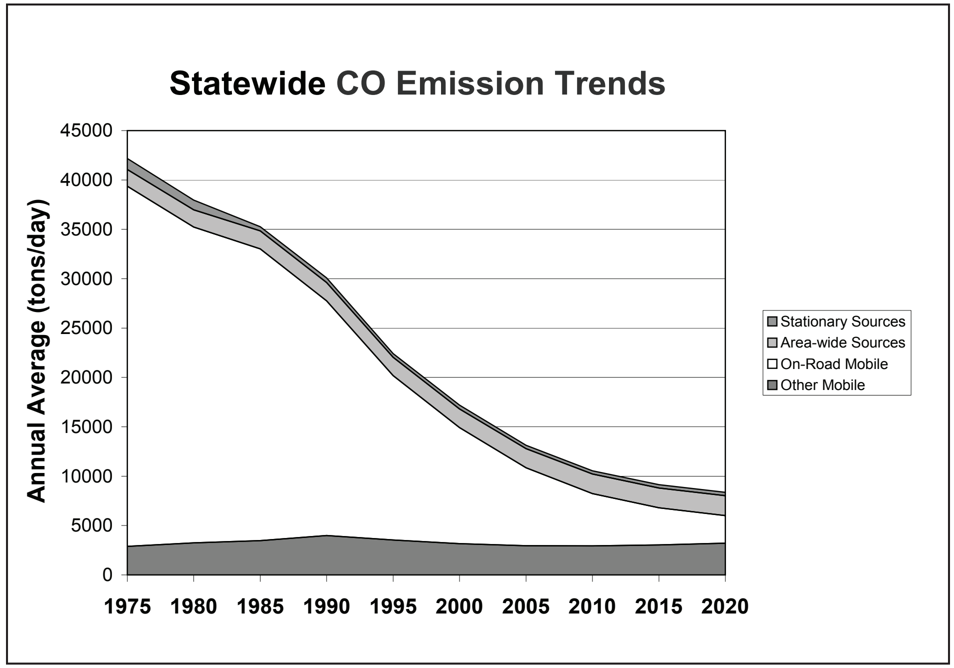


Figure 3-11

| CO Emission Trends (tons/day, annual average) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Source** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020** |
| ***All Sources*** | ***42175*** | ***37958*** | ***35270*** | ***30084*** | ***22405*** | ***17203*** | ***13127*** | ***10543*** | ***9134*** | ***8369*** |
| **Stationary Sources** | 1110 | 983 | 426 | 470 | 371 | 387 | 337 | 325 | 337 | 350 |
| **Area-wide Sources** | 1699 | 1745 | 1828 | 1850 | 1856 | 1897 | 1944 | 1983 | 1998 | 2020 |
| **On-Road Mobile** | 36483 | 31987 | 29546 | 23775 | 16644 | 11762 | 7895 | 5290 | 3759 | 2793 |
| Gasoline Vehicles | 36342 | 31796 | 29281 | 23432 | 16339 | 11491 | 7612 | 5034 | 3553 | 2623 |
| Diesel Vehicles | 141 | 191 | 265 | 343 | 305 | 271 | 283 | 256 | 207 | 170 |
| **Other Mobile** | 2883 | 3244 | 3470 | 3988 | 3534 | 3157 | 2951 | 2944 | 3039 | 3205 |
| Gasoline Fuel | 2091 | 2378 | 2657 | 3065 | 2687 | 2392 | 2217 | 2177 | 2220 | 2324 |
| Diesel Fuel | 400 | 453 | 443 | 533 | 479 | 421 | 368 | 368 | 391 | 422 |
| Other Fuel | 392 | 414 | 370 | 390 | 368 | 344 | 366 | 399 | 429 | 459 |

Table 3-8

## Statewide Air Quality - Carbon Monoxide

Similar to ozone, CO concentrations in all areas of California have decreased substantially over the last 20 years, despite significant growth. Statewide, the maximum peak 8-hour indicator declined about 67 percent from 1988 to 2007. California now meets all CO standards.

The introduction of cleaner fuels has helped bring the entire State into attainment. The U.S. EPA recently redesignated the South Coast as attainment, effective June 11, 2007. While cleaner fuels will have a continuing impact on CO levels, additional emission reductions will be needed in the future to keep pace with increases in population and vehicle usage. These reductions will come from continued fleet turnover, expanded use of LEVs, and measures to promote less polluting modes of transportation.

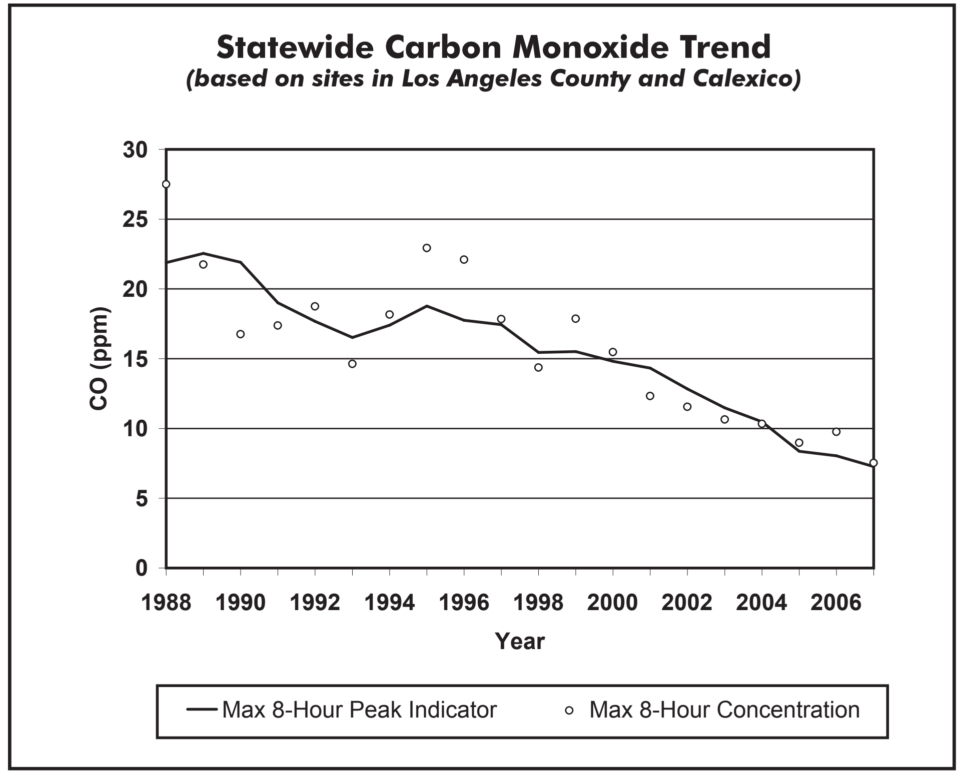


Figure 3-12

## Statewide Air Quality - Lead

The decrease in lead emissions and ambient lead concentrations over the past 32 years is California's most dramatic success story. For the purpose of understanding the progress and impact of emission controls a more exhaustive historical record is provided.

The rapid decrease in lead concentrations can be attributed primarily to phasing out the lead in gasoline. This phase-out began during the 1970s, and subsequent ARB regulations have virtually eliminated all lead from the gasoline now sold in California. All areas of the State are currently designated as attainment for the State lead standard. Although the ambient lead standards are no longer violated, lead emissions from stationary sources still pose "hot spot" problems in some areas. As a result, the ARB identified lead as a TAC in 1997.

Additionally, the EPA recently reviewed the national lead standard and has revised the standard to 0.15 $\mu g/m^3$ as of October 15, 2008 with an effective date of January 15, 2009. The most recent maximum concentration reflected in Figure 3-13 is 0.05 $\mu g/m^3$ which, while not the same as the measurement used for attainment, reflects very low values and shows considerable progress has occurred.

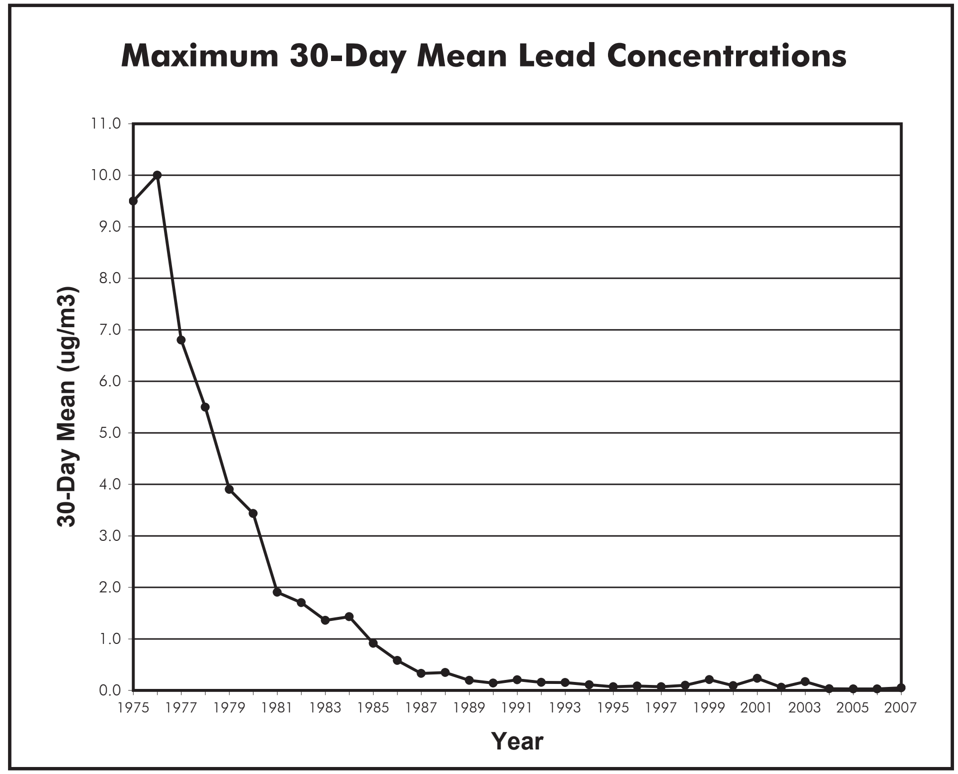


Figure 3-13

# Sulfur Dioxide

## Emission Trends and Forecasts - Oxides of Sulfur

Oxides of Sulfur ($SO_x$) are a group of compounds of sulfur and oxygen. A major constituent of $SO_x$ is sulfur dioxide ($SO_2$). Emissions of $SO_x$ declined tremendously in California between 1975 and 2005. Emissions in 2005 are about 76 percent less than emissions in 1975. Sulfur dioxide emissions from stationary sources decreased between 1975 and 2005 due to improved industrial source controls and switching from fuel oil to natural gas for electric generation and industrial boilers. The $SO_x$ emissions from land-based on- and off-road gasoline and diesel-fueled engines and vehicles have also decreased due to lower sulfur content in the fuel; and recent regulations adopted by the ARB will reduce the sulfur content in fuel used by commercial harbor craft such as tug boats and fishing vessels beginning in 2006. However, as shown in the table below, the $SO_x$ emissions from the "other mobile" categories are expected to increase in the future. This is due to the significant growth in shipping activities predicted for California and the high-sulfur fuels that ocean-going ships typically use. The ARB recently adopted a regulation for fuels used in ship auxiliary engines that will help offset this trend. Substantial reductions in $SO_x$ emissions will occur with implementation of this regulation.

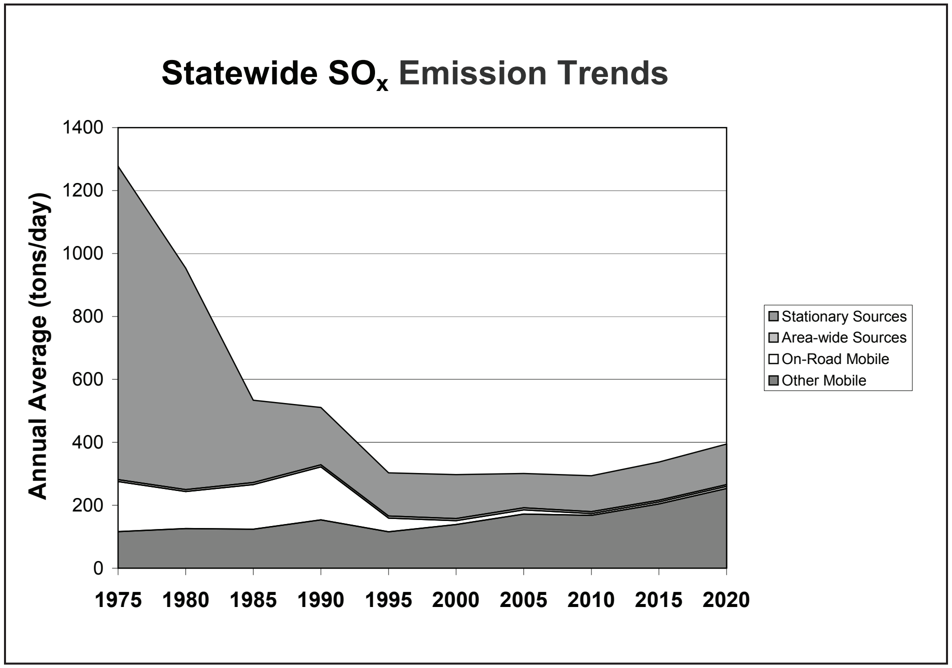


Figure 3-14

| $SO_x$ Emission Trends (tons/day, annual average) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Source** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020** |
| ***All Sources*** | ***1277*** | ***953*** | ***534*** | ***511*** | ***303*** | ***297*** | ***301*** | ***294*** | ***337*** | ***394*** |
| **Stationary Sources** | 995 | 704 | 262 | 182 | 138 | 140 | 109 | 114 | 121 | 129 |
| **Area-wide Sources** | 6 | 6 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 |
| **On-Road Mobile** | 159 | 118 | 142 | 168 | 43 | 13 | 14 | 6 | 6 | 6 |
| Gasoline Vehicles | 112 | 54 | 56 | 62 | 37 | 5 | 5 | 4 | 5 | 5 |
| Diesel Vehicles | 47 | 64 | 85 | 106 | 7 | 7 | 9 | 1 | 1 | 1 |
| **Other Mobile** | 116 | 126 | 124 | 154 | 116 | 139 | 172 | 168 | 204 | 253 |
| Gasoline Fuel | 5 | 3 | 4 | 6 | 4 | 1 | 1 | 1 | 1 | 1 |
| Diesel Fuel | 63 | 73 | 63 | 73 | 15 | 14 | 14 | 6 | 6 | 7 |
| Other Fuel | 49 | 49 | 57 | 75 | 97 | 124 | 157 | 161 | 197 | 245 |

Table 3-9

# Nitrogen Dioxide

## Emission Trends and Forecasts - Oxides of Nitrogen

Nitrogen dioxide ($NO_2$) is a colorless, tasteless gas that can cause lung damage, chronic lung disease, and respiratory infections. Nitrogen dioxide is a component of $NO_x$, and its presence in the atmosphere can be correlated with emissions of $NO_x$. Statewide emissions of $NO_x$ decreased by 28 percent between 1980 and 2005 and are projected to decrease by almost 38 percent from 2005 to 2020 as a result of more stringent emissions standards for stationary source combustion and motor vehicles, and cleaner burning fuels. The introduction of lower emitting vehicles will continue to reduce $NO_x$ emissions.

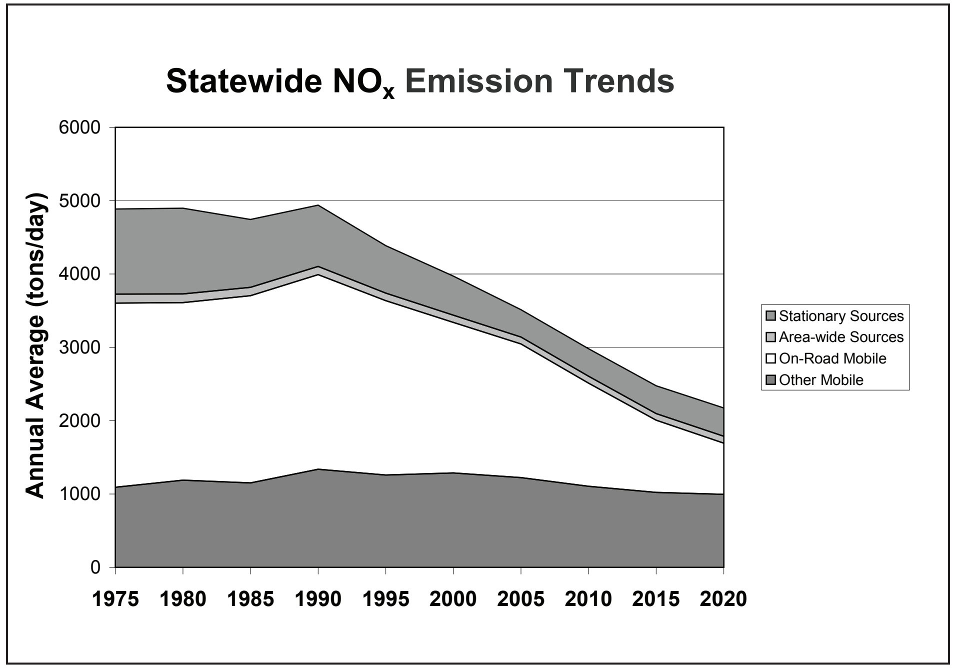


Figure 3-15

| $NO_x$ Emission Trends (tons/day, annual average) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Emission Source** | **1975** | **1980** | **1985** | **1990** | **1995** | **2000** | **2005** | **2010** | **2015** | **2020** |
| ***All Sources*** | ***4886*** | ***4898*** | ***4744*** | ***4940*** | ***4387*** | ***3972*** | ***3513*** | ***2981*** | ***2476*** | ***2173*** |
| **Stationary Sources** | 1161 | 1170 | 926 | 837 | 647 | 533 | 372 | 376 | 378 | 387 |
| **Area-wide Sources** | 122 | 118 | 115 | 111 | 104 | 99 | 95 | 92 | 92 | 93 |
| **On-Road Mobile** | 2510 | 2421 | 2552 | 2654 | 2377 | 2053 | 1823 | 1407 | 984 | 699 |
| Gasoline Vehicles | 2197 | 2014 | 1958 | 1839 | 1574 | 1160 | 754 | 504 | 359 | 263 |
| Diesel Vehicles | 312 | 407 | 593 | 815 | 803 | 893 | 1069 | 904 | 625 | 435 |
| **Other Mobile** | 1093 | 1189 | 1152 | 1338 | 1258 | 1287 | 1223 | 1105 | 1022 | 995 |
| Gasoline Fuel | 51 | 57 | 62 | 72 | 70 | 69 | 75 | 68 | 64 | 64 |
| Diesel Fuel | 914 | 999 | 948 | 1091 | 984 | 968 | 861 | 740 | 602 | 497 |
| Other Fuel | 128 | 132 | 142 | 174 | 205 | 249 | 287 | 297 | 356 | 435 |

Table 3-10

## Statewide Air Quality - Nitrogen Dioxide

$NO_x$ emissions are a by-product of combustion from both mobile and stationary sources, and they contribute to ambient nitrogen dioxide ($NO_2$) concentrations. Since 1988, maximum $NO_2$ concentrations have decreased over 76 percent, due primarily to the implementation of tighter controls on both mobile and stationary sources. Although many of these controls were implemented to reduce ozone, they also benefited $NO_2$. All areas of California are currently designated as attainment for the State $NO_2$ standard and unclassified/attainment for the national $NO_2$ standard. Projections show $NO_x$ emissions will continue to decline, thereby assuring continued attainment.

ARB revised the State 1-hour and adopted a new annual $NO_2$ standard on February 22, 2007. The South Coast is the only area with annual average $NO_2$ concentrations that exceed the level of the new State standard.

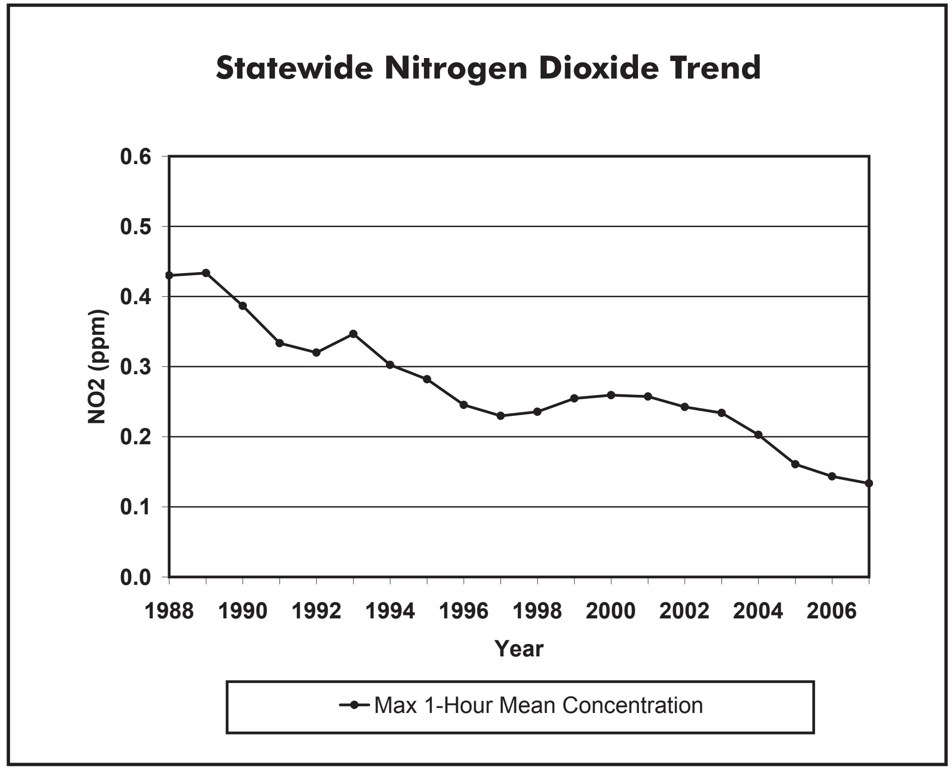


Figure 3-16

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