United States
Environmental Protection
Agency

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EPA

Trends in the Quality of the Nation's Air

A Little Background

The Nation's commitment to clean air has taken many forms. But over the past several years, the evolution of Federal legislation and regulation has shaped and increased a cooperative effort among Federal and State control agencies, industry, and a concerned and informed public. Especially as a result of the 1970 Clean Air Amendments, a considerable expenditure of time, material, and funds has been brought to bear on solutions to the technological and social problems needed to assure protection of public health and welfare from the adverse effects of air pollution.

The States, backed by Federal assistance, have developed wide-ranging regulatory, enforcement, and administrative programs to reduce emissions of air pollution from a great variety of sources. These abatement efforts have been augmented by direct Federal regulation and enforcement of control measures directed toward certain types of pollutants and industrial sources, as well as the Federal program to reduce air pollution emissions from new motor vehicles.

As more and more information becomes available, it also becomes possible to assess with increasing assurance what the success of these programs has been and to describe more fully and accurately the trends in the quality of the Nation's air. Based on a study by the Environmental Protection Agency, *National Air Quality and Emissions Trends Report, 1975*, we can provide some reasonable answers to the question, "What has all of this effort accomplished?"

And the answer quite simply is that the quality of the Nation's air has improved. Over the past five years considerable progress has been made toward achieving the National Ambient Air Quality Standards established by the Environmental Protection Agency, under the 1970 Clean Air Amendments, to protect our public health and welfare.

In the remaining pages, we shall present, in simplified form, some of the information from the study. (Those desiring to review the full, detailed technical and statistical analysis, may obtain a copy from the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N.C. 27711.)

An analysis of special interest, done for the first time, is an estimate of changes in population exposed to high air pollution levels. This has been done for the country for particulate matter where more information was available, and for selected areas for other pollutants.

The Air Quality Trends

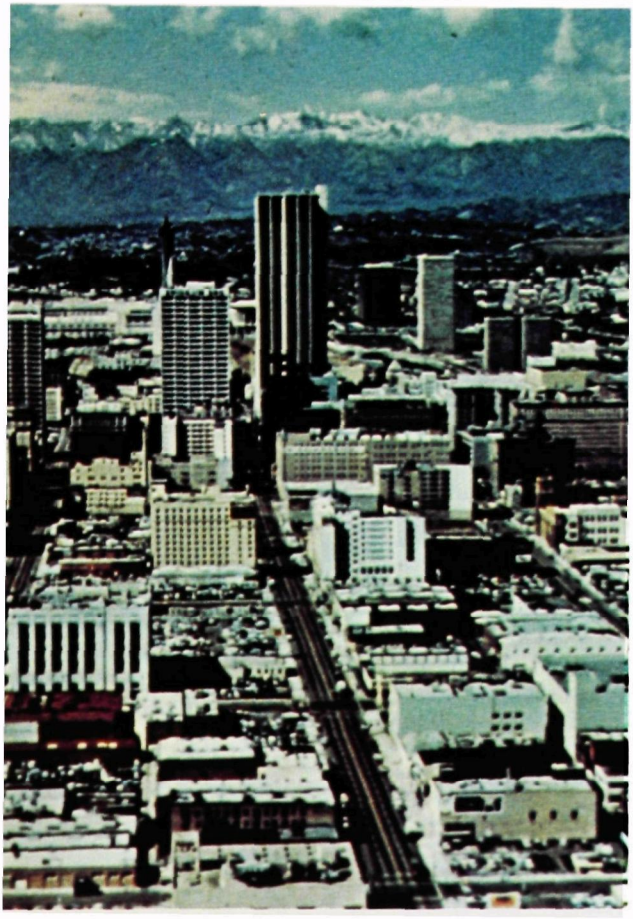
Measurements of actual air pollution levels in the air are made throughout the country by State and local agencies. The number of locations where these measurements are made varies with different State and metropolitan areas; also some pollutants are measured at fewer locations than others, and have been measured for fewer years.

Using the information provided by the States, changes were studied for those pollutants for which EPA has set air quality standards—total suspended particulates, sulfur dioxide, photochemical oxidants, carbon monoxide, and nitrogen dioxide. Trends in the levels of these pollutants were determined on a national basis and on a regional basis. Most of the information covers the period 1971-1975, although other time periods were considered in some cases where more, or less, information may have been available.

Following the general results, some additional detail is provided for particulates, sulfur dioxide, carbon monoxide, and oxidants. (Not enough information is yet available to provide detail for nitrogen dioxide in a non-technical fashion, and the reader is referred to the original study for that information.)

• The Results

- In 1975, 28 million *fewer* people throughout the country were exposed to particulate levels above the health-related air quality standard than had been exposed in 1970. This is a decrease of 38 percent.
- In the greater New York Metropolitan area, 7 million fewer people in 1974 were exposed to particulate levels above the health-related standard than had been exposed in 1971.
- By 1975, average sulfur dioxide levels in urban areas had dropped 30 percent since 1970. This improvement took place most rapidly in the 1970-1973 period. Since then, with much of the emission reduction having been accomplished, and with some movement toward greater use of high sulfur fuels where possible, without exceeding the air quality standard, trends have tended to level off.
- Long-term oxidant data for much of the country is somewhat limited. But short-term trends for the eastern part of the United States for 1973-1975



show some decline in levels exceeding the air quality standard.

- In the Los Angeles Air Basin, there has been a considerable reduction in the number of days on which the health-related oxidant standard has been exceeded. In the mid-60's, people in the Basin were exposed to levels above the standard on an average of 176 days a year. By the mid-70's, this exposure was down to an average of 105 days a year.
- Some 80 percent of the locations where carbon monoxide is measured across the Nation show improvements in levels of this auto-related pollutant, with the rate of improvement more pronounced in California where auto emission standards have been somewhat more stringent than the Federal standards.
- Trends in nitrogen dioxide levels were mixed. Levels in the Los Angeles Basin declined between 1971 and 1975, but in other parts of the country where information is available, levels have declined in some locales, increased in others, and show no particular trend for still others.

Some Details . . . About Particulates

Trends in particulate levels since 1970 show a general improvement at a rate of four percent per year, with the result that 38 percent fewer people throughout the country now are exposed to levels higher than the health-related air quality standard.

Improvement rates have differed in various parts of the country, with higher rates being found in the Northeast and Great Lakes areas, and more level rates in some western States where natural particulate matter poses problems.

Despite the improvements, total suspended particulates still remain a problem. Approximately 28 percent of the Nation's population are still living in areas where the annual standard is exceeded. Because of this, some States may be required to adopt new measures to take care of problems that still exist.

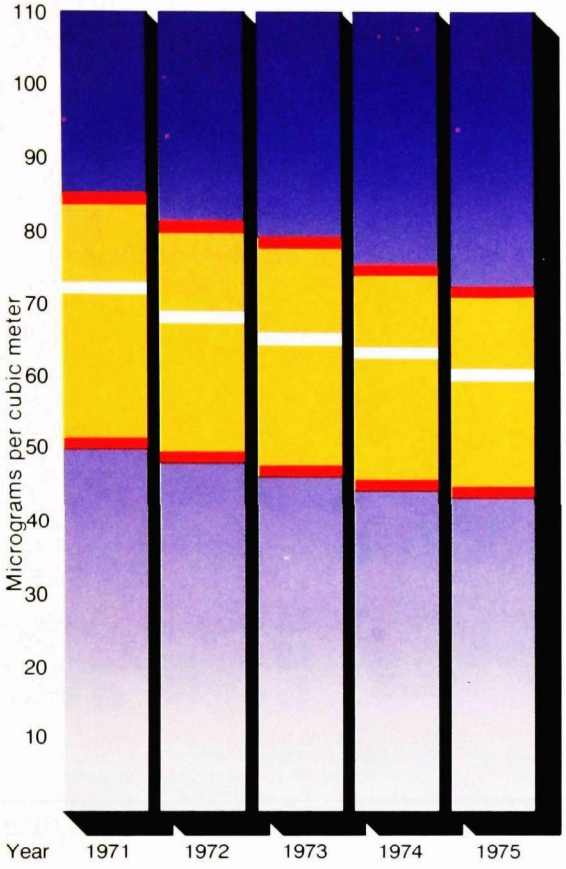
Measurements have been made of levels of particulate matter in the air for more locations and for a longer time than any other air pollutant. Thus, there is enough information available to make it possible to estimate nationwide trends in population exposure. The information available was sufficient to allow such an analysis to be made for most areas of the country, covering some 165 million of the total population.

In 1970, 74 million people were exposed to levels above the health-related air quality standard for particulate matter. By 1975 this number had dropped to 46 million—an improvement of 28 million fewer people, or 38 percent, exposed to levels above the standard.

Moreover, as would be expected from the trends in measured air quality levels, reduced exposures generally occurred at all concentration levels.

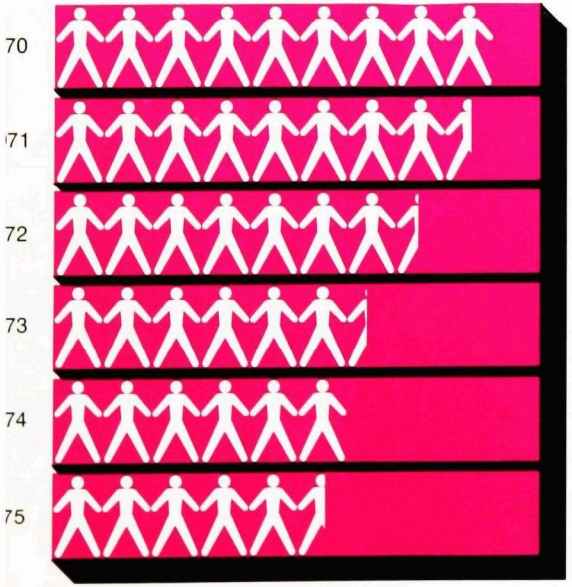
In the greater New York Metropolitan area, measurements have been made of particulate matter at a large number of locations extending back over many years. Thus, it is possible to make especially detailed studies of trends in population exposures to particulates.

National Trends, Yearly Average Particulate Levels, 1971 - 1975



Here we see the year-by-year change in the levels measured throughout the country. The bottom red line shows typical average levels for the cleaner locations, the white line shows the overall average, and the top red line shows the typical average levels for the dirtier locations. A general improvement can be seen for all categories. The cleaner locations, while improving, are not doing so at as great a rate. The overall average shows greater improvement. The dirtier areas show the greatest improvement. This is consistent with planned pollution control programs. Those locations where the yearly average air quality control standards already were met are not so much concerned with further reductions, but rather with maintaining air quality. Those with the greatest problems, because of previously uncontrolled sources, have needed, and achieved, greater emissions reductions and greater rates of air quality improvement.

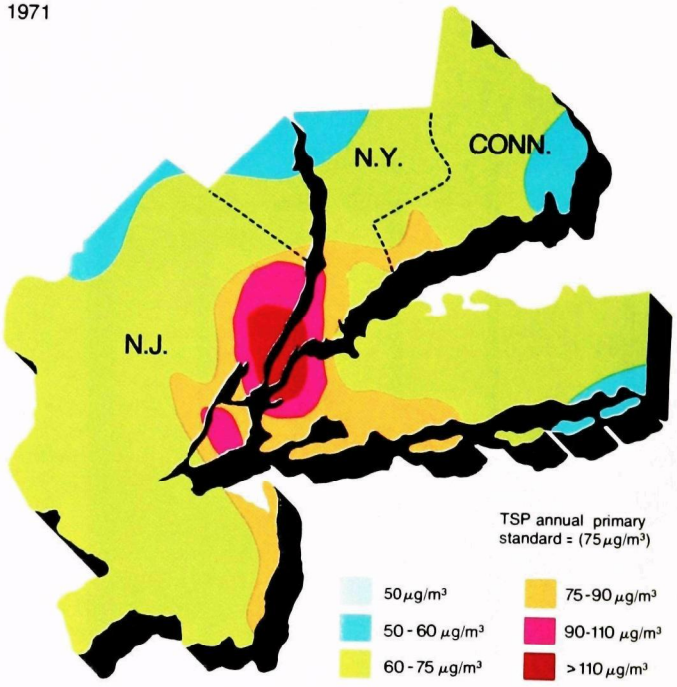
Trend in National Population Exposure to Particulate Matter Levels Above the Health-Related Standard



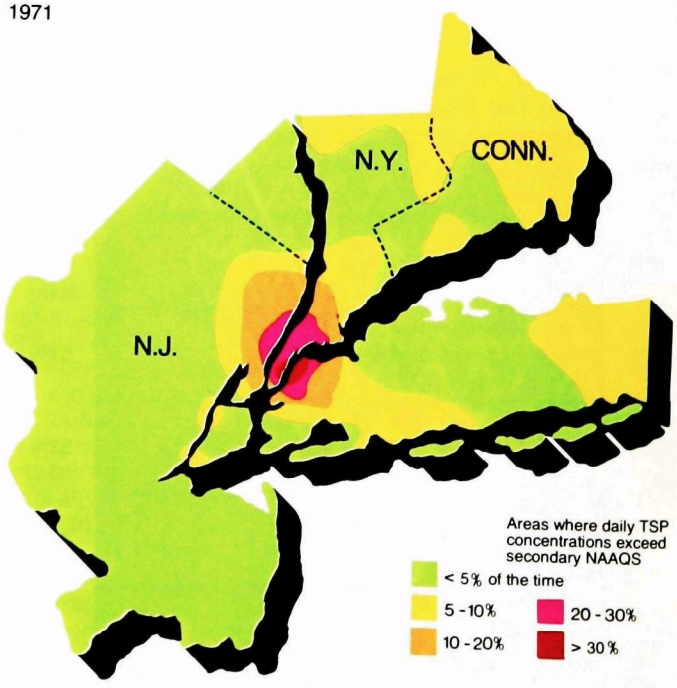
Between 1971 and 1974, annual average levels were reduced 25 percent resulting in 71 percent fewer people living in areas exposed to levels in excess of the health-related air quality standard. And the number of repeated exposures to high daily levels also was reduced.

The numbers of those more likely to be adversely affected by high air pollution levels—the elderly and the school aged—living in the high pollution area—also dropped sharply. Although a slightly higher proportion of the elderly population lives in areas of elevated particulate levels, the overall rates of improvement are similar for the total population, for the school aged, and for the elderly.

Yearly Average Particulate Levels in the New York



New York Population Exposure to Daily Particulate

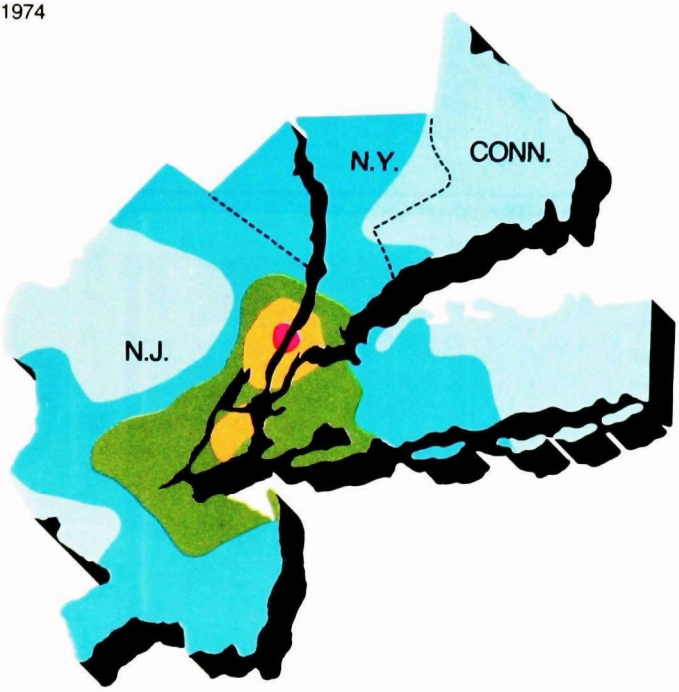


Number of People Living in Areas of New York Exceeding the Annual Particulate Standard

Population Category	Total Population in Millions	Percent of Category Population 1971	Percent of Category Population 1974	Percent reduction in population exposed to levels above annual standard
Total Population	17	58	17	71
School Age	3.9	53	14	74
Elderly	1.8	64	20	69

Area, 1971 and 1974

1974

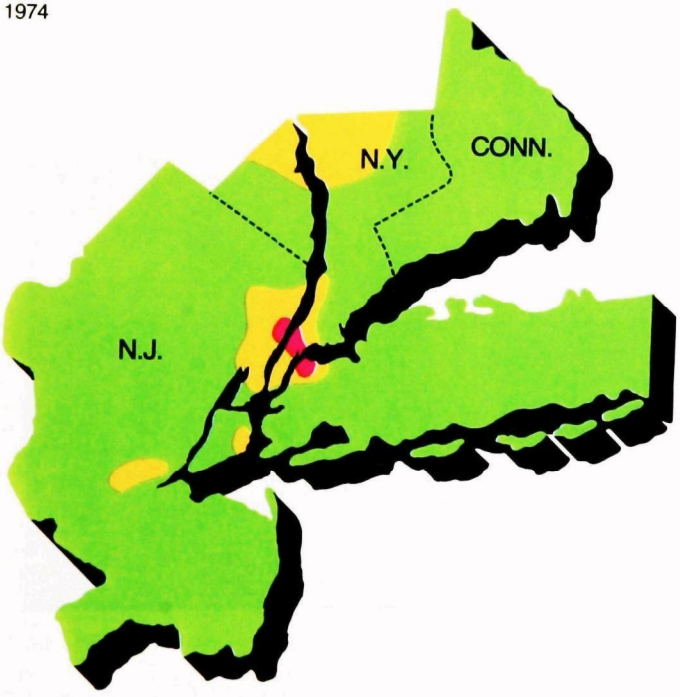


Note: Isopleth maps are based on spatial interpolation from data measured at 103 monitoring sites. Local TSP may vary because of meteorology, topography, and emissions.

In 1971, 19 percent of the land area was exposed to levels higher than the health-related air quality standard. But, in 1974, less than four percent was blanketed by air containing levels this high.

Levels, 1971 and 1974

1974



The percent of people exposed to daily particulate levels in the New York area are shown here for 1971 and 1974. With much smaller areas blanketed by high levels in 1974, many fewer people were exposed to the higher levels. For example, in 1971, some 58 percent of the total population lived in areas where levels exceeded the welfare related standard. But, by 1974, this had dropped to 15 percent.

Some Details . . . About Sulfur Dioxide

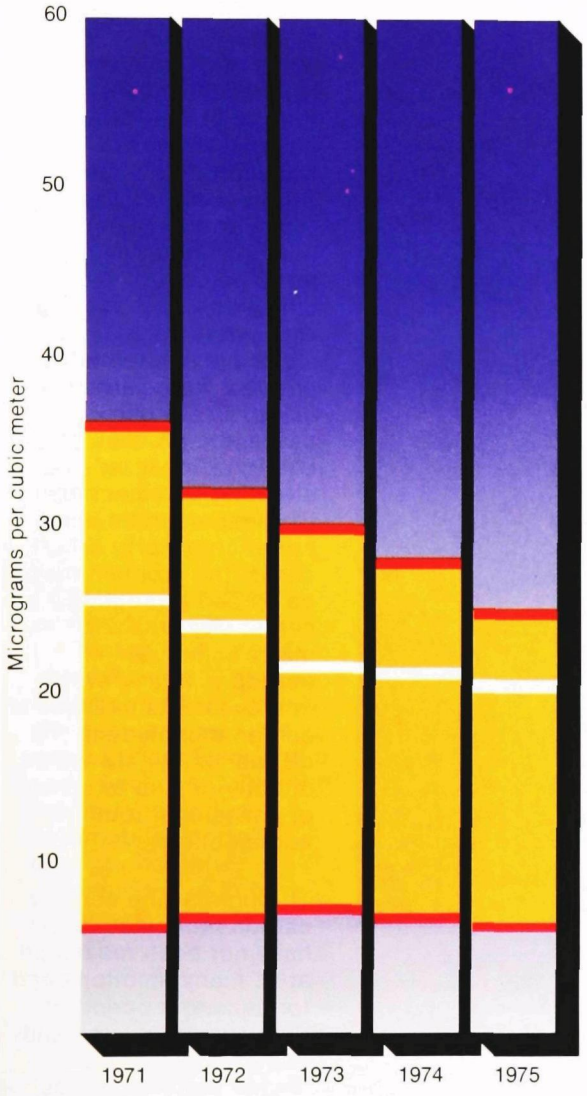
Levels of sulfur dioxide in the air over the Nation's urban areas have decreased by an average of 30 percent from 1970 to 1975. Most of this improvement took place rapidly in the 1970-1973 period. Since then, levels have been fairly constant because many areas had reached levels that met the ambient air quality standard and because of some movement toward greater use of high sulfur fuels where possible, without exceeding the air quality standard.

In some few cases, there seem to have been slight increases during 1975 because of changes in fuel use patterns. In Los Angeles, for instance, even though sulfur dioxide levels are low, there has been an increase because of recent changes in fuel use associated with a curtailment of the use of natural gas for industrial purposes in that area. Similar patterns appear in parts of the Northeast.

From a national viewpoint, the urban sulfur dioxide problem has diminished so that only a small number of areas now exceed the air quality standard for sulfur dioxide. But, of course, continued vigilance will be required to maintain this favorable situation.

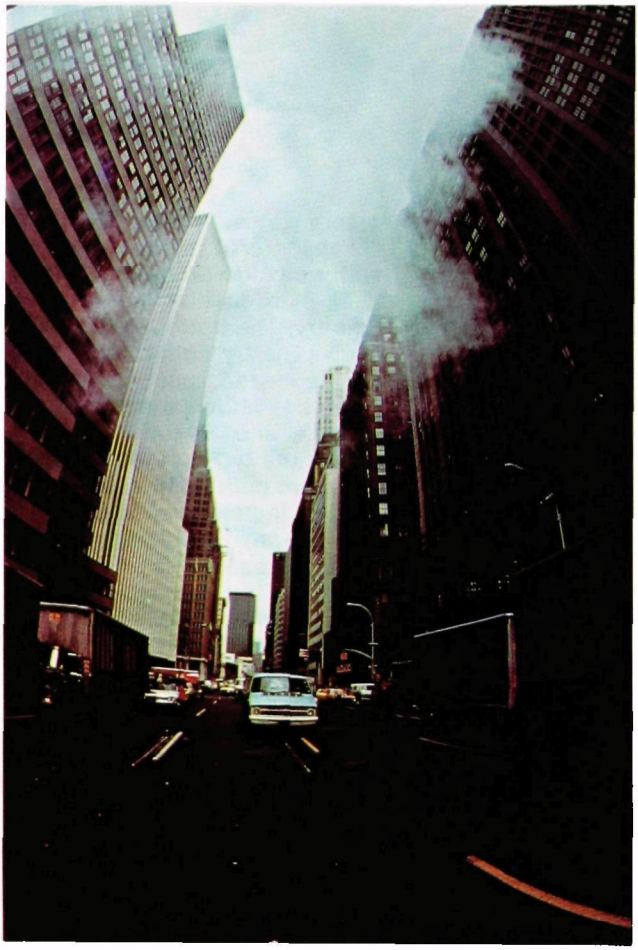
On the other hand, a number of single sources of sulfur dioxide still exist outside of major urban areas. These individual sources, such as smelters, pose the greatest threat to the air quality standards for sulfur dioxide at the present time.

National Trends in Yearly Sulfur Dioxide Levels, 1971-1975



Here we see the year-by- year changes in the levels of sulfur dioxide levels measured at all individual locations in the country. The bottom red line shows the typical average level for the cleaner locations, the white line shows the overall average, and the top red line shows the typical average for the more polluted locations. A general improvement can be seen. Improvement at the cleaner locations is much less evident, while the overall average shows greater improvement, and the more polluted locations show the greatest improvement. This pattern is to be expected because the cleaner areas did not have as far to go, while those areas needing the greatest improvement show the greatest improvement.

Some Details . . . About Carbon Monoxide



The primary source for emissions of carbon monoxide in most U.S. cities is the automobile. Nationally, some three-fourths of the carbon monoxide comes from transportation sources. But in some urban areas, transportation can be responsible for as much as 99 percent of the emissions, and any city with heavy enough traffic may have a potential problem from carbon monoxide. In some cases, the problem may be highly localized—affecting perhaps only the area around a few street corners. In other cases, the problem may be spread throughout the center-city area and near major commuter corridors. In any event, improvements in levels of carbon monoxide in the air will almost always be directly related to control of emissions from automobiles.

Throughout the country, carbon monoxide levels have not been measured at as many locations and for as long a period of time as particulates and sulfur dioxide. This means that it is not as easy to determine national trends in carbon monoxide levels in the air. California, however has been making such measurements

extensively for a longer time, so trends there can be checked more easily. And these can be compared with those in other parts of the country to see whether they agree.

When this is done, the overall picture clearly shows improvement.

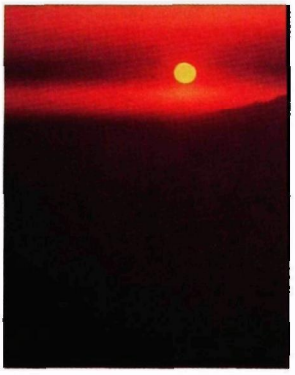
In California, over a three-year period, lower carbon monoxide levels were measured at 81 percent of the sampling locations. For the remainder of the country, this improvement was found at 78 percent of the locations.

In California, carbon monoxide levels decreased at a rate of about 7 percent per year. In the rest of the country, the decrease was at a rate of about 5 percent a year. Because California has more stringent automobile control regulations, this difference should be expected.

Some Details . . . About Oxidants

Oxidants (or photochemical oxidants) are not emitted directly into the air from air pollution sources. This group of chemicals is formed in the air by chemical reactions between hydrocarbons—such things as gasoline vapors and cleaning solvents—and nitrogen oxides—which are formed from the nitrogen and oxygen in the air whenever any kind of burning takes place. The reactions producing oxidants are strongly stimulated by sunlight, but however formed, oxidants are an important air pollutant having adverse effects on public health and welfare.

Oxidants have long been a major air pollution problem in Los Angeles, and other parts of California. They have become increasingly important in other parts of the country as motor vehicle traffic—a major source of hydrocarbons and nitrogen oxides—has increased, and as levels of other contaminants have dropped. However, because oxidants—outside of California—have been recognized as a serious problem only during recent years, there is not enough information on levels in the air extending far enough back to allow



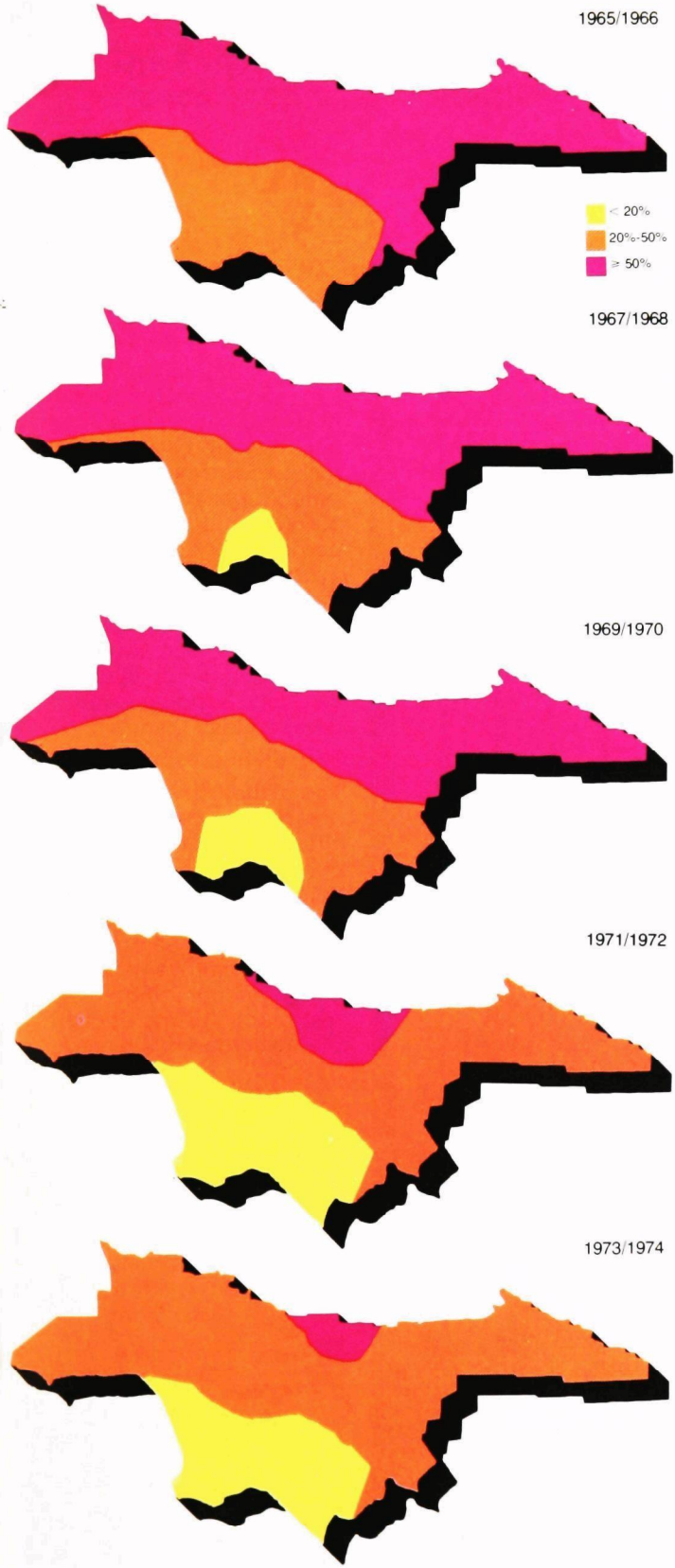
national trends to be determined, although some clues can be found.

Summertime oxidant levels in eastern cities seem to be lower over the past three years.

In California, there has been a general improvement. A decline has occurred in San Francisco over the past ten years. In San Diego, levels declined by some 40 percent over the past ten years. Most of this decline occurred during the first five years of the period, but recent patterns have been mixed, so that there has been no net change over the past five years.

In the Los Angeles area, measurements of oxidants have been made at a large number of locations, over a long period of time. This allows for a more detailed examination of trends in air quality levels and, even more usefully, in changes in the exposure of the population to high levels of this contaminant.

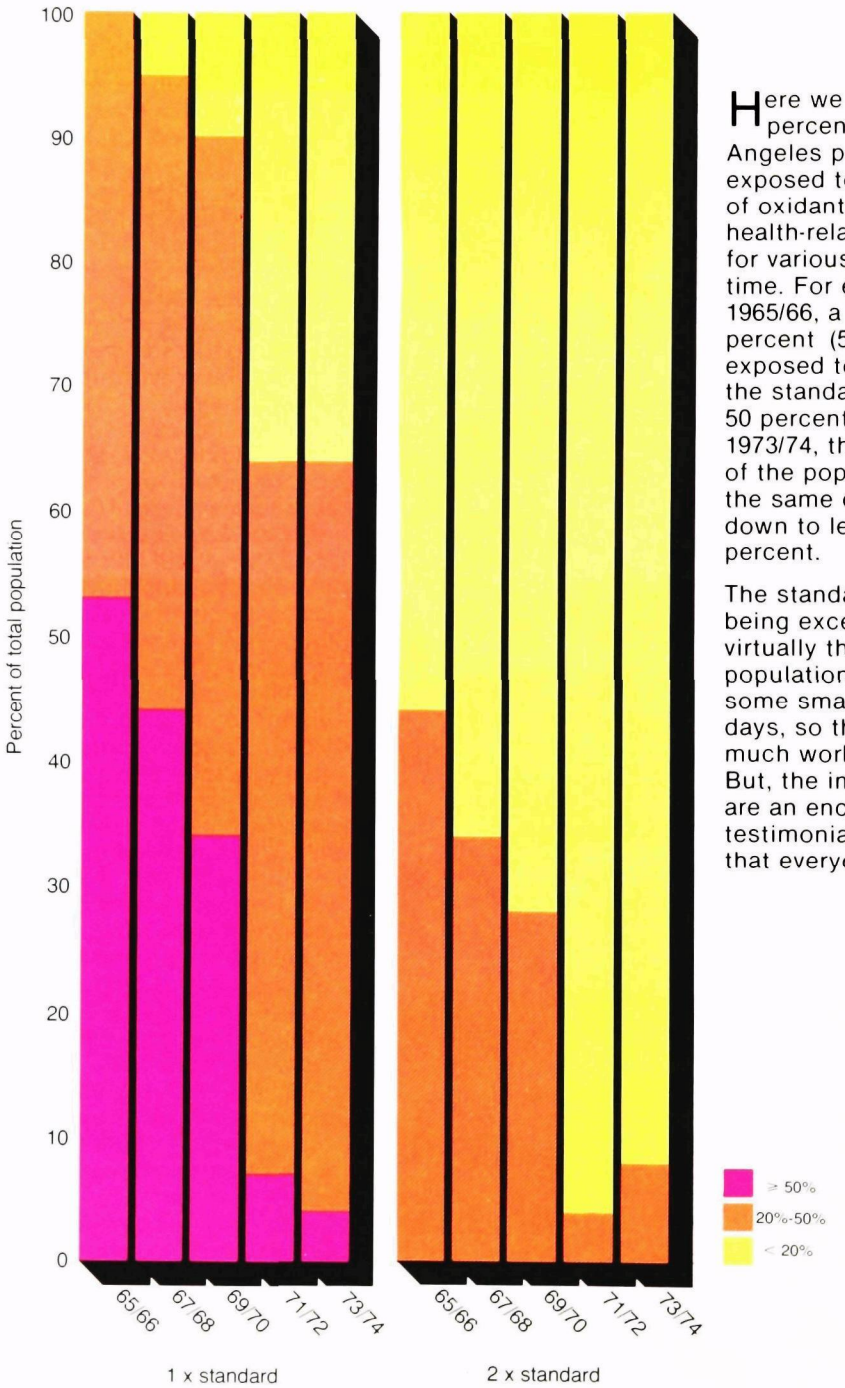
Over a 10-year period, people in the Los Angeles Basin experienced a dramatic decline in the number of days they were exposed to oxidant levels above the health standard. In the two-year period 1965/66 people were exposed an average of 176 days a year. By 1969/70, this had dropped to 144 days a year. And by 1973/74 this exposure was down to 105 days a year. Not only did the number of days decrease—so also did the total time during which a person was exposed. In terms of total hourly exposure, people in Los Angeles were exposed to oxidant levels above the health-related standard an average of 1050 hours a year in 1965/66, but by 1973/74 this exposure had fallen to an average 525 of hours a year—a reduction in exposure of one-half.



Percent of Days on Which Oxidants Exceeded the Health-Related Standard in Los Angeles

Here we see the trend in the percentage of days in the Los Angeles area on which the health-related air quality standard was exceeded. In 1965/66, more than half of the Basin was blanketed with air exceeding the standard on more than half of the days of the year. By 1973/74, this has been reduced to only a small area. This small area remains as the result of a combination of two factors. A significant reduction in emissions of hydrocarbons that react rapidly has taken place in the Los Angeles Basin. This has resulted in sizeable improvements in oxidant air quality in the general vicinity of where the reductions occurred. On the other hand, there still exist emissions of sizeable quantities of hydrocarbons that react more slowly. Movement of these slower reacting materials toward the eastern portions of the Basin, coupled with population growth in these areas, has resulted in increased high levels in some eastern parts of the Basin. An area where the standard was exceeded on fewer than 20 percent of the days has emerged and grown.

Trends in Population Exposure to Oxidants in Los Angeles, 1965-1974



Here we see what percent of the Los Angeles population was exposed to various levels of oxidant above the health-related standard for various amounts of time. For example, in 1965/66, a little over 50 percent (53%) were exposed to levels above the standard on at least 50 percent of the days. In 1973/74, the percentage of the population with the same exposure was down to less than five percent.

The standards still are being exceeded for virtually the entire population for a least some small fraction of days, so there still is much work to be done. But, the improvements are an encouraging testimonial to the efforts that everyone has made.

The Emissions Trends

Another way of measuring pollution control progress is to estimate the changes in amounts of pollution being put into the air. Measures of the levels in the air relate most directly to people and to the effects that air pollution has on health and welfare. Estimates of amounts emitted relate more directly to the sources, and can show where control has been most effective and what sources still need most attention.

Estimates are made for five major pollutants: particulate matter, sulfur oxides, oxides of nitrogen, hydrocarbons, and carbon monoxide. Since oxidants are not, for the most part, emitted directly, estimates of these would be meaningless. But since hydrocarbons are a major ingredient in the formation of oxidants, estimates of these emissions provide important information in determining the effectiveness of control measures.

The Results

During the period 1970 through 1975, for the Nation—

- Particulate emissions from all sources are down by 33 percent.
- Sulfur oxides emissions from all sources are down by 4 percent.
- Nitrogen oxides emissions from all sources are up by 7 percent.
- Hydrocarbon emissions from all sources are down by 9 percent.
- Carbon monoxide emissions from all sources are down by 15 percent.

These figures do not take into account the fact that all emissions would have been higher had there been no pollution controls in effect.

Summary of National Emission Estimates
Millions of Tons a Year

Year	Particulates	Sulfur Oxides	Nitrogen Oxides	Hydrocarbons	Carbon Monoxide
1970	26.8	34.2	22.7	33.9	113.7
1971	24.9	32.3	23.4	33.3	113.7
1972	23.4	36.7	24.6	34.1	115.8
1973	21.9	35.6	25.7	34.0	111.5
1974	20.3	34.1	25.0	32.9	103.3
1975	18.0	32.9	24.2	30.9	96.2

Some Details

Particulate emissions were reduced mainly by installation of control equipment on industrial processes, because of less coal burning by non-utility stationary sources, by installation of control equipment by electric utilities that burn coal, and because of a decrease in the burning of solid waste. The extent of emission reductions by industrial processing also was increased as a result of economic recessions that curtailed production by some industries. This is particularly evident from 1974 to 1975.

Sulfur oxides emissions declined slightly from 1972 through 1975. Although not shown, emissions from electric power generating plants increased somewhat through 1973, and then levelled off. In spite of the overall relatively slight declines in emissions, the air quality trends showed us that levels in the air over urban areas have decreased considerably over the past few years. This difference arises because high sulfur fuels have been shifted from use in urban areas to use in a growing number of sources outside of densely populated areas, where fewer people live and there are fewer other sources.

Nitrogen oxides emissions have increased mainly because of increased emissions from electric utilities and from mobile sources. Emissions from electric utilities rose because of increased electric generation, which requires the use of more fuel. Nitrogen oxides emissions from mobile sources have increased due to increases in the number of vehicle miles travelled by all highway vehicles. For the automobile portion of the highway vehicles, emissions have been essentially constant since 1972 because Federal emission standards that went into effect with the 1972 cars have tended to balance the increase in total miles travelled.

Hydrocarbon emissions have gone down only slightly. Significant reductions have been obtained from highway vehicles as a result of the Federal emission standards. But these reductions have been partially offset by increases in industrial process emissions and losses of gasoline and other hydrocarbon vapors from evaporation at filling stations and other points in the marketing chain, and from the use of various solvents. The increases reflect a general increase in the consumption of these products.

Carbon monoxide emissions have decreased mostly because of the Federal emission standards on motor vehicles and because of less burning of solid waste. Some industrial emissions also have been reduced because of decreases in production, and the phasing-out of some obsolete processes.

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Calculated Total Emissions of Criteria Pollutants by Source Category, 1970 through 1975