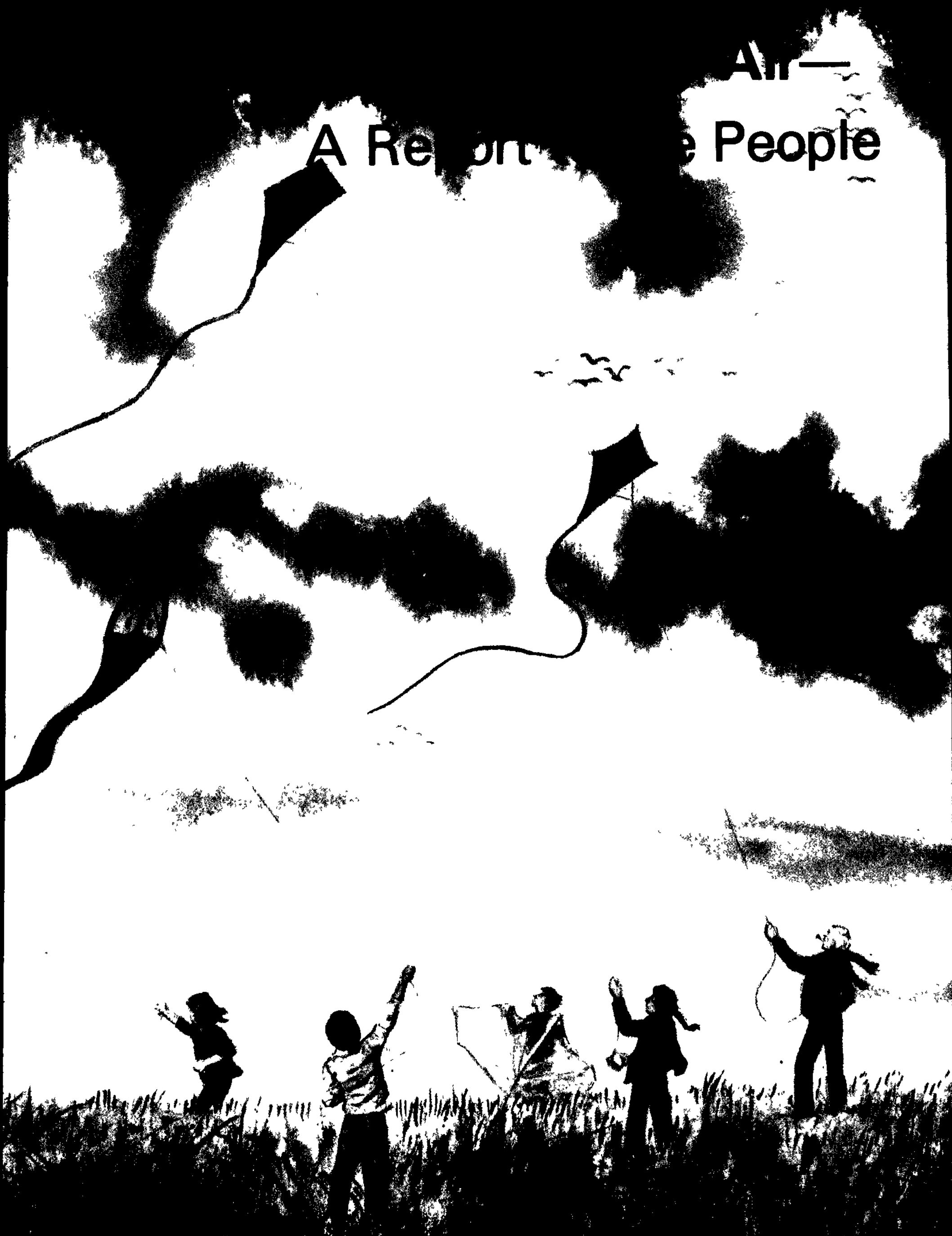


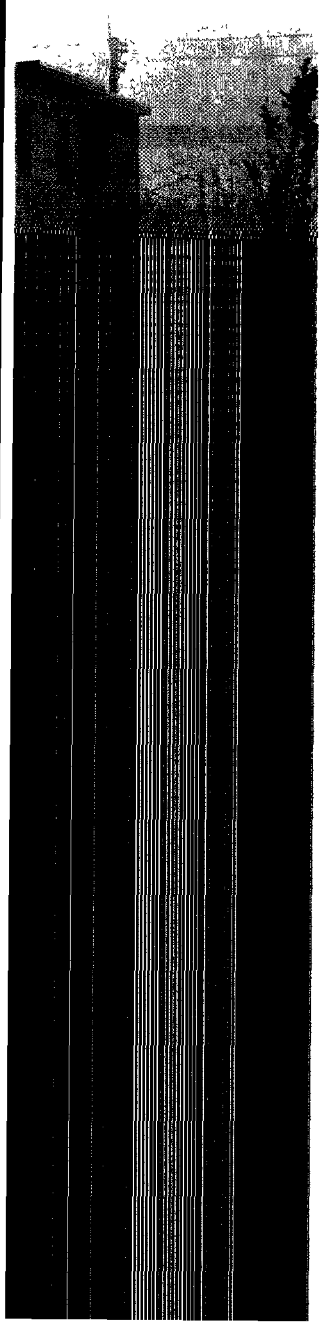
Air—
A Re ort e People

A Little Background

The last two decades have witnessed a growing national commitment to protecting public health and welfare from the effects of air pollution. Recent federal legislation, particularly the 1977 Amendments to the 1970 Clean Air Act, have guided federal and state control agencies, industry, and a concerned public in a cooperative effort aimed at solving the technological and social problems involved in cleaning the Nation's air.

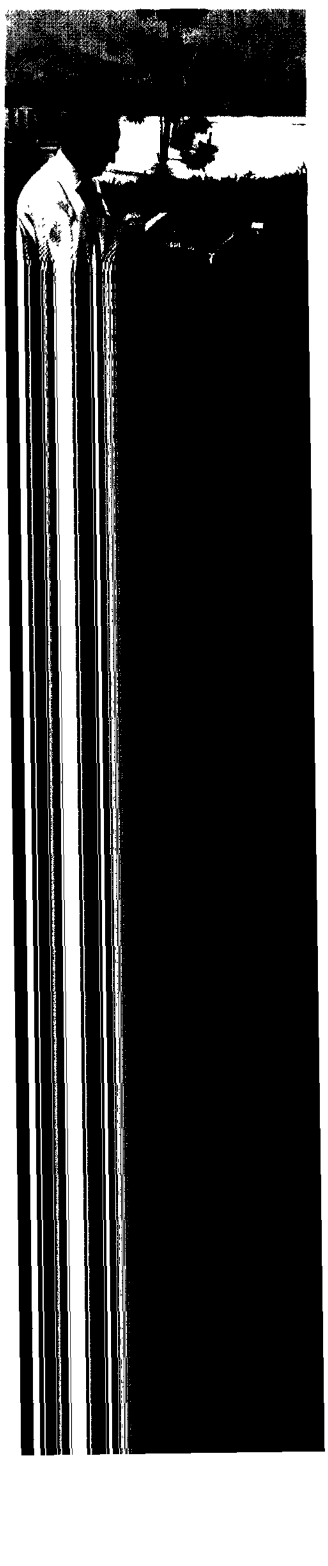
As part of this effort, many states have developed wide-ranging regulatory, enforcement, and administrative programs to reduce emissions of air pollution from a great variety of sources. These abatement efforts have been augmented by federal air pollution regulations and control measures directed toward emissions from new motor vehicles and certain industrial sources. Indirect federal assistance has included dissemination of information on new air pollution control technology, studies of the health effects of air pollution, and the coordination of state efforts.

What has been accomplished by this considerable expenditure of time, material, and funds? How does air quality vary across the United States, and how has it improved during recent years? To help answer these questions, the U.S. Environmental Protection Agency (EPA) published the *National Air Quality and Emissions Trends Report, 1977** in December 1978. It contained estimates of the quality of the Nation's air, emission levels by source category, the exposure of selected urban populations to air pollution, and comparisons with figures from previous years.



Highlights of that detailed report with additional

Summary



More than 8,000 air monitors across the country measure and record air pollution levels. This report covers data accumulated from these stations relative to five principal pollutants. The data is largely quite encouraging. Not all reports are good, but there is more good news than bad about the quality of the Nation's air. For example:

- The level of *particulates* in the air (particles such as soot and dust) decreased 32 percent between 1960 and 1979.

- *Sulfur dioxide* in large urban areas decreased 67 percent from 1964 to 1979.

- *Carbon monoxide* in center-city locations fell 36 percent from 1972 to 1979 declining seven percent per year.

- *Ozone* (smog) has shown no long-term national trend, from 1974-1979, which is consistent with the trend in ozone precursor emissions. The precursor, volatile organic compounds, has remained relatively constant, although the contribution from various types of sources has changed significantly. Emissions from transportation have decreased, while emissions from industrial processes increased. While a 3 percent improvement in ozone levels was observed between 1978 and 1979

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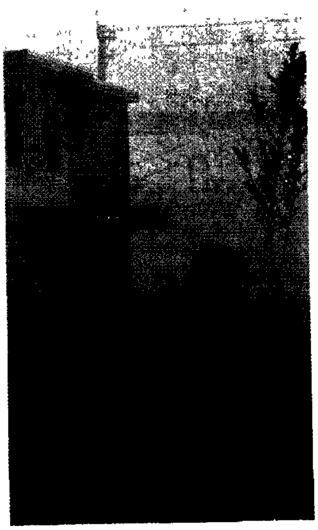
Highlights of that detailed report with additional recent data are contained in this booklet.



*Copies can be obtained from the EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C. 27711.

Summary

More than 8,000 air monitors across the country measure and record air pollution levels. This report covers data accumulated from these stations relative to five principal pollutants. The data is largely quite encouraging. Not all reports are good, but there is more good news than bad about the quality of the Nation's air. For example:

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- *Nitrogen dioxide* levels have increased 15 percent between 1975 and 1979 at 180 sites with five years of data, corresponding to a 12 percent increase in emissions. The increase in emissions is due to an increase in emissions from transportation, as well as increasing emissions from fuel combustion in stationary sources. While this trend is cause for concern, it is important to realize that only 3 percent of the nitrogen dioxide measurements at 933 sites with data exceeded the health-related standard in 1979.

While no one who lives near a large city or industrial complex would claim, on the basis of these figures, that the millenium has been reached, the records of ambient air monitors across the United States do show that we are making significant progress against air pollution.

The source of the encouraging figures, their significance in terms of health, and what they tell us about programs for pollution abatement are discussed in the pages which follow.

Clarifying the Picture

Most of our information about pollution levels is derived from two related sources. (1) estimates of pollution emissions,* and (2) measurements of ambient air quality. Emission estimates and pollution measurements are referred to throughout this booklet, so it is important at the outset to have a clear understanding of what they involve.

Emission estimates are what the name implies—estimates of the amount and kinds of pollution being generated by automobiles, factories, and other sources, based on the best available engineering calculations. Emission estimates tell us how much total pollution is being released into the air in a given area.

Ambient air quality measurements, on the other hand, tell us the amount and kinds of pollutants that are in the air we breathe at a given time and place. Measurements of ambient air quality are taken routinely by monitoring stations operated by state and local agencies.

So, emission estimates tell us how much and what kinds of pollution are being generated; ambient air quality readings tell us how much of that is in the air we breathe. Differences between estimates and measurements (readings) occur because of such things as local changes in weather and wind direction, the use of tall smokestacks, and pollution blown in from distant points.

Air monitoring stations have been operating for a number of years. There are thousands of air monitors across the country routinely measuring local levels of air pollution. Sufficient data has now been compiled from these monitors to reveal local and national trends in levels of five of the most widespread pollutants.

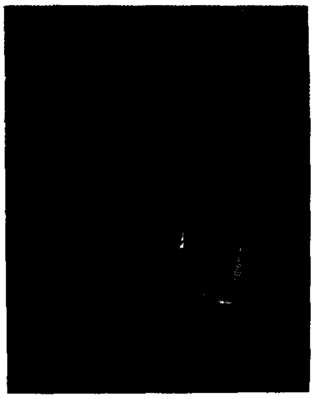
The five are: particulates (particles such as soot and dust), sulfur dioxide, carbon monoxide, ozone, and nitrogen dioxide. All five are known or suspected causes of illness or disease, and they often occur in concentrations that are above the health standards set by EPA.

By monitoring the levels of these pollutants locally, officials can identify potential health problems and take steps to correct them. Studying cumulative records from many monitoring stations reveals regional and national trends in air pollution which may require broader corrections.

For example, the cumulative record of monitoring stations has confirmed that air pollution does not recognize state lines. Wind and weather patterns regularly transport pollutants from their source to places far away. An example is the current pressing problem of acid rain which falls in the Northeast and which may have its origins from sulfur dioxide and nitrogen oxide emissions transported from the industrial Midwest.

*Emission estimates for 1979 are preliminary and may be revised slightly to reflect the latest information being gathered by EPA.

Particulates



Total suspended particulate matter is the general term for particles found in the atmosphere. In addition to soot and dust, particulates are composed of organic matter and compounds containing sulfur, nitrogen, and metals. Some particles may be formed in the air as a result of various chemical and physical processes, so the chemical composition of particulates varies widely, depending upon location and time of year. Certain components of particulates are considered to be inactive in the human body. Others, such as sulfates, nitrates, and metals, are being studied to determine their contribution, if any, to the adverse health effects observed from elevated particulate levels. When airborne particles are inhaled, they may irritate the respiratory system, or damage the clearance mechanism of the lungs, thereby contributing to acute respiratory illnesses in much the same way as gaseous pollutants do. Prolonged inhalation of certain components of airborne particles may increase the number of cases and the severity of chronic respiratory diseases.

Ambient levels of total suspended particles (largely soot and dust) decreased 32 percent during the 20-year period from 1960 to 1979, an improvement of about 2 percent per year. From 1970 to 1979, particulate emissions decreased 50 percent due to the control of industrial emissions. Actual measurements of air quality, however, did not show the same rate of improvement. The difference is attributed to low-level fugitive emissions from industry and to windblown dust. Dust levels remain fairly stable over time.

Some sections of the country show more improvement than others. The Northeast, Great Lakes and Southern states show high rates of improvement, while Western states show little change. In the West, agricultural and natural sources continue to be major contributors of windblown particulates.

Despite the improvements, total suspended particulates remain a problem. Approximately 21 percent of the Nation's population live in areas where the annual standard is exceeded. Although there has been a nationwide decrease in levels of total suspended particulate matter, there is evidence that atmospheric levels of particulates in some size ranges are increasing. This is indicated by the increasing levels of small particulates such as sulfates, and the deterioration of visibility in the Southwest and non-urban areas of the East. These patterns are consistent with the growth of emission sources outside large metropolitan areas.

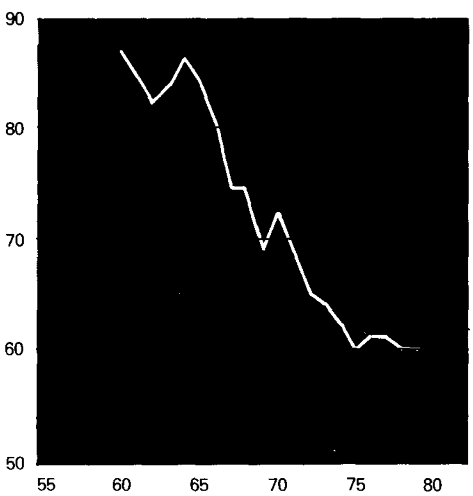
National Trend in Average Particulate Levels, 1960-1979
Graph A)

This shows year-by-year changes in average ambient particulate levels based on measurements taken throughout the country. Nationally, ambient particulate levels measured in 95 urban areas with a long history of data dropped dramatically between 1960 and 1971. This was followed by a more gradual decline from 1972 to 1979, as measured at more than 3000 monitoring sites. The rapid improvement in the late 1960's was largely due to the emission control programs of state and local air pollution control agencies. The improvement in air quality during the latter half of this period is due mainly to control of traditional particulate sources such as fuel combustion, solid waste disposal operations, and industrial process emissions. The slight reversal in the downward trend in 1976 is due to an increase in windblown dust caused by abnormally dry weather.

National Trend in Particulate Emissions
Graph B)

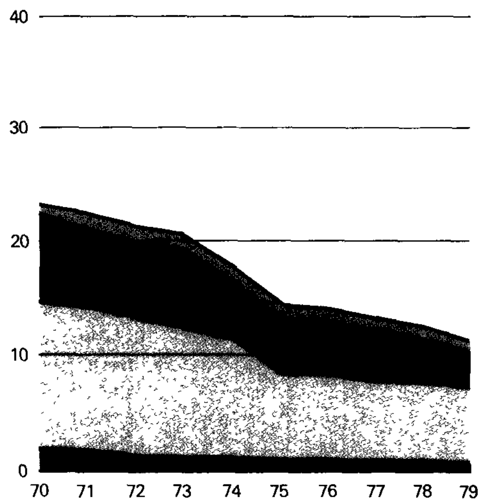
The dramatic 50 percent reduction in particulate emissions from 1970 to 1979 results largely from installation of control equipment on industrial processes, reduced coal burning by non-utility users, installation of control equipment by electric utilities that burn coal, and a decrease in the burning of solid waste.

A



Total Suspended Particulate Concentration ug/m3

B



Emissions, Million Tons/Year

Transportation ■ Fuel Combustion in Stationary Sources Industrial Processes ■ Solid Waste and Miscellaneous

Sulfur Dioxide

Sulfur dioxide is one of a number of sulfur-containing compounds found in the atmosphere. It enters the air primarily from the burning of coal and oil, but also from various other industrial processes. Studies of serious air pollution episodes have found an increase in death rates among people with existing heart and lung disease when high concentrations of sulfur dioxide are present in combination with high concentrations of total suspended particulate matter. Even when concentrations are below the level of a serious episode, there is a noticeable increase in acute and chronic respiratory disease.

Sulfur dioxide reacts in the atmosphere to form other compounds such as sulfuric acid, sulfates, and sulfites. These may be more irritating to the respiratory system than sulfur dioxide. However, not enough is known about these pollutants at present to permit EPA to take any specific regulatory steps other than controlling sulfur dioxide, which generally lowers the concentrations of the other sulfur compounds.

Levels of sulfur dioxide (SO^2) in the air over the Nation's urban areas decreased by 67 percent from 1964 to 1979. Improvement was most rapid during the 1966 to 1971 period because of an increased use of cleaner burning fuels in the residential, commercial and industrial sectors of most urban areas. Local and state air pollution regulations led to a switch from coal and high sulfur oil to natural gas and low sulfur oil. Between 1970 and 1979, the improvement continued with the national average SO^2 levels (ambient readings) dropping 44 percent. A corresponding 7 percent decrease in sulfur oxides emissions was observed between 1970 and 1979. The greater improvement in ambient levels reflects sulfur dioxide trends in urban areas, where most of the emission reductions have taken place. Offsetting the emission reductions in the urban areas was the location of new sources, such as fossil fuel power stations, in rural areas.

Nationally, the sulfur dioxide problem has diminished to the point that only a small number of urban areas now exceed the air quality standard. Some regions outside major urban areas continue to have high sulfur dioxide because of single sources, such as non-ferrous smelters. Today, these individual sources pose the greatest obstacle to the regional attainment of air quality standards for sulfur dioxide.

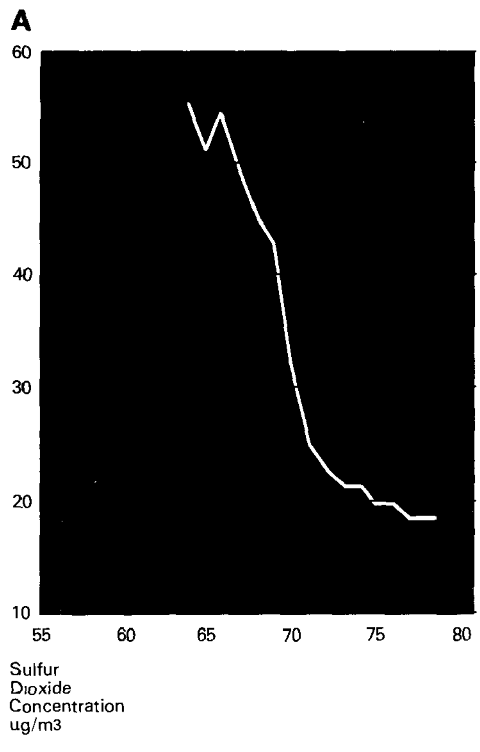
Current plans for converting power plants from oil to coal could increase levels of SO^2.

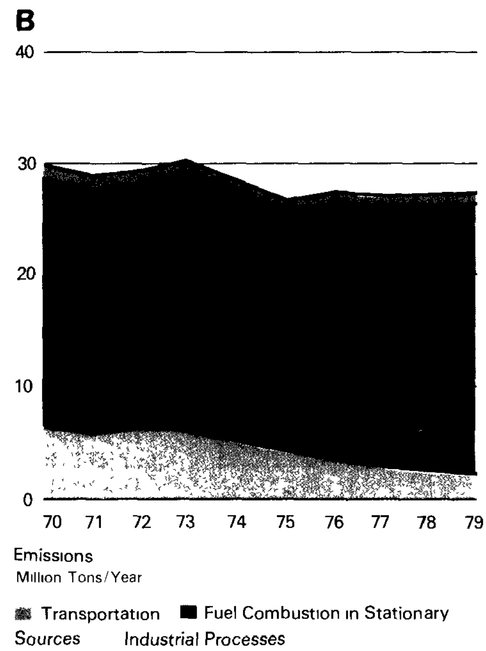
National Trend in Average Sulfur Dioxide Levels, 1965-1979
(Graph A)

Nationally, annual average sulfur dioxide levels measured at 32 urban locations declined dramatically from 1966 to 1971. This was followed by a more gradual decline from 1972 to 1979 as measured at more than 1,000 monitoring sites. The improvement in air quality during the first half of this period is due mainly to (1) the change from coal with a high sulfur content to natural gas, electricity, and low sulfur oils from residential and commercial space heating; (2) strict local emission regulations, which caused the reduction in sulfur content of coal and fuel oil or required the installation of control equipment to remove sulfur; and (3) the location of major new sources, such as fossil-fuel burning power plants, away from urban areas. In recent years, most urban areas have attained the sulfur dioxide standards and are now working to maintain these lower levels rather than reduce sulfur oxides emissions. further. There are still problems, however, with large rural power plants and smelters.

National Trend in Emission of Sulfur Oxides, 1970-1979
(Graph B)

Sulfur oxides emissions declined 7 percent from 1970 to 1979. The moderate decline in emissions parallels a considerable reduction in sulfur dioxide levels in urban areas. This difference between emission and air quality trends arises because the use of high sulfur fuels has shifted from urban areas to a growing number of sources outside of densely populated areas where there are fewer other sources.





Carbon Monoxide

Carbon monoxide is a byproduct of the incomplete burning of fuels—notably by cars and trucks. It is also released by some industrial processes. In some urban areas, automobiles and other modes of transportation are responsible for over 99 percent of these emissions, although any city with heavy traffic may have a potential problem from carbon monoxide. In some cases, the problem is highly localized with only a few street corners experiencing high carbon monoxide levels. In other cases, the problem is spread throughout the center-city area and along major commuter corridors.

Inhaled, carbon monoxide enters the blood stream and binds chemically to hemoglobin, the substance that carries oxygen to the cells. This reduces the amount of oxygen delivered to all tissues of the body. The percentage of hemoglobin inactivated by carbon monoxide depends on the amount of air breathed, the concentration of carbon monoxide in air, and the length of exposure.

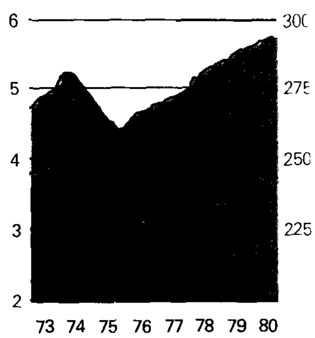
Cigarette smoke also contains carbon monoxide. Therefore, cigarette smokers have a portion of their hemoglobin inactivated by this source as well as by external air pollution.

Carbon monoxide weakens the contractions of the heart, reducing the amount of blood pumped to various parts of the body and, as a result, reduces oxygen available to the muscles and various organs. In a healthy person, this effect significantly reduces the ability to perform physical exercise. In a patient with heart disease who is unable to compensate for the decrease in oxygen, the effect can threaten life. People with coronary artery disease show changes in their electrocardiograms after having been exposed to carbon monoxide from heavy freeway traffic.

Individuals with anemia, emphysema, and other lung disease, as well as those living at high altitudes, are likely to be more susceptible to the effects of carbon monoxide. Even at relatively low concentrations, carbon monoxide can affect mental function, visual acuity, and alertness.

Nationally, ambient carbon monoxide levels in center-city locations have shown a steady decline. From 1972 to 1979 carbon monoxide levels dropped at a rate of 7 percent per year with an overall reduction of about 36 percent. The greatest improvements occurred at sites traditionally having the worst carbon monoxide problem. Estimates of nationwide carbon monoxide emissions from highway vehicles, in contrast, show only a 7 percent decrease since 1972. The smaller reduction in CO emissions is largely due to a 35 percent increase in total vehicle miles travelled since 1970. The improvement in average concentrations is greater than the reduction in CO emissions, because the trend reflects levels at traffic-saturated monitoring sites in the center city. These sites have recorded little or no change in vehicle miles travelled. Therefore, the ambient carbon monoxide trend reflects the reduction in emissions from new cars brought about by federal standards on vehicle emissions.

A



Ambient Carbon Monoxide (parts per million)

Gasoline Consumption (millions of gallons)

Source: New Jersey Department of Environmental Protection

New Jersey Carbon Monoxide Levels
(Graph A)

The significant improvement in ambient carbon monoxide levels at all sites, even after accounting for changing weather conditions, is attributable to state and federal emission reduction programs.

Short-term changes in emission rates can also significantly influence carbon monoxide levels. Witness the effect of the 1974 gasoline shortage when a substantial drop in gasoline consumption caused a rapid reduction in carbon monoxide levels during the winter of 1973-74.

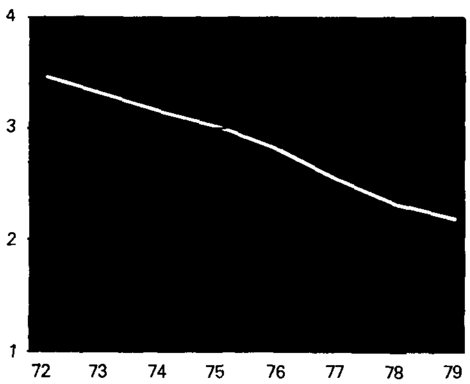
National Trend in Average Carbon Monoxide Levels, 1972-1979
(Graph B)

This graph shows year-by-year changes in annual average carbon monoxide levels at 223 urban sites over the 8 year period, 1972-1979. Carbon monoxide levels improved at a rate of 7 percent per year with an overall reduction of about 36 percent. The improvement reflects levels at traffic-saturated monitoring sites in the center-city. Since these sites have experienced little or no change in the number of vehicles in their vicinity, the improvement in carbon monoxide levels reflects the reductions in emissions from new cars brought about by federal standards on vehicle emissions.

National Trend in Emissions of Carbon Monoxide, 1970-1979
(Graph C)

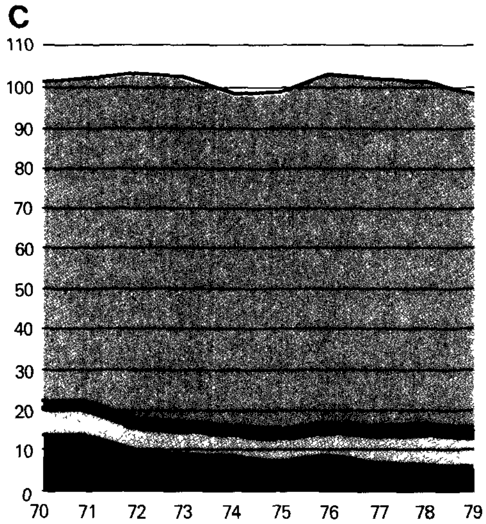
Carbon monoxide emissions in 1979 were 5 percent lower than in 1970. Highway vehicles are the main source of this pollutant, and there was an increase of 35 percent in total vehicle miles travelled during this period. The increase in traffic offsets the decrease in emissions per car achieved by recent pollution control measures. Outside transportation, relatively small reductions in carbon monoxide emissions were obtained in solid waste disposal and agricultural burning.

B



Carbon Monoxide Concentration
mg/m3

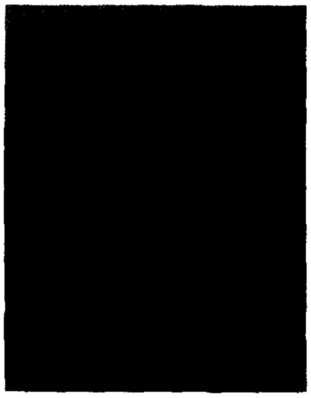
C



Emissions
Million Tons/Year

Transportation ■ Fuel Combustion in Stationary Sources
Industrial Processes ■ Solid Waste and Miscellaneous

Ozone



Unlike the other pollutants discussed here, ozone is not emitted directly by specific sources. Instead, it is formed in the air by chemical reactions between nitrogen oxides and volatile organic compounds, such as the vapors of gasoline, chemical solvents, and combustion products of various fuels. Since these reactions are stimulated by sunlight, ozone reaches peak levels in most parts of the country during the summer. This type of pollution first gained attention in the 1940's as Los Angeles "smog." Since then, photochemical smog has been observed frequently in many other cities as well.

Ozone, the main constituent of photochemical oxidants, and peroxyacyl nitrates are associated with a number of health effects in humans. Peroxyacyl nitrates and other chemicals, such as aldehydes, cause the eye irritation that is characteristic of photochemical pollution.

Ozone severely irritates the mucous membranes of the nose and throat. It impairs normal functioning of the lungs and reduces the ability to perform physical exercise. Its effects are more severe in individuals with chronic lung disease. The length of exposure, frequency of exposure, and ozone concentration are significant factors in determining the effects. Individuals with asthma or diseases of the heart and circulatory system experience symptoms at lower ozone concentrations. It also appears that ozone in combination with sulfur dioxide has a greater effect on respiratory function than either pollutant alone.

Ozone has long been a major air pollution problem in Los Angeles and other parts of southern California. These areas have abundant sunlight and high emissions from heavy motor vehicle traffic—a major source of volatile organic compounds and nitrogen oxides. In recent years, ozone has become increasingly important in most major urban areas as motor vehicle traffic has increased and the levels of other pollutants have dropped. Particularly affected is the urban area from Washington to Boston as well as areas around Chicago, Milwaukee, Denver, and Houston.

Measurements of ozone taken over a 6-year period, 1974-1979, do not reveal a long-term national trend. This is consistent with the trends in the ozone precursor emissions, volatile organic compounds. The trend in volatile organic compounds has remained relatively stable, although the contribution from various types of sources has changed significantly. Emissions from transportation have decreased despite an 18 percent increase in vehicle miles driven between 1974 and 1979, because of the increasing effectiveness of emissions controls. Emissions from industrial sources have increased because of increased industrial production. Between 1978 and 1979 an encouraging 3 percent drop in ozone levels was observed, corresponding to a 3 percent decrease in emissions. The decrease in emissions occurred, primarily, because volatile organic compound emissions from industrial processes remained relatively unchanged, while emissions from motor vehicles dropped. This drop is largely due to the increased level of emissions control and a reduction in motor vehicle miles driven between 1978 and 1979.

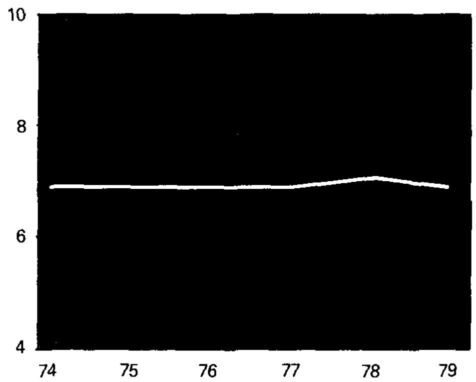
The National Trend in Ozone Levels, 1974-1979
(Graph A)

This shows year-by-year changes in the composite May through October average of daily maximum hour ozone values at 230 urban sites over the 6-year period, 1974-1979. Ozone reveals no long-term trend. The lack of trend is consistent with a similar lack of trend in volatile organic compound emissions.

National Trend in Emissions of Volatile Organic Compounds
(Graph B)

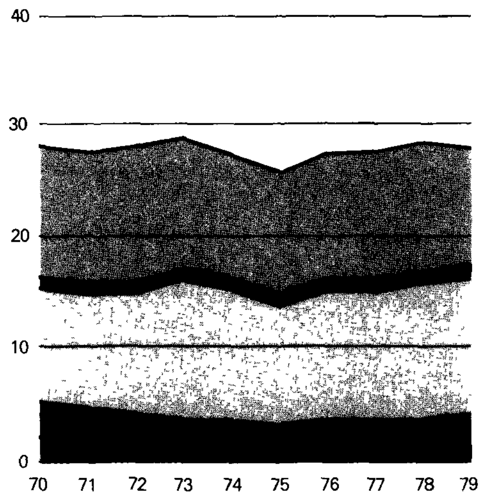
Volatile organic compound emissions in 1979 were 4 percent lower than in 1970. The main sources of this pollutant are transportation and industrial processes. Emissions from transportation decreased, despite a 35 percent increase in vehicle miles driven during this period, while industrial process emission increased over the decade. Additional decreases occurred in the solid waste and miscellaneous categories.

A



Ozone Concentration, pphm

B



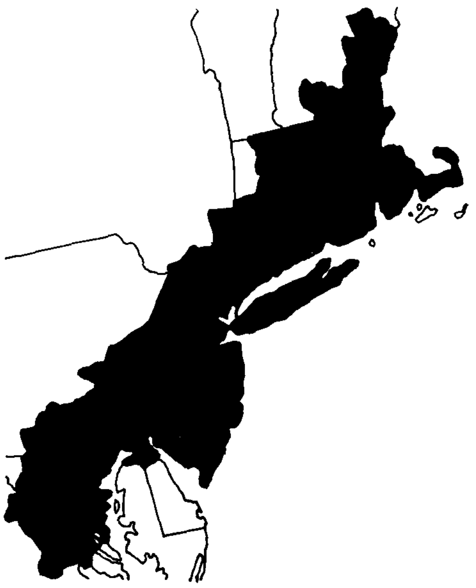
Emissions, Million Tons/Year

Transportation ■ Fuel Combustion in Stationary Sources Industrial Processes ■ Solid Waste and Miscellaneous ■ Non-Industrial Organic Solvent

Ozone Northeast Corridor Population Exposure (Summer 1979)
(Map)

High ozone levels have been measured for many years in the densely populated northeast corridor which extends from Washington to Boston. This map of the counties in the region shows the estimated number of days in one summer during which the ozone levels exceeded 0.12 part per million of air (the current standard).

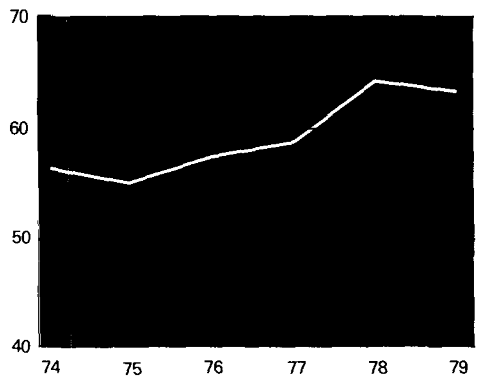
About 61 percent of the population in this region lives in areas which experienced 5 or more days above the ozone standard. Approximately 30 percent lives in areas which experienced 10 or more days above the standard. These areas include most of Connecticut, eastern Long Island, and a few counties in Pennsylvania and New York. Large areas with less severe ozone levels—less than 5 days above the standard—include central Massachusetts and sections of Maryland and Pennsylvania.



Estimated Number of Days Exceeding Ozone Standard In Summer 1979

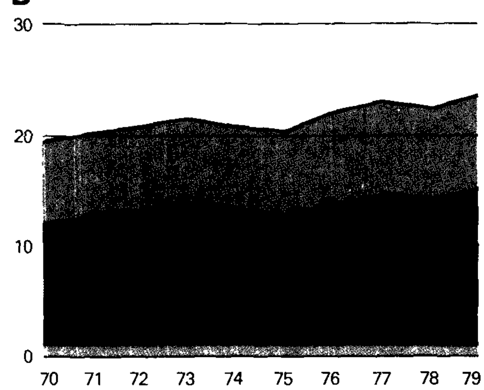
- 0 to 4
- 5 to 9
- 10 or more

A



Nitrogen Dioxide Concentration
ug/m3

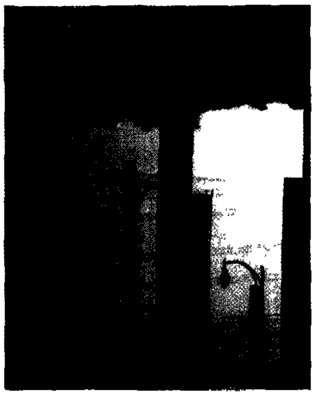
B



Emissions
Million Tons/Year

Transportation · Fuel Combustion in Stationary Sources · Industrial Processes

Nitrogen Dioxide



Nitrogen dioxide is one of a family of nitrogen oxides. The oxides important to air pollution control usually come from high-temperature combustion. Nitrogen dioxide plays a major role in the atmospheric reactions which produce photochemical oxidants (smog) and is primarily responsible for smog's yellow-brown color.

Continued or frequent exposure to high levels of nitrogen dioxide can cause pulmonary edema. At the present time, however, such high concentrations seldom occur.

The health effects of exposure to high concentrations of nitrogen dioxide for short periods are not clear and are still being studied. Individuals with chronic bronchitis and emphysema may have their symptoms aggravated. Animal studies suggest that such exposure impairs resistance to infection.

In the years 1975 through 1979 nitrogen dioxide levels increased about 15 percent at 180 trend sites with 5 years of data, while emissions for the same period were up 12 percent. In 1979, only 3 percent of the nitrogen dioxide measurements at 933 sites with data exceeded the health-related ambient air quality standard.

Most of the increase in nitrogen dioxide emissions came from motor vehicles and electric utility generating plants. Although the emission rates for motor vehicles and generating plants has been steadily reduced, increased demands have more than offset the reductions. During the 1974-1979 period the number of miles travelled by all types of motor vehicles increased substantially and higher electricity demands caused utilities to burn more fuel.

National Trend in Average Nitrogen Dioxide Levels, 1975-1979
(Graph A)

These are year-by-year changes in average nitrogen dioxide levels based on measurements obtained at 180 sites with 5 years of data. There is an increasing trend over the period with nitrogen dioxide levels rising 15 percent. The increase in nitrogen dioxide levels corresponds to increases in nitrogen oxides emissions from transportation and fuel combustion in stationary sources.

National Trend in Emissions of Nitrogen Oxides, 1970-1979
(Graph B)

Nitrogen oxides emissions increased 18 percent from 1970 to 1979. The increase in nitrogen oxides emissions resulted primarily from increased fuel use by stationary sources and increased highway motor vehicle travel. Vehicle miles driven increased 35 percent over the decade. During this same period industrial process emissions remained relatively constant, while solid waste and miscellaneous emissions decreased.