United States
Environmental Protection Agency
Washington DC 20460

May 1988
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EPA

Trends in the Quality of the Nation's Air

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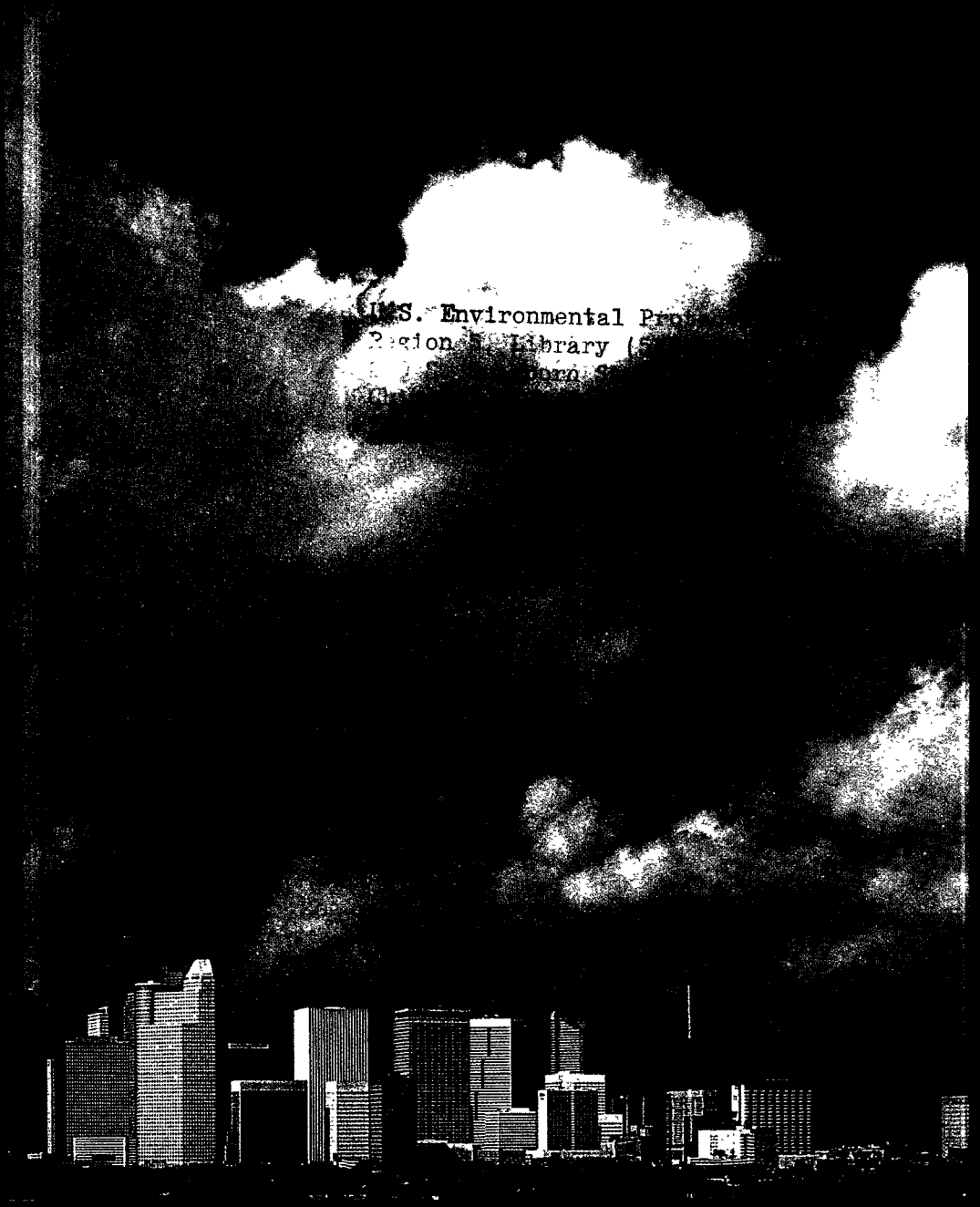
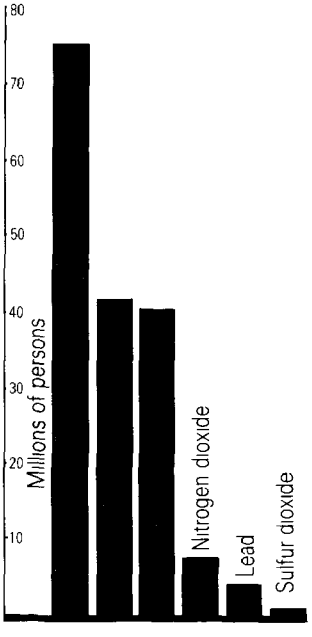


Background

Most air pollution comes either from "stationary sources" such as factories, power plants, and smelters, from "mobile sources" that include cars, buses, planes, trucks, and trains, or from natural sources such as wildfires. Both kinds of man-initiated sources are regulated by EPA under the Clean Air Act which provides the principal framework for state and national efforts to protect air quality Under the Act, EPA is responsible for·

- Setting standards (called "National Ambient Air Quality Standards" or NAAQS) for pollutants considered harmful to public health or welfare.
- In cooperation with the states, enforcing compliance with the standards through state implementation plans (SIPs) and regulations controlling emissions from automobiles and new industrial sources

Number of People Living in Counties that Experienced Air Pollution Levels above Standards for Public Health in 1986



The law provides for two types of standards. Primary standards set limits protective of public health, including the health of "sensitive" populations such as asthmatics, children, or the elderly; secondary standards set limits to protect vegetation, wildlife, and materials.

EPA has set primary and secondary standards for six principal pollutants ozone, particulate matter (total suspended particulates or TSP), carbon monoxide, nitrogen dioxide, lead, and sulfur dioxide. The deadline for meeting these standards was December 31, 1987 and many areas were able to meet the standards for all the pollutants by that date

These are significant achievements. Yet the fact remains that millions of U.S. citizens still live in areas with unhealthy levels of major air pollutants (See Figure) More than 60 major urban areas will not be able to meet the standards for one or more of the six pollutants, chiefly those related to mobile sources—ozone and carbon monoxide. Nevertheless, the latest measurements of air quality are encouraging They show that levels of all six pollutants are lower, in some cases dramatically lower, than they were a decade ago, and that considerable progress has been made in reducing air pollution

Summary

This report summarizes data accumulated on the six NAAQS pollutants between 1977 and 1986 from more than 4,000 monitoring stations around the country. All data are from sites monitored for at least eight of those years. A complete analysis appears in the EPA publication *National Air Quality and Emissions Trends Report, 1986.*

Measurements at selected monitoring sites show that since 1977:

- **Ozone** levels have fallen 21 percent Because of a change in calibration methods between 1978 and 1979,

however, EPA has analyzed the data separately for the period 1979-1986 During that time, ozone levels decreased by 13 percent

- **Total suspended particulate (TSP)** levels have fallen 23 percent
- **Carbon monoxide (CO)** levels have fallen 32 percent
- **Nitrogen dioxide (NO_2)** levels have fallen 14 percent overall, despite increases from 1976 to 1979, and a slight increase during 1984
- **Lead** levels have fallen a dramatic 87 percent
- **Sulfur dioxide (SO_2)** levels have fallen 37 percent

How Air Quality is Determined

Most of our information on air quality is based on data from three related indicators

- Measurements of pollutants in the ambient air
- Estimates of total national pollution emissions
- The number of times that air quality standards are violated

National Trends of Pollutants in the Ambient Air

National trends in air quality are derived from routine measurements recorded over time in areas of high population exposure and high pollutant concentrations, as well as other representative areas. Monitoring stations are operated by state and local government agencies and by some federal agencies. The trends calculated for this report were derived by averaging direct measurements from monitoring sites, and appear in the "A" graph shown for each pollutant

National Trends in Estimated Total Emissions

Another factor in calculating air quality trends is estimated total nationwide emissions. These estimates are based on engineering calculations of the amounts and kinds of pollutants emitted by automobiles, factories, and other sources at a given time. Trends for total emissions appear in the "B" graph shown for each pollutant

Note: Pollutant concentrations do not correlate exactly with pollutant emissions. In the first place, three of the pollutants measured as emissions have different names from the pollutants they help to form in the ambient air Thus, emissions of sulfur oxide help to form the NAAQS pollutant sulfur dioxide, emissions of oxides of nitrogen contribute to nitrogen dioxide pollution; and volatile organic compounds (VOCs) and nitrogen oxides are the principal sources of the pollutant ozone.

Secondly, reductions of pollutant concentrations in the air do not always match reductions of estimated pollutant emissions For example

- Average ambient concentrations of sulfur dioxide declined 37 percent from 1977 to 1986, even though estimated total emissions of sulfur oxides declined only 21 percent This is because sulfur dioxide is monitored primarily in high-population urban centers, whereas the major emitters, such as smelters, large power plants, and other industrial facilities, are located in more rural areas where there are fewer monitors Another factor in the difference between concentrations and emissions reductions is that emitting sulfur oxides through increasingly higher smokestacks allows concentrations at ground level to decrease at a faster rate than emissions

- Ambient carbon monoxide concentrations dropped 32 percent between 1977 and 1986, while estimated total emissions of carbon monoxide decreased only 26 percent Both figures reflect improvements as a result of federal emission standards on newer motor vehicles Since motor vehicles are the largest contributors to carbon monoxide emissions, it is noteworthy that these reductions were achieved despite a 24-percent increase in vehicle miles travelled throughout the United States during this period Carbon monoxide concentrations, however, are generally monitored in center city areas which don't experience significant increases in vehicular travel once traffic has reached a certain saturation point

National Trends in NAAQS Violations

While measurements of air quality and emissions can show the overall reductions in NAAQS pollutants, actual improvement in air quality is measured by comparing recorded ambient air pollution levels against the levels required by national standards As a reasonable alternative to listing the findings from thousands of sites, EPA has charted trends in violations for ozone, sulfur dioxide, and carbon monoxide National Violation Trends (NVTs) appear for these pollutants in the "C" graphs.

Ozone

Nature and Sources of the Pollutant

Ozone is the most complex, difficult to control, and pervasive of the six NAAQS pollutants Many more Americans live in areas with unhealthy levels of ozone than any of the other major pollutants, and levels far in excess of health standards still occur in many heavily populated areas, including some that have instituted strict control measures

Unlike other pollutants, ozone is not emitted directly into the air by specific sources A poisonous form of pure oxygen, it is created by sunlight acting on nitrogen oxides and volatile organic compounds (VOCs) in the air Often, these "precursor" gases are emitted in one area, but the actual chemical reactions, stimulated by sunlight and temperature, take place in another Combined emissions from motor vehicles and stationary sources can be carried hundreds of miles from their origins, forming high ozone concentrations over very large regions

There are literally thousands of sources of these gases, which can come from gasoline vapors, chemical solvents, the combustion products of various fuels, and even common consumer products Sources include not only large industrial facilities and motor vehicles, but also small businesses such as bakeries, dry cleaners, and gas stations

Because it is triggered by sunlight, ozone reaches peak levels in most parts of the country during the summer months, particularly when the air is stagnant for extended periods In 1986, the highest levels of ozone were recorded in the greater Los Angeles basin and in other parts of southern California as they have been for several decades High levels also persist in the Texas Gulf Coast area, much of the Northeast, and in several other heavily populated areas

Health Effects

Ozone severely irritates the eyes and the mucous membranes of the nose and throat, as well as the mucous membranes leading to the lungs Even in healthy individuals, it can directly affect lung function, reducing the ability to perform physical exercise and leading to chest pain, coughing, wheezing, and pulmonary congestion It also appears to have effects on the body's immune system

Length of exposure, frequency of exposure, and level of concentration are significant factors in determining these effects, but they are always more severe in individuals with chronic lung disease, asthma, or diseases of the heart and circulatory system Studies also show that ozone in combination with sulfur dioxide has a greater effect on respiratory functions than does either pollutant alone

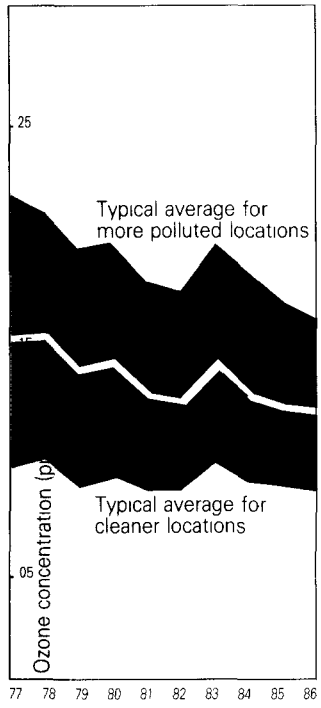
Trends in Ozone Levels

Ozone concentrations nationwide decreased by 21 percent between 1977 and 1986, as measured at 242 sites Because of a change in calibration methods

affecting data prior to 1979, levels from 1979 to 1986 were analyzed separately, for that period, ozone concentrations decreased by 13 percent (The increase in 1983 is likely due to weather conditions in some areas of the country being more favorable that year for ozone formation, such as warmer temperatures) Estimated VOC emissions for 1979-1986 dropped 20 percent

The most significant trend has been the decline in ozone formation attributable to mobile sources, which has occurred despite a 24-percent increase in miles travelled by vehicles EPA estimates that without current emission controls on new vehicles and industrial sources and the vehicle inspection and maintenance programs in 31 states, VOC emissions would be 83 percent higher than they are today

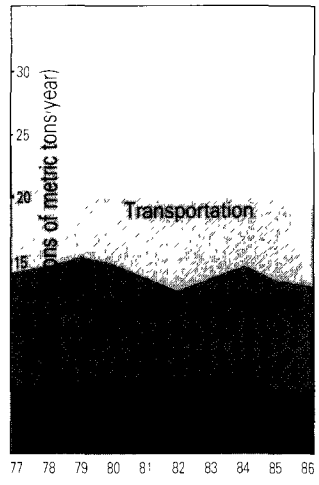
Nevertheless, most of the major population centers do not meet the current ozone standard To bring these areas into attainment may require extraordinary measures such as tougher tail-pipe emissions tests, restrictions on driving and new growth and development, new or expanded controls on industrial sources, and even restrictions on the use of some consumer products



National Trend in Ozone Concentrations, 1977-1986 (Graph A)

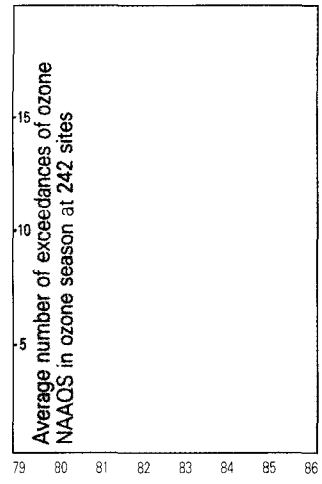
Average ozone concentrations decreased overall by 21 percent as measured at 242 sites between 1977 and 1986 Because of a change in calibration methods, however, the period 1979-1986 shows a 13 percent decrease

Note Because sunlight is crucial to ozone formation, the length of monitoring for the "ozone season" varies among parts of the country, ranging from 12 months per year in the South and Southwest to a few months per year in the far North These factors are taken into account for calculating purposes



National Trend in VOC Emissions, 1977-1986 (Graph B)

Estimated VOC emissions decreased 19 percent from 1977 to 1986, with VOC emissions from transportation sources decreasing by 35 percent Emissions from industrial-process sources also declined



National Violation Trends for Ozone, 1979-1986 (Graph C)

The average number of days that ozone standards were violated dropped sharply, from about 11 days in 1979 to less than seven days in 1986 Despite this overall trend to shorter and fewer exceedances of the standard, ozone levels continued to reach very high levels in several area

Total Suspended Particulates (TSP)

Nature and Sources of the Pollutant

Particulate matter is the general term for solid or liquid particles found in the atmosphere Some particles are large or dark enough to be seen as soot or smoke, others are so small they can be detected only with an electron microscope Because particles originate from a variety of mobile and stationary sources, their chemical and physical compositions vary widely depending on location and time of year

This report summarizes trends based on the measurements for total suspended particulates, which include particles ranging from small to relatively large sizes Recently, however, EPA revised the particulate standards to include only those particles that pose a risk to health because they are small enough to penetrate the most sensitive regions of the respiratory tract Future measurements will be based on these smaller particulates

During 1986, the highest TSP concentrations were recorded in the industrialized Midwest and in arid sections of the West Most violations of the TSP standards are caused by activities that generate soot and dust, and by industrial emissions as well as natural dust

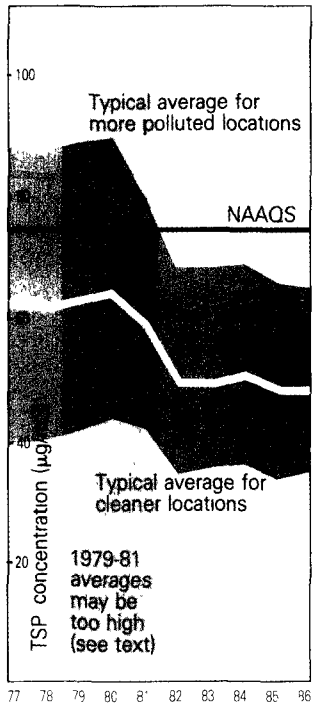
Health Effects

Inhaled particles can irritate or damage the respiratory system, causing acute respiratory illnesses much as gaseous pollutants do, and prolonged inhalation of certain particles may increase the number and severity of chronic respiratory diseases In addition, metal, sulfate, and organic chemical particulates may specifically contribute to other adverse health effects

Trends in TSP Levels

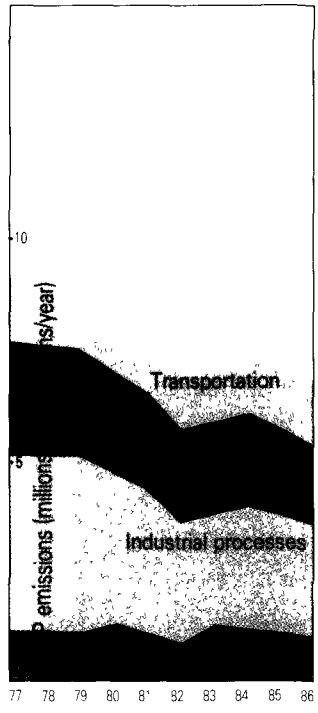
Average composite TSP levels decreased by 23 percent between 1977 and 1986, as measured at 1,435 sites Estimated TSP emissions declined overall by 25 percent during the same period These measurements are considered valid despite technical problems with filters used from 1979 through 1981, and are primarily attributable to reductions in industrial emissions nationwide through use of new control equipment and reduced coal-burning by electric utilities.

The decrease in TSP levels and TSP emissions were similar, although ambient levels are not expected to improve proportionally with reductions in particulate emissions Levels can be influenced by factors such as dust from construction and other activities, as well as by gases such as sulfur dioxide that are transformed into particles in the atmosphere The other major factor affecting TSP levels is precipitation, which reduces reentrainment of particles and washes particulates out of the air



National Trend in TSP Concentrations, 1977-1986
(Graph A)

Average TSP concentrations decreased by 23 percent between 1977 and 1986, as measured at 1,435 sites. Yearly changes between 1978 and 1982 can be attributed in part to a change in measurement method



National Trend in TSP Emissions, 1977-1986
(Graph B)

Emissions of particulates decreased by 25 percent between 1977 and 1986, largely because of emission reductions in industrial processes

Carbon Monoxide

Nature and Sources of the Pollutant

Carbon monoxide is a colorless, odorless, poisonous gas formed when carbon in fuels is not burned completely Its major source is motor vehicle exhaust, which contributes more than two-thirds of all emissions nationwide In cities or other areas with heavy traffic congestion, however, automobile exhaust can cause as much as 95 percent of all emissions, and carbon monoxide concentrations can reach very high levels Other sources include industrial processes and non-transportation fuel combustion

Despite an overall downward trend in concentrations and emissions of carbon monoxide, many metropolitan areas still experience high levels of the pollutant During 1985, the highest levels were recorded in large urban areas with heavy traffic congestion and in high-altitude areas of the Far West and Rocky Mountains

Health Effects

Carbon monoxide binds chemically to hemoglobin, the substance in the blood that carries oxygen to the cells, and thus reduces the amount of oxygen available to the body tissues The amount of oxygen reduction depends on amount of air inhaled, carbon monoxide concentrations, and length of exposure

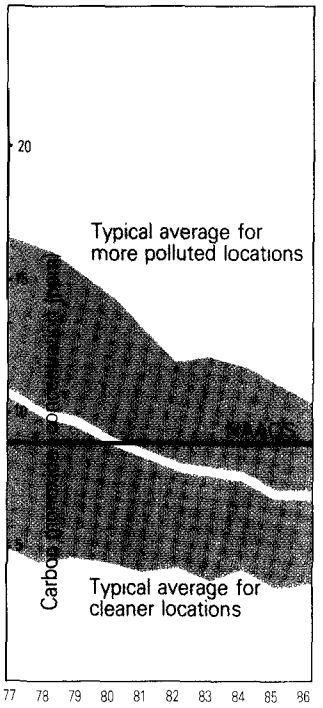
Carbon monoxide also weakens heart contractions, reducing the amount of blood pumped This in turn reduces the amount of oxygen available to the muscles and organs Such oxygen depletion impairs the functioning even of healthy individuals, and can be life threatening to those with heart disease Even at relatively low concentrations, carbon monoxide can affect mental functioning, visual acuity, and alertness Cigarette smokers, those living at high altitudes, and persons suffering from anemia, emphysema, and other lung diseases are likely to be more susceptible to the effects of carbon monoxide

Trends in Carbon Monoxide Levels

Carbon monoxide concentrations decreased 32 percent between 1977 and 1986, as measured at 182 urban sites Overall, estimated carbon monoxide emissions decreased 26 percent during the same period, however, estimated emissions from motor vehicle exhaust—the major source of carbon monoxide emissions—declined by 34 percent These emissions reductions occurred even with an estimated increase of 24 percent in vehicle miles traveled during the same time The difference between concentration reductions and emissions reductions can be affected by the placement of monitors, which typically are located in areas of chronic traffic problems In such areas, vehicle miles travelled tend to remain constant, while emissions decline as control technology improves The result is that concentrations monitored at these

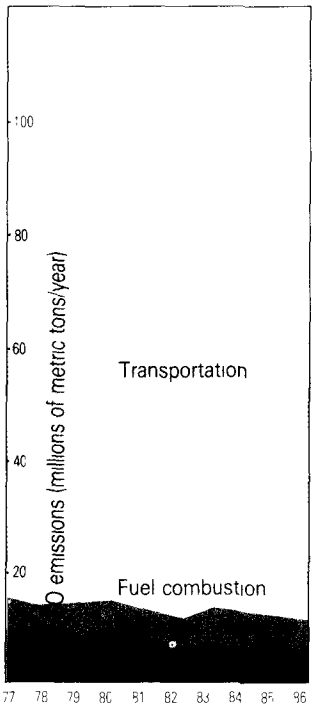
locations may show greater reductions than do estimated emissions

Nevertheless, the declines in both concentrations and emissions show that federal emissions-control requirements for new vehicles have had a major impact in controlling carbon monoxide releases



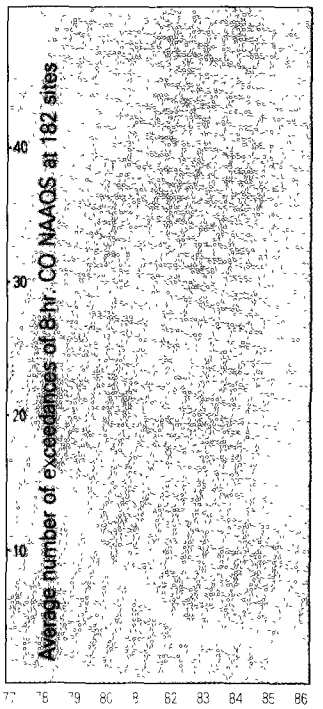
National Trend in Carbon Monoxide Concentrations, 1977-1986
(Graph A)

Average concentrations of carbon monoxide declined 32 percent, as measured at 182 urban sites between 1977 and 1986 This improvement reflects the impact of emissions control standards for new cars since the beginning of the monitoring period, as well as the impact of other measures to control carbon monoxide emissions in traffic-saturated areas Some improvement also may be due to meteorological conditions or changes in the vehicle mix at some locations



National Trend in Carbon Monoxide Emissions, 1977-1986
(Graph B)

Total carbon monoxide emissions decreased 26 percent from 1977 to 1986, but emissions from motor vehicle exhaust decreased 34 percent This decrease took place despite an increase of 24 percent in vehicle miles traveled



National Violation Trends for Carbon Monoxide, 1977-1986
(Graph C)

The average number of times that carbon monoxide standards were violated dropped sharply from about 21 days in 1977 to about two days in 1986 Despite the overall decline, however, some areas exceed the standard a far higher number of times than the average suggests

Nitrogen Dioxide

Nature and Sources of the Pollutant

Nitrogen dioxide belongs to a family of poisonous, highly reactive gases called nitrogen oxides. These gases form when fuel is burned at high temperatures. They come principally from motor vehicle exhaust and stationary sources such as electric utility and industrial boilers.

A suffocating, brownish gas, nitrogen dioxide is a strong oxidizing agent that reacts with water to form corrosive nitric acid. It also plays a major role in the atmospheric reactions that produce ozone.

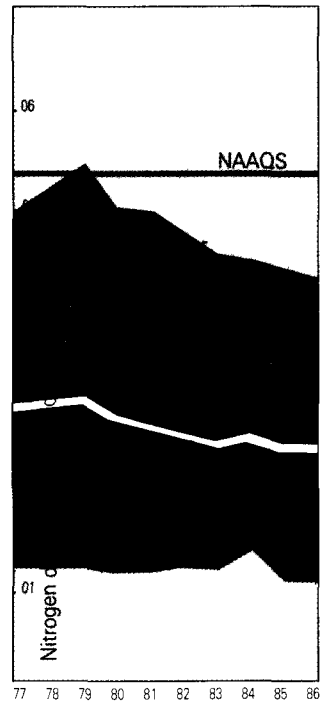
Los Angeles, California, was the only urban area that recorded violations of the health standards for nitrogen dioxide during 1986. Monitoring from all other areas showed levels of the pollutant that were below the standards.

Health Effects

Nitrogen oxides can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections such as influenza. The effects of short-term exposures are still under study, but continued or frequent exposure to concentrations higher than those normally found in the ambient air can cause pulmonary edema.

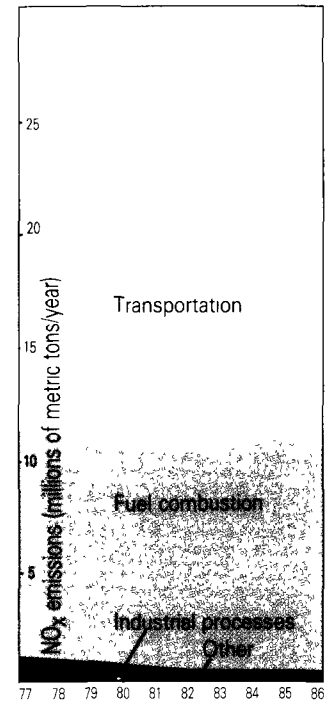
Trends in Nitrogen Dioxide Levels

Despite some yearly fluctuations, average nitrogen dioxide concentrations as measured at 111 sites decreased by 14 percent between 1977 and 1986. Total estimated emissions of nitrogen oxides declined by eight percent, although emissions from motor vehicles dropped by 13 percent. This decline occurred even though vehicle miles traveled increased by 24 percent during the same time.



National Trend in Nitrogen Dioxide Concentrations, 1977-1986
(Graph A)

Nitrogen dioxide does not present a significant air quality problem at this time for most areas of the country With some fluctuations, average concentrations of nitrogen dioxide measured at 111 sites decreased by 14 percent from 1977 to 1986



National Trend in Nitrogen Oxide Emissions, 1977-1986
(Graph B)

Estimated nitrogen oxide emissions declined by eight percent from 1977 to 1986, this decline was accomplished against a 24-percent increase in vehicle miles traveled during the same time

Lead

Sources and Nature of the Pollutant

Non-ferrous smelters, battery plants, and lead additives in gasoline are the major sources of lead emissions to the atmosphere, of these, leaded gasoline is the most significant source, contributing 38 percent of total ead emissions in 1986, down sharply from 69 percent n 1985

During1986, the highest concentrations of lead were found in locations that contain non-ferrous smelters or other stationary sources of lead emissions Most such sources are located in the Midwestern United States

Health Effects

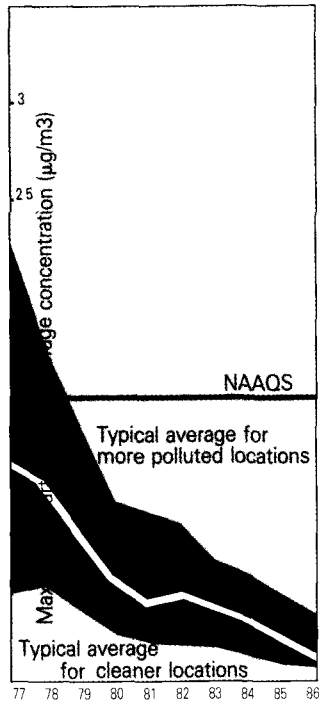
Lead accumulates in the body in blood, bone, and soft tissue Because it is not readily excreted, lead also affects the kidneys, nervous system, and blood-forming organs Ingesting excessive amounts of lead may cause neurological impairments such as seizures, mental retardation, and/or behavioral disorders, infants and children in particular are susceptible to central nervous system damage Recent studies have also shown that lead may be a factor in high blood pressure and subsequent heart disease

Trends in Lead Levels

Average ambient concentrations of lead decreased by 87 percent between 1977 and 1986, as measured at 82 urban sites Measurements for the period 1982 to 1986 at an additional 326 sites in 43 states showed a 68 percent reduction in ambient lead levels Estimated emissions of lead for the same periods dropped by 94 percent and 84 percent, respectively

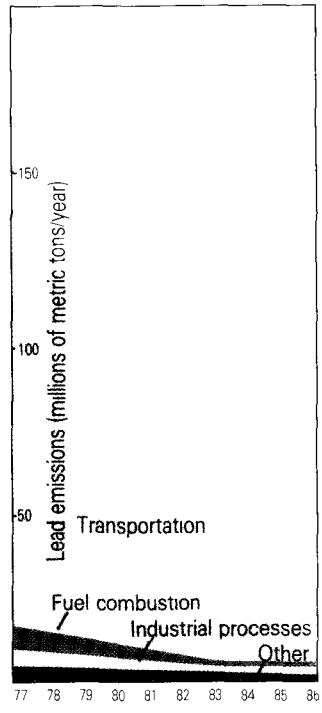
Although controls on stationary sources such as smelters and battery plants have also helped, these reductions are mainly the result of two factors stricter controls on automobile emissions, beginning with the 1975 model-year, and reductions in the amount of lead permitted in leaded gasoline to the current limit of 0.10 grams per gallon

Since 1975, EPA has increasingly restricted automobile emissions As a result, all new cars since then have been equipped with catalytic converters, muffler-like devices that reduce emissions of hydrocarbons, carbon monoxide, and nitrogen oxides Because lead destroys the effectiveness of these converters, the use of unleaded gasoline has increased dramatically, with corresponding decreases in lead emissions from exhaust EPA has moved to accelerate this progress by phasing out and ultimately by banning all lead in gasoline during the 1980's The overall effect of these control programs has been a major reduct on in the amount of lead in the environment



National Trend in Lead Concentrations, 1977-1986
(Graph A)

Average lead concentrations measured at 82 urban sites between 1977 and 1986 decreased by 87 percent This improvement was due mainly to two related factors Because post-1975 cars run on unleaded gasoline, the use of leaded gas has declined sharply, and with it, the emission of lead in automobile exhausts Secondly, the amount of lead in leaded gas itself has been reduced



National Trend in Lead Emissions, 1977-1986
(Graph B)

Estimated lead emissions decreased 94 percent from 1977 to 1986 Most of this reduction came from decreases in the use of leaded gas, as well as decreases in the amount of lead in leaded gas Emissions were also reduced from fuel combustion and industrial processes

Sulfur Dioxide

Nature and Sources of the Pollutant

Sulfur dioxide belongs to the family of sulfur oxide gases These gases are formed from the burning of sulfur-containing fuel, mainly coal and oil, and also from metal smelting and other industrial processes

Most sulfur dioxide monitoring stations are located in urban areas During 1986, the highest monitored concentrations of the pollutant were primarily recorded in industrial communities of the Midwest, although most urban areas were well within the NAAQS standards High concentrations of sulfur dioxide may also be occurring in many other rural areas near smelters, power plants where there are no monitoring stations, or industrial complexes

Health Effects

Sulfur oxides are associated with many types of respiratory diseases, including coughs and colds, asthma, bronchitis, and emphysema High levels of sulfur oxides obstruct breathing, an effect that is enhanced by the presence of high concentrations of particulate matter, and studies have found increasec death rates from high sulfur oxide levels among people with existing heart and lung disease Lower levels also cause a noticeable increase in acute and chronic respiratory diseases

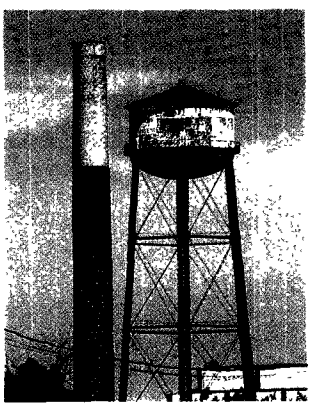
Sulfur dioxide reacts in the atmosphere to form other compounds such as sulfuric acid, sulfates, and sulfites Although these may be even more irritating to the respiratory system than sulfur dioxide, not enough is known about them at present for EPA to control them specifically Controlling sulfur dioxide, however, generally lowers the concentrations of other sulfur compounds as well.

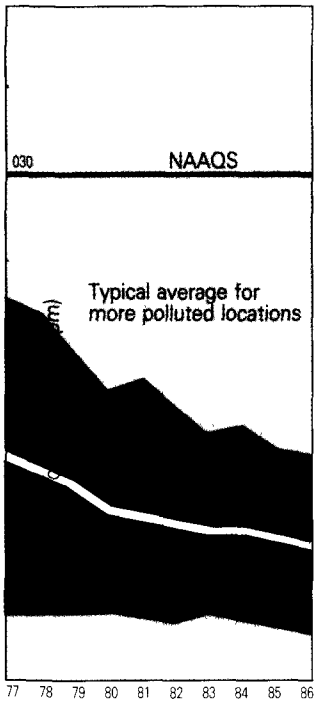
Trends in Sulfur Dioxide Levels

Average concentrations of sulfur dioxide measured at 302 sites decreased by 37 percent between 1977 and 1986 Estimated emissions of sulfur oxides decreased by 21 percent during the same time

Sulfur oxides are emitted mainly by electric utilities that burn coal or oil. Emissions reductions were due mainly to new controls at coal-fired generating stations, to use of lower-sulfur coal, and to decreased use of high-sulfur fuel oil. Emissions were also controlled from nonferrous smelters and from sulfuric acid manufacturing plants.

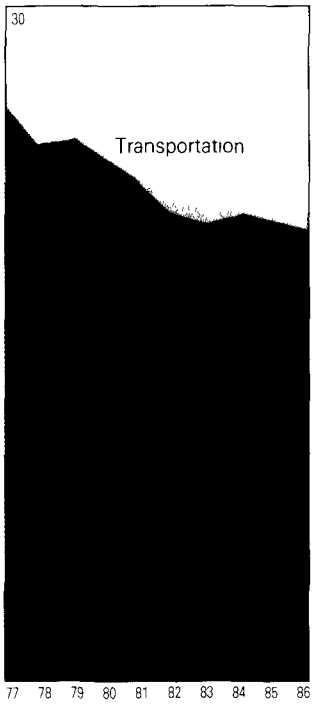
With the exception of some daily violations in a few urban areas, almost all urban monitoring sites had achieved the standard. Violations do still occur in the vicinity of smelters and some large power plants in rural areas.





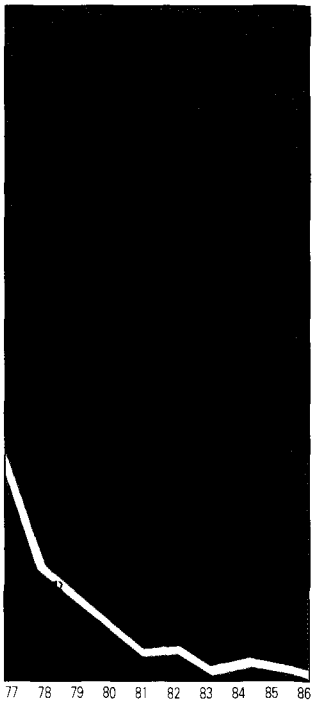
National Trend in Sulfur Dioxide Concentrations, 1977-1986
(Graph A)

Average sulfur dioxide concentrations measured at 302 sites declined by 37 percent between 1977 and 1986 This improvement resulted mainly from: reductions in average sulfur content of fuels burned, installation of flue-gas control equipment at coal-fired generating plants; reduced emissions from industrial processing facilities such as smelters and sulfuric acid manufacturing plants; and the use of cleaner fuels in residential and commercial burners



National Trend in Emissions of Sulfur Oxides, 1977-1986
(Graph B)

Estimated sulfur oxide emissions declined 21 percent between 1977 and 1986 One reason for this decline is that most high-sulfur fuel use has shifted away from urban sites—where most of the monitors are located—to rural areas with fewer recording stations. At urban sites, however, sulfur oxide emissions have declined proportionately with concentrations as a result of energy conservation measures and the use of low-sulfur fuel



National Violation Trends for Sulfur Dioxide, 1977-1986
(Graph C)

The average number of days that sulfur dioxide standards were violated dropped from about 0 9 days per year in 1977 to 0 02 days in 1986 Essentially, the standard is being achieved nationwide

Other Major Air Quality Issues

Although pollutants such as carbon monoxide, ozone, TSP, and the sulfur and nitrogen oxides have been the primary focus of control programs since 1970, Americans have become increasingly aware of other serious air quality problems

Toxic Air Pollutants

The Clean Air Act requires special controls, called NESHAPS (National Emissions Standards for Hazardous Pollutants), for pollutants so toxic that even small emissions are dangerous Thus far, EPA has established NESHAPS for six substances: arsenic, asbestos, benzene, berylium, mercury, and vinyl chloride

Some toxic substances, however, get into the air not from normal industrial emissions, but because of sudden, accidental releases The danger of such releases was vividly illustrated by the catastrophic explosion of a chemical plant in Bhopal, India, in 1985, and by several incidents in the United States Because even small amounts of toxics can threaten the health of nearby people, EPA has focused on determining the health effects of such pollutants and on establishing the most feasible measures for controlling them

Acid Precipitation

Acid precipitation refers to a chain of complex processes that starts with emissions from utilities, industry, and motor vehicles, as well as from natural sources When these emissions interact with sunlight and vapors in the air, they change into acidic compounds that can be transported long distances to other areas and subsequently deposited on the earth's surface with rain or snow, or as dry compounds These deposits may harm fish and other wildlife, lakes, forests, crops, and manmade materials and objects such as buildings and statues

While certain aspects of the acid rain process are generally accepted by the scientific community, others are uncertain Unanswered questions include the geographic range of damage from acid rain, the origin of the pollutants involved in its formation, and the rate at which acidification takes place The role of sulfur emissions in acid rain has been studied most, but other pollutants, including oxides of nitrogen, are also known contributors

At present, EPA believes there is not enough knowledge about acid precipitation to institute specific control measures beyond those in effect for the six NAAQS pollutants However, an extensive research program is underway to help determine the specific causes and effects of acid rain, and new controls could be imposed based on its findings

Indoor Air Pollution

One of the newest concerns about air quality involves indoor pollutants. Recent studies have shown that people are more exposed to chemical pollutants in their own homes than they are to industrial emissions

outdoors The reasons are simple: people spend more time indoors, and pollutants do not disperse as easily inside as they do outdoors, especially in newer buildings that have been tightly insulated to conserve energy. These indoor pollutants can include radon gas, asbestos, formaldehyde, and several volatile organic compounds, as well as tobacco smoke, certain building materials, pesticides, cleaning agents, and a host of commercial and consumer products.

Of these pollutants, those considered most threatening are asbestos, radon gas, and formaldehyde, and they are being addressed by a wide range of regulatory and non-regulatory actions at the federal, state, and local levels.

Asbestos is the name for a group of natural minerals that separate into strong, very fine fibers The fibers are heat-resistant and extremely durable, and these qualities have made asbestos very useful in construction and industry.

The properties that give asbestos its usefulness, however, are also linked to serious health effects, among which are asbestosis, lung cancer, and mesothelioma Asbestos' tiny fibers can remain suspended in the air for long periods of time, and remain in the body when inhaled Because each exposure can increase the burden of asbestos in the body, federal control programs are aimed principally at protecting school children, persons whose work involves exposure to asbestos, and other persons in exposure situations EPA already has prohibited most asbestos use, and is currently considering a total ban

Federal, state, and local programs are also seeking to reduce exposure to radon gas Radon is a colorless, odorless radioactive gas that occurs naturally in soil gas, underground water, and outdoor air at various levels throughout the United States. Prolonged exposure to high levels of radon decay products has been associated with increased risk of lung cancer

Radon gas from soil enters homes through exposed soil in crawl spaces, through cracks and openings in slab-on-grade floors, and through below-grade walls and floors When radon-containing water is heated or agitated—as in a shower or washing machine—it, too, can give off small quantities of radon. (Radon in the outside air is diluted to such low concentrations that it does not present a health hazard)

EPA provides technical assistance to states to help communities with severe radon gas problems The Agency also has developed training, demonstration, and public information programs to support its technical assistance efforts

While EPA has no regulatory program for formaldehyde, other federal agencies have assessed the risks posed by its presence in building materials and have concluded that it probably increases the risk of cancer when inhaled indoors

Global Air Quality Problems

Finally, there are growing concerns in the international community about two global phenomena that could seriously affect the health and welfare of future generations These are the depletion of the stratospheric ozone layer, and global climate change brought about by the ever-increasing concentrations of air pollutants in the earth's atmosphere.

Depletion of the Stratospheric Ozone Layer

Stratospheric ozone (not to be confused with ozone at ground level, where it is a serious pollutant) protects Earth's inhabitants and ecosystems by shielding them from the sun's harmful ultraviolet radiation Since the early 1970s, scientists have predicted that emissions of chlorofluorocarbons (CFCs) and other chemicals would ultimately begin to deplete this essential layer In 1978, EPA banned the use in this country of CFCs in nonessential aerosol propellants, at that time the largest source of CFC emissions Emissions of CFCs from other sources, however, such as refrigerants, air conditioners, and various solvents, have continued to increase Worldwide CFC emissions also have increased, in part because many countries still use CFCs in aerosol sprays and spray products

Most scientific researchers are convinced that global CFC emissions must be reduced substantially to avoid depletion of the stratospheric ozone layer and its consequences for the planet Such depletion, with subsequent increases in ultraviolet radiation, would most likely lead to severe and widespread health problems, ranging from increased cases of skin cancer and eye cataracts to suppression of immune system functioning Ozone depletion may also accelerate the formation of ground-level pollutants and damage agriculture, plants, and fragile aquatic ecosystems

During late 1986, concern about these effects heightened when a very large seasonal depletion of ozone was discovered in the atmosphere over Antarctica; a year later, ozone levels had dropped even further to the lowest levels ever observed there since measurements began more than a decade ago These findings came just as more than 60 nations under the auspices of the United Nations Environment Programme were negotiating an agreement to curtail CFC production sharply The final agreement, which includes all the world's major CFC producers, freezes CFC production levels in the short run, and in the future will cut worldwide production by half

Global Climate Change

Increased economic and industrial activity have produced ever greater concentrations of carbon dioxide, CFCs, methane, nitrous oxides, and other trace gases in Earth's atmosphere In a phenomenon known as the "greenhouse effect," these gases trap heat in the atmosphere, causing

world temperatures to rise—an effect likely to alter the environment.

While difficult to predict with certainty, the economic disruptions and environmental dislocations of climate change could devastate whole regions of the planet Sea levels would certainly rise, threatening major coastal population centers with severe flooding; coastal wetlands and other fragile habitats that incubate critical fish and shellfish species would be wiped out Agriculture and forests would also suffer from marked change in world temperatures or climate patterns. The timetables for many of these prospective changes cannot be predicted with certainty Many contributing factors, such as the role of agricultural emissions, are still far too unclear

One known factor, however, is the rapidly accelerating destruction of the world's tropical rain forests These forests absorb the greenhouse pollutants and give off pure oxygen back into the atmosphere. They also play an indispensable role in maintaining the stability of global weather patterns Yet if current rates of destruction persist, most of these forests will be gone within the next three decades, certainly within the next hundred years.

There is a growing concensus that those problems must be addressed as quickly as possible Most scientists believe that by the time visible manifestations of these problems appear, it may well be too late to reverse them Measures to avoid them may include international controls, massive reforestation programs, and greatly increased use of non-fossil fuels

At the request of Congress, EPA is preparing two reports on global climate change These reports will focus on the effects of climate change and on strategies to stabilize the atmospheric concentrations of trace gases.