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Office of Air Quality
Planning and Standards
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Latest Findings on National Air Quality: 1997 Status and Trends

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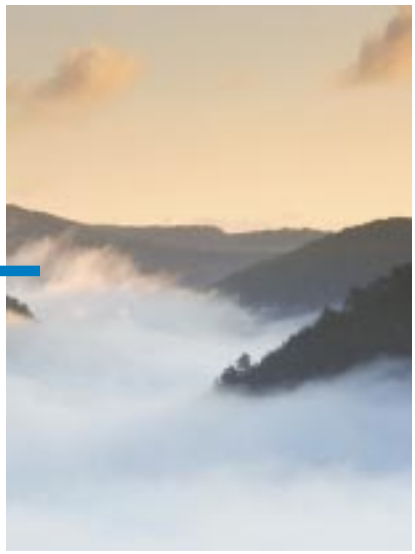
National Air Quality



This brochure highlights the U.S. Environmental Protection Agency's (EPA's) most recent evaluation of status and trends in our nation's air quality.

Highlights include:

- National air quality standards have been set for six principal air pollutants (also referred to as "criteria pollutants"): carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). Emissions of these pollutants, or their precursors, increased significantly between 1900 and 1970.

- Since the 1970 Clean Air Act was signed into law, emissions of each of the six pollutants decreased, with the exception of nitrogen oxides (NO_x). Between 1970 and 1997, emissions of NO_x have increased 11 percent. Emissions of NO_x contribute to the formation of ground-level ozone (smog) and acid rain. In 1998, EPA issued a rule that will significantly reduce emissions of NO_x across 22 states in the eastern half of the United States, and, in turn, reduce the regional transport of ground-level ozone and acid rain formation.

- Nationally, air quality concentration data taken from thousands of monitoring stations across the country has continued to show improvement since the 1980's for CO, Pb, NO_2, O_3, PM, and SO_2. In fact, all the years throughout the 1990's have shown better air quality than any of the years in the 1980's. This steady trend of improvement resulted despite the fact that weather conditions in the 1990's were generally more conducive to higher pollution levels, such as ground-level ozone formation.

- In 1997, despite continued improvements in air quality, approximately 107 million people lived in counties with monitor data showing unhealthy air for one or more of the six principal pollutants. While many of the more industrialized areas have high pollution levels due to increased use of motor vehicles and local industries in their vicinity, some rural locations also are experiencing increased air pollution levels. Some national parks have experienced high air pollution concentrations as a result of pollutants being transported many miles from their original source. For example, ground-level ozone concentrations in remote locations of the Great Smoky Mountains National Park have increased nearly 20 percent over the last 10 years.

- Exposure to air pollutants is associated with numerous effects on human health, including increased respiratory symptoms or decreased lung function, hospitalization for heart or lung diseases, or premature death. Because children's respiratory systems are still developing, and they breathe even more air per pound of body weight, they are generally more susceptible than adults to environmental threats.

- When Congress passed the Clean Air Act Amendments in 1990, they required EPA to address 188 hazardous air pollutants commonly called toxic air pollutants. Since 1990 EPA has issued 27 air standards which when fully implemented will reduce 1 million tons per year of toxic air emissions. Exposure to toxic air pollutants may lead to an increased chance of getting cancer or experiencing other serious health effects. EPA is now developing strategies to address the effects of toxic air pollutants in urban areas.

- Air pollution, such as acid rain, ground-level ozone, and air toxics, can also significantly affect ecosystems. For example, ground-level ozone is responsible for over 500 million dollars in annual reductions of agricultural and commercial forest yields, and airborne releases of nitrogen oxides are one of the largest sources of nitrogen pollution to the Chesapeake Bay.

- Certain pollutants (such as some metals and organic chemicals) that are emitted from industrial sources can be deposited into water bodies and magnified through the food web, adversely affecting fish-eating animals and humans. Currently, about 2,300 U.S. water bodies are under fish consumption advisories, resulting from chemicals such as PCB's, chlordane, dioxins, and mercury.

- Many of the improvements in air quality can be attributed to pollution control programs instituted under the Clean Air Act, state and local laws, and actions taken by industry. EPA and state efforts are continuing to help address such concerns as reducing sulfur in fuels, tightening tailpipe standards for cars and diesel engines, and reducing air pollutants from power plants and other industrial plants.

While the focus of this document is on *national* air pollutant issues, *global* air pollution issues such as destruction of the stratospheric ozone layer and the effect of global warming on the Earth's climate are major concerns and are also addressed in this brochure. EPA continues to work with states, industry, and other partners to find cost-effective and innovative ways to address these and other air pollution problems.

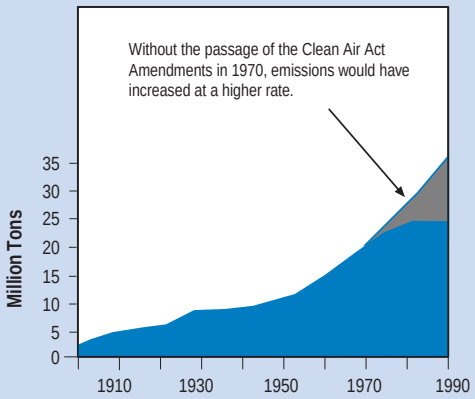
Background

Air pollution comes from many different sources. "Stationary sources," such as factories, power plants, and smelters; "area sources," which are smaller stationary sources such as dry cleaners and degreasing operations; "mobile sources," such as cars, buses, planes, trucks, and trains; and "natural sources," such as windblown dust, and volcanic eruptions, all contribute to air pollution. The Clean Air Act provides the principal framework for national, state, Tribal, and local efforts to protect air quality. Under the Clean Air Act, which was last amended in 1990, EPA has a number of responsibilities, including:

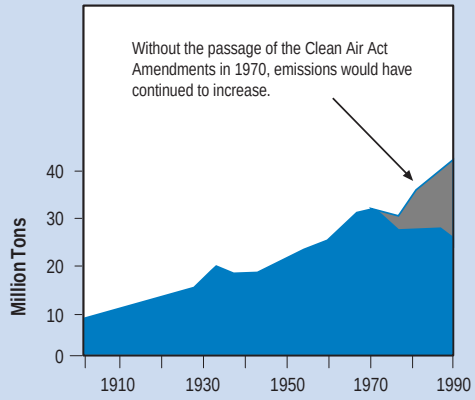
- Setting national ambient air quality standards (NAAQS) for the six principal pollutants which are considered harmful to public health and the environment.
- Ensuring that these air quality standards are met, or attained, (in cooperation with the state, Tribal, and local governments) through national standards and strategies to control air pollutant emissions from automobiles, factories, and other sources.
- Reducing emissions of sulfur dioxide and nitrogen oxides that cause acid rain.
- Reducing air pollutants such as particulate matter, sulfur oxides, and nitrogen oxides that can cause visibility impairment across large regional areas, including many of the nation's most treasured parks and wilderness areas.
- Ensuring that sources of toxic air pollutants that cause or may cause cancer, other adverse human health problems, or adverse environmental effects are well controlled and that risks to public health and the environment are substantially reduced.
- Limiting use of chemicals that damage the stratospheric ozone layer, in order to prevent increased levels of harmful ultraviolet radiation.

This brochure provides an overview of trends in these air pollution problems, as well as global warming issues and the processes EPA has developed for controlling pollutants that contribute to global warming.

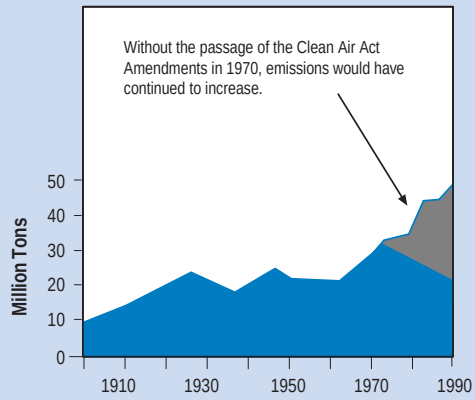
TREND IN EMISSIONS OF NITROGEN OXIDES
(1900 - 1990)



TREND IN EMISSIONS OF VOLATILE ORGANIC COMPOUNDS
(1900 - 1990)



TREND IN EMISSIONS OF SULFUR OXIDES
(1900 - 1990)



SIX PRINCIPAL POLLUTANTS

The Clean Air Act established two types of national air quality standards. "Primary" standards are designed to establish limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. "Secondary" air quality standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

EPA has set national air quality standards for six principal pollutants (referred to as "criteria" pollutants): carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2). [Note: The pollutant ozone is not emitted directly into the air, but is formed when sunlight acts on emissions of nitrogen oxides (NO_x) and volatile organic compounds (VOC).]

For the past 25 years, EPA has examined air pollution trends in concentrations and emissions of each of the six principal pollutants in this country. Each year EPA examines changes in air pollution levels over time and summarizes the current air pollution status. The following sections summarize trends in air quality and emissions during the last 10 years.

Long-Term Emissions Trends

Before the Clean Air Act was signed into law in 1963, the 20th century had witnessed a significant and continued increase in air pollution levels. Although efforts made during the 1960's by state and local air pollution agencies in certain polluted cities in the Northeast helped reduce pollution in some local areas, emissions continued to increase on a national level. Between 1900 and 1970, emissions of NO_x increased 690 percent, VOC increased 260 percent, and SO_2 increased 210 percent. Without the pollution controls resulting from amendments to the Clean Air Act, emissions would have continued to increase at a higher rate, as shown in the three graphs to the left.

Summary of Air Quality and Emissions Trends

EPA tracks two kinds of trends: **air concentrations** based on actual measurements of pollutant concentrations in the ambient (outside) air at selected monitoring sites throughout the country, and **emissions** based on engineering estimates of the total tonnage of these pollutants released into the air annually. In addition, starting in 1994, under the Acid Rain Program, EPA began tracking emissions of SO_2 and NO_x based on data from continuous emission monitors for the electric utility industry.

Generally there are similarities between air quality trends and emission trends for any given pollutant. However, in some cases, there are notable differences between the percent of change in ambient concentrations and the percent of change in emissions. These differences can mainly be attributed to the location of air quality monitors. Because most monitors are positioned in or near urban areas, trends in air quality tend to more closely track changes in urban emissions rather than changes in total national emissions.

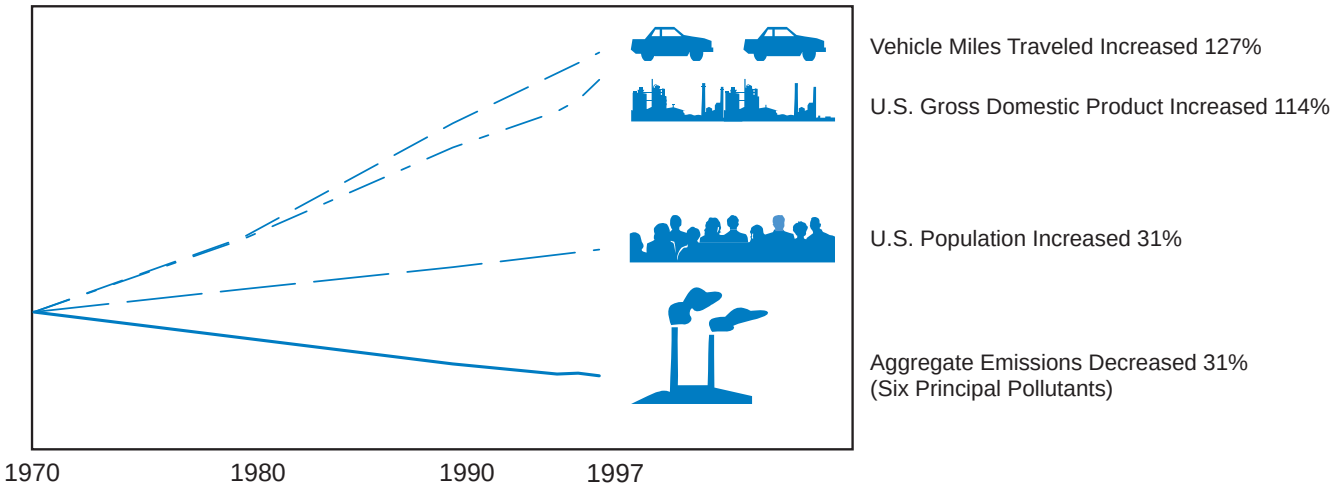
Each year, EPA gathers and analyzes air quality concentration data from thousands of monitoring stations around the country. Monitoring stations are operated by state, Tribal, and local government agencies as well as some Federal agencies, including EPA. Trends are derived by averaging direct measurements from these monitoring sites on a yearly basis. During the last 10 years (1988 through 1997), air quality has continued to improve.

Revised Ozone and Particulate Matter Standards *- In 1997, EPA revised the ozone (O_3) and particulate matter (PM) national air quality standards. Prior to this time, the PM standard applied to particles less than or equal to 10 micrometers in size, or PM-10. With the revised standards, EPA strengthened protection against smaller particles by adding an indicator for PM-2.5 (those less than or equal to 2.5 micrometers).*

As shown in the following chart, the most notable improvements are a 67 percent decrease in Pb concentrations, a 38 percent decrease in CO concentrations, and a 39 percent decrease in SO_2 concentrations. Improvements in measured

	Percent Decrease in Concentrations (1988 - 1997)	Percent Decrease in Emissions (1988 - 1997)
CO	38	25
Pb	67	44
NO_2	14	1 (NO_x)
O_3	19 (Pre-existing NAAQS) 16 (Revised NAAQS)	20 (VOC)
PM-10	26	12
SO_2	39	12

Comparison of Growth Areas and Emission Trends



Between 1970 and 1997, U.S. population increased 31 percent, vehicle miles traveled increased 127 percent, and gross domestic product increased 114 percent. At the same time, total emissions of the six principal air pollutants decreased 31 percent.

concentrations are also noted for the other principal pollutants, including NO_2, ozone, and PM-10 during this same time frame.

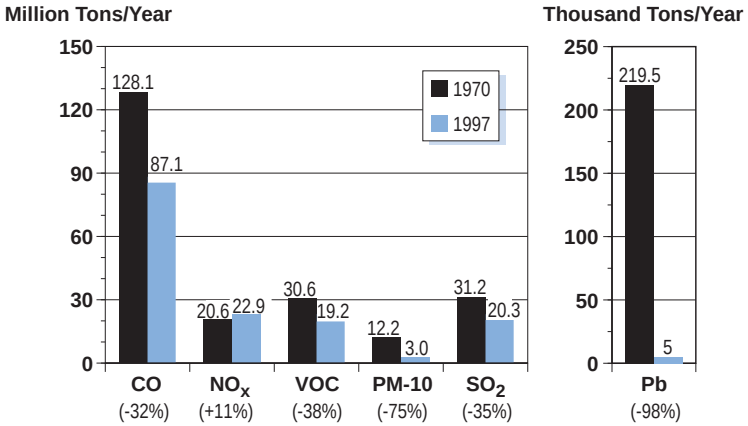
EPA estimates nationwide emissions trends based on actual monitored readings or engineering calculations of the amounts and types of pollutants emitted by automobiles, factories, and other sources. Emission trends are based on many factors, including the level of industrial activity, technology developments, fuel consumption, vehicle miles traveled, and other activities that cause air pollution. Emissions trends also reflect changes in air pollution regulations and installation of emissions controls. Over the last 10-year period, emissions have shown improvement (decreased emissions) for all six principal air pollutants.

The dramatic improvements in emissions and air quality occurred simultaneously with significant increases in economic growth and population. The improvements are a result of effective implementation of clean air laws and regulations, as well as improvements in the efficiency of industrial technologies.

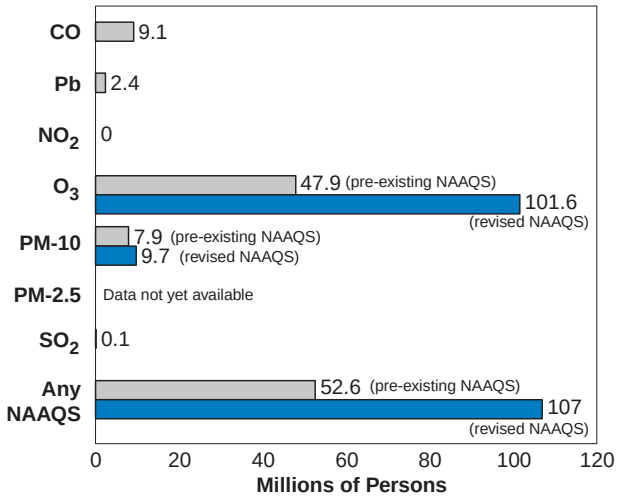
Despite great progress in air quality improvement, in 1997 there were still approximately 107 million people nationwide who lived in counties with monitored air quality levels above the primary national air quality standards.

Comparison of 1970 and 1997 Emissions

(31% decrease for all principal pollutants)

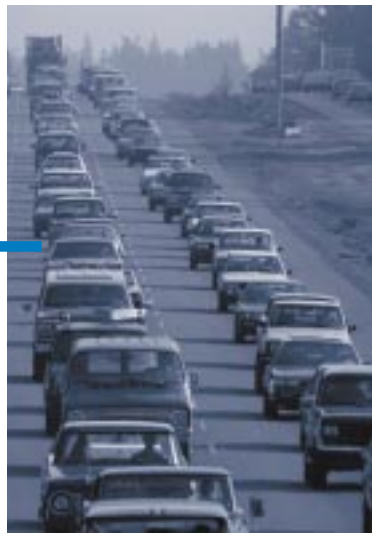


Number of People Living in Counties with Air Quality Concentrations Above the Level of the NAAQS in 1997



Blue bars represent revised standards for ozone and PM.

SIX PRINCIPAL POLLUTANTS



1 CARBON MONOXIDE (CO)

Nature and Sources of the Pollutant: Carbon monoxide (CO) is a colorless, odorless and at high levels, a poisonous gas, formed when carbon in fuel is not burned completely. It is a component of motor vehicle exhaust, which contributes about 60 percent of all CO emissions nationwide. High concentrations of CO generally occur in areas with heavy traffic congestion. In cities, as much as 95 percent of all CO emissions may come from automobile exhaust. Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires. Peak CO concentrations typically occur during the colder months of the year when CO automotive emissions are greater and nighttime inversion conditions (where air pollutants are trapped near the ground beneath a layer of warm air) are more frequent.

Health and Environmental Effects: Carbon monoxide enters the bloodstream through the lungs and reduces oxygen delivery to the body's organs and tissues. The health threat from lower levels of CO is most serious for those who suffer from cardiovascular disease, such as angina pectoris. At much higher levels of exposure, CO can be poisonous and even healthy individuals may be affected. Visual impairment, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks are all associated with exposure to elevated CO levels.

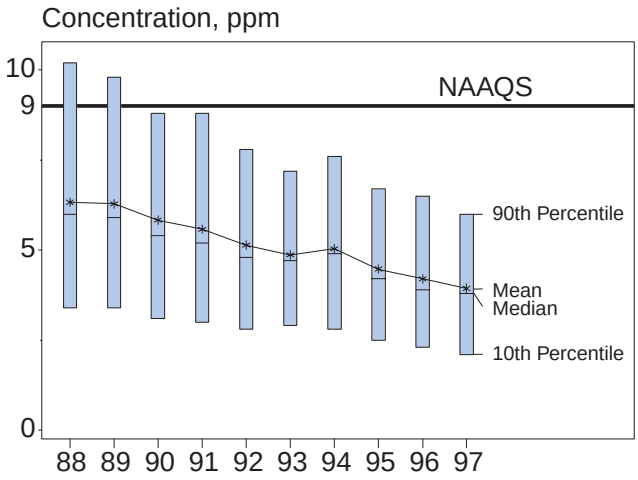
Trends in CO Levels: Long-term improvements in CO continued between 1988 and 1997. Ambient CO concentrations decreased 38 percent, and the estimated number of exceedances of the national standard decreased 95 percent. While CO emissions from highway vehicles alone have decreased 29 percent, total CO emissions decreased only 25 percent overall. Long-term air quality improvement in CO occurred despite a 25 percent increase in vehicle miles traveled in the United States during this 10-year period. Between 1996 and 1997, ambient CO concentrations decreased 7 percent, while CO emissions decreased 3 percent. Transportation sources (including highway and off-highway vehicles) now account for 77 percent of national total CO emissions.

CO Air Quality, 1988-97

Annual 2nd Maximum 8-Hour Average

1988-97: 38% decrease

1996-97: 7% decrease

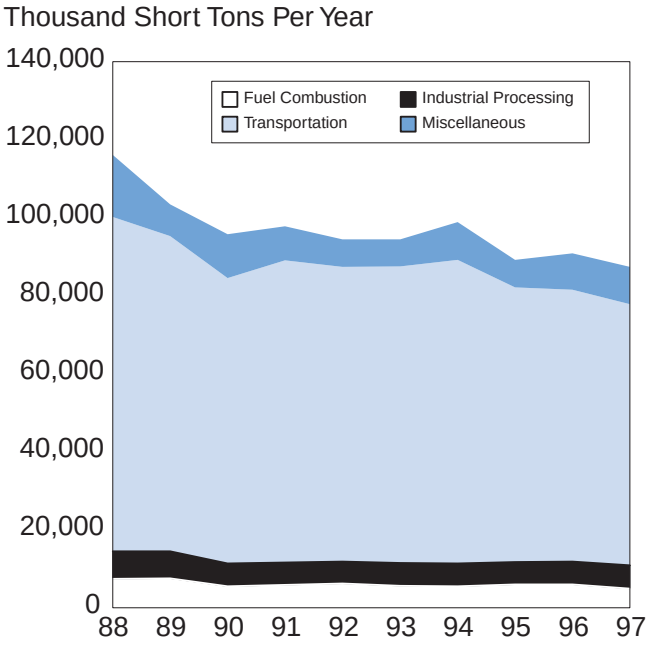


Bold line indicates national air standard.

CO Emissions, 1988-97

1988-97: 25% decrease

1996-97: 3% increase



2 LEAD (Pb)

Nature and Sources of the Pollutant: In the past, automotive sources were the major contributor of Pb emissions to the atmosphere. As a result of EPA's regulatory efforts to reduce the content of Pb in gasoline, the contribution from the transportation sector has declined over the past decade. Today, metals processing is the major source of Pb emissions to the atmosphere. The highest air concentrations of Pb are found in the vicinity of nonferrous and ferrous smelters, and battery manufacturers.

Health and Environmental Effects: Exposure to Pb occurs mainly through inhalation of air and ingestion of Pb in food, water, soil, or dust. It accumulates in the blood, bones, and soft tissues. Lead can adversely affect the kidneys, liver, nervous system, and other organs. Excessive exposure to Pb may cause neurological impairments, such as seizures, mental retardation, and behavioral disorders. Even at low doses, Pb exposure is associated with damage to the nervous systems of fetuses and young children, resulting in learning deficits and lowered IQ. Recent studies also show that Pb may be a factor in high blood pressure and subsequent heart disease. Lead can also be deposited on the leaves of plants, presenting a hazard to grazing animals.

Trends in Pb Levels: Between 1988 and 1997, ambient Pb concentrations decreased 67 percent, and total Pb emissions decreased 44 percent. Since 1988, Pb emissions from highway vehicles have decreased 99 percent due to the phase-out of leaded gasoline. The large reduction in Pb emissions from

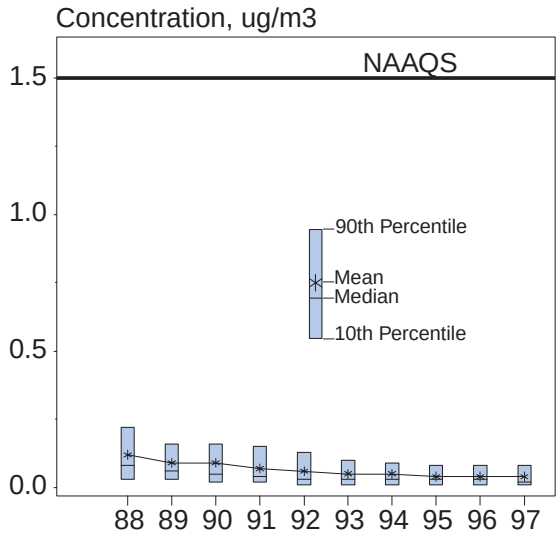
transportation sources has changed the nature of the pollution problem in the United States. While there are still violations of the Pb air quality standard, they tend to occur near large industrial sources such as lead smelters. Between 1996 and 1997, Pb concentrations and emissions remained unchanged.

Lead (Pb) Air Quality, 1988-97

Annual Maximum Quarterly Average

1988-97: 67% decrease

1996-97: no change

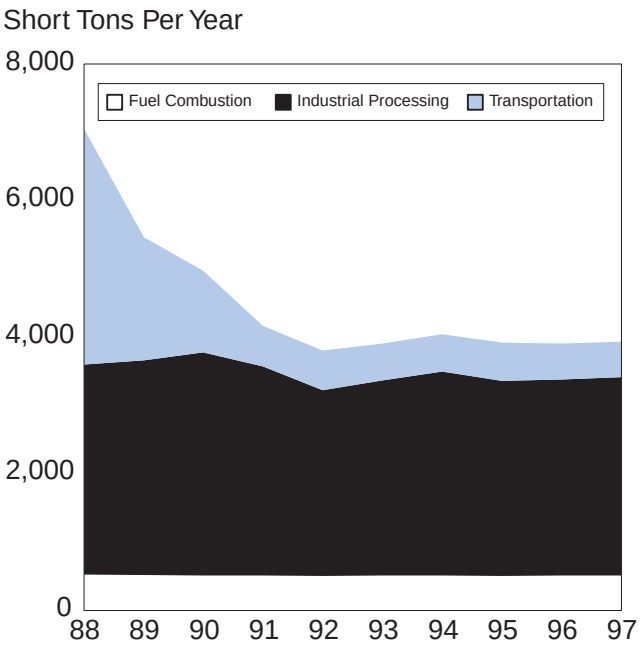


Bold line indicates national air standard.

Lead (Pb) Emissions, 1988-97

1988-97: 44% decrease

1996-97: no change



3 NITROGEN DIOXIDE (NO_2)

Nature and Sources of the Pollutant: Nitrogen dioxide (NO_2) is a reddish brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). Nitrogen oxides (NO_x), the term used to describe the sum of NO, NO_2 and other oxides of nitrogen, play a major role in the formation of ozone. The major sources of man-made NO_x emissions are high-temperature combustion processes, such as those occurring in automobiles and power plants. Home heaters and gas stoves also produce substantial amounts of NO_2 in indoor settings.

Health and Environmental Effects: Short-term exposures (e.g., less than 3 hours) to current nitrogen dioxide (NO_2) concentrations may lead to changes in airway responsiveness and lung function in individuals with pre-existing respiratory illnesses and increases in respiratory illnesses in children (5-12 years old). Long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause alterations in the lung. Atmospheric transformation of NO_x can lead to the formation of ozone and nitrogen-bearing particles (most notably in some western urban areas) which are both associated with adverse health effects.

Nitrogen oxides also contribute to the formation of acid rain. Nitrogen oxides contribute to a wide range of environmental effects, including potential changes in the composition and competition of some species of vegetation in wetland and terrestrial systems, visibility impairment, acidification of freshwater bodies, eutrophication (i.e., explosive algae growth leading to a depletion of oxygen in the water) of estuarine and coastal waters (e.g., Chesapeake Bay), and increases in levels of toxins harmful to fish and other aquatic life.

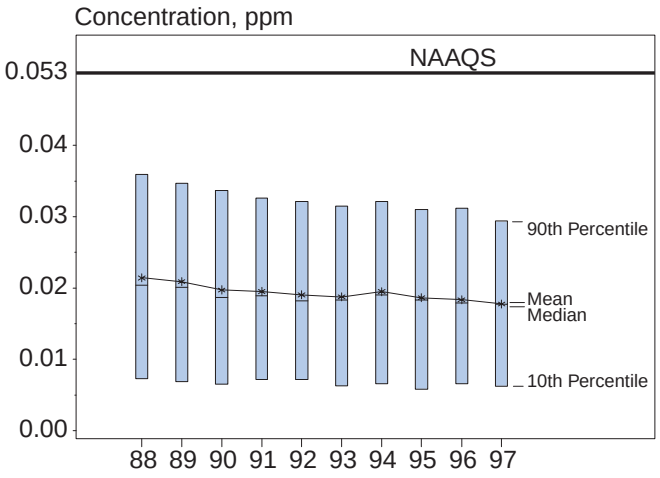
Trends in NO_2 Levels: Over the past ten years, ambient NO_2 concentrations decreased 14 percent. Between 1996 and 1997, national average annual mean NO_2 concentrations remain unchanged. In the last 10 years, NO_x emissions levels have remained relatively constant. Between 1988 and 1997, NO_x emissions declined 1 percent, while they increased slightly (by 1 percent) between 1996 and 1997. However, over the longer term since 1970, total NO_x emissions have increased 11 percent and NO_x emissions from coal-fired power plants have increased 44 percent.

NO_2 Air Quality, 1988-97

Annual Arithmetic Mean

1988-97: 14% decrease

1996-97: no change

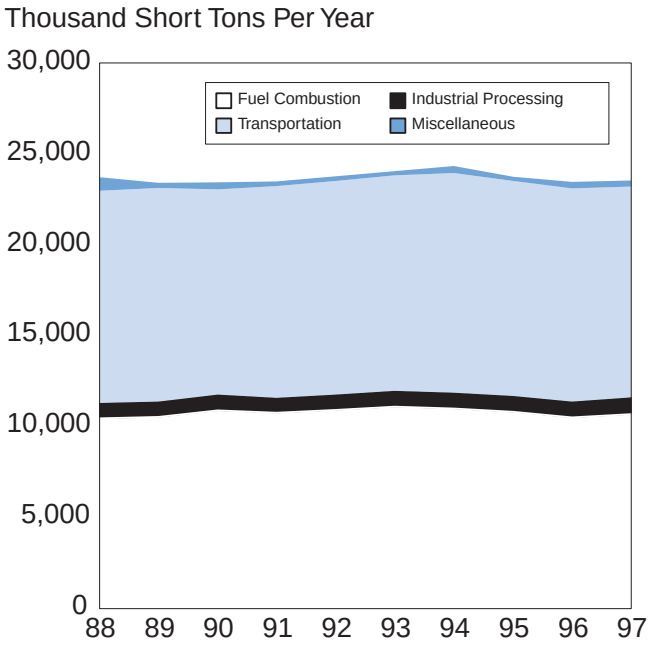


Bold line indicates national air standard.

NO_x Emissions, 1988-97

1988-97: 1% decrease

1996-97: 1% increase



4 GROUND-LEVEL OZONE (O_3)

Nature and Sources of the Pollutant: Ground-level ozone (the primary constituent of smog) continues to be a pervasive pollution problem throughout many areas of the United States. Ozone is not emitted directly into the air but is formed by the reaction of VOCs and NO_x in the presence of heat and sunlight. Ground-level ozone forms readily in the atmosphere, usually during hot summer weather. VOCs are emitted from a variety of sources, including motor vehicles, chemical plants, refineries, factories, consumer and commercial products, and other industrial sources. Nitrogen oxides are emitted from motor vehicles, power plants, and other sources of combustion. Changing weather patterns contribute to yearly differences in ozone concentrations from city to city. Ozone and the precursor pollutants that cause ozone also can be transported into an area from pollution sources found hundreds of miles upwind.

Ozone occurs naturally in the stratosphere and provides a protective layer high above the Earth. *See page 18 for more information on stratospheric ozone.*

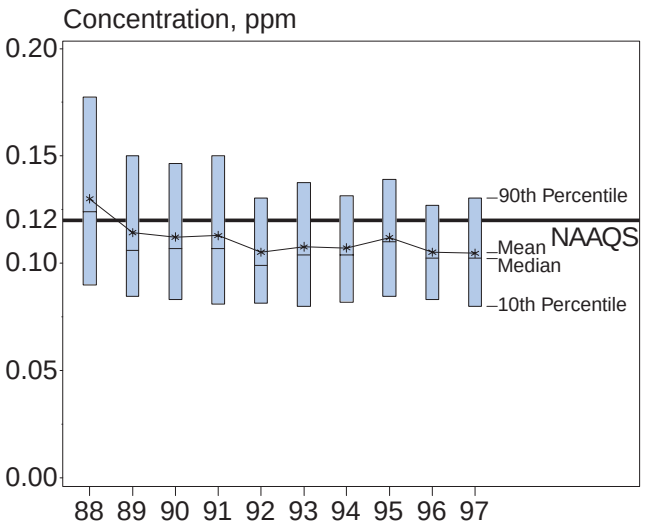
Health and Environmental Effects: Short-term (1-3 hours) and prolonged (6-8 hours) exposures to ambient ozone have been linked to a number of health effects of concern. For example, increased hospital admissions and emergency room visits for respiratory causes have been associated with ambient ozone exposures. Repeated exposures to ozone can make people more susceptible to respiratory infection, result in lung inflammation, and aggravate pre-existing respiratory diseases such as asthma. Other health effects attributed to ozone exposures include significant decreases in lung function and increased respiratory symptoms such as chest pain and cough. These effects generally occur while individuals are engaged in moderate or heavy exertion. Children active outdoors during the summer when ozone levels are at their highest are most at risk of experiencing such effects. Other at-risk groups include adults who are active outdoors (e.g., outdoor workers), and individuals with pre-existing respiratory disease such as asthma and chronic obstructive lung disease. In addition, longer-term exposures to moderate levels of ozone present the possibility of irreversible changes in the lungs which could lead to premature aging of the lungs and/or chronic respiratory illnesses.

Ozone Air Quality, 1988-97

Annual 2nd Daily 1-Hour Maximum

1988-97: 19% decrease

1996-97: no change

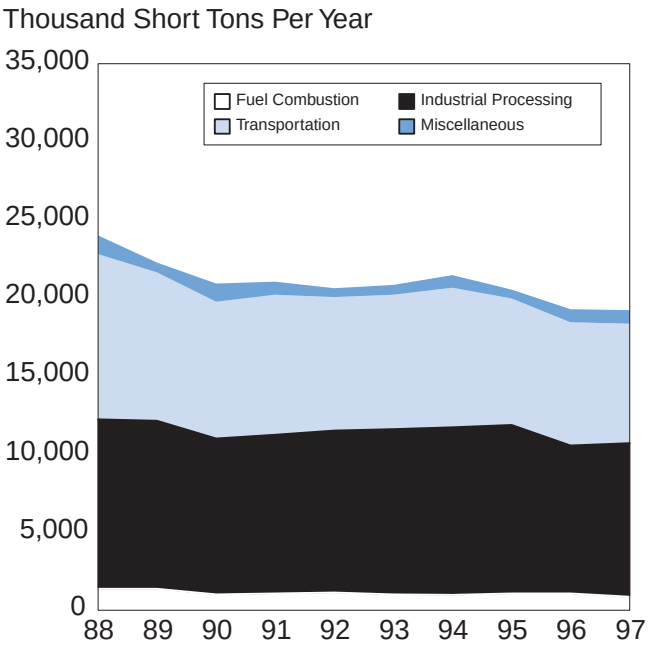


Bold line indicates pre-existing national air standard.

VOC Emissions, 1988-97

1988-97: 20% decrease

1996-97: no change



Ozone also affects vegetation and ecosystems, leading to reductions in agricultural and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to disease, pests, and other environmental stresses (e.g., harsh weather). In long-lived species, these effects may become evident only after several years or even decades, thus having the potential for long-term effects on forest ecosystems. Ground-level ozone damage to the foliage of trees and other plants also can decrease the aesthetic value of ornamental species as well as the natural beauty of our national parks and recreation areas.

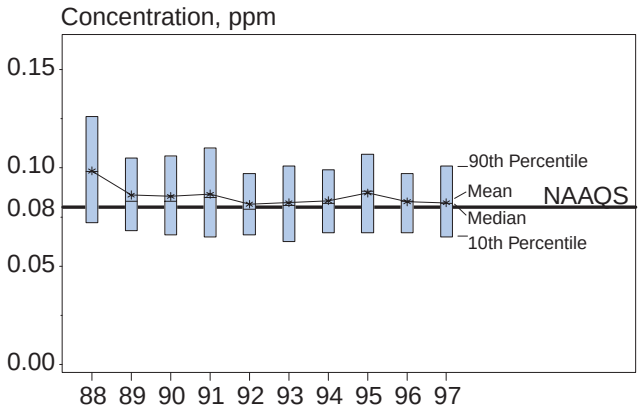
Revised Ozone Standards: *In 1997, EPA revised the national ambient air quality standards for ozone by replacing the 1-hour ozone 0.12 parts per million (ppm) standard with a new 8-hour 0.08 ppm standard. The revision to the O_3 standard was set such that the 1-hour standard will no longer apply once an area has air quality data meeting the 1-hour standard. Although areas that do not meet the new 8-hour standard will not be designated "nonattainment" until the year 2000, EPA is beginning to track trends in 8-hour levels of ozone.*

Ozone Air Quality, 1988-97

Annual 4th Daily 8-Hour Maximum

1988-97: 16% decrease

1996-97: 1% decrease



Bold line indicates revised national air standard.

Trends in Ozone Levels: Ambient ozone trends are influenced by year-to-year changes in meteorological conditions, population growth, loadings of VOC and NO_x in the atmosphere, and by changes in emissions from ongoing control measures. As shown in the chart to the left, between 1988 and 1997, ambient ozone concentrations decreased 19 percent, based on the pre-existing standard. Between 1996 and 1997, ambient ozone concentrations did not change based on the pre-existing standard.

Nationally, 8-hour levels of ozone have decreased 16 percent over the past 10 years. Between 1996 and 1997, O_3 concentrations decreased 1 percent based on the revised standard.

In order to address ozone pollution, EPA has traditionally focused its control strategies on reducing emissions of VOC in nonattainment areas. However, EPA and the states have recognized a need for an aggressive program to reduce regional emissions of NO_x. In 1998, EPA issued a rule that will significantly reduce regional emissions of NO_x in 22 states and the District of Columbia, and, in turn, reduce the regional transport of ozone. National trends in emissions of NO_x and VOC underscore the importance of this new approach. Volatile organic compound emissions decreased 20 percent between 1988 and 1997, while NO_x emissions decreased only 1 percent. VOC emissions from highway vehicles have declined 38 percent since 1988, while highway vehicle NO_x emissions have declined 8 percent since their peak level in 1994. Further, between 1970 and 1997 emissions of VOCs have decreased 38 percent whereas emissions of NO_x have increased 11 percent and NO_x emissions from coal-fired power plants have increased 44 percent.

5 PARTICULATE MATTER (PM-10)

Nature and Sources of the Pollutant: Particulate matter (PM) is the general term used for a mixture of solid particles and liquid droplets found in the air. 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. These particles, which come in a wide range of sizes ("fine" particles are less than 2.5 micrometers in diameter and coarser-size particles are larger than 2.5 micrometers), originate from many different stationary and mobile sources as well as from natural sources. Fine particles (PM-2.5) result from fuel combustion from motor vehicles, power generation, and industrial facilities, as well as from residential fireplaces and wood stoves. Coarse particles (PM-10) are generally emitted from sources, such as vehicles traveling on unpaved roads, materials handling, and crushing and grinding operations, as well as windblown dust. Some particles are emitted directly from their sources, such as smokestacks and cars. In other cases, gases such as sulfur oxide and SO_2, NO_x, and VOC interact with other compounds in the air to form fine particles. Their chemical and physical compositions vary depending on location, time of year, and weather.

Health and Environmental Effects: Inhalable PM includes both fine and coarse particles. These particles can accumulate in the respiratory system and are associated with numerous health effects. Exposure to coarse particles is primarily associated with the aggravation of respiratory conditions, such as asthma. Fine particles are most closely associated with such health effects as increased hospital admissions and emergency room visits for heart and lung disease, increased respiratory symptoms and disease, decreased lung function, and even premature death. Sensitive groups that appear to be at greatest risk to such effects include the elderly, individuals with cardiopulmonary disease, such as asthma, and children. In addition to health problems, PM is the major cause of reduced visibility in many parts of the United States. Airborne particles also can cause damage to paints and building materials.

Revised Particulate Matter Standards: *In 1997, EPA added two new PM-2.5 standards, set at 15 micrograms per cubic meter (μg/m³) and 65 μg/m³, respectively, for the annual and 24-hour standards. In addition, the form of the 24-hour standard for PM-10 was changed. EPA is beginning to collect data on PM-2.5 concentrations. Beginning in 2002, based on 3 years of monitor data, EPA will designate areas as nonattainment that do not meet the new PM-2.5 standards.*

Trends in PM-10 Levels: Between 1988 and 1997, average PM-10 concentrations decreased 26 percent. Short-term trends between 1996 and 1997 showed a decrease of 1 percent in monitored PM-10 concentration levels.

Emissions of PM-10 shown in the chart are based on estimates of anthropogenic emissions including fuel combustion sources, industrial processes, and transportation sources, which account for only 6 percent of the total PM-10 emissions nationwide. Between 1988 and 1997, PM-10 emissions for these sources decreased 12 percent. Emissions of PM-10 between 1996 and 1997 decreased 1 percent.

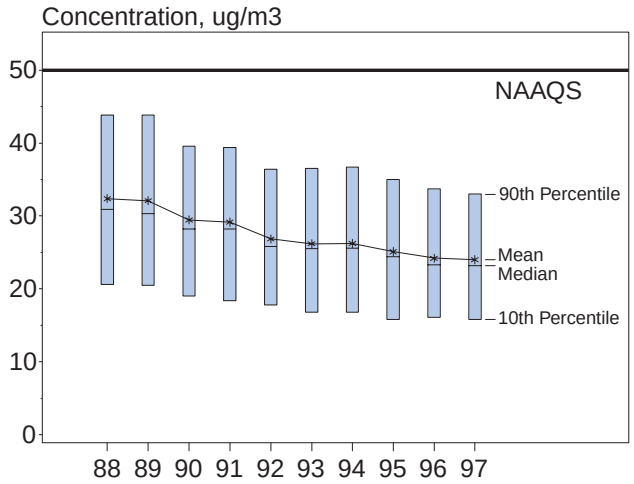
The emissions estimates presented above do not include emissions from natural and miscellaneous sources, such as fugitive dust (unpaved and paved roads), agricultural and forestry activities, wind erosion, wildfires, and managed burning. These emissions estimates also do not account for PM that is secondarily formed in the atmosphere from gaseous pollutants (i.e., SO_2 and NO_x).

PM-10 Air Quality, 1988-97

Annual Arithmetic Mean

1988-97: 26% decrease

1996-97: 1% decrease

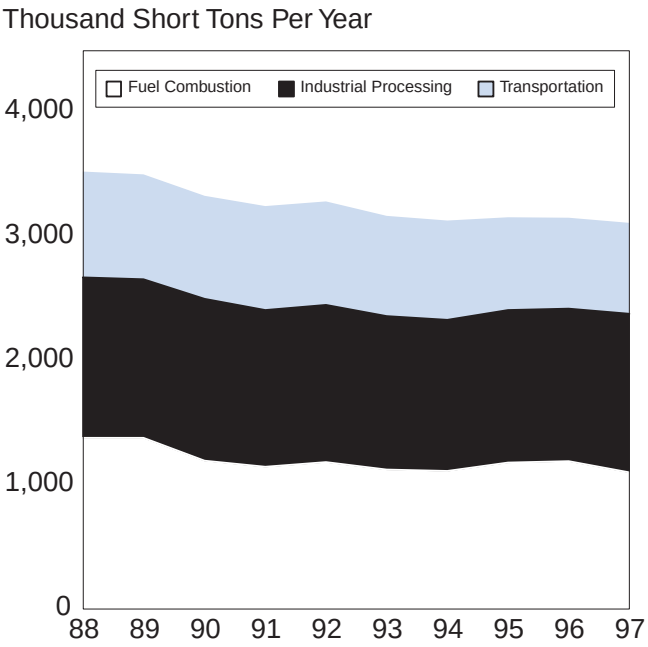


Bold line indicates pre-existing national air standard.

PM-10 Emissions, 1988-97

1988-97: 12% decrease

1996-97: 1% decrease



6 SULFUR DIOXIDE (SO_2)

Nature and Sources of the Pollutant: Sulfur dioxide belongs to the family of sulfur oxide gases. These gases are formed when fuel containing sulfur (mainly, coal and oil) is burned and during metal smelting and other industrial processes. Most SO_2 monitoring stations are located in urban areas. The highest monitored concentrations of SO_2 are recorded in the vicinity of large industrial facilities.

Health and Environmental Effects: High concentrations of SO_2 can result in temporary breathing impairment for asthmatic children and adults who are active outdoors. Short-term exposures of asthmatic individuals to elevated SO_2 levels while at moderate exertion may result in reduced lung function that may be accompanied by such symptoms as wheezing, chest tightness, or shortness of breath. Other effects that have been associated with longer-term exposures to high concentrations of SO_2, in conjunction with high levels of PM, include respiratory illness, alterations in the lungs' defenses, and aggravation of existing cardiovascular disease. The subgroups of the population that may be affected under these conditions include individuals with cardiovascular disease or chronic lung disease, as well as children and the elderly.

Together, SO_2 and NO_x are the major precursors to acidic deposition (acid rain), which is associated with the acidification of soils, lakes, and streams, accelerated corrosion of buildings and monuments, and reduced visibility. Sulfur dioxide also is a major precursor to PM-2.5, which is a significant health concern as well as a main pollutant that impairs visibility.

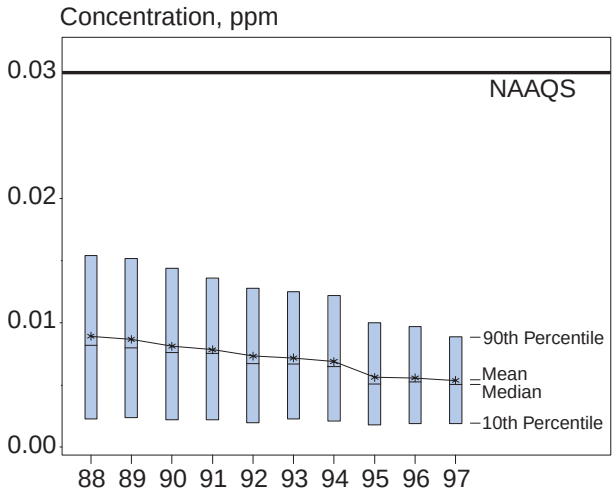
Trends in SO_2 Levels: Between 1988 and 1997, national SO_2 concentrations decreased 39 percent and SO_2 emissions decreased 12 percent. Between 1996 and 1997, national SO_2 concentrations decreased 4 percent and SO_2 emissions increased 3 percent. Sulfur dioxide emissions from electric utilities decreased 12 percent between 1994 and 1997. These recent reductions are due, in large part, to controls implemented under EPA's Acid Rain Program. The 3 percent increase that occurred between 1996 and 1997 is primarily due to increased demand for electricity.

SO_2 Air Quality, 1988-97

Annual Arithmetic Mean

1988-97: 39% decrease

1996-97: 4% decrease

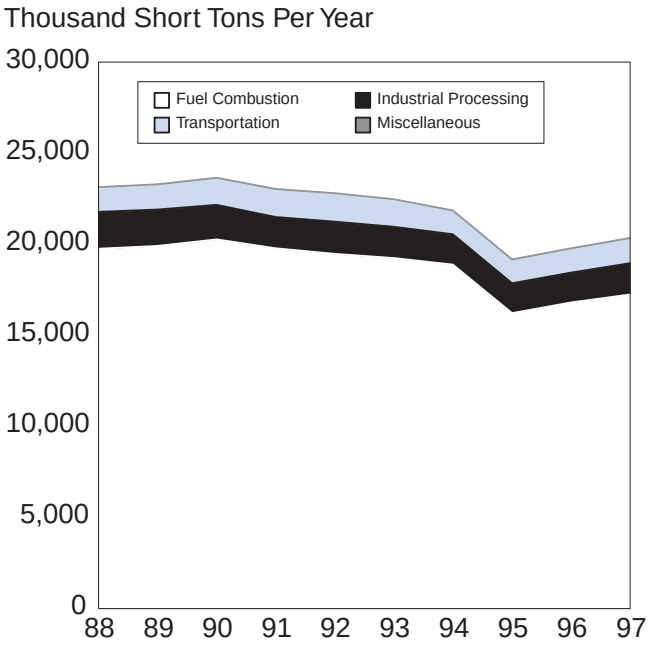


Bold line indicates national air standard.

SO_2 Emissions, 1988-97

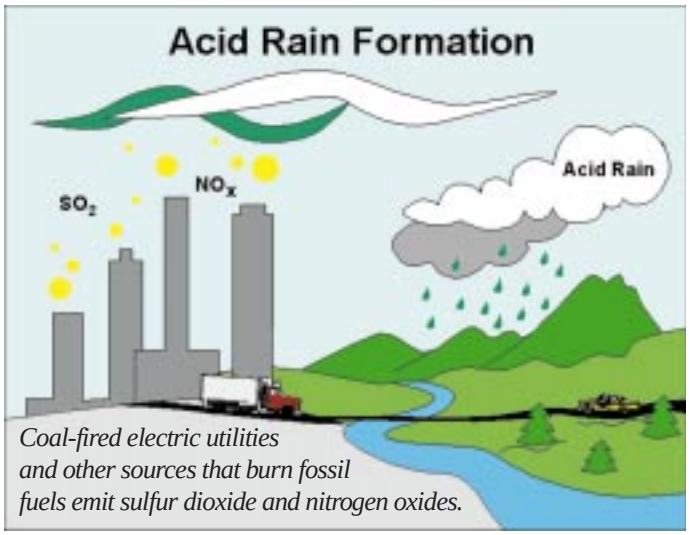
1988-97: 12% decrease

1996-97: 3% increase



Acid Rain

Nature and Source of the Problem: Acidic deposition or "acid rain" occurs when emissions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) in the atmosphere react with water, oxygen, and oxidants to form acidic compounds. These compounds fall to the Earth in either dry form (gas and particles) or wet form (rain, snow, and fog). Some are carried by the wind, sometimes hundreds of miles, across state and national borders. In the United States, about 64 percent of annual SO_2 emissions and 26 percent of NO_x emissions are produced by electric utility plants that burn fossil fuels.



Coal-fired electric utilities and other sources that burn fossil fuels emit sulfur dioxide and nitrogen oxides.

Health and Environmental Effects: Before falling to the Earth, SO_2 and NO_x gases and related particulate matter (sulfates and nitrates) contribute to poor visibility and impact public health. Major human health concerns associated with their exposure include effects on breathing and the respiratory system, damage to lung tissue, and premature death. In the environment, acid rain raises the acid levels in soils and water bodies (making the water unsuitable for some fish and other wildlife), and damages trees at some high elevations. It also speeds the decay of buildings, statues, and sculptures that are part of our national heritage.

Program Structure: The goal of EPA's Acid Rain Program, established by the Clean Air Act, is to improve public health and the environment by reducing emissions of SO_2 and NO_x. The program is being implemented in two phases: Phase I began in 1995 for SO_2 and targets the largest and highest-emitting power plants (boilers). Phase I for NO_x began in 1996 and targets coal-fired power plants. Phase II for both pollutants begins in 2000 and will set restrictions on smaller coal-, gas-, and oil-fired plants.

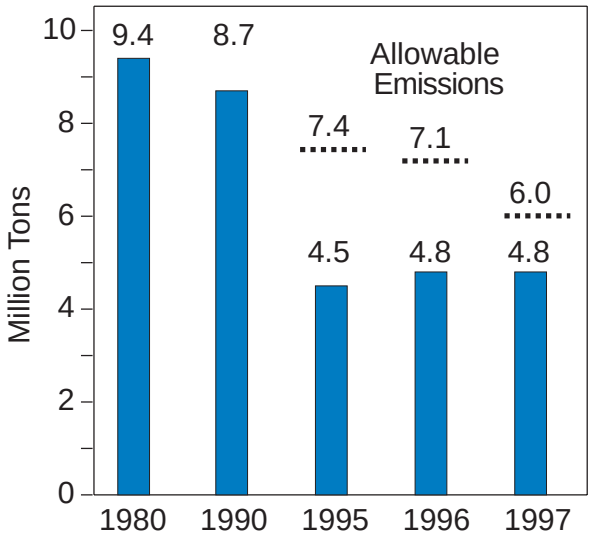
The Acid Rain Program will reduce annual SO_2 emissions by 10 million tons between 1980 and 2010. The program sets a permanent cap on the total amount of SO_2 that may be emitted by power plants nationwide at about half of the amount emitted in 1980. An emissions trading program is in effect to achieve the required emission reduction more cost effectively. This approach gives utilities the flexibility and incentive to reduce emissions at the lowest cost, while ensuring that the overall emission limit is met.

The NO_x component of the Acid Rain Program establishes an emission rate limit for all affected utilities, resulting in a 2 million ton reduction compared to 1980 levels. Under this program, the industry can choose to over-control at units where it is technically easier to control emissions, average these emissions with those at their other units, and thereby achieve overall emissions reductions at lower cost.

Reductions in SO_2 and NO_x will decrease levels of sulfates, nitrates, and ground-level ozone (smog), leading to improvements in public health and other benefits such as better water quality in lakes and streams. Visibility will improve, enhancing the beauty of our country's scenic vistas, including those in national parks. Likewise, damage to the trees that populate mountain ridges from Maine to Georgia will be reduced, and deterioration of our historic buildings and monuments will be slowed.

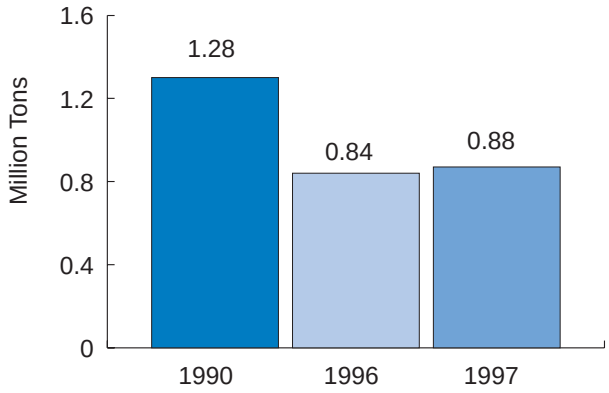
Emissions and Atmospheric Trends: SO_2 emissions reductions have been significant in the first 3 years of compliance with EPA's Acid Rain Program. As shown in the graph below, the 263 core Phase I utility units continued to emit

SO_2 Emissions from 263 Highest-Emitting Phase I Units



In 1997, emissions at the Phase I units were 1.2 million tons below their allowed level.

NO_x Emissions from 263 Phase I Units



1997 emissions from NO_x Phase I Units decreased 32 percent from 1990 levels.

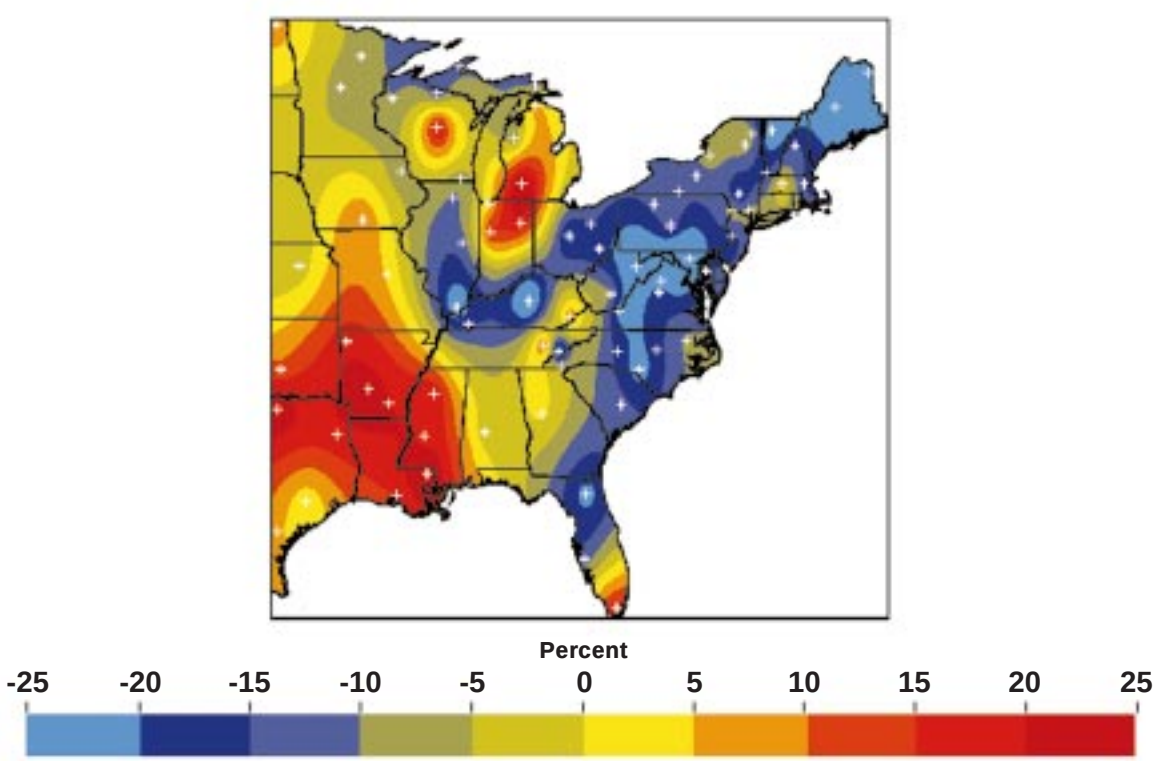
well below the allowable emission levels required by the Clean Air Act. Additional units elected to participate early, bringing the total number of Phase I units to 423 in 1997. Total Phase I units emitted 5.5 million tons, which was still well below the 1997 allowable emissions level for SO_2.

As shown in the chart to the left, actual NO_x emissions decreased by approximately 400,000 tons (32 percent) compared to 1990 levels. NO_x emissions in 1997 increased slightly from 1996, attributable to greater electrical production.

In 1995 and 1996, concentrations of sulfates in precipitation over a large area of the eastern United States exhibited a dramatic and unprecedented reduction. Sulfates have been estimated to be 10 to 25 percent lower than they would have been if the trend from 1983 through 1994 had continued (see figure below). These reductions in acid precipitation are directly related to the large regional decreases in SO_2 emissions resulting from Phase I of the Acid Rain Program. The largest reductions in sulfate concentrations occurred along the Ohio River Valley and in states immediately downwind. Reductions in the East in hydrogen ion concentrations, the primary indicator of precipitation acidity, were similar to those of sulfate concentrations, both in magnitude and location. Nitrate concentrations were not appreciably different in 1995 to 1996 from historical levels.

Percent Change in Sulfate Levels Occurring in 1996 Precipitation

(compared to 1983-1994 predicted levels)



The level of sulfates in rain is an indicator of acidity. A 10 to 25 percent decrease in sulfate levels in rainfall was observed in 1996, particularly in some of the most acid-sensitive regions of the United States.

VISIBILITY

Nature and Sources of the Problem: Visibility impairment occurs as a result of the scattering and absorption of light by air pollution, including particles and gases. In addition to limiting the distance that we can see, the scattering and absorption of light caused by air pollution can also degrade the color, clarity, and contrast of scenes. The same particles that are linked to serious health effects can also significantly affect our ability to see.

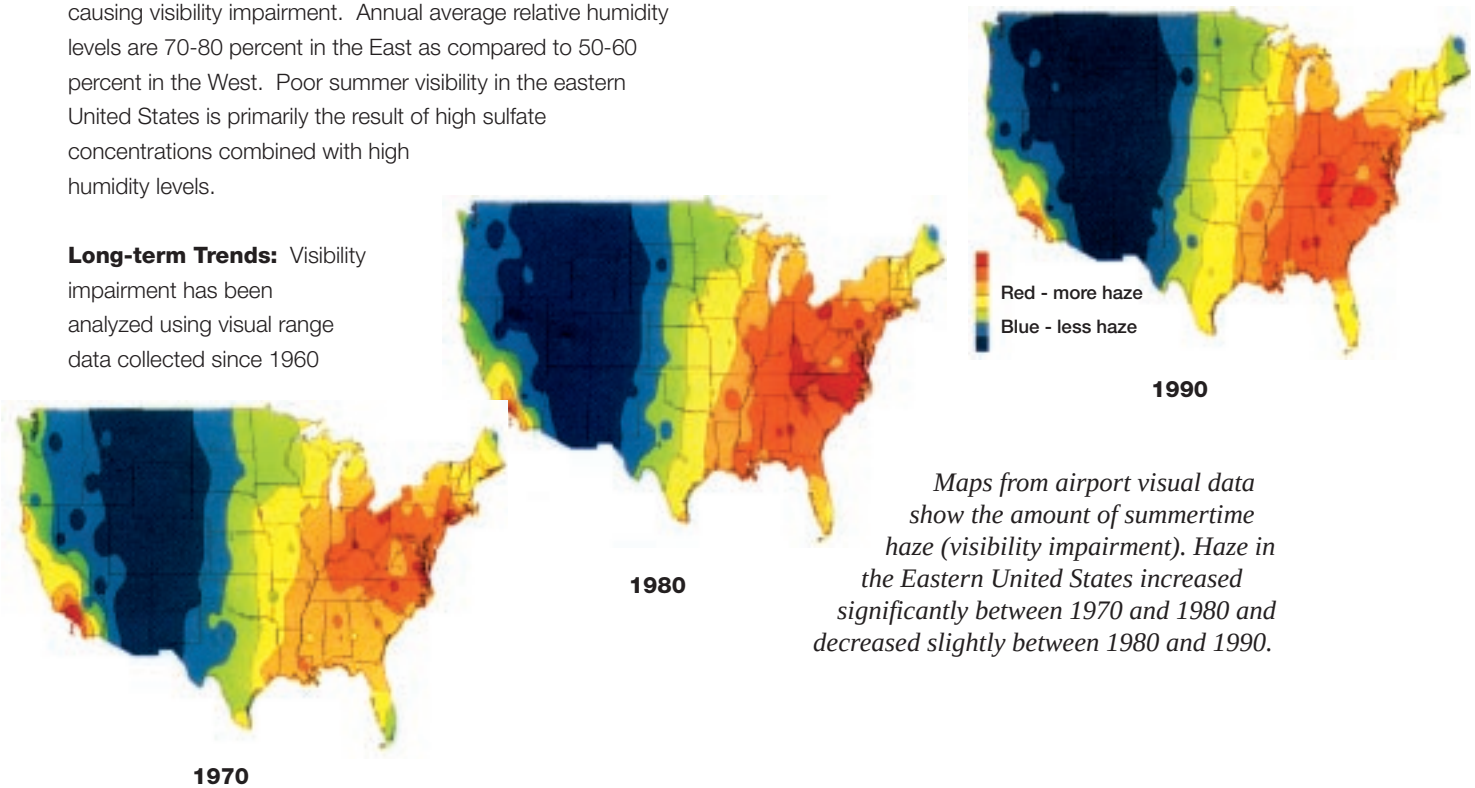
Both primary emissions and secondary formation of particles contribute to visibility impairment. "Primary" particles, such as dust from roads or elemental carbon (soot) from wood combustion, are emitted directly into the atmosphere. "Secondary" particles are formed in the atmosphere from primary gaseous emissions. Examples include sulfate, formed from sulfur dioxide (SO_2), and nitrates, formed from NO_x. In the Eastern United States, reduced visibility is mainly attributable to secondarily-formed particles. While these secondarily-formed particles still account for a significant amount in the West, primary emissions from sources like wood smoke contribute a larger percentage of the total particulate loading than in the East.

Humidity can significantly increase the effect of pollution on visibility. Some particles, such as sulfates, accumulate water and grow in size, becoming more efficient at scattering light and causing visibility impairment. Annual average relative humidity levels are 70-80 percent in the East as compared to 50-60 percent in the West. Poor summer visibility in the eastern United States is primarily the result of high sulfate concentrations combined with high humidity levels.

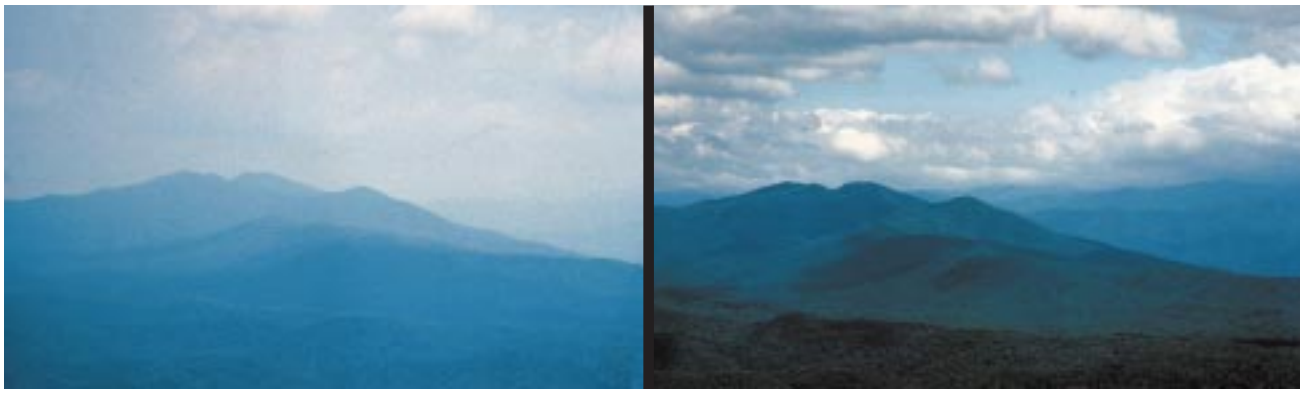
Long-term Trends: Visibility impairment has been analyzed using visual range data collected since 1960 at 280 monitoring stations located at airports across the country. At these stations, measurements of visual range (the maximum distance at which an observer can discern the outline of an object) were recorded. The maps below show the amount of haze during the summer months of 1970, 1980, and 1990. The dark blue color represents less haze and red represents more haze. Overall, the maps show that visibility impairment in the Eastern United States increased greatly between 1970 and 1980 and decreased slightly between 1980 and 1990. This follows the overall trend in emissions of SO_x during these periods.

Visibility Monitoring Network: In 1987, a visibility monitoring network was established as a cooperative effort between the EPA, states, National Park Service, U.S. Forest Service, Bureau of Land Management, and U.S. Fish and Wildlife Service. The network is designed to track progress toward the Clean Air Act's national goal of remedying the existing and preventing future visibility impairment in the 156 national parks and wilderness areas. Each of these sites contains over 5,000 acres. The network is the largest in the country devoted to fully characterizing visibility. It also provides information for determining the types of pollutants and sources primarily responsible for reduced visibility.

Visibility impairment is generally worse in the rural East compared to most of the West. This is primarily due to higher concentrations of man-made pollution, slightly higher background levels of fine particles, and higher relative humidity levels in the East. The chart to the right shows the relative levels of pollutants that contribute to visibility impairment in the Eastern and Western parts of the United States.



Maps from airport visual data show the amount of summertime haze (visibility impairment). Haze in the Eastern United States increased significantly between 1970 and 1980 and decreased slightly between 1980 and 1990.



Great Smoky Mountains National Park under a range of visibility conditions.

Programs to Improve Visibility: EPA proposed a new regional haze program in 1997 to address visibility impairment in national parks and wilderness areas caused by numerous sources located over broad regions. When finalized, the program will lay out a framework within which states develop implementation plans to achieve "reasonable progress" toward the national visibility goal of remedying any existing and preventing any future human-caused impairment. These plans will include emission management strategies to improve visibility over time in national parks, particularly for the worst visibility days. States will be required to periodically track progress and revise any strategies as necessary. Because fine particles are frequently transported hundreds of miles, pollution that occurs in one state may contribute to the visibility impairment in another state. Thus, to effectively address the regional haze problem, states are encouraged to coordinate with each other in developing strategies to improve visibility and to comply with the PM-2.5 and ozone NAAQS.

Other air quality programs are expected to lead to emission reductions that will improve visibility in certain regions of the country. The Acid Rain Program is designed to achieve significant reductions in SO_x emissions, which is expected to reduce sulfate haze, particularly in the Eastern United States. Additional control programs on sources of NO_x to reduce formation of ozone can also improve regional visibility conditions. In addition, programs, such as the national ambient air quality standards, controls on diesel-powered mobile sources, and programs to improve wood stove efficiency can benefit areas adversely impacted by visibility impairment.

	West	East
Sulfates	**25-65%**	**>60%**
Organic Carbon	**15-35%**	**10-15%**
Nitrates	**5-45%**	**10-15%**
Elemental Carbon (soot)	**15-25%**	**10-15%**
Crustal Material (soil dust)	**10-20%**	**10-15%**

Pollutants that contribute to visibility impairment in the eastern and western parts of the United States. Sulfates are generally the largest contributor in both the East and the West.

Toxic Air Pollutants

Nature and Sources: Toxic air pollutants are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The Clean Air Act requires EPA to address 188 toxic air pollutants. Examples of toxic air pollutants include benzene, found in gasoline; perchloroethylene, emitted from some dry cleaning facilities; and methylene chloride, used as a solvent and paint stripper by a number of industries. Some air toxics are released from natural sources such as volcanic eruptions and forest fires. Most, however, originate from human-made sources, including both mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants).

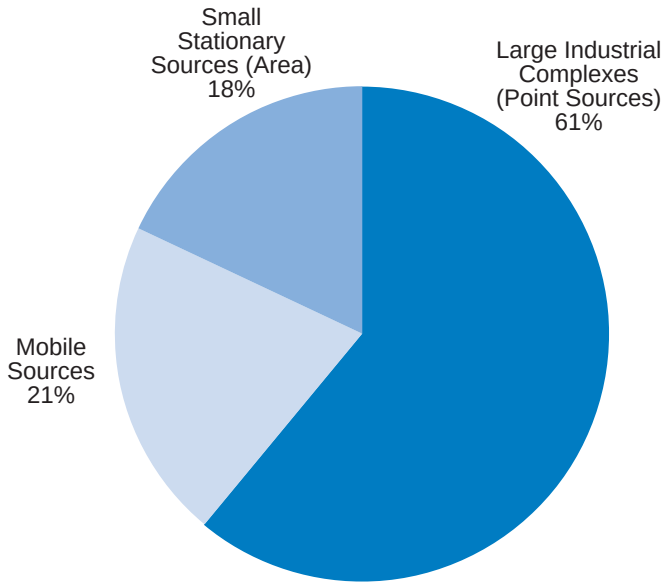
Health and Environmental Effects: People exposed to toxic air pollutants at sufficient concentrations and for sufficient durations have an increased chance of getting cancer or experiencing other serious health effects. These health effects can include damage to the immune system, as well as neurological, reproductive (i.e., reduced fertility), developmental, respiratory and other health problems. Some toxic air pollutants pose particular hazards to people at a certain stage in life, such as young children or the elderly. Some health problems occur very soon after a harmful exposure. Health effects associated with long-term exposures to toxic air pollutants, however, may develop slowly over time or not appear until many months or years after the initial exposure.

Toxic pollutants in the air or deposited on soils or surface waters can have a number of environmental impacts. Like humans, animals experience health problems if exposed to sufficient concentrations of air toxics over time. Persistent toxic air pollutants that can accumulate in plants and animals are of particular concern in aquatic ecosystems because the pollutants accumulate in tissues of animals, magnifying up the food chain to levels many times higher than in the water. Toxic pollutants that disrupt the endocrine system also pose a threat. In some wildlife, for example, exposures to pollutants such as DDT, dioxins, and mercury have been associated with decreased fertility, decreased hatching success, damaged reproductive organs, and altered immune systems.

Program Structure: Control of toxic air pollutants differs from the control of the six principal pollutants for which EPA has established national air quality standards. For the six principal pollutants, the Clean Air Act requires states to develop plans to meet the national air quality standards by specific deadlines. In contrast, for toxic air pollutants, the Act requires EPA to have a two-phased program. The first phase consists of identifying the sources of toxic pollutants and developing technology-based standards to significantly reduce their emissions. The second phase consists of strategies and programs for evaluating the remaining risks and ensuring that the overall program has achieved substantial reduction in risks to public health and the environment. The objective is to ensure that on a national basis sources of toxic air pollution are well controlled and that risks to public health and the environment are substantially reduced.

In addition, the toxic air pollutant program is important in reducing highly localized emissions near industrial sources and in controlling pollutants that are toxic even when emitted in small amounts. Companies handling extremely hazardous chemicals are required by EPA to develop plans to prevent accidental releases and to contain any releases in the event they should occur.

1993 National Toxic Air Pollutant Emissions by Source



According to National Toxics Inventory data, smaller stationary sources account for 18 percent of U.S. toxic emissions, mobile sources account for 21 percent, and larger industrial sources for 61 percent.

Trends in Toxic Air Pollutants: EPA is using the National Toxics Inventory (NTI) to track nationwide emissions trends for toxic air pollutants listed in the Clean Air Act. The NTI includes emissions information for 188 hazardous air pollutants from more than 900 stationary sources based on a 1993 survey. There are approximately 8.1 million tons of air toxics released to the air each year according to NTI. As illustrated in the chart, NTI includes emissions from large industrial or "point" sources, smaller stationary sources called "area" sources, and mobile sources. The NTI estimates of the large point source and mobile source contributions to the national emissions of toxic air pollutants are approximately 61 and 21 percent, respectively.

Currently, EPA has issued 27 air toxics emissions standards under the first (technology-based) phase of the regulations program. These standards affect 52 categories of major industrial sources, such as chemical plants, oil refineries, aerospace manufacturers, and steel mills, as well as eight categories of smaller sources, such as dry cleaners, commercial sterilizers, secondary lead smelters, and chromium electroplating facilities. EPA has also issued two standards to control emissions from solid waste combustion facilities. Together these standards reduce emissions of over 100 different air toxics. When fully implemented, these standards will reduce air toxics emissions by about 1 million tons per year - almost ten times the reductions achieved prior to 1990. In addition, controls for toxic air pollutants will also reduce VOC and PM emissions by more than 2.5 million tons per year over the same time period.

EPA is now moving into the second (risk-based) phase of the regulatory program. EPA has recently published a draft integrated strategy that will address cumulative risks from multiple sources (both stationary and mobile) of toxic pollutants and from combined exposures of these pollutants in urban areas.

EPA collects data through its Photochemical Assessment Monitoring Stations (PAMS) program on concentrations of ozone and its precursors in 22 areas across the nation with the most significant ozone problems. The PAMS program requires routine measurement of ten pollutants that contribute to ozone formation and which also are toxic air pollutants: acetaldehyde, benzene, ethyl benzene, formaldehyde, hexane, styrene, toluene, m/p-xylene, o-xylene, and 2,2,4-trimethylpentene. Preliminary analysis of the monitoring data indicates that concentrations of some of these toxic VOC in the areas monitored are declining. Monitoring networks now being set up will provide more toxics data in the future.

Stratospheric Ozone

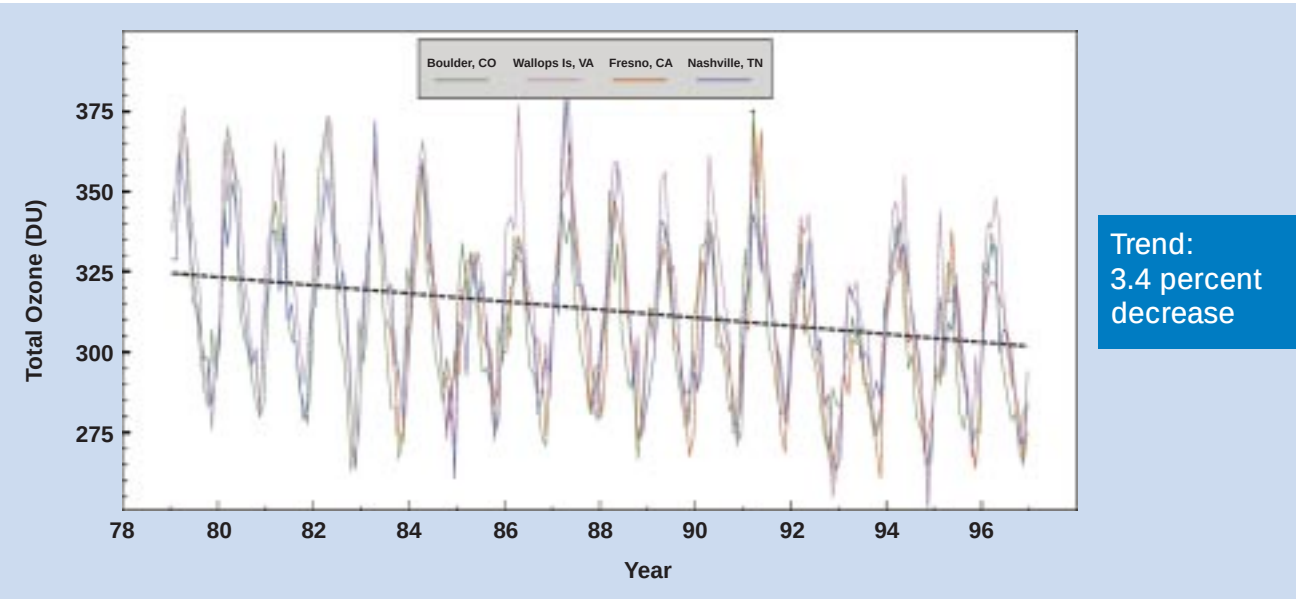
Nature and Sources of the Problem: The stratosphere, located about 6 to 30 miles above the Earth, contains a layer of ozone gas that protects living organisms from harmful ultraviolet radiation (UV-b) from the sun. Over the past two decades, however, this protective shield has been damaged. Each year, an "ozone hole" forms over the Antarctic, and ozone levels fall to 70 percent below normal. Even over the United States, ozone levels are about 5 percent below normal in the summer and 10 percent below normal in the winter. The trend line in the figure below shows a 3.4 percent decrease per decade in average total ozone over Northern Hemisphere mid-latitudes since 1979.

As the ozone layer thins, more UV-b radiation reaches the Earth. In 1996, scientists demonstrated for the first time that UV-b levels over most populated areas have increased. Scientists have linked several substances associated with human activities to ozone depletion, including the use of chlorofluorocarbons (CFCs), halons, carbon tetrachloride, and methyl chloroform. These chemicals are emitted from home air conditioners, foam cushions, and many other products. Strong winds carry them through the lower part of the atmosphere, called the troposphere, and into the stratosphere. There, strong solar radiation releases chlorine and bromine atoms that attack protective ozone molecules. Scientists estimate that one chlorine atom can destroy 100,000 ozone molecules.

Health and Environmental Effects: Some UV-b radiation reaches the Earth's surface even with normal ozone levels. However, because the ozone layer normally absorbs most UV-b radiation from the sun, ozone depletion is expected to lead to increases in harmful effects associated with UV-b radiation. In humans, UV-b radiation is linked to skin cancer, including melanoma, the form of skin cancer with the highest fatality rate. It also causes cataracts and suppression of the immune system.

The effects of UV-b radiation on plant and aquatic ecosystems are not well understood. However, the growth of certain food plants can be slowed by excessive UV-b radiation. In addition, some scientists suggest that marine phytoplankton, which are the base of the ocean food chain, are already under stress from UV-b radiation. This stress could have adverse consequences for human food supplies from the oceans. Because they absorb CO_2 from the atmosphere, significant harm to phytoplankton populations could increase global warming (see following section on Global Warming and Climate Change).

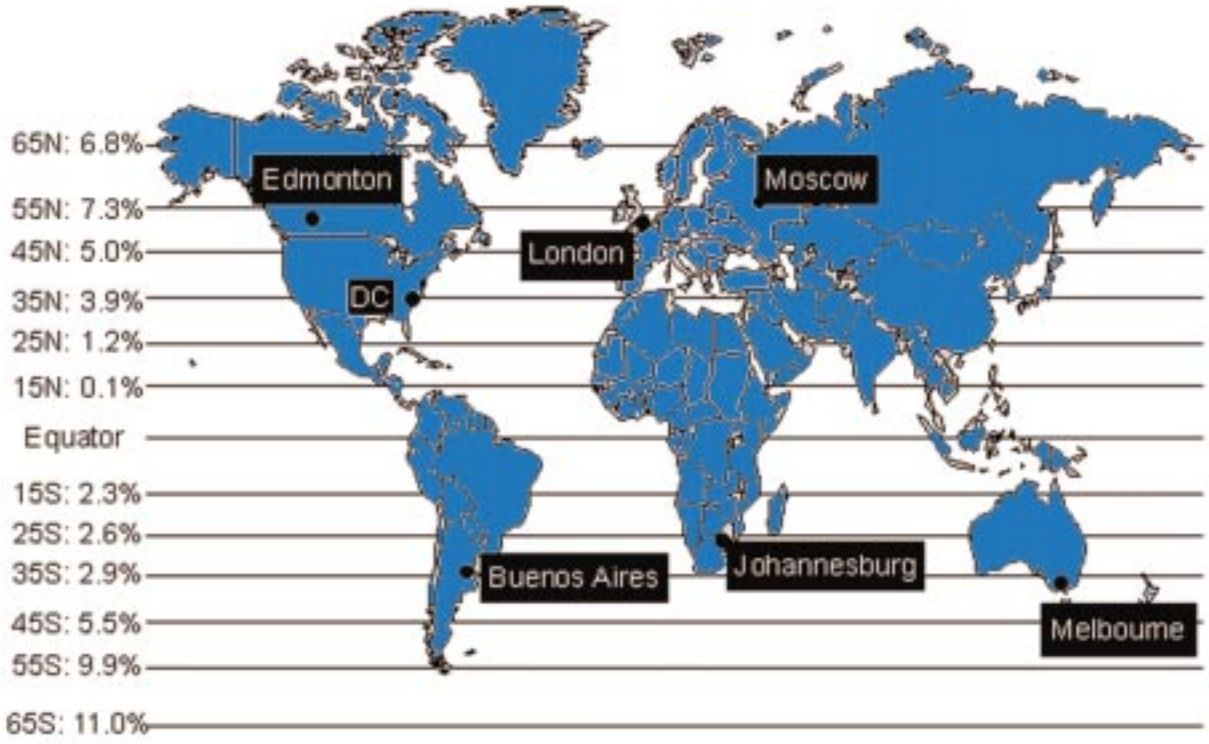
Programs to Restore the Stratospheric Ozone Layer: In 1987, 27 countries signed the Montreal Protocol, a landmark treaty that recognized the international nature of ozone depletion and committed the world to limiting the production of



Source: National Oceanic and Atmospheric Administration, 1998.

Monthly average total ozone measured in Dobson Units (DU) at four mid-latitude stations across the United States from 1979 to 1997. The trend line shows a 3.4 percent decrease in average total ozone over mid-latitudes in the United States since 1979. The large annual variation shown in each of the four cities is a result of ozone transport processes which cause increased levels in the winter and spring and lower ozone levels in the summer and fall at these latitudes.

UV-b Radiation Increases by Latitude



A 1996 study using satellite-based analyses of UV-b trends demonstrated that UV-b levels had increased at ground level. This figure shows the percent increases in average annual UV-b reaching the surface over the past 10 years. UV-b incidence is strongly dependent on latitude. At latitudes that cover the United States, UV-b levels are 4 to 5 percent higher that they were 10 years ago.

ozone-depleting substances. Today, over 160 nations have signed the Protocol, which has been strengthened four times and now calls for the elimination of those chemicals that deplete ozone.

The 1990 Clean Air Act Amendments established a U.S. regulatory program to protect the stratospheric ozone layer. In January 1996, U.S. production of many ozone-depleting substances virtually ended, including CFCs, carbon tetrachloride, and methyl chloroform. Production of halons ended in January 1994. Many new products that either do not affect or are less damaging to the ozone layer are now gaining popularity. For example, computer-makers are using ozone-safe solvents to clean circuit boards, and automobile manufacturers are using HFC-134a, an ozone-safe refrigerant, in new motor vehicle air conditioners. In some sectors, the transition away from ozone-depleting substances has already been completed. EPA is also emphasizing new efforts like the UV Index, a daily forecast of the strength of UV radiation people may be exposed to outdoors, to educate the public about the health risks of overexposure to UV radiation and the steps they can take to reduce those risks.

Trends in Stratospheric Ozone Depletion: Scientific evidence shows that the approach taken under the Montreal Protocol has been effective. In 1996, measurements showed that the tropospheric concentrations of methyl chloroform had started to fall, indicating that emissions had been greatly reduced. Tropospheric concentrations of other ozone-depleting substances, like CFCs, are also beginning to decrease. It takes several years for these substances to reach the stratosphere and release chlorine and bromine. For this reason, stratospheric chlorine levels are expected to continue to rise, peak by the year 2000, and then slowly decline. Because of the stability of most ozone-depleting substances, chlorine will be released into the stratosphere for many years, and the ozone layer will not fully recover until well into the next century.

In 1996, scientists developed a new technique allowing them to draw conclusions about UV-b radiation at ground level. According to satellite-based trend analyses, major populated areas have experienced increasing UV-b levels over the past 15 years. As shown by the figure above, at latitudes that cover the United States, UV-b levels are 4 to 5 percent higher than they were 10 years ago.

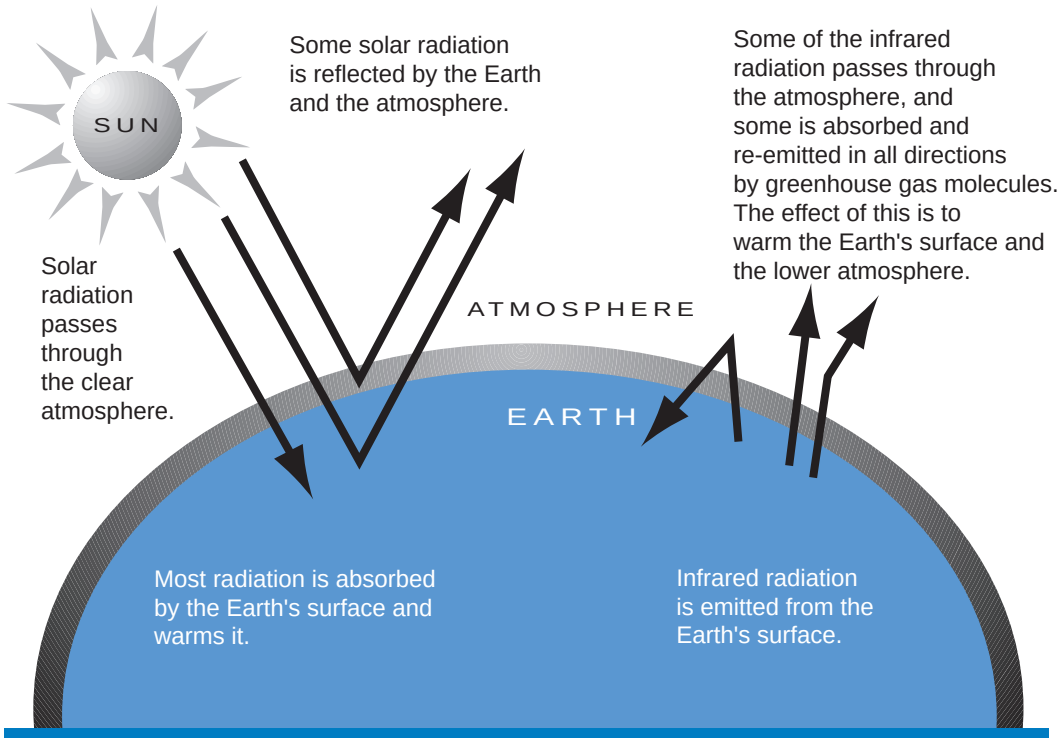
Global Warming and Climate Change

Nature and Sources: The Earth's climate is fueled by the Sun. Most of the Sun's energy, called solar radiation, is absorbed by the Earth, but some is reflected back into space. A natural layer of atmospheric gases absorbs a portion of this reflected solar radiation, eventually releasing some of it into space, but forcing much of it back to Earth. There it warms the Earth's surface creating what is known as the natural "greenhouse effect," as illustrated in the diagram below. Without the natural greenhouse effect, the Earth's average temperature would be much colder, and the planet would be covered with ice.

Recent scientific evidence shows that the greenhouse effect is being increased by release of certain gases to the atmosphere that cause the Earth's temperature to rise. This is called "global warming." Carbon dioxide (CO_2) accounts for about 85 percent of greenhouse gases released in the United States. Carbon dioxide emissions are largely due to the combustion of fossil fuels in electric power generation. Methane (CH_4) emissions, which result from agricultural activities, landfills, and other sources, are the second largest contributor to greenhouse gases in the United States.

Industrial processes such as foam production, refrigeration, dry cleaning, chemical manufacturing, and semiconductor manufacturing produce other greenhouse gas emissions, such as hydrofluorocarbons (HFCs). Smelting of aluminum produces another greenhouse gas called perfluorinated compounds (PFCs). Emissions of NO_x and VOC from automobile exhaust and industrial processes contribute to the formation of ground-level ozone or smog, also a greenhouse gas.

The Greenhouse Effect



Source: U.S. Department of State, 1992

The greenhouse effect is being accelerated by releases of certain gases to the atmosphere that are causing the Earth's temperature to rise.

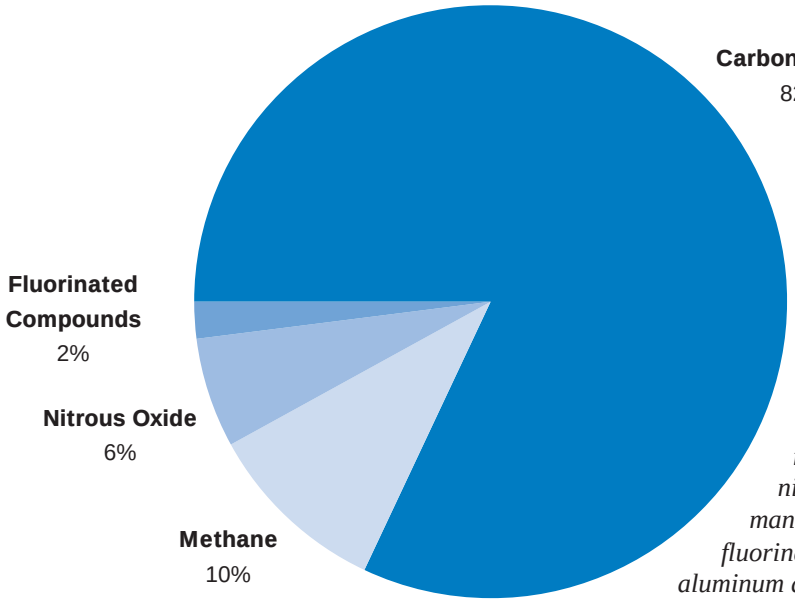
Health and Environmental Effects: Greenhouse gas emissions could cause a 1.8° to 6.3° Fahrenheit rise in temperature during the next century, if atmospheric levels are not reduced. Although this change may appear small, it could produce extreme weather events, such as droughts and floods; threaten coastal resources and wetlands by raising sea level; and increase the risk of certain diseases by producing new breeding sites for pests and pathogens. Agricultural regions and woodlands are also susceptible to changes in climate that could result in increased insect populations and plant disease. This degradation of natural ecosystems could lead to reduced biological diversity.

International Developments: In 1988, the Intergovernmental Panel on Climate Change (IPCC) was formed to assess the available scientific and economic information on climate change and formulate response strategies. In 1995, the IPCC published a report representing the work of more than 2,000 of the world's leading scientists. The IPCC concluded that humans are changing the Earth's climate, and that "climate change is likely to have wide-ranging and mostly adverse impacts on human health, with significant loss of life."

In 1992, 150 countries signed the "Framework Convention on Climate Change" (FCCC), which has the objective of stabilizing the concentration of greenhouse gases in the atmosphere at levels that would prevent dangerous interference with the climate system. Under the FCCC, industrialized countries agreed to aim to reduce greenhouse gas emissions to 1990 levels by the year 2000. It now appears that most industrialized countries, including the United States, will not meet this target. In light of the 1995 scientific findings of the IPCC and the continued rise in greenhouse gas emissions, parties to the FCCC formulated the "Kyoto Protocol" at a 1997 conference held in Kyoto, Japan. The Kyoto Protocol includes greenhouse gas emission targets for industrialized countries for the period of 2008-2012. The average reduction target for all industrialized countries for this period is 5 percent below 1990 emission levels. The reduction target varies across countries to account for differing circumstances, with the United States' target being a 7 percent reduction below 1990 levels. The Kyoto Protocol also provides for market-based measures, such as international emissions trading, to help countries meet their commitments at the lowest possible cost. (The U.S. Administration will seek the Senate's consent for ratification of the Kyoto Protocol after working for further progress on the details of the market mechanisms and on the involvement of key developing countries.)

U.S. Programs to Mitigate Climate Change: The United States adopted a Climate Change Action Plan (CCAP) in 1993 to reduce greenhouse gas emissions. Thousands of companies and nonprofit organizations are working together to effectively reduce their emissions. The Plan involves more than 40 programs implemented by EPA, the Department of Energy, the Department of Agriculture, and other government agencies. In 1997, these voluntary programs reduced greenhouse gas emissions by more than 15 million tons of carbon, while partners saved over $1 billion from energy bill savings.

1996 Greenhouse Gas Emissions



1996 total greenhouse gas emissions rose 9.5 percent from 1990 baseline levels. The major contributor to these emissions is carbon dioxide (CO_2) from fossil fuel combustion. Other contributors include methane gas (CH_4) from landfills, fermentation, natural gas systems, and coal mining; nitrous oxide (N_2O) from agricultural management and mobile sources, and fluorinated compounds from such processes as aluminum and magnesium production and electrical transmission and distribution systems.

Conclusion

The Clean Air Act has been the impetus for many improvements in the quality of the air in the United States. Scientific and international developments continue to have an effect on the air pollution programs that are implemented by the U.S. Environmental Protection Agency. New data helps identify sources of pollutants and the properties of these pollutants. Although much progress has been made to clean up our air, work must continue to ensure steady improvements in air quality, especially because our lifestyles create more pollution sources. Many of the strategies developed by EPA have been adopted by state, local, and Tribal governments as well as business and industry. Air quality improvements are the result of partnerships with government, industry, and the public.

For further information:

National Air Pollutant Emission Trends, 1900-1997
Call: (919) 541-5285
Internet: http://www.epa.gov/oar/oaqps/efig

National Air Quality and Emissions Trends Report, 1997 (EPA-454/R-98-016)
Call: (919) 541-5558
Internet: http://www.epa.gov/oar/aqtrnd97

This brochure is available on the Internet at:
http://www.epa.gov/oar/aqtrnd97/brochure

Acid Rain Hotline: (202) 564-9620

Energy Star (Climate Change) Hotline: (888) STAR-YES

Mobile Sources National Vehicles and Fuel Emissions Lab: (734) 214-4200

Stratospheric Ozone Hotline: (800) 296-1996

Acronyms

Principal Pollutants:

CO ..... Carbon Monoxide
Pb ..... Lead
NO_2, NO_x ..... Nitrogen Dioxide, Nitrogen Oxides
O_3 ..... Ozone
PM-10 ..... Particulate Matter (10 micrometers in diameter or less)
PM-2.5 ..... Particulate Matter (2.5 micrometers in diameter or less)
SO_2, SO_x ..... Sulfur Dioxide, Sulfur Oxides

Other Pollutants:

CFCs ..... Chlorofluorocarbons
CH_4 ..... Methane
CO_2 ..... Carbon Dioxide
HFCs ..... Hydrofluorocarbons
N_2O ..... Nitrous Oxide
PFCs ..... Perfluorinated Carbons
VOC ..... Volatile Organic Compounds

Other Acronyms:

DU ..... Dobson Unit(s)
EPA ..... Environmental Protection Agency
FCCC ..... Framework Convention on Climate Change
IPCC ..... Intergovernmental Panel on Climate Change
NAAQS ..... National Ambient Air Quality Standard
NTI ..... National Toxics Inventory
PAMS ..... Photochemical Assessment Monitoring Stations
ppm ..... parts per million
$\mu g/m^3$ ..... micrograms per cubic meter
UV-b ..... Ultraviolet radiation

United States
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