

The CLEAN AIR Act

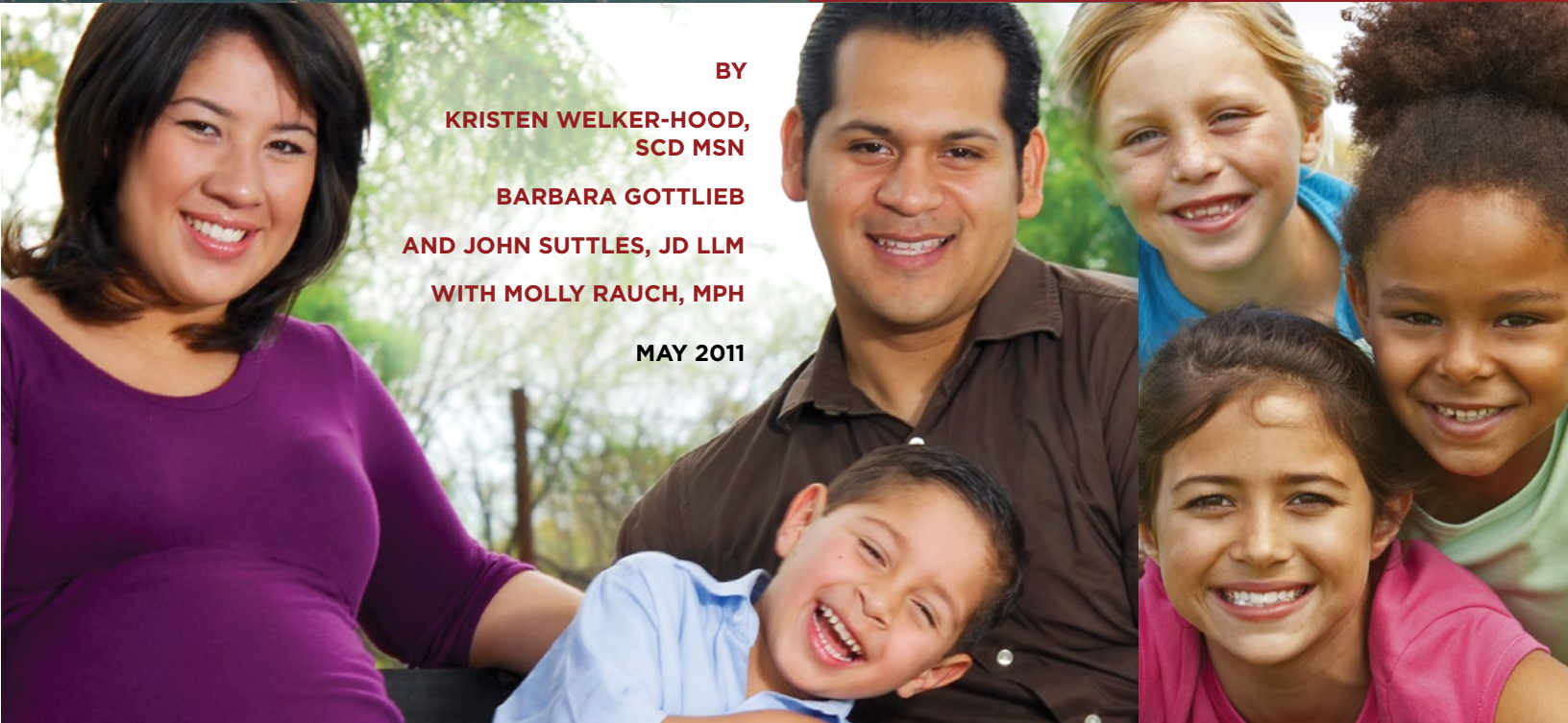
A Proven Tool for Healthy Air



A REPORT FROM

PHYSICIANS FOR SOCIAL

RESPONSIBILITY



BY

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ACKNOWLEDGMENTS

The authors gratefully acknowledge the assistance of the following people who helped make this report possible:

William Snape III, JD of the Center for Biological Diversity read an early draft and provided invaluable input. Jared Saylor and Brian Smith of Earthjustice also read the text and offered suggestions. David Schneider, Shoko Kubotera and Tony Craddock Jr., PSR interns, provided much-appreciated research assistance; David also collaborated on the writing. Finally, we thank the Energy Foundation, Compton Foundation, Marisla Foundation and Earthjustice for their generous financial support.

Any errors in the text are, of course, entirely our own.

For an electronic copy of this report, please see:

www.psr.org/resources/clean-air-act-report.html

ABOUT PHYSICIANS FOR SOCIAL RESPONSIBILITY

PSR has a long and respected history of physician-led activism to protect the public's health. Founded in 1961 by a group of physicians concerned about the impact of nuclear proliferation, PSR shared the 1985 Nobel Peace Prize with International Physicians for the Prevention of Nuclear War for building public pressure to end the nuclear arms race. Today, PSR's members, staff, and state and local chapters form a nationwide network of key contacts and trained medical spokespeople who can effectively target threats to global survival. Since 1991, when PSR formally expanded its work by creating its environment and health program, PSR has addressed the issues of global warming and the toxic degradation of our environment. PSR presses for policies to curb global warming, ensure clean air, generate a sustainable energy future, prevent human exposures to toxic substances, and minimize toxic pollution of air, food, and drinking water.

MAY 2011

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Executive Summary



Since Congress created the Clean Air Act in 1970, it has proven to be one of the nation's most important tools for improving public health. Air pollution from industrialization, motor vehicles, and fossil fuel combustion is pervasive across America, and millions of Americans suffer death and debilitating illnesses as a result: respiratory illnesses, heart attacks, strokes, cancer, birth defects, mental retardation, and more.

The Clean Air Act, by reducing emissions from many of the worst sources of air pollution, has dramatically improved air quality. In so doing it has prevented hundreds of thousands of premature deaths and reduced disease and suffering for millions of people. Yet despite that resounding history of achievement, we as a nation still face major opportunities and challenges for improving air quality and public health. A fully implemented Clean Air Act remains our best tool for making those improvements.

HOW THE CLEAN AIR ACT WORKS

The Clean Air Act combines several distinct approaches in order to prevent air pollution at the source. For six harmful air pollutants that are found widely across the U.S.—particulate matter, ground-level ozone, nitrogen oxides, sulfur dioxide, carbon monoxide and lead—the Act requires the EPA to establish National Ambient Air Quality Standards, or NAAQS. These standards identify the allowable concentration of each of these pollut-



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ants in the atmosphere. The 50 states then develop their own strategies for implementing the NAAQS standards. Pollutants subject to the NAAQS are known as “criteria pollutants” because the EPA sets the standards using science-based guidelines (criteria) reflecting these substances’ damaging impacts on human health and the environment.

The Clean Air Act also establishes a category of hazardous air pollutants, commonly abbreviated as HAPs and referred to as “toxic air contaminants” or “air toxics.” These are 188 pollutants and chemical groups known or suspected to cause serious health effects including cancer, birth defects, and respiratory tract and neurologic illness, even when exposure levels are low. Because HAPs are so potent, the EPA must address all categories of major air toxics sources and develop highly protective control standards for each category.

Finally, the Act sets operating standards for certain categories of major polluters. These include stationary sources of pollution, such as power plants and factories, and mobile sources such as cars, trucks and trains. Stationary sources are subject to different requirements depending on whether they are located in areas in compliance with the NAAQS standards or in non-compliance areas. Controls over stationary sources may include permitting requirements to assure clean functioning, as well as offset requirements to reduce emissions of criteria pollutants from other sources. Because mobile sources move readily across state lines, the EPA has near-exclusive authority over them. To control mobile sources, EPA sets vehicle performance standards and operates a fuel regulation program.

A HISTORY OF SUCCESS

The Clean Air Act has demonstrated dramatic success over its 40-year history. Its success is visible in improvements to air quality and in the decreased cases of morbidity and mortality resulting from reduced air pollution. The pollution controls put in place by 1990 led to major decreases in ambient criteria pollutant concentrations, compared to the levels that would have been expected without implementation of the Act. The greatest reductions were achieved through requiring power plants and industries to install smokestack scrubbers to capture sulfur dioxide and filters to capture particulates; switching to lower-sulfur fuels, and installing catalytic converters to reduce nitrogen oxide emissions from vehicles.

The number of lives saved and poor health outcomes averted by the Clean Air Act are estimated to be substantial. A recent EPA assessment determined that in 2010, the Act and its 1990 amendments prevented 160,000 premature deaths due to fine particulate matter alone; in 2020, the estimated number of lives saved will rise to 230,000. Reductions in particulate pollution are projected to prevent as many as 200,000 heart attacks and 2.4 million asthma attacks in 2020. Reduction of ozone pollution has reduced hospital admissions, emergency room visits, restricted-activity days, and days lost at school and work.

There is another yardstick by which this legislation can be measured: The Clean Air Act has also proven to be an excellent investment in economic terms. Cost-benefit analysis demonstrates that the dollars saved from reduced illnesses, hospital admissions, and lost days from work and school have greatly exceeded the costs associated with reducing air pollution. The EPA estimates a return of \$30 in benefits for every one dollar spent on implementation of pollution controls by 2020. By a similar token, the Act succeeded in reducing air pollution while the nation’s population and economy both grew. Clean Air Act regulations have also spurred technological innovation, generating jobs and economic growth. The successes of the Clean Air Act have shown that protection of health and economic growth can and do work hand in hand.

Finally, a success of a different sort: The Clean Air Act was enacted in nonpartisan fashion, with leadership from both sides of the aisle, under multiple administrations, both Republican and Democrat. Lawmakers clearly recognized that the goal of improving America’s health was a shared interest, far more important than the differences that sometimes hinder policy-making.

FUTURE OPPORTUNITIES FOR CLEANER AIR, GREATER BENEFITS

Even as the benefits of the Act accrue, ambient concentrations of several pollutants are still too high to adequately protect the American people, especially children, the elderly, those



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living in highly polluted communities, and those with chronic health problems. Some 127 million people live in areas of the country that are in non-attainment for at least one or more NAAQS. Additionally, according to EPA estimates, breathing air toxics over a lifetime of exposure contributes to nearly 30 percent of overall cancer risk in the U.S. Some regions in the U.S. are even more heavily affected, with two million (one in 10,000) people facing increased lifetime cancer risk from air toxics exposure. These risks far overshoot EPA's "acceptable" risks goal of one in a million and highlight the need to control pollutant emissions more effectively.

Two criteria pollutants stand out as in need of immediate strengthening of pollution controls. Fortifying the standards for ground-level ozone should be a top priority. When EPA last revised the ozone standard in 2008, it disregarded the recommendations of its own panel of expert scientists and physicians, the Clean Air Scientific Advisory Committee, which advised that the maximum limit for ambient ozone concentrations be lowered from 84 parts per billion (ppb) to a range between 60 to 70 ppb measured as an 8-hour average. Instead, EPA proposed a limit of 75 ppb. To protect public health, the EPA should set the ozone standard at the most health-protective level of 60 ppb immediately.

Particle emissions are likewise in urgent need of stronger regulations. Fine particulate matter (particles smaller than 2.5 microns in diameter, called $PM_{2.5}$) poses a significant cardiovascular risk and contributes to heart attacks, strokes, heart failure, and irregular heartbeats. The current $PM_{2.5}$ standards were last revised in 2006 but are not stringent enough to protect public health. EPA was scheduled to propose new national limits (standards) for $PM_{2.5}$ in February 2011, but had not done so as of mid-April.

A HEALTH IMPERATIVE

The U.S. medical and health community has supported federal action for clean air for over half a century. Cognizant that clean air to breathe is essential to America's health, groups such as the American Medical Association, American Public Health Association, American Academy of Pediatrics, and Physicians for Social Responsibility continue to press for robust, proactive and nationally uniform protection from deadly air pollutants. The Clean Air Act is our best tool to that end. It is essential that we safeguard the Clean Air Act from political maneuvering. It is a public health law that is a proven life-saver, and its job—and its benefits to the American people—are still far from complete.

1. America's Urgent Need for Clean Air



INTRODUCTION

Dangerous air pollutants damage our health from before we are born through our final days. Such pollutants as particulate matter, nitrous oxides, sulfur dioxide, ozone, heavy metals and other air toxics inflict irreparable harm on our airways, lungs, heart and circulatory systems, undermining all our major organ systems. Air pollutants increase hospitalizations and emergency room visits, time lost from school and work, and premature deaths due to cardiopulmonary disease. In fact, air pollution contributes to four of the five leading causes of mortality in the United States: heart disease, cancer, stroke, and chronic lower respiratory diseases.¹

To curb the rising incidence of these diseases, we must reduce the pollutants that contribute to their development and exacerbation. That means controlling emissions of pollutants from the dirtiest and most widespread sources: coal-fired power plants, motor vehicles, heavy industry, and refineries. The Clean Air Act (CAA) is the most effective tool we have to accomplish this goal. It allows communities across the U.S. to combat multiple pollutants at their source, resulting in significant protections for human health. The CAA is designed to establish science-based pollution mitigation strategies that will safeguard public health, protect our most vulnerable individuals, and assure environmental quality for future generations. The Act has been highly successful in achieving these goals.

Its passage paved the way for monumental gains in public health, including major reductions in blood lead levels nationwide and reductions in premature deaths, illnesses and hospitalizations stemming from air pollution exposure.

This report reviews the role the CAA has played in health promotion and disease prevention over the past 40 years. It reviews the context in which the CAA was created, the methods by which it regulates pollutants, its successes in protecting health, and the challenges it faces for controlling the air pollutants of today. The report begins by examining the air pollution calamities that revealed to the nation the depth of its air pollution problem and prompted a powerful national response.

AIR POLLUTION CALAMITIES LEAD TO THE CLEAN AIR ACT

Air pollution isn't a new problem; throughout history there have been accounts of large cities plagued by "heavy air" and acrid odors. In the industrial age, with coal feeding the fires of the industrial revolution, air toxics joined the mixture of urban pollutants. Today, emissions from the combustion of coal and oil have been joined by a multitude of toxic air pollutants, including gasoline and diesel fuels, heavy metals, asbestos, solvents, paint strippers, and persistent organic pollutants, among others. Despite the dangers to health from this chemical stew, it took decades of air pollution tragedies to spur adequate action for air pollution controls.



PITTSBURGH POST-GAZETTE

Noontime smog on a street in Donora, PA, 1948

One of the earliest documented air pollution tragedies occurred in Belgium in 1930. A five-day fog and temperature inversion trapped cold air close to the earth, preventing air circulation and causing a tremendous build-up of smoke and other contaminants from nearby industries. The result of this toxic accumulation was 60 deaths and over 6,000 illnesses.² While there had been earlier accounts of illness and premature death associated with fogs in other cities of the world (such as in Glasgow and London), the Meuse River Valley event was the first case in which increased incidence of morbidity and mortality was directly associated with air pollution.³ The U.S. experienced a similar tragic event in 1948, when a temperature inversion cap occurred in a river valley near the small industrial town of Donora, Pennsylvania, trapping air pollution from a local zinc smelter for five days. The first documented U.S. air pollution disaster, it killed 20 people and caused 6,000 of the town's 14,000 residents to fall ill.⁴

In 1952, air pollution created the first large-scale disaster. The trade winds that normally carried away London's air pollution died down, allowing a "killer fog" to set in. The combination of fog and coal smoke was so intense that people were forced to breathe through cloth masks to protect their burning throats and lungs, and visibility was so reduced that people had to feel their way down the sidewalk. Four thousand people died as a result of this event, including the elderly, the young, and

those with respiratory problems. A similar incident occurred in 1956. This led to the establishment in England of stringent air pollution laws including the Clean Air Acts of 1956 and 1968⁵ that required relocating power stations outside cities, increasing stack heights, fuel switching to cleaner fuel, and banning black smoke. These statutes greatly decreased the smoke that was able to accumulate during fog inversion caps, making London's "killer smog" a thing of the past.

Large industrial cities in the U.S. such as Pittsburgh, St. Louis, New York and Los Angeles suffered their own deadly bouts of smog. West Coast cities witnessed a new kind of air pollution on hot, sunny days. This pollution hung over cities as a thick brown haze, causing lung irritation and burning eyes. Los Angeles' poor air quality resulted from growing motor vehicle usage, waste incineration, maritime and rail shipping, and an increase in petrochemical and refinery activity. During the 1960s, New York's dangerous air pollution resulted in over 1,100 deaths, with additional cases of non-fatal illnesses.⁶

THE FIGHT FOR CLEAN AIR

The shocking morbidity and mortality caused by air pollution spurred the American public to demand action to clean up the air. Initially, air pollution control strategies in the U.S. relied on legal challenges such as common-law torts, public nuisance, private nuisance, trespass and liability lawsuits. Plaintiffs rarely won these cases because of the inherent difficulty in identifying a pollutant's source (since air pollutants can travel long distances), demonstrating harm (due to the latency periods of many diseases), and limitations in scientific knowledge regarding toxicants and related illnesses. Even when cases were successful, defendants were often paid a pittance of the real damages incurred, and the polluter was able to return to business as usual. Not surprisingly, this approach garnered only mediocre pollution controls, with the result that by the mid-1960s, states and local governments were stepping up to take control of air quality problems by passing local ordinances.⁷

The state-based approach, however, had its own weaknesses. The patchwork of pollution rules that emerged was inadequate to protect public health. Not only did protection of public health vary from state to state, but the states had no mechanism for regulating the sources of windborne pollution that blew in from neighboring jurisdictions. To aid the states' efforts and more effectively protect public health, the federal government began to pass a series of "clean air acts" establishing federal programs to control air pollution using nationwide

rules and standards. The timeline of these clean air acts and their regulatory scope is presented in Figure 1.

With each amendment to the original Clean Air Act of 1970, the regulation was enhanced to provide better solutions for controlling different types of pollutants from different sources. While considerable health improvements were achieved during the CAA of 1970, acid rain caused by Midwestern coal power plants burning high-sulfur coal was killing lakes and forests in the Northeast

Figure 1. Timeline of U.S. air pollution regulation and highlights of regulatory strengthening

Air Pollution Control Act	Clean Air Act	Air Quality Act	Clean Air Act Extension	Clean Air Act Amendments	Clean Air Act Amendments
1955	1963	1967	1970	1977	1990
<ul style="list-style-type: none"> • The first federal legislation involving air pollution. It recognized air pollution as a danger to public health and the environment. • Gave the Secretary of Health, Education and Welfare the power to undertake and recommend research programs for air pollution control. • Dedicated federal funds to support research and technical assistance for the states. • State and local governments maintained the authority to set air pollution laws, but reserved for Congress the right to act in the future. 	<ul style="list-style-type: none"> • The first Clean Air Act. It granted \$95 million dollars to state and local governments in order to research air monitoring and create pollution control programs. • Set emission standards for stationary sources such as power plants and steel mills. • Authorized research into techniques to minimize air pollution. • Motor Vehicle Air Pollution Act of 1965—an amendment of the CAA that established standards for automobile emissions. 	<ul style="list-style-type: none"> • Divided the nation into Air Quality Control Regions and initiated enforcement proceedings in areas subject to interstate air pollution so as to achieve consistent air quality. • Established a national emissions standard for stationary sources as opposed to regulating emissions by industry. • Authorized expanded studies of air pollutant emission inventories, ambient monitoring techniques, and control techniques. 	<ul style="list-style-type: none"> • Increased federal enforcement authority. • Authorized the development of comprehensive federal and state regulations to limit emissions from industrial stationary sources and mobile sources. • It set forth four major regulatory programs: <ol style="list-style-type: none"> 1. National Ambient Air Quality Standards (NAAQS); 2. State Implementation Plans; 3. New Source Performance Standards; 4. National Emission Standards for Hazardous Air Pollutants. 	<ul style="list-style-type: none"> • Authorized provisions related to prevention of significant deterioration (PSD), requiring areas with air quality better than the national standard to maintain their level of air quality. • Authorized provisions to NAAQS to establish a major permitting review requirement for areas unable to attain air quality standards. • Marked the first attempts to prevent the destruction of stratospheric ozone. 	<ul style="list-style-type: none"> • Established the Acid Rain Program to control sulfur dioxide and nitrogen oxides. • Created the emissions trading program (<i>the original cap & trade program</i>) to achieve air pollution reductions from stationary sources like coal-fired power plants. • Authorized a program to control 189 toxic air pollutants. • Added provisions requiring the phase-out of ozone-depleting chemicals. • Established Title V permit program requirements.

Sources: U.S. Environmental Protection Agency (2010, Nov.). *History of the Clean Air Act*. Retrieved April 18, 2011 from http://www.epa.gov/air/caa/caa_history.html#milestones

American Meteorological Society. (n.d.). *Clean Air Acts 1955, 1963, 1970 and 1990: a look at U.S. Air pollution laws and their amendments*. Retrieved April 18, 2011 from <http://www.ametsoc.org/sloan/cleanair/cleanairlegisl.html>

HEALTH COMMUNITY SUPPORT FOR THE CAA

One notable element in the effort to create clean air legislation was the growing support of the organized health and medical community, which has been visible for over half a century. As far back as 1955, the American Medical Association (AMA) testified before the U.S. Senate, applauding the idea of a coordinated national program to “stimulate the interest of local agencies” in air pollution control and supporting “limited federal funds” to support research activities in the field.¹² By the time the Air Quality Act of 1967 was introduced, the AMA was urging the federal government to take a preventive approach to air pollution, with a special emphasis on cleaner fuel and vehicles. The AMA also recognized that pollution was often an interstate problem and called for regional air quality commissions. While emphasizing action by local, state and regional jurisdictions, the AMA supported enactment of uniform national laws to control air pollution.¹³

Only a few years later, the AMA’s tone had become more urgent. In testimony before the U.S. Senate in 1970, it emphasized that air in the United States had grown more polluted and that hazards to health had increased. “We must take stronger action to reverse this direction... than we have taken in the past,” AMA urged. “Measures which a few years ago were deemed adequate... simply have not achieved the desired goals.”¹⁴

By 1975, the American Public Health Association and the American Lung Association had joined the AMA in testifying before Congress for clean air legislation. The AMA focused on the health impacts of air pollution, calling for additional research into the health impacts of prolonged exposure to low levels of air pollution, the impacts of simultaneous exposure to multiple pollutants, and the role of air pollution as a causative agent in diseases then on the rise: heart disease, stroke, chronic bronchitis and emphysema and cancer, especially lung cancer. It called the air quality standards and time schedules

contained in the CAA “necessary public health measures.”¹⁵

The American Public Health Association (APHA) chose to focus on the scientific validity of the then-current air quality standards. Much that is known about air pollution today was new at that time, since much of the research was conducted only after CAA air quality standards were promulgated. For example, the APHA testimony drew attention to the fact that sulfur dioxide and particulate matter, when inhaled together, created synergistic effects; that because fine particulate matter was so significant to health, pollution abatement measures that reduced coarse particulates might fulfill air quality standards without benefitting human health; and that studies had clarified the mechanisms by which carbon monoxide interfered with cardiac function. The APHA concluded that the available scientific evidence gave no grounds for relaxing air quality standards.¹⁶

In the wake of the 1974 oil shortage, the American Lung Association (ALA)’s testimony urged “that attempts to weaken (the CAA) under the guise of energy or economic need be rejected, and that the nation’s halting progress toward clean air be speeded up, not aborted.”¹⁷ It called for a robust program to desulfurize gasoline and for maximum sulfur dioxide emissions controls on stationary sources that burned fossil fuels. The ALA also opposed extending the deadlines for implementing air quality controls. And with prescience, it proposed an amendment to the CAA to allow the EPA to regulate any pollutants which were significantly related to serious health effects, including where sufficient scientific data was not yet available.

Today these and other national health organizations, such as Physicians for Social Responsibility and the American Academy of Pediatrics, continue to present the medical community’s consensus: that having clean air to breathe is essential to America’s health, and that a robust, fully implemented Clean Air Act is our best tool to that end.



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and Canada.⁸ In 1984 the Union Carbide disaster occurred in Bhopal, India, when a pesticide plant leaked forty tons of deadly methyl isocyanate gas, killing 3,000 people and damaging the health of over 100,000.⁹ This accident prompted U.S. citizens to worry just how safe their air at home was from toxic air chemicals. Congress investigated and determined that in the 14 years since the passage of the CAA of 1970, the EPA had recognized only five substances as toxic under the Act, leaving thousands of chemicals registered and in production yet unevaluated for safety. This finding led Congress to pass a right-to-know law that included a Toxic Release Inventory to assist communities in accessing valuable information about the types and amounts of chemicals released into their air.¹⁰

In 1989 George H.W. Bush became president and prioritized as a goal of his Administration the strengthening of the CAA to address Americans' concerns for both acid rain and air toxics.¹¹ President Bush submitted a bill to strengthen the Clean Air Act, which Congress then worked in

bipartisan fashion to add strengthening measures. Through a process of debate and public hearings, the result became the modern Clean Air Act Amendments of 1990.

Even this brief summary of the Clean Air Act's history underscores several significant points. First, real improvement to air quality occurred only after consistent federal standards were set for the whole nation. Because air pollution is mobile and does not stay within geographic boundaries, it was necessary to establish national air quality standards; preservation of downwind air quality depended on addressing interstate pollution. Second, the health and medical communities supported federal regulation of air pollutants and continue to do so today: They find it an essential component of safeguarding public health. Finally, in response to the growing evidence of air pollution's threat to health, various Congresses took action to create federal regulation of air pollution. This happened over the course of many years and multiple presidential administrations, yet was achieved in

essentially bipartisan fashion. The EPA was born during the tenure of President Richard Nixon, a Republican, and the Clean Air Act itself was repeatedly strengthened—as with the addition of the Clean Air Act Amendments in 1990—under both Republican and Democratic presidents.

COMMON BUT DEADLY: THE “CRITERIA” AIR POLLUTANTS

Since the nation launched its earliest attempts to regulate air pollution, scientific research has proceeded to identify and document the most common and most health-damaging air pollutants and has pinpointed many of their impacts on the human body. The EPA has flagged six pollutants as particularly widespread across the nation and harmful to both health and the environment. These six are: particulate matter, ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides, and lead. They are known as “criteria pollutants” because the EPA sets national air quality standards for their concentration in the atmosphere, using science-based guidelines (criteria) that reflect their impact on human health and the environment.

Criteria pollutants share two defining characteristics: They endanger public health and welfare, and they are widely present in the outside air, affecting much of the U.S. As a rule, criteria pollutants are emitted by multiple sources, commonly found, such as cars, diesel vehicles, coal-fired power plants and industrial facilities. In addition, rather than settling out of the air to form “hotspots” in the immediate vicinity around their source, these pollutants tend to disperse widely. For these reasons, effective regulation of criteria pollutants is done not on a source-by-source basis, but by monitoring their level in the atmosphere in every state and assuring that they remain at non-harmful levels. The health effects of the six criteria pollutants are summarized below; more information is presented in Figure 2 (on pages 14–15).

PARTICULATE MATTER: Particulate matter is one of the nation’s deadliest air pollutants. It causes or contributes to decreased pulmonary function;



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lower and upper respiratory diseases such as chronic and acute bronchitis; asthma and asthma exacerbations; heart attacks; strokes, and cancer. Particle pollution is also linked to low birth weight, premature birth, and sudden infant death. It is estimated that PM causes an estimated 60,000 premature deaths each year.

GROUND-LEVEL OZONE: Ozone, the major component of smog, is the most pervasive outdoor air pollutant in the U.S. It forms when pollutants released by cars, power plants and other sources react with sunlight and heat. In conjunction with particulate matter, ozone can cause and exacerbate respiratory problems. It is linked to lung cancer development and mortality and also harms the cardiovascular system.

NITROGEN OXIDES (NO_x): Nitrogen oxides are irritants to the eyes, nose, throat, and lungs. High levels of exposure can seriously damage tissues in the throat and upper respiratory tract. Nitrogen oxides are linked to respiratory disease and premature death.

SULFUR DIOXIDE (SO₂): Sulfur dioxide can cause breathing difficulty for people with asthma, while long-term exposure causes respiratory illness and aggravates cardiovascular diseases. It is linked to infant death, ischemic stroke, respiratory disease, and premature death. Its effects on infants include low birth weight, preterm birth, and increased risk of infant death.

CARBON MONOXIDE (CO): Carbon monoxide interferes with oxygen transport through the body by bonding with hemoglobin in the blood. CO exposure has been linked to death from cardiovascular effects, including stroke. People with pre-existing heart conditions, infants (who require more oxygen than adults) and pregnant women are particularly vulnerable to harm. Risks to fetuses, newborns, and children include birth defects, low birth weight, neonatal respiratory mortality, and asthma.

LEAD (Pb): Lead, a heavy metal, is highly neurotoxic. It damages kidney function as well as the nervous, immune, reproductive, developmental, and cardiovascular systems. In infants and young children it contributes to learning problems, behavioral problems, learning deficits, and decreased IQ. In adults it is linked to high blood pressure and heart disease.

AIR TOXICS

The six criteria pollutants may be the most widespread air pollutants in the nation, but they are far from the only dangerous ones. The EPA has also established a category of hazardous air pollutants, commonly abbreviated as HAPs and referred to as “toxic air contaminants” or “air toxics.” These are 188 pollutants and chemical groups known or suspected to cause serious health effects including reproductive dysfunction, developmental disabilities, birth defects, cancer, cardiovascular, respiratory tract and neurologic illness.¹⁸

The Clean Air Act directs the EPA to regulate HAPs, which include compounds such as polycyclic aromatic hydrocarbons, acrolein, and benzene, found in gasoline; solvents such as hexane and toluene; hexavalent chromium from chrome-plating facilities; perchloroethylene, which is emitted from some dry cleaning facilities; methylene chloride, which is used as a solvent and paint stripper by a number of industries; asbestos; metals such as mercury and cadmium; and persistent organic pollutants such as polychlorinated biphenyls. In 2001, diesel exhaust was listed as a mobile-source HAP.

Thirty-three of these compounds are included in a priority list of HAPs that are of special concern because of their widespread use and potential for causing cancer (carcinogenicity) and developmental malformations, especially in the fetus (teratogenicity).

Studies have found that estimated levels of some of the HAPs are a potential public health problem in many parts of the United States.^{19,20,21} Among them, benzene, formaldehyde, and 1,3-butadiene may contribute to extra cases of cancer (at least 1 extra case per million people exposed) in more than 90 percent of the census tracts in the lower 48 states of the U.S. Vehicles account for approximately half of HAPs emissions but may contribute to 88 percent of the added risk from HAPs.²² In general, the health risks from this broad category of air pollutants may be underestimated, because there is limited information on toxicity values for many of the HAPs,²³ and the risk models did not consider the greater vulnerability of children.

VULNERABLE POPULATIONS: MOST AFFECTED BY AIR POLLUTION

While air pollution is a problem that affects many Americans, some groups of people are more vulnerable than others. These groups are multiple and may be overlapping; they include people with respiratory ailments such as asthma, chronic bronchitis and emphysema; people with cardiovascular disease or diabetes; young children; the elderly, and the poor. When ambient air quality standards are set, special attention needs to be paid to ensure that the levels established are stringent enough to protect these vulnerable populations and not only those who are fully grown and in good health.

Children are especially vulnerable to the harmful effects of air pollution.^{24, 25, 26, 27, 28} Children’s ongoing lung development, incomplete metabolic systems, high infection rate, and behavioral traits like high activity levels and time spent outdoors make children more susceptible to harm from airborne pollutants.^{29, 30} Air pollution can also harm children before they are born. Intrauterine mortality has been linked to exposure to nitrogen oxides,

as well as to the synergistic effects of simultaneous exposure to nitrogen oxides, sulfur dioxide, and carbon monoxide.³¹ The developing fetal lung, as well as the infant lung, is more susceptible to injury by lung toxicants (including air pollutants), even at exposure levels below the official “no-effects level” for adults.³² These findings highlight the vulnerability of the 41.7 million children age 18 and under who live with dangerous levels of ozone pollution, the 17.6 million children exposed to dangerous short-term particulate pollution, and the 7.7 million children living in areas with dangerous year-round particulate levels.³³ Standards for air pollution levels may have to be adjusted to protect this vulnerable population.

The elderly are also highly susceptible to criteria air pollutants. The findings of one study indicate that carbon monoxide, nitrogen oxides and particulate matter are associated with increased cardiovascular hospital admissions in the elderly.³⁴ Another study suggests that the elderly are at risk of dying from air pollution at levels deemed acceptable for the general population.³⁵ These findings are particularly significant in light of the over 19.8 million people over the age of 65 who live in counties with unhealthy levels of ozone, the nearly 8.2 million seniors living in areas with unhealthy short-term PM levels, and the over 3.1 million seniors living in areas with dangerous year-round levels of PM.³⁶

Another vulnerable population is made up of people with pre-existing medical conditions, especially asthma and cardiovascular conditions. These populations are particularly susceptible to particulate matter. Millions of people in air pollution-sensitive populations live in counties with high levels of particulate matter. This includes, according to the American Lung Association, nearly 4.6 million adults with asthma and nearly 1.7 million children with asthma living in areas with high



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levels of short-term particle pollution, and nearly 1.8 million adults and over 721,000 children with asthma who live in counties with unhealthy year-round levels of particle pollution. People with cardiovascular disease (coronary heart disease, heart attacks, strokes, hypertension and angina pectoris) are among those who are particularly sensitive to particulate matter, and a whopping 18.6 million people with cardiovascular diseases live in counties with unhealthful levels of short-term particle pollution, putting them at risk for additional complications and possibly premature death.

Finally, the simple fact of living in poverty is correlated with elevated risk for harm from air pollution. People living in poverty are particularly at risk from particulate matter. Over 9.8 million people in poverty live in counties with unhealthful levels of short-term particle pollution, and nearly 4.4 million live in counties with unhealthy year-round levels of particle pollution.

2. *What Does the Clean Air Act Do?* ■ ■

The Clean Air Act is a remarkably comprehensive and complex statute,^{37,38} but its fundamental purpose is simple: Congress enacted the Clean Air Act to protect people and the environment from the mounting dangers of air pollution caused by rapid industrialization, urban growth, and increasing use of motor vehicles.³⁹ The overarching goal of the Act is “to protect and enhance the quality of the Nation’s air resources so as to promote the public health and welfare and the productive capacity of the population.”⁴⁰ In its scope and its effect, the Clean Air Act has proven to be one of the most important and successful public health laws ever enacted.

To achieve the Act’s public health and environmental protection goals, Congress has established a number of programs to address air pollution threats from different types of significant pollution sources: mobile sources like cars, trucks, and off-road equipment, small stationary sources like dry cleaners and paint shops, and large stationary sources like power plants, refineries, and large industrial factories. Each of these types of air pollution sources poses different challenges and opportunities that require different regulatory approaches. In response, Congress has designed the Clean Air Act as a carefully crafted, targeted, and integrated statutory system that effectively addresses these diverse challenges. And each of the Act’s various programs reflects and builds upon an essential Congressional determination: that the prevention of pollution—that is, the reduction or

elimination of air pollution at its source—is the best way to protect public health from harmful air pollution.⁴¹ This critical determination animates the Clean Air Act’s pollution control programs and is an essential reason for the Act’s profound success in protecting the American public.

HOW THE CLEAN AIR ACT WORKS

The Air Quality Approach

The most prominent feature of the Clean Air Act is a system to ensure that outside air quality in all areas of the country meets minimum standards to protect people and the environment. Under this system, EPA first identifies air pollutants that are widely present in the outside air and which endanger public health and welfare.⁴² These pollutants are known as “criteria pollutants,” because the Act requires EPA to establish air quality “criteria” that reflect the kinds and extent of adverse effects the various pollutants may have on people and the environment.⁴³

After designating criteria pollutants, EPA must then determine the maximum allowable levels of these air pollutants in the outside air to protect people’s health and the environment. These are known as the National Ambient Air Quality Standards, or “NAAQS.”⁴⁴ Primary NAAQS are designed to protect people’s health, with an adequate margin of safety to protect especially vulnerable people such as children, the elderly, and people who suffer from chronic illnesses.⁴⁵ EPA is required by law to set primary NAAQS at the

levels necessary to protect public health, without regard to costs. Secondary NAAQS are designed to protect public welfare, which includes the environment, wildlife, weather, visibility, crops and plants, and personal comfort and well-being.⁴⁶ Congress has directed EPA to review and update the NAAQS at least every five years to reflect advances in medical and scientific understanding of the adverse health effects of criteria pollutants.⁴⁷

Once EPA sets these nationwide air quality standards, the states are primarily responsible for implementing them by enacting a system of state-specific regulations known as “state implementation plans.” States, with EPA approval, first are required to sub-divide geographical areas within their borders into “air quality control regions.”⁴⁸ Based on monitored air pollution levels, EPA classifies each air quality control region as either: (1) an attainment area, meaning the area meets the Act’s health-protection-based NAAQS for each pollutant; (2) a nonattainment area, meaning air

quality in the area fails to meet the Act’s health-protection-based NAAQS for one or more pollutants; or (3) unclassifiable, meaning there is not enough data to determine if an area meets or fails to meet the NAAQS; these areas are considered to be in attainment unless otherwise shown.⁴⁹ Each state’s implementation plan has to meet minimum federal requirements and must contain enforceable limitations on air emissions plus other control measures for stationary and mobile air pollution sources, as well as air quality monitoring to show compliance with the NAAQS. In attainment areas, state implementation plans must demonstrate that the plan will preserve healthy air quality and protect against degradation from new or expanded air pollution sources. State implementation plans for nonattainment areas must contain more stringent pollution reduction requirements to bring the areas into attainment as expeditiously as practicable, and by no later than specific deadlines included in the Act.⁵⁰



Controlling Air Pollution at the Source

To control harmful pollution from major stationary air sources, Congress developed a comprehensive system of complementary approaches. They rely principally on three programs: (1) New Source Performance Standards, which establish minimum pollution control standards for new and existing sources and acts as a safety net; (2) the “new source review” program, which is designed to make sure that large, new sources of air pollution do not degrade air quality or threaten people’s health; and (3) the hazardous air pollution program, which requires the most stringent pollution controls for 188 of the most toxic air pollutants. Pollution sources that are subject to new source performance standards, new source review, and the hazardous air pollution program must undergo rigorous analysis and, before the source can be constructed, modified, or operated, obtain a permit demonstrating that they are designed and will be constructed and operated to meet the requirements of each program.

New Source Performance Standards

Congress required EPA to identify categories of new and modified pollution sources that contribute significantly to air pollution that may endanger public health or welfare.⁵¹ EPA must then establish quantified emission limits for each source category, based on the best level of emission control that has been adequately demonstrated for that type of pollution source.⁵² These “new source performance standards” operate as a baseline level of the minimum allowable pollution control for each source category. More stringent pollution controls may be required for criteria pollutants under the new source review program and for hazardous air pollutants under the hazardous air pollutant program.

New Source Review

The new source review program focuses on “criteria pollutants,” such as soot-forming particle pollution and ground level ozone (smog). The new source review provisions actually comprise two distinct programs: one to address attainment areas—in which air quality meets all the NAAQS

standards—and another for non-attainment areas, where air quality does not meet NAAQS health-protection standards for one or more criteria pollutants. The prevention of significant deterioration, or “PSD,” program covers areas that meet—or have “attained”—ambient air quality standards. The non-attainment new source review, or “NNSR,” program applies in areas that do not meet air quality standards, and it contains more rigorous requirements that are designed to improve air quality to meet and maintain healthy air quality. An area can be in attainment for one criteria pollutant and non-attainment for another. Under those circumstances, the PSD provisions would apply to all pollutants that meet the air quality standards and the NNSR provisions would apply to any pollutant that does not.

The PSD program requires a preconstruction analysis and demonstration that a proposed new pollution source will meet three essential requirements before the source can commence construction.⁵³ First, the proposed source must demonstrate that its projected air pollution emissions will not cause or contribute to a violation of the health-based NAAQS, which is essential to maintaining healthy air quality.⁵⁴ Second, to make sure that new air pollution sources do not degrade existing air quality or create a risk of violating health protection standards, the source must demonstrate that it will not exceed a specified “increment” of allowable additional air pollution.⁵⁵ In this manner, the Clean Air Act balances the desire for future industrial growth with the need to achieve and maintain healthy air quality. Third, the source must demonstrate that it will meet the best level of pollution control that is achievable based on available technology.⁵⁶ This technology-based requirement is known as the best available control technology, or “BACT,” standard, and it is designed to require state-of-the-art controls for new and modified sources and to promote technological advancement and innovation.⁵⁷

The non-attainment new source review (“NNSR”) program for areas in non-attainment is more rigorous.⁵⁸ Its level of stringency depends to some degree on the severity of the air pollution

problem in the area and the amount of time that has elapsed beyond the Act's deadline for attaining the applicable air quality standards.⁵⁹ In general, however, the NNSR program requires states to demonstrate the methods by which they will reduce pollution concentrations in the ambient air to meet applicable air quality standards by specified deadlines.⁶⁰ The new implementation plans also must provide for "reasonable further progress" in improving air quality to confirm the areas are on target to meet the attainment deadlines.⁶¹

Under the non-attainment program, all new or modified major sources of air pollution must obtain preconstruction permits demonstrating that the source will meet an enhanced level of pollution control, known as the "lowest achievable emission rate," for all "non-attainment pollutants." The "lowest achievable emission rate" is based on either the most stringent emission limitation adopted as part of any state's implementation plan, or the lowest emission rate achieved in practice by any similar pollution source, whichever is lower.⁶² In addition, the new or modified pollution source must obtain emission offsets, which are reductions of the same nonattainment pollutant from other, existing sources in the area in order to offset the new pollution.⁶³ In this way, the NNSR program assures that new pollution sources do not increase air pollution concentrations, while allowing for additional industrial growth and economic expansion.

Hazardous Air Pollutants

When Congress enacted the modern Clean Air Act in 1970, it recognized that certain types of air pollutants, known as "hazardous air pollutants," are acutely and chronically toxic to people even in small amounts and, thus, present greater risks of serious harm to public health. Thus Congress directed EPA to establish highly protective standards for toxic air pollutants and the sources that emit them. However in the ensuing 20 years, EPA established standards for only seven hazardous air pollutants and addressed only a limited number of possible sources of these pollutants.⁶⁴ Thus, when Congress updated the Act in 1990, it overhauled the hazardous air pollutant provisions of the Act to

better protect public health and the environment from routine emissions of air toxics.⁶⁵

Those updates classify nearly 200 contaminants as hazardous air pollutants and create a stringent national program to lower their emissions.⁶⁶ In particular, Congress directed EPA to list all categories of major sources of air toxics and to develop highly protective, maximum achievable pollution control standards for each listed category on an aggressive schedule.⁶⁷ For new sources, the resulting emission controls were required to achieve levels of emission control achieved in practice by the best-controlled similar source. This established a minimum or "floor" level of control. Beyond that floor, control levels must be tightened as much as possible, taking into account available technologies, costs, non-air quality health and environmental impacts, and energy requirements.⁶⁸ Existing sources also must at least meet a "floor" level of control that is based on the best performing 12 percent of sources.⁶⁹ The floor level of control for new and existing sources is set irrespective of the cost or difficulty in achieving the level of emission control and can result from the application of technological controls as well as from other factors like the use of cleaner fuels or raw materials.⁷⁰

To enforce these standards, the Act prohibits construction or modification of a major source of hazardous air pollutants unless EPA (or a state with delegated authority) first determines and issues a permit requiring that the source will meet maximum achievable pollution control requirements.⁷¹ Where EPA has not yet established a federal maximum pollution control requirements for a category of sources, the Act and its implementing regulations require a "case-by-case" determination.⁷²

Mobile Sources

Mobile sources such as cars, trucks, trains, airplanes and boats emit many of the same types of pollutants as large stationary sources, particularly volatile organic compounds, carbon monoxide, nitrogen oxides, and particulate matter. Moreover,



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while individual mobile source emissions pale in comparison to large stationary sources, cumulatively, mobile sources account for an enormous percentage of emissions of these pollutants. Nevertheless, Congress treated mobile sources quite differently than stationary sources.

Whereas states have a great deal of discretion as to how they implement the Clean Air Act's minimum requirements for stationary sources, EPA has near-exclusive authority to set mobile source standards.⁷³ This owes in large part to the fact that mobile sources, by their nature, regularly cross state boundaries. Additionally, Congress determined that a patchwork of different regulations by the states could wreak havoc with the motor vehicle manufacturing industry. Thus, mobile source regulation is largely a federal matter, and it is illegal to market or sell a mobile source engine without complying with EPA regulations.⁷⁴

Title II of the Act establishes EPA's authority to regulate mobile sources and provides for two basic types of regulations.⁷⁵ The first involves performance standards for different categories of mobile sources, such as cars, heavy duty truck, buses, and diesel locomotives, that emit significant amounts of air pollution.^{76,77} Performance standards limit

the types and amounts of pollutants that different mobile sources can emit, typically on a per-mile-traveled basis. These standards are designed to assure that mobile source engines will comply with applicable emission standards over the life cycle of the source. This involves initial certification that each engine prototype meets emission standards; evaluation of production processes to assure that the "as-manufactured" product meets the same standards as the prototype; in-use testing, to assure that the engines perform properly under normal operating conditions; and provisions to recall faulty engines. These standards are "technology-forcing"—meaning they should spur technological advancement and innovation—and, accordingly, are updated as the state of technology improves.

The second type of mobile source regulation focuses on fuels.⁷⁸ These regulations are designed either to reduce mobile source emissions, or to require a public health assessment of the risks associated with different types of fuels. If a public health assessment indicates that certain fuels present a significant risk to public health—as was the case with leaded gasoline—then EPA may limit or prohibit use of that fuel.⁷⁹ Conversely, if available information demonstrates that different fuels result

Figure 2. Health Effects of Criteria Pollutants

	Description	Sources	Health Effects
Particulate Matter (PM _{2.5} and PM ₁₀)	<ul style="list-style-type: none"> • Mixture of small solid particles and tiny acid droplets. Some can be seen with the naked eye (dust, dirt, soot, or smoke). Others can be detected only with an electron microscope. • Inhalable “coarse particles” (PM₁₀) have diameters between 2.5 and 10 micrometers. These particles serve as the general indicator of exposure to PM. • “Fine particles” (PM_{2.5}) have diameters that are 2.5 micrometers and smaller. • There is a strong correlation between the presence of PM₁₀ and that of other air pollutants. • PM_{2.5} NAAQS standards: 15 µg/m³ annual (arithmetic average) and 35 µg/m³ per 24 hours. PM₁₀ NAAQS standards: 150 µg/m³ per 24 hours 	<ul style="list-style-type: none"> • Fuel combustion; electricity generation, especially coal-fired power plants; motor vehicles; industrial processes • Windblown dust from fields, construction, landfills, and agricultural processes • Wildfires, cooking fires, and brush/waste burning • Can be formed in the atmosphere by emissions of other gases (ex. SO₂, NO_x, or VOCs) • PM₁₀ is a good measure of the complex mix of particles and dust that result from fuel combustion in vehicles. 	<ul style="list-style-type: none"> • Dependent on the size of the particle and how deeply it penetrates into the airway • Exposure to PM_{2.5} (fine particles) is associated with:^{1,2,3,4,5,6,7,8,9,10,11,12,13} <ul style="list-style-type: none"> ▷ increased respiratory symptoms, such as irritation of airway, coughing, or difficulty breathing ▷ decreased lung function ▷ worsening asthma ▷ development of chronic bronchitis ▷ irregular heartbeat and fatal heart attacks ▷ premature death in people with preexisting heart or lung disease ▷ ischemic stroke ▷ lung cancer • Particle pollution is also linked to:¹⁴ <ul style="list-style-type: none"> ▷ low birth weight ▷ premature birth ▷ chronic airway obstruction and remodeling ▷ sudden infant death
Nitrogen Oxides (NO _x)	<ul style="list-style-type: none"> • Group of highly reactive gases known as “oxides of nitrogen” or “nitrogen oxides” (NO_x) including nitrous acid and nitric acid • Reddish-brown in color with an acrid, biting odor • Precursor to ozone formation and acidic precipitation (acid rain) • Forms acidic PM particles in the atmosphere • Nitrogen dioxide NAAQS standards: 100 ppb per hour and 53 ppb annually (arithmetic average). 	<p>Formed from high-temperature combustion of fossil fuels, including:</p> <ul style="list-style-type: none"> • Generation of electricity; coal-fired power plants • Non-vehicle equipment burning gasoline or diesel • To a lesser extent, chemical plant emissions 	<ul style="list-style-type: none"> • Short-term exposures (30 minutes to 24 hours):¹⁵ <ul style="list-style-type: none"> ▷ airway inflammation in healthy people ▷ coughing, shortness of breath, nausea ▷ dampens immune function, decreasing ability to resist respiratory infections such as influenza ▷ worsening asthma symptoms ▷ increased emergency room visits, hospitalizations for respiratory issues, especially asthma ▷ fatal cardiac arrhythmias • When NO_x mixes with ammonia, moisture and other chemicals, small particles created can: <ul style="list-style-type: none"> ▷ penetrate deeply into sensitive parts of the lung ▷ cause or worsen respiratory disease such as emphysema and bronchitis ▷ aggravate existing heart disease ▷ lead to increased hospital admissions and premature death

The notes to this table appear on pages 30–31.

	Description	Sources	Health Effects
Sulfur Dioxide (SO ₂)	<ul style="list-style-type: none"> • Highly corrosive, invisible gas • Belongs to a group of highly reactive gasses known as “oxides of sulfur” • Produces acid rain • Sulfur Dioxide NAAQS standards: 0.03 ppm annual (arithmetic average); 0.14 ppm per 24 hours; 75 ppb per hour. Secondary standard: 0.5 ppm per 3 hours. 	<ul style="list-style-type: none"> • Generation of electricity through coal combustion, particularly high-sulfur coal • Motor vehicles and other fossil fuel combustion • Industrial processes such as extracting metal from ore • Burning of high-sulfur fuels by locomotives, large ships, and non-road equipment 	<ul style="list-style-type: none"> • Short-term exposures in at-risk populations (children, the elderly, and asthmatics) linked to:¹⁶ <ul style="list-style-type: none"> ▷ broncho-constriction ▷ increased asthma symptoms (coughing, wheezing, shortness of breath) ▷ increase in emergency visits and hospitalizations ▷ ischemic stroke • Small particles of SO₂ can: <ul style="list-style-type: none"> ▷ penetrate deeply into the lung ▷ cause or worsen respiratory disease such as emphysema and bronchitis ▷ aggravate existing heart disease ▷ lead to increases in hospital admissions and premature death • SO₂ exposure has been linked to effects on infants, including:¹⁷ <ul style="list-style-type: none"> ▷ increased odds of low birth weight ▷ preterm birth ▷ infants who were small for their gestational age ▷ increased risk of infant death
Carbon Monoxide (CO)	<ul style="list-style-type: none"> • Poisonous, clear, odorless gas • Lethal at high doses • Carbon Monoxide NAAQS standards: 9 ppm (10 mg/m³) per 8 hours and 35 ppm (40 mg/m³) per hour. 	<ul style="list-style-type: none"> • Motor vehicle exhaust contributes 56% of all CO emissions nationwide • Industrial processes • Non-road equipment • Wildfires and brush/waste burning • Residential wood burning 	<ul style="list-style-type: none"> • Binds to blood hemoglobin, impairing oxygen delivery to vital organs such as the brain and heart¹⁸ • Health effects on children and infants include: <ul style="list-style-type: none"> ▷ birth defects¹⁹ ▷ low birth weight²⁰ ▷ neonatal respiratory mortality^{21,22} ▷ asthma^{23,24} • Stroke morbidity^{25,26} and mortality^{27,28} • Heart attack (for people with congestive heart failure)^{29,30}
Lead (Pb)	<ul style="list-style-type: none"> • Soft, gray, non-corrosive heavy metal • Lead NAAQS standards: 0.15 µg/m (rolling 3-month average) and 1.5 µg/m³ (quarterly average). 	<ul style="list-style-type: none"> • Prior to being phased out, leaded gasoline and lead paint were the primary sources of airborne lead. • Metal smelters • Battery manufacturing 	<ul style="list-style-type: none"> • Damage to kidney function as well as the nervous, immune, reproductive, developmental, and cardiovascular systems³¹ • A potent neurotoxin in infants and young children, contributing to learning problems, behavioral problems, learning deficits, and decreased IQ³² • Linked to high blood pressure and heart disease in adults³³
Ozone (O ₃)	<ul style="list-style-type: none"> • Highly corrosive, invisible gas • Beneficial in the upper atmosphere; harmful to health at ground level • Primary component of smog • Most pervasive outdoor air pollutant in the U.S. • Ozone NAAQS standards: 0.075 ppm per 8 hours and 0.12 ppm per hour. 	<ul style="list-style-type: none"> • Caused by atmospheric chemical reactions of NO_x and Volatile Organic Compounds (VOCs) in the presence of sunlight. • Heat increases the production of O₃ • Motor vehicles and electricity generation via NO_x and VOC emissions • Solvent production and use via VOC emissions 	<ul style="list-style-type: none"> • Reduction in lung function³⁴ • Increased respiratory symptoms (coughing, wheezing, shortness of breath)³⁵ • Increased respiratory-related emergency department visits, hospital admissions³⁶ • Premature death possible³⁷ • Lung cancer development and mortality^{38,39,40} • May be related to:⁴¹ <ul style="list-style-type: none"> ▷ premature birth ▷ cardiac birth defects ▷ low birth weight ▷ stunted lung growth

in emissions reductions and improved air quality, EPA may mandate use of those fuels.⁸⁰ A central feature of the fuel-regulation program requires testing and registration of fuels before they can be marketed and sold.⁸¹

Shared Responsibility: The Role of the Federal and State Governments and the Public

To make sure that these and other Clean Air Act programs are fully implemented in a timely way, Congress charged EPA with the ultimate authority and responsibility for developing regulations to meet the Act's requirements. At the same time, Congress directed that the states should have primary responsibility for assuring that the Act's requirements are faithfully carried out within their borders. Thus, the Act requires each state to develop a system of laws to implement the federal Clean Air Act and EPA's regulations. These are known as state implementation plans, or "SIPs." If a state's SIP meets minimum federal CAA requirements and is approved by EPA, the state has primary responsibility for making sure that the CAA is properly implemented. EPA retains oversight to assure the state is, in fact, fulfilling its obligations under the Act.

Recognizing that the federal and state governments may not always have the capacity or will to fully implement the Act's public-health safeguards, Congress added another layer of protection by authorizing individual citizens and citizen groups to act as "private attorneys general" to bring "citizen suits" against polluters and the state and federal government when they violate the Act or fail to enforce its laws.



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The complementary facets of the CAA and the interlocking responsibilities shared among state governments, the federal government and the public, have worked to bring the American people substantial improvements in public health. In the next section we look at how those health improvements have improved the quality of life while saving the American public billions of dollars in health care costs.

3. The Clean Air Act, A Success Story

The successes of the Clean Air Act are reflected most significantly in the improvements in air quality that Americans have enjoyed and the number of premature deaths and unnecessary illnesses averted. The nation has benefitted economically as well, thanks to the savings in health care costs as a result of healthier air. The direct costs of complying with the Clean Air Act have proven to be far less than the costs, especially health costs, that would have been incurred had the Act not taken effect. The value of those benefits has been calculated periodically, since Congress added section 812 to the 1990 CAA Amendments. Section 812 requires the EPA to complete periodic, comprehensive and prospective analyses of the costs and benefits of air pollution controls under the Act.

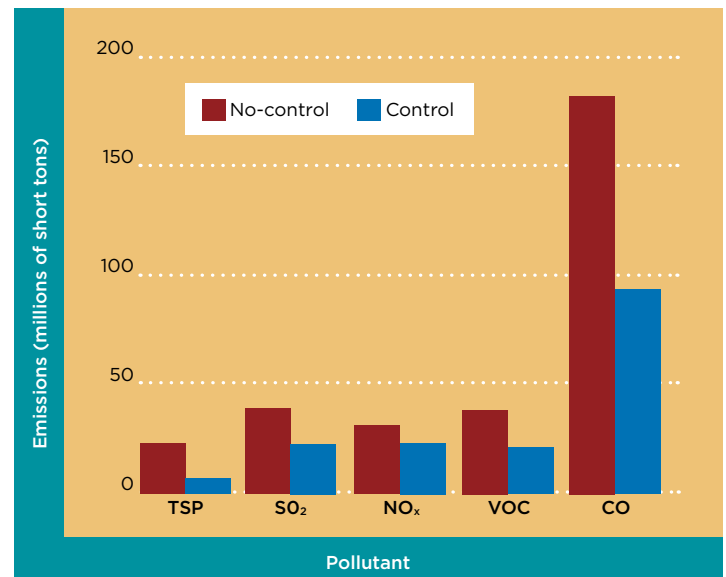
IMPROVEMENTS IN LEVELS OF CRITERIA POLLUTANTS

Air emissions for criteria pollutants (carbon monoxide, ozone, particulates, lead, sulfur dioxide and nitrogen oxides) rose rapidly from 1900 until 1970, when the CAA was passed. For example, air monitoring data spanning those years show that atmospheric concentrations for nitrogen oxides rose 690 percent, sulfur dioxide 210 percent, and volatile organic compounds (necessary for ozone formation) increased 260 percent.⁸²

In the *Retrospective Study 1970–1990*,⁸³ the first analysis conducted under Section 812, EPA developed estimates for pollution levels under two alternative scenarios: a “control scenario”

reflecting regulations required under the Act and a “no control scenario” reflecting the absence of Clean Air Act pollution controls. Figure 3, from the *Retrospective Report*,⁸⁴ shows that by 1990 the pollution controls brought by the Act resulted in dramatic decreases in ambient criteria pollutant concentrations. These reductions were achieved through control measures including the installation of smokestack scrubbers to capture sulfur dioxide and filters to capture particulates, catalytic converters to reduce nitrogen oxide emissions

Figure 3. 1990 control and no-control scenario estimates (in millions of short tons)



SOURCE: U.S. Environmental Protection Agency. *Retrospective Study 1970–1990*. October 1997.

from vehicles, and the switch to lower-sulfur fuels. Notable reductions included a 75 percent decrease in emissions of primary particulates from utility and industrial smokestacks, a 50 percent reduction of carbon monoxide (primarily through motor vehicle controls), and an astonishing 99 percent reduction in lead emissions.⁸⁵ These reductions were achieved while the nation's population grew by 23 percent and the national economy by 70 percent, demonstrating the compatibility of effective air quality regulation with significant growth.

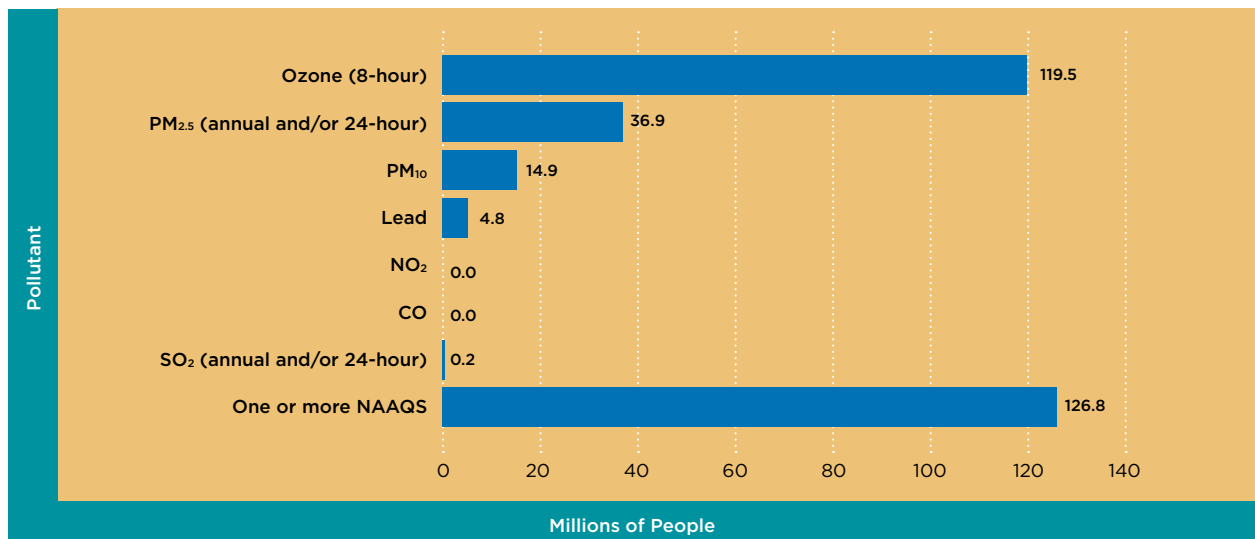
In April 2011 the EPA released its second prospective assessment of the Clean Air Act's effectiveness, this one examining projected emissions trends from 1990 through 2020.⁸⁶ Again, the report utilized dual scenarios. One assumed the application of the 1990 CAA Amendments plus promulgation of additional air pollution prevention rules; the second assumed that in the absence of the 1990 amendments, emissions were allowed to steadily climb as population and economic activity grew. Not surprisingly, net emission reductions are found to be consistently greater in the scenario with CAA amendments for all pollutants throughout the period 2000–2020.

IMPROVEMENTS STILL NEEDED IN AIR QUALITY

Despite advancements in pollution controls achieved under the CAA, 127 million people in the country still live in areas that are in non-attainment for at least one or more NAAQS (Figure 4), especially ozone and fine particulate matter.⁸⁷ The concern that too many people are left to breathe unhealthy air is underscored by analysis conducted by the American Lung Association (ALA),⁸⁸ which found that in 2010, as many as 175.3 million people in the U.S. lived in counties where the outdoor air concentrations were above the safety thresholds.

The difference between the 127 million people living in an area in non-attainment for at least one NAAQS and the ALA's figure of 175 million people living in areas with unhealthy air reflects the EPA's criteria, which allow twice as many days of non-attainment of the short-term NAAQS before an area is designated in non-attainment. Permitting fewer days of high pollution concentrations would better protect the public from short-term spikes in pollution. This is of particular concern in regard to the health impacts of fine particulate matter.

Figure 4. Number of people (in millions) living in counties with air quality concentrations above the level of the primary (health-based) National Ambient Air Quality Standards (NAAQS) in 2008



Source: U.S. Environmental Protection Agency. *Our Nation's Air: Status and Trends Through 2008*. February 2010.

The EPA combines air toxic monitoring data with modeling studies to evaluate trends in hazardous air pollutants. One such modeling study is the National-Scale Air Toxic Assessment (NATA), which combines ambient HAP concentrations with model inhalation exposures and associated health risks for 180 of the 189 HAPs. According to the latest NATA, EPA estimates that all 285 million people in the U.S. (2000 Census data) face an increased cancer risk of greater than 10 in one million, attributable to air toxics exposure.⁸⁹ As a point of comparison, the national average cancer risk in 2002 was 36 in one million for all known causes. Thus, breathing air toxics from outdoor sources over a lifetime of exposure contributes nearly 30 percent to the overall average cancer risk.⁹⁰ Some regions in the U.S. face even more dire risks, with two million people (or one in 10,000) facing increased lifetime cancer risk of greater than 100 in a million from air toxics exposure.⁹¹ These lifetime cancer risks far overshoot the “acceptable” risks goal of one in a million adopted by the EPA, and demonstrate the monumental task still before us in regard to decreasing hazardous air pollutants.

Air quality trends and climate change are closely linked. Ozone, a potent airway irritant, is also a short-lived greenhouse gas, meaning that it contributes to climate change. Climate change, the rise in global mean surface temperature, in turn leads to increased production of ground-level ozone and increased frequency of bad air quality days.⁹² Furthermore, conventional air pollutants like ozone and black carbon can both contribute to a positive feedback loop that propels climate change. Black carbon, a particulate that gives soot its black color, is the dominant absorber of visible solar radiation in the atmosphere and the second strongest contributor to climate change after carbon dioxide.⁹³ Other important contributors to atmospheric concentrations of greenhouse gases include fossil fuel combustion, deforestation, agricultural activities, methane released from vented landfills, mining and livestock production, and releases of synthetic gases such as chlorofluorocarbons and hydrofluorocarbons. Controlling air

emissions of greenhouse gases is critical to deflect the worst health consequences of uncontrolled climate change. U.S. greenhouse gas emissions have increased 17 percent since 1970. Overall carbon dioxide concentrations have increased approximately 35 percent since the start of the industrial revolution; methane and nitrous oxides have experienced similar increases.⁹⁴

BENEFITS IN LIVES SAVED AND ILLNESSES PREVENTED

Another metric for evaluating the effectiveness of the Clean Air Act is the improvement in health resulting from emissions reductions. Reductions in emissions dramatically improve quality of life and reduce the economic impact of illness by decreasing hospital admissions, emergency room visits, restricted activity days and lost school days. The most recent prospective assessment by EPA estimates that in 2010, the Act prevented 160,000 premature deaths due to fine particulate matter, and in 2020, will prevent 230,000. By reducing particulate pollution, as many as 200,000 heart attacks and 2.4 million asthma attacks are projected to be averted by 2020. These and other projected gains are presented in Figure 5.⁹⁵



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Figure 5. Improvements in key health outcomes associated with fine particles (PM_{2.5}) and ozone, with-CAAA and without-CAAA scenarios, for 2010 and 2020

Health Effects (PM _{2.5} & Ozone Only)	Pollutants	Outcomes Averted in Year 2010	Outcomes Averted in Year 2020
PM _{2.5} Adult Mortality	PM	160,000	230,000
PM _{2.5} Infant Mortality	PM	230	280
Ozone Mortality	Ozone	4,300	7,100
Chronic Bronchitis	PM	54,000	75,000
Acute Bronchitis	PM	130,000	180,000
Acute Myocardial Infarction	PM	130,000	200,000
Asthma Exacerbation	PM	1,700,000	2,400,000
Hospital Admissions	PM, Ozone	86,000	135,000
Emergency Room Visits	PM, Ozone	86,000	120,000
Restricted Activity Days	PM, Ozone	84,000,000	110,000,000
School Loss Days	Ozone	3,200,000	5,400,000
Lost Work Days	PM	13,000,000	17,000,000

Source: U.S. Environmental Protection Agency. *The Benefits and Costs of the Clean Air Act from 1990 to 2020*. March 2011.

COMPARING COSTS OF COMPLIANCE WITH AVERTED HEALTH DAMAGES

The EPA's 2011 prospective study impacts focuses on the costs and benefits of Clean Air Act implementation. The study compares the overall health, welfare, ecological, and economic benefits of the 1990 CAA Amendments (CAAA), analyzing the impacts of attaining and maintaining the NAAQS, regulating mobile sources and establishing requirements for clean fuels and efficient vehicles, regulating hazardous air pollutants and reducing acid rain. For all these programs, the cost of compliance is estimated to be \$65 billion.⁹⁶ Benefits were calculated based on reduced exposures to criteria pollutants over time, with the majority of the benefits achieved by reductions in ground-level ozone and particulates.

The study indicates a return of \$30 of benefits for every one dollar spent on implementation of pollution controls by 2020. Of the \$2 trillion in health benefits expected by that year, nearly 90 percent are attributable to avoided premature deaths associated with lowered ambient particulate

matter.⁹⁷ The direct costs attributed to Clean Air Act implementation include the purchase, installation, or operation of pollution control technology on major and area pollution sources. The cost of compliance takes into account five sources: electricity-generating units (\$10 Billion), non-utility industrial sources (\$5 Billion), on-road vehicles and fuel (\$28 Billion), non-road vehicles and fuel (\$1 Billion), and area sources (<\$1Billion).⁹⁸

Electric generating utilities, especially coal-fired power plants, contribute heavily to the nation's air pollution health burden, due to their emissions of air toxics and criteria pollutants. In an effort to estimate the health damages attributed to electric generation, researchers assessed those costs per kilowatt-hour (kWh). Schwartz *et al.* arrived at estimated costs due to air quality attributable to PM_{2.5} in 2005 ranging from \$187.5 billion to \$65 billion; most of these came from mortality.⁹⁹ These numbers translate to an average cost of 9.3¢ per kWh, with a low estimate of 3.2¢ per kWh. The National Research Council of the National Academy of Sciences calculated health



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damages attributed to coal-generated electricity at 3.2 ¢ per kWh and 0.16¢ per kWh for natural gas.¹⁰⁰ These costs are not reflected in the price charged for electricity; they are absorbed by the consumer, whether as the costs of health care, lost earnings due to time lost from work, or premature death. When such so-called “externalized” costs are added in—a fuller accounting of the externalized costs of coal-generated electricity would also include health impacts from coal ash as well as environmental costs from strip mining and mountaintop removal, coal washing, transportation and disposal—the true cost of electricity is revealed. Clean, renewable energy sources such as solar or wind are found to be far more competitive because they do not give rise to the same health and environmental costs.

There is less published research to be found on the health-related economic impacts of air toxics. However, Trasande *et al.* found the direct costs of mercury emissions from coal-fired power plants, due to increases in mental retardation and loss of IQ, were \$361.2 million and \$1.625 billion respectively.^{101,102} In early 2011, EPA released a regulatory impact assessment that estimated the costs and benefits of controlling toxics like mercury, arsenic, other toxic metals, and acid gases from coal and oil-fired power plants. The total health and economic benefits are estimated to be as much as \$140 billion annually. Compared to the costs of reducing these emissions from power plants, the benefits outweigh the costs dramatically, averaging about \$13 in health benefits for every dollar spent to reduce pollution.¹⁰³

4. *Opportunities for Saving Lives* ■ ■ ■ ■

Since Congress created the Clean Air Act in 1970, it has proven to be one of the nation's most important and effective tools for preventing premature deaths, disease, and human suffering. Part of its success owes to the science-driven, iterative process through which EPA and the states identify and address air pollution problems. EPA sets air quality standards based on studies conducted by its own Clean Air Science Advisory Committee (CASAC), as well as the National Research Council and other scientific organizations. As the state of the science and technology improves, EPA periodically re-evaluates the quality of the air and, as it becomes necessary,

revises and strengthens standards to adequately protect the public from risks due to dangerous air pollutants and air toxics. This adaptive approach has improved air quality and public health and greatly reduced health care costs associated with air pollution-induced illnesses. The economic benefits of reduced illnesses, hospital admissions, and days lost from work and school have greatly exceeded the costs associated with reducing air pollution. Furthermore, the Clean Air Act regulations also spur technological innovation, generating jobs and economic growth.

The Clean Air Act's ambient air quality standards and pollution control requirements have





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avoided millions of premature deaths and debilitating illnesses. Yet while the Act represents a remarkably comprehensive effort to solve the problem of air pollution, “Congress has not, however, found a uniform, nationwide solution to all aspects of this problem.”¹⁰⁴ As discussed earlier in this report, ambient concentrations of several pollutants are still too high to adequately protect people, especially vulnerable people like children, the elderly, and those with chronic health problems.

The fact is that air pollution still sickens and kills Americans every day. Several pollutants currently regulated under the Act must be further reduced to protect people’s health and welfare, including ozone, particulates, certain hazardous air pollutants and greenhouse gases. In this section we discuss a number of overdue Clean Air Act improvements that should be proposed, finalized or implemented over the next several years. Many are mandated by growing evidence that current air quality standards do not adequately protect public health. In some cases, they are necessary to comply with court decisions directing EPA to fully implement the Clean Air Act’s guaranteed protections.

FUTURE CHALLENGES IN AMBIENT POLLUTION (CRITERIA POLLUTANTS)

In order to comply with the Clean Air Act’s directive to regularly review standards for criteria pollutants and, if necessary to protect people’s health, revise them, the EPA will need to issue revised standards for ozone and particulate pollution over the next several years.

Ozone 8-hour standard

EPA last revised the ozone standard in 2008. Unfortunately, when it did so, EPA disregarded the recommendations of their own panel of expert scientists and physicians, the Clean Air Scientific Advisory Committee (CASAC), which advised that the maximum limit for ambient ozone concentrations be lowered from 84 parts per billion (ppb) to a range between 60–70 ppb, measured as an 8-hour average. Epidemiological evidence and modeling show that lowering the ozone standard would save between 4,000 and 12,000 lives and prevent 58,000 asthma attacks and 21,000 hospital and emergency room visits every year. EPA estimated that 187.3 million people

(based on 2000 Census figures) in 650 U.S. counties would be protected from unhealthy levels of ozone if the standard was set at 60 ppb. These health cost benefits far exceed the cost of industry compliance.

CASAC's recommendation for revising the ozone standard was based on a comprehensive review of 1,700 studies on the health impacts of ozone. Physicians for Social Responsibility, along with others in the medical and scientific community, called in 2008 for the revised ozone standard to be set at 60 ppb. But EPA ignored those recommendations and the considerable public health benefits that would accrue, yielding to industry pressure by selecting an arbitrary 75 ppb standard. In 2009, the United States Court of Appeals, D.C. Circuit ruled that EPA had violated the Clean Air Act and rejected the agency's proposed ozone standard in the case of *American Farm Bureau v. EPA*, 559 F.3d 512 (D.C. Cir. 2009). The Court ordered EPA to reconsider and finalize a more protective standard by December 31, 2010.

Despite that deadline, EPA has yet (as of April 2011) to finalize the revised 8-hour ozone standard. EPA recently announced that the ozone standard would be delayed until July 29, 2011 to allow for additional consultation. Based on EPA's own analysis, this six-month delay could result in as many as 6,000 premature deaths. Physicians for Social Responsibility urges the EPA to act in the best interest of the people they serve by immediately setting the 8-hour ozone standard at the most health-protective level of 60 ppb immediately.

Particulate Matter

The American Heart Association (AHA) articulated in a July, 2010 policy statement the urgent need for improved standards for ambient air particulates. After a comprehensive review of scientific literature, AHA found that both short-term and long-term exposure to fine particulates (PM_{2.5}) pose a significant cardiovascular risk, significantly contributing to heart attacks, strokes, heart failure, and irregular heartbeats.¹⁰⁵ These threats are not limited to the U.S. A study by the World Health Organization confirmed that each year, fine



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particulate matter is causing some 800,000 premature deaths globally, representing 6.4 million years of life lost.^{106,107} As is the case here, the deaths attributed to PM_{2.5} were associated with a variety of diseases, including cancer of the trachea, bronchus and lungs; cardiopulmonary disease among adults, and acute respiratory infections in children.

In these studies, both AHA and WHO recommend that emissions for fine particulates be reduced to protect the public from preventable illness and death. The current U.S. 24-hour PM_{2.5} standard is 35 micrograms per cubic meter and the annual average is set at 15 micrograms per cubic meter. These standards were last revised in 2006 but, as research indicates, are not stringent enough to protect public health. Brooks *et al.* reported that PM_{2.5} concentrations and cardiovascular risk followed a direct dose-response relationship, meaning as concentrations of PM_{2.5} rise so do cardiovascular illness, and that this relation was observed below 15 micrograms per cubic meter without a discernable safety threshold.¹⁰⁸ EPA was scheduled in October of 2010 to release the policy assessment report in which EPA staff would recommend the new proposed ranges for PM_{2.5} based on the Integrated Science Assessment. The PM_{2.5} NAAQS proposed rule was scheduled to be released by February 2011. The EPA has released neither the policy report nor the proposed rule.

Controlling pollutants at their source

Beyond establishing standards for the six criteria pollutants through the NAAQS program, the EPA and states can make marked reductions in air pollutants by requiring emission reductions and technology controls from major and area sources. Several rules recently finalized or pending in 2011 will dramatically cut our exposure to air toxics, ozone, particulates and greenhouse gases that drive alarming climate change trends.

Power plants are a major source for all of these types of pollutants but have been under-regulated. In July 2010, EPA proposed the Clean Air Transport Rule to reduce the high levels of ozone and particulate-forming pollutants that are emitted from power plants and travel across state borders to cause air pollution problems in downwind states. The Transport Rule will replace the earlier Clean Air Interstate Rule, vacated in 2008 by the DC Circuit Court of Appeals as being inadequately protective of public health. The Transport



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Rule will require 31 Northeast, Midwest and Southeastern states to significantly reduce sulfur dioxide and nitrogen oxide emissions that cause or contribute to air quality problems in other states.¹⁰⁹ It is estimated that the Transport Rule, once finalized, will reduce sulfur dioxide emissions by 71 percent and will reduce nitrogen oxide emissions by 51 percent over 2005 levels. These pollution



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AIR ALLIANCE HOUSTON

reductions are anticipated to prevent 14,000 to 36,000 premature deaths a year, yielding \$120 to \$290 billion in annual health-related cost savings. These savings far exceed the \$2.8 billion a year compliance costs.¹¹⁰

HAZARDOUS AIR POLLUTANT REGULATIONS

The 1990 Clean Air Act amendments directed EPA to establish highly protective emission standards for all major hazardous air pollution sources within ten years. More than two decades later, EPA is just now issuing emission standards for some of the largest sources of hazardous air pollution: coal- and oil-fired electric power plants, cement kilns, and industrial boilers.

Power Plant Mercury and Air Toxics Rule

Coal-fired power plants are responsible for 99 percent of the air toxics pollution emitted into America's air. Nearly half of coal-burning power

plants today do nothing to reduce their toxic air pollution. This, despite the fact that commercially available and widely used pollution control equipment exists that would slash toxic air pollution from power plants. Other health benefits would also accrue; as just one example, equipment that captures hazardous air pollutants also reduces particulate matter that lodges deep in the lungs and kills people.

Responding to a court-ordered deadline, on March 16, 2011 EPA announced a proposed rule to limit toxic air emissions from coal- and oil-fired power plants. As proposed, the regulation would cut mercury emissions by 91 percent, emissions of acid gases by 91 percent, and sulfur dioxide emissions by 53 percent, and it would eliminate 100,000 tons of particulate pollution every year. EPA estimates that the proposed mercury and air toxics standards will avoid up to 17,000 premature deaths and up to 120,000 cases of aggravated asthma incidences every year. The benefits of the proposed standards are projected to range from \$57 billion to \$140 billion dollars a year and would exceed

costs to industry by a factor of between five and 13 to one. In addition, the rule would create 10,000 or more new construction and pollution control jobs. Under the court order that prompted the proposed rule, EPA must promulgate final standards by November 16, 2011.¹¹¹

Cement Kilns

Cement kilns emit enormous amounts of mercury, total hydrocarbons, particulate pollution, acid gases, and hazardous organic pollutants. Mercury is especially toxic to small children, disrupting brain development and causing lifelong learning deficits. Other hazardous air pollutants emitted by cement plants cause cancer and other serious, chronic health problems. Despite the fact that cement kilns are among the most dangerous industrial polluters in the country, they have evaded hazardous air pollution controls for more than a decade.

But in the summer of 2010, EPA finally issued long-overdue standards for toxic air pollution from cement kilns. Relying on demonstrated and cost-effective control technologies, the EPA regulation would slash mercury emissions by 80 percent to 90 percent; reduce hydrocarbon and toxic organic emissions by up to 98 percent; cut acid gases by as much as 99.9 percent; and cut particulate pollution by up to 99.9 percent.¹¹² As with the pollution reductions that would be achieved with the power plant air toxics rule, the air toxics rule for cement kilns would save 2,500 lives and \$18 billions of dollars in health care costs every year, would prevent 17,000 asthma attacks, and lead to 130,000 fewer missed days from school and work.¹¹³ It also would generate short-term construction and long-term pollution control jobs. Yet there has been an effort in Congress to gut these important health protections. If successful, this effort would endanger the health and well-being of thousands of Americans at enormous personal and financial cost. It is long

past time for our elected representatives to protect the health and best interests of the American public from one of the dirtiest industries in the country.

Industrial Boilers

Industrial boilers are a third major source of toxic air pollution that, until very recently, has avoided toxic air pollution controls. There are 187,000 existing area source industrial boilers at 92,000 facilities¹¹⁴ in the United States across the country; they are major emitters of toxic lead, arsenic, and acid gas pollution. Despite the fact that industrial boilers cause thousands of cases of asthma attacks, heart attacks and hospital admissions each year, they remained virtually unregulated for over a decade due to industry-led efforts. The health benefits of reducing fine particles from industrial boilers have been estimated \$210 million to \$520 million in the year 2014.¹¹⁵

Finally, in February 2011, EPA issued toxic air pollution rules for industrial boilers that will save thousands of lives and billions of dollars in health-care costs annually. As with the regulations protecting the public from power plant and cement kiln pollution, the industrial boiler protections now face attacks in Congress. This and the other vital health protection standards discussed above are too important to fall prey to partisan politics and industry self-interest. Rather, Congress should act to protect public health by implementing the full range of Clean Air Act provisions, guaranteed to the American public more than forty years ago.



While the Clean Air Act has made great strides in reducing certain pollutants, its work is far from done. The health and the lives of millions of Americans will depend on continued vigorous implementation of the Act.

NOTES

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FIGURE 2 NOTES

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