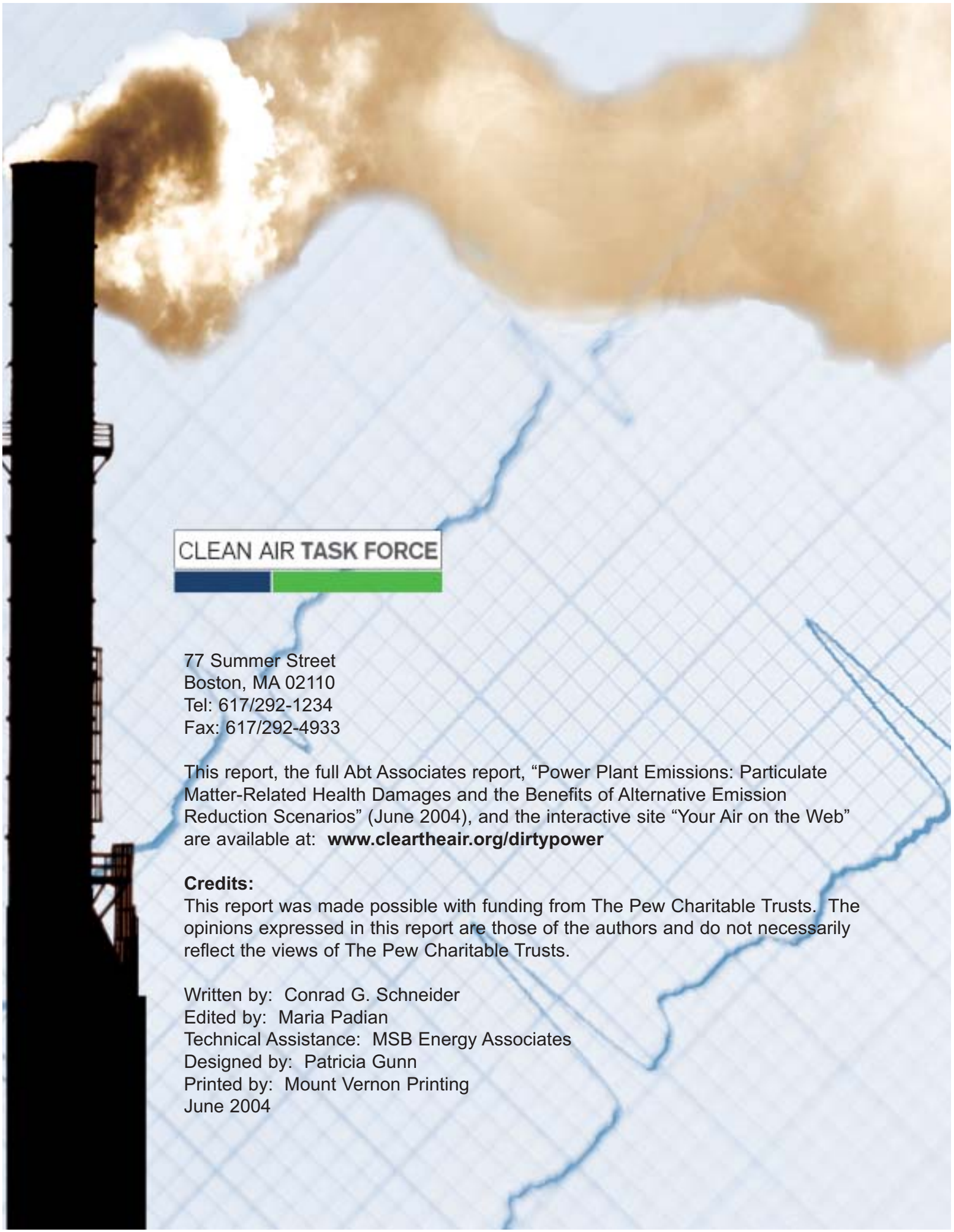
Dirty Air, Dirty Power

Mortality and Health Damage Due to Air Pollution from Power Plants

CLEAR THE AIR

JUNE 2004



CLEAN AIR TASK FORCE

77 Summer Street
Boston, MA 02110
Tel: 617/292-1234
Fax: 617/292-4933

This report, the full Abt Associates report, “Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios” (June 2004), and the interactive site “Your Air on the Web” are available at: **www.cleartheair.org/dirtypower**

Credits:
This report was made possible with funding from The Pew Charitable Trusts. The opinions expressed in this report are those of the authors and do not necessarily reflect the views of The Pew Charitable Trusts.

Written by: Conrad G. Schneider
Edited by: Maria Padian
Technical Assistance: MSB Energy Associates
Designed by: Patricia Gunn
Printed by: Mount Vernon Printing
June 2004

"The Dirty Secret Behind Dirty Air: Dirty Power"

by Angela Ledford, Clear the Air

Four years ago, Clear the Air released its first report on the health impacts of power plant pollution. Because of a loophole in the Clean Air Act, we pointed out, power plants built before 1970 had avoided installing modern pollution controls. Coal burning power plants were making people sick and shortening their lives – thousands of them – each year.

Something needed to be done – or at least election-year politicians knew that's what people wanted to hear. Both candidates for president said that mandatory regulations of all four major pollutants from power plants, including sulfur dioxide, nitrogen oxides, mercury, and carbon dioxide, were needed. Candidate Bush highlighted this commitment in no uncertain terms:

> *Governor Bush will work with Congress, the Environmental Protection Agency, the Department of Energy, consumer and environmental groups and industry to develop legislation that will establish mandatory reduction targets for emissions of four main pollutants: sulfur dioxide, nitrogen oxide, mercury and carbon dioxide.**

** Governor George W. Bush, "A Comprehensive National Energy Policy," September 29, 2000.*

Dirty Air, Dirty Power, documents for the first time how many heart attacks and lung cancer deaths are caused by power plant pollution.

At the same time members of Congress in both houses, from both parties, were proposing legislation to accomplish Candidate Bush's goal. Even the electric power companies had come around to the inevitability of a massive clean up. Industry faced a gauntlet of new regulations under the Clean Air Act, each of which would entail cuts in power plant emissions. By 1999, facing millions of dollars in clean up costs following the largest clean air enforcement action by the Department of Justice in history, the electric power industry had opened discussions with the environmental community to explore clean up proposals.

Had these proposals become law, by the end of this decade we would have substantially reduced the number of ozone smog "red alert days" and asthma attacks that routinely keep kids out of school. Virtually every American would be breathing healthy air, and very few people would die from exposure to pollution from power plants.

But none of that happened because of a dirty little secret: **instead of cleaning up power plants as promised, the Bush administration is allowing the polluters to re-write clean air rules.** The Administration is presenting as "progress," proposals that delay action on air pollution, weaken health standards, and undermine enforcement of the law.

The administration began giving in to the polluters almost immediately after it took office. Two months after being sworn in, President Bush reneged on his campaign promise to require mandatory reductions in carbon dioxide – a pollutant that causes global warming. Vice President Cheney met in secret with representatives of the very companies that had been sued for violating the Clean Air Act and agreed to "study" the rules that the companies had broken. Famous last words – industry eventually got its way, and the "new source review" rules were rewritten.

But the Administration didn't stop there. Since taking office they have issued rules that:

- Delay the deadlines for reducing ozone smog;
- Delay the deadlines for removing deadly fine particles from the air;
- Delay action to reduce haze from the national parks; and
- Delay by more than 10 years real reductions in toxic mercury emissions from power plants, allowing up to seven times more mercury emissions than current law permits.

Dirty Air, Dirty Power reveals, in unprecedented detail, the human cost of the failure of our nation's leaders to solve this problem. This analysis, performed by EPA's own air quality consultants using EPA standard methodology, documents the asthma attacks, hospitalizations, lost work and school days, and premature deaths linked to pollution from power plants.

Since release of our 2000 report, *Death, Disease & Dirty Power*, new scientific studies have found links between air pollution and both heart attacks and lung cancer. This report, *Dirty Air, Dirty Power*, documents for the first time how many heart attacks and lung cancer deaths are caused by power plant pollution.

In addition, *Dirty Air, Dirty Power* goes one step further and compares the Bush administration's air pollution plan to faithful enforcement of the Clean Air Act and proposed "four-pollutant" legislation that would close the power plant loophole once and for all. The results are staggering: the government knows what to do to effectively eliminate the problem of air pollution from power plants, but the Bush air pollution plan represents a step backward from simply enforcing current law.

The American people need stronger, not weaker, clean air protections.

Many of the administration's proposals to weaken clean air laws are just that – proposals and not yet law. The American people have the opportunity to shape those proposals by letting the administration know that we need stronger, not weaker, clean air protections.

The results of this report, which are available on Clear the Air's interactive website, empower individual citizens to tell the story of how power plant pollution affects them. Our work is designed to cut through the spin and reinvigorate the national debate.

If there was ever a time for people to stand up and demand action, it is now.

Angela Ledford
Director, Clear The Air
June 2004

Executive Summary

Asthma attacks, respiratory disease, heart attacks, and premature deaths—all of these are among the serious public health problems caused by air pollution from the electric power sector. In 2000, the Clean Air Task Force, on behalf of the Clear the Air campaign, commissioned Abt Associates to quantify the health impacts of fine particle air pollution from power plants. This study found that tens of thousands of people die prematurely every year and hundreds of thousands more suffer asthma attacks as a result of power plant pollution alone.

With new research linking lung cancer deaths and heart attacks to power plant pollution, Clear the Air commissioned Abt Associates to update its 2000 study to reflect this new science and examine different policies being debated at the federal level to clean up power plants. This report summarizes the findings of the Abt Associates study, reviews the contribution of power plants to particle pollution, and compares the relative benefits of the chief policy proposals to reduce power plant fine particle pollution. Key findings include:

• Fine particle pollution from U.S. power plants cuts short the lives of nearly 24,000 people each year, including 2800 from lung cancer.

• The average number of life-years lost by individuals dying prematurely from exposure to particulate matter is 14 years.

• Hundreds of thousands of Americans suffer each year from asthma attacks, cardiac problems, and respiratory problems associated with fine particles from power plants. These illnesses result in tens of thousands of emergency room visits, hospitalizations, and lost work days each year.

• Power plant pollution is responsible for 38,200 non-fatal heart attacks per year.

• The elderly, children, and those with respiratory disease are most severely affected by fine particle pollution from power plants.

• People who live in metropolitan areas near coal-fired plants feel their impacts most acutely – their attributable death rates are much higher than areas with few or no coal-fired plants.

The vast majority (at least 90 percent or 22,000) of the deaths due to fine particle pollution could be avoided by capping power plant sulfur dioxide and nitrogen oxide pollution at levels consistent with the installation of today's best available emissions controls.

Compared with the requirements of current law, the Bush Administration's so-called "Clear Skies" proposal would result in 4,000 additional preventable premature deaths each year while repealing the very safeguards that could save those additional lives.

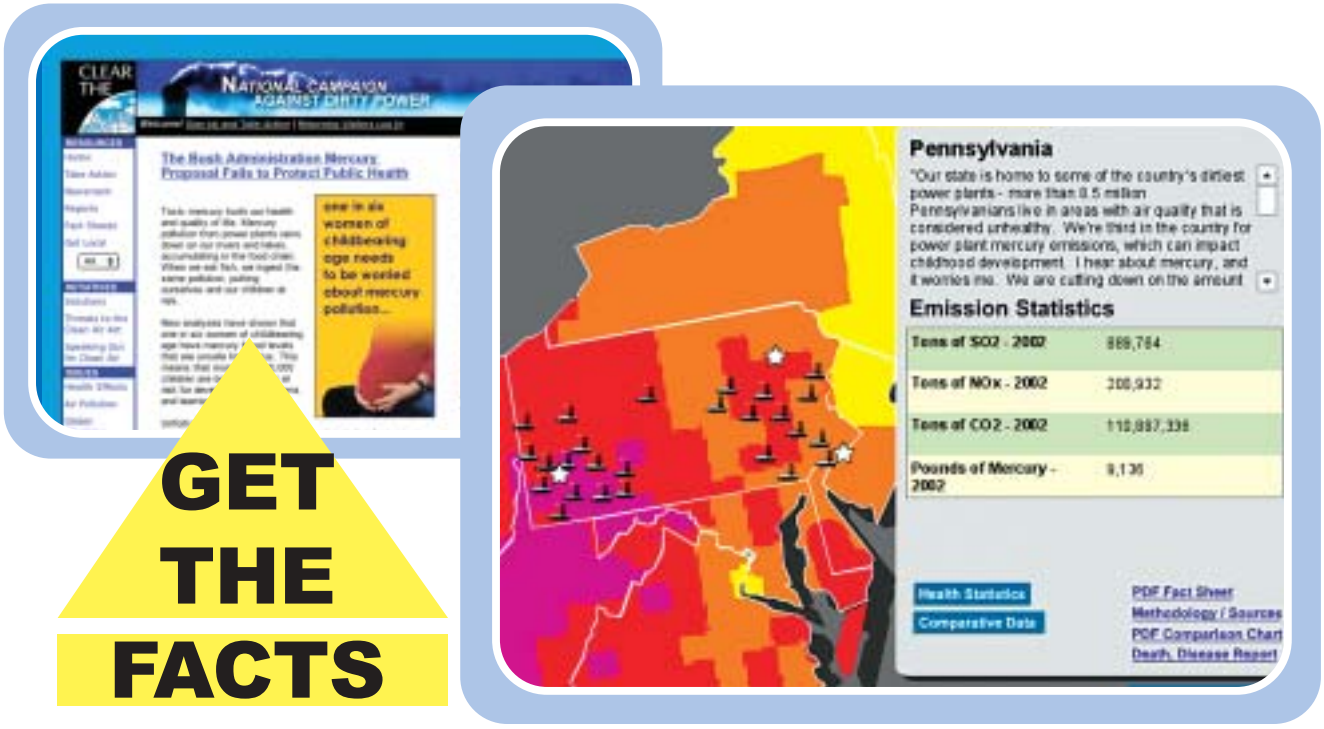
Recommendations

For more than thirty years, the oldest, dirtiest coal-burning power plants have circumvented air emissions standards required of modern power plants. As a result, these "grandfathered" power plants are permitted to emit more than 10 times more nitrogen oxides and sulfur dioxide than modern coal plants. The Bush administration's administrative rollbacks of New Source Review and the statutory rollbacks embodied in its proposed legislation would continue this lethal legacy. Polluting coal-fired plants must be made to comply with modern emission control standards. In addition, the nation's power fleet should be held to stringent caps on all four key power plant pollutants, including nitrogen oxides, sulfur dioxide, mercury, and carbon dioxide.

Requirements such as these can ensure that U.S. energy policy better accounts for the public health and environmental costs associated with electricity production and will propel us toward a more sustainable energy future.

Hundreds of thousands of Americans suffer each year from asthma attacks, cardiac problems, and respiratory problems associated with fine particles from power plants.

Your Air On the Web



On Power Plant Pollution

To learn more about:

- The problem of power plant pollution in your state or metropolitan area;
- The extent to which the Bush plan falls short of current law; and
- How proposals to strengthen the Clean Air Act can improve health in your community.

Go to: www.cleartheair.org/dirtypower

There, using the latest in Flash™ animation technology, you can:

- View a dynamic comparison of the risk of premature death under the Bush plan, current law, and the bipartisan proposal to strengthen the Clean Air Act;
- View the health impacts from power plant pollution in your state or metropolitan area including attributable premature deaths, lung cancer deaths, heart attacks, and asthma attacks; and
- View health impact data and other specific information about specific power plants in your state including premature deaths and pollution statistics.

The Problem: Power Plants

Despite progress over the last decade, Americans are still suffering from the adverse health effects of air pollution. Over the past few decades, medical researchers examining air pollution and public health have shown that air pollution is associated with a host of serious adverse human health effects, including asthma attacks, heart attacks, hospital admissions, and premature death.[1] The adverse health consequences of breathing air pollution caused by emissions from utility power plants are severe and well documented in the published medical and scientific literature.[2]

One of the air pollutants most carefully studied in the last decade is fine particles. Fine particles, such as those that result from power plant emissions, can bypass the defensive mechanisms of the lung and become lodged deep in the lung where they can cause a variety of health problems. Indeed, the latest evidence indicates that short-term exposure not only causes respiratory damage, but also causes cardiac effects, including increasing the risk of heart attacks.[3] Moreover, long-term exposure to fine particles increases the risk of cardiac, respiratory, and lung cancer death and has been estimated to shorten life expectancies of people living in the most polluted cities relative to those living in cleaner cities.[4] The average number of life-years lost by individuals dying prematurely from exposure to particulate matter is 14 years.[5] Moreover, in 2003 researchers documented fine particle-related mortality at low concentrations demonstrating that there is no lower threshold for premature death from the long-term inhalation of particles.[6]

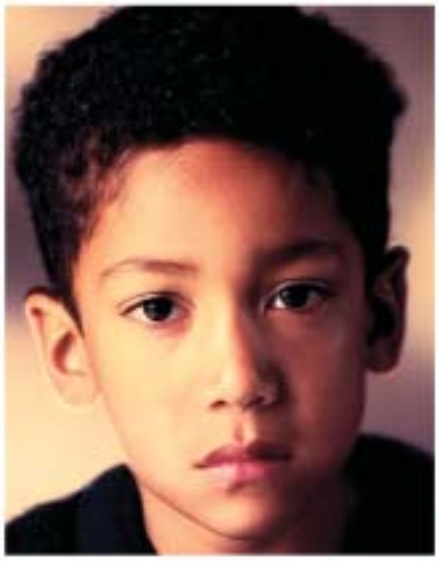
What Are Fine Particles?

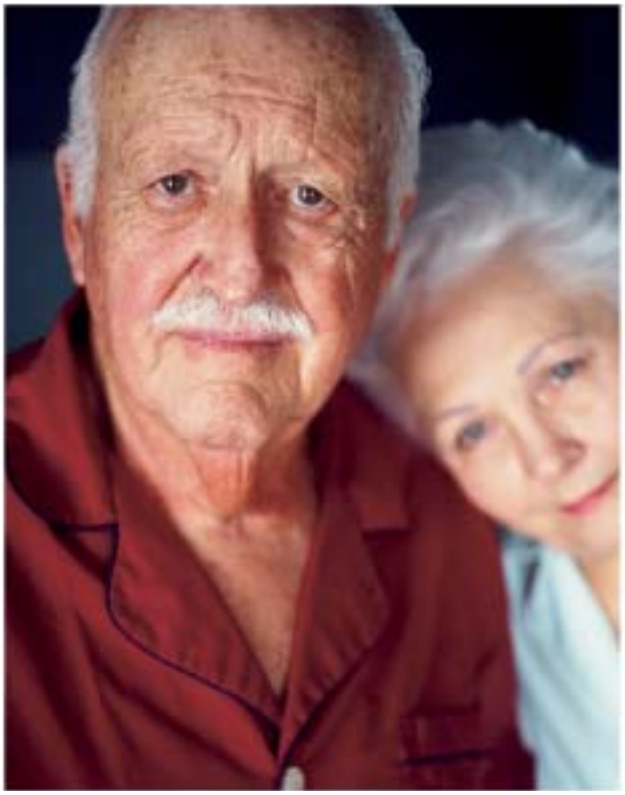
Fine particles are a mixture of harmful pollutants (e.g. soot, acid droplets, metals) that originate primarily from combustion sources such as power plants, diesel trucks, buses, and cars. In 1997 EPA set national health standards for fine particles (referred to EPA as "PM2.5" or particulate matter smaller than 2.5 microns – 2.5 millionths of a meter in diameter – less than one-hundredth the width of a human hair and smaller). Fine particles are either soot emitted directly from these combustion sources or formed in the atmosphere from power plant sulfur dioxide (SO2) or nitrogen oxides (NOx) emissions. Among airborne particles, the smallest (fine) combustion particles are of gravest concern because they are so tiny that they can be inhaled deeply and be absorbed into the bloodstream, thus evading the human lung's natural defenses.

Health Effects of Power Plant Pollutants

Pollutant	What is it?	How is it produced?	Health effects	Most vulnerable populations
Ozone	Ozone is a highly corrosive, invisible gas.	Ozone is formed when nitrogen oxides (NOx) react with other pollutants in the presence of sunlight.	Rapid shallow breathing, airway irritation, coughing, wheezing, shortness of breath. Makes asthma worse. May be related to premature birth, cardiac birth defects, low birth weight and stunted lung growth.	Children, elderly, people with asthma or other respiratory disease. People who exercise outdoors.
Sulfur Dioxide (SO2)	SO2 is a highly corrosive, invisible gas. Sulfur occurs naturally in coal.	SO2 is formed in the gases when coal is burned. SO2 reacts in the air to form sulfuric acid, sulfates, and in combination with NOx, acidic particles.	Coughing, wheezing, shortness of breath, nasal congestion and inflammation. Makes asthma worse. SO2 gas can de-stabilize heart rhythms. Low birth weight, increased risk of infant death.	Children and adults with asthma or other respiratory disease.
Particulate Matter (PM)	A mixture of small solid particles (soot) and tiny sulfuric acid droplets. Small particles are complex and harmful mixtures of sulfur, nitrogen, carbon, acids, metals and airborne toxics.	Directly emitted from coal burning. Formed from SO2 and NOx in the atmosphere.	PM crosses from the lung into the blood stream resulting in inflammation of the cardiac system, a root cause of cardiac disease including heart attack and stroke leading to premature death. PM exposure is also linked to low birth weight, premature birth, chronic airway obstruction and remodeling, and sudden infant death.	Elderly, children, people with asthma.
Nitrogen Oxides (NOx)	A family of chemical compounds including nitrogen oxide and nitrogen dioxide. Nitrogen occurs naturally in coal.	NOx is formed when coal is burned. In the atmosphere can convert to nitrates and form fine acidic particles. Reacts in the presence of sunlight to form ozone smog.	NOx decreases lung function and is associated with respiratory disease in children. Converts to ozone and acidic PM particles in the atmosphere.	Elderly, children, people with asthma.
Mercury	A metal that occurs naturally in coal.	Mercury is released when coal is burned.	Developmental effects in babies that are born to mothers who ate contaminated fish while pregnant. Poor performance on tests of the nervous system and learning. In adults may affect blood pressure regulation and heart rate.	Fetuses and children are directly at risk. Pregnant women, children and women of childbearing age need to avoid mercury exposure.
Carbon Dioxide	Coal has the highest carbon content of any fossil fuel.	Carbon dioxide is formed when coal is burned.	Indirect health effects may be associated with climate change including the spread of infectious disease, higher atmospheric ozone levels and increased heat and cold-related illnesses.	People of Color, children, people with asthma.

The state of the science on fine particles and health has undergone thorough review, as reflected in the recently updated U.S. Environmental Protection Agency (EPA) Criteria Document for Particulate Matter.[7] Since EPA set the fine particle standard in 1997, hundreds of new published studies, taken together, robustly confirm the relationship between fine particle pollution and severe adverse human health effects. In addition, the new research has provided plausible biological mechanisms for the serious impacts associated with fine particle exposure.[8]





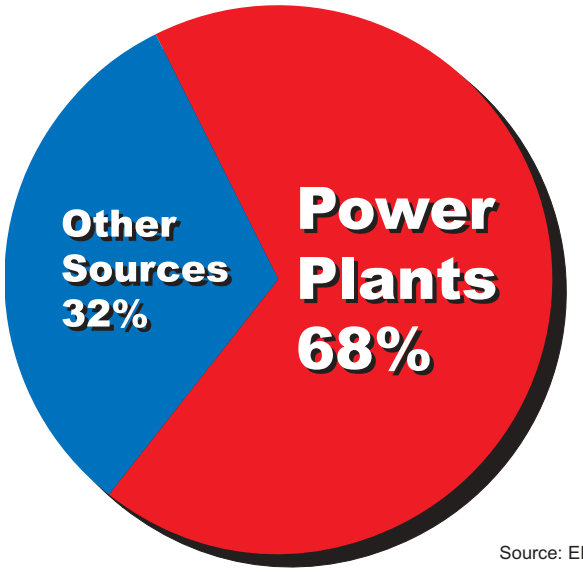
The Face of Air Pollution Today

While all of us are at risk from exposure to power plant pollution, the elderly, people with lung and heart disease, and children are at greatest risk. Young children need healthy lungs to play, learn, and grow into strong adults. School-age kids find participating in sports and even studying difficult when battling respiratory problems such as asthma. Studies estimate that tens of thousands of elderly people die each year from existing levels of fine particle pollution from power plants and other sources.[9] These fine particles are also associated with tens of thousands of hospital admissions annually.[10] Many of these involve elderly people already suffering from lung or heart disease. Respiratory ailments can rob the elderly of the full enjoyment of their sunset years.

Power Plants: The Dominant Source

East of the Mississippi, sulfates are the dominant fine particle species; these particles are mostly from coal-fired powered plants. Nationwide, power plants emit two thirds of the sulfate-forming sulfur dioxide in the U.S. Half of all the electricity in the U.S. comes from coal.[11] However, coal-burning power plants account for nearly 90 percent of the sulfur dioxide emitted by all power plants.[12] Therefore, major reductions in pollution emissions from older coal-fired power plants are critical to reduce the health risk from particulate matter.

Sources of Sulfur Dioxide, 2002



Source: EPA

Breathing fine particles can also hurt individuals of any age with heart disease, emphysema, asthma, and chronic bronchitis by forcing them to require additional medical treatment. People struggling with these ailments try to cope by limiting their exposure to respiratory irritants in their environment, but they cannot control the quality of the outdoor air they breathe.

Air pollution is of special concern for communities of color. For example, in 2000, 71 percent of African Americans lived in counties that violate federal air pollution standards. Similarly, Latinos make up 13 percent of the U.S. population, yet in 2000 more than seven out of 10 Latinos (70 percent) lived in counties that violated federal air pollution standards for one or more pollutants.[13] In addition, 68 percent of African Americans live within 30 miles of a coal-fired power plant — the distance within which the maximum effects of the smokestack plume are expected to occur.[14] In the Midwest, dozens of these coal-burning power plants are located in the middle of heavily Latino communities. The same is true for power plants in the Southwest — specifically in Arizona, New Mexico and Colorado.[15] A recent study supports these observations and found that Hispanic, African-American, and Asian/Pacific Islander mothers experienced higher levels of air pollution and were over twice as likely to live in the most polluted counties compared to white mothers.[16] The study concluded that additional risk of living in areas with poor air quality may exacerbate health problems of infants and children already at increased risk for poor health.

Beyond Any Reasonable Doubt

The hazards of particulate matter have become particularly clear in the past decade's research. Two of the largest landmark studies on particulate matter and death, the Harvard Six Cities Study, published in 1993, followed by the American Cancer Society (ACS) Study in 1995, demonstrated greater risk of premature death from particulate matter in more polluted cities as compared with cities with cleaner air.[17] Fine particles, especially sulfates (largely from power plants), were most strongly associated with excess mortality in polluted cities. The ACS study examined half a million people in more than 150 metropolitan areas throughout the United States and found a 17 percent greater risk of mortality between the city with the least sulfate and particulate matter and the city with the highest levels of particulate pollution. The results of these studies were challenged by industry, resulting in an independent reanalysis by the Health Effects Institute (HEI), which is funded by industry and EPA. In 2000, HEI confirmed the associations found by the original investigators.[18] Furthermore, a recent National Institute of Environmental Health Sciences (NIEHS)-funded extension of the ACS study strengthens the original conclusions of the ACS study and, importantly, now links increased risk of lung cancer to long-term exposure to particulate matter and sulfate air pollution.[19]

Recent epidemiological and toxicological evidence also suggests that the particles resulting from coal-fired power plants are particularly dangerous. Many studies in the published literature have indicated that sulfate particles, which are predominantly formed from coal-fired power plant sulfur dioxide emissions, are more strongly associated with human mortality than other components of particulate matter.

Published analysis of U.S. mortality and particulate matter by source category found that coal combustion-related particles were more strongly associated with variations in annual mortality rates across U.S. cities than were other components of particulate matter.[20] More recently, an analysis by Laden and co-authors at Harvard University of particulate matter sources and daily pollution confirms that coal-combustion particles, along with automobile pollution, are among the particulate matter components that most affect daily variations in mortality.[21]

Researchers estimate that as many as 60,000 people die prematurely each year because of exposure to fine particles.[22] Some researchers believe that the actual figure may even be higher.[23] EPA estimates that attainment of the more protective health standards for fine particles alone could save 15,000 lives per year.[24]

New Findings

In 2000, Abt Associates issued a study commissioned by the Clean Air Task Force for Clear the Air quantifying for the first time the deaths and other health effects attributable solely to the fine particles from power plants. That study tracked the methodology approved at that time by EPA's Science Advisory Board and used by EPA in a variety of regulatory applications. Since that analysis, many additional studies linking fine particles to adverse health effects have been published in peer-reviewed journals. Several studies identified additional associated effects, such as lung cancer deaths, stroke,[25] non-fatal heart attacks,[26] and infant death /Sudden Infant Death Syndrome (SIDS).[27] Also, EPA has updated its methodology, refining the computer models it uses to quantify the benefits of pollution controls. The updated methodology has been reviewed and approved by the National Academy of Sciences. EPA used this updated methodology in estimating the benefits of the Bush administration's proposed power plant legislation.[28]

Moreover, since 2000, the Bush administration and Congress have proposed several new power plant clean up policies.[29] The Clean Air Task Force on behalf of Clear the Air commissioned Abt Associates to reflect the most recent science and compare the benefits of the various competing policy proposals.

This report, "Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios,"[30] finds that nearly 24,000 deaths each year are attributable to fine particle pollution from U.S. power plants. The average number of life-years lost by individuals dying prematurely from exposure to particulate matter is 14 years.[31] Further, the study finds that 22,000 of these

National Power Plant Impacts

Health Effect	Incidence (cases per year)
Mortality	23,600
Hospital Admissions	21,850
Emergency Room Visits for Asthma	26,000
Heart Attacks	38,200
Chronic Bronchitis	16,200
Asthma Attacks	554,000
Lost Work Days	3,186,000

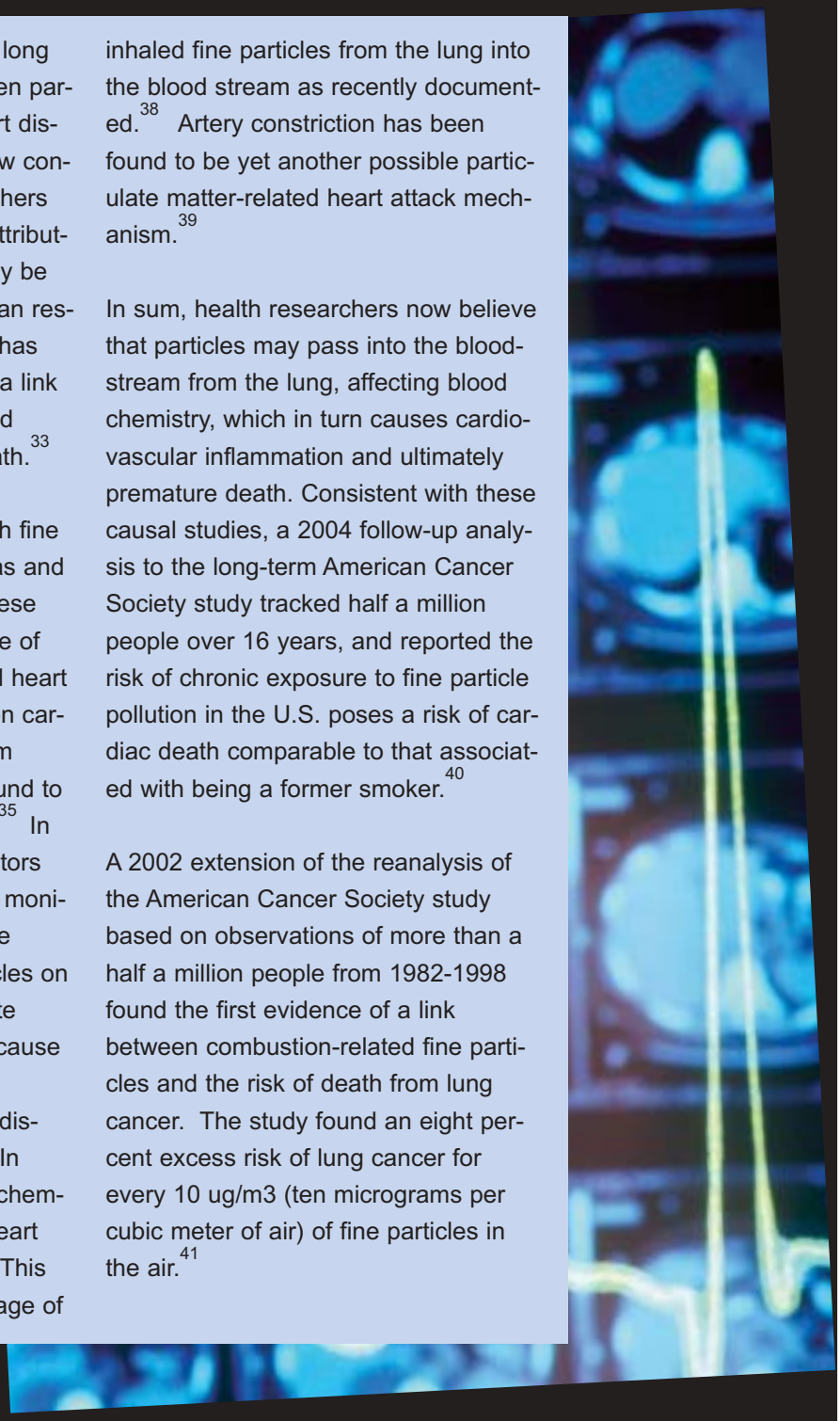
New Studies Link Fine Particles to Heart Attacks and Lung Cancer

Health researchers have long suspected a link between particulate matter and heart disease, but recent studies have now confirmed this link.[32] In fact, researchers believe that most of the deaths attributable to fine particulate matter may be due to cardiopulmonary rather than respiratory disease. A recent study has also, for the first time, confirmed a link between fine particle pollution and increased risk of lung cancer death.[33]

Numerous recent studies link high fine particle levels to heart arrhythmias and heart attacks.[34] Furthermore, these studies have helped identify some of the causes of fine particle-related heart attacks. For example, in a Boston cardiac arrest onset study, short-term changes in fine particles were found to elevate the risk for heart attacks.[35] In other studies, implanted defibrillators and portable "electrocardiogram" monitors have directly documented the adverse effects of elevated particles on heart function.[36] These heart rate studies show that particle levels cause changes in heart rate variability, increasing risk of coronary heart disease and sudden cardiac death. In another study, changes in blood chemistry associated with increased heart attack risk were documented.[37] This may be related to the rapid passage of inhaled fine particles from the lung into the blood stream as recently documented.[38] Artery constriction has been found to be yet another possible particulate matter-related heart attack mechanism.[39]

In sum, health researchers now believe that particles may pass into the bloodstream from the lung, affecting blood chemistry, which in turn causes cardiovascular inflammation and ultimately premature death. Consistent with these causal studies, a 2004 follow-up analysis to the long-term American Cancer Society study tracked half a million people over 16 years, and reported the risk of chronic exposure to fine particle pollution in the U.S. poses a risk of cardiac death comparable to that associated with being a former smoker.[40]

A 2002 extension of the reanalysis of the American Cancer Society study based on observations of more than a half a million people from 1982-1998 found the first evidence of a link between combustion-related fine particles and the risk of death from lung cancer. The study found an eight percent excess risk of lung cancer for every 10 ug/m3 (ten micrograms per cubic meter of air) of fine particles in the air.[41]



deaths could be avoided by requiring the nation's fleet of older, dirty power plants to cut their sulfur dioxide and nitrogen oxide emissions to levels consistent with today's available emissions controls.

The deaths from power plant pollution exceed the death toll from other causes commonly understood to be major public policy priorities. For instance, drunk driving causes more than 17,000 deaths per year.[42] There are more than 20,000 homicides in the U.S. each year.[43] Moreover, the 22,000 power plant pollution-related deaths per year that could be avoided by cleaning up the nation's power plants are two times the 11,000 automobile fatalities avoided each year through the use of safety belts.[44]

States: Health Impacts (Annual)

Rank	State	Mortality	Hospital Admissions	Heart Attacks
1	Pennsylvania	1,825	1,664	3,329
2	Ohio	1,743	1,638	2,873
3	Florida	1,416	1,367	2,145
4	Illinois	1,356	1,333	2,361
5	New York	1,212	1,191	2,455
6	Texas	1,160	1,105	1,791
7	North Carolina	1,133	1,013	1,603
8	Virginia	989	895	1,421
9	Michigan	981	968	1,728
10	Tennessee	952	804	1,276
11	Georgia	946	837	1,352
12	Indiana	887	845	1,491
13	Missouri	754	699	1,237
14	Kentucky	745	639	1,022
15	Maryland	687	631	1,014

States: Per Capita Deaths

Rank	State	Total Mortality (annual)	Mortality Risk Per 100,000 adults
1	West Virginia	399	33.1
2	Kentucky	745	28.2
3	Tennessee	952	25.1
4	Ohio	1,743	24.6
5	Indiana	887	23.3
5	Pennsylvania	1,825	23.3
7	Arkansas	395	22.8
8	Alabama	643	21.9
9	North Carolina	1,133	21.5
10	Virginia	989	21.2
11	Missouri	754	21.1
12	South Carolina	564	20.7
13	Maryland	687	19.9
14	Mississippi	337	19.1
15	Oklahoma	400	18.6

The Abt Associates analysis further shows that hundreds of thousands of Americans suffer from asthma attacks, cardiac problems, and respiratory ailments associated with fine particles from power plants. These health damages result in thousands of respiratory and cardio-pulmonary related hospitalizations and emergency room visits annually as well as hundreds of thousands of lost work and school days each year. For instance, the study finds that power plant pollution causes more than 38,200 heart attacks and 554,000 asthma attacks per year.

Respiratory distress severe enough to require a trip to the emergency room can be a terrifying experience for patients and their families. Victims of asthma attacks say that during an attack they wonder if and when their next breath will come. In addition to these serious physical and emotional costs, air pollution also wracks up large monetary costs. Emergency room and hospital treatment costs can cripple a family financially. The average stay for a respiratory ailment lasts about a week.[45] Bouts of respiratory illness and asthma attacks mean lost workdays for workers and lost productivity for their employers. And, although priceless, in a variety of contexts we place a monetary value on the loss of a human life. Using accepted valuation methodology employed by EPA in recent regulatory impact analyses and for the Bush administration's bill, Abt Associates finds that the total monetized health costs of U.S. power plant pollution is a staggering $167.3 billion annually.[46]

By modeling the impact of power plant pollution throughout the lower 48 states, Abt Associates developed health impact estimates for every state and major metropolitan area. Not surprisingly, states with large populations in close proximity to many coal-fired power plants fared the worst.

Conversely, states with large populations but without coal-fired power plants fared much better. For example, California, which has the nation's largest population and some of its worst air quality, has few coal or oil-fired plants. Abt Associates estimates that only 249 deaths are attributable to power plant pollution in California, and the state ranked 46th in per capita impact (number of deaths per 100,000 adults). West Virginia, a state heavily reliant on coal for electricity production, ranked first in related per capita mortality with more than 33 deaths per 100,000 adults, or more than 25 times higher than California's per capita mortality rate.

Similarly, metropolitan areas with large populations in relative proximity to coal-fired plants feel their impacts most acutely. In such large metropolitan areas, many hundreds of lives are shortened each year.

However, much smaller metropolitan areas in and around "coal country," such as Wheeling, West Virginia; Steubenville, Ohio; Cumberland, Maryland; and Johnstown, Pennsylvania, suffer the greatest per capita impacts. Their death rates are much higher, for example, than that of New York City. For instance, the mortality rate from power plant pollution is 35 deaths per 100,000 adults in Pittsburgh, Pennsylvania compared with nine per 100,000 in New York City.

In fact, because these health effects estimates include only the effects from airborne fine particles, they sig-

Metro Areas: Health Impacts (Annual)

Rank	Metro Area	Mortality	Hospital Admissions	Heart Attacks
1	New York, NY	1,002	1,008	2,098
2	Chicago, IL	855	848	1,519
3	Pittsburgh, PA	563	506	990
4	Philadelphia, PA	559	505	1,007
5	Washington, DC	515	524	851
6	Detroit, MI	446	439	783
7	Atlanta, GA	436	409	672
8	St. Louis, MO	368	339	599
9	Baltimore, MD	357	311	496
10	Cincinnati, OH	319	300	517
11	Cleveland, OH	308	287	502
12	Dallas, TX	290	288	476
13	Tampa, FL	265	244	380
14	Miami, FL	247	250	393
15	Indianapolis, IN	223	211	376
16	Columbus, OH	218	211	379
17	Boston, MA	215	221	461
18	Louisville, KY	204	182	293
19	Houston, TX	203	199	334
20	Kansas City, MO	191	192	345

Metro Areas: Per Capita Deaths

Rank	Metro Area	Total Mortality (annual)	Mortality Risk Per 100,000 adults
1	Wheeling, WV	38	38.2
2	Cumberland, MD	23	36.0
3	Steubenville, OH	31	35.9
4	Charleston, WV	74	35.6
5	Pittsburgh, PA	563	35.6
6	Huntington, WV	65	35.5
7	Johnstown, PA	33	34.0
8	Harrisonburg, VA	21	33.0
9	Kingsport, TN	52	32.7
10	Parkersburg, WV	35	32.3
11	Bristol, TN	15	32.1
12	Terre Haute, IN	33	31.9
13	Morgantown, WV	21	31.6
14	Morristown, TN	27	31.5
15	Owensboro, KY	22	31.0
16	Blacksburg, VA	26	30.6
17	Gadsden, AL	21	30.4
18	Altoona, PA	25	30.2
19	Knoxville, TN	128	29.9
20	Youngstown, OH	115	29.9

Health effects such as the impacts from eating fish contaminated by power plant mercury emissions are often excluded from estimates.

nificantly understate the total adverse impact on public health from power plant pollution.[47] Excluded from these estimates are the health effects from other power plant pollutants, such as air emissions that result in ozone smog, air toxics, and global warming, as well as the impacts from the consumption of fish contaminated by power plant mercury emissions.

Competing Cleanup Proposals

Mindful of these concerns, in 1999, Senators James Jeffords (I-VT), Joseph Lieberman (D-CT), and Susan Collins (R-ME) and Representatives Henry Waxman (D-CA) and Sherwood Boehlert (R-NY) introduced aggressive multi-pollutant legislation that would set stringent caps on nitrogen oxides, sulfur dioxide, mercury, and carbon dioxide within a decade. The "Jeffords bill" would set plant-by-plant mercury emissions limits and contains a "birthday" provision that would require plants to install modern pollution controls for nitrogen oxides and sulfur dioxide by a plant's 40th birthday. The Jeffords bill also would begin a serious effort to reduce carbon by capping power sector carbon dioxide emissions at 1990 levels.[48]

The public's support for power plant clean up grew over time and as a candidate for the presidency in the year 2000, George W. Bush pledged support for legislation to reduce significantly all four power plant pollutants.[49] Within 60 days of his inauguration, however, President Bush reneged on this campaign promise and refused to include carbon dioxide in the legislation.[50]

In the summer and fall of 2001, EPA began to develop three-pollutant legislation that would couple nationwide caps on nitrogen oxides, sulfur dioxide, and mercury with the repeal of all or most of the Clean Air Act requirements relating to power plant emissions. The original agency proposal was developed with the goal of delivering at least as much clean up of sulfur dioxide, nitrogen oxides, and mercury emissions in a time frame consistent with that required under current law, while gaining the purported efficiency advantages of a cap-and-trade program.

Comparison of Major Provisions of S.366 (Jeffords/Lieberman/Collins), S. 843 (Carper/Gregg/Chafee), S. 485 (Bush Administration), EPA 2001 Proposal, & EPA Proposed Interstate Air Quality, Regional Haze, and Mercury MACT Rules

	Nitrogen Oxides (NOx)	Sulfur Dioxide (SO2)	Mercury (Hg)	Carbon Dioxide (CO2)	New Source Review	Effect on other CAA Programs
Jeffords/ Lieberman/ Collins Clean Power Act S.366	1.51 million ton cap by 2009	2.255 million ton cap by 2009	5 ton cap by 2009. Each plant limited to 2.48 grams of mercury per 1000 megawatt hours, or less as determined by EPA	2.05 billion ton cap by 2009	No Change to existing law	No changes to visibility or air toxics sections of existing law
Bush Clear Skies Act S.485	2.1 million ton cap by 2008 1.7 million ton cap by 2018	4.5 million ton cap by 2010 3 million ton cap by 2018	34 tons per year by 2010 (trading allowed) 15 tons per year by 2018. Sources can avoid emission reductions through mercury emission credit trades	No limit on CO2 emissions	Would practically eliminate new source review for new and existing power plants	Would eliminate visibility and interstate air pollution protections, delay attainment of NAAQS and repeal power plant air toxics controls
Carper/Gregg/ Chafee Clean Air Planning Act S.843	1.87 million ton cap by 2009 1.7 million ton cap by 2013	4.5 million ton cap by 2009 3.5 million ton cap by 2013 2.25 million tons by 2016	24 tons by 2009 10 tons by 2013 Each unit must cut emissions to 50% of the mercury in delivered coal by 2009 and 70% of Hg in coal by 2013, or meet an alternative output emission rate. Limited mercury emission trading and banking is allowed	Power plant emissions capped at year 2006 level for calendar years 2009-2012 Power plant emissions capped at year 2001 level by 2013 and beyond	Retains NSR for new plants, but eliminates offsets for new sources with reductions from other sources; also limits cost of new source controls Performance standards for all plants in 2020 of 4.5 lbs/MWh SO2 and 2.5 lbs/MWh NOx	Would eliminate the requirement for a Mercury MACT standard for power plants Would grant a 20 year exemption from BART requirements in the visibility provisions of existing S169A
EPA 2001 Proposal	1.87 million ton cap by 2008 1.25 million ton cap by 2012	2 million ton cap by 2010	24 ton cap by 2008 7.5 ton cap and a 70% facility-specific reduction requirement by 2012	No limit on CO2 emissions	Would repeal new source review for existing power plants	Would replace nearly every CAA program applicable to power plants except NAAQS
Proposed Interstate Air Quality Rule, Regional Haze/ Best Available Retrofit Technology (BART) Rule, and Mercury Rule	2.4 million ton cap by 2010 2.1 million ton cap by 2015	4.6 million ton cap by 2010 3.5 million ton cap by 2015	MACT proposal: 34 tons by 2008 Section 112(n) trading alternative: 34 tons by 2010 Section 111 cap and trade alternative: 34 tons by 2010 and 15 tons by 2018	No limit on CO2 emissions	Final rule may include NSR rollbacks	N/A

Several of the proposals delay rules to clean up haze in our national parks.

Because the caps in the proposal were meant to replace the corresponding provisions of the Clean Air Act, EPA first estimated the reductions that would be achieved through full and faithful implementation of the Clean Air Act and then devised caps that would achieve the same level of reductions. The resulting "Straw" proposal was then circulated for interagency and White House review.[51]

After intense lobbying by the power industry, the caps in the "Straw" proposal were significantly weakened while the full panoply of Clean Air Act rollbacks was retained. The result was the Bush administration's so-called "Clear Skies" proposal. Because it supplants the requirements of the current Clean Air Act with reductions that are much less stringent and that will take effect over a much longer time frame than the "Straw" proposal, the Administration's bill rolls back the Clean Air Act.[52]

To date, neither the Jeffords bill nor Bush's bill has been able to garner sufficient support for passage. Seeking to break this gridlock, Senator Tom Carper (D-DE), along with Senators Lincoln Chafee (R-RI), Lamar Alexander (R-TN), and Judd Gregg (R-NH) in 2003 introduced alternative legislation that "splits the difference" between the Jeffords and Bush proposals. On the one hand, the caps in the Carper bill are not as stringent as those in the Straw or Jeffords proposals. On the other hand, the Carper bill contains only partial rollbacks of the current Clean Air Act, as compared with the Bush plan, but still repeals the New Source Review program as it applies to existing plants, weakens technology standards for new plants, repeals the program designed to reduce toxic mercury pollution from each and every power plant, and delays the implementation of rules to protect national park visibility.[53]

In the absence of legislative action on its proposal, EPA has proposed regulations to implement similar caps administratively. The "Interstate Air Quality Rule" (IAQR) would cap the emissions of power plant nitrogen oxides and sulfur dioxide in the eastern U.S. at levels comparable to those proposed in the Bush bill.[54] EPA also proposed a rule in 2004 to review and update emissions controls on old power plants throughout the U.S. in an effort to cut air pollution that causes the haze that impairs scenic vistas in our national parks. This rule would effectively extend the proposed IAQR cap to the entire nation.[55] Lastly, EPA has proposed a power plant mercury rule that would require no more overall mercury reduction from power plants than would be achieved as a co-benefit of these proposed caps for nitrogen oxides and sulfur dioxide.[56]

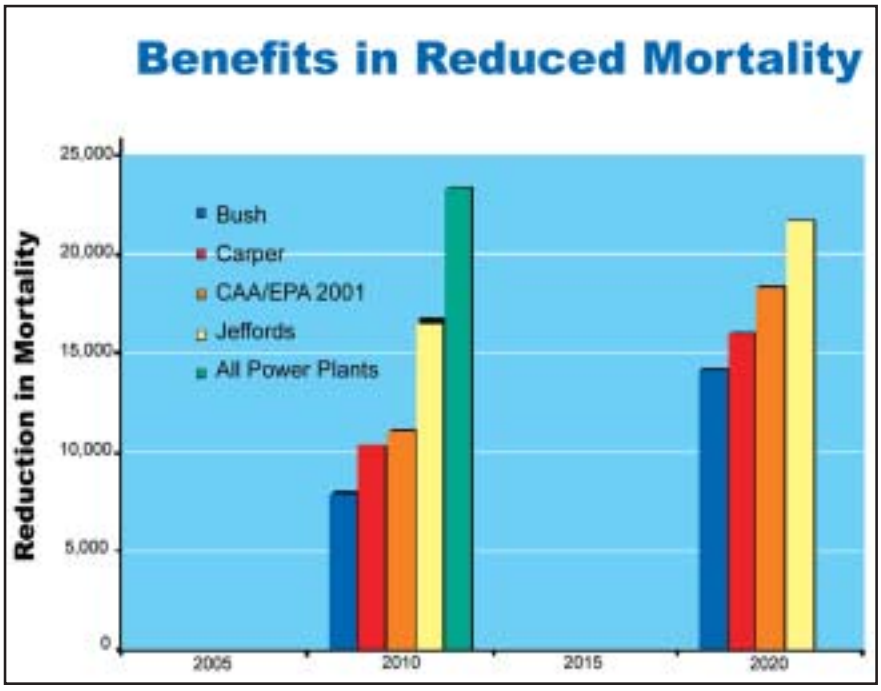
The target caps for each of the proposals are detailed in the table on the previous page.

Calculating the Benefits of Power Plant Cleanup

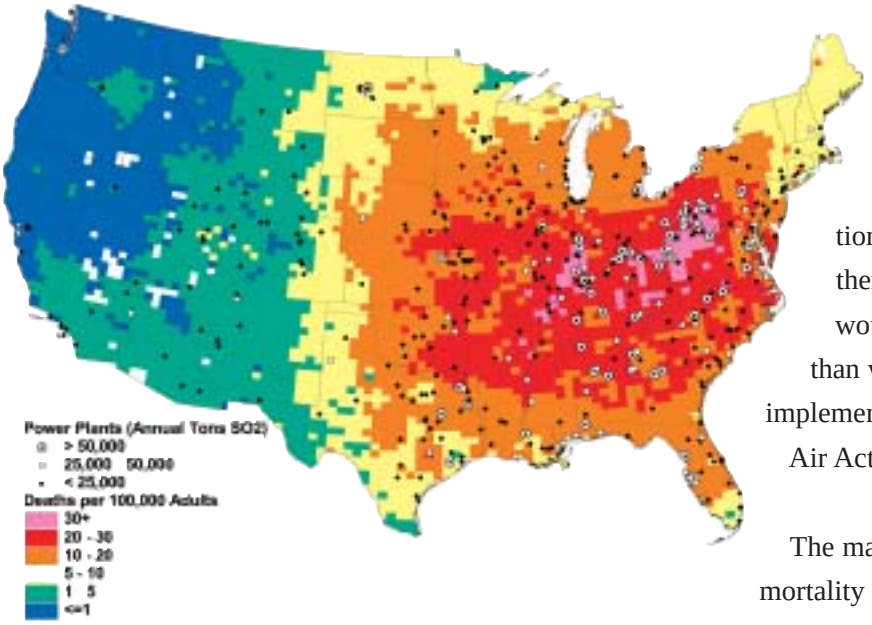
Recent policy analyses have quantified some of the potential health benefits of cleaning up emissions of sulfur dioxide and nitrogen oxides from the nation's fossil-fuel power plants. These analyses generally rely on methodology prescribed by U.S. EPA's Science Advisory Board (SAB) for quantifying the benefits of air regulatory actions in Regulatory Impact Analyses and in the prospective and retrospective studies of benefits of the Clean Air Act. For example, using this methodology, EPA estimated that attainment of the National Ambient Air Quality Standard (NAAQS) for fine particulate matter would avoid more than 15,000 premature deaths per year and hundreds of thousands of asthma attacks.[57] For purposes of cost-benefit analysis, these benefits can be monetized. When the Bush administration introduced its power plant legislation in Congress, EPA released a benefits analysis of the bill using the SAB methodology.[58] This type of analysis can be used to compare the benefits of the various power plant clean up proposals.

Now, for the first time, the Clean Air Task Force and Abt Associates, using EPA's SAB-approved methodology and the identical modeling platforms used by EPA in calculating the benefits of the Administration's bill, have tallied the relative benefits of EPA's original 2001 proposal, the Jeffords bill, and the Carper bill in order to compare them to the benefits of the Bush bill. The benefits of each bill in avoided premature deaths per year are summarized in the bar chart at right.

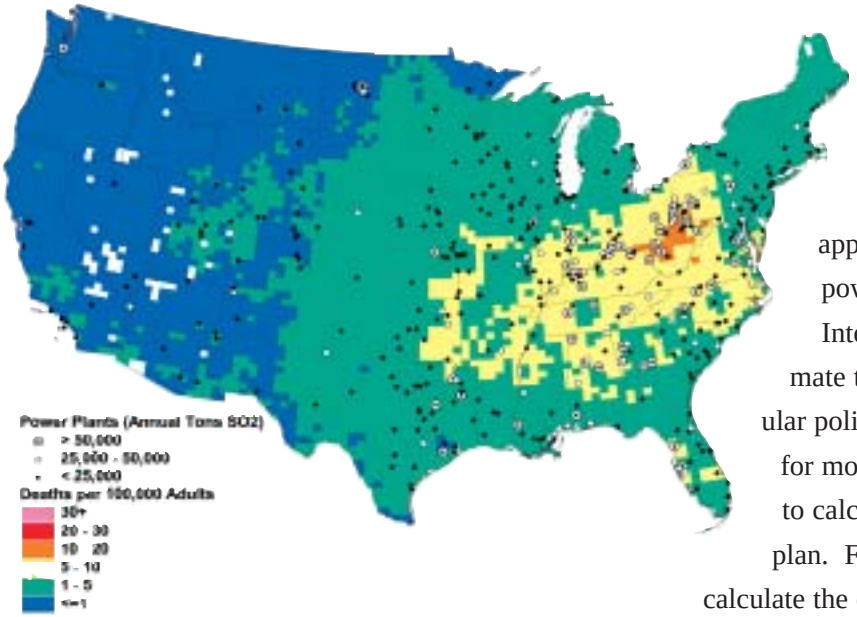
By 2020, the Jeffords bill would save 100,000 more lives than the Bush administration's bill.



Power Plant Deaths Per 100,000 Adults...



... and under the Jeffords Bill in 2020



With its tighter caps and faster implementation, the bipartisan proposal to strengthen the Clean Air Act (Jeffords bill) virtually eliminates the health impacts from power plants. For example, the Jeffords bill would avoid 22,000 of the 24,000 total power plant-related deaths per year. By 2020, the Jeffords bill would save 100,000 more lives than the Bush administration's bill and 8,000 more lives every year thereafter. Moreover, the Bush plan would mean 4,000 more deaths in 2020 than would be saved each year by faithful implementation of the requirements of the Clean Air Act applicable to power plants.

The maps on these pages illustrate the risk of mortality (deaths per 100,000 adults) nationwide under each bill.

As can be seen from these maps, the areas of greatest per capita risk from power plant pollution come in areas with heavy concentrations of coal-fired power plants. The Jeffords bill would virtually eliminate this risk, while the Bush plan would cut that risk by less than half in the most heavily-polluted areas.

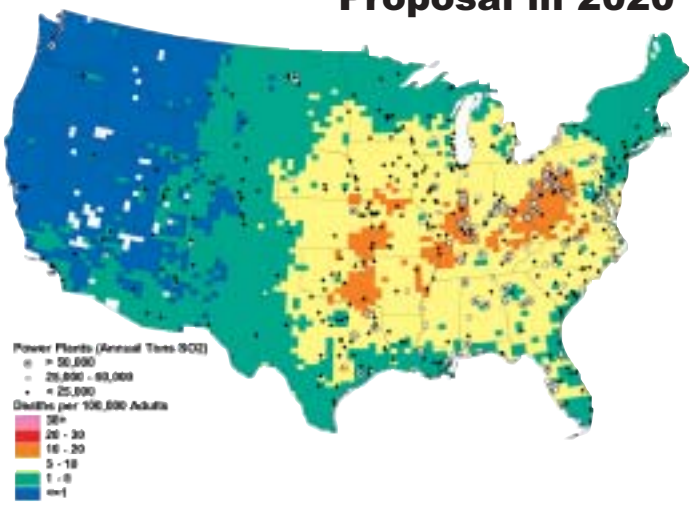
As a first step in determining the emissions under each plan, the SAB-approved methodology begins by running a power system economic model (the Integrated Planning Model or IPM) to estimate the power system's response to a particular policy. See Methodology Section page 28 for more detail. The IPM model also allows us to calculate the costs of a proposed clean up plan. For example, EPA used the IPM model to calculate the cost of compliance with the Bush bill.

Likewise, Clean Air Task Force commissioned ICF Consulting as part of this report to use the IPM model, exactly as EPA specified the model in its "Clear Skies" modeling runs, to estimate the power system response to each of the competing scenarios examined in this report: the Jeffords bill, EPA's 2001 proposal, and the Carper bill. ICF also provided us with cost estimates for each of these proposals.

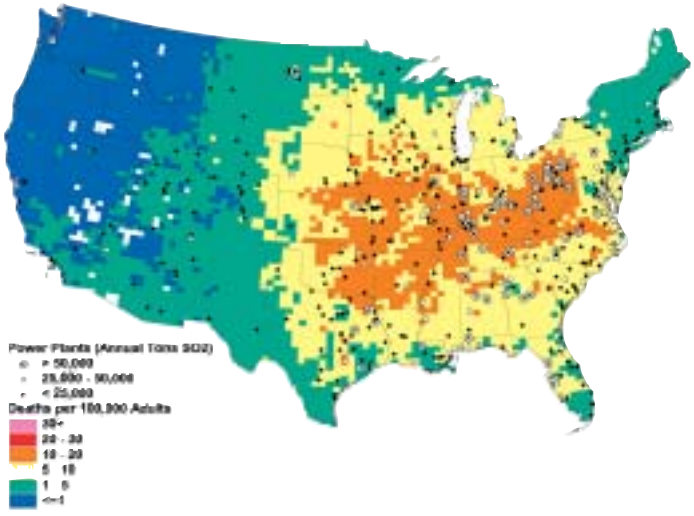
The cost estimates here of a proposal, such as the Jeffords bill, that leaves the underlying requirements of the Clean Air Act intact are greatly overstated because they attribute the full cost of the pollution reductions to the bills themselves when faithful implementation of the Clean Air Act also would reduce pollution – and increase costs. The cost of the Jeffords bill, then, would most accurately be reflected by the difference between the cost of faithful implementation of the Clean Air Act and the incremental additional cost of strengthening the Act as proposed in the Jeffords bill. Secondly, the IPM model assumptions used by EPA to gauge the costs of the Bush administration's bill fail to include a "demand response" function. We know that in the real world as electricity prices rise, people will tend to use less electricity. That is, as price rises, demand is curtailed by some amount. If, as a result of a reduction in demand, less electricity is needed and less is produced, this results in a lower total cost of electricity production than would otherwise be the case. IPM as specified by EPA fails to account for this effect and thus overstates the cost of power plant clean up policies that increase electricity prices.

Moreover, different cost models yield different outcomes even when evaluating the same policy scenarios. For example, the Energy Information Administration's recent modeling of the Bush bill

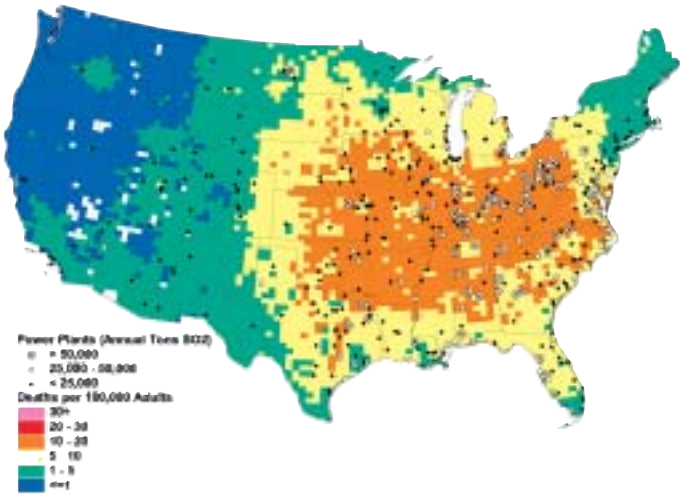
... and under the Clean Air Act/EPA Proposal in 2020



... and under the Carper Bill in 2020



... and under the Bush administration's bill in 2020



yielded different results than EPA's IPM analysis.[59] Nevertheless, the IPM model does provide a basis to estimate the relative costs of the competing policy scenarios to each other and allows us to add an estimate of cost to a cost-benefit comparison of the scenarios.

The table below displays the relative costs and benefits of each of the four proposals.

EPA is under a standing Executive Order to choose among regulatory and policy alternatives that result in the greatest net benefits (i.e., benefits – costs = net benefits).[60] According to EPA's own benefits methodology, all of the competing proposals yield greater net benefits than the Bush bill. Indeed, the Jeffords bill yields the greatest net benefits of all the proposals.

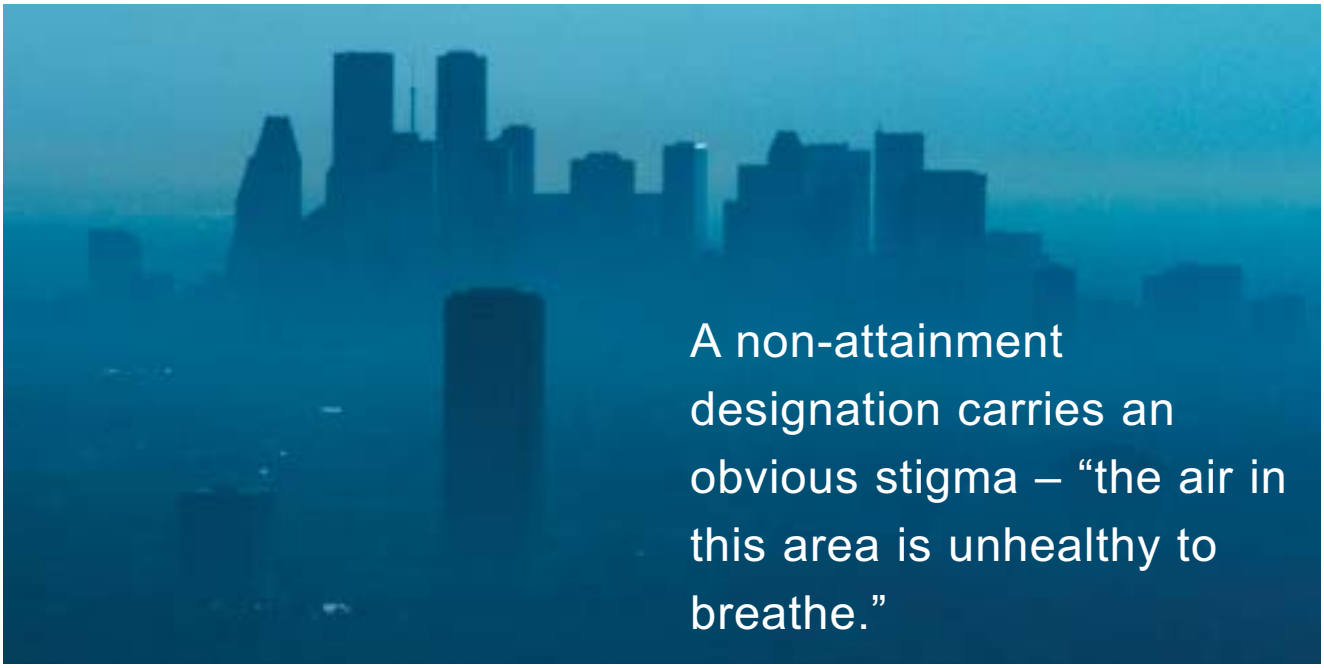
Annual Costs and Benefits of the Alternative Scenarios in 2020

(all costs and benefits in billions of dollars compared to the base case)

Scenario	Bush Bill	Carper Bill	CAA/EPA 2001	Jeffords Bill
Costs ($B)	6.2	9.3	10.9	34.0
Benefits ($B)	113.8	130.4	148.0	175.5
Net Benefits ($B)	107.6	121.1	137.1	141.5
Lives saved (2020)	14,000	16,000	18,000	22,000

While we have fundamental concerns about attempting to reduce human death, illness, and misery into dollars, it is important to note the monetized health costs the administration's proposal would impose on the public. In the year 2020, the original EPA 2001 proposal (i.e., the scenario consistent with the requirements of current law) would cost industry $4.7 billion dollars more to implement than the Administration's bill. However, in the same year, the original EPA proposal would produce $34 billion in additional benefits beyond those expected from the Bush administration's bill due to additional reductions in premature death and disease. The White House chose a plan that would inflict an additional $34 billion a year in health damages on the public in order to save power plant owners $4.7 billion in compliance costs. In choosing to weaken the Clean Air Act via its bill, the Bush administration would allow the power industry to continue to stick the American people with $34 billion per year in health damages, who bear that cost in the form of preventable disease and death.

Finally, the Jeffords bill, because of its stringent provisions and timetable that strengthen the Clean Air Act, would eliminate nearly 90 percent of all power plant-related deaths and other health effects, in addition to requiring significant cuts in mercury and carbon dioxide (consistent with the 1992 Rio Treaty on climate change). Indeed, in 2020 for a total of $34 billion in cost, the Jeffords bill would yield total health benefits of $175 billion per year ($60 billion more per year than the Bush administration's bill) and avoid nearly 22,000 premature deaths per year.



Attainment Benefits

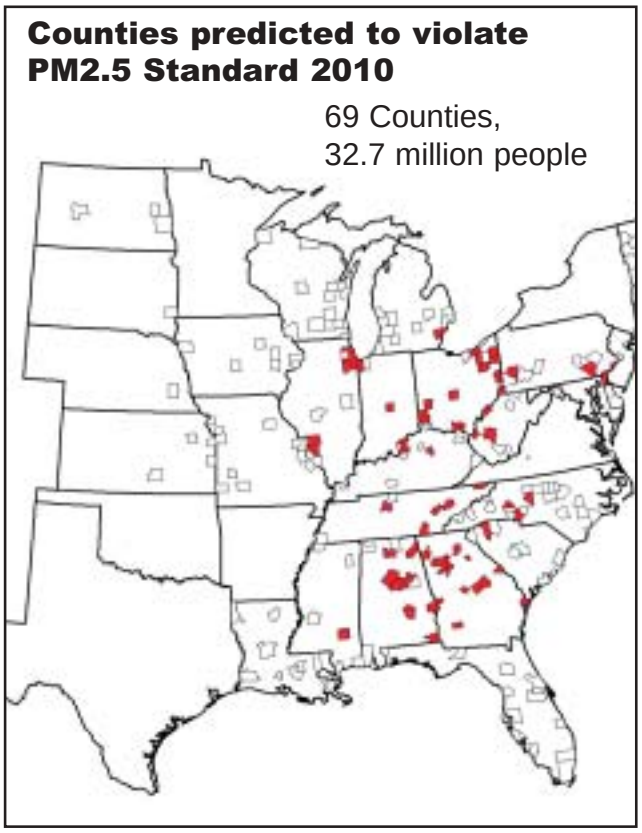
In December 2004, EPA will propose the designation for the first time of hundreds of counties as out of attainment with national ambient air quality standard for fine particles originally promulgated in 1997.[61] Under the Clean Air Act, these areas are required to achieve attainment by 2010.[62] The designations will be based on air quality measurements from a network of monitors located in certain counties around the country.[63]

Nonattainment status presents serious concerns for a community. First and foremost, nonattainment designation is an official declaration that the air fails to meet federal health standards. Such a classification carries an obvious stigma – “the air in this area is unhealthy to breathe.” For emissions sources within the area, such as local businesses and vehicles, nonattainment can mean paying the cost of pollution controls to reduce pollution produced in the area. Moreover, because the law requires new emission sources within a nonattainment area to offset their emissions so that they do not add to the problem, nonattainment can present an obstacle to business development. Areas branded nonattainment usually seek to achieve attainment status as quickly as possible for the least cost – both monetary and political.

As part of its benefits analysis of the Administration’s bill, EPA used modeling analysis to predict the counties that would attain the standard under its caps. Using EPA’s methodology, Abt Associates was able to replicate that analysis for each of the com-

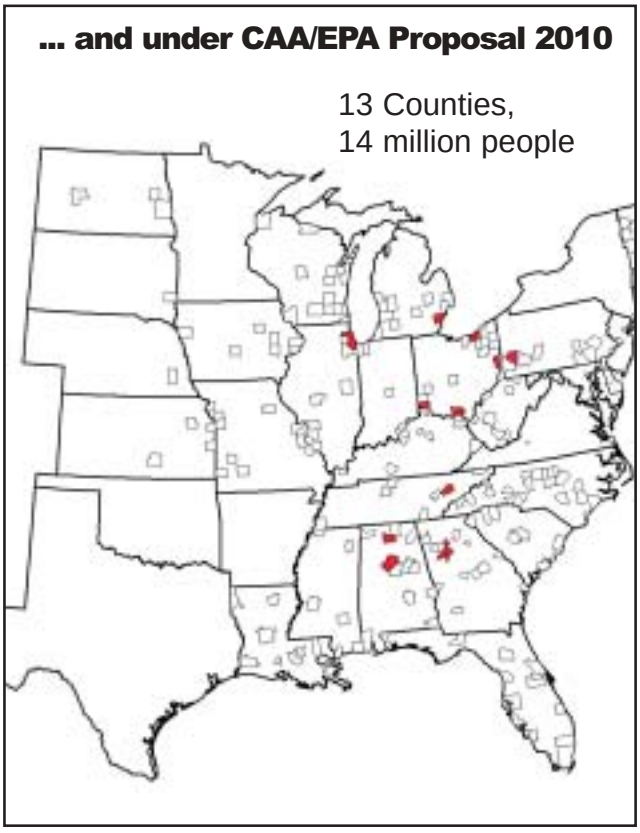
Counties Violating Fine Particle (PM2.5) Health Standard in 2010

Scenario	Base 2010	Bush Bill	Carper Bill	CAA/EPA 2001	Jeffords Bill
Number of Counties	69	27	16	13	5
Population (in millions)	32.7	19.1	15.6	14	10.3

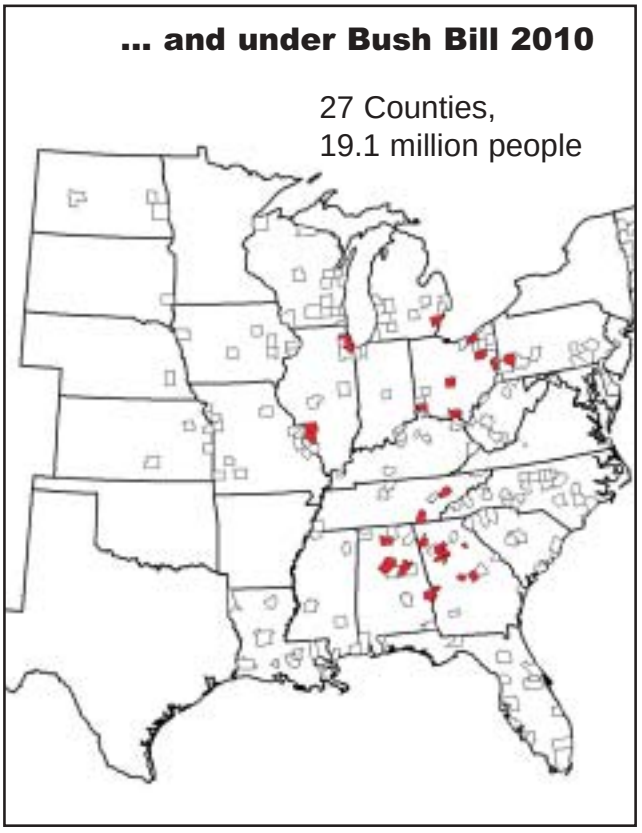


peting power plant clean up proposals. Under the Jeffords bill in the eastern U.S. by 2010, all but five counties would achieve attainment. By contrast, under the Bush plan, 27 eastern counties, home to more than 19 million people, would still be out of attainment in 2010.

In sum, the Jeffords bill yields more tons reduced, more lives saved, more adverse health effects avoided, and fewer areas in nonattainment. Because of its stringent carbon dioxide requirements, the Jeffords bill drives even greater reductions in power plant nitrogen oxides and sulfur dioxide than would be required under the Clean Air Act.

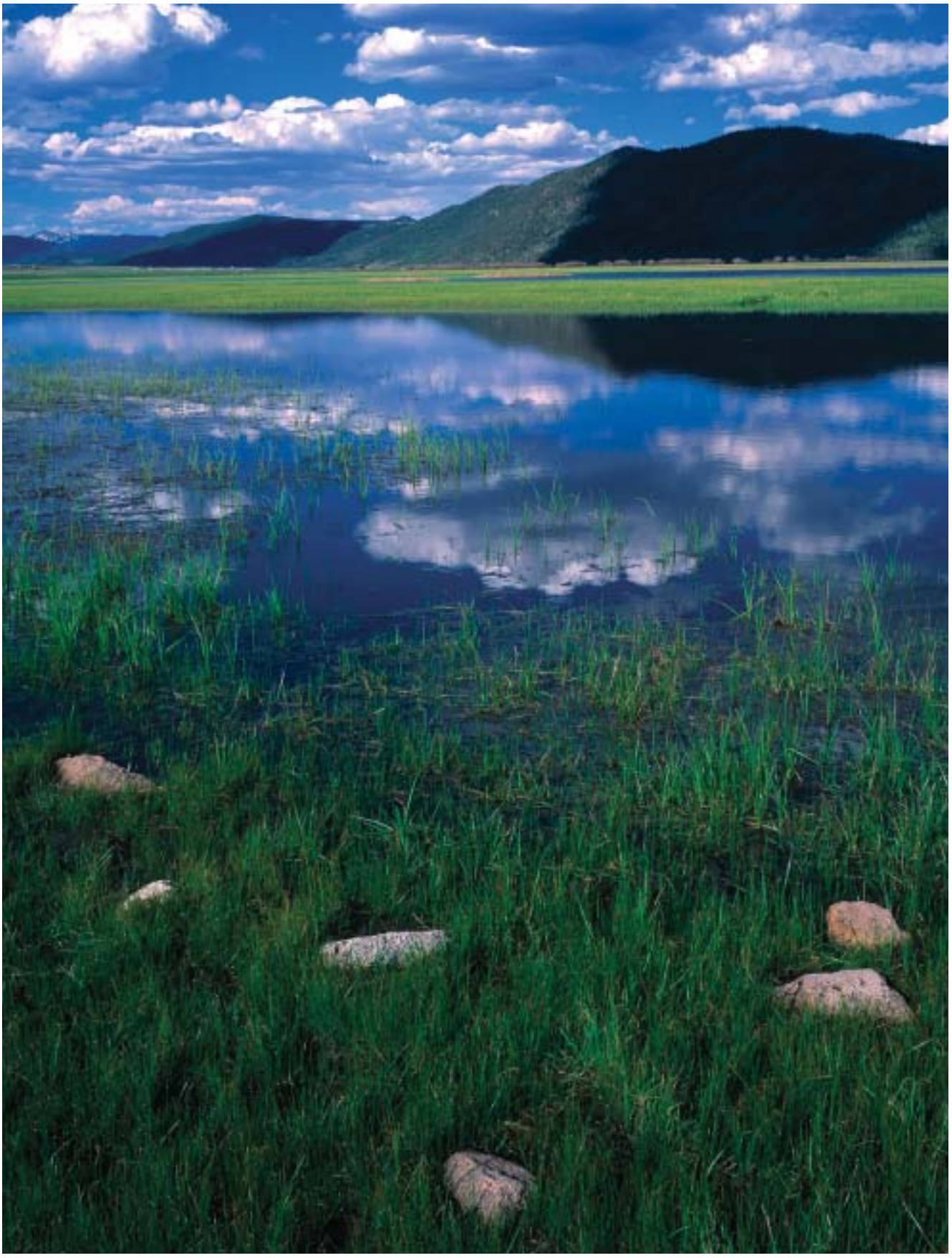


In sum, the Jeffords bill yields more tons reduced, more lives saved, more adverse health effects avoided.



It's Time To Clear The Air

Steep reductions in power plant emissions are needed to protect Americans from power plant particle pollution. Polluting coal-fired plants must be made to comply with modern emissions control standards. In addition, the nation's power fleet should be held to nationwide caps on all four key power plant pollutants, including nitrogen oxides, sulfur dioxide, mercury, and carbon dioxide. Reducing power plant nitrogen oxides and sulfur dioxide levels by at least 75 percent this decade will dramatically reduce fine particle pollution. To achieve the national health-based air quality standard for fine particles on the schedule mandated by the Clean Air Act, these reductions must be made no later than 2010. The deaths, hospitalizations, and lost work time caused by fine particles from power plants can be reduced comprehensively only when the Clean Air Act's 30-year loophole for old, dirty power plants is finally closed. Requirements such as these can ensure that U.S. energy policy better accounts for the public health and environmental costs associated with electricity production and will propel us toward a more sustainable energy future.



Methodology

This type of analysis uses risk assessment methods to attribute mortality and morbidity impacts to groups of pollution sources such as power plants. It rests on the idea that if a pollutant has health effects at current levels (above any threshold), then an incremental reduction will have an incremental public health benefit. The methodology typically involves modeling the economic response of the electric power system to the imposition of costs of pollution reduction, modeling the air quality concentration changes from the pollution controls, and relating those air quality changes to changes in human exposure and expected changes in specific health effects across the population, based on the risk factors found in the scientific literature.

The Clean Air Task Force commissioned Abt Associates, the consulting firm relied upon by U.S. EPA to assess the health benefits of many of the agency's air regulatory programs, to quantify the benefits of each of the respective clean up scenarios. The objective of the study was to quantify the expected health benefits (avoidable premature deaths, hospitalizations, etc.) of each of the scenarios. The health endpoints analyzed included death, lung cancer deaths, hospitalizations, emergency room visits, asthma attacks, and a variety of lesser symptoms.

To analyze the avoidable health impacts of fine particles based on the alternative policy scenarios, the Clean Air Task Force asked Abt Associates to run the various scenarios using methods developed for and employed by the U.S. EPA, extensively reviewed by EPA's Science Advisory Board, recently approved in a review by the National Academy of Sciences, and accepted by the U.S. Office of

Management and Budget in a variety of regulatory impact and assessment contexts.

In its analysis, Abt Associates replicated all the assumptions used by EPA in performing its benefits analysis of the "Clear Skies" proposal focusing on years 2010 and 2020.

Abt Associates (health endpoint assessment and damage valuation) led the study team with support from ICF Consulting (power system economics and air quality modeling), and E.H. Pecan and DynTel (emissions and air quality modeling).

Power System Economics (ICF Consulting)

The first module of the modeling involves power system economics and asks two questions relevant to this discussion: how will the power system respond to the costs of clean up? And, how much will the clean up cost? Possible compliance responses by the plants include reducing emissions through control equipment, obtaining emission reduction credits from other plants that "over controlled" their emissions relative to their allocated emission reduction levels, reduced utilization of the plant, or retirement and replacement with other sources of electricity. The analysis assumed that the power sector will meet the proposed pollution reduction goals in the most cost-effective manner

available and provides critical information on the spatial distribution of power plant emissions before and after clean up. ICF Consulting, EPA's power system modeling consultant, ran its Integrated Planning Model (IPM) to determine the production costs and the spatial distribution of emissions under the various scenarios. In running the model, ICF Consulting used inputs and assumptions consistent with EPA's "Clear Skies" modeling analysis.

The cost estimates of the Carper bill do not include estimates of the costs of carbon dioxide provision calculated by EPA exogenously from the IPM model based on carbon dioxide supply curves of off-system carbon reduction options.[64]

Air Quality Modeling (E.H. Pechan and DynTel)

The outputs from the IPM model provide the power plant emissions inputs to the air quality modeling work performed by Pechan and DynTel. First, they assembled the emissions inventory for all non-power plant sources of NOx, SO2, and direct particulate emissions. Using the power plant emissions inputs from ICF Consulting, Pechan and DynTel ran EPA's PM air quality model Regional Emission Modeling System for Acidic Deposition (REMSAD) (approved by EPA's Science Advisory Board). The REMSAD model was used to estimate the baseline fine particle contributions attributable to the power plants and the reductions in pollutant concentrations due to the targeted reductions in each clean up scenario. The inputs and assumptions used by Pechan and DynTel are consistent with the identical analysis run for the "Clear Skies" proposal.[65] The health effects estimates reported here are based on the REMSAD modeling outputs.

Health Impacts Analysis (Abt Associates)

The air pollution concentration outputs from Pechan and DynTel's air quality analysis provide the inputs for Abt Associates' health effects modeling. Using health effects studies described above that link changes in ambient fine particle concentrations to changes in risk of mortality and morbidity, pollution concentration-response functions were derived that quantify the relationship between the forecasted changes in exposure and the expected changes in specific health effects. Abt Associates then used the modeled changes in pollutant concentrations (from the base case to each of the emission reduction scenarios) to estimate the power plant-attributable health impacts from each. The difference between the base case and the emission reduction scenario yielded estimates of the health benefits, i.e. avoided adverse impacts.

Once the avoidable health impacts were determined, the monetary values of each of the various health endpoints was estimated through economic valuation techniques previously used in EPA's "Clear Skies" analysis. Given the attributable and avoided health impacts calculated, Abt Associates tallied the health damages – from lost work and cost of emergency room care, to the statistical value of human lives lost from power plant emissions – and estimated the benefits of the health endpoints avoided under each clean up scenario.

Appendix A: State Mortality

Annual Avoided Deaths in 2020

State	Bush Bill	Carper Bill	Clean Air Act/EPA Proposal	Jeffords Bill
Alabama	404	471	535	599
Arizona	24	34	43	64
Arkansas	220	243	285	365
California	54	67	93	124
Colorado	39	51	75	119
Connecticut	141	162	181	198
Delaware	68	77	84	92
District of Columbia	45	51	55	61
Florida	875	1,073	1,168	1,260
Georgia	677	760	850	951
Idaho	1	4	5	6
Illinois	750	831	966	1,281
Indiana	528	591	672	813
Iowa	158	178	218	297
Kansas	119	140	177	252
Kentucky	461	521	584	674
Louisiana	227	254	296	360
Maine	41	47	53	58
Maryland	504	563	612	668
Massachusetts	217	249	280	307
Michigan	545	615	737	917
Minnesota	155	171	215	298
Mississippi	203	230	264	310
Missouri	392	449	530	695
Montana	3	6	7	10
Nebraska	69	82	107	149
Nevada	10	12	16	23
New Hampshire	37	42	48	53
New Jersey	404	451	494	536
New Mexico	12	19	23	36
New York	778	876	979	1,055
North Carolina	740	849	942	1,055
North Dakota	16	21	26	37
Ohio	1,034	1,169	1,319	1,501
Oklahoma	174	203	253	365
Oregon	2	4	4	5
Pennsylvania	1,192	1,334	1,461	1,600
Rhode Island	40	46	51	57
South Carolina	394	451	503	573
South Dakota	24	30	39	53
Tennessee	621	701	785	908
Texas	547	675	781	1,176
Utah	9	14	25	22
Vermont	22	25	28	30
Virginia	659	750	825	915
Washington	12	12	14	17
West Virginia	234	267	293	321
Wisconsin	257	286	342	471
Wyoming	5	7	9	13

Appendix B: MSA Mortality

Annual Avoided Deaths in 2020

Rank	MSA	Bush Bill	Carper Bill	Clean Air Act/ EPA Proposal	Jeffords Bill
1	New York, NY	680	764	842	915
2	Chicago, IL	471	518	606	825
3	Pittsburgh, PA	327	370	406	453
4	Philadelphia, PA	388	432	472	514
5	Washington, DC	382	428	467	513
6	Detroit, MI	251	284	337	404
7	Atlanta, GA	327	363	407	457
8	St. Louis, MO	201	230	264	336
9	Baltimore, MD	265	294	319	348
10	Cincinnati, OH	198	226	254	287
11	Cleveland, OH	177	198	224	256
12	Dallas, TX	134	164	192	300
13	Tampa, FL	156	191	207	222
14	Miami, FL	143	178	193	209
15	Indianapolis, IN	138	156	176	208
16	Columbus, OH	136	153	173	196
17	Boston, MA	138	158	178	196
18	Louisville, KY	122	138	156	182
19	Houston, TX	118	144	164	231
20	Kansas City, MO	92	106	131	181
21	Nashville, TN	118	132	148	172
22	Virginia Beach, VA	114	132	146	163
23	Birmingham, AL	102	120	138	153
24	Memphis, TN	98	109	125	152
25	Richmond, VA	106	121	133	148
26	Charlotte, NC	107	122	136	154
27	Minneapolis-St. Paul, MN	85	93	116	161
28	Buffalo, NY	91	101	116	122
29	Milwaukee, WI	78	86	102	140
30	Knoxville, TN	88	99	110	124
31	Dayton, OH	75	86	97	111
32	Orlando, FL	83	100	108	119
33	Youngstown, OH	65	75	83	93
34	Los Angeles, CA	26	31	42	56
35	New Orleans, LA	67	75	87	102
36	Tulsa, OK	48	55	71	101
37	San Antonio, TX	45	56	63	99
38	Providence, RI	63	72	81	89
39	Akron, OH	59	67	75	85
40	Oklahoma City, OK	42	51	62	90
41	Jacksonville, FL	61	73	80	85
42	Greensboro, NC	59	68	75	84
43	Rochester, NY	54	60	69	72
44	Columbia, SC	60	68	76	88
45	Sarasota, FL	50	62	67	72
46	Chattanooga, TN	55	63	70	80
47	Little Rock, AR	47	52	60	76
48	Raleigh, NC	56	64	70	78
49	Toledo, OH	45	50	59	71
50	Scranton, PA	53	60	66	69

ENDNOTES

1. Bascom, R. et al., *Health Effects of Outdoor Air Pollution, Part 1*, 153 American Journal of Respiratory and Critical Care Medicine 3-50 (1996); Bascom, R. et al. *Health Effects of Outdoor Air Pollution, Part 2*, 153 American Journal of Respiratory and Critical Care Medicine 477-498 (1996).

2. Abt Associates, *The Particulate-Related Health Benefits of Reducing Power Plant Emissions*, (October 2000). Available online at: http://www.catf.us/publications/reports/Abt_PM_report.php; Levy, J., and Spengler, J., *Estimated Health Impacts of Criteria Pollutant Air Emissions from the Salem Harbor and Brayton Point Power Plants*, Harvard School of Public Health (May 2000). Available online at: http://www.hsph.harvard.edu; Levy, J.I. et al., Using *CALPUFF to Evaluate the Impacts of Power Plant Emissions in Illinois: Model Sensitivity and Implications*, 36 Atmospheric Environment 1063–1075 (2002); Levy, J. et al., *The Importance of Population Susceptibility for Air Pollution Risk Assessment: A Case Study of Power Plants Near Washington, DC*, 110 Env. Health Persp. (No. 12) 1253 (December 2002); Levy, J. et al., *Estimation of Primary and Secondary Particulate Matter Intake Fractions for Power Plants in Georgia*, Environ. Sci. Technol. 37,5528-5536 (2003).

3. Devlin, R.B., Ghio, A.J., Kehrl, H., Sanders, G., and Cascio, W., *Elderly Humans Exposed to Concentrated Air Pollution Particles Have Decreased Heart Rate Variability*, 21 The European Respiratory Journal (Suppl. 40) 76s-80s (2003); Holguin, F., Tellez-Rojo, M.M., Hernandez, M., Cortez, M., Chow, J.C., Watson, J.G., Mannino, D., and Romieu, I., *Air Pollution and Heart Rate Variability Among the Elderly in Mexico City*. 14 Epidemiology (No. 5) 521-527 (2003); Mittleman, M.A. and Verrier, R.L., *Air Pollution: Small Particles, Big Problems?* Commentary. 14 Epidemiology (No. 5) 512-513 (September 2003).

4. Brunekreef, B., *Air Pollution and Life Expectancy: Is There a Relation?* 54 Occup. Environ. Med. 781–84 (1997).

5. U.S. EPA, OAR, "Final Report to Congress on Benefits and Costs of the Clean Air Act, 1970 to 1990", EPA 410-R-97-002 (October 1997) at I-23.

6. Vedal, Sverre, Brauer, Michael, White, Richard, and Petkau, John, *Air Pollution and Daily Mortality in a City with Low Levels of Pollution*, 111 Environ Health Perspectives 45–51 (2003).

7. U.S. EPA, "Fourth External Review Draft of Air Quality Criteria for Particulate Matter Vols. 1 and 2," EPA/600/P-99/002aD (June 2003). Available online at: http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=58003

8. Peters, Annette, and Pope, C.A., *Cardiopulmonary Mortality and Air Pollution*, 360 The Lancet 1184 (October 19, 2002); Nemmar, A., Hoet, P.H.M., Vanquickenborne, B., Dinsdale, D., Thomeer, M., Hoylaerts, M.F., Vanbilloen, H., Mortelmans, and L. Nemery, B., *Passage of Inhaled Particles Into the Blood Circulation in Humans* 105 Circulation 105:411-414 (2002); Brook, Robert D., Brook, Jeffrey R., Urch, Bruce, Vincent, Renaud, Rajagopalan, Sanjay, and Silverman, Frances, *Inhalation of Fine Particulate Air Pollution and Ozone Causes Acute Arterial Vasoconstriction in Healthy Adults* 105 Circulation 1534-1536 (2002).

9. Wilson, Richard, and Spengler, John, eds. *Particles in Our Air: Concentrations and Health Effects* (1999) p. 212.

10. Ibid.

11. Energy Information Administration, "Electric Power Annual 2002," DOE/EIA-0348(2002) (December 2003) at 6.

12. U.S. EPA, OAQPS, "National Air Quality and Emissions Trends Report, September 2003" EPA 454/R-03-005. Available online at: http://www.epa.gov/air/aqtrnd03/toc.html

13. U.S. EPA Green Book 2004. Available online at: http://www.epa.gov/oar/oaqps/gbook/; The 2002 population data by race came from the U.S Census Bureau web site at http://eire.census.gov/popest/data/counties/CO-EST2002-ASRO-02.php. Data compiled by MSB Energy Associates.

14. Ibid. Energy Information Administration, Form 767 (2000).

15. Ibid. See also, Therrien, M. and R. Ramirez, "The Hispanic Population in the United States: March 2000," Current Population Reports P20-535, U.S. Census Bureau, Washington, D.C.; Metzger, R., Delgado, J.L., and Herrel, R., "Environmental Health and Hispanic Children," presented at Preventing Child Exposures to Environmental Hazards: Research and Policy Issues. Symposium. Washington D.C. (March 1994).

16. Woodruff, Tracey J., Parker, Jennifer D., Kyle, Amy D., and Schoendorf, Kenneth C., *Disparities in Exposure to Air Pollution During Pregnancy*. 111 Environmental Health Perspectives 7 (June 2003).

17. Dockery, D.W., Pope, C.A., Xu, S., Spengler, J.D., et al. *An Association Between Air Pollution and Mortality in Six U.S. Cities*, 329 New England J. Med. 1753-59 (1993). Available online at http://www.nejm.org/content/1993/0329/0024/1753.asp; Pope, C.A., Thun, M.J., Namboordiri, M.M., Dockery, D.W., et al., *Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults*. 151 Am. J. Respir. Crit. Care Med. 669-74 (1995). Available online at: http://ajrccm.atsjournals.org/search.shtml

18. Krewski, D., Burnett, R.T., Goldberg, M.S., Hoover, K., Siemiatycki, J., Jerrett, M., Abrahamowicz, A. and White, W.H., *Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Matter and Mortality*, Health Effects Institute, Cambridge MA, (Research Report, PrePrint version, July 2000).

19. Pope, C. A., Burnett, R. T., Thun, M. J., Calle, E. E., Krewski, D., Ito, K., and Thurston, G. D., *Lung Cancer, Cardiopulmonary Mortality and Long-term Exposure to Fine Particulate Air Pollution* 287 Journal of the American Medical Association (JAMA) 1132-1141 (2002).

20. Ozkaynak, H, and Thurston, G.D., *Associations Between 1980 U.S. Mortality Rates and Alternative Measures of Airborne Particle Concentration*, Risk Anal. 7(4) 449-61 (December 1987).

21. Laden, Francine, Neas, Lucas M., Dockery, Douglas W., and Schwartz, Joel, *Association of Fine Particulate Matter From Different Sources with Daily Mortality in Six U.S. Cities*, 108 Environmental Health Perspectives No. 10 (October 2000).

22. Wilson and Spengler, *Particles in Our Air*, p. 212.

23. Schwartz, J., "Air Pollution Deadlier than Previously Thought," Harvard School of Public Health, Press Release, March 2, 2000.

24. U.S. EPA, OAQPS, "1996 Staff Papers on Smog and Soot Pollution: Review of the National Ambient Air Quality Standards for Ozone and Particulate Matter." (1996).

25. Hong, Yun-Chul, Lee, Jong-Tae, Kim, Ho, and Kwon, Ho-Jang, *Air Pollution: A New Risk Factor in Ischemic Stroke Mortality*, 33 Stroke 2165-2169 (2002).

26. Peters, Annette, Dockery, Douglas W., Muller, James E., and Mittleman, Murray A., *Increased Particulate Air Pollution and the Triggering of Myocardial Infarction*, 103 Circulation 1-6 (June 12, 2001).

27. See *infra* note 35 (heart attacks) and 36 (lung cancer); Woodruff, T., Grillo, J. and Schoendorf, K., *The Relationship Between Selected Causes of Postneonatal Infant Mortality and Particulate Air Pollution in the United States*, 105 Environmental Health Perspectives 608-612 (1997); Kaiser, R., Kunzli, N., and Schwartz, J., "The Impact of PM 10 on Infant Mortality in Eight U.S. Cities." Abstract. American Thoracic Society, Abstract Preview: ATS1P1_6266 (2001); Bobak, M., and Leon, D., *The Effect of Air Pollution on Infant Mortality Appears Specific for Respiratory Causes in the Postneonatal Period*, 10 Epidemiology (No. 6) 666-670 (1999); Loomis, D.,

Castillejos, M., Gold, D., McDonnell, W., and Borja-Aburto, V., *Air Pollution and Infant Mortality in Mexico City*. 10 Epidemiology 118-123 (1999); Chay, Kenneth, *The Impact of Air Pollution on Infant Mortality: Evidence from Geographic Variation in Pollution Shocks Induced by a Recession*, 118(3) Quarterly Journal of Economics 1121-1167 (2003) (SIDS/infant death).

28. Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Act of 2003. Available online at: http://www.epa.gov/air/clearskies/tech_addendum.pdf

29. Clean Power Act of 2003 S. 366; Clean Air Planning Act of 2003 S. 843; The Clear Skies Act of 2003 S. 485.

30. Abt Associates, *Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios* (June 2004). Available online at: www.catf.us/publications/index.php.

31. U.S. EPA, OAR, "Final Report to Congress on Benefits and Costs of the Clean Air Act, 1970 to 1990", EPA 410-R-97-002 (October 1997) at I-23.

32. Peters, Annette, and Pope, C.A., *Cardiopulmonary Mortality and Air Pollution*, 360 The Lancet 1184 (October 19, 2002); Devlin, R.B., Ghio, A.J., Kehrl, H., Sanders, G., and Cascio, W. *Elderly Humans Exposed to Concentrated Air Pollution Particles Have Decreased Heart Rate Variability*, 21 The European Respiratory Journal (Suppl. 40) 76s-80s (2003); Holguin, F., Tellez-Rojo, M.M., Hernandez, M., Cortez, M., Chow, J.C., Watson, J.G., Mannino, D., and Romieu, I., *Air Pollution and Heart Rate Variability Among the Elderly in Mexico City*, 14 Epidemiology (No. 5) 521-527 (2003), Mittleman and Verrier, 14 Epidemiology (No. 5) 512-513.

33. Pope, Burnett, Thun, Calle, Krewski, Ito, and Thurston, JAMA, March 2002.

34. Dockery, Douglas W., *Epidemiologic Evidence of Cardiovascular Effects of Particulate Air Pollution*, 109 Environmental Health Perspectives Supplement 4 (August 2001). See also *supra* note 36.

35. Peters, Dockery, Muller, amd Mittleman, 103 Circulation, pp. 1-6.

36. Pope, C.A., Verrier, R.L., Lovett, E.G., Larson, A.C., Raizenne, M.E., Kanner, R.E., Schwartz, J., Villegas, G.M., Gold, D.R., and Dockery, D.W., *Heart Rate Variability Associated With Particulate Air Pollution*, 138 Am. Heart J. 890–899 (1999).

37. Peters, A., Doring, A., Wichmann, H.E., and Koenig, W., *Increased Plasma Viscosity During an Air Pollution Episode: A Link to Mortality?* 349 (9065) The Lancet 1582–1587 (1997); Peters, A., Fröhlich, M., Döring, A., Immervoll, T., Wichmann, H.E., Hutchinson, W.L., Pepys, M.B., and Koenig, W., *Particulate Air Pollution is Associated with an Acute Phase Response in Men: Results from the MONICA-Augsburg Study*. 22 Eur. Heart J. 1198–1204 (2001).

38. Nemmar, Hoet, Vanquickenborne, Dinsdale, Thomeer, Hoylaerts, Vanbilloen, Mortelmans, and Nemery, 105 Circulation 411-414.

39. Brook, Brook, Urch, Vincent, Rajagopalan, and Silverman, 105 Circulation 1534-1536.

40. Pope, C.A., Burnett, R.T., Thurston, G.D., Thun, M.J., Calle, E.E., Krewski, D., and Godleski, J.J., *Cardiovascular Mortality and Long-Term Exposure to Particulate Air Pollution: Epidemiological Evidence of General Pathophysiological Pathways of Disease*, 109 Circulation 71-77 (2004). Published online before print at: http://www.circulationaha.org, DOI: 10.1161/01.CIR.0000108927.80044.7F.

41. Pope, Burnett, Thun, Calle, Krewski, Ito, and Thurston, JAMA, March 2002.

42. Mothers Against Drunk Driving online at: http://www.madd.org/stats/0,1056,1112,00.html

43. Arias, E. et al., "Deaths: Final Data for 2001," Centers for Disease Control, 52 National Vital Statistics Reports No. 3 (September 18, 2003). Available online at: http://www.cdc.gov/nchs/data/nvsr/nvsr52/nvsr52_03.pdf

44. U.S. Department of Transportation, National Highway Traffic Safety Administration *Traffic Safety Facts 2000: Occupant Protection* (Washington, DC, 2001). Available online at: http://www.bts.gov/publications/transportation_statistics_annual_report/2001/html/chapter_06_figure_01_152_table.html.

45. U.S. Centers for Disease Control and Prevention, "National Hospital Discharge Summary 1998," Advance Data #316 (June 30, 2000). Available online at http://www.cdc.gov/nchs

46. As described more fully in the methodology section, this figure refers to the total monetized value of power plant health impacts as modeled by Abt Associates for the year 2010. Like EPA's assumptions in assessing the benefits of the Clear Skies Act, it assumes the implementation of a variety of clean air measures relating to power plants including: the NOx SIP Call; The Acid Rain program/Title IV of the Clean Air Act Amendments of 1990; settlements of several New Source Review enforcement actions; and several state power plant clean up initiatives. It thus understates the impacts of power plant pollution at today's emission levels. See Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Act of 2003. Available online at: http://www.epa.gov/air/clearskies/tech_addendum.pdf

47. In addition, recent analysis suggests that work such as this that fails to take into account the susceptibility of certain subpopulations (e.g., people of color, people with diabetes) may understate the impact of air pollution in certain communities because it fails to account for the greater underlying incidence of disease or the greater relative risk from air pollution in such populations. Levy, J.I. et al., 110 Env. Health Persp. (December 2002) at 1253. In keeping with EPA's standard methodology, however, Abt Assocs. made no attempt to take this into account.

48. Clean Power Act of 2003 S. 366

49. AIR Daily, "Bush Pushes Mandatory Utility Emission Cuts," October 3, 2000; Governor George W. Bush, "A Comprehensive National Energy Policy," September 29, 2000.

50. President Bush letter to Sen. Chuck Hagel March 13, 2001.

51. U.S. EPA, "A Comprehensive Approach to Clean Power: Straw Proposal and Supporting Analysis for Interagency Discussion" (August 3, 2001). Available online at: http://www.catf.us/publications/other/epa_straw_proposal.html

52. The Clear Skies Act of 2003 S. 485.

53. Clean Air Planning Act of 2003 S. 843

54. "Proposed Rule To Reduce Interstate Transport of Fine Particulate Matter and Ozone (Interstate Air Quality Rule)," 40 CFR Parts 51, 72, 75, and 96, 69 Federal Register No. 20 (Friday, January 30, 2004). Available online at: http://a257.g.akamaitech.net/7/257/2422/30jan20040800/edocket.access.gpo.gov/2004/pdf/04-808.pdf

55. U.S. EPA, "Proposed Rule Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations," 69 Fed. Reg. 25183. Available at: http://a257.g.akamaitech.net/7/257/2422/14mar20010800/edocket.access.gpo.gov/2004/pdf/04-9863.pdf

56. "Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units," 40 CFR Parts 60 and 63; 69 Federal Register 4652, No. 20 (Friday, January 30, 2004). Available online at: http://a257.g.akamaitech.net/7/257/2422/30jan20041000/edocket.access.gpo.gov/2004/pdf/04-1539.pdf

57. U.S. EPA, OAQPS, "1996 Staff Papers on Smog and Soot Pollution: Review of the National Ambient Air Quality Standards for Ozone and Particulate Matter." (1996).

58. Technical Addendum: "Methodologies for the Benefit Analysis of the Clear Skies Act of 2003." Available online at: http://www.epa.gov/air/clearskies/tech_addendum.pdf

59. For example, a report by the Energy Information Administration compared the costs of "Clear Skies" using EIA's model vs. the IPM model. SR/OIAF/2003-03 Analysis of S. 485, the Clear Skies Act of 2003, and S. 843, the Clean Air Planning Act of 2003 September 2003 Energy Information Administration Office of Integrated Analysis and Forecasting, U.S. Department of Energy Washington, DC 20585SR/OIAF/2003-03 at pps. 43-44.

60. Executive Order 12866 requires that "in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach." Regulatory Planning and Review 58 Federal Register 51735, Executive Order 12866, (September 30, 1993). Available online at: http://www.epa.gov/fedrgstr/eo/eo12866.htm

61. See http://www.epa.gov/pmdesignations/state.htm

62. 42 U.S.C. §172(a)(2).

63. See http://www.epa.gov/ttn/amtic/datasrc.html

64. U.S. EPA, S. 3135, The Clean Air Planning Act of 2002, Presentation for Jeff Holmstead, November 2002 available online at: http://www.catf.us/publications/other/Carter_EPA_Presentation_November_19_2002.pdf. For this report, ICF Consulting modeled only the Carper bill's nitrogen oxides, sulfur dioxide, and mercury provisions. According to the EPA's analysis, the bill's carbon dioxide requirements would add negligible additional cost to the bill due to the wide availability of inexpensive offsets from non-power plant sources.

65. Technical Addendum: Methodologies for the Benefit Analysis of the Clear Skies Act of 2003. Available online at http://www.epa.gov/air/clearskies/tech_addendum.pdf.


YOUR
AIR
ON THE WEB
www.cleartheair.org/dirtypower

Clear The Air
1200 18th Street, NW
5th Floor
Washington, DC 20036
Tel: 202-887-1715
Fax: 202-887-8877

www.cleartheair.org/dirtypower