CLEAN AIR TASK FORCE

The Toll From Coal

An Updated Assessment of Death and Disease from America's Dirtiest Energy Source

SEPTEMBER 2010

Founded in 1996, the Clean Air Task Force is a nonprofit organization dedicated to restoring clean air and healthy environments through scientific research, public education, and legal advocacy.

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EXECUTIVE SUMMARY

Among all industrial sources of air pollution, none poses greater risks to human health and the environment than coal-fired power plants. Emissions from coal-fired power plants contribute to global warming, ozone smog, acid rain, regional haze, and—perhaps most consequential of all from a public health standpoint — fine particle pollution. In 2000 and again in 2004, the Clean Air Task Force commissioned comprehensive studies of health impacts caused by fine particle air pollution from the nation's roughly 500 coal-fired power plants. Each study incorporated the latest scientific findings concerning the link between air pollution and public health, as well as up-to-date emissions information. Both found that emissions from the U.S. power sector cause tens of thousands of premature deaths each year and hundreds of thousands of heart attacks, asthma attacks, emergency room visits, hospital admissions, and lost workdays.

This study provides a new update on the burden of death and disease from coal-based electricity production across the United States. Estimated impacts are based on projected power sector emissions in 2010. As in our 2000 and 2004 reports, Clean Air Task Force commissioned Abt Associates to conduct the analysis for this study. Abt Associates developed estimates of health impacts using a well-established and extensively peer-reviewed methodology that has been approved by both the U.S. Environmental Protection Agency's (EPA's) Science Advisory Board and the National Academy of Sciences (NAS). In fact, the same methodology has provided the basis for regulatory impact analyses in the context of recent EPA rulemakings.

Results from this latest assessment indicate that although coal plant emissions of key particle-forming pollutants like sulfur dioxide (SO_2) and nitrogen oxides (NOx) have declined significantly over the last several years, existing plants remain among the top contributors to fine particle pollution in the United States. As a result, their emissions continue to take a significant toll on the health and longevity of millions of Americans.

Specifically, Abt Associate's analysis finds that fine particle pollution from existing coal plants is expected to cause nearly 13,200 deaths in 2010. Additional impacts include an estimated 9,700 hospitalizations and more than 20,000 heart attacks per year. The total monetized value of these adverse health impacts adds up to more than $100 billion per year. This burden is not distributed evenly across the population. Adverse impacts are especially severe for the elderly, children, and those with respiratory disease. In addition, the poor, minority groups, and people who live in areas downwind of multiple power plants are likely to be disproportionately exposed to the health risks and costs of fine particle pollution.

These figures take into account emissions reductions from regulatory changes that have happened since 2004, when the Clean Air Task Force last sponsored a comprehensive assessment of adverse health impacts from the

fleet of existing coal-fired power plants. In 2005, EPA issued the Clean Air Interstate Rule (CAIR), which was designed to achieve further reductions in SO_2 and NOx emissions from power plants in the eastern United States. CAIR was subsequently challenged and ultimately struck down in federal court in 2008 for failing to conform to aspects of the Clean Air Act, but the court has allowed the CAIR requirements to remain in place until EPA can issue a replacement rule. For the purposes of this reanalysis of health impacts from the nation's existing power plants, Abt Associates assumed that a regulation as stringent as the CAIR rule would be in place in 2010.

Comparing estimated health impacts from the 2004 analysis and this updated assessment serves to underscore the direct link between reduced power plant emissions and substantial public health benefits. For example, Abt Associates' estimate of 13,200 deaths from fine particle pollution in 2010 compares to an estimate of nearly 24,000 deaths per year from existing plants in the 2004 study. Similar public health gains are evident in the estimated incidence of other adverse impacts including hospital admissions (9,700 in 2010 compared to 21,850 in 2004) and heart attacks (20,400 in 2010 compared to 38,200 in 2004).

Jobs and Public Health

Reducing air pollution from the nation's power plants is not just good for public health; it is also good for the nation's economy. Pollution control technologies, such as scrubbers for SO_2, are large projects that require a tremendous amount of skilled labor and materials. Since 2004 roughly 130 scrubbers have been installed at existing power plants. The average scrubber requires 380,000 man-hours or 200 person-years to complete. Each scrubber installation can take roughly 2 years to complete which means roughly 100 people working over this period. These jobs are both engineering and management jobs as well as jobs for boilermakers and other skilled labor.[1]

The improvements in public health estimated by Abt Associates are consistent with observed reductions in national sulfur dioxide emissions since 2004. Over that period of time, sulfur dioxide emissions nationally fell from 10.3 million tons in 2004 to 5.7 million tons in 2009.[1] These reductions largely resulted from the addition of over 130 flue gas desulfurization (FGD) (also known as "scrubbers") installations on coal-fired units, mostly in the eastern U.S. These scrubbers were installed as a result of the combination of the Clean Air Interstate Rule (CAIR), federal and state enforcement of the New Source Review (NSR) provisions of the Clean Air Act, and state power plant clean up laws. These actions are responsible for saving nearly 11,000 lives per year and demonstrate that judicious use of the Clean Air Act offers a powerful solution to power plant pollution.

These results not only point to the necessity of preserving emissions reductions mandated under CAIR, but the need for even stronger measures to further mitigate the still unacceptably high burden of death and disease from coal-fired power plants going forward. With a national commitment to deploy the most advanced pollution control technologies, implement cost-effective efficiency improvements, and steadily increase the use of inherently cleaner sources of electricity, the opportunity exists to save thousands more lives and avert costly health impacts due to power sector emissions.

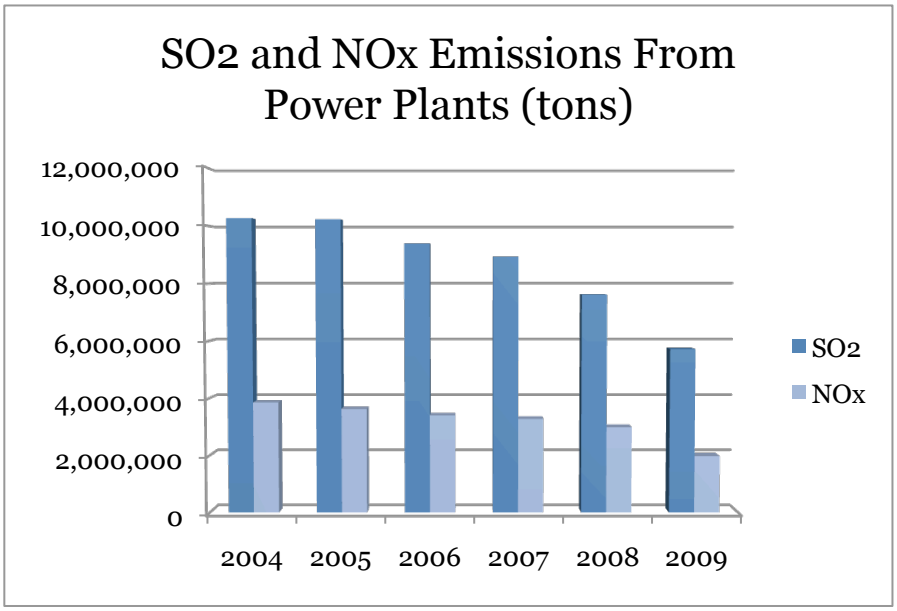


Figure 1. Source: EPA

Specifically, to reduce the death and disease associated with power plant-related particulate matter pollution from SO_2 and NOx, EPA should strengthen and finalize the recently proposed Transport Rule to replace the judicially invalidated Clean Air Interstate Rule. Stronger regional caps on SO_2 and NOx pollution are achievable and cost effective and would reflect both the progress made and the performance of the most recent pollution control equipment.[2] In the last five years, emissions control equipment installed at power plants around the country (flue gas desulfurization or FGD for SO_2 and selective catalytic reduction or SCR for NOx reduction) have helped coal plants achieve reductions in their emission rates of SO_2 and NOx by an average of 72 percent and 74 percent respectively.[3] The result has been a reduction in SO_2 and NOx pollution by almost half without noticeably affecting electricity prices or bills, natural gas prices, or the reliability of the power system.

Over the years; however, implementation of the Clean Air Act has often been stalled due to lawsuits and other delays. To preserve the recent emission reductions, speed further reductions, avoid years of costly litigation delay from industry challenges to these regulations, and offer certainty with respect to environmental objectives and costs, CATF supports efforts in Congress to set a more protective national cap on power plant SO_2 emissions

at 2 million tons per year in 2015 and 1.5 million tons per year in 2018. This same proposal would establish a national power plant NOx cap at 1.6 million tons in 2015. CATF has testified in support of strengthening and passing this legislation that, if enacted, would prevent tens of thousands of premature deaths, heart attacks and other health impacts.[4]

How do the numbers compare to EPA's?

U.S. EPA in its Transport Rule proposal estimates that the rule will prevent the deaths of 14,000 to 36,000 people annually from power plant pollution starting in 2014. How does this estimate compare to CATF's estimate in this report that power plant pollution is causing the premature deaths of 13,200 people in 2010? The answer gets to the heart of why we need a strong Clean Air Transport Rule.

First, remember that one of the steps that has reduced emissions from power plants since our 2004 report rests on shaky legal ground. Some of the reductions were driven by the Clean Air Interstate Rule (CAIR), which the court struck down in 2008. In the proposed Regulatory Impact Analysis of the Transport Rule, EPA had to assume that the CAIR does not exist. So, EPA compared the benefits of its proposed Transport Rule to a base case with none of the cleanup measures required by the CAIR. By contrast, CATF in this report is estimating the total number of power plant pollution-related deaths that will occur this year under current emissions—that is, with all the existing cleanup measures in place and operating. CATF assumed that a rule at least as stringent as CAIR is in effect in 2010. In fact, the CAIR rule has driven the installation of dozens of sulfur scrubbers since 2004 and these emission control devices currently are running. So, we credit those reductions as part of our analysis. However, there is an operation and maintenance cost associated with these scrubbers and power companies will not continue to run them indefinitely unless they are legally required to do so. That is why it is so important that EPA strengthen and finalize the Transport Rule – otherwise, these reductions are at risk.

Secondly, EPA estimated the lives saved by the Transport Rule as a range (i.e., 14,000 to 36,000 lives annually). The lower number of this range is based on the results from the American Cancer Society study (Pope et al. 2002) and the higher number is based on the Harvard Six-Cities Study (Laden et al. 2006). CATF in its 2000 and 2004 reports used the American Cancer Society study. For consistency's sake, we do so again in the current report. That means that if we used estimates based on the Harvard Six-Cities Study, the number of lives saved each year would be much, much higher.

The Link between Power Plant Pollution and Human Health

The direct link between power plant emissions and human health has been documented in an extensive body of scientific research drawing on multiple lines of evidence, including several rigorous, large-scale epidemiological studies. Much of that literature has been reviewed and summarized in formal rulemakings and regulatory analyses by the U.S. Environmental Protection Agency (EPA) over the last several years and in reports published by the Clean Air Task Force and other organizations advocating on behalf of more stringent regulation of power sector emissions.[5]

In brief, public health concerns have focused, for at least the last decade, on the role of very small airborne particles in causing or contributing to a host of respiratory and cardiopulmonary ailments and increasing the risk of premature death. Fine particles are especially dangerous because they can bypass the body's defensive mechanisms and become lodged deep in the human lung. Indeed, research also indicates that short-term exposures to fine particle pollution is linked to cardiac effects, including increased risk of heart attack.[6] Meanwhile, long-term exposure to fine particle pollution has been shown to increase the risk of death from cardiac and respiratory diseases and lung cancer, resulting in shorter life-expectancy for people living in the most polluted cities compared to people who live in cleaner cities.[7] And although research suggests fine particles reduce the average life span of the general population by a few years, the life of an individual dying as a result of exposure to air pollution may be shortened by 14 years.[8] Adverse effects, including excess mortality, occur even at low ambient concentrations of fine particles—suggesting there is no "safe" threshold for this type of pollution.[9] Recent studies have also succeeded in identifying plausible biological mechanisms such as systemic inflammation, accelerated atherosclerosis, and altered cardiac function to explain the cardiac and other serious health impacts associated with exposure to airborne fine particles.[10] Because most fine particle-related deaths are thought to occur within a year or two of exposure, reducing power plant pollution will have almost immediate benefits.[11]

Unfortunately, persistently elevated levels of fine particle pollution are common across wide swaths of the country, particularly in the eastern United States. Fine particle pollution itself consists of a complex mixture of harmful pollutants including elements as diverse as soot, acid droplets, and metals. Most of these pollutants originate from combustion sources such as power plants, diesel trucks, buses, and cars. East of the Mississippi, sulfates are a dominant ingredient of fine particle pollution. Sulfates are formed in the atmosphere from sulfur dioxide (SO_2) emissions, which also contribute—along with emissions of nitrogen oxides (NOx)—to the formation of airborne acidic particles. In 2008, power plants accounted for 66% of the national SO_2 inventory with the vast majority of this contribution (more than 98%) coming from coal-fired power plants. Sulfur emissions from coal-fired power plants thus emerge as the chief driver of adverse health impacts from industrial sources of air pollution across much of the country. Moreover, many of the nation's existing coal plants are old—in fact, the average age of the current coal fleet is 44 years and has very little in the way of modern

pollution controls. These same aging plants also contribute disproportionately to power-sector emissions of other harmful pollutants such as mercury and other air toxics, as well as emissions of the chief greenhouse gas, carbon dioxide.

Over the last two decades considerable progress has been achieved in reducing SO_2 and NOx emissions from the U.S. power sector. Under a variety of Clean Air Act programs and regulations designed to address acid rain, particulate matter (PM) pollution, ozone smog, and regional haze, power plant emissions of SO_2 in 2009 fell to approximately one-third of the national total in 1980; a similar reduction was likewise achieved in national-level power sector NOx emissions over the same time frame.[12] The updated estimates of adverse health impacts presented in the next section take these trends into account and assume that actual emissions in 2010 remain in line with recent experience and regulatory expectations under the CAIR rule. They show that despite the record of progress in reducing power plant emissions over the last 15 to 20 years, the burden of death and disease from coal-based electricity production in the United States remains too high.

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 first 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 (SO_2) 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 and transported to vital organs, thus evading the human lung's natural defenses.

Results of the Analysis

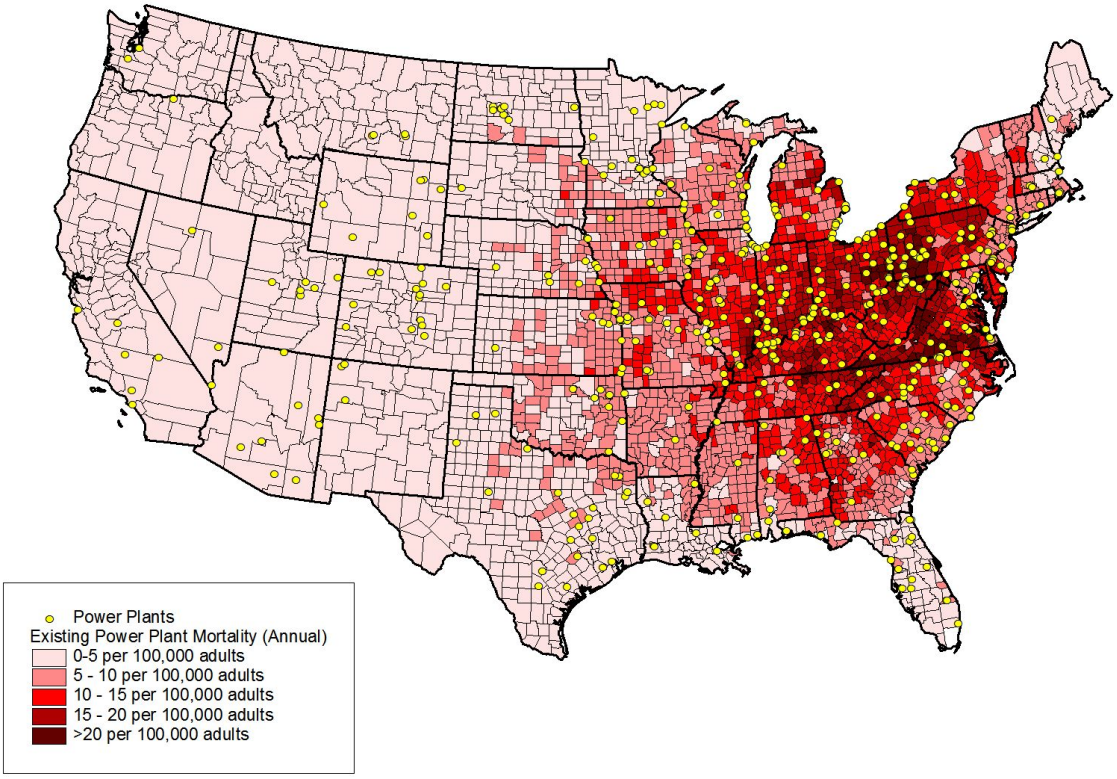
To analyze adverse health impacts from current levels of power plant emissions in the United States, Abt Associates analyzed emission data supplied by US EPA and applied methodologies used in previous Clean Air Task Force studies and in recent EPA regulatory impact analyses which have been extensively peer-reviewed and approved by both EPA's Science Advisory Board and by the National Academy of Sciences. Briefly, it begins by calculating the impact of a given change in power plant emissions on ambient air quality and specifically on ambient fine particle concentrations. It then applies results from epidemiological studies to estimate expected changes in the incidence of several adverse health outcomes, such as hospital admissions, asthma attacks, and premature deaths.

Table 1 summarizes the results of Abt Associate's analysis for the nation's existing fleet of coal plants in 2010. The table includes estimates of the monetary cost associated with these impacts using standard valuation metrics for illness and premature death. It suggests that the total monetized value of adverse health impacts attributable to existing coal plants in the United States exceeds **$100 billion per year.** Figure 2 shows how these health risks and costs are distributed geographically. Clearly those areas with the highest concentration of coal plants (indicated by yellow circles on the map) bear a disproportionate share of the aggregate burden of adverse impacts.

Table 1. National Power Plant Impacts (2010 est.)

Health Impact	**Incidence** (annual)	**Valuation** ($millions)
Mortality	13,200	$96,300
Hospital Admissions	9,700	$230
ER Visits for Asthma	12,300	$5
Heart Attacks	20,400	$2,230
Chronic Bronchitis	8,000	$3,560
Asthma Attacks	217,600	$11
Lost Work Days	1,627,800	$150

Figure 2. Power Plant Mortality Per 100,000 Adults



The analysis indicates that even with the first phase of the CAIR rule in place, the nation's power plants still cause a broad swath of death and disease across the coal-burning Midwest, the South and the Mid-Atlantic region. Table 2 shows state-level results for those states with the highest incidence of adverse impacts. Not surprisingly, states with large populations in close proximity to many coal-fired power plants fare the worst. Conversely, states with large populations but without coal-fired plants fare much better. For example, California—the state with the largest population and some of the nation's worst air quality—has very few coal or oil-fired power plants. Abt Associates estimates that only 41 premature deaths are attributable to power plant pollution in California; as a result, the state ranks almost last for power plant related mortality risk (47th out of the lower 48 states and the District of Columbia). West Virginia, the state with the highest reliance on coal for electricity production, ranks first in mortality risk.

Table 2. State Health Impacts (Annual 2010 est.)

Rank	State	Mortality	Hospital Admissions	Heart Attacks
1	Pennsylvania	1,359	1,016	2,298
2	Ohio	1,221	835	1,891
3	New York	945	796	1,767
4	North Carolina	681	487	912
5	Michigan	678	487	1,097
6	Virginia	647	477	896
7	Illinois	621	455	1,018
8	Indiana	550	389	870
9	Georgia	536	396	728
10	New Jersey	531	445	987
11	Tennessee	499	340	640
12	Kentucky	412	286	539
13	Maryland	392	291	547
14	Florida	313	228	435
15	Alabama	296	200	377

Table 3. State Per Capita Mortality Risk (2010 est.)

Rank	State	Total Mortality (Annual)	Mortality Risk per 100,000 Adults
1	West Virginia	214	14.7
2	Pennsylvania	1,359	13.9
3	Ohio	1,221	13.9
4	Kentucky	412	12.6
5	Indiana	550	11.4
6	Virginia	647	10.9
7	Delaware	70	10.6
8	Tennessee	499	10.5
9	North Carolina	681	9.7
10	District of Columbia	46	9.6
11	Maryland	392	9.1
12	Michigan	678	8.9
13	South Carolina	283	8.4
14	Alabama	296	8.3
15	Vermont	39	8.0

Similarly, metropolitan areas with large populations near coal-fired power plants feel their impacts most acutely. In larger metropolitan areas, many hundreds of lives are shortened each year at current levels of power plant pollution.

Table 4. Metro Area Health Impacts (Annual 2010 est.)

Rank	Metro Area	Mortality	Hospital Admissions	Heart Attacks
1	New York-Newark-Edison, NY-NJ-PA	799	698	1,541
2	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	452	351	767
3	Chicago-Naperville-Joliet, IL-IN-WI	347	264	584
4	Pittsburgh, PA	340	242	555
5	Washington-Arlington-Alexandria, DC-VA-MD-WV	299	259	480
6	Detroit-Warren-Livonia, MI	275	198	446
7	Atlanta-Sandy Springs-Marietta, GA	249	202	369
8	Cleveland-Elyria-Mentor, OH	228	153	350
9	Baltimore-Towson, MD	191	134	252
10	Cincinnati-Middletown, OH-KY-IN	190	139	299
11	Boston-Cambridge-Quincy, MA-NH	144	128	283
12	St. Louis, MO-IL	141	98	220
13	Columbus, OH	133	99	219
14	Indianapolis, IN	122	91	199
15	Richmond, VA	115	80	150

In terms of added mortality and morbidity risks to individuals in different parts of the country, residents of much smaller metropolitan areas in and around “coal country” suffer the greatest individual risk of adverse health impacts. Examples of such areas include Johnstown, Pennsylvania; Steubenville, Ohio; Scranton, Pennsylvania; and Wheeling, West Virginia. People who live in these communities confront much higher mortality rates from fine particle pollution than do the residents of New York City: the estimated mortality risk for residents of Johnstown, Pennsylvania at 25 deaths per 100,000 people, for example, is more than four times that for New York City residents at nearly 6 deaths per 100,000 people.

Table 5. Metro Area Per Capita Mortality Risk (2010 est.)

Rank	Metro Area	Total Mortality (Annual)	Mortality Risk per 100,000 Adults
1	Johnstown, PA	30	25.5
2	Cumberland, MD-WV	17	20.8
3	Steubenville-Weirton, OH-WV	21	20.7
4	Altoona, PA	21	20.6
5	Sandusky, OH	12	19.8
6	Wheeling, WV-OH	23	19.3
7	Youngstown-Warren-Boardman, OH-PA	85	18.6
8	Mansfield, OH	18	18.4
9	Springfield, OH	20	18.0
10	Pittsburgh, PA MSA	340	17.9
11	Scranton--Wilkes-Barre, PA	78	17.5
2	Roanoke, VA	40	16.7
13	Erie, PA	36	16.5
14	Ocean City, NJ	13	16.4
15	Winchester, VA-WV	15	16.3

At the same time, residents who live near, or are downwind (sometimes hundreds of miles) of the biggest coal plants suffer high mortality impacts, and other health impacts. For example, just ten of the worst plants are responsible for over 1,600 premature deaths a year.

Table 6. Top Ten Plants for Health Impacts (Annual 2010 est.)

Rank	Plant	State	County	Mortality (Annual)	Hospital Admissions	Heart Attacks
1	Monroe	Michigan	Monroe County	278	206	445
2	Scherer	Georgia	Monroe County	175	125	245
3	W H Sammis	Ohio	Jefferson County	163	124	268
4	Kingston	Tennessee	Roane County	150	109	219
5	Bowen	Georgia	Bartow County	149	107	210
6	Harllee Branch	Georgia	Putnam County	145	104	203
7	J H Campbell	Michigan	Ottawa County	142	105	228
8	Walter C Beckjord	Ohio	Clermont County	141	102	217
9	Rockport	Indiana	Spencer County	138	99	210
10	Clifty Creek	Indiana	Jefferson County	128	93	196

Conclusion

Though significant reductions in power sector SO_2 and NOx emissions have been achieved since 2000 when CATF first analyzed the impact of power plant pollution on our nation's health, the task of cleaning up the number one source of pollution is far from over. Thousands of lives have been saved, but the fact remains that thousands more could be saved—and a much greater number of asthma attacks, heart attacks, hospitalizations, emergency room visits, lost workdays and the associated societal costs could still be avoided. The progress to date—since 2004, the U.S. has cut SO_2 and NOx pollution by almost half without affecting electricity prices or bills, natural gas prices, or the reliability of the power system—powerfully confirms that: (1) the Clean Air Act works, and (2) the technologies required to achieve deep reductions in these pollutants are widely available and very effective. Now is the time to finish the job of cleaning up our nation's power sector by strengthening and finalizing a stringent Transport Rule, as well as by reducing mercury and other toxics, as well as greenhouse gas emissions. Doing so would provide a host of benefits—prominent among them further substantial gains in the health and longevity of millions of Americans—and would help propel the nation to a more sustainable energy future.

For full state and MSA data tables, please go to:
www.catf.us/coal/problems/power_plants/existing/

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[5] See, for example, EPA *Integrated Science Assessment for Particulate Matter* available at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=201805 and material available on the CATF publications page: http://www.catf.us/resources/publications/.
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