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A Preliminary Analysis of the Benefits and Costs of Current New Source Review Litigation

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June 24, 2002

Introduction

In 1999 The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Justice (DOJ) launched its New Source Review (NSR) enforcement initiative parallel to the State of New York that, combined, identified 51 power plants from 13 companies that were illegally modified without appropriate permit review. In early 2001, EPA announced that it would undertake a policy review of the NSR program. On June 13, 2002 EPA announced the results of its policy review and recommended changes to the NSR program that would narrow its application for modifications at power plants and other industrial facilities.

Because EPA has not, to our knowledge, informed the process with an analysis of the costs and benefits of NSR enforcement, the Clean Air Task Force has undertaken a preliminary analysis of the costs and benefits. This review is based on an analysis by Abt (2000)[1], which utilized standard EPA methodologies. While further analysis would be useful, the preliminary results suggest that the benefits of the NSR program as applied to existing power plants are substantially greater than the costs.

Power Plant Emissions Harm Millions of Americans Every Year

As well documented in EPA's own Air Quality Criteria for Particulate Matter, fine particulate matter including secondary sulfates have been linked to mortality and morbidity in cities throughout the United States in numerous robust studies.[2] Moreover, important recent research demonstrates that there are serious and sometimes permanent

impacts to children associated with power plant emission such as asthma attacks, new diagnoses of asthma, birth defects and infant death as summarized *Children at Risk*.[3] Moreover, much of the visibility impairment in the East— which NSR is designed in part to remedy—is dominated by sulfate particulate matter from these and other power plants located in the "enforcement" region shown in Figure 1.[4] Sulfur dioxide emissions are also the primary cause of acid rain in the same region.

In 2000 the Clean Air Task Force commissioned Abt Associates to undertake an analysis of the health-related benefits of reducing power plant emissions.[5] The analysis followed standard EPA protocols—approved by the EPA Scientific Advisory Board—and as routinely utilized in EPA's regulatory risk analyses.[6] The Abt report estimated that approximately 30,000 annual premature deaths, and 600,000 asthma attacks per year are attributable to primary and secondary particulate matter–related emissions from power plants. In addition, power plant emissions were found to be responsible for thousands of emergency room visits and hospitalizations, and millions of lost work and minor restricted activity days. In total, health impacts from all fossil power plants are valued at $178 billion per year in 1999 dollars.[7] Because the plants cited for violating NSR make up about one quarter of the U.S. emissions of sulfate-forming sulfur dioxide, significant mortality and morbidity is attributable to these 51 plants. Also in 2000, for the Clean Air Task Force, Abt estimated that the impact of all power plant emissions on visibility as measured in people's willingness to pay for visibly cleaner air in parks and wilderness areas and the communities where they live, at $7.7 million dollars per year.[8]

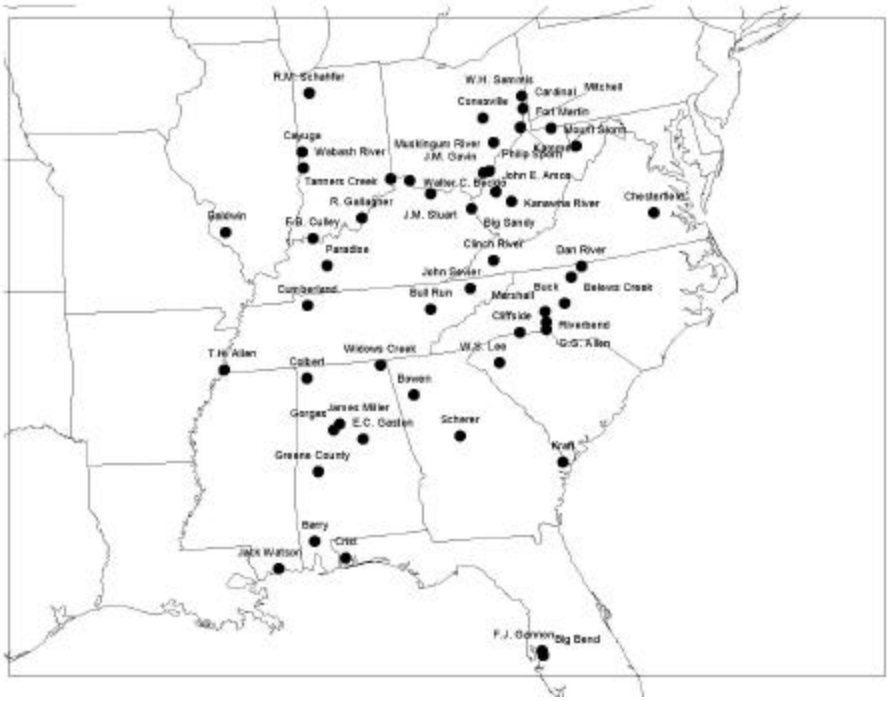

Figure 1. Location of the 51 power plants subject to NSR action

NSR Power Plants Constitute a Disproportionate Share of Emissions

The power plants charged with NSR violations constitute a disproportionate fraction of the emissions from all U.S. power plants. Although they make up 11 percent of the nation's electric capacity, they account for more than double the share of emissions, 24 percent of the nitrogen oxides and 27 percent of the sulfur dioxide.[9] Both NO_X and SO_2 are contributors to the formation of secondary fine particulate matter. Sulfates typically make up over half of the fine particulate matter mass in the eastern half of the United States. Moreover, two thirds of the sulfate-forming sulfur dioxide gas released in the United States is attributable to the electric utility sector.[10]

The Benefits and Costs of New Source Review Enforcement are 7 to 10 times the cost

Methodology. To estimate the health impacts of the NSR plants the Clean Air Task Force asked MSB Energy Associates to estimate the mortality and asthma attacks associated with the 51 power plants cited by EPA and the State of New York for violations of the New Source Review based on the Abt (2000) analysis. This analysis was reported on in Clean Air Task Force/Clear the Air report *Power to Kill*.[11] Health benefits were estimated using two air quality models, S-R matrix and REMSAD and are therefore presented as a range of values herein, low (S-R Matrix) and high (REMSAD). Appendix A summarizes the Abt (2000)[12] methodology for the estimation of health impacts and monetized health benefits. As summarized in Appendix B, the cost of NSR enforcement was calculated on a company-by-company basis by adding sufficient flue gas desulfurization (FGD) and selective catalytic reduction (SCR) to the plants subject to the enforcement actions to bring each company's average emission rates (for the cited plants) down to BACT levels. Each company's compliance was done in the most cost-effective way for that company. The cost and performance of FGD and SCR was based on EPA[13] and Energy Information Administration[14] reports. Recovery of the capital costs of the FGDs and SCRs was based on standard utility capital cost recovery practices using a ten-year equipment life. Costs are in 2001 dollars, escalated from the costs given in the reports.

Results. Figure 2 shows that the plants charged with NSR violations are located in the regions with the greatest power plant particulate matter-related mortality risk in deaths per 100,000 people. The Abt Associates data provided by MSB Energy Associates demonstrates that between 5,500 and 9000 deaths are attributable to the 51 power plants charged with NSR violations each year. Of these, 4,300-7,000 would be avoided if Best Available Control Technology (BACT) were applied. Abt also estimated that between 106,000 and 165,000 asthma attacks are attributable to the 51 power plants and that 80,000 to 120,000 of these could be avoided under BACT-level controls. The monetized value of the premature deaths and asthma attacks ranges from $31 to $49 billion 1999 dollars.

If all 51 plants were cleaned up to BACT levels, avoided asthma and premature deaths alone would total $24-38 billion 1999 dollars. The total cost of the reductions is roughly an order of magnitude less than the benefits--on an annual basis, the cost to clean up

these plants would amount to about $3.6 billion 2001 dollars. This means that the benefits outweigh the annual costs of pollution controls by seven to ten times. NSR enforcement holds significant promise for reducing particulate matter, ozone, haze and acid rain where impacts are most severe and emissions reductions will have the most benefit.

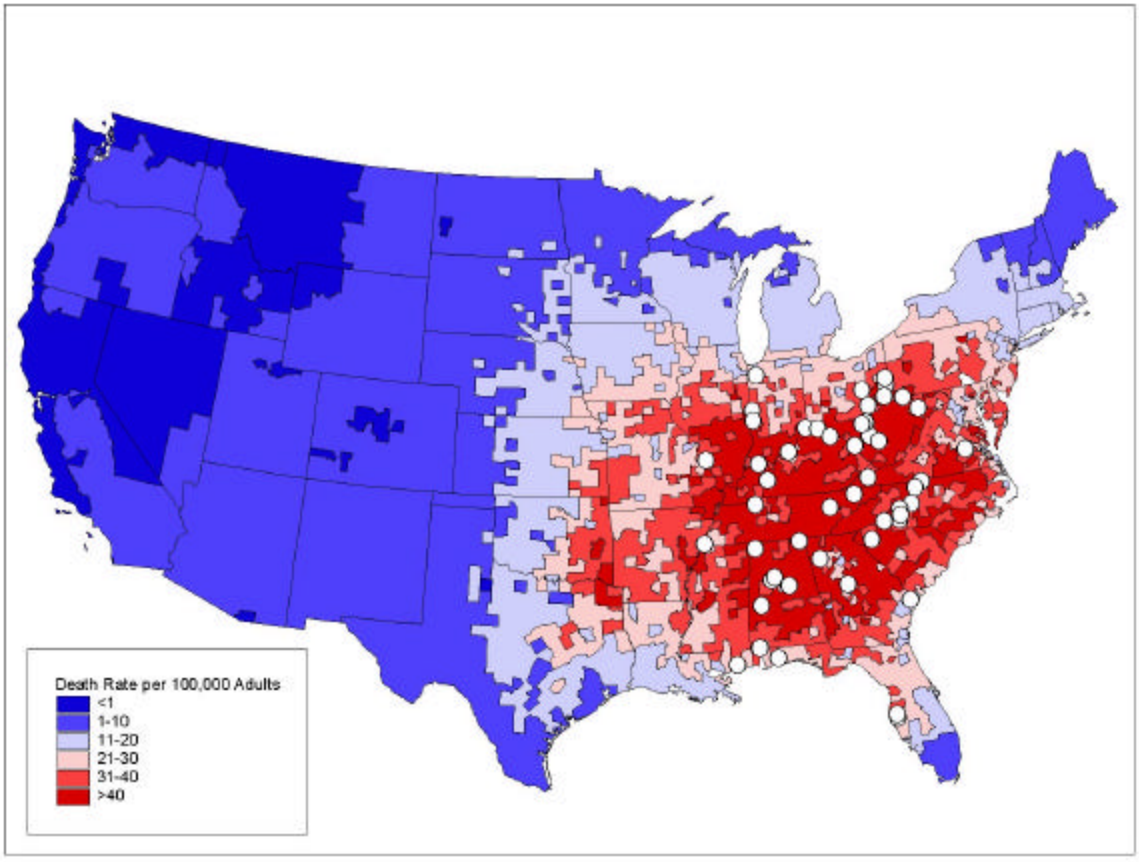

Figure 2. The plants charged with violating NSR, shown as white dots, are located in areas of highest risk of premature death due to particulate matter from power plants (MSB Energy Associates).

Table 1 provides a preliminary analysis of the health impacts and monetized values attributable to companies charged with violations. Tables 1, 2, 3 and Figure 3 report results for those companies having four or more plants under NSR investigation (AEP, Cinergy, Duke, Southern Company and TVA.) Because the air modeling technique has higher uncertainty when the data from just one or two plants are isolated, companies with only a few plants (Allegheny Power, Dominion, DPL, Illinova, NIPSCO, Ohio Edison, SigCorp and TECO) have been combined under "all other NSR companies." Table 2 shows the value of the benefits of NSR enforcement if the 51 plants were required to meet modern standards (BACT). Table 3 shows the associated NSR compliance costs. The analysis suggests that, on the average for the 13 companies, the benefits of NSR

enforcement would significantly outweigh the costs by greater than 7 to 1 in the low case and 10 to1 in the high case (Figure 3).

Company	Mortality Low	Mortality High	Value Low (millions)	Value High (millions)	Asthma Attacks Low	Asthma Attacks High	Value Low (millions)	Value High (millions)
All NSR Plants	5,503	8,700	$31,011	$49,025	106,397	164,795	$4.4	$6.8
AEP	1,418	2,241	$7,989	$12,629	26,598	41,197	$1.1	$1.7
Cinergy	434	685	$2,443	$3,862	8,516	13,190	$0.3	$0.5
Duke	681	1,076	$3,836	$6,064	13,644	21,132	$0.6	$0.9
Southern Company	1,003	1,585	$5,650	$8,932	19,855	30,752	$0.8	$1.3
TVA	517	817	$2,912	$4,603	10,452	16,189	$0.4	$0.7
All Other NSR Companies	1,452	2,295	$8,182	$12,935	27,332	42,334	$1.1	$1.7

Table 1. Health impacts and monetized value associated with emissions from power plants subject to NSR enforcement.

Company	Mortality Low	Mortality High	Value Low (millions)	Value High (millions)	Asthma Attacks Low	Asthma Attacks High	Value Low (millions)	Value High (millions)
All NSR Plants	4,299	6,796	$24,223	$38,293	80,278	124,340	$3.3	$5.1
AEP	1,121	1,772	$6,315	$9,983	20,496	31,746	$0.8	$1.3
Cinergy	338	534	$1,904	$3,009	6,436	9,968	$0.3	$0.4
Duke	569	899	$3,204	$5,065	10,619	16,448	$0.4	$0.7
Southern Company	878	1,388	$4,947	$7,821	16,924	26,213	$0.7	$1.1
TVA	187	295	$1,052	$1,663	3,674	5,691	$0.2	$0.2
All Other NSR Companies	1,207	1,908	$6,801	$10,752	22,129	34,275	$0.9	$1.4

Table 2. Benefits associated with emissions from power plants if they were subject to full enforcement/BACT.

Company	Annual Costs ($millions)
All NSR Plants	3,613
AEP	815
Cinergy	192
Duke	409
Southern Company	852
TVA	477
Other Companies	868

Table 3. Estimated annual costs to meet BACT by Company.

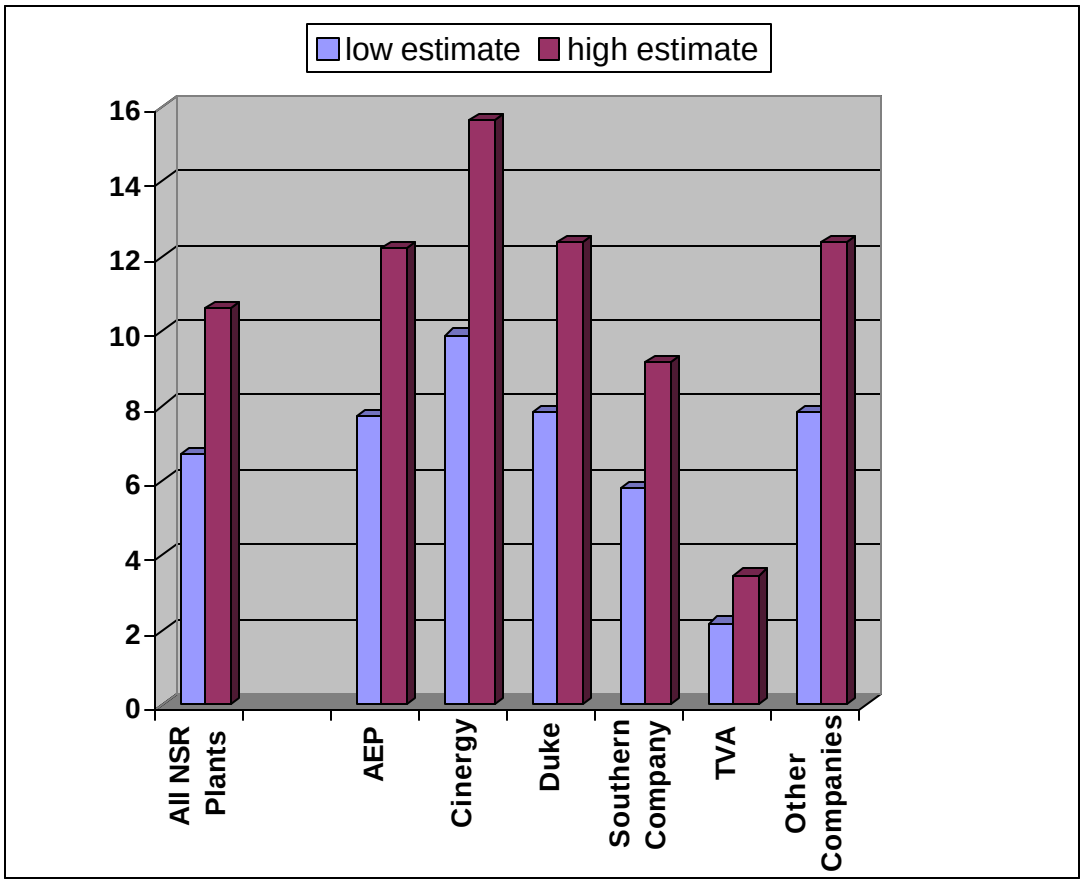

Figure 3. Benefit to cost ratio for cleaning up power plants subject to NSR enforcement to BACT levels. Five companies shown individually for illustration. Eight other companies combined under "other companies" as analysis lacks adequate resolution for one single or a few plants.

Appendix A: Abt (2000) Health Benefits Methodology

Abt Associates used methods developed for and employed by the EPA, extensively reviewed and endorsed by EPA's Science Advisory Board, and accepted by the U.S. Office of Management and Budget in a variety of regulatory impact and assessment contexts.[15] Because these health effects estimates include solely the effects of airborne fine particles—just one of many pollutants attributable to power plants, these estimates significantly understate the total adverse health impacts on the public from power plants due to other air pollutants as well as impacts on our land and water resources. Excluded from these estimates are the health effects from other power plant pollutants, such as air emissions that result in ozone smog, air toxics, global warming, and the impacts from the consumption of fish contaminated by power plant mercury emissions.

In its analysis, Abt Associates assumed full implementation of the laws and regulations that currently require air pollution reductions from the power industry, even though all of the required emission reductions have not yet occurred. The base case assumed full implementation of EPA's Summer Smog rule (i.e., the NO_X SIP Call) and implementation through 2007 of the Acid Rain program. Abt Associates analyzed the following scenarios:

1. Base case: full implementation to 2007 of the Acid Rain program (Phases 1 and 2) and EPA's Summer Smog rule (the NO_X SIP Call);
2. Base case in 2007 minus all power plant emissions -- subtracting power plant emissions from the base case gives us the health endpoints due solely to power plant emissions;
3. Base case in 2007 minus a 75 percent reduction in nitrogen oxides and sulfur dioxide from 1997 levels (based on equals 0.3 lbs./mmbtu emissions rate for sulfur dioxide and 0.15 lbs./mmbtu rate for nitrogen oxides).[16]

Using the emissions inventory for power plant and non-power plant emissions of nitrogen oxides, sulfur dioxide, and direct particulate matter emissions, the study team ran EPA's particulate matter air quality models: Source-Receptor Matrix (S-R Matrix) (used to model the NO_X SIP Call and other regulatory actions) and Regional Emission Modeling System for Acid Deposition (REMSAD) (approved by EPA's Science Advisory Board and used in the Clean Air Act cost-benefit study). Both air quality models were used to estimate the baseline fine particle contributions attributable to the power plants and the reductions in pollutant concentrations due to the targeted reductions. The inputs and assumptions used by the team were consistent with recent regulatory impact analyses performed for EPA, such as the Summer Smog rule (regional NO_X SIP Call rule), automobile emissions standards (Tier 2), Heavy-Duty Diesel rule (HDE), and other similar analyses. The health effects and benefits are reported here as a range between the S-R Matrix results and the REMSAD results.[17]

This air pollution concentration analysis provided inputs for the health effects assessment. Then utilizing health studies which link changes in ambient fine particle concentrations to changes in risk of mortality and asthma attacks, pollution

concentration-response functions were derived that quantify the relationship between the forecasted changes in exposure and the expected changes in these specific health effects. Abt Associates then used the modeled changes in pollutant concentrations (from the base case to the 75% reduction or "BACT" case) to estimate the power plant-attributable health impacts. The difference between the base case and the BACT case yielded estimates of the health benefits (or avoided adverse impacts).

MSB Energy Associates on behalf of the Clean Air Task Force extracted the relevant data from the Abt Associates study using the underlying data from the October 2000 Abt Associates report and a proprietary computer program designed by Abt Associates. The analysis isolates the contribution to premature mortality and asthma attacks attributable solely to the pollution from the NSR enforcement target plants for each of the areas of interest.

Appendix B. NSR Enforcement Cost Methodology

There are a number of key assumptions on which this analysis relies. These assumptions fall into the following categories.

- Cost and performance of flue gas desulfurization equipment (FGD).
- Cost and performance of selective catalytic reduction equipment (SCR).
- Current operations and emissions of the power plants addressed in the study.
- Financial parameters of the plant owners.

Flue Gas Desulfurization

Cost and performance parameters for FGD equipment were based on the EPA Office of Research and Development report, “Controlling SO2 Emissions: A Review of Technologies.” In this report costs are shown graphically as a function of plant size and FGD type. These costs were given in 1998 dollars, and were escalated to 2001 dollars using an annual escalation rate of 2.5%. The report suggests that removal efficiencies of 90-95% or higher for spray dryer scrubbers can be expected. This analysis used 95%.

Selective Catalytic Reduction

Assumptions for the SCR were based on the Energy Information Administration report, "Strategies for Reducing Multiple Emissions from Power Plants." EIA provides two sets of costs. This report is based on the higher set. The costs are in 1997 dollars and were escalated to 2001 dollars using the same factors as for the FGD costs.

Current Operations and Emissions

Operations and emissions from 1999 were used as the base for this analysis. Emissions data come from the EPA Acid Rain Scorecard (CEMS Data). Generation data (MWH produced by each unit) come from FERC Form 767 and 759.

Financial Parameters

Financial parameters such as the cost of debt and equity and the capital structure are used to calculate the annual amortization of the capital costs. This study does not calculate separate amortization factors for each plant owner, but rather calculates a factor based on the general values for investor-owned utilities. The cost of debt, preferred stock, and equity and the capital structure are calculated from the Composite Statement of Income and the Composite Balance Sheet as reported in the 1999 Electric Power Annual issued by the Energy Information Administration. A ten year equipment life with a five year tax life using sum-of-the-years-digits depreciation was used.

These values were used in a capital recovery model to determine an annualized capital recovery factor of 13.99%.

[1] Abt Associates, Inc., The Particulate-Related Health Benefits of Reducing Power Plant Emissions (October 2000) and Clean Air Task Force, Death, Disease, and Dirty Power: Mortality and Health Damage Due to Air Pollution from Power Plants (October 2000).

[2] E.g., Pope, C.A. et. Al. 1995. Particulate air pollution as a predictor of mortality in a prospective study of U.S. adults. American Journal of Respiratory and Critical Care Medicine, vol. 151, p. 669-674; Pope, C.A. et al (2002) Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. Journal of the American Medical Association, vol. 287, no. 9, March 6, 2002; Dockery, D.W. et. al. 1993. An association between air pollution and mortality in six U.S. cities. New England Journal of Medicine, vol. 329 p. 1753-1759; Krewski et. al., 2000. Reanalysis of the Harvard Six Cities Study and American Cancer Society Study of Particulate Air Pollution and Mortality; Health Effects Institute, Cambridge MA; Samet, J. et. al. (2000); The national morbidity, mortality and air pollution study Part II: morbidity and mortality from air pollution in the Untied States. Health Effects Institute, Number 94, Part II. June 2000.

[3] Clean Air Task Force, Clear the Air , Physicians for Social Responsibility (2002): Children at risk: how air pollution from power plants threatens the health of America's children (May 2002); http://clnatf.org/publications

[4] U.S. EPA (2001). Visibility in mandatory federal class I areas (1994-1998) a report to Congress. EPA-452/R-01-008, November 2001.

[5] Abt Associates, Inc., The Particulate-Related Health Benefits of Reducing Power Plant Emissions (October 2000) and Clean Air Task Force, Death, Disease, and Dirty Power: Mortality and Health Damage Due to Air Pollution from Power Plants (October 2000); http://clnatf.org/publications

[6] E.g. the regional haze, tier 2 and heavy duty diesel rules as well as in estimating the costs and benefits of the Clean Air Act and the 2000 EPA analysis of the Acid Deposition and Ozone Control Act, S. 172.

[7] See Abt (2000) exhibit 6-3. Mortality estimate was based on particulate matter levels estimated by REMSAD air quality modeling and the dose-response from the American Cancer Society study (1995), reanalysis in Krewski et. al., 2000. Reanalysis of the Harvard Six Cities Study and

American Cancer Society Study of Particulate Air Pollution and Mortality A Special Report to the Institute's Particle Epidemiology Reanalysis Project, July 2000; Health Effects Institute, Cambridge MA;

[8] Abt Associates, Out of Sight: The Science and Economics of Visibility Impairment, June 2000 *Prepared for* Clean Air Task Force, Boston, MA; Abt Associates Inc. 4800 Montgomery Lane Bethesda, MD 20814-5341.

[9] Clean Air Task Force (2002). Power to Kill: Death and Disease from Power Plants Charged with Violating the Clean Air Act. http://clnatf.org/publications

[10] U.S. EPA, (2001). National air quality and emissions trends report 1999. . EPA 454/R-01-004, March.

[11] Clean Air Task Force (2002). Power to Kill: Death and Disease from Power Plants Charged with Violating the Clean Air Act. http://clnatf.org/publications

[12] See section 5, Health Benefits, Abt Associates, Inc., The Particulate-Related Health Benefits of Reducing Power Plant Emissions (October 2000) and Clean Air Task Force, Death, Disease, and Dirty Power: Mortality and Health Damage Due to Air Pollution from Power Plants (October 2000); http://clnatf.org/publications

[13] EPA Office of Research and Development, "Controlling SO2 Emissions: A Review of Technologies," 2000.

[14] Energy Information Administration, "Analysis of Strategies for Reducing Multiple Emissions from Power Plants," 2000.

[15] Ibid.

[16] Abt Associates Inc. October 2000 original work assumed a national cap based on a 75% reduction from 1997 emissions based full compliance with the NOx SIP Call and through Phase 2 of the Acid Rain program with emissions grown to 2007. Assuming full compliance with the NOx SIP Call and the Acid Rain program the results here greatly understate the current impacts from these plants. The cap was based on emission rate limits of 0.3 lbs./mmbtu for SO_2 and 0.15 lbs./mmbtu for NOx. The analysis allowed emissions credit trading between plants to comply with the requirements. As a result, the emissions inventories do not assume full BACT compliance at each unit for the entire U.S. fleet. However, the results of the analysis found that the 51 NSR target plants do meet a level of overall emission reduction commensurate with BACT. Thus, the relative benefits of BACT controls are not likely to be understated.

[17] The S-R Matrix results for the NSR plants are modeled outputs. The REMSAD results are based on modeled REMSAD county-by-county values and a comparison of ratios derived from S-R Matrix county-level results.