# Expensive Neighbors:

## The Hidden Cost of Harmful Pollution to Downwind Employers and Businesses

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** This Appendix was not included in December 2010 version of the report.*

## Executive Summary and Introduction

On July 6, 2010, EPA proposed its Clean Air Transport Rule (the "Transport Rule") under the Clean Air Act ("CAA") requiring reductions in the emission of dangerous pollutants from power plants that have not installed pollution controls for sulfur dioxide ("$SO_2$") and nitrogen oxide ("$NO_X$"). These harmful pollutants are known to travel hundreds of miles in the air stream causing massive health and economic losses in downwind regions. The proposed new rule is designed to fulfill the CAA's "Good Neighbor Rule", which prohibits upwind regions from polluting downwind regions.[1]

In its analysis of Transport Rule benefits, EPA focuses almost exclusively on health benefits, estimating that the proposed rule would save many billions in annual health and welfare benefits and avoid thousands of premature deaths each year.[2] But even these staggering numbers substantially understate the adverse regional impacts of interstate pollution transfer as they fail to consider the resulting economic inequities and losses suffered by downwind states, in particular higher labor and health insurance costs, lost jobs, lost state and local tax revenue, and higher gasoline prices. This Report details why EPA's conservative modeling, therefore, actually understates the Transport Rule benefits and likely overstates compliance costs.

This Report also takes EPA's analysis a step further and explores the additional hidden costs of air pollution to businesses and economies that are downwind of the minority of the Nation's power plants that have failed to install pollution controls. In addition, we explore the argument made by some plant owners to delay environmental regulations because, they claim the Nation's economy is too weak to sustain the costs of implementing the Transport Rule without extending or exacerbating the recession. Those generation owners assert that installing controls will increase their local electricity prices and may trigger the retirement of some older units, causing localized job losses at a time when the nation is recovering from recession.

We conclude that:

- **There is no economic rationale justifying further delay.** On the contrary, implementing the Transport Rule will stimulate the economies, increase employment and tax revenue, and hasten economic recovery in downwind areas. Under any reasonable set of assumptions, the Transport Rule benefits far outweigh compliance costs; **each dollar invested in necessary pollution controls avoids $50-100 dollars in downwind costs annually.**

- Under highly probable conditions, refining EPA's estimates would likely mean **Transport Rule benefits exceed compliance costs by about 100 times.**

[1] 42 U.S.C. §7410 (a)(2)(D)(i) 1990. Although EPA's proposal offers several alternatives for implementing the Transport Rule, its "preferred remedy" is to allocate emissions allowances among the Affected States and to allow for intrastate trading and limited interstate trading of these allowances among power plants, within states' specific emissions limits.

[2] According to EPA's analysis, "The proposed rule would yield more than $120 to $290 billion in annual health and welfare benefits in 2014, including the value of avoiding 14,000 to 36,000 premature deaths….[which] far outweighs the estimated annual costs of $2.8 billion.", EPA, "Regulatory Impact Analysis for the Proposed Federal Transport Rule" (June 2010) ("RIA") at 329,330.

- Pollution from power plants that have failed to install pollution controls is causing nearly $6 billion in annual costs, because of higher labor expenses, lost work days, lost productivity, and higher insurance costs.

- As a result of uncontrolled pollution in downwind regions, between 2005 and 2012:

  - Businesses will suffer over $47 billion in costs;

  - Over 360,000 jobs will be lost;

  - State and local governments will lose almost $9.3 billion in tax revenue; and

  - Families and businesses in polluted areas will pay $26.0 billion more for reformulated gasoline as a result of ongoing pollution.

**TABLE ES-1**
**Summary of Pollution Costs on Affected States Without the Transport Rule**
**$ are in Billions**

| | **Annual** | **Cumulative (8 Years) 2005 through 2012** |
|---|---|---|
| Lost Income[1] | $5.92 billion | $47.2 billion |
| Lost State and Local Tax Revenue | $1.16 billion | $9.28 billion |
| Higher Gasoline Prices | $3.25 billion | $26.0 billion |
| Lost Jobs | 45,010 | 360,080 |

[1] "Lost Income" derives from lost "work" (i.e., higher labor costs, lost work days, and lost productivity) and higher insurance costs.

For the reasons set forth below, these economic conclusions lead us to a clear policy recommendation to expedite installing pollution controls on the minority of plants that have failed to install controls.

## Section I. EPA's Conservative and Reasonable Cost Benefit Analysis of the Transport Rule.

EPA's core mission is protecting human life, health, and the environment. As air pollution travels hundreds of miles with wind currents and increases the downwind concentration of harmful pollutants, a primary purpose of the proposed Transport Rule is to reduce adverse health effects on downwind areas. In its Regulatory Impact Analysis ("RIA") of the Transport Rule, EPA poses the critical question: Do health-related savings from curbing pollution emissions exceed compliance costs? The answer is clearly "yes", even when focusing only on the morbidity and mortality effects of increased concentrations of $PM_{2.5}$ and ground level ozone. In its RIA, EPA cites extensive evidence that demonstrates conclusively the higher concentrations of these harmful air pollutants, which result from adding upwind emissions to local emissions, exponentially increase health and related economic damages. As detailed in Section II of the Report, using peer-reviewed scientific and economic evidence, EPA concludes in its RIA that the annual benefits of reducing premature deaths and illnesses through the Transport Rule exceed compliance costs by 50 to 100 times.

Based on an independent review of EPA's detailed and extensive economic analysis in the Transport Rule RIA, this Report concludes that EPA's models, methods, sensitivity analyses, and data meet and surpass the professional and scientific requirements of independent peer review. Further, independent sensitivity analysis of several critical components of EPA's cost benefit analysis confirms that EPA's analysis is reasonable and conservative; that likely the Transport Rule's benefits are understated and its compliance costs overestimated; and that the benefits of the Transport Rule far outweigh the compliance costs under any reasonable set of assumptions.

### A. EPA's Cost/Benefit Assessment Methodology Meets or Exceeds the Standard for Peer Review.

The purpose of the Transport Rule is to reduce the concentrations of $NO_X$ and $SO_2$ while also controlling their downwind transport. Nationally, coal plants are the largest source of $SO_2$ emissions and among the largest sources of $NO_X$ emissions. $SO_2$ and $NO_X$ react in the atmosphere to form fine particle pollution ($PM_{2.5}$)[3] and ground level ozone (smog). These pollutants are carried through the air contributing to pollution in other states. $PM_{2.5}$ not only can travel in the air stream hundreds of miles, but also can be deeply inhaled, absorbed and passed through the blood stream to susceptible organs in the body, causing premature deaths, serious illnesses such as chronic bronchitis and heart attacks, and numerous respiratory problems. Similarly, because the chemical reactions that create ground level ozone take place while wind blows the pollutants through the air, ground level ozone can be even worse miles away than at the source of the emissions. The first air pollution and mortality studies that conclusively established links between air pollutants and human health[4] in the 1970's were primarily based upon statistical correlation. Recently, the focus has shifted to causation, a more scientific

[3] $PM_{2.5}$ refers to fine particles with a diameter of 2.5 microns or less. A micron is one-millionth the size of a meter, which is about 1% of the width of a human hair.
[4] Lester Lave and Eugene Seskin with support from Resources for the Future (RFF) established the statistical links between air pollutants and human health in a variety of studies summarized in their 1977 book: Air Pollution and Human Health, Baltimore: the Johns Hopkins University Press for Resources of the Future.

approach that analyzes the harm to humans through deep inhalation of such fine particles in the air.

In effect, the air stream operates as a free waste transfer system, transporting air pollution to downwind populations. To control such interstate pollution transfer, EPA proposes to allocate $SO_2$ and $NO_X$ "permits" or "allowances"[5] to 31 states and the District of Columbia ("Affected States"), to enable intrastate trading and limited interstate trading among power plants. The goal is to prevent electric generators in upwind states from securing allowances that would allow them to transport their harmful air pollution to downwind states that cannot reasonably attain acceptable $PM_{2.5}$ and ground level ozone emission levels.

In its RIA, following extensive evaluation of the vast body of authoritative scientific research, the EPA estimated that in 2014 the Transport Rule would protect public health by avoiding: 14, 000 – 36,000 premature deaths; 21,000 cases of acute bronchitis; 23,000 non-fatal heart attacks; 26,000 hospital and ER visits; 1.9 million days when people miss work or school; 240,000 cases of aggravated asthma; and 440,000 cases of upper and lower respiratory symptoms. The Transport Rule therefore would provide mortality and morbidity annual health and welfare benefits totaling between $120 to $290 billion.[6]

To estimate the changes in ambient air concentrations of air pollutants and resulting health effects, EPA uses only proven, state-of-the-science models and methods. Its quantitative and qualitative models, sensitivity analyses, and data meet and surpass professional and scientific requirements of independent peer review. In determining the impact of increasing concentrations of harmful pollutants by adding transported upwind emissions to locally produced downwind emissions, the EPA followed the widely-accepted science of concentration-response ("C-R"). Under the C-R approach the "odds", or relative risk, of premature death or illnesses increase exponentially.

To convert $SO_2$ and $NO_X$ emissions into estimates of ambient concentrations of $PM_{2.5}$ pollution and resulting by-products such as ground level ozone, EPA uses an air quality model called $CAM_X$ (Comprehensive Air Quality Model with Extensions). To estimate resulting concentrations of both primary and secondary particles in the atmosphere, this robust, proven model uses $SO_2$ and $NO_X$ emissions as inputs and includes geographically dispersed meteorological inputs such as wind speed and direction, temperature, moisture, vertical diffusion, and rainfall.

To estimate ground level ozone concentrations, the $CAM_X$ results are combined with the AIRS (Aeromatic Information Retrieval System) model. EPA's peer-reviewed quantitative benefits model (BenMAP) then determines the different health and social consequences of implementing the Transport Rule based upon estimated differences in concentrations of $PM_{2.5}$ and ground level ozone.

Table 1, which reproduces EPAs RIA Table 3-8, shows the significant power plant reductions in $SO_2$ and $NO_X$ emissions from implementing the Transport Rule as calculated by EPA using these conservative, tested, and sound scientific methods.

[5]The economics literature typically refers to tradable rights to emit as "permits." In the Transport Rule, EPA refers to them as "allowances."
[6] EPA "Fact Sheet: Proposed Transport Rule Would Reduce Interstate Transport of Ozone and Fine Particle Pollutants" (July 6, 2010) at 4.

**TABLE 1**
**Table 3-8. Summary of Emissions Changes for the Transport Rule in Lower 48 States**

| Item | Pollutant | |
|---|---|---|
| | $NO_X$ | $SO_2$ |
| 2014 EGU Emissions | | |
| Base Case EGU Emissions (tons) | 2,908,844 | 8,469,820 |
| Control EGU Emissions (tons) | 2,089,744 | 4,045,465 |
| Reductions to Base Case in Control Case (tons) | 819,101 | 4,424,358 |
| Percentage Reductions of Base EGU Emissions | 28.2% | 52.2% |
| Total 2014 Man-made Emissions[1] | | |
| Total Base Case Emissions (tons) | 14,096,244 | 12,330,575 |
| Total Control Case Emissions (tons) | 13,277,143 | 7,906,217 |
| Percentage Reduction of All Manmade Emissions | 5.8% | 35.9% |

[1]In this table, man-made emissions includes average fires

Based on these substantial $SO_2$ and $NO_X$ emission reductions, and using state-of-the-science, proven methodology discussed at length in Section I (B)(1)(i) of this report, EPA also calculated that implementing the Transport Rule could prevent 14,000 to 36,000 premature deaths per year, as shown in the following Table 2[7].

[7] EPA uses two significant digit rounding. Therefore the combined premature deaths estimated for ozone and $PM_{2.5}$ equal the number of premature deaths for adults and children combined and attributable to ozone and $PM_{2.5}$ combined. Annual ozone-related premature deaths and infant $PM_{2.5}$ are both less than 500 deaths per year, so that those numbers round down to zero when combined with the adult $PM_{2.5}$ numbers.

**TABLE 2**

**TR Reductions in Annual Premature Mortality Within the Transport Rule States[1]**

**Fine Particles**

| | **Source** | **Range** | **Midpoint** |
|---|---|---|---|
| (1) | Pope, et al 2002 >30 | 4,000 - 25,000 | 14,000 |
| (2) | Laden, et al 2006 >25 | 17,000 - 55,000 | 36,000 |
| (3) | Infant | 59 | 59 |

**Ozone**

| | | | |
|---|---|---|---|
| (1) | Bell, et al 2004 All Ages | 16 - 83 | 50 |
| (2) | Schwartz, et al 2005 All Ages | 23 -130 | 76 |
| (3) | Huang, et al 2005 All Ages | 31 - 130 | 83 |
| (4) | Ito, et al 2005 All Ages | 130 -310 | 220 |
| (5) | Bell, et al 2005 All Ages | 76 -250 | 160 |
| (6) | Levy, et al 2005 All Ages | 160 - 300 | 230 |

[1]Source for PM and Ozone premature mortality estimates is Table 5-17, pages 178-179 of the TR RIA.

## B. Independent Review of Several Critical Issues Confirms that EPA's Methodology is Reasonable and Conservative.

A comprehensive review of EPA's analysis confirms its cost/benefit methodology for valuing annual mortality and morbidity health and welfare benefits is reasonable and conservative. In particular, an independent review of EPA's: (1) baseline conditions; (2) explicit value of human life that drives its numbers; (3) quantitative omission of some benefits; and (4) conservatively high compliance costs, verifies that health benefits alone from the Transport Rule far exceed compliance costs under any set of reasonable assumptions, and that the Agency's approach is conservative because it tends to understate benefits and overstate costs. **Under highly probable conditions, the analysis indicates that refining EPA's estimates** would likely mean that Transport Rule benefits would exceed compliance costs by about 100 times.

### 1. Baseline Conditions

In determining the benefits and costs for the Transport Rule, EPA assumed the following baseline conditions: the Clean Air Interstate Rule ("CAIR") is not in effect, but all other federal and state requirements to reduce emissions contributing to ground level ozone and $PM_{2.5}$ pollution in place as of February 2009 are reflected. Critics might contend that under these assumptions EPA's RIA inappropriately compares benefits "without" CAIR to incremental costs "with" CAIR. To a large degree, however, EPA's baseline approach simply reflects the Court's decision in *North Carolina v. EPA*[8] vacating and remanding CAIR to EPA, and requiring EPA to establish a new rule to address CAIR's deficiencies. Through its actions the Court, therefore, effectively established a new "without" CAIR baseline. The Court had found that "EPA's approach – region wide caps with no state-specific quantitative contribution determinations or emissions requirements – was fundamentally flawed"[9] and that CAIR had failed in its crucial goal of "prohibiting sources 'within the state' from contributing to nonattainment or interfering with maintenance in 'any other state.'"[10] That the Court subsequently found it would not be good policy to abandon air quality controls, even flawed ones, during the transition period, does not mean that a flawed CAIR should nonetheless be used to establish the Transport Rule baseline. In addition, even if the Court's decision would allow such a baseline, using an actual CAIR starting point would be nearly impossible, because no one has calculated how much CAIR's flaws would have reduced EPA's original estimates of CAIR's benefits.

To reinforce how the Transport Rule benefits far exceed compliance costs under any reasonable scenario, however, Table 3 shows EPA'S March 2005 RIA CAIR benefits estimate for 2014, using 2006 dollars, compared to the low and high Transport Rule RIA benefits. In its RIA for the proposed Transport Rule, EPA also estimated the annual social compliance costs, which were \$2.03 billion and \$2.23 billion at 3% and 7% discount rates, respectively.[11] Notably, therefore, as shown in Table 3, even if you assumed CAIR had worked properly, and compared the Transport Rule benefits with those estimated under a well-functioning CAIR, the incremental Transport Rule benefits still far exceed the \$2 plus billion in social compliance costs.

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[8] 531 F.3d 896 (June 11, 2008).
[9] *State of North Carolina v. Environmental Protection Agency*, 531 F.3d 896, 929.
[10] Ibid at 907.
[11] RIA at 2.

**TABLE 3**
**Summary of Annual Benefits in 2014 for CAIR (Assumed to Work) and TR**
**Billions of 2006$**

| CAIR[1] | | Low TR[2] | | High TR[3] | |
|---|---|---|---|---|---|
| 3%[4] | 7%[4] | 3% | 7% | 3% | 7% |
| $116.0 | $98.6 | $124.0 | $114.0 | $294.0 | $264.0 |

**Improved Benefits for TR Compared to Assumed Working CAIR**

| Incremental Low TR[5] | | Midpoint | | Incremental High TR[6] | |
|---|---|---|---|---|---|
| 3% | 7% | 3% | 7% | 3% | 7% |
| $8.0 | $15.4 | $93.0 | $90.4 | $178.0 | $165.4 |

[1] See Table 1.1, Regulatory Impact Analysis for the Final Clean Air Interstate Rule (CAIR), EPA-452/R-05-002, March 2005.

[2] See Table 1.1, Regulatory Impact Analysis for the Proposed Federal Transport Rule, EPA-HQ-OAR-2009-0491, June 2010.

[3] Equals Net Benefit plus Social Costs interpolated between 2010 and 2015 and adjusting 1999$ for CPI to 2006$ to match TR estimates for the 3% discount rate case.

[4] Same as for footnote 3 for the 7% discount rate case.

[5] Equals low TR less CAIR for respective 3% and 7% discount rate cases.

[6] Equals high TR less CAIR for respective 3% and 7% discount rate cases.

For example, even the substantially understated incremental benefits estimates of $8 billion per year for the 3% low Transport Rule case are four times the corresponding annual incremental costs of about $2 billion, and in the 7% low case, benefits exceed costs by almost seven to one (i.e., $15.4 billion ÷ $2.23 billion). Even more significantly, comparing high Transport Rule incremental benefit estimates to those for assumed successful CAIR, benefits would exceed costs by 89 and 74 times respectively.[12] Moreover, significant net health benefits

[12] $178 billion in benefits divided by $2 billion in costs equals a cost benefit ratio of 89 for the 3% case. $165.4 billion in benefits divided by $2.23 billion in costs equals a cost benefit ratio of 74 for the 7% case.

under these highly conservative incremental scenarios would increase markedly by adding the demonstrated business and government benefits discussed later in Section II.[13]

The previous discussion of these very conservative potential incremental cost/benefit ratios appropriately utilized "social cost," which is deemed to be the conceptually correct, appropriate[14] economic efficiency measure in calculating such ratios. Social costs represent the welfare costs of the rule measured as the loss of consumer utility, i.e., the costs to society of using resources to comply with the Transport Rule.[15] EPA, however, also used the highly regarded Integrated Planning Model (IPM) to estimate that the power sector's incremental annual private costs, i.e., what the power industry will directly expend to comply with the Transport Rule, would be $3.7 billion in 2012 and $2.8 billion in 2014.[16] EPA estimates 2012's incremental compliance costs are greater as generators make the required investments and bank unused emissions. EPA reasonably estimates, however, that, even as emission controls become more stringent in 2014, compliance costs would be lower because generators would rely to a larger extent on investments and changes added in 2012 and 2013.

Moreover, replacing the widely accepted and conceptually correct social costs measurement for cost/benefit ratios with the power sector's higher annual private costs would not alter the conclusion that Transport Rule benefits easily exceed costs even under the very conservative assumption that the baseline is a working CAIR. Furthermore, adding private costs and social costs together would still not cause incremental Transport Rule costs to exceed benefits even using an assumed working CAIR as the baseline.

### 2. EPA Used a Reasonable Value of Statistical Life (VSL)

The value of statistical life ("VSL") EPA used in calculating the value of fewer premature deaths represents the largest share of the Transport Rule benefits. Accordingly, we conducted an independent sensitivity analysis on this key variable. This analysis concludes that EPA's VSL methodology represents current state-of-the-science.

Although important work continues in refining monetization of the value of premature loss of life, the EPA's VSL analysis was vetted fully, subjected to robust peer review in the scientific community, and applies the most scientifically objective methodology for valuing human life currently available. Moreover, even if EPA had selected an unreasonably low VSL value, the Transport Rule benefits still far outweigh the compliance costs.

EPA's VSL relies conceptually on two critical issues: (1) reducing the risks of premature death, i.e., the effect of a "small reduction in risk on a large number of people"; and (2) the "willingness of people to pay" (WTP) to reduce such risks. It is important to understand that the VSL evaluation represents payments, i.e., a relatively small individual WTP[17] across all the

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[13] The midpoint incremental Benefits-to-Cost ratios are 46 and 40 for the 3% and 7% discount rate cases. These may be the more relevant comparisons because the 2005 CAIR did not provide a low and high range. This makes the 2010 Transport Rule midpoint more comparable to the 2005 CAIR estimates.
[14] RIA at 14.
[15] Ibid at 31.
[16] Ibid at 255.
[17] The three approaches to determine WTP are: (1) Wage-Risk Studies, which compare relative salary differences to different fatal injuries, adjusting for confounding factors in the regression analysis; (2) Continent Valuation Studies, which pose hypothetical questions related to risk, hypothetical insurance premiums, changes in monetary

potentially affected population, to reduce the risk of premature death, rather than an attempt to determine the value of a specific human life.

Consider an example. Suppose one million people are each willing to pay $100 per year to reduce the risk of deaths from 20 per million people to ten per million. The sum of WTP equals $100 million per year and the reduction in expected deaths is 10 per year, so the VSL would be $10 million per person. ($100 million divided by 10 people per year)

In determining the Transport Rule VSL, the EPA relied on its Guidelines for Preparing Economic Analyses (U.S. EPA 2000) (Guidelines).[18] Notably, EPA's Scientific Advisory Board's ("SAB") Environmental Economics Advisory Committee (EEAC), comprising "leading U.S. environmental economists affiliated with major colleges, university, and economic research institutions,"[19] provided an overall rating of "excellent" to the Guidelines.[20]

To derive its Transport Rule VSL, the EPA used state-of-the-science methods including a "meta analysis" of 26 "high-quality" studies conducted between 1974 and 1991, which estimated a value of mortality risk reduction.[21] Each study was peer-reviewed, tested, and endorsed by the SAB. The EPA Guidelines recommend taking a $4.8 million (1990$) figure for VSL and updating that figure for inflation to the base year of the benefit analysis. To adjust the VSL for inflation, EPA used the Consumer Price Index ("CPI") rather than the Gross Domestic Product Deflator inflation index, as CPI "is used consistently throughout the analysis."[22]

Pursuant to the endorsed Guidelines in its Transport Rule RIA, EPA, therefore, reasonably derived a VSL of $7.8 million by adjusting a VSL of $6.3 million in 2000 dollars to 2006 dollars using the CPI growth of 24.5% from 2001 to 2006 ($6.3 * 1.245% = $7.844).[23]

#### (i) EPA Uses a Reasonable Approach to Calculate the Number of Avoided Premature Deaths

The value of the VSL is a critical variable in EPA's cost/benefit calculations because health-related and, in particular, mortality-related benefits, dominate the estimated benefits for the Transport Rule. The Transport Rule RIA estimated that in 2014 approximately 14,000 to 36,000 premature deaths would be avoided within the Affected States. Avoiding these premature deaths represents about $110 billion[24] of the $120 billion, or nearly 92% of the low case's estimated benefits for the 3% discount case. The corresponding estimates for the high case are $280 billion[25] for premature mortality out of $290 billion in annual benefits, or about 96.5%.[26]

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remuneration, etc.; and (3) Consumer Market Studies, which examine the actual economic trade-offs people make between risks and benefits in their product consumption and insurance decisions.

[18] RIA at page 112.
[19] Ibid Preface page 1.
[20] Ibid.
[21] See Guidelines for Preparing Economic Analyses, Exhibit 7-3 Value of Statistical Life Estimates (mean values in 1997 dollars), page 89 (September 2000).
[22] RIA at footnote 31, page 90.
[23] Ibid at footnote 25, page 112.
[24] This equals 14,000 premature deaths per year times $7.8 million in VSL.
[25] This equals 36,000 premature deaths per year times $7.8 million in VSL.
[26] See Table 1-3 of the Transport Rule, RIA at 6.

EPA's approach to estimate the number of avoided premature deaths is called a Concentration-Response ("C-R") method. This widely endorsed method, which has been used extensively in the epidemiology, public health and economics fields, uses a log-linear function. Such an approach is consistent with a low incidence of low exposure that increases exponentially until a threshold is approached and incidence again slows. The EPA's low case (14,000 deaths per year) relies upon American Cancer Society data and a 2002 peer-reviewed study published in the Journal of the American Medical Association ("Pope Study").[27] The EPA's high case (36,000 deaths per year) is based on data from a 2006 Harvard six cities, peer-reviewed cohort study published in The American Journal of Respiratory and Critical Care Medicine ("Laden Study").[28]

The Transport Rule RIA uses two ranges for mortality estimates: the low range uses the 2002 Pope Study for $PM_{2.5}$ mortality and Bell[29] for ozone; and the high range uses the 2006 Laden Study for $PM_{2.5}$ mortality and Levy[30] for ground level ozone. To address the overall uncertainty in the analysis, EPA used: (1) widely accepted Monte Carlo methods for "characterizing random sampling error associated with the concentration response functions from epidemiological studies and economic valuation function,"[31]; and (2) an expert elicitation on the relationship between premature mortality and ambient $PM_{2.5}$ concentration.[32] Moreover, since issuing the CAIR RIA in 2005, EPA adopted the following technical enhancements in its Transport Rule RIA:

1. The Transport Rule RIA supplements CAIR's analysis, which quantified PM-related mortality using the C-R function from the 2002 Pope Study, with the 2006 Laden Study's C-R function estimate. Thus, the EPA presents two core $PM_{2.5}$ estimates; one based on the Pope Study and the second based on the Laden Study.

2. The Transport Rule RIA also includes the twelve $PM_{2.5}$-mortality estimates based on EPA's expert elicitation study used in the CAIR study, and "presents $PM_{2.5}$-mortality estimates based on the 12 risk estimates derived from the final elicitation."[33]

3. Whereas the CAIR RIA analysis considered short-term ozone mortality only in a sensitivity analysis, in response to a recommendation from the National Academy of

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[27] See Pope, C.A., III, R. T. Burnett, M.J. Thun, E.E. Calle, D. Krewski, K. Ito, and G.D. Thurston. 2002. Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution. Journal of the American Medical Association 287:1132-1141; Pope, C.A., III, R.T. Burnett, G.D. Thurston, M.J. Thun, E.E. Calle, D. Krewski, and J.J. Godleski. 2004. Cardiovascular Mortality and Long-term Exposure to Particulate Air Pollution. Circulation 109:71-77; Pope, C.A. III, E. Majid, D. Dockery. 2009. Fine Particle Air Pollution and Life Expectancy in the United States. New England Journal of Medicine 360:376-386; Pope, C.A. III, M.J. Thun, M.M. Namboodiri, D.W. Dockery, J.S. Evans, F.E. Speizer, and C.W. Heath, Jr. 1995. Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults. American Journal of Respiratory Critical Care Medicine 151:669-674; and Pope, C.A. III, D.W. Dockery, J.D. Spengler, and M.E. Raizenne. 1991. Respiratory Health and $PM_{10}$ Pollution: A Daily Time Series Analysis. American Review of Respiratory Diseases 144:668-674.

[28] See Laden, F., J. Schwartz, F.E. Speizer, and D.W. Dockery. 2006. Reduction in Fine Particulate Air Pollution and Mortality. American Journal of Respiratory and Critical Care Medicine 173:667-672.

[29] Michelle L. Bell, Aidan McDermott, Scott L. Zeger, Jonathan M. Samet, Francesca Dominici (2004) "Ozone and Short Term Mortality in 95 US Urban Communities, 1987-2000". Journal of American Medical Assoc. 292, 2372-2378.

[30] Levy JI, Chemerynski SM, Sarnat JA. July 2005. Ozone Exposure and Mortality: an Empiric Bayes Metaregression Analysis, Epidemiology 14(4):458-68.

[31] RIA at 72.

[32] Ibid at 72.

[33] Ibid at 76.

Sciences, in the Transport Rule RIA, EPA also included the short-term ozone mortality estimates in its primary estimates.[34]

As $SO_2$ and $NO_X$ emissions increase, $PM_{2.5}$ concentrations in the air also increase and, as $NO_X$ emissions rise, ozone concentrations in the air also increase. Based on the widely accepted C-R method, peer-reviewed scientific evidence finds conclusively, with great statistical confidence, that higher concentrations in the air of these hazardous substances increases the incidence of premature mortality. Numerous variables in the proven C-R model remove confounding factors and purge missing variable bias. To estimate the likely range of premature deaths, EPA's two state-of-the-science approaches considered a wide range of variables in a complex sensitivity analysis. Table 4 below, which reproduces EPA's Table 5-4 in the RIA,[35] describes EPA's comprehensive and robust approach. For example, EPA prefers to use the most recent peer-reviewed research available, and prefers cohort studies that, unlike ecological studies, can be controlled for important confounding variables. Further, EPA prefers using domestic, multi-city studies covering the broadest population to best ascertain total national level health impacts.

[34] Ibid at 76.
[35] RIA at 88-91.

| TABLE 4<br>Table 5-4. Criteria Used when Selecting C-R functions | |
|---|---|
| *Consideration* | *Comments* |
| Peer-Reviewed Research | Peer-reviewed research is preferred to research that has not undergone the peer-review process. |
| Study Type | Among studies that consider chronic exposure (e.g. over a year or longer) prospective cohort studies are preferred over ecological studies because they control for important individual-level confounding variables that cannot be controlled for in ecological studies. |
| Study Period | Studies examining a relatively longer period of time (and therefore having more data) are preferred, because they have greater statistical power to detect effects. More recent studies are also preferred because of possible changes in pollution mixes, medical care, and lifestyle over time. However, when there are only a few studies available, studies from all years will be included. |
| Population Attributes | The most technically appropriate measures of benefits would be based on impact functions that cover the entire sensitive population but allow for heterogeneity across age or other relevant demographic factors. In the absence of effect estimates specific to age, sex, preexisitng condition status, or other relevant factors, it may be appropriate to select effect estimates that cover the broadest population to match with he desired outcome of the analysis, which is total national-level health impacts. When available, multi-city studies are preferred to single city studies because they provide a more generalizable representation of the C-R function. |
| Study Size | Studies examining a relatively large sample are preferred because they generally have more power to detect small magnitude effects. A large sample can be obtained in several ways, either through a large population or through repeated observations on a smaller population (e.g. through a symptom diary recorded for a panel of asthmatic children). |
| Study Location | U.S. studies are more desirable than non-U.S. studies because of potential differences in pollution characteristics, exposure patterns, medical care system, population behavior, and lifestyle. |
| Pollutants Included in Model | When modeling the effects of ozone and PM (or other pollutant combinations) jointly, it is important to use properly specified impact functions that include both pollutants. Using single-pollutant models in cases where both pollutants are expected to affect a health outcome can lead to double-counting when pollutants are correlated. |
| Measure of PM | For this analysis, impact functions based on $PM_{2.5}$ are preferred to $PM_{10}$ because of the focus on reducing emissions of $PM_{2.5}$ precursors, and because air quality modeling was conducted for this size fraction of PM. When $PM_{2.5}$ functions are not available, $PM_{10}$ functions are used as surrogates, recognizing that there will be potential downward (upward) biases if the fine fraction of $PM_{10}$ is more (less) toxic than the coarse fraction. |
| Economically Valuable Health Effects | Some health effects, such as forced expiratory volume and other technical measurements of lung functions, are difficult to value in monetary terms. These health effects are not quantified in this analysis. |
| Non-overlapping Endpoints | Although the benefits associated with each individual health endpoint may be analyzed separately, care must be exercised in selecting health endpoints to include in the overall benefits analysis because of the possibility of double-counting of benefits. |

To scientifically estimate the range of premature deaths from $PM_{2.5}$ and ozone, EPA makes "with and without" comparisons that effectively shift the C-R function for air emissions under the Transport Rule as contrasted to 2005 emissions baseline conditions. Based on the shift from the baseline in C-R expected under the Transport Rule, the midpoint of the range of 14,000 to 36,000 deaths is 25,000 premature deaths per year. Using the midpoint of 25,000 avoided premature deaths per year and a $7.8 million per death VSL, the Transport Rule annual health benefits alone would equal $195 billion per year. If you then applied social costs of about $2 billion per year to that midpoint benefits amount, for just avoided premature deaths, Transport Rule benefits would exceed costs by 97.5, or almost 100 to one. Even using the highest private cost estimate of $3.7 billion per year, benefits would still exceed cost by over 50 to1.

#### (ii) Benefits Exceed Cost Even Under Extreme Scenarios

In determining its VSL, EPA also performed various sensitivities based on endorsed scientific methods. To determine the suitability and reasonableness of EPA's cost/benefit comparison, additional sensitivity analyses were performed using extremely conservative values. These analyses further demonstrate that the Transport Rule benefits far exceed costs even under such extreme scenarios.

Specifically, as set forth in Table 5, sensitivity analyses were conducted by modifying three key variables. The first calculation shows benefits even if avoided premature deaths were just 2% of the likely midpoint EPA scientifically estimated. The second calculation shows benefits even if VSL were set at less than 2% of the scientifically determined estimate EPA used. Notably, however, even using such statistically unlikely and extreme variables for avoided premature deaths or VSL, annual Transport Rule benefits still exceed costs.

The third analysis used a VSL calculation based on the concept of social altruism to represent how much each person or household would be willing to pay to avoid a stranger's premature death. Using the midpoint (25,000) for annual avoided premature deaths, and applying the very conservative assumption that each U.S. household would be willing to pay only about one-tenth of a cent per stranger's premature death avoided, annual Transport Rule benefits would equal about $4 billion and still exceed costs.

**TABLE 5**
**Extreme Values Show That the Benefits of TR Exceed the Estimated Social Costs of about $2 Billion Per Year, As Well as the Midpoint of Private Costs of $3.25 Billion Per Year**

| | |
|---|---|
| Example 1 | Cut premature deaths 90% from 25,000 per year to 2,500.<br>Premature Death Benefits = 2,500 * $7.8 million = $19.5 billion<br>**In fact, even assuming a mere 2% reduction in premature deaths, or only 500 avoided deaths, would still result in $3.9 billion in annual benefits.** |
| Example 2 | Reduce the estimated VSL from $7.8 million to $1 million.<br>Premature Death Benefits = 25,000 * $1 million = $25 billion.<br>**Reducing the VSL even further from $7.8 million to only $150,000 (1.9%) would still result in $3.75 billion in annual benefits.** |
| Example 3 | Determine the amount 125 million households would spend for each stranger's avoided death per year to achieve $4 billion in annual benefits.<br>Annual benefits = $4 billion<br>Annual Avoided Deaths = 25,000<br>Required VSL = $ billion ÷ 25,000 = $160,000<br>Amount Spent per Household to Avoid One Death = $160,000 ÷125 million = $0.0013<br>**Even if households were only willing to pay about one tenth of a cent per stranger's premature death avoided, benefits still exceed costs.** |

As such, the peer-reviewed and scientifically estimated values and methods EPA used in the Transport Rule RIA unequivocally demonstrate the Transport Rule's expected benefits far exceed estimated costs under any reasonable scenario.

### 3. Other Reasons Why EPA's Benefit/Cost Comparison is Very Conservative

Additional reasons for concluding that EPA's Transport Rule RIA cost/benefit comparison is very conservative and likely understates benefits include: (1) it has comprehensively identified and fully accounted for possible uncertainties; (2) it does not account for *all* benefits and, therefore, understates benefits; (3) it does not break out the higher incidence of health-related damages downwind, particularly for nonattainment areas, as discussed in Section II, below; and (4) it overstates estimated costs.

#### (i) Comprehensive Identification of Uncertainties

First, EPA preformed a careful and comprehensive review of the uncertainties inherent in all cost/benefit analyses. EPA recognized that there are limitations in its ability to model the health damages caused by power plant emissions and to quantify the benefits of emission reductions. As for the implications of these uncertainties, EPA noted: "There are costs and important benefits that EPA could not monetize. Upon considering the limitations and certainties, it remains clear the benefits of the proposed Transport Rule are substantial and far outweigh the costs."[36] The transparency of EPA's exhaustive discussion of uncertainties, as detailed below in Table 6, and resulting quantitative omission of some benefits, represents the best in scientific methods and underscores that EPA benefits are likely understated.

[36] EPA 2010 Fact Sheet, at 4.

**TABLE 6**

**Table 5-3. Primary Sources of Uncertainty in the Benefits Analysis**

| |
|---|
| *1. Uncertainties Associated with Impact Functions*<br>- The value of the ozone or PM effect estimate in each impact function<br>- Application of a single impact function to pollutant changes and populations in all locations.<br>- Similarity of future-year impact functions to current impact functions.<br>- Correct functional form of each impact function.<br>- Extrapolation of effect estimates beyond the range of ozone or PM concentration observed in the source epidemiological study.<br>- Application of impact functions only to those subpopulations matching the original study population. |
| *2 Uncertainties Associated with CAMx-Modeled Ozone and PM Concentrations*<br>- Responsiveness of the models to changes in precursor emissions from the control policy.<br>- Projections of future levels of precursor emissions, especially ammonia and crustal materials.<br>- Lack of ozone and $PM_{2.5}$ monitors in all rural areas requires extrapolation of observed ozone date from urban to rural areas. |
| *3 Uncertainties Associated with PM Mortality Risk*<br>- Limited scientific literature supporting a direct biological mechanism for observed epidemiological evidence.<br>- Direct causal agents within the complex mixture of PM have not been identified.<br>- The extent to which adverse health effects are associated with low-level exposures that occur many times of the year versus peak exposures.<br>- The extent to which effects reported in the long-term exposure studies are associated with historically higher levels of PM rather than the levels occurring during the period of study.<br>- Reliability of the $PM_{2.5}$ monitoring data in reflecting actual $PM_{2.5}$ exposures. |
| *4 Uncertainties Associated with Possible Lagged Effects*<br>- The portion of the PM-related long-term exposure mortality effects associate with changes in annual PM levels that would occur in a single year is uncertain as well as the portion that might occur in subsequent years. |
| *5 Uncertainties Associated with Baseline Incidence Rates*<br>- Some baseline incidence rates are not location specific (e.g. those taken from studies) and therefore may not accurately represent the actual location-specific rates.<br>- Current baseline incidence rates may not approximate well baseline incidence rates in 2014.<br>- Projected population and demographics may not represent well future-year population and demographics. |
| *6 Uncertainties Associated with Economic Valuation*<br>- Unit dollar values associated with health and welfare endpoints are only estimates of mean WTP and therefore have uncertainty surrounding them.<br>- Mean WTP (in constant dollars) for each type of risk reduction may differ from current estimates because of differences in income or other factors. |
| *7 Uncertainties Associated with Aggregation of Monetized Benefits*<br>- Health and welfare benefits estimates are limited other available impact functions. Thus, unquantified and unmonetized benefits are not included.<br>Source: RIA at 86. |

### (ii) EPA Has Minimized Benefits by Excluding Certain Non-Health Related Benefits.

EPA's RIA is also very conservative because its benefits analysis focused almost exclusively on the health-related benefits of protecting the population from the adverse effects of ground level ozone and $PM_{2.5}$. EPA's RIA attributed more than 90% of the estimated benefits to premature deaths. Decreased sickness, health costs, and morbidity were relatively important components of the remaining ten percent of EPA's benefits estimates. Yet even when limiting Transport Rule benefits to the health-related ones noted above, EPA found Transport Rule benefits exceed social costs by at least 55 to 1.[37]

Given these staggering health benefits, EPA had little scientific reason to look beyond mortality and morbidity. Although EPA does quantify a $3.6 billion benefit attributable to visibility improvements in national parks and wilderness areas, it omits other significant welfare benefits simply categorizing them as "B" to represent real benefits without quantification. In addition to the substantial omissions related to government and business losses discussed at length in the following Section II, the EPA did not quantify significant pollution reduction benefits such as improvements in recreational and commercial fishing, agricultural yield, and forest productivity. As noted in the RIA[38], substantial quantitative benefit omissions or underestimates include:

(1) Enhanced *Ecosystem Services*, which include use and non-use values individuals and organizations derive from ecosystems. Figure 1 reproduces EPA's description of these services and the potential users.

(2) Reduced *Ecological Effects*, which are damages avoided for animal and plant life due to alterations in biogeochemistry. The Eastern United States is particularly sensitive to air-borne related losses in this category, including, for example, acidification of lakes due to transformation of $SO_2$ to sulfuric acid.

(3) Reductions of *Other Hazardous Substances.* The Transport Rule not only will reduce $SO_2$, $NO_X$, and $PM_{2.5}$ emissions and transport, but also very likely will reduce harmful mercury and greenhouse gas emissions.

(4) Enhancement of *Quality of Life and Recreation.* The Transport Rule will enhance visibility and reduce ecological damages, which diminish the quality, as well as affect the types and quantity, of outdoor activity.

(5) Reduced *Material Damages to Buildings, etc.* Air pollutants such as $SO_2$ can increase maintenance costs and cause building materials to deteriorate.

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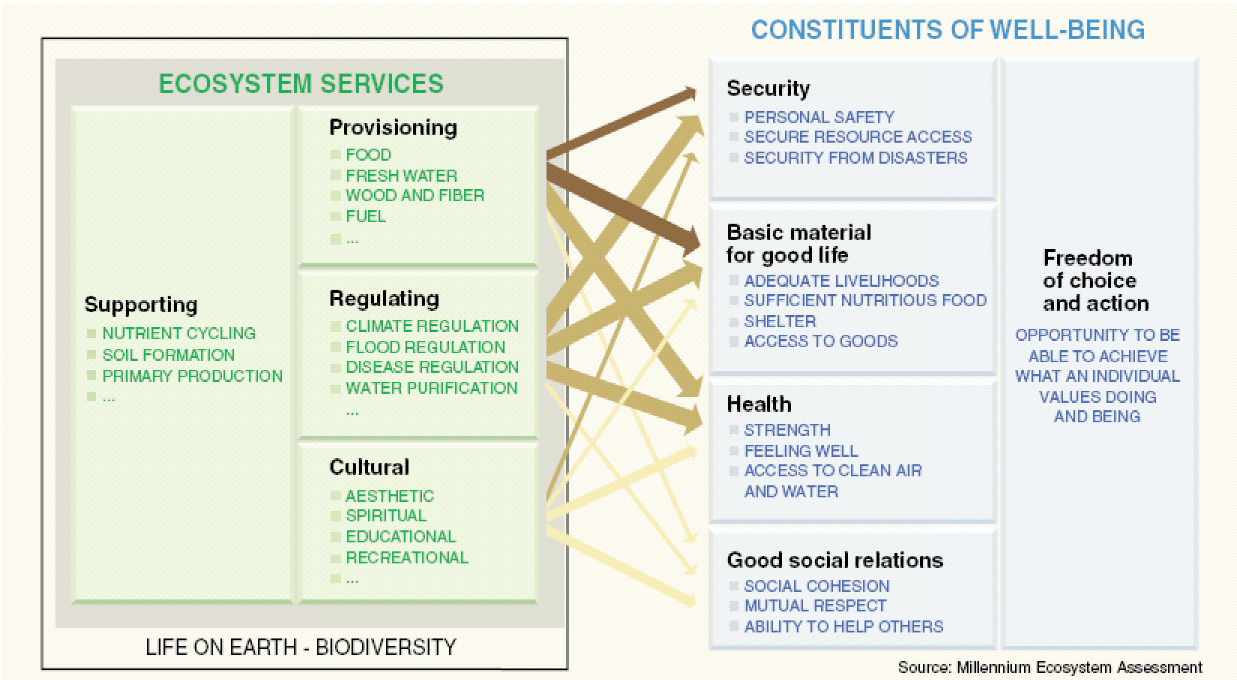
[37] See RIA, page 1, Section 1.1 (Key Findings), where the EPA says "The benefits outweigh social costs by 60 to 145 to 1, or 55 to 130 to 1." See also Table 1-1 on page 2.
[38] RIA at 11.

**Figure 1**
**Figure 5-5: Linkages between categories of ecosystem services and components of human well-being from Millennium Ecosystems Assessment (MEA, 2005)(CATR RIA page 142)**




### (iii) Downwind, Nonattainment Health Effects Have <u>Not</u> Been Separated From the Transport Rule Regional Estimates.

As detailed previously, EPA's conservative state-of-the science cost/benefit analysis and sensitivity analyses confirm that interstate pollution transfer increases mortality and illnesses to downwind populations. As explained in Section II below, however, these health effects *also* translate into major economic losses through increased health care costs, increased lost work days, and reduced productivity. In the United States, health care costs are borne by private employers and governments through health insurance, Medicare, and Medicaid. As quantified in Section II, higher health insurance premiums in downwind areas increase the private costs of doing business, increase state and federal taxpayer costs, depress wages, depress income, and drive companies to locate in other areas. EPA's RIA, however, understates the resulting economic inequities and losses suffered in downwind non-attainment areas.

The non-profit Clean Air Task Force (CATF) published a report in September 2010 entitled "The Toll from Coal: An Updated Assessment of Death and Disease from America's Dirtiest Energy Source." This report and analysis relies, in part, on EPA's Concentration-Response (C-R) models discussed previously. CATF developed estimates of premature mortality related to coal-fired electricity generation (13,200 premature deaths in 2010) similar to the EPA RIA's low case of 14,000 in 2014.[39] CATF breaks down the adverse health effects by state. Table 7 shows the 2010 health effects from coal-burning power plants for Illinois and Pennsylvania, two states containing severe non-attainment areas.

**TABLE 7**
**Adverse Health Effects Related to Coal-Fired Electricity Generation (2010)[1]**

| | Annual Premature Mortality | Hospital Admissions | Heart Attacks |
|---|---|---|---|
| Illinois | 1,359 | 1,016 | 2,298 |
| Pennsylvania | 621 | 455 | 1,097 |

[1]See Clean Air Task Force Report, Table 2.

As shown in Table 8, CATF also estimated these same adverse health impacts for the metro areas that include the two major cities in those states: Chicago and Philadelphia.

**TABLE 8**
**Adverse Health Effects Related to Coal-Fired Electricity Generation (2010)[1]**

| Metro Areas | Annual Premature Mortality | Hospital Admissions | Heart Attacks |
|---|---|---|---|
| Philadelphia, Camden, Wilmington | 452 | 351 | 767 |
| Chicago, Naperville, Joliet | 347 | 264 | 584 |

[1]See Clean Air Task Force, Table 4.

The annual cost in higher mortality and morbidity in the Chicago and Philadelphia metropolitan areas attributed to coal-fired generation is, in large part, due to upwind $PM_{2.5}$ and ground level ozone pollution transported to the exposed population in these cities. The economic

[39] The benefits of the reduction in premature mortality and improved health calculated in the Transport Rule RIA also represent the costs or "charges" currently being imposed on the residents of downwind areas. These are referred to as "negative externalities" in economics literature. To the extent that the costs of negative externalities can be transferred to the activity giving rise to the negative externality, economic efficiency will be increased. *See,* Calabresi, *The Costs of Accidents.*(1970).

costs of illnesses are very significant, regardless of whether people, business, insurers or governments pay for them directly and indirectly. These costs have not been fully monetized in EPA's cost/benefit analyses. Nevertheless, the populations of these areas effectively pay a very large "pollution charge" in decreased health and shortened life spans.

### (iv) Overestimation of Compliance Costs

Fourth, fairly consistently, previous estimates of various environmental compliance costs have been substantially lower than originally projected. M.J. Bradley Associates reported that $SO_2$ and VOC emission *ex ante* compliance cost estimates significantly overestimated costs.[40] EPA determined estimated compliance costs using the widely endorsed Integrated Planning Model (IPM), but acknowledges that its estimated costs may well be too high. Specifically, the EPA concedes that the IPM analysis does not take into account the "potential for advancements in the capabilities of pollution control technologies for $SO_2$ and $NO_X$ removal, as well as reductions in their costs over time."[41] Moreover, the EPA notes that cost estimates for the Clean Air Act Title IV acid rain $SO_2$ program made by Resources for the Future and MIT were as much as 83% lower than EPA's original projections, which were made using "an optimization model like IPM." *Ex ante*, EPA's acid rain cost estimates were $2.7 to $6.2 billion, whereas *ex post* they were estimated to be only $1.0 to $1.4 billion.[42] Further, EPA notes that W. Harrington *et al* have "examined cost analyses of EPA programs and found a tendency for predicted costs to overstate actual implementation costs in market-based programs."[43] In fact, of the 25 compliance cases Harrington, *et al* analyzed, only 6 had costs that exceeded *ex ante* estimates, while 12 had lower than expected compliance costs.

There are two very important additional reasons why the IPM compliance cost estimates very likely are too high. First, the electricity industry has an uninterrupted, successful history of implementing technical improvements and reducing costs through least cost engineering principles. Numerous entities in the power sector will be focused on reducing costs and achieving savings through fuel switching, enhanced generation utilization and accelerated use of more efficient, state-of-the-art equipment. Second, EPA likely over-estimated costs because it failed to quantify the effect of reasonably anticipated accelerated supply side and demand side responses.

Generators maintain, retire, or replace power plant based on a combination of engineering economic factors and analyses. A new pollution rule such as the Transport Rule alters the relative costs and prices throughout the electric power industry. Although models such as IPM can broadly estimate response costs, retirements, replacements and reliability requirements, in actual real world engineering, the many smaller "parts" of the industry will seek their own customized engineering and economic responses. The sum of these many smaller parts will, therefore, invariably achieve lower overall response costs than a model such as IPM might estimate for the power sector as a whole. Thus, the IPM model conservatively favors the *status quo*. This fact is well known, transparent, and has been thoroughly vetted. This is not a

[40] Van Alten, C and L. Hoffman-Andrews of M. J. Bradley Associates, "The Clean Air Act's Economic Benefits Past Present and Future, Small Business Majority and The Main Street Alliance, October 2010, p.7.

[41] See RIA at page 271.

[42] Ibid.

[43] Ibid. Referencing Harrington, W.D., R.D. Morgenstern, and P. Nelson. 2000. "On the Accuracy of Regulatory Cost Estimates." *Journal of Policy Analysis and Management* 19(2):297-322.

criticism of the IPM estimates, but further confirms that Transport Rule benefits will likely exceed costs by more than 100 to one.[44]

Furthermore, the nation's electric and natural gas sectors are increasingly supporting new end-use customer investments in demand response, distributed and centralized renewable energy and in energy efficiency. Nationwide, the electricity industry is approaching $5 billion in annual spending on utility-sponsored demand response programs and natural gas distributors are spending nearly $1 billion each year to encourage consumers to conserve natural gas. A recent American Gas Association survey[45] of natural gas utilities reported a 46.7% increase in conservation expenditures between actual expenditures for 2008 and budgeted expenditures for 2009. The electricity sector has been increasing electricity-related energy efficiency and demand response spending as well. The U.S. Department of Energy's Energy Information Administration (EIA) reports a similar 47% increase between 2007 and 2008.[46] The planned and actual expansions of the "smart grid" also will likely lead to greater end use efficiencies and more load management. Additionally, expanding the use of distributed and centralized renewable energy to replace some older, less efficient fossil-fired, particularly coal-based generation, may lower compliance costs. These efforts to become more efficient on both sides of the meter will combine to further reduce the likely compliance costs related to the Transport Rule.

Thus, the conclusion is clear. As many changes have already been made in the electricity industry to reduce demand and harmful emissions, compliance costs for the Transport Rule will very likely be less and the expected benefits far greater than EPA estimates.

## Section II. The Transport Rule Imposes Significant Costs on Downwind Employers, Businesses, and Governments

This section of the Report focuses on the increased costs interstate pollution transfer imposes on employers, businesses, and governments in downwind nonattainment areas. These are real and significant costs[47]that EPA does not quantify in its RIA. Most importantly, these costs will continue to plague downwind nonattainment areas if the EPA listens to critics that seek to delay implementing the Transport Rule.

Most notably, the Transport Rule will reap tremendous annual benefits by substantially reducing illness and premature deaths. It will also help address other significant regional economic inequities that disproportionately affect downwind populations, which are either in nonattainment with the National Air Ambient Quality Standards ("NAAQS") for the pollutants, or are marginally in compliance and struggle to maintain compliance with the NAAQS. The nonattainment status of these downwind regions harms the health of individuals and families in

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[44] Although EPA subsequently revised its modeling to incorporate higher capital costs for scrubbers, higher coal prices and lower natural gas prices, these changes do not have a material effect on my conclusions.
[45] AGA "Natural Gas Efficiency Report 2008 Program Year", Appendix B.
[46] EIA Form 861.
[47] In focusing on employers, businesses and governments, this section does not double count individual benefits from decreased morbidity and mortality. To avoid such double counting, this section does not discuss any additional lost utility for individual workers (sometimes referred to as pain and suffering), who lose jobs, suffer illnesses, or die prematurely.

those areas, and also imposes costs on their economies causing an inequitable wealth transfer to upwind states. As explained, some critics advocate delaying EPA's implementation of the Transport rule claiming the nation's economy is too weak to sustain the implementation costs. Contrary to these claims, however, this section demonstrates that the benefits of immediately implementing the Transport Rule far outweigh the costs as the Transport Rule will strengthen, not weaken, the economies in already hard-pressed downwind nonattainment areas. Even without considering or quantifying the benefits to businesses, employers, and governments detailed below, the EPA has already conclusively demonstrated Transport Rule benefits outweigh costs by nearly 100-fold. Therefore, this section is not intended as a cost/benefit analysis. Rather, it is intended to quantify additional significant costs interstate pollution transfer imposes on downwind employers, businesses, and governments to reinforce the need to implement the Transport Rule without delay.

Downwind economies struggling to achieve or maintain attainment with NAAQS subsidize upwind regions of the country that continue to operate power plants without pollution controls. While these downwind areas incur harmful health effects and higher costs, the upwind areas served by older, uncontrolled coal-fired power plants effectively receive an unfair subsidy in the form of lower costs and/or lower electric prices, depending upon the state's regulatory and market structure. The costs on downwind areas increase their economic development costs, reduce their businesses' profitability, and decimate their governments' tax revenue.

As further developed below, examples of higher nonattainment-related costs include:

(i) lost work days and increased labor costs;

(ii) higher health insurance costs;

(iii) higher costs to comply with New Source Standards in the form of Emission Reduction Credits (ERCs) and resulting increased electricity prices; and

(iv) higher costs of Reformulated Gasoline (RFG) [48]. (This category is in addition to the business, employer and government losses listed above.)

In its RIA, EPA mostly ignored these interstate economic inequities, concentrating instead on the substantial adverse health consequences of interstate air pollution transfer. Given its CAA mandate to protect human health, life, and the environment, EPA's primary focus on health effects is reasonable. Nonetheless, the substantial, demonstrated economic losses to businesses, governments, and jobs are no less relevant.

Further, as EPA largely omitted adverse economic impacts from its cost/benefit analysis, it also generally ignored geographic impacts. Clearly a premature death is damaging no matter where the person lives. But when the focus is increased business costs or job losses, geographic location becomes very relevant, particularly as the nation struggles to restore its economy.

The following discussion uses the higher prevalence of adverse effects in downwind nonattainment areas within the various Transport Rule States to estimate the higher costs that downwind businesses, governments, and people currently pay and will continue to pay if the

[48] As detailed in Appendix C, nonattainment areas can also potentially face sanctions, such as the loss of federal highway trust funds.

Transport Rule is not implemented. **The substantial economic/business costs quantified in the following sections are above the $120 - $290 billion EPA quantified in its RIA**, which focused almost exclusively on premature death and illness impacts.

### A. Lost Work Days and Increased Labor Costs

EPA estimates the number of lost work days due to $PM_{2.5}$ and ground level ozone emissions under both baseline conditions and the Transport Rule, calculating that workers 18 to 65 years of age annually lose 1,800,000 work days across all the Transport Rule states. EPA further estimates the economic impact of lost work for average workers to be about $130 per day[49] for an annual total of $234,000,000. Notably, however, EPA measures losses only from the perspective of employees or the individuals who work less, yet businesses or employers also incur losses as they typically pay not only wages for each employee, but also pay for sick days and other benefits.[50] For example, the Bureau of Labor Statistics reported in June 2010 that total compensation comprised 70.6% for wages and salaries and 29.4% for benefits, with the combined civilian workforce total compensation averaging $29.52 per hour, state and local government workers averaging $39.74 per hour, and private sector workers averaging $27.64 per hour.[51]

Beyond paying employees sick leave and related payroll taxes and benefits, employers incur additional costs due to lost productivity. For example, personnel discontinuity, required replacement workers and temporary staff, redundant training and missed or postponed opportunity costs, all impose higher costs on businesses. In the spring of 2010, Mercer Consulting[52] surveyed 276 organizations from all major U.S. industry segments, sizes, and regions, including colleges and universities; health care; hospitality; manufacturing, life sciences, and energy; public sector, government and public schools; retail or wholesale trade, services; and transportation, distribution, and telecommunications. The Mercer study estimated that unplanned absences reduce productivity by about 19%[53], meaning civilian business and government employers would, on average, lose about $35.13 per hour ($29.52 * 1.19), or about $281 per day for each work loss day. Therefore, **without the Transport Rule, just this one category of business losses would exceed more than a half billion dollars per year (1,800,000*$281= $506 million per year).**

Interstate air pollution transfer also requires businesses to pay more for employee recruiting, training, integration, and replacement. In its median case, EPA estimates conservatively that implementing the Transport Rule would avoid 25,000 premature annual deaths for ages 18-65. Applying US Census Bureau estimates that 80% of the population is in the work-force, the report estimates 20,000[54] of these premature deaths are in the work force. As

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[49] RIA at 127. As this is based on a national median wage of $16.25 hourly for 2000, it is a very conservative estimate.
[50] "Survey on the Total Financial Impact of Employee Absences", Mercer and Kronos Incorporated, June 2010.
[51] BLS News Release, September 8, 2010, USDL-10-1241.
[52] Mercer Consulting is a leading consultancy in Human Resources (HR) and related financial products and services. It is a wholly owned subsidiary of Marsh & McLennan Companies, Inc. and has more than 19,000 employees worldwide in over 180 cities and 40 countries and territories. See www.mercer.com/about-mercer.
[53] Mercer, "Survey of the Total Financial Impact of Employee Absences", June 2010, page 8.
[54] The U.S. Census Bureau reports that there were approximately 189 million people between the age of 18 and 65 in the U.S. There were approximately 153 million people in the workforce, or about 80% of the population. 25,000 times 80% equals 20,000. See 2006-2008 American Community Service Survey 3-Year Estimate. U.S. Census Bureau. http://factfinder.census.gov.servlet/SSTable. Accessed 9/22/2010

the typical person works about 48 five-day weeks, or 240 work days per year, the typical civilian employee's total compensation (wages plus benefits) equals $67,400 (240 days * $281/day). Various estimates show the cost to replace an employee is about 40%[55] of total compensation ($67,440), or about $27,000 (0.40 * $67,440) per replaced worker. **As such, the employers' total cost to recruit, train, integrate, and replace 20,000 workers each year throughout the Transport Rule states would be 20,000 workers, multiplied by $27,000, or $540 million per year.**

Interstate air pollution transfer also causes businesses to lose money through restricted activities for outdoor workers. This report conservatively restricts its analysis to outdoor workers, even though restricted activities apply also to indoor workers and schoolchildren. In the RIA, EPA estimates there are 10,000,000 restricted activity person-days for adult workers in the 18 to 65 year old category based on the statistical work of Ostro and Rothschild[56], which limits lost person days to the outdoor workers likely to be restricted because of air pollution. Reduced activity clearly causes a loss in productivity, but is less severe than losing a full work day. As discussed above, Mercer Consulting estimates that unplanned absences reduce productivity about 19%. Assuming that a restricted worker would function at about half his usual level, **a conservative estimate of restricted output equals approximately 950,000 lost days.** (10,000,000 restricted days * 0.19 loss in productivity * ½ level of effort), **which causes employers in the Transport Rule States to lose $267 million per year in lost productivity (950,000 lost days * $281/day).**

**Therefore, the combined increased employer business costs in the categories of lost work days, employee recruiting, training, integration, and replacement, and restricted outdoor activities totals about $1.31 billion per year.**[57] Significantly, these increased business costs from interstate pollution transfer are likely greater in nonattainment areas, rather than

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[55] Ostro, Bart D. "The Effects of Air Pollution on Work Loss and Morbidity." Journal of Environmental Economics and Management 10, 371-382 (1983); Ostro, Bard D. and Susy Rothschild. "Air Pollution and Acute Respiratory Morbidity: An Observational Study of Multiple Pollutants." Environmental Research 50, 238-247 (1989); Ostro, Bart D. "Air Pollution and Morbidity Revisited: A Specification Test." Journal of Environmental Economics and Management 14, 87-98 (1987); Rumsberger, Jill S., Christopher S. Hollenbeak, and David Kline, "Potential Costs and Benefits of Smoking Cessation: An Overview of the Approach to State Specific Analysis." Penn State. April 30, 2010; Hayday, Beban S., "Costing Sickness Absence in the UK." Institute for Employment Studies, Report 382, October 2001; Bureau of Labor Statistics, "Employer Costs for Employee Compensation – June 2010", USDL-10-1241, September 8, 2010; "Estimating Mortality Risk Reduction and Economic Benefits from Controlling Ozone Air Pollution." The National Academies, Committee on Estimating Mortality Risk Reduction Benefits from Decreasing Tropospheric Ozone Exposure, ISBN 0-309-119995-2 (2008); Scitovsky, Anne A., "Estimating the Direct Costs of Illness." The Milbank Memorial Fund Quarterly. Health and Society, Vol. 60, No. 2 (Summer 1982), pp. 463-491; "Full Cost of Employee Absence Equals 36 Percent of Payroll, According to New Mercer Study Sponsored by Kronos." Boston Business Journal, October 21, 2008; Hadzima, Joe. "How Much Does an Employee Cost?" http://web.mit.edu/e-club/hadzima/how-much-does-an-employee-cost.html; U.S. Bureau of Labor Statistics, "Total Nonfatal Occupational Injury and Illness Cases, by Category of Illness, Private Industry, 2006" (October 2007); U.S. Bureau of Labor Statistics, "Number of Injuries and Illnesses with Days Away from Work, Private Industry, 2003-2006" (November 2007); Berk, Aviva, Lynn Paringer, Selma T. Mushkin, "The Economic Cost of Illness, Fiscal 1975." Medical Care, Vol. 16, No. 9 (Sep. 1978), pp 785-790; Cooper, Barbara S. and Dorothy P. Rice, "The Economic Cost of Illness Revisited" Office of Research and Statistics, Social Security Administration Adapted from a paper presented at the annual American Public Health Association meetings in Chicago, Ill., November 20, 1973 (Bulletin 1976); Abt Associates Inc., Technical Support Document for the Powerplant Impact Estimator Software Tool, prepared for the Clean Air Task Force, July 2010.

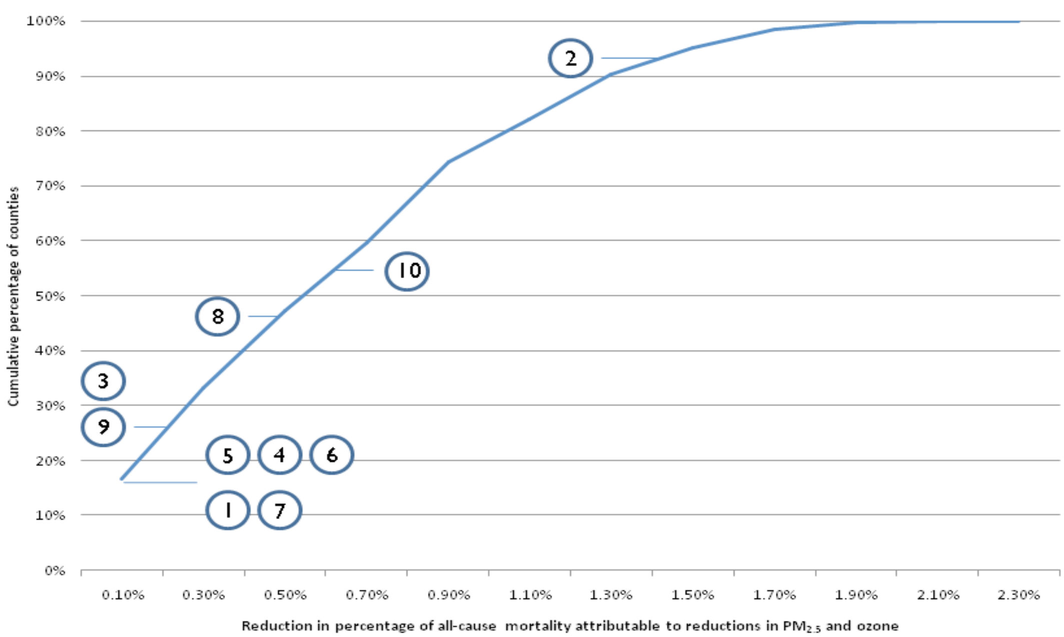
[56] Ostro, Bart D. and Susy Rothschild. "Air Pollution and Acute Respiratory Morbidity: An Observational Study of the Multiple Pollutants." Environmental Research 50, 238-247 (1989).

[57] $506 million + $540 million + $267 million = $1.31 billion.

spread uniformly across the Transport Rule region. As highlighted in Figure 2 below, and as reported by EPA, for example, the more polluted non-attainment areas, such as the three counties that include Chicago, Philadelphia, and New York, will experience the greatest percentage of reductions in premature deaths through the Transport Rule. As interstate air pollution transfer is reduced under the Transport Rule, these more polluted nonattainment areas will also experience a larger proportion of employer savings by avoiding the pollution charges described here.

Figure 2

Cumulative percentage of the reduction in all-cause mortality attributable to reduction in $PM_{2.5}$ and Ozone resulting from the proposed remedy by county in 2014 (TR RIA page 186)




**10 Counties with Largest Populations, Rank Ordered**

1—Los Angeles; 2—Chicago; 3—Houston; 4—Phoenix; 5—San Diego; 6—Dallas; 7—San Jose; 8—New York; 9—San Antonio; 10—Philadelphia

^ Bell et al. 2005 ozone mortality estimate and Pope et al. 2002 $PM_{2.5}$ mortality estimates.

In fact, the incidence of health-related benefits in EPA's RIA approximates how the economic benefits from reduced costs on downwind businesses will affect nonattainment areas. To allocate Transport Rule benefits, there are two extreme analytical choices: (1) all the economic benefits occur in nonattainment areas; or (2) the economic benefits are distributed based on population. As Appendix A indicates, population in non-attainment areas for $PM_{2.5}$ and ground level ozone represents 34.9% of the total Transport Rule population. Using the midpoint between the two extreme approaches, 67.45% of the losses are assigned to nonattainment areas (100% + 34.9% divided by 2.). Assigning the median value to nonattainment areas, the direct losses caused by interstate air pollution in nonattainment areas equal $884 million ($1.31 billion * 0.6745).

Appendix A uses a simplified regression analysis to test the hypothesis that EPA's estimated incidence of premature death is greater in states that have a larger portion of their population living in non-attainment areas. This hypothesis cannot with a high degree of confidence be rejected statistically. Furthermore, equation 2 in Appendix A shows the incidence of premature deaths in non-attainment areas would be about 85.9% greater (148/79.6).

In addition to the substantial employer losses resulting from the Transport Rule, a multiplier effect applies across the nonattainment areas economies. Because of the interconnections among industries and between industries and households, higher costs for wages, benefits and health insurance cause negative ripple effects throughout the affected economies. Negative ripple effects result in job loss and reductions in economic outputs because of decreased disposable income as fewer workers are hired and fewer wages are paid to employees, as well as reduced equipment and supplies purchased from local businesses, and reduced government tax revenues. These ripple effects are called multipliers effects or multipliers. The Department of Commerce publishes a widely used model to determine the employment and economic effects for increased spending.[58] Without the Transport Rule, the economies of the nonattainment regions will suffer losses of about $1.635 billion per year. Assuming state and local tax expenditures equal 19.6% of Gross Domestic Product ("GDP"),[59] state and local tax revenues will decrease by about $320 million per year. Further, the reduced local Gross Domestic Product (GDP) will cause about 12,393 lost jobs based on 7.58 jobs lost per million dollars of reduced GDP.[60]

Table 9 summarizes these economic losses related to labor costs, taxes and lost jobs without the Transport Rule.

[58] The U.S. Department of Commerce publishes RIMS II Type I multipliers, which represent the additional indirect or upstream jobs generated within a state for each job directly added in the selected industry. The RIMS II Type II multipliers add incidental jobs within the state due to the additional stimulative economic effect of added direct and indirect/upstream employment or, conversely, eliminate jobs as a result of reduced economic activity. The ripple effect can be thought of in terms of three buckets. For example, consider a manufacturing facility in a downwind nonattainment state that lays off four workers due to air pollution. The first bucket comprise of these four direct manufacturing jobs that are lost as a result of air pollution in the downwind nonattainment state in which the manufacturing plant is located. These four lost jobs and the concomitant reduced manufacturing output at the manufacturing facility have an indirect effect on those upstream industries that support the manufacturing facility. This indirect effect is the second bucket. The indirect effects of reduced manufacturing output downstream result in a loss of two jobs in the support industries upstream of the manufacturing facility. The six total direct and indirect lost jobs due to air pollution in the downstream nonattainment state mean that the unemployed former employees have less money available to spend in the state where the manufacturing facility is located. This reduced available money to be spent in the state results in one lost incidental job in the state, comprising the third bucket. Thus, the combined direct (bucket 1), indirect (bucket 2), and incidental (bucket 3) effects result in a total loss of seven jobs.

[59] In 2008, state and local spending were 19.6% of GDP. "US Governments Spending," Christopher Chantrill, September, 2010. www.usgovernmentsspending.com, link Federal, State and Local for 2008 tax year.

[60] The Department of Commerce's RIMS Type II multipliers range between 5.029 and 10.124 jobs per million dollars of GDP, with a midpoint of 7.58 jobs per million dollars for the 50 states. See Appendix D.

**TABLE 9**
**Economic Losses Related to Employers' Labor Costs, State and Local Taxes, and Jobs Without the Transport Rule**

| | All TR States | Estimated Nonattainment Shares |
|---|---|---|
| Increased Employers' Labor Costs | **$2.42 billion**[1] | **$1.6 billion**[1] |
| Lost State and Local Tax Revenues[2] | **$475 million**[1] | **$320 million**[1] |
| Lost Jobs[3] | **18,374 jobs**[1] | **12,393 jobs**[1] |

[1]All TR states are based on a 0.6745 non-attainment share.
[2]Based on 19.6% of GDP for all state and local tax expenditures.
[3]Based on 7.58 jobs lost per million dollars of reduced GDP.

## B. Higher Health Insurance Costs

Mercer Consulting estimates that health insurance benefits average about 13.6%[61] of each employee's total compensation. The higher levels of $PM_{2.5}$ and ground level ozone in nonattainment areas increase illnesses. Table 10 shows EPA estimates nearly 750,000 additional illnesses each year at a cost, based on lost income and direct health care costs, of about $7 billion per year.

**TABLE 10**
**EPA's Annual Morbidity Estimates and Costs Within the TR Region[1]**

| Disease | Illnesses | Cost per Year |
|---|---|---|
| Chronic Bronchitis | 9,200 | $4,300,000,000 |
| Non-Fatal Heart Attacks | 22,000 | $2,450,000,000 |
| Hospital Admissions and Emergency Rooms | 25,000 | $265,000,000 |
| Other | 691,000 | $37,000,000 |
| | **747,000** | **$7,052,000,000** |
| | Average $9,438 per illness | |

[1]See Tables 5-17 and 5-18 in TR RIA.

Higher employer health care and insurance costs due to increased illnesses are more likely to be disproportionately prevalent in nonattainment areas. The following calculations outline these effects on the employers and businesses in the downwind nonattainment areas. With the increased morbidity and mortality rates described by EPA, one would expect that insurance companies would charge higher insurance premiums to employers and businesses to provide health insurance to employees in those downwind nonattainment areas. This analysis, however, differs from EPA's Annual Morbidity Estimates and Costs with the Transport Region because it focuses on employers' and businesses' additional insurance costs, not on the pain and suffering costs for individuals residing within the downwind nonattainment areas.

(1) Nonattainment population[62] = 56,000,000

(2) Insurance costs @ 13.6% of compensation of $67,440 per year = $9,200/year

(3) Coverage for 2.5 persons/household[63]. Estimated policies = 56,000,000 people ÷ 2.5 persons per household = 22,400,000.

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[61] Mercer. "2009 National Survey of Employer-Sponsored Health Plans" as referenced in Mercer's June 2010 "Survey on the Total Financial Impact of Employee Absences" at page 8.
[62] See Appendix A.

(4) Estimated insurance cost for employers in nonattainment areas = 22,400,000*$9,200 = $206,100,000,000.

(5) Assigned insurance costs to non attainment areas:

All Transport Rule = $7,052,000,000 for both lost income and cost of illness.

Assume half direct health = $3,500,000,000

Estimated prevalence in nonattainment areas using (3,500,000,000 x 67.45% = $2,361,000,000)[64]

(6) Increase in employers' insurance costs within nonattainment areas

$2,361,000,000 ÷ $206,100,000,000 = 1.15%

This analysis is conservative for two reasons. First, it assumes that only half of the EPA's costs of lost income and cost of illness are for increased insurance costs. Second, as discussed above, the analysis uses a conservative 67.45% share of these costs to calculate the increased insurance cost for employers and businesses in the downwind nonattainment areas. Cleary, therefore, without the Transport Rule, medical costs are higher. Per the conservative calculations above, interstate air pollution transfer increases the insurance costs for employers and businesses in nonattainment areas by about 1.15% per year. Ignoring any increased insurance mark-ups, these increased non-fatal health costs are about $2.37 billion per year in downwind nonattainment areas.

Table 11 below shows the magnitude of increased employer insurance costs, lost state and local tax revenues and lost jobs that Transport Rule States as a whole, as well as non-attainment areas separately, would suffer without the Transport Rule.

[63] Based upon the range for Illinois and Pennsylvania.

[64] As detailed on page 28 above, the 67.45% multiplier assigned to non-attainment areas represents the midpoint between the two extreme analytical choices.

**TABLE 11**
**Economic Losses Related to Employers' Insurance Costs, State and Local Taxes and Jobs Without the Transport Rule**

| | All TR States | Estimated Nonattainment Share |
|---|---|---|
| Increased Employers' Insurance Costs[1] | $3.5 billion | $2.37 billion |
| Lost State and Local Tax Revenue[2] | $689 million | $465 million |
| Lost Jobs[3] | 26,636 | 17,966 |

[1] This assumes that when employers incur $1 in lost employee time, they lose money, which decreases income, and decreases GDP.
[2] Based on 19.6% of GDP for all state and local tax expenditures.
[3] Based on 7.58 jobs lost per $1 million of reduced GDP.

### C. Impeding Downwind Economic Development and Imposing Higher Business Costs

State regulatory agencies have generally required most existing pollution sources in downwind areas either to shut down or to install pollution control equipment to achieve or maintain the reductions necessary to meet the applicable NAAQS. As downwind states cannot regulate upwind emissions, however, without the Transport Rule, it is unlikely that downwind locations (*e.g.*, Philadelphia or Chicago) can meet required NAAQS, achieve attainment status, or continue to maintain these standards when and if they are attained.

Nonattainment status depresses economic activity by imposing high costs that deter the development, expansion or even modernization of certain existing businesses. Specifically, the CAA requirements for new source review ("NSR") in nonattainment areas, 42 U.S.C. §§ 7501-7503, provide that when a new major air pollution source is built, or an existing source is significantly modified: (1) the owners must purchase offsets for any new or increased emissions, and in many cases, purchase more offsets than the increase in emissions; and (2) the facility must employ emissions control technology that achieves the lowest achievable emissions rate ("LAER"). As described in the following examples, LAER control technology can involve substantially higher capital expenses and higher operating expenses than the best available control technology ("BACT") required in attainment areas. Such higher capital expenses in turn can deter economic investment in nonattainment areas and unfairly drive investment to the very upwind areas contributing to downwind pollution.

Requiring nonattainment areas to offset new emissions means that many new or expanded industrial facilities, including power plants, must purchase Emission Reduction Credits (ERCs) for any new emissions. New, low heat rate, highly efficient, and cleaner burning natural gas replacement generation in ground level ozone non-attainment areas, therefore, must secure ERCs for $NO_X$ and volatile organic compounds ("VOCs"), both of which are ozone precursors. For example, in southeastern Pennsylvania, a non-attainment area, new sources must acquire 1.3 ERCs for every ton of new $NO_X$ and VOC emissions, as well as offsets for $SO_2$ precursors to $PM_{2.5}$, all of which increases capital costs for new sources and expansions.

Moreover, not only must new boilers, power plants, and other industrial operations that emit $SO_2$, $NO_X$, VOCs and/or other $PM_{2.5}$ purchase ERC offsets to comply, but also they likely will operate less frequently, and take longer to gain approval if located in nonattainment areas. Examples of adversely affected businesses include: industrial boilers, oil refineries, heat recovery cogeneration, biomass, and clean natural gas-fired combined cycle combustion turbine generating units, cement kilns, petro chemical plants, inorganic chemical manufacturing plants, paper mills, agricultural chemical manufacturing plants, and surface coating operations.[65]

Primary factors in determining the required extra costs include the engineering or heat rate efficiency of the various new sources, the specific type and grade of fuel used, the types of emission controls, and the hours of annual operations.

Accordingly, new, expanded and modernized businesses must pay more to locate in downwind nonattainment areas, which may well cause businesses to shift operations elsewhere to avoid these additional compliance charges. If a business decides to locate elsewhere in the United States to avoid additional nonattainment costs and likely delays, although there may be little or no national net investment, tax and job losses,[66] the losses at the state and municipal level remain, losses disproportionately affecting nonattainment cities or states. Any location that loses investments, particularly when unemployment is high, not only loses jobs and tax revenue, but also must pay more to address greater social and economic needs. Moreover, eventually such adverse impacts may cause people to move, further undermining localized economic recovery.

More stringent new source requirements may also affect marginal production costs because nonattainment status causes more stringent pollution controls that reduce the efficiency of manufacturing and electricity generation. Wholesale electricity markets match demand and supply. At low demand, only the units with lower marginal operating costs clear the market. The primary determinants of an electric generating unit's marginal operating costs are its heat rate, defined as BTUs of input/MWHs of output, and the cost of fuel, expressed as \$/BTU. More stringent pollution control requirements would increase a generator's heat rates and thus its marginal operating costs. Figure 3 illustrates the market when a new source natural gas unit clears the market under two conditions: (i) BACT is required for all natural gas plants; and (ii) more stringent emissions and LAER with higher heat rates is required just for nonattainment areas.

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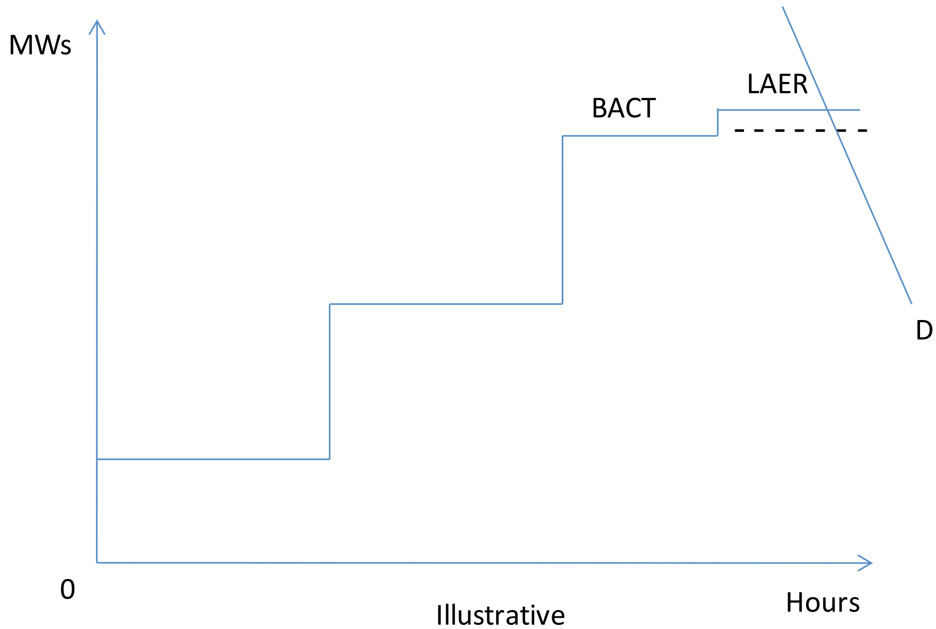
[65] This includes furniture manufacturing. For example, although 80% of the cherry in the world is grown in the Pennsylvania's Allegheny plateau, furniture manufacturing has moved from Pennsylvania to North Carolina and is moving out of the U.S.

[66] Many of the urban, downwind non-attainment areas have existing infrastructure in the form of storm and sanitary sewers, water treatment and distribution systems, transportation systems, and schools, while the areas to which businesses move will require new infrastructure to serve the businesses and their employees, much of which is often provided or subsidized by federal, state and local tax dollars.

**Figure 3**




The full market price effect of even small changes in the heat rates of new units based on nonattainment status and NSR regulations cannot be determined without a complete and comprehensive analysis using electricity dispatch and expansion models such as IMPLAN. Nevertheless, it is clear even relatively small differences in heat rates could affect the wholesale prices for the entire market if and when the units setting wholesale prices operate at lower efficiency due to their location in nonattainment areas with more stringent new source controls.

Although without such detailed analysis, the effect of this cost cannot be quantified explicitly, the adverse economic impacts are real, resulting effectively in a wealth transfer from hard hit downwind urban centers to upwind states operating uncontrolled power plants. Moreover, the regional economic inequities from interstate pollution transfer violate principles of environmental justice as the poorest residents of adversely affected downwind areas are least able to cope when businesses and jobs shift to less affected areas.

### D. Higher Cost of Reformulated Gasoline (RFG) and Potential Loss of Highway Funds

Another higher cost for downwind families and businesses caused by interstate pollution transfer is the requirement in some ozone nonattainment areas to use more expensive reformulated gasoline. *See* 42 U.S.C. § 7545(k). Drivers in downwind states derive virtually *no* benefit from any lower electricity prices in upwind areas where uncontrolled coal-fired generation operates, yet incur not only higher concentrations of harmful pollutants, but also higher gasoline prices.

RFG additives add about 13.85 cents per gallon for mid grade gasoline prices compared to conventional gasoline.[67] The average consumption of gasoline in Illinois, for example, is 412 gallons per person per year, and 420 gallons per person per year in Pennsylvania.[68] At 13.85 cents per gallon additional cost for RFG, the average person in these major non-attainment areas, therefore, pays about $58 per person per year more for gasoline ($0.1385 * 416 gallons per person per year).

As shown in Appendix A, about 56 million people live in non attainment areas covered by the Transport Rule. Multiplying 56 million people times the $58 per person per year derived above means that the additional cost of RFG adds about $3.25 billion per year in higher gasoline bills in all TR nonattainment areas.

Moreover, although rarely invoked under the CAA, EPA also can impose sanctions that lead to the loss of highway funding for nonattainment areas.[69] Only certain types of projects are affected and many are specifically exempted either by statute or through agreement between the Department of Transportation and EPA. Nevertheless, the risk of losing critical transportation infrastructure funds is a legitimate concern in nonattainment markets.[70]

### E. Totaling the Costs of Interstate Pollution Transfer Imposes on Nonattainment Areas

Table 12[71] summarizes the easily quantifiable and substantial interstate pollution transfer costs implicitly imposed on nonattainment areas and on all the Transport Rule States. Without the Transport Rule, nonattainment areas downwind annually will suffer: $3.97 billion in reduced GDP, through what we have categorized as "Lost Work", (i.e., higher labor costs, lost work days and lost productivity) and higher insurance costs; about $785 million in lost state and local tax revenues; more than 30,000 lost jobs; and about $3.25 billion in higher gasoline prices In addition, new sources are likely to cost more to build and operate in non-attainment areas and, as such, interstate air pollution transfer deters economic development in those areas. The combined annual losses in all Transport Rule States equal over $5.90 billion in reduced GDP, about $1.16 billion in lost state and local tax revenue, and over 45,000 lost jobs.

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67 For the six months from February 2010 through July 2010, the U.S. Energy Information Administration (EIA) reported average monthly price differences between mid-grade RFG and mid-grade conventional gasoline. The average six-month difference was 13.85 cents per gallon for midgrade (13, 11.1, 10.7, 14.2, 17.1, 17), http://eia.gov/dnav/pet.

68 U.S. Department of Energy, Energy Efficiency and Renewable Energy. Illinois Energy Summary and Pennsylvania Energy Summary. http://apps1.eere.energy.gov/states/energy_summary.cfm/state=Il; http://apps1.eere.energy.gov/states/energy_summary.cfm/state= PA.

69 See "Highway Sanctions", U.S. Department of Transportation, Federal Highway Administration. www.fhwa.dot.gov/environment/sanction.htm.

70 See Appendix C for a discussion of the potential loss of Highway Trust Funds.

71 The information presented in Table 12 is available by state in Appendix E.

**TABLE 12**
**Estimated Total Annual Economic Losses for Lost Work and Increased Health Insurance Costs Without the Transport Rule**

| | Lost Work | + | Increased Insurance | = | Total |
|---|---|---|---|---|---|
| | **Nonattainment Areas** | | | | |
| Lost Income[1] | $1.6 billion | + | $2.37 billion | = | **$3.97 Billion** |
| Lost State and Local Tax Revenues | $320 million | + | $465 million | = | **$785 million** |
| Lost Jobs | 12,393 jobs | + | 17,966 jobs | = | **30,359 jobs** |
| Higher Gas Prices | **$3.25 billion** | | | | |
| | **All TR States** | | | | |
| Lost Income[1] | $2.42 billion | + | $3.5 billion | = | **$5.92 billion** |
| Lost State and Local Tax Revenues | $475 million | + | $689 million | = | **$1.16 billion** |
| Lost Jobs | 18,374 jobs | + | 26,636 jobs | = | **45,010 jobs** |

[1] "Lost Income" derives from "Lost Work" (i.e., higher labor costs, lost work days and lost productivity) and higher insurance costs.

As described previously in Section I, EPA estimates that annual social compliance costs for the Transport Rule will range between $2.03 billion and $2.23 billion.[72] Even focusing narrowly on quantified annual reductions in GDP for Lost Work and employers' higher insurance costs, the $5.92 billion gain from implementing the Transport Rule easily exceeds EPA's average expected compliance costs ($5.92 ÷ $2.13) by 2.8 to 1. Further, focusing only on the comparative downwind nonattainment benefits for this one category, even the $3.97 billion per year benefit is almost two times greater than EPA's average estimated compliance costs ($3.97 ÷ $2.13). Adding the quantifiable and substantial losses detailed in this section due to higher gasoline prices, lost jobs, reduced new source development, and lower state and local tax revenues would substantially increase the Transport Rule's cost/benefit ratio. Notably as well, these billions in quantifiable and real adverse economic impacts from interstate pollution transfer supplement EPA's comprehensive analyses of the tremendous adverse health consequences of increased premature deaths and increased illness, which EPA conservatively estimated to range from $120 - $290 billion yearly. Accordingly, in any reasonable scenario, whether focusing exclusively on downwind nonattainment areas or on all Affected States, the Transport Rule's demonstrated benefits far exceed EPA's estimates of annual compliance costs, which, as explained previously in Section I, are themselves likely overestimated.

[72] RIA at Table 1-1 page 2.

## Section III. Conclusion

As detailed in this Report, EPA's comprehensive and conservative cost/benefit analyses rely upon sound, proven scientific methods and data. Some aver that EPA should delay implementing the Transport Rule because the economy is currently too weak to absorb the implementation costs without extending the recession. They are wrong for two reasons. First, if anything, EPA's analyses understate the Transport Rule's benefits and overestimate its costs. In fact, if all the Transport Rule benefits and likely costs are monetized, the expected annual benefits are roughly one hundred times compliance costs. Further, in focusing almost exclusively on health related benefits, EPA did not consider that interstate pollution transfer costs businesses in Affected States almost $6 billion annually. Implementing the Transport Rule will reduce these tremendous costs, which in turn will stimulate the economies, increase employment and tax revenue, and hasten economic recovery in downwind nonattainment areas.

Power plants without pollution controls can no longer be permitted to use the air stream as a free waste transfer system that pollutes the air for downwind populations, not only causing many thousands of premature deaths and illnesses each year, but also causing higher labor and health insurance costs, lost jobs, lost state and local tax revenues and higher gasoline prices in downwind regions.

# APPENDIX A

**APPENDIX A**

| | Population Nonattainment Areas Subject to TR | Population in TR Areas | Percent Nonattainment |
|---|---|---|---|
| Ozone | 68,073,359 | 185,794,026 | 36.6% |
| $PM_{2.5}$ | 40,981,903 | 182,838,543 | 22.4% |
| Requires RFG | 58,322,115 | 123,530,979 | 45.5% |
| Average of all Three | 55,792,459 | Average Percent of all Three | 34.9% |

**States Covered for 8-Hour Ozone in Table III.A.1, Page 30 (TR) (Highlighted in Yellow)**

| A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|
| | | Covered for 24 Hour and/or Annual $PM_{2.5}$ | Covered for 8-Hour Ozone/Required to Reduce Ozone Season $NO_X$ | Population in State (U.S. Census 2000) | Population in Ozone Nonattainment Areas (From EPA's Green Book) | % of State's Population in Nonattainment Areas F/E | % of State's Population to U.S. Poplation E/TOTAL POPULATION | Population in Ozone Nonattainment State | % of Population in Ozone Non Attainment State to Total Population in all Ozone Nonattainment States I/TOTAL POP IN NONATT. AREA |
| 1 | ***Alabama*** | X | X | 4,447,100 | | | 1.58% | 4,447,100 | 2.39% |
| | Alaska | | | 626,932 | | | 0.22% | | |
| | Arizona | | | 5,130,632 | | | 1.82% | | |
| 2 | ***Arkansas*** | | X | 2,673,400 | | | 0.95% | 2,673,400 | 1.44% |
| | California | | | 33,871,648 | | | 12.04% | | |
| | Colorado | | | 4,301,261 | | | 1.53% | | |
| 3 | ***Connecticut*** | X | X | 3,405,565 | | 45.34% | 1.21% | 3,405,565 | 1.83% |
| | Greater Connecticut | | | | 1,543,919 | | | | |
| 4 | ***Delaware*** | X | X | 783,600 | | | 0.28% | 783,600 | 0.42% |
| 5 | ***D.C.*** | X | X | 572,059 | | 34.39% | 0.20% | 572,059 | 0.31% |
| | DC-MD-VA | | | | 4,452,498 | | | | |
| 6 | ***Florida*** | X | X | 15,982,378 | | | 5.68% | 15,982,378 | 8.60% |
| 7 | ***Georgia*** | X | X | 8,186,453 | | 51.65% | 2.91% | 8,186,453 | 4.41% |
| | Atlanta | | | | 4,228,492 | | | | |
| | Hawaii | | | 1,211,537 | | | 0.43% | | |
| | Idaho | | | 1,293,953 | | | 0.46% | | |
| 8 | ***Illinois*** | X | X | 12,419,293 | | | 4.41% | 12,419,293 | 6.68% |
| 9 | ***Indiana (combined with Illinois)*** | X | X | 6,080,485 | | 47.34% | 2.16% | 6,080,485 | 3.27% |
| | Chicago-Gary-Lake County | | | | 8,757,808 | | | | |
| | **Iowa** | X | | 2,926,324 | | | 1.04% | | |
| 10 | ***Kansas*** | X | X | 2,688,418 | | | 0.96% | 2,688,418 | 1.45% |
| 11 | ***Kentucky*** | X | X | 4,041,769 | | | 1.44% | 4,041,769 | 2.18% |
| 12 | ***Louisiana*** | X | X | 4,468,976 | | 14.24% | 1.59% | 4,468,976 | 2.41% |
| | Baton Rouge | | | | 636,214 | | | | |
| | Maine | | | 1,274,923 | | | 0.45% | | |
| 13 | ***Maryland*** | X | X | 5,296,486 | | 47.44% | 1.88% | 5,296,486 | 2.85% |
| | Baltimore | | | | 2,512,431 | | | | |
| | **Massachussetts** | X | | 6,349,097 | | | 2.26% | | |
| 14 | ***Michigan*** | X | X | 9,938,444 | | 1.06% | 3.53% | 9,938,444 | 5.35% |
| | Allegen Co, | | | | 105,665 | | | | |
| | **Minnesota** | X | | 4,919,479 | | | 1.75% | | |
| 15 | ***Mississippi*** | X | X | 2,844,658 | | | 1.01% | 2,844,658 | 1.53% |
| | **Missouri** | X | | 5,595,211 | | | 1.99% | | |
| | Montana | | | 902,195 | | | 0.32% | | |
| | **Nebraska** | X | | 1,711,263 | | | 0.61% | | |
| | Nevada | | | 1,998,257 | | | 0.71% | | |
| | New Hampshire | | | 1,235,786 | | | 0.44% | | |
| 16 | ***New Jersey*** | X | X | 8,414,350 | | | 2.99% | 8,414,350 | 4.53% |
| | New Mexico | | | 1,819,046 | | | 0.65% | | |
| 17 | ***New York (Combined with New Jersey)*** | X | X | 18,976,457 | | 86.88% | 6.74% | 18,976,457 | 10.21% |
| | Albany-Schenectday-Troy | | X | | 923,778 | | | | |
| | Buffalo-Niagara Falls | X | X | | 1,170,111 | | | | |
| | Essex County | | | | 1,000 | | | | |
| | Jamestown | | | | 139,750 | | | | |
| | Jefferson County | | | | 111,738 | | | | |
| | New York-New Jersey-Long Island | | | | 19,634,122 | | | | |
| | Poughkeepsie | | | | 717,262 | | | | |
| | Rochester | | | | 1,098,201 | | | | |
| 18 | ***North Carolina (Combined with S. Car)*** | X | X | 8,049,313 | | 36.80% | 2.86% | 8,049,313 | 4.33% |
| | Charlotte-Gastonia-Rock Hill | | | | 1,476,564 | | | | |
| | North Dakota | | | 642,200 | | | 0.23% | | |
| 19 | ***Ohio*** | X | X | 11,353,140 | | | 4.03% | 11,353,140 | 6.11% |
| 20 | ***Oklahoma*** | | X | 3,450,654 | | | 1.23% | 3,450,654 | 1.86% |
| | Oregon | | | 3,421,399 | | | 1.22% | | |
| 21 | ***Pennsylvania (comb with parts of NJ & MD)*** | X | X | 12,281,054 | | 79.51% | 4.36% | 12,281,054 | 6.61% |
| | Philadelphia-Wilimington-Atlantic City | | | | 7,333,475 | | | | |
| | Pittsburg-Beaver Valley | | | | 2,431,087 | | | | |
| | Rhode Island | | | 1,048,319 | | | 0.37% | | |
| 22 | ***South Carolina*** | X | X | 4,012,012 | | | 1.43% | 4,012,012 | 2.16% |
| | South Dakota | | | 754,844 | | | 0.27% | | |
| 23 | ***Tennessee*** | X | X | 5,689,283 | | 12.55% | 2.02% | 5,689,283 | 3.06% |
| | Knoxville | | | | 713,755 | | | | |
| 24 | ***Texas*** | | X | 20,851,820 | | 48.37% | 7.41% | 20,851,820 | 11.22% |
| | Beaumont-Port Arthur | | | | 385,090 | | | | |
| | Dallas-Fort Worth | | | | 5,030,828 | | | | |
| | Houston-Galveston-Brazoria | | | | 4,669,571 | | | | |
| | Utah | | | 2,233,169 | | | 0.79% | | |
| | Vermont | | | 608,827 | | | 0.22% | | |
| 25 | ***Virginia*** | X | X | 7,078,515 | | | 2.52% | 7,078,515 | 3.81% |
| | Washington | | | 5,894,121 | | | 2.09% | | |
| 26 | ***West Virginia*** | X | X | 1,808,344 | | | 0.64% | 1,808,344 | 0.97% |
| | **Wisconsin** | X | | 5,363,675 | | | 1.91% | | |
| | Wyoming | | | 493,782 | | | 0.18% | | |
| | **TOTAL** | | | **281,421,906** | **68,073,359** | | **100.00%** | **185,794,026** | **100.00%** |

State that are bolded (26) are on EPA's List of TR States. Those that are bolded and italicized are on the TR 8 Hour Ozone and highlighted in yellow.

Also several states that are not CATR 8-Hour Ozone states are listed as an EPA nonattainment Areas in EPA's Green Book. These are: Missouri (St. Louis), Massachusetts (Springfield, Boston); New Hampshire; Rhode Island (Providence); and Wisconsin (Racine, Sheboygan).

**States Covered for $PM_{2.5}$ in Table III.A.1, Page 30 (TR) (Highlighted in Blue)**

| A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|
| | | Covered for 24 Hour and/or Annual $PM_{2.5}$ | Covered for 8-Hour Ozone/Required to Reduce Ozone Season $NO_X$ | Population in State (U.S. Census 2000) | Population in $PM_{2.5}$ Nonattainment Areas (From EPA's Green Book) | % of State's Population in Nonattainment Areas F/E | % of State's Population to U.S. Poplation E/TOTAL POP | Population in $PM_{2.5}$ Nonattainment State | % of Population in $PM_{2.5}$ Non Attainment State to Total Population in all $PM_{2.5}$ Nonattainment States I/TOTAL POP NONATT AREA |
| 1 | ***Alabama*** | X | X | 4,447,100 | | 18.16% | 1.58% | 4,447,100 | 2.43% |
| | Birmingham | | | | 807,612 | | | | |
| | Alaska | | | 626,932 | | | 0.22% | | |
| | Arizona | | | 5,130,632 | | | 1.82% | | |
| | ***Arkansas*** | | X | 2,673,400 | | | 0.95% | | |
| | California | | | 33,871,648 | | | 12.04% | | |
| | Colorado | | | 4,301,261 | | | 1.53% | | |
| 2 | ***Connecticut*** | X | X | 3,405,565 | | | 1.21% | 3,405,565 | 1.86% |
| 3 | ***Delaware*** | X | X | 783,600 | | | 0.28% | 783,600 | 0.43% |
| 4 | ***D.C.*** | X | X | 572,059 | | | 0.20% | 572,059 | 0.31% |
| 5 | ***Florida*** | X | X | 15,982,378 | | | 5.68% | 15,982,378 | 8.74% |
| 6 | ***Georgia*** | X | X | 8,186,453 | | | 2.91% | 8,186,453 | 4.48% |
| | Hawaii | | | 1,211,537 | | | 0.43% | | |
| | Idaho | | | 1,293,953 | | | 0.46% | | |
| 7 | ***Illinois*** | X | X | 12,419,293 | | | 4.41% | 12,419,293 | 6.79% |
| 8 | ***Indiana*** | X | X | 6,080,485 | | | 2.16% | 6,080,485 | 3.33% |
| 9 | **Iowa** | X | | 2,926,324 | | | 1.04% | 2,926,324 | 1.60% |
| 10 | ***Kansas*** | X | X | 2,688,418 | | | 0.96% | 2,688,418 | 1.47% |
| 11 | ***Kentucky*** | X | X | 4,041,769 | | | 1.44% | 4,041,769 | 2.21% |
| 12 | ***Louisiana*** | X | X | 4,468,976 | | | 1.59% | 4,468,976 | 2.44% |
| | Maine | | | 1,274,923 | | | 0.45% | | |
| 13 | ***Maryland*** | X | X | 5,296,486 | | | 1.88% | 5,296,486 | 2.90% |
| 14 | **Massachussetts** | X | | 6,349,097 | | | 2.26% | 6,349,097 | 3.47% |
| 15 | ***Michigan*** | X | X | 9,938,444 | | 48.63% | 3.53% | 9,938,444 | 5.44% |
| | Detroit | | | | 4,833,493 | | | | |
| 16 | **Minnesota** | X | | 4,919,479 | | | 1.75% | 4,919,479 | 2.69% |
| | ***Mississippi*** | X | X | 2,844,658 | | | 1.01% | | |
| 17 | **Missouri** | X | | 5,595,211 | | | 1.99% | 5,595,211 | 3.06% |
| | Montana | | | 902,195 | | | 0.32% | | |
| 18 | **Nebraska** | X | | 1,711,263 | | | 0.61% | 1,711,263 | 0.94% |
| | Nevada | | | 1,998,257 | | | 0.71% | | |
| | New Hampshire | | | 1,235,786 | | | 0.44% | | |
| 19 | ***New Jersey*** | X | X | 8,414,350 | | | 2.99% | 8,414,350 | 4.60% |
| | New Mexico | | | 1,819,046 | | | 0.65% | | |
| 20 | ***New York (Combined with New Jersey and Conn))*** | X | X | 18,976,457 | | 64.30% | 6.74% | 18,976,457 | 10.38% |
| | New York-N. New Jersey- Long Island, NY, NJ, CT | | | | 19,802,587 | | | | |
| 21 | ***North Carolina*** | X | X | 8,049,313 | | | 2.86% | 8,049,313 | 4.40% |
| | North Dakota | | | 642,200 | | | 0.23% | | |
| 22 | ***Ohio*** | X | X | 11,353,140 | | 28.73% | 4.03% | 11,353,140 | 6.21% |
| | Canton-Massillon | | | | 378,098 | | | | |
| | Cleveland-Akron-Lorain | | | | 2,752,208 | | | | |
| | Steubenville-Weirton, OH-WV | | | | 132,008 | | | | |
| | ***Oklahoma*** | | X | 3,450,654 | | | 1.23% | | |
| | Oregon | | | 3,421,399 | | | 1.22% | | |
| 23 | ***Pennsylvania (comb with parts of NJ & MD)*** | X | X | 12,281,054 | | 56.52% | 4.36% | 12,281,054 | 6.72% |
| | Allentown | | | | 579,156 | | | | |
| | Harrisburg-Lebanon-Carlisle-York | | | | 967,550 | | | | |
| | Johnstown | | | | 164,514 | | | | |
| | Lancaster | | | | 470,658 | | | | |
| | Liberty-Clairton | | | | 21,519 | | | | |
| | Philadelphia-Wilmington, PA-NJ-DE | | | | 5,536,911 | | | | |
| | Pittsburg-Beaver Valley | | | | 2,195,156 | | | | |
| | Rhode Island | | | 1,048,319 | | | 0.37% | | |
| 24 | ***South Carolina*** | X | X | 4,012,012 | | | 1.43% | 4,012,012 | 2.19% |
| | South Dakota | | | 754,844 | | | 0.27% | | |
| 25 | ***Tennessee*** | X | X | 5,689,283 | | 10.53% | 2.02% | 5,689,283 | 3.11% |
| | Knoxville | | | | 599,009 | | | | |
| | ***Texas*** | | X | 20,851,820 | | | 7.41% | | |
| | Utah | | | 2,233,169 | | | 0.79% | | |
| | Vermont | | | 608,827 | | | 0.22% | | |
| 26 | ***Virginia*** | X | X | 7,078,515 | | | 2.52% | 7,078,515 | 3.87% |
| | Washington | | | 5,894,121 | | | 2.09% | | |
| 27 | ***West Virginia*** | X | X | 1,808,344 | | 13.92% | 0.64% | 1,808,344 | 0.99% |
| | Charleston | | | | 251,662 | | | | |
| 28 | **Wisconsin** | X | | 5,363,675 | | 27.78% | 1.91% | 5,363,675 | 2.93% |
| | Milwaukee - Racine | | | | 1,489,762 | | | | |
| | Wyoming | | | 493,782 | | | 0.18% | | |
| | **TOTAL** | | | **281,421,906** | **40,981,903** | | **100.00%** | **182,838,543** | **100.00%** |

State that are highlighted in Blue (28) are on EPA's List of TR States for $PM_{2.5}$. Those that are bolded and italicized are on the TR 8 Hour Ozone.

New York is combnied with New Jersey and Connecticut. The calculation of the % of the state's population for NY of the state's total population includes the populations for New York, New Jersey and Connecticut

Pennslvania includes parts of New Jersey and Maryland. As New Jersey's population is already included with New York's, it is not added here. Maryland's population is combined with Pennsylvania's population for this calculation.

| | States Covered for RFG (Highlighted in Pink) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | E | F | G | H | I | J |
| | | Covered for 24 Hour and/or Annual $PM_{2.5}$ | Covered for 8-Hour Ozone/Required to Reduce Ozone Season $NO_X$ | Population in State (U.S. Census 2009) | Population in RFG Areas | % of State's Population in RFG Areas F/E | % of State's Population to U.S. Poplation E/TOT POP | Population in RFG Nonattainment State | % of Population in RFG State to Total Population in all RFG Nonattainment States I/TOT POP NONATT AREA |
| | ***Alabama*** | X | X | 4,708,708 | | | 1.53% | | |
| | Alaska | | | 698,473 | | | 0.23% | | |
| | Arizona | | | 6,595,778 | | | 2.15% | | |
| | ***Arkansas*** | | X | 2,889,450 | | | 0.94% | | |
| | California | | | 36,961,664 | | | 12.04% | | |
| | Colorado | | | 5,024,748 | | | 1.64% | | |
| 1 | ***Connecticut*** | X | X | 3,518,288 | 2,150,989 | 61.14% | 1.15% | 3,518,288 | 2.85% |
| 2 | ***Delaware*** | X | X | 885,122 | 692,375 | 78.22% | 0.29% | 885,122 | 0.72% |
| 3 | ***D.C.*** | X | X | 599,657 | 599,657 | 100.00% | 0.20% | 599,657 | 0.49% |
| | ***Florida*** | X | X | 18,537,969 | | | 6.04% | | |
| 4 | ***Georgia*** | X | X | 9,829,211 | 4,749,461 | 48.32% | 3.20% | 9,829,211 | 7.96% |
| | Hawaii | | | 1,295,178 | | | 0.42% | | |
| | Idaho | | | 1,545,801 | | | 0.50% | | |
| 5 | ***Illinois*** | X | X | 12,910,409 | 8,526,870 | 66.05% | 4.21% | 12,910,409 | 10.45% |
| 6 | ***Indiana*** | X | X | 6,423,113 | 657,809 | 10.24% | 2.09% | 6,423,113 | 5.20% |
| | **Iowa** | X | | 3,007,856 | | | 0.98% | | |
| | ***Kansas*** | X | X | 2,818,747 | | | 0.92% | | |
| | ***Kentucky*** | X | X | 4,314,113 | | | 1.41% | | |
| 7 | ***Louisiana*** | X | X | 4,492,076 | 717,924 | 15.98% | 1.46% | 4,492,076 | 3.64% |
| | Maine | | | 1,318,301 | | | 0.43% | | |
| | ***Maryland*** | X | X | 5,699,478 | 5,003,250 | 87.78% | 1.86% | 5,699,478 | 4.61% |
| | **Massachussetts** | X | | 6,593,587 | | | 2.15% | | |
| | ***Michigan*** | X | X | 9,969,727 | | | 3.25% | | |
| | **Minnesota** | X | | 5,266,214 | | | 1.72% | | |
| | ***Mississippi*** | X | X | 2,951,996 | | | 0.96% | | |
| | **Missouri** | X | | 5,987,580 | | | 1.95% | | |
| | Montana | | | 974,989 | | | 0.32% | | |
| | **Nebraska** | X | | 1,796,619 | | | 0.59% | | |
| | Nevada | | | 2,643,085 | | | 0.86% | | |
| | New Hampshire | | | 1,324,575 | | | 0.43% | | |
| 8 | ***New Jersey*** | X | X | 8,707,739 | 8,230,298 | 94.52% | 2.84% | 8,707,739 | 7.05% |
| | New Mexico | | | 2,009,671 | | | 0.65% | | |
| 9 | ***New York*** | X | X | 19,541,453 | 13,006,717 | 66.56% | 6.37% | 19,541,453 | 15.82% |
| | ***North Carolina*** | X | X | 9,380,884 | | | 3.06% | | 0.00% |
| | North Dakota | | | 646,844 | | | 0.21% | | |
| | ***Ohio*** | X | X | 11,542,645 | | | 3.76% | | 0.00% |
| | ***Oklahoma*** | | X | 3,687,050 | | | 1.20% | | |
| | Oregon | | | 3,825,657 | | | 1.25% | | |
| 10 | ***Pennsylvania*** | X | X | 12,604,767 | 4,012,573 | 31.83% | 4.11% | 12,604,767 | 10.20% |
| | Rhode Island | | | 1,053,209 | | | 0.34% | | |
| | ***South Carolina*** | X | X | 4,561,242 | | | 1.49% | | |
| | South Dakota | | | 812,383 | | | 0.26% | | |
| | ***Tennessee*** | X | X | 6,296,254 | | | 2.05% | | |
| 11 | ***Texas*** | | X | 24,782,302 | 5,815,339 | 23.47% | 8.07% | 24,782,302 | 20.06% |
| | Utah | | | 2,784,572 | | | 0.91% | | |
| | Vermont | | | 621,760 | | | 0.20% | | |
| 12 | ***Virginia*** | X | X | 7,882,590 | 2,233,203 | 28.33% | 2.57% | 7,882,590 | 6.38% |
| | Washington | | | 6,664,195 | | | 2.17% | | |
| | ***West Virginia*** | X | X | 1,819,777 | | | 0.59% | | |
| 13 | **Wisconsin** | X | | 5,654,774 | 1,925,650 | 34.05% | 1.84% | 5,654,774 | 4.58% |
| | Wyoming | | | 544,270 | | | 0.18% | | |
| | **TOTAL** | | | **307,006,550** | **58,322,115** | | **100.00%** | **123,530,979** | **100.00%** |

**TESTING THE HYPOTHESIS THAT NON-ATTAINMENT AREAS HAVE A GRETER PREVALENCE OF PREMATURE DEATHS**

```
SST Spool File:  catr2.log
Fri Nov 19 13:08:32 2010

load file[catr.dbf] dbase

recode var[*] map[-999=md]
range obs[1-$(size(statecde))]

label var[statecde] lab[State code]

set napopoz = napopoz/1000
label var[napopoz]  lab[Non-attainment population-ozone (000s)]

set napoppm = napoppm/1000
label var[napoppm]  lab[Non-attainment population-PM2.5 (000s)]

set napoprfg = napoprfg/1000
label var[napoprfg] lab[Non-attainment population-RFG (000s)]
label var[mort_pm]  lab[Avoided PM2.5-related premature mortalities for
the proposed remedy in 2014, Avg of Pope and Laden]
label var[mort_oz]  lab[Avoided onzone-related premature mortalities for
the proposed remedy in 2014, Avg of Levy and Bell]

set stpop09 = stpop09/1000
label var[stpop09]    lab[State population in 2009 (000s)]

set uspop09 = uspop09/1000
label var[uspop09]    lab[Population for lower 48 states in 2009 (000s)]

set stpop00 = stpop00/1000
label var[stpop00]    lab[State population in 2000 (000s)]

set uspop00 = uspop00/1000
label var[uspop00]    lab[Population for lower 48 states in 2000 (000s)]

# Create Percentage Variables
set mpmrate = mort_pm / uspop00
set mozrate = mort_oz / uspop00
set stpoppct = stpop00/uspop00
set napmpct = napoppm / stpop00
set naozpct = napopoz / stpop00
set narfgpct = napoprfg / stpop09

# Remove Negative Values from Avoided Premature Mortalities Variables
set mortpm1 = mort_pm ; if[mort_pm>0]
set mortpm1 = 0       ; if[mort_pm<0]
set mortoz1 = mort_oz ; if[mort_oz>0]
set mortoz1 = 0       ; if[mort_oz<0]
Warning: no valid observations
set mpmrate1 = mortpm1 / uspop00
set mozrate1 = mortoz1 / uspop00


# Create Log Variables
```

```
set lmpmrate = log(mpmrate1+1)
set lmozrate = log(mozrate1+1)
set lstpoppc = log(stpoppct+1)
set lnapmpct = log(napmpct+1)
set lnaozpct = log(naozpct+1)
set lnarfgpc = log(narfgpct+1)
set lmortpm  = log(mortpm1+1)
set lmortoz  = log(mortoz1+1)
set lstpop00   = log(stpop00+1)

list

---- Variables ----
lmortoz     43  Fri Nov 19 13:08:33 2010
lmortpm     43  Fri Nov 19 13:08:33 2010
lmozrate    43  Fri Nov 19 13:08:33 2010
lmpmrate    43  Fri Nov 19 13:08:33 2010
lnaozpct    43  Fri Nov 19 13:08:33 2010
lnapmpct    43  Fri Nov 19 13:08:33 2010
lnarfgpc    43  Fri Nov 19 13:08:33 2010
lstpop00    43  Fri Nov 19 13:08:33 2010
lstpoppc    43  Fri Nov 19 13:08:33 2010
mort_oz     43  Fri Nov 19 13:08:32 2010 Avoided onzone-related premature
morta
mort_pm     43  Fri Nov 19 13:08:32 2010 Avoided PM2.5-related premature
mortal
mortoz1     43  Fri Nov 19 13:08:33 2010
mortpm1     43  Fri Nov 19 13:08:33 2010
mozrate     43  Fri Nov 19 13:08:33 2010
mozrate1    43  Fri Nov 19 13:08:33 2010
mpmrate     43  Fri Nov 19 13:08:33 2010
mpmrate1    43  Fri Nov 19 13:08:33 2010
naozpct     43  Fri Nov 19 13:08:33 2010
napmpct     43  Fri Nov 19 13:08:33 2010
napopoz     43  Fri Nov 19 13:08:32 2010 Non-attainment population-ozone
(000s)
napoppm     43  Fri Nov 19 13:08:32 2010 Non-attainment population-PM2.5
(000s)
napoprfg    43  Fri Nov 19 13:08:32 2010 Non-attainment population-RFG
(000s)
narfgpct    43  Fri Nov 19 13:08:33 2010
statecde    43  Fri Nov 19 13:08:32 2010 State code
stpop00     43  Fri Nov 19 13:08:32 2010 State population in 2000 (000s)
stpop09     43  Fri Nov 19 13:08:32 2010 State population in 2009 (000s)
stpoppct    43  Fri Nov 19 13:08:33 2010
uspop00     43  Fri Nov 19 13:08:32 2010 Population for lower 48 states in
2000
uspop09     43  Fri Nov 19 13:08:32 2010 Population for lower 48 states in
2009

save file[catr]



# Mean of State Pop
calc mstpop = mean(stpop00)
```

```
calc mstpop
      6.50194e+003

# Mean of State Pop Pct
calc mstpoppc = mean(stpoppct+1)
calc mstpoppc
      1.02326

# Mean of NA Pct for PM2.5
calc mnapmpct = mean(napmpct+1)
calc mnapmpct
      1.06886

# Mean of NA Pct for Ozone
calc mnaozpct = mean(naozpct+1)
calc mnaozpct
      1.10423
```

**# 1 PREMATURE MORTALITY RATES INCREASE WITH STATE POPULATION SHARE FOR THE US, PERCENT OF THE STATE IN OZONE AND PM2.5 NON-ATTAINMENT AREAS**

```
reg dep[lmpmrate] ind[(1) lstpoppc lnaozpct lnapmpct] coef[b6]


********* ORDINARY LEAST SQUARES ESTIMATION *********

Dependent Variable:  lmpmrate
```

| Independent Variable | Estimated Coefficient | Standard Error | t-Statistic |
|---|---|---|---|
| (1) | 5.10216e-004 | 3.59014e-004 | 1.42116 |
| lstpoppc | 2.73610e-002 | 1.30446e-002 | 2.09749 |
| lnaozpct | 7.23465e-003 | 1.97807e-003 | 3.65743 |
| lnapmpct | 6.50525e-003 | 2.19940e-003 | 2.95773 |

| | |
|---|---|
| Number of Observations | 43 |
| R-squared | 0.65735 |
| Corrected R-squared | 0.63100 |
| Sum of Squared Residuals | 1.17366e-004 |
| Standard Error of the Regression | 1.73476e-003 |
| Durbin-Watson Statistic | 2.22002 |
| Mean of Dependent Variable | 2.09346e-003 |

```
# Predicted PM2.5 avoided mortality rate-0 Non-Attainment
calc pmpmrat1 = b6[1] + b6[2]*log(mstpoppc)
calc exp(pmpmrat1)
      1.00114

# Predicted PM2.5 avoided mortality rate-Avg Non-Attainment
calc pmpmrat2 = b6[1] + b6[2]*log(mstpoppc) + b6[3]*log(mnaozpct) +
b6[4]*log(mnapmpct)
calc exp(pmpmrat2)
      1.00229
```

**# 2 REPLACING PREMATURE MORTALITY RATES WITH ESTIMATED STATE CASES**

```
reg dep[lmortpm] ind[(1) lstpop00 lnaozpct lnapmpct] coef


********* ORDINARY LEAST SQUARES ESTIMATION *********

Dependent Variable:   lmortpm

Independent        Estimated              Standard               t-
 Variable         Coefficient              Error              Statistic

     (1)           -2.94905               3.29556             -0.89486
 lstpop00           0.83444               0.41217              2.02453
 lnaozpct           3.87105               2.63903              1.46685
 lnapmpct           3.54472               2.99032              1.18540


Number of Observations                   43
R-squared                                 0.35294
Corrected R-squared                       0.30316
Sum of Squared Residuals                  2.14885e+002
Standard Error of the Regression          2.34731
Durbin-Watson Statistic                   2.17921
Mean of Dependent Variable                4.45163


# Predicted PM2.5 avoided mortality-0 Non-Attainment
calc pmortpm1 = b6a[1] + b6a[2]*log(mstpop)
calc exp(pmortpm1)
     79.61788

# Predicted PM2.5 avoided mortality-Avg Non-Attainment
calc pmortpm2 = b6a[1] + b6a[2]*log(mstpop) + b6a[3]*log(mnaozpct) +
b6a[4]*log(mnapmpct)
calc exp(pmortpm2)
      1.47983e+002
```

**# 3 ADDING TESTS FOR THE SHARE OF EACH STATE IN RFG NON-ATTAINMENT AREAS WITH PM 2.5**

```
reg dep[lmpmrate] ind[(1) lstpoppc lnarfgpc lnapmpct]


********* ORDINARY LEAST SQUARES ESTIMATION *********

Dependent Variable:  lmpmrate

Independent        Estimated              Standard                  t-
 Variable         Coefficient              Error                Statistic

      (1)           4.28017e-004           3.86942e-004           1.10615
 lstpoppc           3.71891e-002           1.34264e-002           2.76985
 lnarfgpc           5.29772e-003           2.15273e-003           2.46094
 lnapmpct           7.63698e-003           2.32245e-003           3.28832


Number of Observations                   43
R-squared                                 0.60168
Corrected R-squared                       0.57104
Sum of Squared Residuals                  1.36435e-004
Standard Error of the Regression          1.87038e-003
Durbin-Watson Statistic                   2.18238
Mean of Dependent Variable                2.09346e-003
```

**# 4 TESTING FOR ALL 3 NON-ATTAINMENT AREAS**

```
reg dep[lmpmrate] ind[(1) lstpoppc lnaozpct lnarfgpc lnapmpct]


********* ORDINARY LEAST SQUARES ESTIMATION *********

Dependent Variable:  lmpmrate

Independent        Estimated             Standard              t-
 Variable         Coefficient             Error             Statistic

      (1)          5.60088e-004          3.61634e-004          1.54877
 lstpoppc          2.60935e-002          1.30821e-002          1.99459
 lnaozpct          1.08716e-002          3.97976e-003          2.73173
 lnarfgpc         -4.22875e-003          4.01709e-003         -1.05269
 lnapmpct          6.38566e-003          2.19930e-003          2.90350


Number of Observations                  43
R-squared                                0.66706
Corrected R-squared                      0.63202
Sum of Squared Residuals                 1.14040e-004
Standard Error of the Regression         1.73236e-003
Durbin-Watson Statistic                  2.17698
Mean of Dependent Variable               2.09346e-003


quit
```

APPENDIX B

| Table 5-17: Estimated Reduction in Incidence of Adverse Health Effects of the Proposed remedy (95% confidence intervals)[A] | | | |
|---|---|---|---|
| *Health Effect* | *Within transport region* | *Beyond transport region* | *Total* |
| PM-Related endpoints<br>Premature Mortality | | | |
| Pope et al. (2002) (age >30) | 14,000<br>(4,000-24,000) | 130<br>(35-220) | 14,000<br>(4,000-25,000) |
| Laden et al. (2006) (age >25) | 36,000<br>(17,000-55,000) | 320<br>(150-500) | 36,000<br>(17,000-56,000) |
| Infant (< 1 year) | 59<br>(-66-180) | 0.3<br>(-0.3-0.8) | 59<br>(-66-180) |
| Chronic Bronchitis | 9,200<br>(310-18,000) | 89<br>(3-160) | 9,200<br>(320-18,000) |
| Non-fatal heart attacks (age>18) | 22,000<br>(5,700-39,000) | 250<br>(64-440) | 23,000<br>(5,800-39,000) |
| Hospital admissions – respiratory (all ages) | 3,500<br>(1,400-5,500) | 35<br>(14-56) | 3,500<br>(1,400-5,500) |
| Hospital admissions – cardiovascular (age>18) | 7,500<br>(5,200-8,800) | 76<br>(51-93) | 7,500<br>(5,200-8,900) |
| Emergency room visits for asthma (age<18) | 14,000<br>(7,100-21,000) | 71<br>(36-110) | 14,000<br>(7,200-21,000) |
| Acute bronchitis (age 8-12) | 21,000<br>(-4,800-46,000) | 150<br>(33-320) | 21,000<br>(-4,800-46,000) |
| Lower respiratory symptoms (age 7-14) | 250,000<br>(98,000-400,000) | 1,700<br>(670-2,800) | 250,000<br>(98,000-400,000) |
| Upper respiratory symptoms (asthmatics age 9-18) | 190,000<br>(36,000-350,000) | 1,300<br>(250-2,400) | 190,000<br>(36,000-350,000) |
| Asthma exacerbation (asthmatics 6-18) | 230,000<br>(8,300-800,000) | 1,700<br>(11-5,700) | 230,000<br>(8,300-800,000) |
| Lost work days (age 18-65) | 1,800,000<br>(1,500,000-2,000,000) | 14,000<br>(12,000-17,000) | 1,800,000<br>(1,500,000-2,000,000) |
| Minor restricted activity days (ages 18-65) | 10,000,000<br>(8,600,000-12,000,000) | 86,000<br>(71,000-100,000) | 10,000,000<br>(8,600,000-12,000,000) |
| | | | |
| Ozone-related endpoint<br>Premature Mortality | | | |
| Multi-City and NMMAPS | | | |
| Bell et al. (2004) (all ages) | 50<br>(16-83) | 0.6<br>(0.2-1) | 50<br>(17-84) |
| Schwartz et al. (2005)(all ages) | 76<br>(23-130) | 1<br>(0.2-2) | 77<br>(24-130) |
| Huang et al. (2005) (all ages) | 83<br>(31-130) | 1<br>(0.3-2) | 84<br>(31-140) |
| Meta-analyses | | | |
| Ito et al. (2005)(all ages) | 220<br>(130-310) | 3<br>(2-4) | 230<br>(140-320) |
| Bell et al. (2005) (all ages) | 160<br>(76-250) | 2<br>(1-3) | 160<br>(77-250) |
| Levy et al. (2005) all ages | 230<br>(160-300) | 3<br>(2-4_ | 230<br>(160-300) |
| Hospital Admissions – respiratory causes (ages>65) | 380<br>(-18-730) | 4<br>(-0.4-9) | 390<br>(-18-740) |
| Hospital Admissions- Respiratory | 290 | 4 | 300 |

| | | | |
|---|---|---|---|
| Causes (ages<2) | (130-460) | (1-6) | (130-460) |
| Emergency room visits for asthma (all ages) | 230<br>(-30-730) | 2<br>(-0.4-8) | 230<br>(-30-730) |
| Minor restricted activity days (ages 18-65) | 300,000<br>(120,000-480,000) | 3,700<br>(1,300-6,100) | 300,000<br>(130,000-480,000) |
| School absence days | 110,000<br>(38,000-160,000) | 1,300<br>(380-2,100) | 110,000<br>(38,000-160,000) |
| Estimates rounded to two significant figures; column values will not sum to total value. | | | |
| [B] The negative estimates for certain endpoints are the result of the weak statistical power of the study used to calculate these health impacts and do not suggest that increases in air pollution exposure result in decreased health impacts. | | | |

| Table 5-18: Estimated Economic Value of Health and Welfare Benefits (95% confidence intervals, billions of 2006$)[A] | | | | |
|---|---|---|---|---|
| *Health Effect* | *Pollutant* | *Within transport region* | *Beyond transport region* | *Total* |
| Premature Mortality (Pope et al. 2002 PM mortality and Bell et al. 2004 ozone mortality estimates) | | | | |
| 3% discount rate | $PM_{2.5}$ and $O_3$ | \$110 (\$8.8-\$330) | \$0.1 (\$0.08-\$3) | \$110 (\$8.8-\$330) |
| 7% discount rate | $PM_{2.5}$ and $O_3$ | \$100 \$7.9-\$300) | \$0.09 \$0.07-\$2.7) | \$100 \$7.9-\$300) |
| Premature Mortality (Laden et al. 2006 PM mortality and Levy et al. 2005 ozone mortality estimates) | | | | |
| 3% discount rate | $PM_{2.5}$ and $O_3$ | \$280 (\$25-\$810) | \$2.5 ((\$0.02-\$7.3) | \$280 (\$25-\$810) |
| 7% discount rate | $PM_{2.5}$ and $O_3$ | \$250 (\$22-\$320) | \$2.3 (\$0.2-\$6.6) | \$250 (\$22-\$320) |
| Chronic Bronchitis | $PM_{2.5}$ | \$4.3 (\$0.02-\$20) | \$0.04 ((\$0.002-\$0.2) | \$4.3 (\$0.02-\$20) |
| Non-fatal heart attacks 3% discount rate | $PM_{2.5}$ | \$2.5 (\$0.04-\$6) | \$0.03 (\$0.005-\$0.07) | \$2.5 (\$0.04-\$6) |
| 7% discount rate | $PM_{2.5}$ | \$2.4 (\$0.4-\$5.9) | \$0.03 (\$0.005-\$0.07) | \$2.4 (\$0.4-\$5.9) |
| Hospital admissions – respiratory | $PM_{2.5}$ and $O_3$ | \$0.06 (\$0.03-\$0.1) | \$0.00006 (\$0.00003-\$0.001) | \$0.06 (\$0.03-\$0.1) |
| Hospital admissions – cardiovascular | $PM_{2.5}$ | \$0.2 (\$0.1-\$0.3) | \$0.002 (\$0.001-\$0.003) | \$0.2 (\$0.1-\$0.3) |
| Emergency room visits for asthma | $PM_{2.5}$ and $O_3$ | \$0.005 (\$0.002-\$0.008) | --- | \$0.005 (\$0.002-\$0.008) |
| Acute bronchitis | $PM_{2.5}$ | \$0.009 (-\$0.0004-\$0.03)[C] | --- | \$0.009 (-\$0.0004-\$0.03)[C] |
| Lower respiratory symptoms | $PM_{2.5}$ | \$0.005 (\$0.02-\$0.009) | --- | \$0.005 (\$0.02-\$0.009) |
| Upper respiratory symptoms | $PM_{2.5}$ | \$0.006 (\$0.001-\$0.014) | --- | \$0.006 (\$0.001-\$0.014) |
| Asthma exacerbations | $PM_{2.5}$ | \$0.012 (\$0.001-\$0.046) | --- | \$0.012 (\$0.001-\$0.046) |
| Lost work days | $PM_{2.5}$ | \$0.2 (\$0.19-\$0.24) | \$0.002 (\$0.0002-\$0.002) | \$0.2 (\$0.19-\$0.24) |
| School loss days | $O_3$ | \$0.01 (\$\$0.004-\$0.013) | --- | \$0.01 (\$\$0.004-\$0.013) |
| Minor restricted-activity days | $PM_{2.5}$ and $O_3$ | \$0.64 (\$0.34-\$0.97) | \$0.005 (\$0.003-\$0.008) | \$0.64 (\$0.34-\$0.97) |
| Recreational visibility, Class I areas | $PM_{2.5}$ | \$3.5 | \$0.03 | \$3.6 |
| Social cost of carbon (3% discount rate, 2014 value | $CO_2$ | | | \$0.35 |
| Monetized total Benefits (Pope et al. 2002 $PM_{2.5}$ mortality and Bell et al. ozone mortality estimates | | | | |
| 3% discount rate | $PM_{2.5}$ and $O_3$ | \$120 (\$10-\$360) | \$1.1 (\$0.09-\$3.3) | \$120 (\$10-\$360) |
| 7% discount rate | $PM_{2.5}$ and $O_3$ | \$110 (\$9-\$330) | \$0.9 (\$0.08-\$2.9) | \$110 (\$9-\$330) |
| Monetized total Benefits (Laden et al 2006 $PM_{2.5}$ mortality, and Levy et al. 2005 ozone mortality estimates) | | | | |
| 3% discount rate | $PM_{2.5}$ and $O_3$ | \$290 (\$26-\$840) | \$2.6 (\$0.2-\$7.5) | \$290 (\$26-\$840) |
| 7% discount rate | $PM_{2.5}$ and $O_3$ | \$260 | \$2.4 | \$260 |

| | | | | |
|---|---|---|---|---|
| | | ($23-$760) | ($0.2-$6.8) | ($23-$760) |
| [A] Estimates rounded to two significant figures. | | | | |
| [B] Monetary value of endpoints marked with dashes are <$100,000. States included in transport region may be found in Chapter 2. | | | | |
| [C] The negative estimates for certain endpoints are the result of the weak statistical power of the study used to calculated these health impacts and do not suggest that increases in air pollution exposure result in decreased health impacts. | | | | |
| | | | | |

# APPENDIX C

## The Potential Loss of Highway Funds

Potential Loss of Highway Funds

The specific sanctions leading to a loss in highway funding are found in Section 179 of the Clean Air Act (42 USC 7509), which requires EPA to impose automatic sanctions in nonattainment areas when:

4. EPA finds that a State has failed to submit a required state implementation plan (SIP) or revision

5. EPA disapproves a required SIP or revision

6. EPA finds that a requirement for an approved SIP is not being implemented

Sanctions may occur in steps. First, the EPA can impose an offset sanction that requires owners of new or expanded stationary sources of a pollutant for which an area is in nonattainment to "offset" their increased emissions by reducing emissions at existing facilities by at least the amount of the increase. Second, offset sanctions could require new or expanded stationary sources to reduce emissions by 2 tons for every 1 ton of emission growth. This would increase the cost or penalty for economic expansion in nonattainment regions.

Third, if the specific deficiency is not corrected within 6 months of the time EPA imposes an offset sanction, the EPA can impose highway sanctions. Once EPA imposes highway sanctions, the Federal Highway Administration may not approve or award any grants in the sanctioned area, except for those that are specifically exempted.

Table C-1 summarizes the projects that nonattainment status could cause a region to lose Federal Highway Administration funding.

**TABLE C-1**
**Projects Subject to Sanctions**

| | |
|---|---|
| 1 | The addition of general purpose through lanes to existing roads. |
| 2 | New highway facilities on new locations. |
| 3 | New interchanges on existing highways. |
| 4 | Improvements to or reconfiguration of existing interchanges. |
| 5 | Additions of new access points to the existing road network. |
| 6 | Increasing functional capacity of the facility. |
| 7 | Relocating existing highway facilities. |
| 8 | Repaving or resurfacing except for safety purposes,. |
| 9 | Project development activities, including NEPA documentation and preliminary engineering, right-of-way purchase, equipment purchase, and construction solely for non-exempt projects. |
| 10 | Transportation enhancement activities associated with the rehabilitation and operation of historic transportation buildings, structures, or facilities not categorically exempted. |

Source: U.S. Department of Transportation, Federal Highway Administration. Www.fhwa.dot.gov/environment/sanction.htm

APPENDIX D

RIMS II Multipliers
Total Multipliers for Output, Earnings, Employment, and Value Added by State
Industry: 2211A0 Electric power generation, transmission, and distribution (Type I)
Series: 2002 U.S. Benchmark I-O data and 2007 Regional Data

| # | State | Multiplier | | | | | |
|---|---|---|---|---|---|---|---|
| | | Final Demand | | | | Direct Effect | |
| | | Output [1] (dollars) | Earnings [2] (dollars) | Employment [3] (number of jobs) | Value-added [4] (dollars) | Earnings [5] (dollars) | Employment [6] (number of jobs) |
| 1 | Alabama | 1.3317 | 0.3214 | 4.7465 | 0.8573 | 1.4034 | 1.9376 |
| 2 | Alaska | 1.2855 | 0.31 | 4.5774 | 0.8329 | 1.3338 | 1.5469 |
| 3 | Arizona | 1.2299 | 0.3064 | 4.2465 | 0.8138 | 1.308 | 1.6919 |
| 4 | Arkansas | 1.2142 | 0.2862 | 4.5833 | 0.7921 | 1.2477 | 1.5588 |
| 5 | California | 1.2798 | 0.3214 | 3.9326 | 0.8382 | 1.3639 | 1.7858 |
| 6 | Colorado | 1.427 | 0.3549 | 4.8954 | 0.9168 | 1.5292 | 1.9411 |
| 7 | Connecticut | 1.1682 | 0.278 | 3.2054 | 0.7807 | 1.2308 | 1.5189 |
| 8 | Delaware | 1.1921 | 0.2359 | 3.1281 | 0.7896 | 1.2573 | 1.6091 |
| 9 | District of Columbia | 1.1333 | 0.0329 | 0.4584 | 0.7618 | 1.5336 | 2.284 |
| 10 | Florida | 1.1892 | 0.2986 | 4.3513 | 0.7941 | 1.2726 | 1.6182 |
| 11 | Georgia | 1.2254 | 0.2991 | 4.4435 | 0.8112 | 1.3071 | 1.6723 |
| 12 | Hawaii | 1.1503 | 0.2859 | 4.1749 | 0.7673 | 1.2119 | 1.4823 |
| 13 | Idaho | 1.1683 | 0.2848 | 4.0988 | 0.7753 | 1.2281 | 1.6354 |
| 14 | Illinois | 1.3556 | 0.3279 | 4.1408 | 0.8768 | 1.4575 | 1.9696 |
| 15 | Indiana | 1.2981 | 0.3067 | 4.6699 | 0.8363 | 1.3584 | 1.7567 |
| 16 | Iowa | 1.1668 | 0.2647 | 3.8449 | 0.7718 | 1.2067 | 1.5171 |
| 17 | Kansas | 1.2552 | 0.2882 | 4.2767 | 0.8139 | 1.2837 | 1.5912 |
| 18 | Kentucky | 1.3246 | 0.3026 | 4.9479 | 0.8506 | 1.3918 | 1.7753 |
| 19 | Louisiana | 1.3165 | 0.3168 | 4.7354 | 0.8492 | 1.3793 | 1.7396 |
| 20 | Maine | 1.1843 | 0.2902 | 4.7353 | 0.7857 | 1.2479 | 1.5886 |
| 21 | Maryland | 1.1943 | 0.2766 | 3.4171 | 0.7963 | 1.2753 | 1.6862 |
| 22 | Massachusetts | 1.2 | 0.2825 | 3.3582 | 0.8004 | 1.2864 | 1.6365 |
| 23 | Michigan | 1.201 | 0.2925 | 3.816 | 0.7945 | 1.2858 | 1.6921 |
| 24 | Minnesota | 1.2142 | 0.2933 | 3.967 | 0.8012 | 1.2903 | 1.6445 |
| 25 | Mississippi | 1.2578 | 0.2989 | 4.8045 | 0.8125 | 1.2955 | 1.6248 |

RIMS II Multipliers

Total Multipliers for Output, Earnings, Employment, and Value Added by State

Industry: 2211A0 Electric power generation, transmission, and distribution (Type I)

Series: 2002 U.S. Benchmark I-O data and 2007 Regional Data

| # | State | Multiplier | | | | | |
|---|---|---|---|---|---|---|---|
| | | Final Demand | | | | Direct Effect | |
| | | Output [1] (dollars) | Earnings [2] (dollars) | Employment [3] (number of jobs) | Value-added [4] (dollars) | Earnings [5] (dollars) | Employment [6] (number of jobs) |
| 26 | Missouri | 1.3179 | 0.2894 | 4.5762 | 0.8578 | 1.4019 | 1.7294 |
| 27 | Montana | 1.3511 | 0.3243 | 5.1532 | 0.8655 | 1.3713 | 1.8216 |
| 28 | Nebraska | 1.159 | 0.2628 | 3.295 | 0.7695 | 1.2217 | 1.6389 |
| 29 | Nevada | 1.1665 | 0.2737 | 3.628 | 0.7793 | 1.252 | 1.6198 |
| 30 | New Hampshire | 1.1527 | 0.2597 | 3.4583 | 0.7716 | 1.2236 | 1.5566 |
| 31 | New Jersey | 1.204 | 0.2792 | 3.3539 | 0.7988 | 1.2844 | 1.651 |
| 32 | New Mexico | 1.355 | 0.3284 | 5.3021 | 0.8672 | 1.4238 | 1.7933 |
| 33 | New York | 1.1779 | 0.2737 | 3.2102 | 0.789 | 1.2374 | 1.5151 |
| 34 | North Carolina | 1.1906 | 0.2833 | 4.0118 | 0.7909 | 1.2685 | 1.7497 |
| 35 | North Dakota | 1.3051 | 0.3055 | 4.6616 | 0.8384 | 1.3312 | 1.6282 |
| 36 | Ohio | 1.3164 | 0.3086 | 4.5076 | 0.8525 | 1.4 | 1.8771 |
| 37 | Oklahoma | 1.3272 | 0.3217 | 4.9551 | 0.8554 | 1.3885 | 1.8195 |
| 38 | Oregon | 1.1999 | 0.276 | 3.8717 | 0.7955 | 1.2853 | 1.7282 |
| 39 | Pennsylvania | 1.3726 | 0.3273 | 4.2341 | 0.8827 | 1.459 | 2.0197 |
| 40 | Rhode Island | 1.1621 | 0.24 | 3.4718 | 0.7758 | 1.2446 | 1.582 |
| 41 | South Carolina | 1.192 | 0.2613 | 4.3634 | 0.7905 | 1.285 | 1.6744 |
| 42 | South Dakota | 1.1414 | 0.2718 | 4.1998 | 0.7591 | 1.1716 | 1.4125 |
| 43 | Tennessee | 1.2348 | 0.2861 | 4.5559 | 0.81 | 1.3017 | 1.617 |
| 44 | Texas | 1.3921 | 0.3455 | 4.4661 | 0.8935 | 1.4788 | 2.0454 |
| 45 | Utah | 1.4076 | 0.3495 | 5.2795 | 0.9019 | 1.5028 | 2.1891 |
| 46 | Vermont | 1.1494 | 0.2377 | 3.2642 | 0.768 | 1.2485 | 1.7852 |
| 47 | Virginia | 1.317 | 0.3078 | 4.1217 | 0.858 | 1.403 | 1.9226 |
| 48 | Washington | 1.231 | 0.2912 | 3.8338 | 0.8089 | 1.3146 | 1.7106 |
| 49 | West Virginia | 1.3451 | 0.3005 | 4.9173 | 0.8587 | 1.3978 | 1.7847 |
| 50 | Wisconsin | 1.1833 | 0.2866 | 4.258 | 0.7839 | 1.2439 | 1.5739 |
| 51 | Wyoming | 1.3266 | 0.315 | 4.7048 | 0.851 | 1.366 | 1.6208 |

[1] Each entry represents the total dollar change in output that occurs in all industries within the state for each additional dollar of output delivered to final demand by the selected industry.

[2] Each entry represents the total dollar change in earnings in households employed by all industries within the state for each additional dollar of output delivered to final demand by the selected industry.

[3] Each entry represents the total change in number of jobs that occurs in all industries within the state for each additional million dollars of output delivered to final demand by the selected industry.

[4] Each entry represents the total dollar change in value added that occurs in all industries within the state for each additional dollar of output delivered to final demand by the selected industry.

[5] Each entry represents the total dollar change in earnings of households employed by all industries within the state for each additional dollar of earnings paid directly to households employed by the selected industry.

[6] Each entry represents the total change in number of jobs in all industries within the state for each additional job in the selected industry.

[7] Multipliers are based on the 2002 Benchmark Input-Output Table for the Nation and 2007 regional data.

Source: Regional Input-Output Modeling System (RIMS II), Regional Product Division, Bureau of Economic Analysis.

RIMS II Multipliers
Total Multipliers for Output, Earnings, Employment, and Value Added by State
Industry: 2211A0 Electric power generation, transmission, and distribution (Type II)
Series: 2002 U.S. Benchmark I-O data and 2007 Regional Data

| # | State | Multiplier | | | | | |
|---|---|---|---|---|---|---|---|
| | | Final Demand | | | | Direct Effect | |
| | | Output [1] (dollars) | Earnings [2] (dollars) | Employment [3] (number of jobs) | Value-added [4] (dollars) | Earnings [5] (dollars) | Employment [6] (number of jobs) |
| 1 | Alabama | 1.7248 | 0.4302 | 8.4879 | 1.0883 | 1.8787 | 3.465 |
| 2 | Alaska | 1.5877 | 0.3938 | 7.3197 | 1.0173 | 1.6942 | 2.4736 |
| 3 | Arizona | 1.6022 | 0.413 | 7.5399 | 1.0441 | 1.7631 | 3.0041 |
| 4 | Arkansas | 1.5139 | 0.3664 | 7.5266 | 0.967 | 1.5973 | 2.5598 |
| 5 | California | 1.742 | 0.4509 | 7.4005 | 1.1118 | 1.9136 | 3.3606 |
| 6 | Colorado | 1.9295 | 0.4977 | 9.0737 | 1.2187 | 2.1443 | 3.5979 |
| 7 | Connecticut | 1.4804 | 0.3627 | 5.433 | 0.971 | 1.6061 | 2.5743 |
| 8 | Delaware | 1.4578 | 0.2981 | 5.0286 | 0.9514 | 1.5885 | 2.5868 |
| 9 | District of Columbia | 1.1513 | 0.0342 | 0.4976 | 0.773 | 1.5924 | 2.4791 |
| 10 | Florida | 1.5665 | 0.4071 | 7.7788 | 1.0275 | 1.7351 | 2.8928 |
| 11 | Georgia | 1.6518 | 0.4173 | 8.0775 | 1.0672 | 1.8236 | 3.04 |
| 12 | Hawaii | 1.4811 | 0.3798 | 7.2559 | 0.9692 | 1.6099 | 2.5763 |
| 13 | Idaho | 1.4277 | 0.3555 | 6.7739 | 0.932 | 1.5332 | 2.7027 |
| 14 | Illinois | 1.8474 | 0.4635 | 7.8249 | 1.1671 | 2.0601 | 3.722 |
| 15 | Indiana | 1.6957 | 0.4134 | 8.3299 | 1.0652 | 1.8307 | 3.1334 |
| 16 | Iowa | 1.4255 | 0.3326 | 6.2801 | 0.9243 | 1.5163 | 2.478 |
| 17 | Kansas | 1.5485 | 0.3623 | 6.8674 | 0.9867 | 1.6136 | 2.5551 |
| 18 | Kentucky | 1.7153 | 0.4041 | 8.478 | 1.0753 | 1.8584 | 3.0419 |
| 19 | Louisiana | 1.6659 | 0.4161 | 8.1742 | 1.0582 | 1.8114 | 3.0029 |
| 20 | Maine | 1.5247 | 0.3878 | 8.211 | 0.9917 | 1.6675 | 2.7546 |
| 21 | Maryland | 1.5315 | 0.3672 | 6.0392 | 1.0033 | 1.6934 | 2.9801 |
| 22 | Massachusetts | 1.5542 | 0.3799 | 5.8907 | 1.0152 | 1.7301 | 2.8705 |
| 23 | Michigan | 1.5825 | 0.401 | 7.263 | 1.0207 | 1.7626 | 3.2206 |
| 24 | Minnesota | 1.6018 | 0.4004 | 7.2099 | 1.0287 | 1.7611 | 2.9888 |
| 25 | Mississippi | 1.5802 | 0.386 | 8.1078 | 1.0007 | 1.6734 | 2.7419 |

RIMS II Multipliers

Total Multipliers for Output, Earnings, Employment, and Value Added by State

Industry: 2211A0 Electric power generation, transmission, and distribution (Type II)

Series: 2002 U.S. Benchmark I-O data and 2007 Regional Data

| # | State | Multiplier | | | | | |
|---|---|---|---|---|---|---|---|
| | | Final Demand | | | | Direct Effect | |
| | | Output [1] (dollars) | Earnings [2] (dollars) | Employment [3] (number of jobs) | Value-added [4] (dollars) | Earnings [5] (dollars) | Employment [6] (number of jobs) |
| 26 | Missouri | 1.7233 | 0.3929 | 8.0134 | 1.095 | 1.9031 | 3.0284 |
| 27 | Montana | 1.6739 | 0.4156 | 8.7254 | 1.0613 | 1.7572 | 3.0844 |
| 28 | Nebraska | 1.3857 | 0.3229 | 5.4506 | 0.9052 | 1.5009 | 2.711 |
| 29 | Nevada | 1.4394 | 0.3493 | 6.0051 | 0.9491 | 1.598 | 2.6811 |
| 30 | New Hampshire | 1.4607 | 0.3425 | 5.932 | 0.961 | 1.614 | 2.67 |
| 31 | New Jersey | 1.593 | 0.3819 | 6.0778 | 1.0325 | 1.757 | 2.992 |
| 32 | New Mexico | 1.6986 | 0.4254 | 8.9084 | 1.075 | 1.8441 | 3.013 |
| 33 | New York | 1.4911 | 0.3533 | 5.2898 | 0.9799 | 1.597 | 2.4966 |
| 34 | North Carolina | 1.5592 | 0.3857 | 7.4384 | 1.0111 | 1.7269 | 3.2441 |
| 35 | North Dakota | 1.5839 | 0.3775 | 7.3644 | 1.0051 | 1.6453 | 2.5722 |
| 36 | Ohio | 1.7546 | 0.4288 | 8.3788 | 1.1068 | 1.945 | 3.4892 |
| 37 | Oklahoma | 1.7164 | 0.4314 | 8.9375 | 1.085 | 1.8618 | 3.2818 |
| 38 | Oregon | 1.5347 | 0.3671 | 6.8805 | 0.9966 | 1.7093 | 3.0713 |
| 39 | Pennsylvania | 1.8511 | 0.4568 | 8.0194 | 1.1631 | 2.036 | 3.8252 |
| 40 | Rhode Island | 1.4439 | 0.3129 | 5.7659 | 0.9487 | 1.6226 | 2.6274 |
| 41 | South Carolina | 1.5272 | 0.3533 | 7.6768 | 0.9914 | 1.7378 | 2.9458 |
| 42 | South Dakota | 1.3796 | 0.3358 | 6.5462 | 0.9024 | 1.4477 | 2.2017 |
| 43 | Tennessee | 1.6556 | 0.3991 | 7.9883 | 1.0584 | 1.8155 | 2.8352 |
| 44 | Texas | 1.9289 | 0.4952 | 8.8724 | 1.2099 | 2.1192 | 4.0634 |
| 45 | Utah | 1.8965 | 0.4864 | 10.1238 | 1.1923 | 2.0914 | 4.1978 |
| 46 | Vermont | 1.395 | 0.3042 | 5.6212 | 0.9172 | 1.5979 | 3.0743 |
| 47 | Virginia | 1.7102 | 0.4107 | 7.3237 | 1.0931 | 1.8721 | 3.4162 |
| 48 | Washington | 1.607 | 0.3952 | 6.9348 | 1.0344 | 1.7841 | 3.0944 |
| 49 | West Virginia | 1.6521 | 0.3808 | 8.0348 | 1.0438 | 1.7713 | 2.9162 |
| 50 | Wisconsin | 1.5336 | 0.3842 | 7.5898 | 0.9881 | 1.6675 | 2.8054 |
| 51 | Wyoming | 1.5522 | 0.3754 | 6.9516 | 0.9897 | 1.628 | 2.3948 |

[1] Each entry represents the total dollar change in output that occurs in all industries within the state for each additional dollar of output delivered to final demand by the selected industry.

[2] Each entry represents the total dollar change in earnings in households employed by all industries within the state for each additional dollar of output delivered to final demand by the selected industry.

[3] Each entry represents the total change in number of jobs that occurs in all industries within the state for each additional million dollars of output delivered to final demand by the selected industry.

[4] Each entry represents the total dollar change in value added that occurs in all industries within the state for each additional dollar of output delivered to final demand by the selected industry.

[5] Each entry represents the total dollar change in earnings of households employed by all industries within the state for each additional dollar of earnings paid directly to households employed by the selected industry.

[6] Each entry represents the total change in number of jobs in all industries within the state for each additional job in the selected industry.

[7] Multipliers are based on the 2002 Benchmark Input-Output Table for the Nation and 2007 regional data.

Source: Regional Input-Output Modeling System (RIMS II), Regional Product Division, Bureau of Economic Analysis.

# APPENDIX E*

** This Appendix was not included in December 2010 version of the report.*

## State Allocation of Economic Losses W/O Transport Rule for Nonattainment Areas
## (Individual States)

| # | State Name | Lost Income in Nonattainment Areas | Lost Tax Revenue in Nonattainment Areas | Higher Gas Prices in Nonattainment Areas | Annual Lost Jobs in Nonattainment Areas | Avoided Annual Premature Mortalities Related to PM2.5 and Ozone |
|---|---|---|---|---|---|---|
| 1 | Alabama | $ 29,399,954 | $ 5,813,341 | $ - | 225 | 652 |
| 2 | Connecticut | $ 56,204,151 | $ 11,113,415 | $ 119,863,867 | 430 | 306 |
| 3 | Delaware | $ 47,054,963 | $ 9,304,319 | $ 17,202,822 | 360 | 112 |
| 4 | Dist of Columbia | $ 10,720,978 | $ 2,119,891 | $ 18,463,944 | 82 | 68 |
| 5 | Georgia | $ 153,932,171 | $ 30,437,470 | $ 264,663,726 | 1,177 | 988 |
| 6 | Illinois | $ 212,896,404 | $ 42,096,644 | $ 341,777,212 | 1,628 | 1,269 |
| 7 | Indiana | $ 105,919,004 | $ 20,943,682 | $ 170,039,048 | 810 | 1,125 |
| 8 | Louisiana | $ 23,160,456 | $ 4,579,586 | $ 40,006,317 | 177 | 377 |
| 9 | Maryland | $ 101,898,220 | $ 20,148,640 | $ 175,491,725 | 779 | 897 |
| 10 | Michigan | $ 179,802,945 | $ 35,552,975 | $ - | 1,375 | 1,056 |
| 11 | New Jersey | $ 489,232,489 | $ 96,737,407 | $ 364,790,015 | 3,741 | 977 |
| 12 | New York | $ 1,097,909,996 | $ 217,093,034 | $ 818,642,697 | 8,396 | 1,680 |
| 13 | North Carolina | $ 36,166,870 | $ 7,151,384 | $ - | 277 | 1,264 |
| 14 | Ohio | $ 118,759,850 | $ 23,482,741 | $ - | 908 | 2,309 |
| 15 | Pennsylvania | $ 670,096,156 | $ 132,500,122 | $ 244,980,417 | 5,124 | 2,510 |
| 16 | South Carolina | $ 17,585,320 | $ 3,477,198 | $ - | 134 | 594 |
| 17 | Tennessee | $ 47,789,286 | $ 9,449,519 | $ - | 365 | 1,260 |
| 18 | Texas | $ 367,147,725 | $ 72,597,220 | $ 324,059,780 | 2,808 | 924 |
| 19 | Virginia | $ 140,929,027 | $ 27,866,319 | $ 242,711,580 | 1,078 | 1,253 |
| 20 | West Virginia | $ 9,161,393 | $ 1,811,510 | $ - | 70 | 503 |
| 21 | Wisconsin | $ 54,232,643 | $ 10,723,583 | $ 107,306,851 | 415 | 341 |
| | **Total** | **$ 3,970,000,000** | **$ 785,000,000** | **$ 3,250,000,000** | **30,359** | **20,463** |

Notes:

(1) Total state nonattainment population was determined by taking the average nonattainment population for ozone and PM2.5.

(2) Nonattainment population was reported by Metropolitan Statistical Area. Economic losses for states with multi-state MSAs were allocated by total state population.

**State Allocation of Economic Losses W/O Transport Rule for Attainment and Nonattainment Areas**
**(Individual States)**

| # | State Name | Lost Income in Attainment and Nonattainment Areas | Lost Tax Revenue in Attainment and Nonattainment Areas | Higher Gas Prices in Attainment and Nonattainment Areas | Annual Lost Jobs in Attainment and Nonattainment Areas | Avoided Annual Premature Mortalities Related to PM2.5 and Ozone |
|---|---|---|---|---|---|---|
| 1 | Alabama | $ 100,975,447 | $ 19,724,680 | $ - | 763 | 652 |
| 2 | Connecticut | $ 101,866,008 | $ 19,988,207 | $ 119,863,867 | 773 | 306 |
| 3 | Delaware | $ 51,025,804 | $ 10,076,087 | $ 17,202,822 | 390 | 112 |
| 4 | Dist of Columbia | $ 18,242,898 | $ 3,581,844 | $ 18,463,944 | 138 | 68 |
| 5 | Georgia | $ 282,205,109 | $ 55,368,466 | $ 264,663,726 | 2,141 | 988 |
| 6 | Illinois | $ 378,933,615 | $ 74,367,466 | $ 341,777,212 | 2,876 | 1,269 |
| 7 | Indiana | $ 188,524,889 | $ 36,998,877 | $ 170,039,048 | 1,431 | 1,125 |
| 8 | Louisiana | $ 92,558,991 | $ 18,067,814 | $ 40,006,317 | 699 | 377 |
| 9 | Maryland | $ 173,390,783 | $ 34,043,862 | $ 175,491,725 | 1,316 | 897 |
| 10 | Michigan | $ 304,504,226 | $ 59,789,788 | $ - | 2,312 | 1,056 |
| 11 | New Jersey | $ 522,288,817 | $ 103,162,201 | $ 364,790,015 | 3,990 | 977 |
| 12 | New York | $ 1,172,093,281 | $ 231,511,222 | $ 818,642,697 | 8,953 | 1,680 |
| 13 | North Carolina | $ 183,879,023 | $ 35,860,566 | $ - | 1,386 | 1,264 |
| 14 | Ohio | $ 283,553,298 | $ 55,511,827 | $ - | 2,146 | 2,309 |
| 15 | Pennsylvania | $ 726,643,748 | $ 143,490,654 | $ 244,980,417 | 5,549 | 2,510 |
| 16 | South Carolina | $ 89,407,003 | $ 17,436,387 | $ - | 674 | 594 |
| 17 | Tennessee | $ 141,560,670 | $ 27,674,829 | $ - | 1,070 | 1,260 |
| 18 | Texas | $ 695,347,663 | $ 136,385,823 | $ 324,059,780 | 5,273 | 924 |
| 19 | Virginia | $ 239,805,900 | $ 47,083,926 | $ 242,711,580 | 1,821 | 1,253 |
| 20 | West Virginia | $ 37,325,802 | $ 7,285,515 | $ - | 282 | 503 |
| 21 | Wisconsin | $ 135,867,025 | $ 26,589,958 | $ 107,306,851 | 1,028 | 341 |
| | **Total** | **$ 5,920,000,000** | **$ 1,164,000,000** | **$ 3,250,000,000** | **45,010** | **20,463** |

Notes:

(1) Total state nonattainment population was determined by taking the average nonattainment population for ozone and PM2.5.

(2) Nonattainment population was reported by Metropolitan Statistical Area. Economic losses for states with multi-state MSAs were allocated by total state population.