# Public Health Benefits of Reducing Ground-level Ozone and Fine Particle Matter in the Northeast U.S.

## A Benefits Mapping and Analysis Program (BenMAP) Study

**Prepared by**
**NESCAUM**
**For**
**The Ozone Transport Commission and**
**The Mid-Atlantic/Northeast Visibility Union**

**January 15, 2008**

## Members of Northeast States for Coordinated Air Use Management

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## A BENMAP STUDY


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# Executive Summary

In this report, the Northeast States for Coordinated Air Use Management (NESCAUM) examines the public health and monetary benefits of several potential emission control programs under consideration by the Ozone Transport Commission (OTC) and Mid-Atlantic/Northeast Visibility Union (MANE-VU) states. These programs include an electric generating unit (EGU) control strategy for nitrogen oxides ($NO_X$) and sulfur dioxide ($SO_2$) that increases the stringency of the current Clean Air Interstate Rule (CAIR) and $SO_2$ emissions control strategies that would complement existing regulations to further reduce fine particle concentrations and improve visibility under the Regional Haze Rule. In addition, we performed an examination of the benefits of achieving several different levels of the National Ambient Air Quality Standard (NAAQS) for 8-hour average ozone concentrations (NAAQS rollback).

We have used the U.S. Environmental Protection Agency's (EPA's) Environmental Benefits Modeling and Analysis Program (BenMAP) (Abt Associates, 2007) to determine the magnitude and value of avoided adverse health endpoints in the northeast U.S. associated with the various emission control programs in 2018. Future year air quality associated with implementation of various control strategies have been simulated using two air quality modeling platforms, the Community Multi-scale Air Quality modeling system (CMAQ) and the California Photochemical Grid Model (CALGRID).

We estimated future air quality associated with a more stringent CAIR rule (CAIR+) using CALGRID. Based on our benefits analysis for 2018, we found that $PM_{2.5}$ reductions throughout the year due to CAIR+ could result in 230 avoided premature deaths in the OTC states. Combined with reduced incidences of various morbidity endpoints, we estimated a total $PM_{2.5}$ related benefit of 1.5 billion dollars annually in the OTR. Using the same modeling platform, we estimated that CAIR+ reductions in ozone during the May 1$^{st}$-September 30$^{th}$ ozone season could lead to 24 to 76 avoided premature deaths (range of five ozone mortality risk estimates). When added to other projected benefits due to reduced incidences of morbidity, we estimated a total ozone related benefit of 170 to 500 million dollars. Overall, we estimate the CAIR+ program to result in health benefits of 1.7 to 2.0 billion dollars in 2018 due to reduced adverse health endpoints from exposures to $PM_{2.5}$ and ozone in the OTR. In states outside the OTR, we estimated a benefit of 560 million to 1.4 billion dollars due to ozone reductions and 4.4 billion dollars due to $PM_{2.5}$ reductions- a total benefit of 5.5 to 5.8 billion dollars. Across the entire modeled domain (Eastern US) we estimated a total benefit to the program of 6.7 to 7.8 billion dollars.

We examined four potential control strategies aimed at reducing visibility impairment, or regional haze, at Class I areas in the MANE-VU region. The programs under consideration include limitations on the fuel sulfur content of distillate (500 ppm fuel sulfur content for the S1 strategy and 15 ppm fuel sulfur content for the S2 strategy) and residual oil sold in the region, the Best Available Retrofit Technology (BART) provisions of the Regional Haze Rule, and controls on 167 stacks at EGUs ("167 EGU strategy") that have the most significant impacts on MANE-VU Class I areas. Of the four programs, the 167 EGU stack control program leads to the greatest benefit in the region, resulting in 6.5 billion dollars of health benefit. The first phase of a sulfur-in-fuels limitation (S1) leads to health benefits of almost 3.4 billion dollars in MANE-VU. Controlling the fuel-sulfur content to 15 ppm (S2) could lead to an additional 431 million dollars in benefits, bringing the total benefits to 3.7 billion dollars. The BART estimate is based on controls at 14 units likely to be controlled under BART alone and with no other program that would satisfy the BART requirement. CMAQ and BenMAP modeling suggest that controls at these units could lead to 1.4 billion dollars of benefits in MANE-VU.

Looking across all regional haze programs, we estimate a four program total of 11.7 billion dollars in health benefits to MANE-VU in 2018. This benefit estimate is based on a 15 ppm fuel sulfur control, BART controls on 14 units in MANE-VU, and stack controls at 167 EGUs in the East, Southeast, and the Midwest. Additionally, 4.9 billion dollars of health benefits are estimated for the states within The Visibility Improvement State and Tribal Association of the Southeast (VISTAS) and The Midwest Regional Planning Organization (MWRPO) in 2018 due to implementation of these haze control strategies.

In the third step of this analysis, we estimated the benefits of attaining three alternative 8-hour ozone health standards – 0.060 ppm, 0.070 ppm, and 0.075 ppm ($4^{th}$ highest daily 8-hour max) – in the Ozone Transport Region (OTR) using BenMAP. We started with a baseline that included all “Beyond on the Way” (BOTW) measures and CAIR+, then used BenMAP to roll back all monitors in the domain to each of the three alternative ozone standards. We calculated benefits based on the difference between the baseline grid and the rolled back grid.

The analysis showed that there are significant monetized health benefits in going beyond a revised ozone national ambient air quality standard (NAAQS) of 0.075 ppm, which is the upper end of EPA’s range for its proposed ozone NAAQS revision (0.070 ppm – 0.075 ppm). Rolling back to a NAAQS of 0.075 ppm after CAIR+ gave an estimate of 27 to 142 avoided premature deaths over the 2018 ozone season in the OTR. When added to the benefits from avoided morbidity endpoints, we estimated monetary benefits of 192 to 918 million dollars over the 2018 ozone season. By contrast, adopting an ozone NAAQS of 0.070 ppm (i.e., the upper limit of the range recommended by the Clean Air Scientific Advisory Committee (CASAC)) increases the mortality benefits with an estimated 43 to 220 avoided premature deaths in the OTR over the 2018 ozone season. When added to the benefits from avoided morbidity endpoints, we estimate an additional monetary benefit of 107 to 498 million dollars beyond a 0.075 ppm standard (total benefit of 300 million to 1.4 billion dollars after CAIR+). Finally, adopting an ozone NAAQS at the lower end of the CASAC recommended range, 0.060 ppm, results in an increased estimate of 84 to 407 avoided premature deaths in the OTR over the 2018 ozone season. Compared to the 0.075 ppm scenario, the modeling indicates that a NAAQS set at 0.060 ppm could net almost twice the monetary benefits by providing 394 million dollars to 1.7 billion dollars beyond a 75 ppb standard (total benefit of 530 million to 2.6 billion dollars after CAIR+)

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# 1. INTRODUCTION

In order to fully understand the benefits of emission control programs, we must understand how reductions in direct emissions of air pollutants and their precursor species translate into improvements in ambient air quality. This has traditionally been achieved through the development of emissions inventories and their application to chemical transport models that simulate air quality under different inventory assumptions. Our growing understanding of the public health effects of air quality has allowed the development of a new suite of tools for assessing the next link in this chain – the subsequent effect of ambient air quality on public health.

Assessment tools are now available that take simulated or monitored ambient air quality as an input and link them to changes in health outcomes. Based on assumed or modeled changes in pollution levels, the tool tabulates the most likely public health response and quantifies the economic value of the associated health costs. This enables the analyst to more fully account for the benefits of potential emission control strategies. In this report, we demonstrate that ability by examining the public health and monetary benefits of several potential emission control programs under consideration by the Ozone Transport Commission (OTC) and Mid-Atlantic/Northeast Visibility Union (MANE-VU) States. We have conducted this analysis in the event that the states find the information useful in establishing reasonable progress goals or considering future control programs related to achieving an ozone or fine particulate NAAQS. The control programs considered include:

- An EGU control strategy for nitrogen oxides ($NO_X$) and sulfur dioxide ($SO_2$) that increases the stringency of the current Clean Air Interstate Rule (CAIR),
- Additional $SO_2$ emissions control strategies that would complement existing regulations to further reduce fine particle concentrations and improve visibility under the regional haze rule, and
- A theoretical examination of the benefits of achieving several different levels of the National Ambient Air Quality Standard (NAAQS) for 8-hour average ozone concentrations (NAAQS rollback).

We have used EPA's Environmental Benefits Modeling and Analysis Program (BenMAP) (Abt Associates, 2007) to determine the magnitude and value of avoided adverse health endpoints in the northeast U.S. associated with air quality improvement in 2018. Future year air quality associated with implementation of various control strategies have been simulated using two air quality modeling platforms, the Community Multi-scale Air Quality modeling system (CMAQ) and the California Photochemical Grid Model (CALGRID).

In the first step of this analysis, we used CALGRID modeled ozone and $PM_{2.5}$ concentrations in the Ozone Transport Region (OTR) in 2018 to examine the potential health benefits of an increase in the stringency of the current Clean Air Interstate Rule (CAIR). Multi-state discussions within the OTR and with neighboring states outside the

OTR have included the potential of states acting alone or in partnership with EPA to increase the stringency of the CAIR program, termed CAIR+. The specific analysis here represents a CAIR+ proposal as a potential compromise among a large number of northeastern and Midwestern states. This proposal had been modeled in ICF International, Inc.'s Integrated Planning Model (IPM) and subsequently simulated by the New Hampshire Department of Environmental Services with the CALGRID modeling platform. We present these results as representative of the magnitude of health benefits associated with this type of program rather than the specific benefits that would accrue under whatever additional EGU control program may eventually result from such discussions in the future.

A second analysis examined potential benefits of modeled sulfate reductions in 2018 due to implementation of four potential control strategies aimed at reducing visibility impairment, or regional haze, at Class I areas in the MANE-VU region (NESCAUM, 2007a). The programs under consideration include limitations on the fuel sulfur content of distillate and residual oil sold in the region (S1 strategy-500 ppm fuel sulfur content for No. 2 distillate, 0.25 percent sulfur for No. 4 oil, and 0.5 percent sulfur for No. 6 oil; S2 strategy-15 ppm fuel sulfur content for No. 2 distillate, 0.25 percent sulfur for No. 4 oil, and 0.5 percent for sulfur No. 6 oil), the BART provisions of the Regional Haze Rule, and controls on 167 stacks at EGUs ("167 EGU strategy") that have the most significant impacts on MANE-VU Class I areas.

Finally, we applied a "rollback" approach to determine the health benefits that can be accrued if various levels of the 8-hr average NAAQS for ozone were met in 2018. We estimated the benefits of attaining three alternative 8-hour ozone health standards – 0.060 ppm, 0.070 ppm, and 0.075 ppm ($4^{th}$ highest daily 8-hour max) – in the OTR using BenMAP. We started with a baseline that included all "Beyond on the Way" (BOTW) measures and CAIR+, then used BenMAP to roll back all monitors in the domain to each of the three alternative ozone standards.

Chapter 2 provides a detailed description of the BenMAP framework and how we used it to estimate health benefits for the northeast U.S. This includes descriptions of the various health studies and detailed descriptions of the modeling procedure and statistical methods for the three strategies. Chapters 3 through 5 discuss each of the potential control strategies and present results of the corresponding health benefits analyses.

# 2. METHODS

## 2.1. Benefits Analysis Overview

The U.S. EPA along with Abt Associates Inc. have developed BenMAP, a Windows-based program, as a tool for estimating the health impacts and associated economic values resulting from changes in ambient air pollution. This is accomplished by applying health impact functions that relate a change in pollutant concentration with a change in the incidence of a health endpoint. The program allows users to estimate the health and economic benefits of an air quality program while adequately describing the uncertainty and variability in the estimate (Davidson *et al.*, 2007).

Ambient air quality grids (gridded data files that include air pollution information used in BenMAP) are created from monitored air quality data, modeled air quality data, or a combination of the two. Potentially exposed populations can be modeled for incidence rates at any year after 1990, using 1990 and 2000 census data along with county-level projections out to 2025. Populations can be further broken down by geographical area, race, gender, and age.

BenMAP uses a "damage-function" approach to estimate the benefits associated with improvements air quality. This method assigns values to changes in individual health endpoints (specific effects that can be associated with changes in air quality). Total benefits are then calculated as the sum of the values of all non-overlapping health endpoints.[1] This introduces no overall preference structure and does not account for potential income or substitution effects, so that adding a new endpoint will not affect the value of changes in other endpoints. (Davidson *et al.*, 2007; EPA, 2005; Levy *et al.*, 2001; Hubbell *et al.*, 2005). Figure 2-1 shows the major steps taken in the damage function approach used by BenMAP to develop benefit estimates.

BenMAP estimates pollutant exposures using air quality monitoring or modeling data, or a combination thereof. The user can create air quality grids to estimate average exposure to particulate matter and ozone for people living in a specified domain using outputs from various air quality models. Alternatively, the user can input monitoring data and estimate a population's exposure based on proximity to pollutant monitors or use the monitoring data available in the BenMAP package. Combining the two approaches, BenMAP can scale the monitoring data spatially and/or temporally using modeled data.

Included in the BenMAP package are databases of concentration-response functions and economic valuations of health impacts. BenMAP users first choose the health endpoints they wish to model and then choose from a list of epidemiological studies reporting incidence rates for each chosen health endpoint. The user can pool different incidence rates from multiple studies using a variety of statistical methods. Similarly, valuation functions are available for different health endpoints, allowing the user to choose valuation studies and pool across multiple studies.

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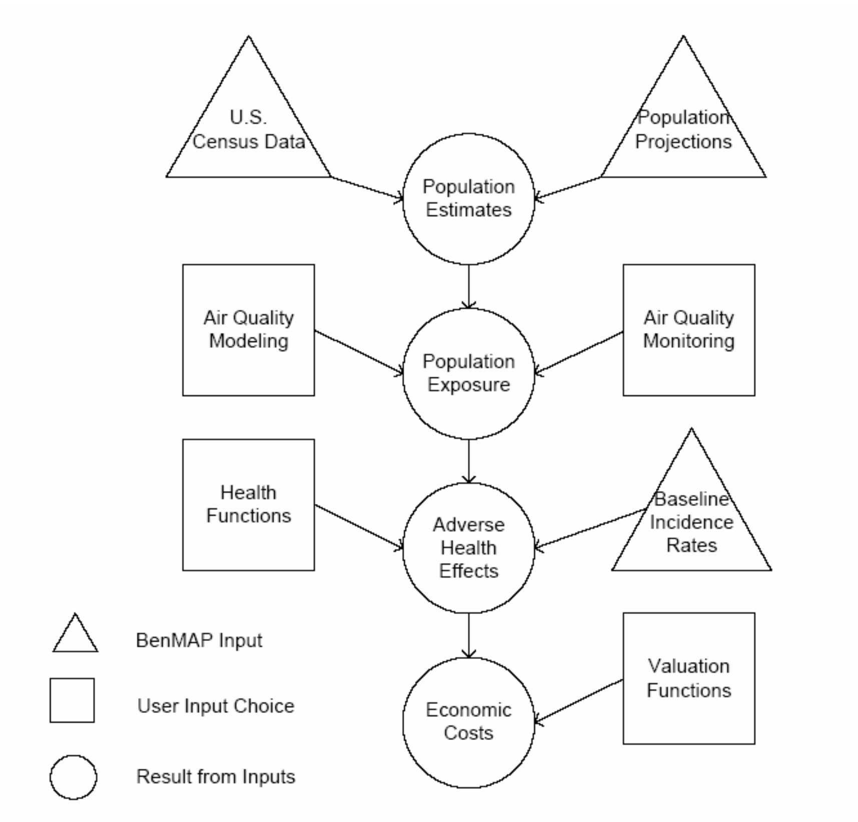
[1] Overlapping endpoints are effect estimates that may describe the same effect. For example, one study may describe the relationship between ozone exposure and pneumonia while another describes the relationship between ozone exposure and any adverse respiratory endpoint, which would include pneumonia.

We used U.S. census data and population projections for the baseline and control population databases. These databases, included in the BenMAP package, contain demographic and population distribution information. In the second step, we used air quality modeling data developed using the CMAQ and CALGRID models, formatted to BenMAP specifications. We supplied the air quality grids for the baseline scenario and control scenario and BenMAP calculated the grid-cell-specific change in air quality. In the third step, we chose the health endpoints of interest as well as the published studies describing the risk estimate. We based our choices of studies from EPA (2005) and Davidson *et al.* (2007). Finally, we chose valuation functions for each health endpoint to determine the economic benefit of each control scenario.

**Figure 2-1. BenMAP analysis approach (taken from BenMAP User's Manual, Abt Associates, 2003)**

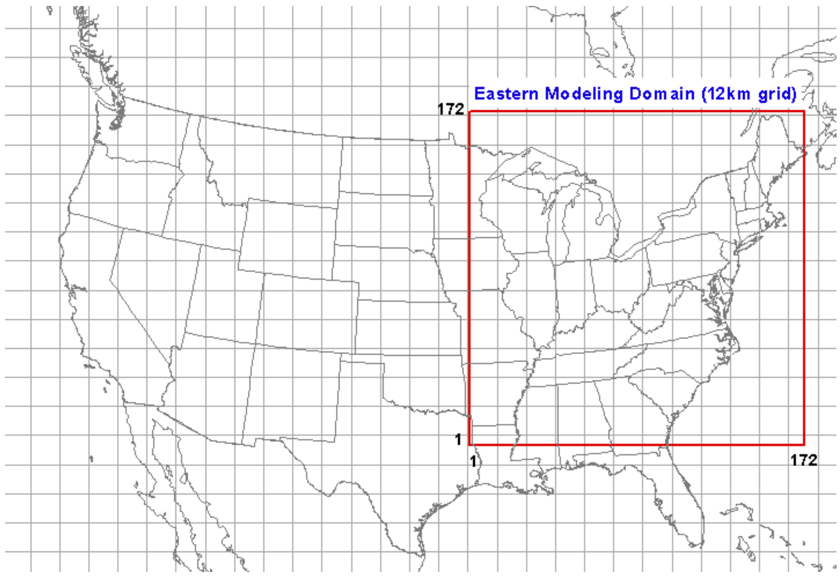



## 2.2. Estimates of Air Pollution Exposure

BenMAP offers several ways to estimate exposures using a combination of air quality modeling and/or monitoring data. For this benefits analysis, we have used two regional-scale air quality models, CMAQ and CALGRID, to simulate ozone and $PM_{2.5}$ concentrations in future years. Both platforms model air quality within a 12-km domain that covers the northeastern, central and southeastern US as well as southeastern Canada. The domain extends from $66^oW \sim 94^oW$ in longitude and $29^oN \sim 50^oN$ in latitude with

172X172 grid cells. Figure 2-2 displays the modeling domain used in the CMAQ and CALGRID platforms.

**Figure 2-2. Modeling domain used for CMAQ and CALGRID modeling studies. Gridlines are shown at 180 km intervals (15 x 15 12km cells).**




## 2.2.1. CALGRID Modeling for $O_3$ and $PM_{2.5}$

The CALGRID model is an Eulerian photochemical transport and dispersion model. It includes modules for horizontal and vertical advection and diffusion, dry deposition, and chemical mechanisms. The New Hampshire Department of Environmental Services performed all CALGRID modeling and provided the results to NESCAUM.

CALGRID modeling was performed to assess the benefits of one potential Clean Air Interstate Rule Plus (CAIR+) program option. To determine the benefits of this option, the concentration change between two future-year modeled scenarios was assessed. The chosen reference scenario represents a 2018 projection of emissions and air quality, which corresponds to compliance with all current Clean Air Act regulations, as well as state and federal measures that are seen by states as being necessary to achieve compliance with the current 8-hour ozone NAAQS. With the inclusion of state measures that have been or will be adopted by OTC states for their 2007 ozone state implementation plans (SIPs), this scenario goes *beyond* previous requirements and is referred to as “Beyond on the Way” (BOTW). While states and EPA are currently determining whether these measures will be enough to achieve the ozone NAAQS by the 2010 attainment date, there is little question that these programs will be fully implemented by 2018, the analysis year for this study. The MANE-VU Regional Planning Organization (RPO) inventory development and modeling work provide more detailed information on the BOTW scenario (MARAMA, 2007a; NESCAUM, 2007a).

The control scenario compared against this reference scenario is a CAIR+ scenario. A separate report documents the basis of this scenario and the associated assumptions used in its creation (MARAMA, 2007b).

For analysis of CAIR+ reductions in ozone, we supplied BenMAP with hourly data files for the summertime ozone season, May 1st-September 30th in 2018 and 2002. The application used these hourly data files to generate a variety of air quality metrics including, 8-hour average, 8-hour maximum, 24-hour average, 5-hour average, and maximum 1-hour average. For analysis of $PM_{2.5}$, we used 24-hour average data available from CALGRID modeling for the entire year of 2018 and 2002.

We developed future year air quality grids for ozone in BenMAP using the "monitor and model relative" option. In this option, we began with 2002 EPA Air Quality System (AQS) monitoring data. These data were interpolated to the 172x172 12km modeling grid definition using the Voronoi Neighbor Averaging (VNA) algorithm. A detailed description of the VNA algorithm can be found in Appendix C of Abt, 2005.

The monitor values were scaled using the modeled air quality data. This was done in two steps, spatial scaling and temporal scaling. In the spatial scaling step, BenMAP used 2002 CALGRID modeling data with 2002 EPA AQS interpolated monitoring data. BenMAP spatially scaled by adjusting the modeled concentration of each grid cell without a monitor by multiplying the monitored concentration from the nearest monitor by the ratio of the modeled concentration at the grid cell without the monitor to the modeled concentration at the grid cell containing the monitor. In the temporal scaling step, the concentrations of the monitors were scaled by the ratio of the 2002 modeled concentration to the 2018 modeled concentration for the grid cell in which the monitor is located to develop future year estimates of air quality.

The scaling approach is meant to take advantage of real world measured $PM_{2.5}$ and ozone concentrations. The spatial scaling step is meant to improve the interpolation of monitor data to grid cells without monitors by including modeled information on spatial characteristics. The temporal scaling step is useful for using monitored data in combination with model predicted changes in air quality to develop future year air quality estimates (Davidson *et al*., 2007).

The interpolation and scaling steps result in two sets of 172 x 172 12km grid cell air quality grids for CAIR+ and BOTW, one set for ozone and one set for $PM_{2.5}$. We assessed the benefits of the CAIR+ program by looking at the difference between the CAIR+ grid and the BOTW grid for each pollutant individually. Concentration differences within each grid cell were applied to concentration-response functions to determine the change in adverse health endpoints within each grid cell.

We present the results of the health benefits analysis for this CAIR+ simulation in Chapter 3. In addition to analysis of CAIR+, we used the same CALGRID modeling data to assess the benefits of attainment of various proposed NAAQS for ozone. We describe this methodology in Chapter 5.

### 2.2.2. CMAQ Modeling for $PM_{2.5}$ for Regional Haze Control Programs

The Community Multi-scale Air Quality (CMAQ) modeling system is a three-dimensional Eulerian chemical transport model that incorporates output fields from emissions and meteorological modeling systems and several other data sources through special interface processors. CMAQ is designed to provide an air quality modeling system with a "one atmosphere" capability containing state-of-science parameterizations of atmospheric processes affecting transport, transformation, and deposition of such pollutants as ozone, particulate matter, airborne toxics, and acidic and nutrient pollutant species (Byun and Ching, 1999).

We have used the results from CMAQ sulfate modeling of 2018 to develop air quality grids for a baseline and multiple control scenarios. The baseline scenario for the work described here represents an "On the Books/On the Way" (OTB/OTW) emissions inventory. This is a projection that requires implementation of existing regulations in the face of "business as usual" projected growth and technology change. We have also developed multiple control scenarios to examine the benefits of regulation beyond OTB/OTW including a dual-phase fuel sulfur-content control strategy (S1 and S2), BART, and controls on 167 stacks at EGUs (167 EGU strategy). Chapter 4 of this document describes each of these control scenarios in further detail.

CMAQ provided hourly sulfate concentration fields for the baseline scenario and the various control scenarios. To input this result into BenMAP, we used the sulfate concentrations to calculate the total $PM_{2.5}$ concentrations using the IMPROVE algorithm:

**Equation 2-1.**

$$\text{Total } PM_{2.5} = (SO4*1.375)+(NO3*1.29)+OC+EC+FineSoil$$

By applying Equation 2-1 to the sulfate concentrations predicted by CMAQ, we calculated hourly $PM_{2.5}$ concentrations for each grid cell for the baseline scenario and each of the four control scenarios. For BenMAP compatibility, we then used the hourly files to generate 24-hr average concentrations for each modeled day.

The 24-hour $PM_{2.5}$ CMAQ predicted modeling results from 2018 were input into BenMAP's "model direct" format. Using this format, BenMAP imports the baseline and each control grid to create air quality grids that reflect $PM_{2.5}$ concentrations within each grid cell. BenMAP then looks at the difference between the grid cell concentrations in the baseline and control case to develop an estimate of change in concentration that is then used in determining the health benefit.

### 2.2.3. EPA's Air Quality System

BenMAP contains monitored concentrations of ozone, $PM_{2.5}$, and $PM_{10}$ for the years 2000-2004 from EPA's Air Quality System (AQS). In this analysis, we scaled 2002 monitored concentrations of ozone and $PM_{2.5}$ using model data to develop future year projections of air quality.

## 2.3. Population

We developed population estimates using PopGrid, an application developed by Abt Associates that aggregates U.S. census data to specified grid definitions. We aggregated the census data to the CMAQ 12km grid definition described above to give a baseline population grid that matched the pollution grid used in the analysis. The population grid contains a variety of information including race, age, and gender. For the control scenarios, we calculate a 2018 population projection in BenMAP by calculating a population-weighted average of the county level population projection ratios for each grid cell.

## 2.4. Health Benefits Assessment

BenMAP can calculate adverse health effects related to hundreds of health impact functions that correspond to changes in $PM_{2.5}$ and ozone concentrations. BenMAP's database contains incidence rate data used to establish the baseline health conditions prior to calculating the change in health effect. In general terms, to calculate point estimates of the changes in incidence of a given health effect, BenMAP assesses the health impact function needed for analysis and accesses any data needed by the health impact function for each grid cell. These data include population information, the change in pollution exposure at the grid cell, the baseline incidence rate, and coefficients describing the uncertainty in the measurement. For each grid cell, the model calculates the change in incidence of adverse health effects for each health impact function and stores the information (Davidson *et al.*, 2007).

The relationship between the change in concentration of a pollutant and the change in incidences of a particular endpoint is described by a concentration-response (C-R) function. C-R functions used in BenMAP's calculations of health benefits are derived from epidemiological studies where researchers have used data on pollutants and associated health responses to develop these relationships. In general, these relationships follow a linear, log-linear, or quadratic form relating change in incidence to the change in pollution exposure in a grid cell using population information, the baseline incidence rate, and coefficients describing the uncertainty in the measurement. Section 2.8 of this document briefly describes each of the health studies used in this analysis.

## 2.5. Describing Uncertainty

Due to inherent uncertainty in health effect risk estimates and valuation estimates, we applied several steps to describe the uncertainty of the final benefit estimate. Each health impact function contains a mean risk estimate as well as a standard error of the estimate that are used to generate a distribution of estimates.

To describe uncertainty in health effect estimates, BenMAP utilizes a "Latin Hypercube Points" method. Based on the number of points chosen by the user, BenMAP will generate a number of incidence estimates that mirror the variability in the inputs to the health impact function. At each grid cell, BenMAP calculates the incidence estimate multiple times, each time adjusting the pollutant coefficient to describe a different level of the distribution. BenMAP bases the adjustment on a calculation utilizing the standard error of the pollution coefficient, derived from the published epidemiological study. The output contains the mean of the estimate as well as an estimate of the incidence at multiple levels of the distribution. To describe the entire distribution, we have presented health estimates as a mean and the 5 percent and 95 percent levels of the distribution.

In addition to providing confidence levels, we provide a range of estimates based on multiple studies examining ozone mortality. We chose five studies examining ozone effects on mortality to develop a range of estimated effects. For other morbidity endpoints, we provide specific estimates derived from studies examining groups of adverse endpoints (i.e. any cardiovascular endpoint) as well as individual adverse health outcomes (i.e. myocardial infarctions).

Throughout this document we present summary data on incidence and mortality as the mean of the distribution of the estimate. However, to ensure the uncertainty of the estimate is adequately represented, Appendices A and B present the estimates in further detail, showing each individual health endpoint and the 95 percent confidence interval surrounding the estimate.

## 2.6. Pooling and Aggregation of Studies

When a single study exists for a pollutant-health endpoint combination, BenMAP calculates the health benefit as the change in incidence rate based on that study's concentration-response function. However, for endpoints where multiple impact functions are available from multiple studies, BenMAP can pool the incidence estimates using a variety of methods to increase the power of the estimate. For this analysis, when multiple studies were used to characterize a single health endpoint, we used fixed or random effects models to pool the multiple estimates. The fixed effects model assumes that a single true concentration-response estimate exists and differences between studies are simply the result of sampling error. This method assumes that there is one pollutant coefficient that can represent the entire modeled area. Fixed effects pooling weighs each study's estimate by its inverse variance, giving more weight to studies with greater statistical power. When it cannot be assumed that that the only difference between studies is due to sampling error, random effects pooling is chosen. Random effects pooling is basically the same as the fixed effects model except it assumes that there is not only sampling error associated with each study, but that there is also between-study variability where underlying populations are different. Therefore, the variance is calculated as the sum of the within-study variance and the between study variance. Random effects pooling would be appropriate in situations with differing population groups, such as combining studies that take place in different locations, to account for differences in population susceptibility (Abt, 2005).

When operating BenMAP, the user can choose random/fixed effects pooling when combining multiple studies. When this parameter is chosen, BenMAP first tests if random effects pooling should be used. This is done by testing a null hypothesis that there is a single underlying parameter (fixed effect pooling). If this null hypothesis is rejected, the random effects pooling method is utilized. If not, then one can assume sample error is the only source of variability and fixed effect pooling can be used (Abt,. 2005).

After pooling results and determining changes in incidences within each grid cell of the domain, the user can aggregate the results to various levels including county, state, and nation. We chose to aggregate these results to present the results as a total benefit across the entire state.

## 2.7. Baseline Incidence Rates

To estimate the change in incidences of health endpoints, BenMAP relies on a database of baseline incidence rates. Rather than absolute number of incidences, epidemiological studies estimate the relationship between changes in air quality and the relative risk of adverse health endpoints. This relative risk is applied to the baseline incidence rate to determine the number of adverse cases avoided.

Baseline incidence rates are available within the BenMAP database. These rates are derived from a variety of sources including published estimates and Center of Disease Control (CDC) data. Depending on the health endpoint, incidence rates can be nationwide or region specific. In most cases, age specific incidence rates are available and are applied to the age specific population estimates within each grid cell. For tables and description of incidence rates used within BenMAP, refer to Abt (2005).

## 2.8. Concentration-Response Functions and Valuation Methods

In the following sections, we describe the studies used to estimate health risks associated with exposures to ozone and $PM_{2.5}$. We also describe the methodologies applied to monetize the benefits of reduced incidences of mortality and morbidity endpoints.

Health and economic benefits presented here are limited to those available in BenMAP. Certain benefits are not quantified within the model, including non-asthma related ER visits, chronic respiratory damage, increased need for prescription medication, and adverse effects on pulmonary function. Some quantified benefits only monetize ER visits and cost of hospital admissions which may not take into account additional health costs incurred after initial treatment. Furthermore, we only quantify the human health benefits of the programs under consideration. Additional non-health benefits such as improved visibility and decreased crop damage would add to the overall benefits of the programs (EPA 2005). Due to these factors, many of the benefits described in this analysis may in fact underestimate the true benefit of the programs.

## 2.8.1. Ozone Concentration-Response Functions

Except for mortality, the choice of studies included in determining the ozone-related impacts of the control measures within CAIR+ was based on those used in EPA's impact analysis of the Clean Air Interstate Rule. We followed EPA's methodology for study choices and pooling methods. EPA's CAIR analysis did not include estimates of ozone related mortality so we chose to use C-R functions from fives studies with published nation-wide estimates of mortality risks from ozone exposure. The following sections describe the studies and C-R functions used by BenMAP to calculate the incidence changes associated with changes in ozone concentrations while a summary of the studies used can be found in. A more detailed description is available in the Technical Appendices of the BenMAP User Manual developed by Abt Associates (available at http://www.epa.gov/ttn/ecas/benmodels.html).

**Table 2-1. Summary of studies used in ozone benefits assessment.**

| Health Endpoint | Metric | Study | Study Location | Study Population |
|---|---|---|---|---|
| | 24 Hour Mean | Bell et al. 2004 | 95 US Cities | All Ages |
| | 1 Hour Max | Ito et al. 2005 | 7 US Cities | All Ages |
| | 24 Hour Mean | Huang et al. 2005 | 19 US Cities | All Ages |
| | 1 Hour Max | Levy et al. 2005 | US | All Ages |
| *Mortality* | 24 Hour Mean | Bell et al. 2005 | US | All Ages |
| | 24 Hour Mean | Schwartz 1995 (all respiratory) | New Haven, CT | >64 Years, pooled estimate |
| | 24 Hour Mean | Schwartz 1995 (all respiratory) | Tacoma, Wa | |
| | 24 Hour Mean | Schwartz 1994a (pneumonia) | Detroit, MI | >64 Years, pooled estimate |
| | 24 Hour Mean | Schwartz 1994b (pneumonia) | Minneapolis, MN | |
| | 24 Hour Mean | Moolgavkar et al 1997 (pneumonia) | Minneapolis, MN | |
| | 24 Hour Mean | Schwartz 1994b (COPD) | Detroit, MI | |
| | 24 Hour Mean | Moolgavkar et al 1997 (COPD) | Minneapolis, MN | |
| *Hospital Admissions-Respiratory* | 1 Hour Max | Bernett et al. 2001 | Toronto, CN | <2 Years |
| | 5 Hour Mean | Weisel et al. 1995 | New Jersey | All ages, Pooled Estimate |
| | 5 Hour Mean | Cody et al. 1992 | New Jersey | |
| | 1 Hour Max | Stieb et al. 1995 | New Bruswick, CN | |
| *Asthma Related ER Visits* | 24 Hour Mean | Stieb et al. 1996 | New Bruswick, CN | |
| | 8 Hour Mean | Gilliland et al. 2001 | Southern California | 6-11 Years, Pooled Estimate |
| *School absence days* | 1 Hour Max | Chen et al. 2000 | Washoe Co, NV | |
| *Worker Productivity* | 24 Hour Mean | Crocker and Horst 1981 | Nationwide | Outdoor workers, 18-65 |

## *Mortality*

To estimate the impact of ozone reductions due to CAIR+ on mortality incidences in the region, we chose five multi-city epidemiological studies. We provide mortality impacts separately for each study to give a range of mortality estimates from multiple independent studies. We chose these five studies due to their recent publication and nationwide sample population.

The C-R function used to estimate the change in mortality incidences associated with changes in mortality can be described by the following log-linear equation:

**Equation 2-2.**

$$\Delta I_f = (1-(1/e(\beta*\Delta Q)))*I_c*P*A$$

where $\Delta I_f$ is the change in mortality incidence, $\beta$ is the pollution coefficient, $\Delta Q$ is the change in ozone concentration, $I_c$ is the current mortality rate, P is the population, and A is a scalar to convert annual the mortality rate to a daily mortality rate.

Each study utilized in this analysis provides a relative risk that is used to develop the pollution coefficient ($\beta$) and standard error estimates. The following section gives a short description of each mortality study used in this analysis.

### *Bell et al., 2004, 95 US Cities*

Bell *et al.* (2004) used the databases developed for the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) to estimate a national average relative rate of mortality associated with ozone exposure in 95 cities, representing about

40 percent of the U.S. population, between 1987 and 2000. The NMMAPS model employs a two stage statistical model for estimating the percent increase in mortality associated with exposures to ozone. In the first stage, a time-series analysis is performed within each community. The results are then combined across all communities in the second stage to produce a national average estimate.

The NMMAPS approach utilizes cause-specific mortality counts obtained from the National Center for Health Statistics, pollutant data from US EPA's Aerometric Retrieval Service (AIRS), and meteorological data from the National Climatic Data Center on Earth-Info. Time-series analyses of each community controlled for weather, seasonality, long-term trends such as influenza epidemics, and $PM_{10}$. Results from individual communities were then pooled to give a nationwide estimate of mortality risk to ozone exposure on the same day as well as multiple days after exposure (lags). Results were reported for single-lag models, where estimates of increased mortality risk were given for exposures on the same day, next day, two days after exposure, and three days after exposure (defined as lag 0, lag 1, lag 2, and lag 3, respectively). In addition, cumulative exposures were investigated using distributed-lag models that estimated the association between mortality risk and cumulative exposure to ozone over the previous week.

Across the 95 cities used in the NMMAPS analysis, Bell *et al.* (2004) estimated that an increase of 10 ppb in the previous week's ozone concentration was associated with a 0.52 percent increase in mortality (95% posterior interval = 0.27%-0.77%). Although BenMAP contains C-R functions for seven individual cities derived from Bell *et al.* (2004), we chose to use the 95 city average to characterize mortality reduction from this study because it was an estimate of the nationwide risk.

### *Bell et al., 2005, US Nationwide Meta-Analysis*

Bell *et al.* (2005) performed a meta-analysis of 144 effect estimates from 39 time-series studies examining the relationship between ozone and mortality. The results were compared to the estimates from the National Morbidity, Mortality, and Air Pollution Study (NMMAPS) to provide a means for comparing different methods for determining the effect of ozone on mortality. Both effect estimates were used in the analysis of OTC's control measures: using the NMMAPS estimate from Bell *et al.* (2004), and the US meta-analysis estimate from Bell *et al.* (2005).

The meta-analysis included 39 time series studies conducted between 1990 and 2004 that had been peer reviewed, not based on NMMAPS analysis results, and provided numerical estimates of the relationship between short-term changes in ozone and mortality including information on the uncertainty of the estimate. The meta-analysis combined information across locations and estimated the pooled effect using a 2-stage Bayesian hierarchical model. The statistical methods are described in detail in Bell *et al.* (2005). The results of the meta-analysis showed that a 10 ppb increase in daily ozone at single day or 2-day averaged of lags 0, 1, or 2 days was associated with an 0.87 percent increase in mortality (95% posterior interval = 0.55% to 1.18%). These percent increase estimates were converted to a log-relative rate with a standard error, the form used in BenMAP's C-R function.

The multi-city meta-analysis showed a larger association between same day ozone exposure (lag 0) and mortality as compared to the NMMAPS 95 city study. When a comparison across the cities common to both methods with the same lag structure (8 cities, lag 0), the study found a much lower pooled effect in the NMMAPS analysis. Bell *et al.* (2005) indicated that this pattern was indicative of a possible publication bias in the meta-analysis; papers reporting a positive association may be more likely to be submitted or accepted for publication. In addition, larger pooled effects were seen in studies that reported a single lag (lag 0 or 1) as opposed to those reporting multiple lags, a pattern that researchers suggested indicates that the lag with the largest effect was most likely to be reported. The study concluded that while the meta-analysis is useful for combining multiple studies and examining study differences, it may be biased to overestimate the ozone/mortality relationship.

### *Ito et al., 2005, 7 US Cities*

Ito *et al.* (2005) conducted a review and meta-analysis of short term ozone mortality studies published between 1990 and 2003 and performed an additional time-series analysis for seven U.S. cities (Chicago, Detroit, Houston, Minneapolis-St. Paul, New York City, Philadelphia, and St. Louis).

The review and time-series analysis showed a combined estimate of 0.39 percent increase in mortality associated with a 10 ppb increase in the 1-hour daily maximum ozone. The study reported no significant reduction in the effect estimate when particulate matter was included in the estimate. For our analysis, we used the single-pollutant, log-linear C-R function to describe the relationship.

### *Huang et al., 2005, 19 US Cities*

Huang *et al.* (2005) developed a Bayesian hierarchical distributed lag model to estimate the association of daily variations of summertime ozone and cardiovascular and respiratory mortality counts in 19 cities. The study used data from NMMAPS for summers between 1987 and 1994 for the 19 large cities included in the database (Los Angeles, New York, Chicago, Dallas/Fort Worth, Houston, San Diego, Santa Ana/Anaheim, Phoenix, Detroit, Miami, Philadelphia, Seattle, San Jose, Cleveland, San Bernardino, Pittsburgh, Oakland, Atlanta, and San Antonio).

The 19 city effect estimate from Huang *et al.* (2005) was derived using a two stage approach similar to Bell *et al.* (2004). In the first step, city-specific relative rates of cardiovascular and respiratory mortality associated with short-term exposures to ozone are estimated using a distributed lag Poisson regression model. The regression model includes factors that control for various confounders such as age, yearly trends, day of the week, temperature and dew point, and other pollutants. The overall effect is then developed by combining information across the 19 cities by assuming the true city-specific effects are normally distributed.

Across the 19 cities investigated in this study, it was found that a 10 ppb increase in summertime ozone over the previous week is associated with a 1.25 percent increase (95% posterior interval = 0.47-2.03) in cardiovascular and respiratory mortality. Although BenMAP contains separate C-R functions adjusted for co-pollutants ($PM_{10}$, $NO_2$, $SO_2$, and CO), we used the single pollutant function in analysis of OTC's ozone control programs.

### *Levy et al., 2005, US Nationwide*

Levy *et al.* (2005) gathered results from 28 time-series studies, selecting 48 effect estimates to be used in a metaregression analysis of ozone exposure and mortality. Only time-series studies with published city-specific, year-round, all-age relative risk and variance estimates were used. In addition, the most recent studies were used when multiple studies were available from the same author describing the same cities and study years. Studies based on the NMMAPS database were removed as these data were being reanalyzed by other researchers.

Based on the metaregression analysis conducted in this study, Levy *et al.* (2005) estimate a 0.21 percent increase (95% confidence interval = 0.16-0.26%) in mortality with a 10 $\mu g/m^3$ increase in the one hour max ozone (0.41% increase in mortality per 10 ppb increase in the one hour max ozone).

## ***Hospital Admissions due to Respiratory Disease***

The concentration response functions we used in this BenMAP analysis to relate changes in ozone concentration to hospital admissions due to respiratory disease can be described by the same log-normal relationship described in Equation 2-2. The baseline incidence rate and change in incidence in this case are numbers of hospital admissions due to respiratory diseases.

To estimate the avoided incidences of respiratory hospital admissions, we looked at six studies examining a range of respiratory conditions, following the same methodology employed by EPA in its CAIR impact analysis. For adults over 65, we used effect estimates from five studies. Schwartz (1995) provided effects estimates relating 24 hour mean exposures to ozone and all respiratory hospital admissions in New Haven, CT and Tacoma, WA. These impact functions were pooled together before pooling with other studies. Moolgavkar *et al.* (1997) and Schwartz (1994a) reported effect estimates for ozone- and pneumonia-related hospital admissions in Minneapolis while Schwartz (1994b) reported effect estimates for the same endpoint in Detroit. The impact functions for the Minneapolis studies were first pooled, and then the resulting function was pooled with the Detroit impact function. Two studies, Moolgavkar *et al.* (1997) in Minneapolis and Schwartz (1994b) in Detroit, provided effect estimates for Chronic Obstructive Pulmonary Disease (COPD) hospital admissions. These two studies were pooled together with the resulting impact function added to the pneumonia impact function. This result was then reported along with the all respiratory incidence function derived from Schwartz (1995) to give the estimate for total respiratory admissions in adults over 65.

Only one study was available with an effect estimate for respiratory hospital admissions in children under 2 and its impact function was calculated separately. Burnett *et al.* (2001) conducted a time series study examining hospital admissions in children below 2 years of age in Toronto, Canada between 1980 and 1994. The study found that a 1-hr maximum ozone concentration of 45 ppb (5-day moving average between May and August) was associated with a 35 percent increase (95% confidence interval = 19%-52%) in the daily hospitalization rate for respiratory problems.

### Emergency Room Visits due to Asthma

Following the methodology applied in EPA's impact analysis for CAIR, we estimated reduced emergency room visits due to asthma related symptoms by pooling results from three studies, Stieb *et al.* (1996), Cody *et al.* (1992), and Weisel *et al.* (1995). The 24-hr and 1-hr max effect estimates from Stieb *et al.* (1996) were first pooled using fixed/random effects pooling. The resulting estimate of incidence change was pooled with the incidence change calculated from Cody *et al.* (1992) and Weisel *et al.* (1995) to give the overall effect estimate.

Stieb *et al*. (1996) investigated the relationship between ozone concentration and asthma related emergency room visits for all age groups in the summers of 1984 to 1992 in Saint John, New Brunswick, Canada. After controlling for other pollutants, weather variables, and long term trends, the investigators found that a statistically significant, non-linear relationship existed between the frequency of asthma related ER visits and elevated ozone levels, noting a 33 percent higher frequency of asthma related ER visits when the daily 1-hr maximum ozone concentration exceeded 75 ppb. Because the authors described a strong quadratic relationship, BenMAP uses this form for the concentration response function. Equation 2-3 describes this C-R function derived from the quadratic regression model (Abt, 2003):

**Equation 2-3.**

$$\Delta Asthma\ ER\ Visits = \frac{\beta}{BasePop} * \left[ \left(O_{3,baseline}\right)^2 - \left(O_{3,control}\right)^2 \right] * pop$$

where β is the pollution coefficient (different estimate published for 1-hr max and 24-hr average ozone concentration), *BasePop* is the baseline population of St. John, New Brunswick published in Stieb *et al.* (1996), and *pop* is the all-ages population within the grid cell. The estimates based on the 1-hr max ozone and 24-hr average ozone was pooled together to develop an all ages estimate that was pooled with the estimates from Cody *et al.* (1992) and Wiesel *et al.* (1995).

Cody *et al.* (1992) and Wiesel *et al.* (1995) describe the relationship between ozone and asthma related ER visits in New Jersey. These studies provide a C-R function that follows a linear form relating the increase in asthma-related ER visits to increases in 5-hr ozone concentrations. BenMAP uses this linear relationship in its calculations of change in incidences associated with changes in 5-hr ozone concentrations. The C-R function can be described by the following linear relationship:

**Equation 2-4.**

$$\Delta Asthma\ ER\ Visits = (\beta/A) * \Delta Q * Pop$$

where β is the pollution coefficient, A is the New Jersey study population, ΔQ is the change in ozone concentration, and *Pop* is the population within the grid cell where the incidence is being calculated.

The effect estimates from these two studies are pooled together with the effect estimates from Stieb *et al.* (1996) to give an overall estimate of change in asthma-related ER visits.

### *School Loss Days*

BenMAP calculates the benefits of reduced absenteeism in schools from effect estimates derived from two studies, Gilliland *et al.* (2000) and Chen *et al.* (2000). The studies estimate the relationship of elevated ozone to absenteeism in schools due to illness resulting from exposure to ozone. The estimates from these two studies were pooled together to give an estimate of school loss days avoided with reduced ozone exposures.

Gilliland *et al.* (2000) investigated the relationship between ozone and other pollutants and school absenteeism in a cohort of fourth grade school children in southern California. Based on school absence reports and parental interviews to determine the cause of absence, the authors reported that an increase in 20 ppb of ozone (8-hr, 10 a.m. to 6 p.m. window) was associated with an increase of 62.9 percent of illness-related absence rates (95% confidence interval = 18.4-124.1%). The C-R function reflects the results of the single pollutant model and can be described by the following log-linear relationship:

**Equation 2-5.**

$$\Delta \textit{Total Absence} = (1-(1/e^{(\beta*\Delta Q)}))*I*P*A*B$$

where β is the pollution coefficient derived from the study, ΔQ is the change in ozone concentration, I is the baseline rate of new absences, P is the population within the grid cell, A is scalar for the percent of school days in the ozone season, and B is a constant describing the population of school children at-risk for a new absence.

We pooled the change in absence incidence from Gilliland *et al.* (2000) with the estimate from Chen *et al.* (2000). Chen *et al.* examined the association between air pollution and daily elementary school absenteeism in Washoe County, Nevada. The investigators regressed daily absence rates on three pollutants ($PM_{10}$, CO, and $O_3$) and confounders such as meteorological variables and indicators for day of the week. The authors found that CO and $O_3$ were statistically significant indicators of absenteeism. Chen *et al.* (2000) published the results of multi-pollutant linear regression model, presenting the β pollution coefficient and standard error based on the 1-hr maximum ozone from the previous two weeks. BenMAP calculates the change in incidence using this β in the following linear C-R function:

**Equation 2-6.**

$$\Delta \textit{Total Absence} = \beta *C* \Delta Q *(I/B)*P*A$$

where β is the published pollution coefficient based on the 1-hr maximum ozone from the previous two weeks, C is a constant to convert β to a proportion, ΔQ is the change in ozone concentration, I is the baseline rate of new absences, B is a constant describing the study-specific school absence rate, P is the population within the grid cell, and A is scalar for the percent of school days in the ozone season.

### *Worker Productivity*

Estimates of increased worker productivity with decreased ozone concentrations is based on Crocker and Horst (1981) where the investigators examined the impacts of ozone exposure on the productivity of outdoor citrus workers in southern California. The study measured worker productivity as the change in income with respect to ozone concentration, reporting a 1.4 percent increase in income with a 10 percent reduction in 24-hr ozone concentration. This estimate is based on the presumption that elevated ozone influences the worker's ability to work and thus decreases their productivity. The C-R relationship used by BenMAP can be described by the following linear relationship:

**Equation 2-7.**

$$\Delta Productivity = \beta * \frac{Q_1 - Q_0}{Q_1} * dailyincome * P$$

where $\beta$ is the pollution coefficient, $Q_1$ and $Q_0$ are the control and baseline ozone concentrations, *dailyincome* is the median daily income for outdoor workers, and P is the population of adults employed as outdoor farm workers.

## 2.8.2. $PM_{2.5}$ Concentration-Response Functions

We chose health studies for the analysis of $PM_{2.5}$ control programs based on selection criteria described in EPA (2005) and Davidson *et al.* (2007). Selection criteria included whether the study was peer reviewed, study design, study location, study size, and characteristics of study samples, among other considerations. We gave preference to prospective cohort studies performed in the U.S. with large sample sizes. The study choices attempted to cover all age groups when choosing studies to give an accurate representation of the entire population (i.e., if a children's health study was used, a similar study characterizing adult exposures was also used). Peer reviewed studies and those examining longer periods of time (thus having more data) were preferentially chosen to characterize chronic health effects.

The sections below give descriptions of the selected studies and C-R functions used in the BenMAP model. A more detailed description is available in the Technical Appendices of the BenMAP User Manual developed by Abt Associates (available at http://www.epa.gov/ttn/ecas/benmodels.html). Table 2-2 shows a summary of the studies chosen for analysis of $PM_{2.5}$ control options.

**Table 2-2. Summary of studies used in $PM_{2.5}$ benefits analysis.**

| Health Endpoint | Metric | Study | Study Location | Study Population |
|---|---|---|---|---|
| *Mortality* | 24 Hour Mean | Woodruff et al. 1997 | 86 Cities | Infant (<1 Year) |
| | 24 Hour Mean | Pope et al. 2002 | 51 Cities | >30 Years |
| *Chronic Bronchitis* | 24 Hour Mean | Abbey et al. 1995 | San Francisco, San Diego, South Coast Air Basin | >27 Years |
| *Acute Myocardial Infarction (Non-Fatal)* | 24 Hour Mean | Peters et al. 2001 | Boston, MA | >18 Years |
| *Hospital Admissions, Chronic Lung Disease* | 24 Hour Mean | Moolgavkar 2003 (COPD) | Los Angeles, CA | >65 Years. Pooled Estimate |
| | 24 Hour Mean | Ito 2003 (COPD) | Detroit, MI | |
| *Hospital Admissions, Chronic Lung Disease (less Asthma)* | 24 Hour Mean | Moolgavkar, 2000 (COPD) | Los Angeles, CA | 18-64 Years |
| *Hospital Admissions, Pneumonia* | 24 Hour Mean | Ito, 2003 | Detroit, MI | >65 Years. |
| *Hospital Admissions, Asthma* | 24 Hour Mean | Sheppard, 2003 | Seattle, WA | 0-64 Years |
| *Hospital Admissions, All Cardiovascular (less MI)* | 24 Hour Mean | Moolgavkar, 2003 | Los Angeles, CA | 65-99 Years, Pooled Estimate |
| | 24 Hour Mean | Ito 2003, (ischemic heart disease, dysrhythmia, hearth failure) | Detroit, MI | |
| | 24 Hour Mean | Mookgavkar, 2000 | Los Angeles, CA | 18-64 Years |
| *Asthma related ER Visits* | 24 Hour Mean | Norris et al. 1999 | Seattle, WA | <17 Years |
| *Acute Bronchitis* | 24 Hour Mean | Dockery et al. 1996 | 24 Communities | 8-12 Years |
| *Lower Respiratory Symptoms* | 24 Hour Mean | Schwartz and Neas 2000 | 6 US Cities | 7-14 Years |
| *Asthma Exacerbation, Cough, Wheeze, Shortness of Breath* | 24 Hour Mean | Ostro et al. 2001 | Los Angeles, CA | 6-18 Years, Pooled Estimate |
| | 24 Hour Mean | Vedal et al. 1998 | Vancouver, CN | |
| *Work Loss Days* | 24 Hour Mean | Ostro, 1987 | Nationwide | 18-64 Years |

## *Mortality*

EPA (2005) reported that the Science Advisory Board Health Effects Subcommittee has recommended using the Pope *et al.* (2002) study as the basis for the primary mortality estimate for adults to be used in its benefit analyses. This study is based on data collected by the American Cancer Society as part of an ongoing prospective cohort mortality study of approximately 1.2 million adults. The researchers have used information on mortality in the study cohort and $PM_{2.5}$ monitored data to develop mortality risk estimates by applying a Cox proportional hazards survival model. Pope *et al.* (2002) provides relative risks for all-cause mortality as well as cardiopulmonary, lung cancer, and all-other cause mortality. For this analysis, we have provided estimates based on the all-cause mortality estimate. This estimate is calculated using the log-linear C-R function described in Equation 2-2.

While Pope *et al.* (2002) provides an estimate of mortality in the population above 30 years of age, Woodruff *et al.* (1997) provides a relationship between particulate matter exposure and infant mortality. The investigators evaluated the relationship within a cohort of approximately 4 million infants born between 1989 and 1991 and particulate matter exposure. The estimate is calculated using the logistic C-R function described below:

**Equation 2-8.**

$$\Delta \textit{Cases of Infant Mortality} = (1-(1/((1-I)*e^{(\beta*\Delta Q)}+I)))*I*P$$

where $\beta$ is the pollution coefficient, I is the incidence rate, $\Delta Q$ is change in $PM_{2.5}$ concentration, and P is the population 2 years and younger.

### *Chronic Bronchitis*

BenMAP provides an effect estimate for reductions in cases of chronic bronchitis from Abbey *et al.* (1995). The study examined the relationship between $PM_{2.5}$, $PM_{10}$, and TSP and chronic respiratory symptoms in a population of 1,868 Californian Seventh Day Adventists. In the single pollutant models, long-term exposures to elevated ambient concentrations of $PM_{2.5}$ showed a statistically significant association with development of symptoms of chronic bronchitis between 1977 and 1987. The C-R response function used by BenMAP to estimate the change in chronic bronchitis incidences follows the following logistic form:

**Equation 2-9.**

$$\Delta \textit{Cases of Chronic Bronchitis} = (1-(1/((1-I)*e^{(\beta*\Delta Q)}+I)))*I*P*(1-\textit{Prevalence})$$

where β is the pollution coefficient, I is the incidence rate, ΔQ is change in $PM_{2.5}$ concentration, P is the population 27 years and older without chronic bronchitis, and *Prevalence* is the prevalence of chronic bronchitis in the population.

### *Acute Myocardial Infarctions (Non-Fatal)*

We estimated the association of $PM_{2.5}$ exposure to non-fatal heart attacks using Peters *et al.* (2001). This is the only currently available U.S. study that provides a specific estimate for heart attacks (EPA, 2005). Peters *et al.* (2001) used a case-crossover approach to analyze evidence that exposures to $PM_{2.5}$ elevated the risk of myocardial infarctions (MI). The investigators interviewed 772 patients with MI in the greater Boston area from 1995 and 1996 as part of the Determinants of Myocardial Infarction Study while collecting hourly concentrations of $PM_{2.5}$, black carbon, and gaseous air pollutants. Using a conditional logistic regression analysis, Peters *et al.* (2001) estimated an odds ratio of 1.69 (95% confidence interval = 1.13-2.34) for an increase of 20 $\mu g/m^3$ in the 24-hr $PM_{2.5}$ concentration on the day before the onset. These odds ratios were converted to a pollution coefficient and a standard error to be used in the following logistic C-R function:

**Equation 2-10.**

$$\Delta \textit{Cases of Acute MI} = (1-(1/((1-I*A)*e^{(\beta*\Delta Q)+I*A)}))*I*A*P$$

where I is the incidence rate, A is a constant to adjust the incidence rate to number of MI cases that survive 28 days (93 percent), β is the pollution coefficient, ΔQ is change in $PM_{2.5}$ concentration, and P is the population above 18 years of age.

### *Hospital Admissions, Respiratory*

We estimated total avoided incidences of respiratory hospital admissions by using impact functions for several respiratory conditions including chronic obstructive pulmonary disease (COPD), pneumonia, and asthma. Two studies were used to estimate COPD in populations above 65 years old, Moolgavkar (2003) and Ito (2003). The Ito (2003) estimate is based on a study published to reanalyze Lippman (2000) to address issues with the S-plus default convergence criteria. The original study, performed during 1985-1990 and 1992-1994, examined the association between particulate matter and hospitalizations among adults above 65 years of age. BenMAP estimates the health benefits using a log-linear model (Equation 2-2) with a pollutant coefficient derived from Ito's reported relative risk of 1.043 for a 36 $\mu g/m^3$ increase in 24-hr $PM_{2.5}$. We pooled the estimate from Ito (2003) for populations above 65 years with Moolgavkar (2003). Moolgavkar (2000a) first used generalized additive models to analyze daily admissions for COPD in Cook County, IL, Los Angeles County, CA, and Maricopa County, AZ between 1987 and 1995. The results were then reanalyzed in Moolgavkar (2003) to address issues with the S-plus default convergence criteria. The reanalysis provided the effect estimate used for COPD in populations above 65 years of age while the original analysis (Moolgavkar, 2000a) provided the effect estimate for populations between 18 and 65. We therefore provided a separate estimate for COPD in populations between 18 and 65 from the Los Angeles effect estimate derived from Moolgavkar (2000a) and an estimate for adults above 65 pooled from Ito (2003) and Moolgavar (2003).

We estimated the avoided cases of hospital admissions due to pneumonia in populations above 65 using estimates published in Ito (2003). The estimates are based on the same Detroit, MI study population used to develop the COPD estimates. Ito (2003) applied a Poisson regression model with generalized additive models to develop a risk estimate that showed a statistically significant relationship between pneumonia related hospital admissions and 24-hr $PM_{2.5}$. The relative risk of 1.154 for a 36 $\mu g/m^3$ increase in 24-hr $PM_{2.5}$ was used to generate a pollutant coefficient to be used in a log-linear C-R function (Equation 2-2).

Sheppard (2003) provides a reanalysis of Sheppard (1999), investigating the relationship between air pollution and hospital admissions for asthma in Seattle between 1987 and 1994. The study, reanalyzed in 2003 for issues involving the S-plus default convergence criteria, used a Poisson regression model with control for temperature, season, and long term trends. Sheppard (2003) reported a statistically significant association between 24-hour average $PM_{2.5}$ concentrations and asthma related hospital admissions. The relative risk of 1.04 for an 11.8 $\mu g/m^3$ increase in 24-hr $PM_{2.5}$ was used to generate a pollutant coefficient to be used in a log-linear C-R function (Equation 2-2).

### *Hospital Admissions, Cardiovascular*

We used effect estimates from three studies to assess the benefits of reduced hospital admissions due to cardiovascular illness (Moolgavkar, 2000b; Moolgavkar, 2003; Ito, 2003). In our analysis, we provide separate results for hospital admissions due to all cardiovascular illness not including MI (Moolgavkar, 2000b; Moolgavkar, 2003), ischemic heart disease (Ito, 2003), dysrythmia (Ito, 2003), and congestive heart failure (Ito, 2003).

Moolgavkar (2000b; 2003) provides effect estimates describing the association of ambient $PM_{2.5}$ and hospital admissions due to cardiovascular illness. The 2003 paper reports the updated results of 2000b after addressing the S-plus default convergence criteria issue. In these studies, Moolgavkar used a Poisson regression model with generalized additive models to analyze data from three cities – Los Angeles, Chicago, and Phoenix. $PM_{2.5}$ analysis was performed on the population within Los Angeles. For populations between 18 and 65, we used the log-linear function based on the effect estimate from Moolgavkar (2000b) (1.4 percent increase in hospital admissions due to cardiovascular illness associated with a 10 μg/$m^3$ increase in $PM_{2.5}$). For populations above 65, we used the log-linear function based on the effect estimate from Moolgavkar (2003) (1.58 percent increase in hospital admissions due to cardiovascular illness associated with a 10 μg/$m^3$ increase in $PM_{2.5}$). Since these estimates describe different populations we present the benefits to each separately.

In addition to providing estimates for hospital admissions due to COPD and pneumonia, Ito (2003) reported effect estimates for hospital admissions due to ischemic heart disease, congestive heart failure, and dysrythmia. Ito (2003) was a reanalysis of Lippmann (2000), a study investigating the association between particulate matter and daily mortality and hospitalization among the elderly in Detroit, MI. Table 2-3 below illustrates the reported effect estimates for the different cardiovascular endpoints examined in the BenMAP analysis.

**Table 2-3. Effect estimates for hospital admissions due to cardiovascular illness from Ito (2003).**

| Reason for Hospital Admission | Effect Estimate | Form of Effect Estimate | BenMAP C-R Function Form |
|---|---|---|---|
| Dysrythmia | 1.046 | Relative risk for 36 μg/m3 increase in 24-hr PM2.5 | Log-Linear |
| Ischemic Heart Disease | 1.053 | Relative risk for 36 μg/m3 increase in 24-hr PM2.5 | Log-Linear |
| Congestive Heart Failure | 1.17 | Relative risk for 36 μg/m3 increase in 24-hr PM2.5 | Log-Linear |

## *Asthma Related Emergency Room Visits*

We estimated the effects of $PM_{2.5}$ exposure on incidences of asthma related emergency room visits by using the effect estimate from a study by Norris *et al.* (1999). The study examined the association between fine particulate matter and emergency room visits for asthma in Seattle, WA among children under 18 years. It found a significant association showing a change of 11μg/$m^3$ in $PM_{2.5}$ was associated with an increased relative rate of asthma emergency room visits of 1.15 (95% confidence interval = 1.08-1.23). EPA (2005) noted that children tend to have higher rates of hospitalization, thus this estimate should capture a large part of the impact of $PM_{2.5}$ on asthma ER visits in the population, but there may still be significant impacts in older populations not represented here. We used the effect estimate from Norris *et al.* (1999) in a log-linear C-R function to describe the benefits in the population below 18 years old.

## *Work Loss Days*

Work loss days are a measure of days of work lost due to exposures to elevated $PM_{2.5}$ (personal symptoms or caring for a sick relative). We estimated days of work lost due to $PM_{2.5}$ using a log-linear C-R function (Equation 2-2) derived from Ostro (1987), a 6-year, nationwide study performed between 1976 and 1981. Ostro (1987) utilized a national survey to estimate work loss days and restricted activity days and how exposure to $PM_{2.5}$ were correlated to these endpoints. Based on a regression analysis, Ostro (1987) reported that two-week average $PM_{2.5}$ exposures were significantly associated with work-loss days in a population between 18 and 65.

### *Lower Respiratory Symptoms*

To estimate the effect of $PM_{2.5}$ on lower respiratory symptoms, we used an effect estimate derived from Schwartz and Neas (2000). As part of the Harvard Six City Diary Study, Schwartz and Neas (2000) examined the association of $PM_{2.5}$ on lower respiratory symptoms in 1,184 school children in grades 2 through 5 in six urban areas in the eastern U.S. The investigators defined a day indicating an occurrence of a lower respiratory symptom as any day with a report of at least two of cough, phlegm from the chest, pain in the chest, or wheezing. The study found a statistically significant association between lower respiratory symptoms in the cohort of children and $PM_{2.5}$. The BenMAP model uses a pollution coefficient and standard error derived from the reported odds ratio in a logistic C-R function (Equation 2-10) applied to the population between ages 7 and 14.

### *Asthma Exacerbation*

We estimated the effects of $PM_{2.5}$ exposure on a variety of acute effects in asthmatic children between 6 and 18 years of age. We developed estimates of reductions in symptoms of shortness of breath and wheezing from Ostro *et al.* (2001) and an estimate of reduction in cough symptoms based on a pooled estimate from Ostro *et al.* (2001) and Vedal *et al.* (1998).

Ostro *et al.* (2001) gathered daily data on respiratory symptoms among a group of 138 African-American children between the ages of 8 and 13 who had physician diagnosed asthma. Using a logistical regression model, the authors developed odds ratios to describe the relationship between elevated particulate matter, ozone, and $NO_2$ and three asthma symptoms, cough, wheeze, and shortness of breath. Similarly, Vedal *et al.* (1998) used a logistical regression model to examine the relationship between particulate matter and cough symptoms among asthmatic children between the ages of 6 and 13 years in Vancouver, BC. We described the effect estimates for wheeze and shortness of breath from Ostro *et al.* (2001) and the effect estimate for cough from a pooled estimate of Ostro *et al.* (2001) and Vedal *et al.* (1998). Table 2-4 below shows the published effect estimates used by BenMAP.

**Table 2-4. Effect estimates used by BenMAP to estimate benefits from asthma exacerbation.**

| Asthma Symptom | Effect Estimate | Form of Effect Estimate | BenMAP C-R Function Form |
|---|---|---|---|
| Shortness of Breath, Ostro *et al.* (2001) | 1.10 | Odds Ratio, 12-hr PM2.5 | Logistic |
| Wheeze, Ostro *et al.* (2001) | 1.08 | Odds Ratio, 12-hr PM2.5 | Logistic |
| Cough, Ostro *et al.* (2001) | 1.10 | Odds Ratio, 12-hr PM2.5 | Logistic |
| Cough, Vedal *et al.* (1998) | 1.07 | Odds Ratio, 24-hr PM2.5 | Logistic |

### *Acute Bronchitis*

We estimated benefits from reductions in cases of acute bronchitis from estimates developed by Dockery *et al.* (1996). The study investigated the health effects of exposures to acidic air pollution in 13,369 white children between the ages of 8 and 12 years old in 24 communities between 1988 and 1991. The study developed estimates of pollutant exposures on cases of bronchitis, asthma, wheeze, cough, and phlegm. Cases of bronchitis were defined as a chest illness diagnosed as bronchitis occurring within the previous 12 months. Although this does not differentiate between temporary, chronic, or acute bronchitis, BenMAP assumes this estimate describes cases of acute bronchitis (Abt, 2005). BenMAP uses a logistic C-R function based on an odds ratio of 1.50 (95% CI=0.91-2.47) associated with being in the most polluted city versus the least polluted city.

## 2.8.3. Economic Value for Health Benefits

Concentration-response functions derived from epidemiologic studies provide estimates of the number of incidences avoided of a particular adverse health effect attributed to a reduction in air pollution. An estimate of the value of this reduced risk can be described as either a willingness to pay (WTP) or cost of illness (COI) or a combination of the two. The WTP describes the medical cost of a certain health endpoint along with value associated with avoiding the pain and suffering resulting from the illness. In many cases, WTP estimates are not available, and the value of a health benefit is described by the COI, or the cost of treating an illness combined with the value of lost productivity. The COI estimates generally underestimate the true health benefit because they do not include the value of avoided pain and suffering from the health the effect (EPA 2005).

In the following sections, we offer a short description of the valuation estimates used in this analysis for various health endpoints. For a more thorough discussion refer to Abt (2005), EPA (2005), and EPA (2007). A summary of the unit values used in this analysis can be found in Table 2-5.

**Table 2-5. Unit values for health incidences used in benefits analysis (Abt, 2005).**

| Endpoint Group | Endpoint | Unit Value of Avoided Incidence (2000$) |
|---|---|---|
| Mortality | Mortality, All Ages | $6,324,101 |
| Hospital Admissions, Respiratory | All Respiratory, >65 Years | $18,393 |
| | All Respiratory, <2 Years | $7,759 |
| | Pneumonia, >65 years | $17,844 |
| | COPD, >65 Years | $13,648 |
| | Asthma | $7,788 |
| | All Cardiovascular, >65 years | $21,191 |
| | Congestive Heart Failure, >65 | $15,218 |
| | Dysrythmia | $15,237 |
| | Ischemic Heart Disease | $25,876 |
| Emergency Room Visits | Asthma Related Emergency Room Visits | $261-$312, Pooled Estimate |
| School Loss days | School Loss Day | $75 |
| Work Loss Days | Work Loss Days | Based on county specific median daily wage |
| Chronic Bronchitis | Chronic Bronchitis, >30 Years | $340,482 |
| Acute Bronchitis | Acute Bronchitis, Ages 8-12 | $374 |
| Acute Myocardial Infarction | Acute MI, Age specific estimates | $66,000-$143,000* |
| Lower Respiratory Symptoms | Lower Respiratory Symptoms, Ages 7-14 | $187 |
| Asthma Exacerbations | Cough, Shortness of Breath, Wheeze, Ages 6-18 | $74 |

* Value estimate is age specific, range is shown here.

## *Mortality Valuation*

To estimate the economic benefit associated with reduced mortality risk, we used the "value of statistical lives" saved (VSL) approach available in BenMAP. The VSL estimate is based on 26 value of life studies, with a mean estimate of 6.3 million dollars (2000$) per avoided incidence of mortality. Of the 26 value of life studies, some gather WTP estimates from study subjects while others are wage-risk studies that derive WTP estimates from information about the additional compensation demanded for riskier jobs. The VSL value used here does not distinguish among people based on age or quality of life, thus applied equally to all premature deaths.

## *Hospital Admissions Valuation*

To estimate the economic benefits associated with reduced hospital admissions due to a variety of health endpoints, we used the cost of illness estimates available in BenMAP (cost of medical treatment plus estimate of wages lost). Because estimates of WTP were unavailable, these estimates tend to be biased downward as they do not include the value of avoiding pain and suffering.

The COI estimates available are specific to the individual health endpoint as classified by the International Classification of Diseases (ICD). The estimates are calculated as the year 2000$ sum of hospital charges and cost of time spent in the hospital, estimated as the value of lost daily wages (based on the county-specific median wage).

### Emergency Room Visits due to Asthma Valuation

We estimated the value of reduced asthma related ER visits by pooling the two COI estimates available in BenMAP (Smith *et al.*, 1997; Stanford *et al.*, 1999). Smith *et al.* (1997) estimated the average cost per emergency room visit for asthma at $312 while Stanford *et al.* (1999) estimated the cost at $261. We pooled these estimates to present the COI-based value of avoided incidences of ER visits due to asthma.

### Worker Productivity Valuation

Crocker and Horst (1981) estimated the value of increased worker productivity with decreased ozone concentrations for outdoor citrus workers in southern California. Both incidences and value of the benefit are described as loss of income due to reduced worker productivity.

### School Loss Days Valuation

BenMAP offers a single estimate for the value of school loss days. The estimate is based on the probability that if a child stays home from school, a parent will have to stay home from work to take care of the child. The value is based on the value of the parent's lost productivity. This was done by first estimating the number of single, married, and "other" (i.e., widowed, divorced, or separated) women with children in the workforce. Then, based on the median wage for women above 25 years old, the value of a missed day of work is estimated. This value is then used as the value of a school loss day.

This method for valuing school loss days likely underestimates the true value as the WTP is not included in the estimate and only school absences resulting in a missed day of work for the parent is quantified. Abt (2005) considers this valuation estimate an "interim" value until an alternative method for the valuation of this health endpoint is developed. In addition, BenMAP calculates school absences based on the assumption that children are in school during all of May, two weeks in June, one week in August, and all of September. The estimated health benefits do not account for absences during summer school sessions.

### Chronic Bronchitis Valuation

Following the methodology employed by EPA 2005, we estimate the value of reduced incidences of chronic bronchitis using the WTP estimate based on Viscusi *et al.* (1991). Because Viscusi *et al.* (1991) describes the WTP for severe cases of chronic bronchitis, BenMAP uses an adjusted estimate to account for the likelihood that an average case of pollution-related chronic bronchitis is not severe. Details on the adjustment procedure can be found in Abt (2005).

### Acute Bronchitis Valuation

BenMAP estimates the value of reduced incidences of acute bronchitis in children based on WTP data on bronchitis related symptoms. Abt (2005) notes that WTP estimates have not been developed for cases of acute bronchitis and need to be extrapolated from data on symptoms related to the condition. Additionally, WTP data on symptoms associated with acute bronchitis are available only in adults. Therefore, the estimate within BenMAP is based on an adjusted value previously used in EPA's benefit analyses. The unit value has been adjusted to account for the duration of events of acute bronchitis and data showing that parents are willing to pay about twice as much to avoid sickness in their children as in themselves (Dicky *et al.*, 2002). We based the acute bronchitis valuation estimate on the Dicky *et al*. (2002) estimate of the cost of a case of acute bronchitis with 28 symptom days. Details on the unit values and adjustment methods can be found in Abt (2005).

### *Acute Myocardial Infarctions (Non-Fatal) Valuation*

BenMAP contains several age-specific COI estimates that can be used to assign a value to an avoided incidence of myocardial infarction. In this analysis, we applied a methodology similar to that used in EPA's CAIR Regulatory Impact Analysis (EPA, 2005). We used a simple average of the cost estimates available from Russel *et al.* (1998) and Wittels *et al.* (1990). These studies estimate the expected total medical cost of a myocardial infarction over five years, offer separate estimates for different age categories, and use a 3 percent discount rate in the value calculation.

### *Work Loss Days Valuation*

The value of a lost day of work is calculated based on the county-specific median daily wages. The total value is simply the product of work days missed and the median daily wage within the county.

### *Asthma Exacerbation Valuation*

Of the several valuation units available, we used an estimate based on a study performed by Dicky *et al*. (2002). BenMAP relies on this study's WTP estimate for an avoided incidence of childhood asthma. The estimate is doubled based on evidence from Dicky *et al.* (2002) that parents are willing to pay about twice as much to avoid symptoms and illness in their children as in themselves.

# 3. BENEFITS OF CAIR-PLUS CONTROL SCENARIO

## 3.1. Benefits from Reductions in Ozone

We utilized CALGRID model output and 2002 monitoring data to provide estimates of ozone concentrations in 2018 under a BOTW control scenario and a CAIR+ control scenario. We quantified the benefits based on the difference of these two control scenarios to determine what health benefits can be attributed to implementation of the CAIR+ program.

The majority of the ozone health impact studies are based on changes in the 1-hr maximum ozone concentration and the 24-hr mean ozone concentration. BenMAP uses the change in these metrics to calculate the change in risk of experiencing an adverse health endpoint, and in turn the reduced number of incidences. Figure 3-1 and Figure 3-2 show the average change in 1-hr max and 24-hr mean ozone concentrations during the 2018 ozone season between the BOTW scenario and the CAIR+ scenario.

**Figure 3-1. Average change in 1-hr maximum ozone concentration due to CAIR+ measures during 2018 ozone season (May 1st-Sept. 30th), ppb (positive numbers indicates an ozone decrease)**

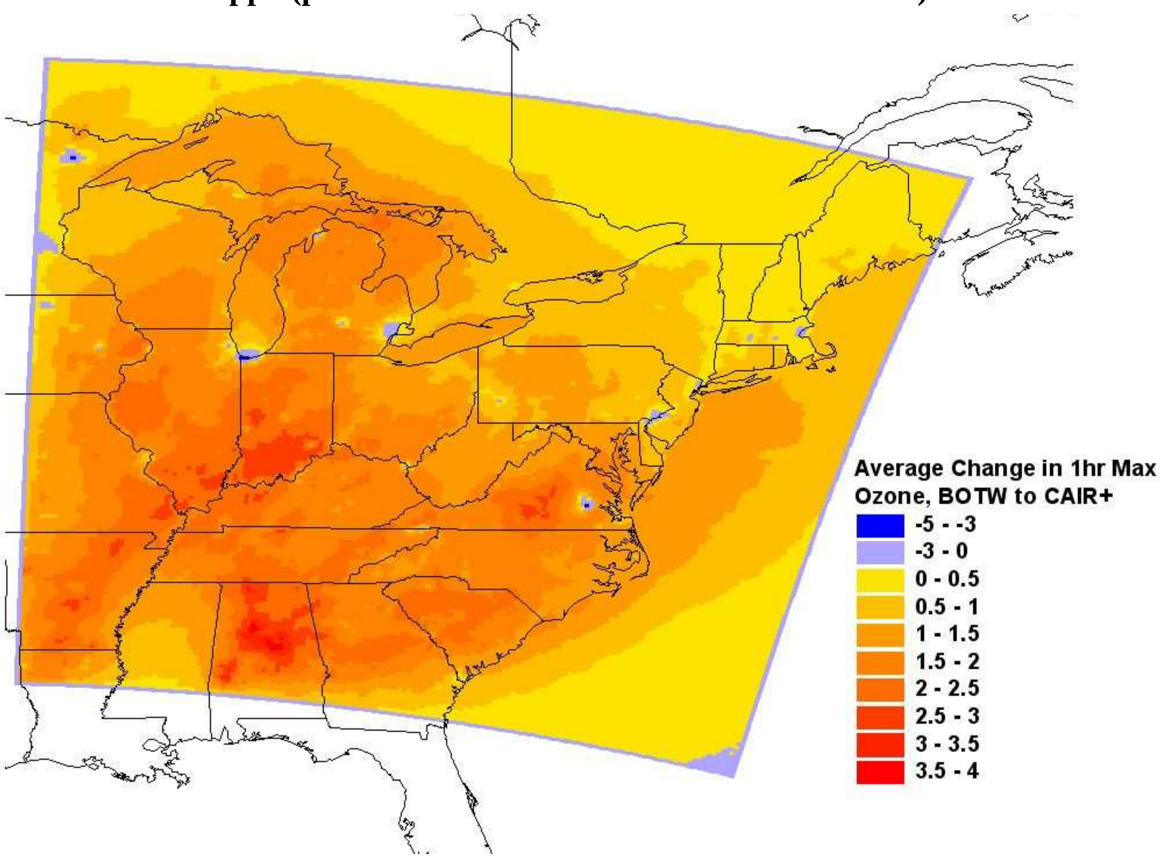


**Figure 3-2. Average change in 24-hr mean ozone concentration due to CAIR+ measures during 2018 ozone season (May 1st-Sept. 30th), ppb (positive numbers indicate an ozone decrease)**

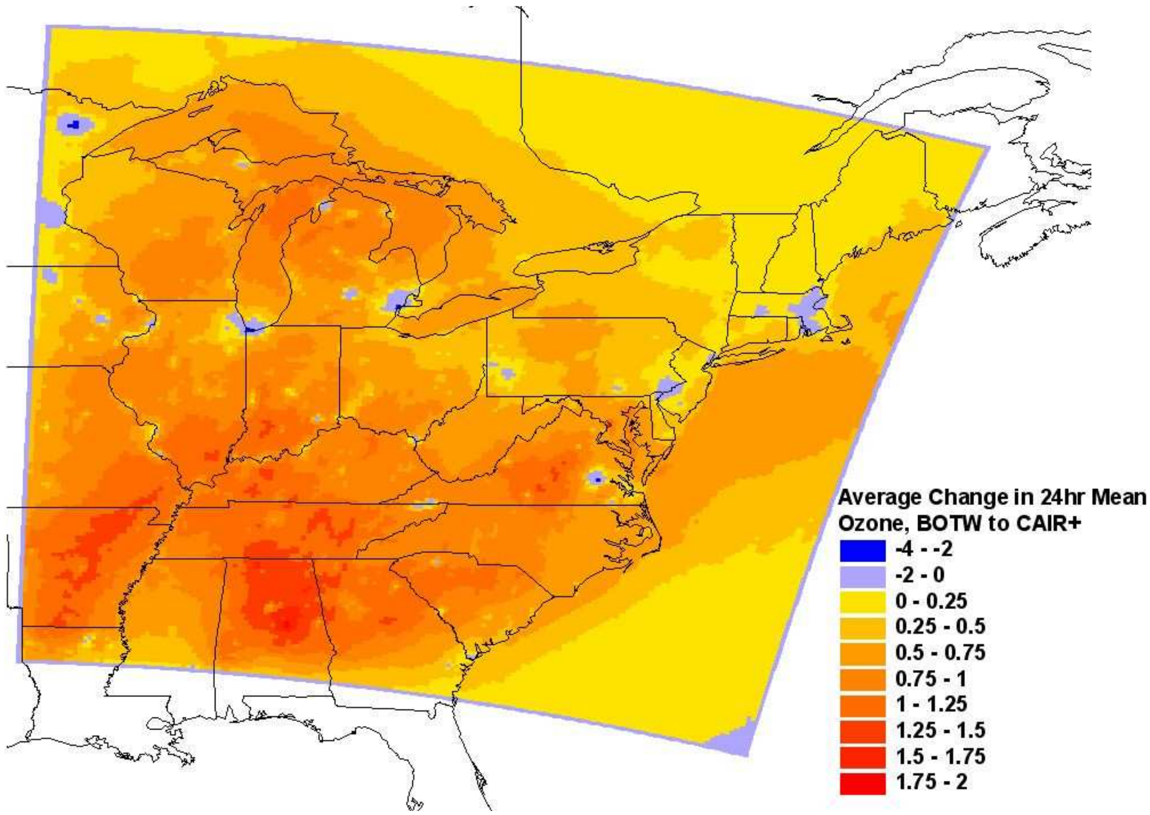



Figure 3-1and Figure 3-2 indicate that while the largest decreases in ozone levels due to CAIR+ are occurring in the south/southeast region, the OTR states still see decreases in average ozone concentrations. Within certain metropolitan areas, such as Boston and Philadelphia, we see increases in average ozone concentrations. We investigated this by looking at the diurnal profiles for the CAIR+ and BOTW scenarios within the grid cells surrounding the cities where average increases were found. In these grid cells, we saw slight to moderately higher hourly levels in the CAIR+ case during the nighttime hours while hourly concentrations during the day time were very similar in the two cases. Nighttime levels were between 5 and 20 ppb depending on the grid cell while differences between the two cases at night were generally between 5 and 10 ppb. The wide availability of NOx in urban environments rapidly depletes ozone concentrations after sunset when ozone production is no longer taking place, an effect known as NOx scavenging. We conclude that the CALGRID and BenMAP results reflect a decrease in nighttime NOx scavenging which allow ozone concentrations to return closer to natural background levels (~30ppb) than what is currently observed during overnight hours.

Based on the reduced ozone concentrations shown in Figures 3-1 and 3-2, we estimated the avoided incidences and value of the avoided incidences of mortality and several morbidity endpoints. Table 3-1 displays the mean of the estimated value of reduced incidences of mortality and morbidity. We present mortality as a range of estimates based on five studies examining the relationship between elevated ozone concentrations and mortality. More detailed estimates of avoided incidences along with study specific mortality estimates and confidence intervals of the estimates can be found in Appendix B.

**Table 3-1. Summary of avoided incidences attributed to reduced ozone due to CAIR+ in OTR states.**

| *State* | *ER Visits, Asthma* | *Hospital Admissions, All Respiratory Endpoints, >64 Years and <2 Years* | *School Loss Days* | *Loss of Income Due to Decreased Worker Productivity* | *Mortality (Range of Five Studies)* |
|---|---|---|---|---|---|
| CT | 2.0 | 19.4 | 3350 | 52694 | 1.3 - 2.9 |
| DE | 0.3 | 2.1 | 642 | 14732 | 0.1 - 0.6 |
| DC | 1.1 | 11.8 | 1438 | 11115 | 0.9 - 2 |
| ME | 0.5 | 6.1 | 865 | 102753 | 0.5 - 1.1 |
| MD | 9.5 | 90.0 | 14531 | 255691 | 5.8 - 13.1 |
| MA | 0.6 | -2.0 | 1625 | -44271 | -1.3 - 1.8 |
| NH | 0.5 | 4.2 | 893 | 22557 | 0.3 - 0.8 |
| NJ | 3.5 | 22.7 | 6221 | 45732 | 1 - 6 |
| NY | 11.9 | 107.7 | 19439 | 356131 | 7.2 - 18 |
| PA | 6.2 | 44.3 | 10681 | 311259 | 2.3 - 13.4 |
| RI | 0.4 | 1.5 | 712 | 2558 | 0 - 0.8 |
| VT | 0.2 | 2.5 | 326 | 31347 | 0.2 - 0.4 |
| VA | 10.5 | 96.8 | 16470 | 544941 | 5.7 - 15.5 |
| **OTR Total** | 47.4 | 407.2 | 77191 | 1707240 | 24.4 - 76 |

Table 3-2 shows that reductions in ozone due to CAIR+ control strategies could result in 24 to 76 reduced incidences of premature mortality over all OTR states. Table 3-2 shows that these reductions result in the majority of the value of the program predicted by BenMAP. Appendix B displays a more detailed state-by-state estimate of the value of reduced incidences in OTR states.

**Table 3-2. Summary of the value of avoided incidences attributed to reduced ozone due to CAIR+ in OTR states.**

| *State* | ***Total Value of Avoided Respiratory Endpoints-** Hospital Admissions >64 Years and <2 Years, Asthma ER Visits, School Loss Days, Decreased Worker Productivity (Millions of 2000$)* | ***Mortality-** Range of Five Studies (Millions of 2000$)* |
|---|---|---|
| CT | 0.59 | 8 - 18.52 |
| DE | 0.09 | 0.35 - 3.91 |
| DC | 0.30 | 5.64 - 12.9 |
| ME | 0.26 | 2.9 - 6.92 |
| MD | 2.64 | 36.28 - 82.57 |
| MA | 0.00 | -8.23 - 11.46 |
| NH | 0.15 | 1.58 - 5.27 |
| NJ | 0.79 | 6.06 - 37.57 |
| NY | 3.40 | 45.62 - 113.91 |
| PA | 1.70 | 14.22 - 84.45 |
| RI | 0.07 | 0.04 - 4.76 |
| VT | 0.09 | 1.18 - 2.65 |
| VA | 3.13 | 35.66 - 97.78 |
| **OTR Total** | 13.20 | 153.86 - 479.55 |

Table 3-2 shows that a CAIR+ program could result in an estimated 167 to 493 million dollars in saved health costs due to avoided morbidity and mortality in 2018. Over 90 percent of this estimate is based on the benefit calculated from reduced incidences of premature mortality. Appendix B displays the estimates of incidence and value of each morbidity endpoint and mortality study used in this analysis as well as confidence intervals calculated within BenMAP.

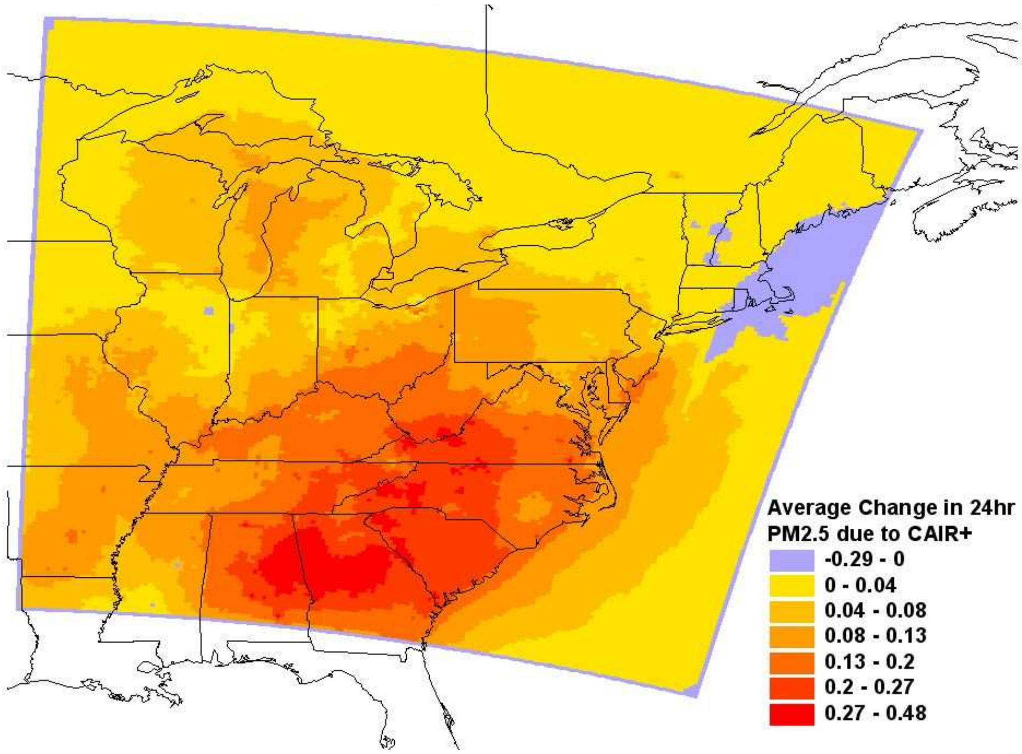
Figure 3-2 indicates that the majority of the CAIR+ induced ozone reductions tend to occur in the South and Southeast region. Based on our analysis, we estimate an additional 43 million dollars in benefit from reduced incidences of respiratory endpoints and 520 million to 1.4 billion dollars in benefit from reduced incidences in mortality in the states outside of the OTR. Overall, CAIR+ results in an additional benefit of 560 million to 1.4 billion dollars of benefit in the states outside of the OTR (within the modeled domain) due to reductions in ozone.

## 3.2. Benefits from Reductions in $PM_{2.5}$

We utilized the CALGRID model output and 2002 monitoring data to estimate $PM_{2.5}$ concentrations in 2018 under a BOTW control scenario and a CAIR+ control scenario. Much like the method used to develop air quality grids for ozone, we used the ratio of the 2002 CALGRID modeling data to each of the future year scenarios to adjust 2002 monitoring data. The future year air quality grids contained information on the 24-hr average $PM_{2.5}$ concentrations for each of the future year scenarios over the entire year. The change in 24-hr $PM_{2.5}$ is the only metric used to calculate avoided health endpoints due to reduced exposures to $PM_{2.5}$.

Figure 3-3 shows that while the majority of the $PM_{2.5}$ reductions used in the calculation of health benefits are expected to occur in the southern states, significant reductions also occur within the OTR. Within the OTR, the largest $PM_{2.5}$ reductions due to CAIR+ occur in the southern part of the region while the northern states see a smaller benefit from the program. The CALGRID modeling predicts slight increases in $PM_{2.5}$ along the eastern coast of Massachusetts and in Rhode Island. A more detailed examination of this phenomenon revealed that the two modeled scenarios were developed from IPM model runs that had different (and inconsistent) reference assumptions (e.g. the price of natural gas). The result is that a significant increase in coal-fired power generation in the Northeast was modeled in the CAIR+ scenario that was not a result of the CAIR+ program itself (these simulated plants are in the IPM CAIR scenario as well as the CAIR+ scenario that used the same assumptions). However, when we compare this scenario to the BOTW scenario that used different assumptions (resulting in little or no new coal generation in the region) we see project increased PM2.5 due to the input assumptions not related to the CAIR+ program.

**Figure 3-3. Average change in 24-hr mean $PM_{2.5}$ concentration due to CAIR+ measures during 2018 (Jan. 1st-Dec. 31st), $\mu g/m^3$ (positive numbers indicate a decrease)**




While this calls into question the specific benefits assessment for any given location, we are confident that the overall regional estimates of benefits are still valid given the broad-based reductions required under the CAIR+ program. This analysis would need to be repeated with air quality scenarios based on consistent IPM assumptions in order to develop location-specific estimates of health benefits for the CAIR+ program.

We applied the changes in $PM_{2.5}$ concentrations predicted by CALGRID from Figure 3-3 to estimate the magnitude and value of avoided adverse health endpoints within the domain. Table 3-3 displays the total benefit from all OTR states for all the endpoints calculated within this study. State-specific estimates and confidence intervals of the estimates are in Appendix B.

**Table 3-3. Summary of the number and value of avoided incidences attributed to reduced $PM_{2.5}$ due to CAIR+ in OTR states.**

| | OTR Totals | |
|---|---|---|
| | Incidences (Mean) | Value (mean, Millions of 2000$) |
| Mortality (Adults ages 30 and older) | 228 | 1433.66 |
| Mortality (Infants less than 1 year of age) | 0.38 | 2.42 |
| Acute Bronchitis (Children, ages 8-12) | 319 | 0.12 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 404 | 26.65 |
| Astham Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 2446 | 0.38 |
| Astham Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 4282 | 0.67 |
| Astham Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 2708 | 0.42 |
| Chronic Bronchitis (Adults 27 years and older) | 145 | 48.80 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 166 | 0.05 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 50 | 0.76 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 14 | 0.22 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 25 | 0.66 |
| Hospital Admissions- Asthma (Population under 65 years) | 26 | 0.20 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 87 | 1.86 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 45 | 1.02 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 22 | 0.29 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 11 | 0.12 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 65 | 1.17 |
| Work Loss Days (Adults 18-65 years) | 26716 | 3.66 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 3793 | 0.71 |

Table 3-4 indicates that much like ozone, the majority of the economic benefits of CAIR+ reductions in $PM_{2.5}$ are due to reduced mortality in the region. It should be noted, however, that hundreds of emergency room visits and hospital admissions would also be avoided each year. Table 3-4 displays the total monetary benefit of CAIR+ reductions in $PM_{2.5}$ in the OTR for the three categories of benefits – cardiovascular endpoints, respiratory endpoints, and mortality.

**Table 3-4. Total estimated value of avoided incidences attributed to reduced $PM_{2.5}$ due to CAIR+ in OTR states.**

| ***Endpoint*** | ***OTR Total Value (Millions of 2000$)*** |
|---|---|
| Mortality | 1436.08 |
| Cardiovascular Symptoms | 31.17 |
| Respiratory Symptoms | 56.60 |

In states outside the OTR, we see significant additional benefits attributed to CAIR+ reductions in $PM_{2.5}$. Table 3-5 below displays the monetized benefit to states outside the OTR (but within the modeling domain) attributed to reductions in $PM_{2.5}$. Overall we estimate that CAIR+ could result in 4.4 billion dollars in benefits to the states outside of the OTR.

**Table 3-5. Total estimated value of avoided incidences attributed to reduced $PM_{2.5}$ due to CAIR+ in states outside of OTR.**

| *Endpoint* | *Total Value from States Outside OTR (Millions of 2000$)* |
|---|---|
| Mortality | 4185.95 |
| Cardiovascular Symptoms | 74.34 |
| Respiratory Symptoms | 165.57 |

## 3.3. CAIR+ Benefits Discussion

Based on our analysis of modeled concentrations in 2018 using BenMAP, we estimated benefits from reductions of ozone and $PM_{2.5}$ in the OTR due to CAIR+ control measures. We estimated a total value in 2018 of 1.52 billion dollars from reductions in $PM_{2.5}$ exposure and a total value in the five month ozone season in 2018 of 167 to 492 million dollars from reductions in ozone exposure. Overall, the we estimate that the CAIR+ program could result in 1.7 to 2.0 billion dollars in 2018 due to reduced adverse health endpoints from exposures to $PM_{2.5}$ and ozone in the OTR. In states outside the OTR, we estimated a benefit of 560 million to 1.4 billion dollars due to ozone reductions and 4.4 billion dollars due to $PM_{2.5}$ reductions- a total benefit of 5.5 to 5.8 billion dollars. Across the entire modeled domain (Eastern US) we estimated a total benefit to the program of 6.7 to 7.8 billion dollars.

While the majority of the reductions in $PM_{2.5}$ and ozone occur in the south and southeast regions, a large benefit is also accrued along the East Coast. States showing the largest benefit to these programs are along the southern portion of the OTR including Maryland, Virginia, New York, and New Jersey. Fewer benefits are seen in the northern states such as Maine and New Hampshire as projections indicate that compliance with CAIR+ tends to reduce power plant emissions to a greater extent in the southern states. In addition, the use of inconsistent input assumptions to the two IPM runs used to create the different air quality scenarios result in estimated increases of $PM_{2.5}$ within some grid cells. Some small increases in ozone in urban locations can be attributed to reduced nighttime NOx scavenging. However, such increases were small and limited in spatial scale while the overall program results in large net benefits to the broader region.

# 4. $SO_2$ CONTROL MEASURES IN MANE-VU

We analyzed a second set of control scenarios with respect to potential health benefits based on four control strategies aimed at reducing regional haze at Class I areas in the MANE-VU region. These programs include two separate but linked low-sulfur content fuel initiatives (the S1 and S2 strategies), the BART provisions of the Regional Haze Rule, and controls on EGUs at the 167 stacks most likely to affect MANE-VU Class I areas (167 EGU strategy). This chapter reviews the control strategies in more detail, describes the potential emissions reductions, and describes the potential health benefits of each strategy and the combination.

## 4.1. Reduced sulfur fuel content (S1 and S2)

The MANE-VU states have agreed through consultations to pursue a low sulfur fuel strategy within the region. This phased strategy would be implemented in two steps; however, both components of the strategy are to be fully implemented by 2018. We have analyzed both steps of the program as separate strategies, but it is the combined benefit of implementing the program that is relevant to the question of program benefits.

The S1 strategy requires the lowering of fuel-sulfur content in distillate (#2 oil) from current levels that range between 2,000 and 2,300 ppm down to 500 ppm by weight. It also restricts the sale of heavier blends of residual oil (#4 fuel oil and #6 bunker fuels) that have sulfur content greater than 0.25 percent sulfur and 0.5 percent sulfur by weight, respectively. The S2 strategy further reduces the fuel-sulfur content of the distillate fraction to 15 ppm sulfur by weight. The residual oil is maintained at the same S1 level for this strategy.

The S1 strategy and S2 strategy are to be implemented in sequence with slightly different timing for "inner zone" states[2] and the remainder of MANE-VU. All states, however, have agreed to pursue reductions that would take place no later than 2018. Thus for the purposes of this analysis, we have examined the benefits of the S1 and S2 strategies separately below.

Based on the fuel sulfur limits within the S1 strategy, we estimated a decrease of 140,000 tons of $SO_2$ emitted from distillate combustion and 40,000 tons of $SO_2$ from residual combustion in MANE-VU. Figure 4-1 displays the resulting average change in 24-hr average $PM_{2.5}$ between the baseline case (OTB/OTW) and the control case where the S1 fuel strategy has been implemented.

We used the concentration changes in Figure 4-1 above to derive health benefits and their associated valuation using BenMAP. Table 4-1 and Table 4-2 display the total number of reduced incidences and value of reduced incidences within MANE-VU, VISTAS, and MWRPO. Because the S1 fuel sulfur program only affects sources within MANE-VU, that region sees the largest $PM_{2.5}$ reduction and the greatest health benefits.

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[2] The inner zone includes New Jersey, Delaware, New York City, and potentially portions of eastern Pennsylvania.

**Figure 4-1. Average change in 24-hr $PM_{2.5}$ due to S1 emission reductions ($\mu g/m^3$)**

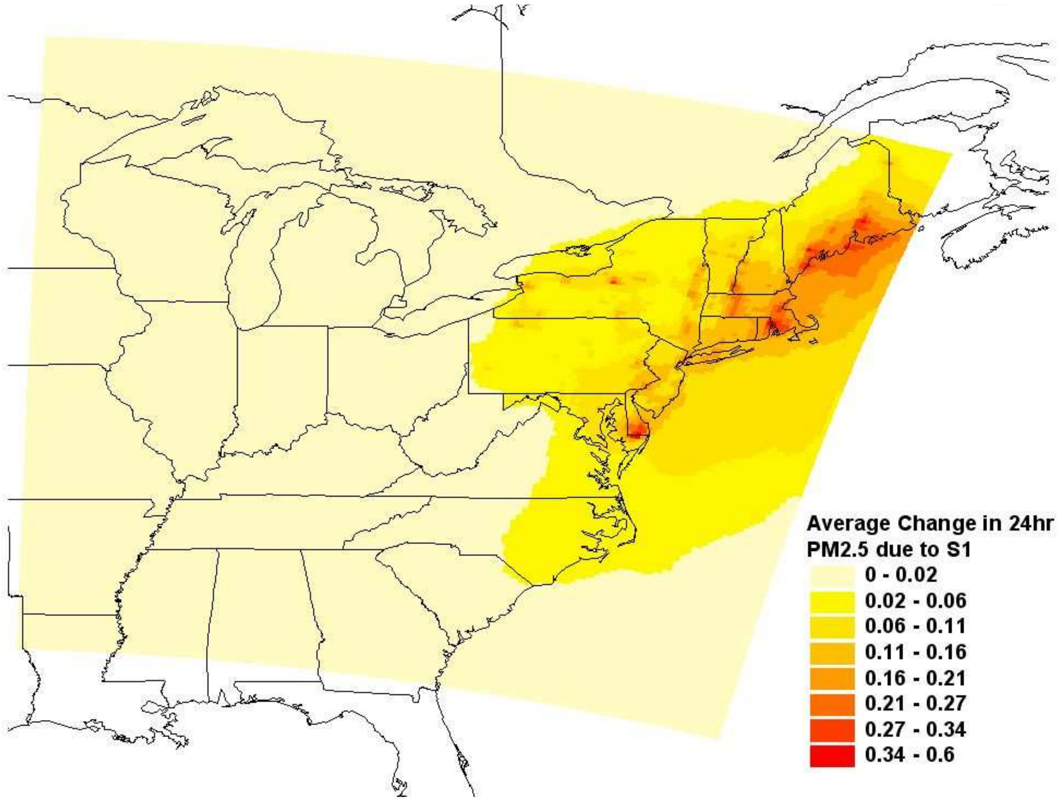



**Table 4-1. Avoided incidences attributed to reduced $PM_{2.5}$ due to S1 fuel sulfur control.**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 513 | 32.1 | 8.7 |
| Mortality (Infants less than 1 year of age) | 0.77 | 0.07 | 0.02 |
| Acute Bronchitis (Children, ages 8-12) | 754 | 50.9 | 12.9 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 145 | 9.6 | 2.49 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 812 | 78.7 | 15.9 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 1421 | 137.7 | 27.74 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 899 | 87.1 | 17.55 |
| Chronic Bronchitis (Adults 27 years and older) | 337.5 | 22.1 | 5.61 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 44.8 | 6.84 | 1.64 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 16.1 | 1.38 | 0.34 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 5 | 0.33 | 0.08 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 8.6 | 0.65 | 0.15 |
| Hospital Admissions- Asthma (Population under 65 years) | 10 | 0.59 | 0.13 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 29.5 | 2.25 | 0.52 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 14.7 | 1.3 | 0.22 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 7 | 0.61 | 0.14 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 3.7 | 0.32 | 0.07 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 20.5 | 1.86 | 0.48 |
| Work Loss Days (Adults 18-65 years) | 8795 | 849 | 167 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 1245 | 122 | 25 |

**Table 4-2. Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1 fuel sulfur control (millions of 2000$).**

| | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 3230 | 202 | 55 |
| Mortality (Infants less than 1 year of age) | 4.86 | 0.47 | 0.12 |
| Acute Bronchitis (Children, ages 8-12) | 0.28 | 0.02 | 0.005 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 9.55 | 0.63 | 0.16 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.13 | 0.01 | 0.002 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.22 | 0.02 | 0.004 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.14 | 0.01 | 0.003 |
| Chronic Bronchitis (Adults 27 years and older) | 114 | 7 | 2 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.01 | 0 | 0 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.25 | 0.02 | 0.005 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.08 | 0.01 | 0.001 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.22 | 0.02 | 0.004 |
| Hospital Admissions- Asthma (Population under 65 years) | 0.08 | 0 | 0.001 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.63 | 0.05 | 0.011 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.34 | 0.03 | 0.005 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.1 | 0.01 | 0.002 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.04 | 0 | 0.001 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 0.37 | 0.03 | 0.009 |
| Work Loss Days (Adults 18-65 years) | 1.24 | 0.1 | 0.021 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.23 | 0.02 | 0.005 |

Table 4-3 displays the total value of the S1 program in each of the three RPOs. Implementation of this fuel strategy aimed at regional haze improvement could result in almost 3.5 billion dollars of benefit to the MANE-VU states. Additionally, this strategy could result in 270 million dollars of health benefit to the states within the VISTAS and MWRPO states.

**Table 4-3. Total value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1 fuel sulfur control (millions of 2000$).**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality | 3234 | 203 | 55 |
| Cardiovascular Symptoms | 10.5 | 0.71 | 0.2 |
| Respiratory Symptoms | 117 | 7.7 | 2 |

The S2 fuel strategy further reduces the sulfur content of distillate from 500 ppm to 15 ppm while keeping the sulfur limits on residual oils to 0.25 percent and 0.5 percent for No. 4 and No. 6 oils, respectively. By lowering the distillate fuel sulfur limit from 500 ppm to 15 ppm we estimate an additional reduction of 27,000 tons of $SO_2$ emissions in MANE-VU from distillate combustion in 2018. Figure 4-2 displays the average change in 24-hr $PM_{2.5}$ calculated from CMAQ modeled concentrations between the S1 scenario and the S2 scenario. The change reflects the predicted change in $PM_{2.5}$ due solely to the change from 500 ppm to 15 ppm distillate. Due to a high baseline fuel sulfur level, the incremental change in $PM_{2.5}$ concentration is much smaller between 500 ppm and 15 ppm than the baseline to 500 ppm levels observed in the S1 scenario.

**Figure 4-2. Average change in 24-hr $PM_{2.5}$ due to S2 emission reductions, relative to S1 ($\mu g/m^3$)**

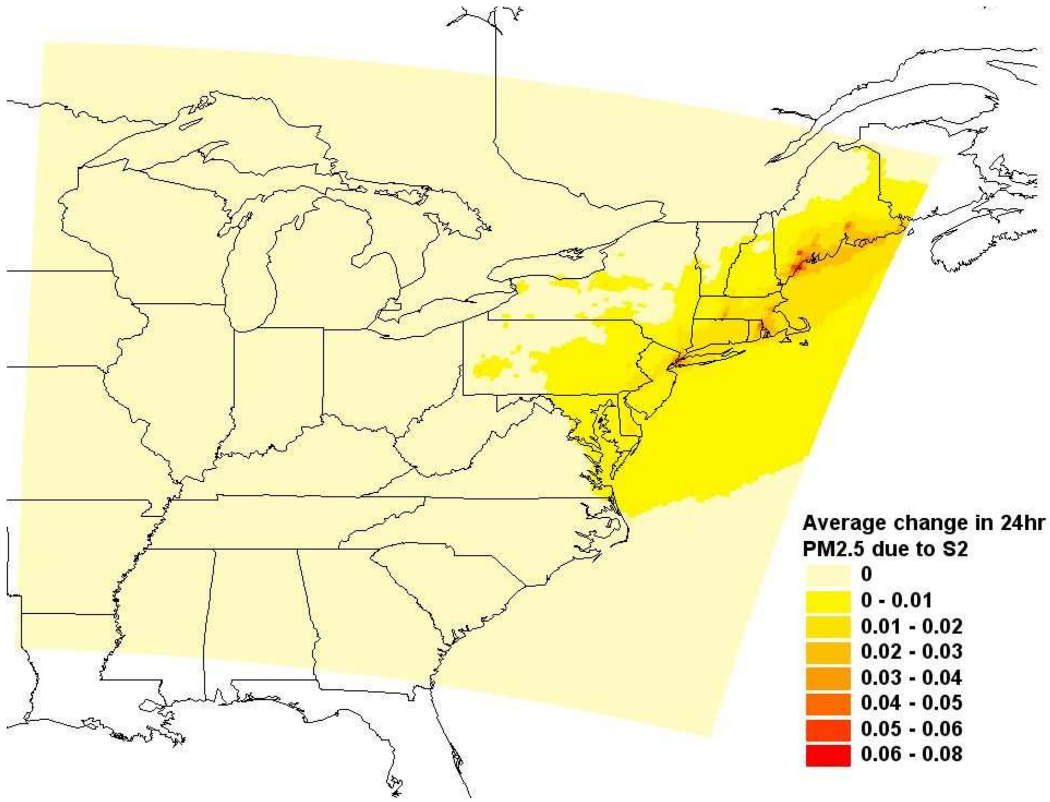



Table 4-4 and Table 4-5 display the additional health benefits that can be realized from the S2 portion of the fuel strategy. Table 4-6 indicates that almost 450 million dollars in health benefits could be accrued with an S2 fuel sulfur strategy in MANE-VU. An additional 28 million dollars in benefits could be found in the VISTAS and MWRPO states.

**Table 4-4. Avoided incidences attributed to reduced $PM_{2.5}$ due to 15 ppm fuel sulfur control relative to 500 ppm sulfur limit.**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 68 | 3.5 | 0.8 |
| Mortality (Infants less than 1 year of age) | 0.11 | 0.01 | 0.002 |
| Acute Bronchitis (Children, ages 8-12) | 103.9 | 5.6 | 1.2 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 18.99 | 1.06 | 0.22 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 107 | 8.7 | 1.4 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 188 | 15.2 | 2.4 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 119 | 9.6 | 1.5 |
| Chronic Bronchitis (Adults 27 years and older) | 46.1 | 2.5 | 0.54 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 5.91 | 0.76 | 0.14 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 2.09 | 0.153 | 0.03 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.65 | 0.036 | 0.01 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1.12 | 0.072 | 0.01 |
| Hospital Admissions- Asthma (Population under 65 years) | 1.33 | 0.065 | 0.012 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 3.83 | 0.249 | 0.04 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 1.92 | 0.144 | 0.02 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.91 | 0.067 | 0.01 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.49 | 0.035 | 0.006 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 2.66 | 0.21 | 0.042 |
| Work Loss Days (Adults 18-65 years) | 1175 | 94 | 14 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 165 | 13 | 2 |

**Table 4-5. Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 15 ppm fuel sulfur control relative to 500 ppm sulfur limit (millions of 2000$).**

| | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 430 | 20 | 5.3 |
| Mortality (Infants less than 1 year of age) | 0.69 | 0.05 | 0.01 |
| Acute Bronchitis (Children, ages 8-12) | 0.04 | 0.002 | 0.0005 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1.25 | 0.07 | 0.01 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.02 | 0.001 | 0.0002 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.03 | 0.002 | 0.0004 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.02 | 0.002 | 0.0002 |
| Chronic Bronchitis (Adults 27 years and older) | 15.55 | 0.83 | 0.18 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.002 | 0 | 0 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.03 | 0.002 | 0.0005 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.01 | 0.001 | 0.0001 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.03 | 0.002 | 0.0003 |
| Hospital Admissions- Asthma (Population under 65 years) | 0.01 | 0.001 | 0.0001 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.08 | 0.005 | 0.001 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.04 | 0.003 | 0.0004 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.01 | 0.001 | 0.0002 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.01 | 0 | 0.0001 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 0.05 | 0.004 | 0.001 |
| Work Loss Days (Adults 18-65 years) | 0.17 | 0.011 | 0.002 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.03 | 0.003 | 0.0004 |

**Table 4-6. Total value of avoided incidences attributed to reduced $PM_{2.5}$ due to 15 ppm fuel sulfur control relative to 500 ppm sulfur limit (millions of 2000$).**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality | 431 | 22 | 5 |
| Cardiovascular Symptoms | 1.38 | 0.08 | 0.02 |
| Respiratory Symptoms | 16 | 0.85 | 0.19 |

To determine the full benefit of the fuel strategies being considered relative to the OTB/OTW baseline, we can look at the combined benefit of the S1 (500 ppm distillate and 0.25/0.5 percent residual oil) strategy *and* the S2 (15 ppm distillate) strategy. Table 4-7 shows the total value of avoided incidences relative to OTB/OTW from a 15 ppm fuel sulfur limit program. The CMAQ and BenMAP modeling results suggest that this fuel program could result in 3.8 billion dollars in benefits for MANE-VU and an additional 300 million dollars in benefits for the VISTAS and MWRPO states.

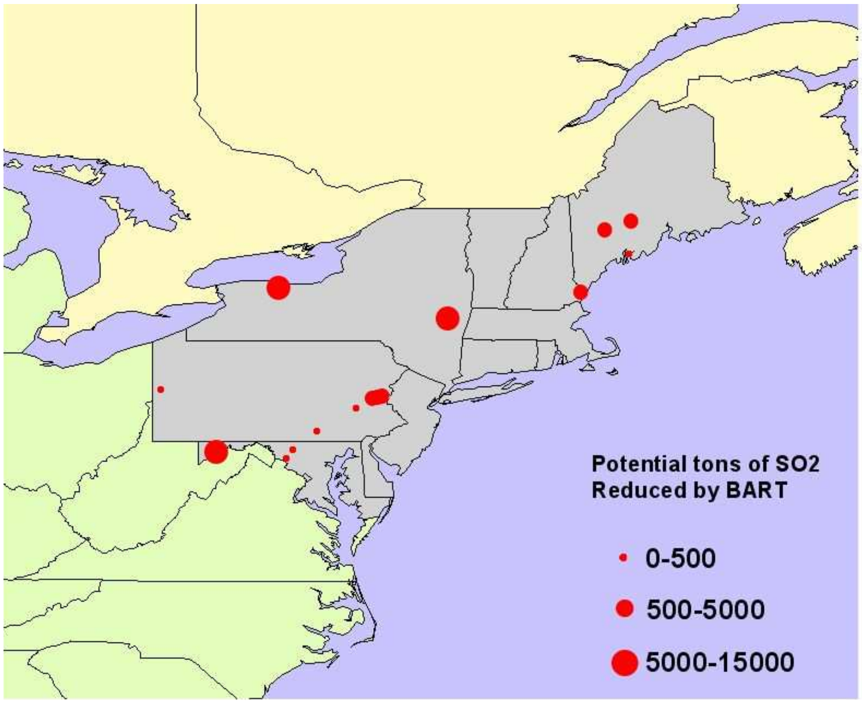
**Table 4-7. Total value of avoided incidences attributed to reduced $PM_{2.5}$ due to 15 ppm fuel sulfur control relative to OTB/OTW (millions of 2000$).**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality | 3665 | 225 | 60 |
| Cardiovascular Symptoms | 12 | 1 | 0 |
| Respiratory Symptoms | 133 | 9 | 2 |

## 4.2. Best Available Retrofit Program (BART)

To assess the impacts of the implementation of the BART provisions of the Regional Haze Rule, we included estimated reductions anticipated for 14 BART-eligible facilities in MANE-VU in the 2018 CMAQ modeling analysis. An initial survey of state staff indicated that these 14 units would possibly be controlled under BART alone. These states provided potential control technologies and levels of control, which were in turn incorporated into the 2018 emission inventory projections. The survey approach can be found in NESCAUM (2007b). Figure 4-3 displays the locations of the modeled BART sources and estimated $SO_2$ reductions expected in 2018.

**Figure 4-3. Potential reductions from BART-eligible sources in the MANE-VU region (tons)**




We applied the $SO_2$ reductions at these 14 facilities relative to the 2018 OTB/OTW emissions inventory. Figure 4-4 shows the average change in 24-hr $PM_{2.5}$ concentrations within the modeling domain used to calculate the health benefits.

**Figure 4-4. Average change in 24-hr $PM_{2.5}$ due to BART emission reductions ($\mu g/m^3$)**

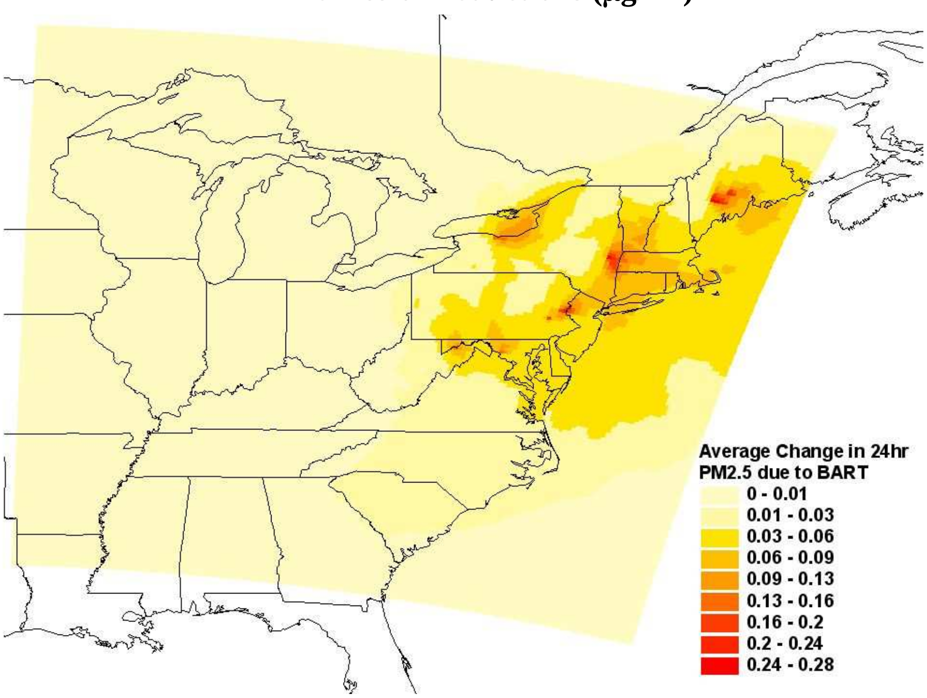


Table 4-8 and Table 4-9 display the avoided incidences and value benefit predicted from BenMAP. As expected, the majority of the benefits are found in MANE-VU as the emissions reductions occur in these states. Based on our BART analysis, we expect 38,000 tons of $SO_2$ to be reduced in MANE-VU at the 14 sources expected to control based on BART alone. Table 4-8 and Table 4-10 show that the reductions in $SO_2$ at these 14 sources can result in 200 avoided incidences in mortality and a total monetary benefit of 1.8 billion dollars in 2018.

Comparing across RPOs, we see that reductions at BART sources in the MANE-VU region could result in benefits within other RPOs. Reducing 38,000 tons of $SO_2$ at five MANE-VU states could give an added benefit of 200 million dollars in VISTAS states and 80 million dollars in MWRPO states in 2018.

**Table 4-8. Avoided incidences attributed to reduced $PM_{2.5}$ due to BART.**

| | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 209 | 30.4 | 11.6 |
| Mortality (Infants less than 1 year of age) | 0.315 | 0.068 | 0.026 |
| Acute Bronchitis (Children, ages 8-12) | 308 | 47.5 | 17.3 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 61.7 | 9.05 | 3 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 343.6 | 73.46 | 19.2 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 601.4 | 128.56 | 33.6 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 380.4 | 81.33 | 21.2 |
| Chronic Bronchitis (Adults 27 years and older) | 137.37 | 20.54 | 7.49 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 19.18 | 6.38 | 1.99 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 6.83 | 1.3 | 0.41 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 2.11 | 0.31 | 0.1 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 3.65 | 0.61 | 0.18 |
| Hospital Admissions- Asthma (Population under 65 years) | 4.19 | 0.55 | 0.16 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 12.5 | 2.12 | 0.62 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 6.29 | 1.22 | 0.27 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 2.97 | 0.58 | 0.17 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 1.59 | 0.3 | 0.09 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 8.7 | 1.76 | 0.58 |
| Work Loss Days (Adults 18-65 years) | 3694 | 788.3 | 202.5 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 531 | 114 | 30 |

**Table 4-9. Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART (millions of 2000$).**

| | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 1319 | 191 | 73 |
| Mortality (Infants less than 1 year of age) | 1.98 | 0.431 | 0.163 |
| Acute Bronchitis (Children, ages 8-12) | 0.12 | 0.018 | 0.006 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 4.07 | 0.596 | 0.19 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.05 | 0.011 | 0.003 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.09 | 0.02 | 0.005 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.06 | 0.013 | 0.003 |
| Chronic Bronchitis (Adults 27 years and older) | 46 | 6.9 | 2.5 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.005 | 0.002 | 0.001 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.105 | 0.02 | 0.006 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.03 | 0.005 | 0.001 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.09 | 0.016 | 0.005 |
| Hospital Admissions- Asthma (Population under 65 years) | 0.03 | 0.004 | 0.001 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.27 | 0.045 | 0.013 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.14 | 0.028 | 0.006 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.04 | 0.008 | 0.002 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.02 | 0.003 | 0.001 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 0.16 | 0.031 | 0.01 |
| Work Loss Days (Adults 18-65 years) | 0.52 | 0.094 | 0.026 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.099 | 0.021 | 0.006 |

**Table 4-10. Total Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART (millions of 2000$).**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality | 1321 | 192 | 73 |
| Cardiovascular Symptoms | 4.5 | 0.7 | 0.2 |
| Respiratory Symptoms | 48 | 7 | 3 |

CMAQ and BenMAP modeling suggest that approximately 1.8 billion dollars of benefits from avoided adverse health outcomes could be realized from BART in MANE-VU. Although all the BART sources we modeled were located in MANE-VU, emission reductions at these units resulted in an estimated 270 million dollars of health benefit in the VISTAS and MWRPO states.

## 4.3. 167 EGU Strategy

The MANE-VU states have recognized that $SO_2$ emissions from power plants are the single largest contributing sector to the visibility impairment experienced in northeast Class I areas. The $SO_2$ emissions from power plants continue to dominate the inventory. Sulfate formed through atmospheric processes from $SO_2$ emissions are responsible for over half the mass and approximately 70-80 percent of the extinction on the worst visibility days (NESCAUM, 2006a,b). In order to ensure that EGU controls are targeted at those EGUs with the greatest impact on visibility in MANE-VU, a modeling analysis was conducted to determine which sources those were. A list of 167 EGU stacks was identified (MANE-VU, 2007) that includes the 100 largest impacts at each MANE-VU Class I site during 2002. MANE-VU is currently asking for 90 percent control on all units emitting from those stacks by 2018 as part of consultations within MANE-VU and with other RPOs.

The 167 EGU strategy, if implemented, could lead to large reductions in $SO_2$ emissions due to installation of stack control technologies such as $SO_2$ scrubbers. To determine the possible health benefits of this EGU control program, we modeled 2018 emissions for the 167 EGUs in the Northeast, Southeast, and Midwest at levels equal to 10 percent of their 2002 emissions. We used CMAQ to model sulfate concentrations in 2018 after implementation of this control program and converted sulfate concentrations to $PM_{2.5}$ concentrations. Figure 4-5 displays the average change in 24-hr $PM_{2.5}$ seen between the OTB/OTW baseline and the EGU stack control program.

**Figure 4-5. Average change in 24-hr $PM_{2.5}$ due to 167 EGU emission reductions**

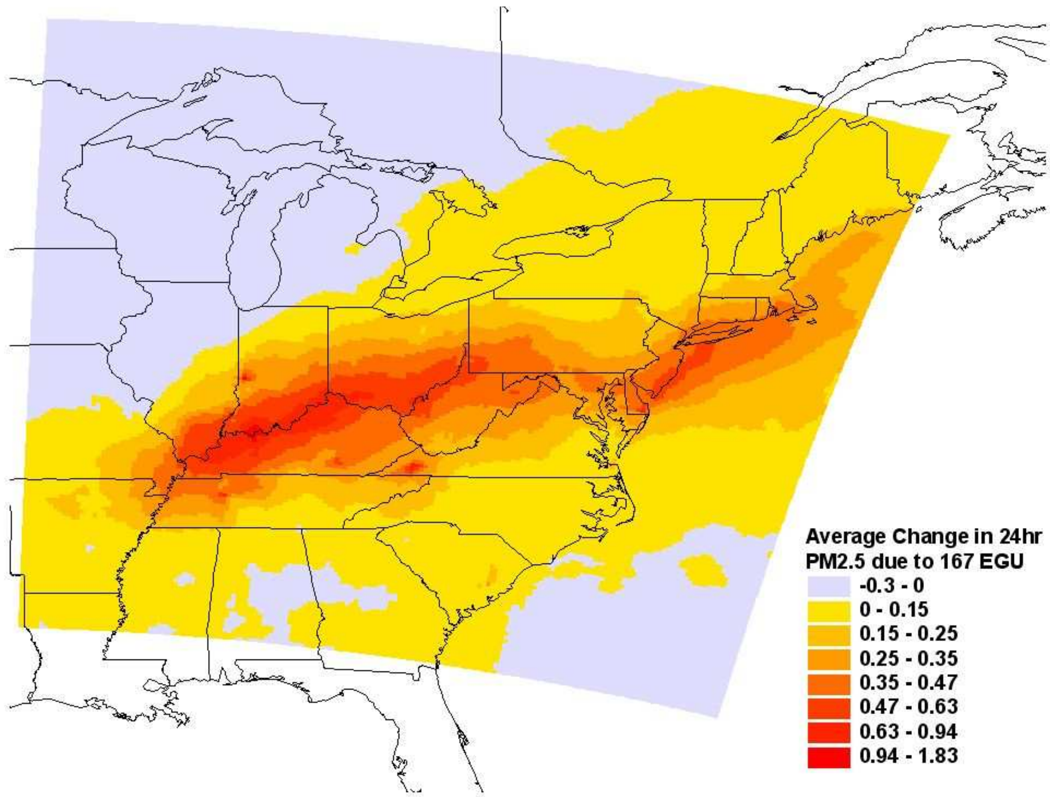



Figure 4-5 shows that significant reductions of $PM_{2.5}$ are predicted for the MANE-VU region. Table 4-12 describes the number and value of avoided incidences estimated from BenMAP based on this reduction in $PM_{2.5}$. Of the four regional haze programs discussed, we see the largest benefit attributed to the 167 EGU stack control program.

**Table 4-11. Avoided incidences attributed to reduced $PM_{2.5}$ from 167 EGU strategy.**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 994 | 323 | 334 |
| Mortality (Infants less than 1 year of age) | 1.52 | 0.67 | 0.74 |
| Acute Bronchitis (Children, ages 8-12) | 1424 | 450 | 485 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 301 | 96 | 51 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 1699 | 732 | 324 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 2976 | 1282 | 568 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 1881 | 810 | 359 |
| Chronic Bronchitis (Adults 27 years and older) | 641 | 203.6 | 213 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 97 | 63.3 | 32 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 34.3 | 14.2 | 7.1 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 10.5 | 3.4 | 1.7 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 18.1 | 6.73 | 3.2 |
| Hospital Admissions- Asthma (Population under 65 years) | 20.5 | 5.56 | 2.8 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 62.3 | 23.27 | 11.1 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 31.03 | 12.62 | 4.9 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 14.87 | 6.33 | 3.1 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 7.85 | 3.14 | 1.6 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 43.72 | 19.18 | 10.1 |
| Work Loss Days (Adults 18-65 years) | 18392 | 7895 | 3474 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 2610 | 1128 | 490 |

**Table 4-12. Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU strategy (millions of 2000$).**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality (Adults ages 30 and older) | 6261 | 2035 | 2107 |
| Mortality (Infants less than 1 year of age) | 9.61 | 4.23 | 4.64 |
| Acute Bronchitis (Children, ages 8-12) | 0.53 | 0.17 | 0.18 |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 19.84 | 6.33 | 3.36 |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.27 | 0.11 | 0.05 |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.46 | 0.2 | 0.09 |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.29 | 0.13 | 0.06 |
| Chronic Bronchitis (Adults 27 years and older) | 216.2 | 68.7 | 71.93 |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.03 | 0.02 | 0.01 |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.53 | 0.22 | 0.11 |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.16 | 0.05 | 0.03 |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.47 | 0.17 | 0.08 |
| Hospital Admissions- Asthma (Population under 65 years) | 0.16 | 0.04 | 0.02 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1.33 | 0.49 | 0.24 |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.71 | 0.29 | 0.11 |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.2 | 0.08 | 0.04 |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.08 | 0.03 | 0.02 |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 0.79 | 0.34 | 0.18 |
| Work Loss Days (Adults 18-65 years) | 2.6 | 0.9 | 0.41 |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.49 | 0.21 | 0.09 |

The CMAQ and BenMAP modeling suggests that 6.5 billion dollars in benefit could be realized in MANE-VU in 2018 by adopting appropriate controls at 167 EGU stacks (Table 4-13). Because this control strategy extends to sources in the VISTAS and

MWRPO states, we see significant benefits to populations within those states. Due to controls at these sources, we estimate 2.1 billion dollars in benefits for the VISTAS states and 2.2 billion dollars in benefits for the MWRPO states. The majority of this estimate lies in the number of avoided mortalities as we estimate this program to reduce premature mortality by 1,600 cases across the three RPOs.

**Table 4-13. Total value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU strategy (millions of 2000$).**

| *Endpoint* | *MANE-VU* | *VISTAS* | *MWRPO* |
|---|---|---|---|
| Mortality | 6271 | 2040 | 2112 |
| Cardiovascular Symptoms | 22 | 7 | 4 |
| Respiratory Symptoms | 222 | 71 | 73 |

## 4.4. Summary of Regional Haze Program Benefits

While regional haze programs are designed to improve visibility at Class I areas, significant health benefits can also occur in MANE-VU with improved air quality. Table 4-14 displays the mean value of reduced adverse health endpoints in MANE-VU for the four haze programs.

**Table 4-14. Total value of avoided incidences attributed to reduced $PM_{2.5}$ due to regional haze programs in MANE-VU (millions of 2000$).**

| *Endpoint* | *S1* | *S2** | *BART* | *EGU* | *4-Program Total* |
|---|---|---|---|---|---|
| Mortality | 3234 | 431 | 1321 | 6271 | 11246 |
| Cardiovascular Symptoms | 11 | 1 | 4 | 22 | 38 |
| Respiratory Symptoms | 117 | 16 | 48 | 222 | 401 |

* Avoided incidences are relative to S1.

Of the four programs, we estimate the 167 EGU strategy to have the greatest benefits for the region. This program focuses on EGUs that are the largest uncontrolled emitters of $SO_2$ and considerable improvement in air quality could result with their control. The first phase of a sulfur-in-fuels limitation (S1) leads to almost 3.4 billion dollars of health benefit in MANE-VU. Controlling the fuel-sulfur content to 15 ppm (S2) could lead to an additional 431 million dollars in benefit, bringing the total benefit relative to OTB/OTW to 3.7 billion dollars of benefit. The BART estimate is based on controls at 14 units likely to be controlled under BART alone and with no other program that would satisfy the BART requirement. CMAQ and BenMAP modeling suggest that controls at these units could lead to 1.4 billion dollars of benefit in MANE-VU.

Looking across all regional haze programs, we estimate a four program total of 11.7 billion dollars in health benefits to MANE-VU in 2018. We base this benefits estimate on a 15 ppm fuel sulfur control, BART controls on 14 units in MANE-VU, and stack controls at 167 EGUs in the East, Southeast, and Midwest. Additionally, 4.9 billion dollars of health benefit are estimated for the states within VISTAS and MWRPO in 2018 due to implementation of these haze control strategies.

# 5. BENEFITS ANALYSIS OF THE PROPOSED OZONE NAAQS

## 5.1. Overview and Input Assumptions

To assess the benefits of alternative ozone standards, NESCAUM estimated the magnitude and value of avoided adverse health endpoints that would result in attaining a range of proposed ozone primary NAAQS in 2018. The purpose of this benefits analysis is to estimate what additional benefits can be accrued by reducing ozone levels to various attainment levels beyond levels reached by a suite of actual and hypothetical control programs – in this case the “Beyond On The Way” (BOTW) programs and the “Clean Air Interstate Rule Plus” (CAIR+) program – that states in the Ozone Transport Region (OTR) have considered in planning efforts to attain the current 8-hour ozone NAAQS.

Future and current year ozone modeling was performed by the New Hampshire Department of Environmental Services using the California Photochemical Grid Model (CALGRID). The model output reflects expected hourly ozone concentrations in 2018 after implementing a suite of assumed BOTW control strategies in the OTR and the CAIR+ program in the eastern United States. The use of this hypothetical control scenario is meant to create a base case in which the modeled region meets or is close to meeting the current ozone NAAQS. Use of projected ozone levels in 2018 in a scenario attaining the current 8-hour NAAQS (0.08 ppm) avoids attributing to a revised primary ozone NAAQS that portion of monetized health benefits that would occur in any event from meeting the current NAAQS. The hypothetical measures incorporated in the base case, however, are not necessarily the actual measures to be adopted by individual states for attaining the present ozone NAAQS.

Using the CALGRID modeled concentrations (CALGRID modeling domain described in Section 2.1) that have included all BOTW measures and CAIR+ as our baseline, we estimated the benefits of attaining three alternative 8-hour standards, 60 ppb, 70 ppb, and 75 ppb ($4^{th}$ highest daily 8-hour max) in the OTR using the U.S. Environmental Protection Agency’s (EPA’s) Environmental Benefits Modeling and Analysis Program (BenMAP). BenMAP can currently roll back monitored ozone data to user specified standards and calculate the health benefits of the rollback. To take advantage of BenMAP’s rollback capabilities, we reformatted the CALGRID model output data to a monitor format that the tool would accept. This was done by first generating a file that contained modeled values for all the monitors in our domain for the period of May 15 through September 15. Each monitor’s hourly modeled values were defined as the 2018 CALGRID modeled concentrations for the grid cell in which the monitor resides. In addition to monitors that already existed, we supplied modeling data for grid cells with more than 25,000 people not containing a monitor. This was done by adding a new monitor at the center of the grid cell.

In our comparisons of 2002 CALGRID modeled data and 2002 monitored data, we found that the model generally underestimated monitored ozone concentrations. We therefore expect that our approach of using solely modeling data to represent concentrations in 2018 will give a conservative estimate of the benefits of attainment (i.e., underestimate the monetized health benefits). Furthermore, we do not include consideration of health benefits from reductions in fine particulate matter ($PM_{2.5}$) that may occur as a result of reductions in ozone precursors.

The 2018 CALGRID modeling data was rolled back to each of the various health standards using BenMAP's quadratic rollback method. The quadratic rollback method is based on an algorithm developed by Horst and Duff (1995), where large values are reduced proportionally more than small values while just achieving the standard. We set a background level of 40 ppb, which specifies the portion of the ozone concentration that was not be affected by the rollback. Our assumed ozone background is higher than the policy relevant background used by the EPA of 0.015 to 0.035 ppm (72 FR 37857), thus is conservative and will tend to underestimate monetized health benefits.

BenMAP's rollback method occurs in two steps. First, it calculates each monitor's 4$^{th}$ highest 8-hr max value and determines whether the monitor is in or out of attainment of the specified standard. It then develops a list of target metric values for each monitor by rolling back each day's 8-hr max value using the quadratic method to meet the attainment standard. In the second step, BenMAP rolls back the hourly values at each monitor on each day to arrive to a set of hourly concentrations that meet the target metric value calculated in the first step. The overall method therefore gives new hourly values at each monitor that place it in attainment of the defined standard.

After rolling back the monitor values to the defined attainment standard, the monitor concentrations were interpolated to a 12 km grid in BenMAP using the Voronoi Neighbor Averaging algorithm. We then calculated the benefits of the rollback within each grid cell and aggregated these benefits across each state within the domain.

The health benefits of the model data rollback are calculated by applying concentration response functions. These functions, derived from published epidemiological studies, calculate the health response from a change in ozone concentration, taking into account the population within each grid cell and the baseline incidence rate. For our analysis, we chose five studies on ozone mortality and 14 studies on respiratory-based adverse health endpoints, including hospital admissions due to respiratory disease, emergency room visits due to asthma, school absence days, and decreased worker productivity. Using the reduced incidences attributed to improved air quality, BenMAP calculates the value of reduction using a variety of Cost of Illness (COI) and Willingness to Pay (WTP) valuation functions available within BenMAP. Table 2-1 in Section 2.8.1 describes the studies we used in this rollback analysis.

## 5.2. Results

Applying the health impact and valuation functions to estimated changes in ozone concentrations gave estimates in reductions in adverse health effects and the associated value of this reduction. Tables Table 5-1 through Table 5-3 show the estimated reductions in incidences attributed to attaining three ozone standards beyond implementation of CAIR+ and BOTW measures for the District of Columbia and each state belonging to the Ozone Transport Region. Table 5-4 through Table 5-6 show estimated value of these reductions.[3] For incidence results, we have presented each non-mortality health endpoint separately (with a combined incidence for respiratory hospital admissions in the elderly and children under 2 years of age) while mortality is shown as the range of the five mortality studies used. In the valuation tables, we have presented the combined value of all non-mortality health endpoints and the range of estimates from the five mortality studies used in this analysis.

**Table 5-1. Rollback from 2018 CAIR+ to 60 ppb Ozone Standard, Estimated Avoided Incidences**

| *State* | *ER Visits, Asthma* | *Hospital Admissions, All Respiratory Endpoints, >64 Years and <2 Years* | *School Loss Days* | *Loss of Income Due to Decreased Worker Productivity* | *Mortality (Range of Five Studies)* |
|---|---|---|---|---|---|
| CT | 9.3 | 79.7 | 21,933 | 103,880 | 3.8 - 19.3 |
| DE | 2.5 | 25.2 | 6,316 | 69,363 | 1.1 - 5.8 |
| DC | 2.3 | 20.7 | 4,145 | 11,509 | 1.1 - 5.2 |
| ME | 0.2 | 3.2 | 602 | 25,807 | 0.2 - 0.8 |
| MD | 23.9 | 234.4 | 55,316 | 337,687 | 10.6 - 47.3 |
| MA | 9.9 | 84.8 | 24,077 | 117,724 | 3.8 - 21.6 |
| NH | 0.8 | 6.9 | 1,993 | 17,097 | 0.3 - 1.6 |
| NJ | 33.0 | 290.0 | 80,844 | 358,430 | 14.1 - 73.3 |
| NY | 36.3 | 309.2 | 89,418 | 336,746 | 13.8 - 78.1 |
| PA | 39.6 | 396.5 | 89,286 | 921,220 | 24.4 - 104.3 |
| RI | 1.9 | 16.8 | 4,611 | 27,456 | 0.8 - 4.4 |
| VT | 0.0 | 0.1 | 20 | 444 | 0 - 0 |
| VA | 23.9 | 235.0 | 56,209 | 445,286 | 10 - 45 |
| **OTR Total** | 183.5 | 1,702.5 | 434,770 | 2,772,649 | 84 - 406.7 |

**Table 5-2. Rollback from 2018 CAIR+ to 70 ppb Ozone Standard, Estimated Avoided Incidences**

| *State* | *ER Visits, Asthma* | *Hospital Admissions, All Respiratory Endpoints, >64 Years and <2 Years* | *School Loss Days* | *Loss of Income Due to Decreased Worker Productivity* | *Mortality (Range of Five Studies)* |
|---|---|---|---|---|---|
| CT | 5.3 | 46.1 | 12,982 | 54,523 | 2 - 11.5 |
| DE | 1.4 | 13.9 | 3,552 | 34,442 | 0.6 - 3.2 |
| DC | 1.6 | 14.9 | 3,045 | 7,821 | 0.8 - 3.9 |
| ME | 0.0 | 0.4 | 70 | 3,919 | 0 - 0.1 |
| MD | 15.4 | 157.0 | 37,628 | 200,285 | 6.7 - 32.1 |
| MA | 2.1 | 19.0 | 5,125 | 27,980 | 0.8 - 4.9 |
| NH | 0.1 | 0.8 | 209 | 2,222 | 0 - 0.2 |
| NJ | 18.8 | 171.8 | 48,642 | 202,596 | 7.9 - 44.4 |
| NY | 13.1 | 117.4 | 34,045 | 108,546 | 5 - 29.6 |
| PA | 22.4 | 228.4 | 53,610 | 480,424 | 13.2 - 62.6 |
| RI | 0.7 | 6.8 | 1,877 | 11,201 | 0.3 - 1.8 |
| VT | - | - | - | - | 0 - 0 |
| VA | 13.8 | 137.4 | 33,568 | 219,802 | 5.3 - 25.5 |
| **OTR Total** | 94.8 | 913.8 | 234,352 | 1,353,762 | 42.7 - 219.7 |

[3] The entry for Virginia in each of the tables is for the entire state, thus includes incidences and monetized benefits beyond the DC metropolitan portion of Virginia within the Ozone Transport Region.

**Table 5-3. Rollback from 2018 CAIR+ to 75 ppb Ozone Standard, Estimated Avoided Incidences**

| *State* | *ER Visits, Asthma* | *Hospital Admissions, All Respiratory Endpoints, >64 Years and <2 Years* | *School Loss Days* | *Loss of Income Due to Decreased Worker Productivity* | *Mortality (Range of Five Studies)* |
|---|---|---|---|---|---|
| CT | 3.4 | 29.2 | 8,251 | 33,192 | 1.3 - 7.2 |
| DE | 0.8 | 7.8 | 2,031 | 18,085 | 0.3 - 1.8 |
| DC | 1.4 | 12.4 | 2,557 | 6,425 | 0.6 - 3.2 |
| ME | 0.0 | 0.0 | 1 | 25 | 0 - 0 |
| MD | 11.8 | 120.7 | 29,178 | 142,763 | 5 - 24.7 |
| MA | 0.2 | 2.1 | 572 | 3,772 | 0.1 - 0.6 |
| NH | 0.0 | 0.2 | 52 | 540 | 0 - 0 |
| NJ | 12.3 | 113.1 | 32,303 | 134,709 | 5.1 - 29.5 |
| NY | 7.1 | 64.2 | 18,735 | 53,422 | 2.7 - 16.2 |
| PA | 14.8 | 150.1 | 35,947 | 300,149 | 8.6 - 41.7 |
| RI | 0.2 | 1.7 | 469 | 3,710 | 0.1 - 0.5 |
| VT | - | - | - | - | 0 - 0 |
| VA | 9.7 | 94.8 | 23,469 | 134,217 | 3.5 - 16.9 |
| **OTR Total** | 62 | 596 | 153,565 | 831,008 | 27.3 - 142.4 |

**Table 5-4. Rollback from 2018 CAIR+ to 60 ppb Ozone Standard, Estimated Value of Avoided Incidences**

| *State* | ***Total Value of Avoided Respiratory Endpoints-*** *Hospital Admissions >64 Years and <2 Years, Asthma ER Visits, School Loss Days, Decreased Worker Productivity (Millions of 2000$)* | ***Mortality-*** *Range of Five Studies (Millions of 2000$)* |
|---|---|---|
| CT | 2.78 | 23.99 - 121.97 |
| DE | 0.85 | 7.18 - 36.42 |
| DC | 0.60 | 7.16 - 33.07 |
| ME | 0.12 | 1.21 - 5.21 |
| MD | 7.44 | 66.89 - 298.59 |
| MA | 3.00 | 23.89 - 136.18 |
| NH | 0.25 | 1.83 - 10.07 |
| NJ | 10.13 | 88.74 - 462.5 |
| NY | 10.89 | 86.8 - 492.55 |
| PA | 13.11 | 153.72 - 658.38 |
| RI | 0.59 | 5.3 - 27.74 |
| VT | 0.00 | 0.03 - 0.18 |
| VA | 7.55 | 62.89 - 283.66 |
| **OTR Total** | 57.30 | 529.62 - 2566.52 |

**Table 5-5. Rollback from 2018 CAIR+ to 70 ppb Ozone Standard, Estimated Value of Avoided Incidences**

| State | ***Total Value of Avoided Respiratory Endpoints-*** *Hospital Admissions >64 Years and <2 Years, Asthma ER Visits, School Loss Days, Decreased Worker Productivity (Millions of 2000$)* | ***Mortality-*** *Range of Five Studies (Millions of 2000$)* |
|---|---|---|
| CT | 1.61 | 12.91 - 72.26 |
| DE | 0.47 | 3.67 - 20.38 |
| DC | 0.43 | 4.9 - 24.39 |
| ME | 0.01 | 0.15 - 0.67 |
| MD | 4.96 | 42 - 202.68 |
| MA | 0.65 | 5.36 - 30.7 |
| NH | 0.03 | 0.2 - 1.11 |
| NJ | 6.00 | 49.7 - 279.88 |
| NY | 4.10 | 31.45 - 186.69 |
| PA | 7.59 | 83.22 - 395.06 |
| RI | 0.24 | 2.03 - 11.34 |
| VT | 0.00 | 0 - 0 |
| VA | 4.38 | 33.37 - 160.99 |
| **OTR Total** | 30.48 | 268.96 - 1386.14 |

**Table 5-6. Rollback from 2018 CAIR+ to 75 ppb Ozone Standard, Estimated Value of Avoided Incidences**

| State | ***Total Value of Avoided Respiratory Endpoints-*** *Hospital Admissions >64 Years and <2 Years, Asthma ER Visits, School Loss Days, Decreased Worker Productivity (Millions of 2000$)* | ***Mortality-*** *Range of Five Studies (Millions of 2000$)* |
|---|---|---|
| CT | 1.02 | 8.08 - 45.73 |
| DE | 0.26 | 2.02 - 11.47 |
| DC | 0.36 | 4.02 - 20.48 |
| ME | 0.00 | 0 - 0.02 |
| MD | 3.80 | 31.6 - 155.93 |
| MA | 0.07 | 0.64 - 3.55 |
| NH | 0.01 | 0.05 - 0.27 |
| NJ | 3.96 | 32.47 - 186.15 |
| NY | 2.24 | 17.01 - 102.4 |
| PA | 5.00 | 53.99 - 263.19 |
| RI | 0.06 | 0.52 - 2.89 |
| VT | 0.00 | 0 - 0 |
| VA | 3.01 | 21.86 - 106.62 |
| **OTR Total** | 19.79 | 172.25 - 898.72 |

The results above show that adopting an ozone NAAQS of 0.075 ppm (i.e., the upper limit of EPA's proposal) after CAIR+ could result in an estimated 27 to 142 avoided premature deaths over the 2018 ozone season in the OTR. When added to the benefits from avoided morbidity endpoints, we estimate a monetary benefit of 192 to 918 million dollars over the 2018 ozone season. By contrast, adopting an ozone NAAQS of 0.070 ppm (i.e., the upper limit of the CASAC recommended range), could result in 43 to 220 avoided premature deaths in the OTR over the 2018 ozone season. When added to the benefits from avoided morbidity endpoints, we estimate an additional monetary benefit of 107 to 498 million dollars beyond the 0.075 ppm standard (total benefit of 300 million to 1.4 billion dollars after CAIR+). Finally, adopting an ozone NAAQS at the lower end of the CASAC recommended range, 0.060 ppm, could result in an estimated 84 to 407 avoided premature deaths in the OTR over the 2018 ozone season. Compared to the 0.075 ppm scenario, the modeling indicates that a NAAQS set at 0.060 ppm, could net almost twice the monetary benefit with a benefit of 394 million dollars to 1.7 billion dollars beyond the 75 ppb standard (total benefit of 530 million to 2.6 billion dollars after CAIR+).

The BenMAP results indicate substantial benefits from revising the current ozone NAAQS to within the CASAC range. Even in this regard, however, we believe the benefit estimates are quite conservative and are likely substantially higher, for the following reasons:

- The rollback method uses unadjusted modeled 2018 ozone concentrations as proxies for monitored data that likely underestimate regional ozone levels,[4] therefore the extent of actual ozone reductions in the Northeast in 2018 may be greater than estimated in the rollback method.
- The ozone background level used of 0.040 ppm is higher than EPA's policy relevant background of 0.015 to 0.035 ppm, so ozone reductions could occur to lower levels than allowed in the rollback method employed here. Not accounting for lower potential levels of ozone will reduce the estimated benefits of a more stringent ozone NAAQS.
- The estimated benefits do not include consideration of additional reductions in mortality and morbidity endpoints associated with reduced $PM_{2.5}$ due to NOx reductions needed to meet a more stringent ozone NAAQS. The EPA's Regulatory Impact Analysis indicates these can be in the billions of dollars, thus substantially increasing the projected benefits from a revised ozone NAAQS.
- The estimated health benefits do not include potential benefits from reduced volatile organic compound (VOC) emissions. Many VOCs are air toxics and can have health impacts apart from their contributions to ozone formation.
- The analysis covered the period May 15 through September 15, thus omitting four weeks of the ozone season. In addition, there may be adverse health impacts from ozone exposure during the non-ozone season, as elevated ozone values in the 0.060 ppm range have been monitored in portions of the domain outside the assumed ozone season.
- BenMAP calculates school absences based on the assumption that children are in school during all of May, two weeks in June, one week in August, and all of September. The estimated health benefits do not account for absences during summer school sessions.
- The focus on the primary ozone NAAQS in this analysis does not include benefits from non-health endpoints (i.e., welfare values), such as reduced losses in the agriculture and forestry sectors due to lower regional ozone levels.

[4] In general, the model tends to underestimate ozone levels in most grid cells of the model domain during the full ozone season. In a subset of high peak ozone days, however, the model can overpredict ozone levels in some grid cells during some hours, but these incidents are spatially and temporally limited.

# 6. CONCLUSIONS

In this report, we have used the CALGRID, CMAQ, and BenMAP models to investigate the public health and monetary benefits of several potential emission control programs under consideration by the OTC and MANE-VU states. These programs include an electric generating unit control strategy ("CAIR+") for nitrogen oxides and sulfur dioxide that increases the stringency of the current Clean Air Interstate Rule and $SO_2$ emissions control strategies that would complement existing regulations to further reduce fine particle concentrations and improve visibility under the Regional Haze Rule. In addition, we performed an examination of the benefits of achieving several different options for a revised National Ambient Air Quality Standard for ozone (NAAQS rollback).

Based on our benefits analysis for 2018, we found that $PM_{2.5}$ reductions throughout the year due to CAIR+ could result in 230 avoided premature deaths in the OTR states. Combined with reduced incidences of various morbidity endpoints, we estimated a total $PM_{2.5}$ related benefit of 1.5 billion dollars annually. Using the same modeling platform, we estimated that CAIR+ reductions in ozone during the May 1-September 30 ozone season could lead to 24 to 76 avoided premature deaths in the OTR states (range of five ozone mortality risk estimates). When added to other projected benefits due to reduced incidences of morbidity, we estimated a total ozone related benefit of 170 to 500 million dollars. Overall, we estimate the CAIR+ program to result in health benefits of 1.7 to 2.0 billion dollars in 2018 in the OTR due to reduced adverse health endpoints from exposures to $PM_{2.5}$ and ozone. In states outside the OTR, we estimated a benefit of 560 million to 1.4 billion dollars due to ozone reductions and 4.4 billion dollars due to $PM_{2.5}$ reductions- a total benefit of 5.5 to 5.8 billion dollars. Across the entire modeled domain (Eastern US) we estimated a total benefit due to the CAIR+ program of 6.7 to 7.8 billion dollars.

We examined four potential control strategies aimed at reducing regional haze in Class I areas of the MANE-VU region. Two programs under consideration include limitations on the sulfur content of fuel oil. The S1 strategy would restrict the fuel sulfur content of distillate sold in the region to no higher than 500 ppm whereas the S2 strategy would restrict it to 15 ppm. Residual oil is restricted under both programs to 0.25 and 0.5 percent sulfur for No. 4 and No. 6 oil respectively. The third program is the Best Available Retrofit Technology (BART) provisions of the Regional Haze Rule, and finally controls on 167 stacks at EGUs ("167 EGU strategy") that have the most significant impacts on MANE-VU Class I areas are also considered.

Of the four programs, the 167 EGU stack control program leads to the greatest benefit in the region, resulting in 6.5 billion dollars of health benefits. The first phase of a sulfur-in-fuels limitation (S1) leads to health benefits of almost 3.4 billion dollars in MANE-VU. Controlling the fuel-sulfur content to 15 ppm (S2) could lead to an additional 431 million dollars in benefits, bringing the total benefits to 3.7 billion dollars. The BART estimate is based on controls at 14 units likely to be controlled under BART alone and with no other program that would satisfy the BART requirement. CMAQ and BenMAP modeling suggest that controls at these units could lead to 1.4 billion dollars of benefits in MANE-VU. If all regional haze programs were implemented, we estimate a total of 11.7 billion dollars in health benefits to MANE-VU in 2018. Additionally, 4.9

billion dollars of health benefits are estimated for the states within the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) and the Midwest Regional Planning Organization (MWRPO) in 2018 due to implementation of these haze control strategies.

In the third step of this analysis, we estimated the benefits of attaining three alternative 8-hour ozone NAAQSs – 0.060 ppm, 0.070 ppm, and 0.075 ppm ($4^{th}$ highest daily 8-hour max) – in the Ozone Transport Region (OTR) using BenMAP. The analysis showed that there are significant monetized health benefits in going beyond a revised ozone national ambient air quality standard (NAAQS) of 0.075 ppm, which is the upper end of EPA's range for its proposed ozone NAAQS revision (0.070 ppm – 0.075 ppm). Rolling back to a NAAQS of 0.075 ppm after CAIR+ gave an estimate of 27 to 142 avoided premature deaths over the 2018 ozone season in the OTR. When added to the benefits from avoided morbidity endpoints, we estimated monetary benefits of 192 to 918 million dollars over the 2018 ozone season. By contrast, adopting an ozone NAAQS of 0.070 ppm (i.e., the upper limit of the range recommended by the Clean Air Scientific Advisory Committee (CASAC)) increases the mortality benefits with an estimated 43 to 220 avoided premature deaths in the OTR over the 2018 ozone season. When added to the benefits from avoided morbidity endpoints, we estimate an additional monetary benefit of 107 to 498 million dollars beyond a 0.075 ppm standard (total benefit of 300 million to 1.4 billion dollars after CAIR+). Finally, adopting an ozone NAAQS at the lower end of the CASAC recommended range, 0.060 ppm, results in an increased estimate of 84 to 407 avoided premature deaths in the OTR over the 2018 ozone season. Compared to the 0.075 ppm scenario, the modeling indicates that a NAAQS set at 0.060 ppm could net almost twice the monetary benefits by providing 394 million dollars to 1.7 billion dollars beyond a 75 ppb standard (total benefit of 530 million to 2.6 billion dollars after CAIR+).

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# Appendix A: State Level Benefits for Regional Haze Programs

## Table A-1- Avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI)

| *Endpoint* | *CT* | *DE* | *DC* | *ME* | *MD* | *MA* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 28 (8,49) | 8 (2,14) | 3 (1,6) | 20 (6,35) | 33 (9,57) | 82 (22,141) |
| Mortality (Infants less than 1 year of age) | 0.04 (0.02,0.07) | 0.02 (0.01,0.03) | 0.01 (0,0.01) | 0.02 (0.01,0.03) | 0.07 (0.03,0.11) | 0.08 (0.03,0.14) |
| Acute Bronchitis (Children, ages 8-12) | 44 (-10,99) | 11 (-3,25) | 3 (-1,8) | 22 (-5,50) | 50 (-11,110) | 123 (-29,275) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 8 (2,15) | 2 (0,3) | 1 (0,1) | 6 (1,11) | 7 (2,12) | 24 (6,41) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 49 (-18,239) | 11 (-4,57) | 4 (-1,18) | 24 (-9,119) | 51 (-19,252) | 132 (-49,648) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 85 (16,154) | 20 (4,36) | 6 (1,11) | 42 (8,76) | 89 (17,162) | 230 (44,417) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 54 (-1,108) | 13 (0,26) | 4 (0,8) | 27 (-1,54) | 57 (-1,114) | 146 (-3,294) |
| Chronic Bronchitis (Adults 27 years and older) | 18.5 (0.5,36.5) | 5.2 (0.1,10.3) | 2 (0.1,3.9) | 12.4 (0.3,24.4) | 22.2 (0.6,43.8) | 56 (1.6,110.3) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 2.6 (1.3,3.8) | 1 (0.5,1.4) | 0.3 (0.2,0.5) | 1.3 (0.7,1.9) | 4.4 (2.3,6.6) | 6.8 (3.5,10.1) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.9 (0.2,1.7) | 0.2 (0,0.4) | 0.1 (0,0.2) | 0.6 (0.1,1.2) | 1 (0.2,1.8) | 2.6 (0.5,4.7) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.3 (-0.6,1.2) | 0.1 (-0.1,0.2) | 0 (0,0.1) | 0.2 (-0.5,0.9) | 0.2 (-0.5,0.9) | 0.8 (-1.8,3.4) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.5 (-0.3,1.3) | 0.1 (-0.1,0.3) | 0 (0,0.1) | 0.4 (-0.2,1) | 0.4 (-0.3,1.1) | 1.4 (-0.8,3.6) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.6 (0.2,1) | 0.1 (0,0.1) | 0 (0,0.1) | 0.3 (0.1,0.6) | 0.4 (0.2,0.6) | 1.7 (0.6,2.7) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1.7 (1,2.4) | 0.4 (0.2,0.6) | 0.1 (0.1,0.2) | 1.2 (0.7,1.7) | 1.5 (0.9,2.2) | 4.8 (2.7,6.8) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.8 (0.4,1.2) | 0.2 (0.1,0.3) | 0.1 (0,0.1) | 0.6 (0.3,0.9) | 0.9 (0.5,1.4) | 2.4 (1.2,3.5) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.4 (0.2,0.6) | 0.1 (0,0.2) | 0 (0,0.1) | 0.3 (0.1,0.5) | 0.4 (0.2,0.6) | 1.1 (0.5,1.8) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.2 (0.1,0.3) | 0.1 (0,0.1) | 0 (0,0) | 0.2 (0.1,0.3) | 0.2 (0.1,0.4) | 0.6 (0.2,1) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 1.2 (0.2,2.2) | 0.3 (0.1,0.6) | 0.1 (0,0.2) | 0.8 (0.1,1.5) | 1.3 (0.2,2.4) | 3.2 (0.6,5.9) |
| Work Loss Days (Adults 18-65 years) | 495 (419,571) | 126 (107,146) | 49 (41,56) | 302 (255,348) | 567 (480,654) | 1436 (1216,1656) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 75 (28,120) | 18 (7,29) | 5 (2,9) | 38 (15,62) | 80 (30,129) | 197 (75,318) |

# Table A-2- Avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), continued

| *Endpoint* | *NH* | *NJ* | *NY* | *PA* | *RI* | *VT* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 12 (3,21) | 67 (18,116) | 158 (43,273) | 77 (21,132) | 20 (5,34) | 4 (1,7) |
| Mortality (Infants less than 1 year of age) | 0.01 (0,0.02) | 0.11 (0.04,0.17) | 0.27 (0.11,0.44) | 0.11 (0.04,0.18) | 0.02 (0.01,0.04) | 0 (0,0.01) |
| Acute Bronchitis (Children, ages 8-12) | 18 (-4,40) | 103 (-24,229) | 254 (-59,565) | 94 (-22,209) | 27 (-6,60) | 5 (-1,11) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 4 (1,6) | 20 (5,35) | 47 (12,83) | 21 (5,36) | 5 (1,9) | 1 (0,2) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 18 (-7,91) | 112 (-42,553) | 275 (-103,1355) | 102 (-38,501) | 29 (-11,142) | 5 (-2,24) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 32 (6,58) | 197 (37,356) | 482 (91,872) | 178 (34,322) | 50 (10,91) | 8 (2,15) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 20 (0,41) | 124 (-2,251) | 305 (-6,615) | 113 (-2,227) | 32 (-1,64) | 5 (0,11) |
| Chronic Bronchitis (Adults 27 years and older) | 8.7 (0.2,17.1) | 45 (1.2,88.7) | 109 (3,214.8) | 43.6 (1.2,85.9) | 12.1 (0.3,23.8) | 2.7 (0.1,5.3) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 1 (0.5,1.5) | 5.9 (3,8.8) | 14.4 (7.4,21.5) | 5.4 (2.7,8) | 1.5 (0.8,2.2) | 0.3 (0.1,0.4) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.4 (0.1,0.7) | 2.1 (0.4,3.9) | 5.1 (0.9,9.3) | 2.3 (0.4,4.3) | 0.6 (0.1,1.1) | 0.1 (0,0.2) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.1 (-0.3,0.5) | 0.7 (-1.5,2.8) | 1.6 (-3.5,6.8) | 0.7 (-1.6,3.1) | 0.2 (-0.4,0.8) | 0 (-0.1,0.2) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.2 (-0.1,0.5) | 1.2 (-0.7,3) | 2.8 (-1.6,7.2) | 1.2 (-0.7,3.2) | 0.3 (-0.2,0.8) | 0.1 (0,0.2) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.2 (0.1,0.4) | 1.4 (0.5,2.3) | 3.4 (1.3,5.6) | 1.3 (0.5,2.1) | 0.4 (0.1,0.6) | 0.1 (0,0.1) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.7 (0.4,1) | 4 (2.3,5.7) | 9.5 (5.4,13.5) | 4.3 (2.5,6.1) | 1.1 (0.6,1.5) | 0.2 (0.1,0.3) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.4 (0.2,0.6) | 2 (1,3) | 4.7 (2.5,7) | 1.9 (1,2.9) | 0.5 (0.3,0.8) | 0.1 (0.1,0.2) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.2 (0.1,0.3) | 0.9 (0.4,1.5) | 2.2 (0.9,3.5) | 1 (0.4,1.6) | 0.2 (0.1,0.4) | 0.1 (0,0.1) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.1 (0,0.2) | 0.5 (0.2,0.8) | 1.2 (0.4,2) | 0.5 (0.2,0.8) | 0.1 (0,0.2) | 0 (0,0.1) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.5 (0.1,0.8) | 2.7 (0.5,4.9) | 6.4 (1.2,11.7) | 3 (0.5,5.4) | 0.8 (0.1,1.4) | 0.2 (0,0.3) |
| Work Loss Days (Adults 18-65 years) | 212 (180,245) | 1217 (1031,1404) | 2930 (2481,3379) | 1097 (929,1266) | 304 (257,350) | 60 (50,69) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 29 (11,47) | 175 (67,283) | 422 (161,682) | 157 (60,254) | 42 (16,68) | 7 (3,12) |

## Table A-3- Avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), continued

| *Endpoint* | *AL* | *GA* | *KY* | *MS* | *NC* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 1 (0.3,1.7) | 3.2 (0.9,5.5) | 1.3 (0.4,2.3) | 0.2 (0.1,0.3) | 7.7 (2.1,13.3) |
| Mortality (Infants less than 1 year of age) | 0 (0,0) | 0.01 (0,0.02) | 0 (0,0) | 0 (0,0) | 0.02 (0.01,0.03) |
| Acute Bronchitis (Children, ages 8-12) | 1.3 (-0.3,2.9) | 6.4 (-1.5,14.2) | 1.8 (-0.4,4.1) | 0.3 (-0.1,0.6) | 12.1 (-2.8,27) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.3 (0.1,0.6) | 1.1 (0.3,2) | 0.4 (0.1,0.6) | 0.1 (0,0.1) | 2.5 (0.6,4.3) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 2.3 (-0.9,11.4) | 11.6 (-4.3,57.2) | 2.6 (-1,13) | 0.5 (-0.2,2.2) | 21.1 (-7.9,103.9) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 4 (0.8,7.3) | 20.3 (3.9,36.7) | 4.6 (0.9,8.3) | 0.8 (0.2,1.4) | 36.9 (7,66.7) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 2.6 (-0.1,5.2) | 12.8 (-0.3,25.9) | 2.9 (-0.1,5.9) | 0.5 (0,1) | 23.3 (-0.5,47.1) |
| Chronic Bronchitis (Adults 27 years and older) | 0.6 (0,1.1) | 2.4 (0.1,4.8) | 0.8 (0,1.6) | 0.1 (0,0.2) | 5 (0.1,9.9) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.2 (0.1,0.3) | 1.01 (0.52,1.51) | 0.23 (0.12,0.34) | 0.04 (0.02,0.06) | 1.81 (0.92,2.7) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.05 (0.01,0.09) | 0.15 (0.03,0.27) | 0.05 (0.01,0.09) | 0.01 (0,0.01) | 0.36 (0.06,0.66) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.01 (-0.02,0.05) | 0.04 (-0.08,0.15) | 0.01 (-0.03,0.05) | 0 (0,0.01) | 0.09 (-0.19,0.36) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.02 (-0.01,0.06) | 0.07 (-0.04,0.19) | 0.02 (-0.01,0.06) | 0 (0,0.01) | 0.17 (-0.1,0.44) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.02 (0.01,0.03) | 0.08 (0.03,0.14) | 0.02 (0.01,0.03) | 0 (0,0.01) | 0.15 (0.06,0.25) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.08 (0.04,0.11) | 0.25 (0.14,0.35) | 0.08 (0.05,0.12) | 0.01 (0.01,0.02) | 0.59 (0.34,0.84) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.04 (0.02,0.06) | 0.17 (0.09,0.25) | 0.05 (0.02,0.07) | 0.01 (0,0.01) | 0.33 (0.17,0.48) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.02 (0.01,0.03) | 0.07 (0.03,0.11) | 0.02 (0.01,0.04) | 0 (0,0.01) | 0.16 (0.07,0.25) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.01 (0,0.02) | 0.04 (0.01,0.07) | 0.01 (0,0.02) | 0 (0,0) | 0.08 (0.03,0.13) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.06 (0.01,0.11) | 0.2 (0.04,0.37) | 0.07 (0.01,0.13) | 0.01 (0,0.02) | 0.49 (0.09,0.9) |
| Work Loss Days (Adults 18-65 years) | 24 (20,28) | 119 (101,137) | 28 (24,33) | 4 (4,5) | 219 (185,253) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 4 (1,6) | 18 (7,29) | 4 (2,7) | 1 (0,1) | 32 (12,52) |

## Table A-4- Avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), continued

| *Endpoint* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 3.2 (0.9,5.5) | 1.6 (0.4,2.7) | 12.3 (3.4,21.2) | 1.7 (0.5,2.9) |
| Mortality (Infants less than 1 year of age) | 0.01 (0,0.01) | 0 (0,0.01) | 0.03 (0.01,0.04) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 4.1 (-1,9.2) | 2.1 (-0.5,4.6) | 21 (-4.9,46.8) | 1.8 (-0.4,3.9) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1.1 (0.3,1.9) | 0.5 (0.1,0.8) | 3.4 (0.8,5.9) | 0.4 (0.1,0.6) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 7.6 (-2.8,37.5) | 3.5 (-1.3,17.3) | 27.4 (-10.2,135) | 2.1 (-0.8,10.3) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 13.3 (2.5,24.1) | 6.2 (1.2,11.1) | 48 (9.1,86.8) | 3.7 (0.7,6.6) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 8.4 (-0.2,17) | 3.9 (-0.1,7.9) | 30.3 (-0.6,61.3) | 2.3 (0,4.7) |
| Chronic Bronchitis (Adults 27 years and older) | 1.9 (0.1,3.7) | 0.9 (0,1.8) | 9.4 (0.3,18.5) | 0.9 (0,1.8) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.66 (0.34,0.99) | 0.3 (0.15,0.45) | 2.4 (1.22,3.58) | 0.18 (0.09,0.27) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.16 (0.03,0.29) | 0.07 (0.01,0.13) | 0.47 (0.08,0.86) | 0.06 (0.01,0.1) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.04 (-0.08,0.16) | 0.02 (-0.04,0.07) | 0.11 (-0.25,0.47) | 0.01 (-0.03,0.06) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.07 (-0.04,0.19) | 0.03 (-0.02,0.09) | 0.22 (-0.13,0.57) | 0.03 (-0.02,0.07) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.06 (0.02,0.09) | 0.03 (0.01,0.04) | 0.21 (0.08,0.34) | 0.02 (0.01,0.03) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.26 (0.15,0.37) | 0.12 (0.07,0.17) | 0.77 (0.44,1.1) | 0.09 (0.05,0.13) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.14 (0.07,0.2) | 0.06 (0.03,0.09) | 0.47 (0.24,0.7) | 0.04 (0.02,0.06) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.07 (0.03,0.11) | 0.03 (0.01,0.05) | 0.21 (0.09,0.32) | 0.02 (0.01,0.04) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.03 (0.01,0.06) | 0.02 (0.01,0.03) | 0.12 (0.04,0.19) | 0.01 (0,0.02) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.22 (0.04,0.39) | 0.1 (0.02,0.18) | 0.64 (0.12,1.16) | 0.08 (0.01,0.14) |
| Work Loss Days (Adults 18-65 years) | 82 (69,95) | 38 (32,44) | 310 (262,358) | 24 (21,28) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 12 (5,19) | 5 (2,9) | 43 (16,69) | 3 (1,5) |

## Table A-5- Avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 1 (0.3,1.8) | 1.2 (0.3,2) | 1.1 (0.3,1.9) | 5.3 (1.4,9.1) | 0.2 (0,0.3) |
| Mortality (Infants less than 1 year of age) | 0 (0,0) | 0 (0,0) | 0 (0,0) | 0.01 (0,0.02) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 1.7 (-0.4,3.8) | 1.9 (-0.4,4.2) | 1.7 (-0.4,3.9) | 7.3 (-1.7,16.4) | 0.2 (-0.1,0.5) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.25 (0.06,0.44) | 0.35 (0.09,0.61) | 0.32 (0.08,0.56) | 1.54 (0.38,2.7) | 0.03 (0.01,0.05) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 1.7 (-0.6,8.5) | 2.4 (-0.9,11.9) | 2.1 (-0.8,10.3) | 9.4 (-3.5,46.5) | 0.2 (-0.1,0.9) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 3 (0.57,5.43) | 4.23 (0.8,7.66) | 3.67 (0.7,6.64) | 16.51 (3.14,29.89) | 0.33 (0.06,0.59) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 1.9 (-0.04,3.84) | 2.68 (-0.05,5.41) | 2.32 (-0.05,4.69) | 10.45 (-0.21,21.1) | 0.21 (0,0.42) |
| Chronic Bronchitis (Adults 27 years and older) | 0.7 (0.02,1.38) | 0.78 (0.02,1.54) | 0.75 (0.02,1.48) | 3.27 (0.09,6.45) | 0.11 (0,0.21) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.18 (0.09,0.26) | 0.25 (0.13,0.37) | 0.22 (0.11,0.33) | 0.98 (0.5,1.46) | 0.02 (0.01,0.03) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.04 (0.01,0.06) | 0.05 (0.01,0.08) | 0.04 (0.01,0.08) | 0.21 (0.04,0.38) | 0 (0,0.01) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.01 (-0.02,0.03) | 0.01 (-0.02,0.05) | 0.01 (-0.02,0.04) | 0.05 (-0.11,0.21) | 0 (0,0) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.02 (-0.01,0.04) | 0.02 (-0.01,0.05) | 0.02 (-0.01,0.05) | 0.09 (-0.05,0.24) | 0 (0,0) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.01 (0.01,0.02) | 0.02 (0.01,0.03) | 0.02 (0.01,0.03) | 0.08 (0.03,0.13) | 0 (0,0) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.05 (0.03,0.07) | 0.07 (0.04,0.1) | 0.07 (0.04,0.09) | 0.32 (0.18,0.46) | 0.01 (0,0.01) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.02 (0.01,0.03) | 0.03 (0.02,0.05) | 0.03 (0.02,0.04) | 0.14 (0.07,0.2) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.01 (0.01,0.02) | 0.02 (0.01,0.03) | 0.02 (0.01,0.03) | 0.09 (0.04,0.14) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.01 (0,0.01) | 0.01 (0,0.02) | 0.01 (0,0.02) | 0.04 (0.02,0.07) | 0 (0,0) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.05 (0.01,0.09) | 0.07 (0.01,0.12) | 0.06 (0.01,0.11) | 0.3 (0.05,0.54) | 0.01 (0,0.01) |
| Work Loss Days (Adults 18-65 years) | 18 (15,21) | 25 (21,28) | 22 (19,26) | 101 (85,116) | 2 (2,2) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 3 (1,4) | 4 (1,6) | 3 (1,5) | 15 (6,24) | 0.3 (0.1,0.5) |

**Table A-6- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), 2000$**

| *Endpoint* | *CT* | *DE* | *DC* | *ME* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 178178000 (13654000,549219000) | 51668000 (3960000,159262000) | 20542000 (1574000,63319000) | 126771000 (9716000,390761000) |
| Mortality (Infants less than 1 year of age) | 276000 (23000,811000) | 100000 (8000,294000) | 45000 (4000,131000) | 115000 (10000,339000) |
| Acute Bronchitis (Children, ages 8-12) | 16500 (-3800,37000) | 4200 (-1000,9400) | 1300 (-300,2900) | 8400 (-1900,18600) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 556400 (137000,974200) | 108400 (26800,189600) | 39900 (9800,69900) | 396800 (98000,693100) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 7580 (-2820,37190) | 1790 (-670,8810) | 570 (-210,2780) | 3770 (-1400,18470) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 13270 (2510,24310) | 3140 (590,5760) | 990 (190,1820) | 6590 (1250,12080) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 8390 (-170,17080) | 1990 (-40,4040) | 630 (-10,1280) | 4170 (-80,8480) |
| Chronic Bronchitis (Adults 27 years and older) | 6257500 (115600,29528700) | 1760300 (32500,8306200) | 664400 (12300,3135300) | 4183400 (77400,19738700) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 710 (340,1130) | 270 (130,430) | 90 (40,140) | 360 (170,570) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 14600 (2600,26600) | 3600 (600,6500) | 1400 (200,2600) | 9800 (1700,17800) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 4500 (-9900,18900) | 900 (-1900,3600) | 300 (-700,1400) | 3200 (-6900,13200) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 12700 (-7400,32800) | 2900 (-1700,7500) | 1100 (-600,2800) | 9500 (-5500,24600) |
| Hospital Admissions- Asthma (Population under 65 years) | 4700 (1800,7700) | 700 (300,1200) | 200 (100,400) | 2700 (1000,4300) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 36600 (20900,52200) | 8200 (4700,11700) | 3100 (1800,4500) | 25900 (14800,37000) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 19000 (9900,28200) | 5000 (2600,7400) | 1800 (900,2600) | 13400 (7000,19900) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 5400 (2300,8400) | 1400 (600,2200) | 500 (200,800) | 3900 (1700,6100) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 2300 (800,3800) | 600 (200,1000) | 200 (100,300) | 1600 (600,2700) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 21700 (4000,39400) | 5600 (1000,10300) | 2300 (400,4100) | 14400 (2600,26200) |
| Work Loss Days (Adults 18-65 years) | 76200 (64500,87900) | 16500 (14000,19000) | 7200 (6100,8300) | 33300 (28200,38300) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 13900 (5300,22700) | 3300 (1300,5400) | 1000 (400,1600) | 7100 (2700,11600) |

## Table A-7- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), 2000$, continued

| *Endpoint* | *MD* | *MA* | *NH* | *NJ* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 206915000 (15856000,637797000) | 514585000 (39438000,1586164000) | 77310000 (5925000,238301000) | 423199000 (32431000,1304473000) |
| Mortality (Infants less than 1 year of age) | 422000 (36000,1239000) | 534000 (45000,1570000) | 76000 (6000,222000) | 682000 (58000,2005000) |
| Acute Bronchitis (Children, ages 8-12) | 18500 (-4300,41400) | 46200 (-10700,103100) | 6800 (-1600,15200) | 38400 (-8900,85900) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 440200 (108400,771000) | 1565200 (386700,2734700) | 235400 (58000,412000) | 1312900 (323400,2298500) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 7990 (-2980,39200) | 20560 (-7670,100830) | 2880 (-1070,14130) | 17540 (-6540,86070) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 13980 (2650,25620) | 36010 (6810,65970) | 5040 (950,9240) | 30710 (5810,56260) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 8840 (-180,18000) | 22770 (-450,46320) | 3190 (-60,6490) | 19420 (-390,39520) |
| Chronic Bronchitis (Adults 27 years and older) | 7497700 (138500,35383900) | 18908100 (349800,89214400) | 2932100 (54200,13836100) | 15193900 (280800,71701000) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 1230 (590,1970) | 1890 (910,3020) | 270 (130,430) | 1650 (800,2640) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 14800 (2600,26900) | 39400 (6900,71800) | 5500 (1000,10000) | 33100 (5800,60400) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 3500 (-7600,14500) | 12500 (-27400,52200) | 1800 (-3900,7400) | 10400 (-22800,43700) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 11400 (-6600,29500) | 36600 (-21200,94400) | 5200 (-3000,13500) | 30300 (-17500,78000) |
| Hospital Admissions- Asthma (Population under 65 years) | 3100 (1200,5000) | 13200 (5100,21200) | 1900 (700,3100) | 11300 (4300,18200) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 33000 (18900,47100) | 101900 (58300,145400) | 14400 (8300,20600) | 85000 (48600,121300) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 21000 (10900,31100) | 54700 (28400,81100) | 8800 (4600,13100) | 46100 (23900,68200) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 5700 (2400,8800) | 15300 (6500,23900) | 2200 (900,3400) | 12700 (5400,19900) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 2400 (800,4000) | 6500 (2300,10800) | 1100 (400,1700) | 5500 (1900,9100) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 23500 (4300,42700) | 58400 (10700,106000) | 8100 (1500,14800) | 49200 (9000,89500) |
| Work Loss Days (Adults 18-65 years) | 82200 (69600,94800) | 212000 (179500,244400) | 27800 (23500,32000) | 189500 (160500,218600) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 14900 (5700,24400) | 36800 (14000,59900) | 5400 (2100,8800) | 32800 (12500,53400) |

**Table A-8- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), 2000$, continued**

| *Endpoint* | *NY* | *PA* | *RI* | *VT* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 997249000 (76424000,3073932000) | 482212000 (36953000,1486373000) | 123495000 (9466000,380663000) | 27384000 (2098000,84408000) |
| Mortality (Infants less than 1 year of age) | 1729000 (146000,5083000) | 706000 (60000,2074000) | 145000 (12000,426000) | 31000 (3000,90000) |
| Acute Bronchitis (Children, ages 8-12) | 94800 (-21900,211900) | 35100 (-8100,78600) | 10100 (-2300,22600) | 1800 (-400,4000) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 3110700 (766900,5442700) | 1361100 (335200,2382900) | 343900 (85100,600100) | 79400 (19600,139100) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 42980 (-16030,210910) | 15890 (-5920,77980) | 4500 (-1680,22050) | 760 (-280,3720) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 75260 (14240,137900) | 27820 (5260,50980) | 7880 (1490,14430) | 1330 (250,2430) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 47600 (-950,96860) | 17600 (-350,35810) | 4980 (-100,10130) | 840 (-20,1710) |
| Chronic Bronchitis (Adults 27 years and older) | 36792300 (680200,173610000) | 14704300 (271700,69393300) | 4081300 (75600,19257600) | 914000 (16900,4313200) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 4020 (1940,6410) | 1490 (720,2380) | 410 (200,660) | 70 (30,110) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 78300 (13800,142800) | 35800 (6300,65300) | 9100 (1600,16500) | 1900 (300,3500) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 24700 (-54200,103600) | 11200 (-24500,46900) | 2800 (-6200,11800) | 600 (-1400,2600) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 72100 (-41800,185900) | 32200 (-18600,83000) | 7900 (-4600,20400) | 1900 (-1100,4900) |
| Hospital Admissions- Asthma (Population under 65 years) | 27100 (10400,43800) | 10100 (3900,16400) | 2800 (1100,4500) | 500 (200,900) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 201700 (115500,288000) | 91200 (52200,130200) | 22800 (13000,32500) | 5200 (3000,7400) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 108300 (56200,160400) | 44200 (22900,65500) | 11600 (6000,17100) | 2700 (1400,4000) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 30200 (12900,47100) | 13500 (5800,21100) | 3300 (1400,5200) | 800 (300,1200) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 12900 (4500,21300) | 5300 (1800,8800) | 1400 (500,2300) | 300 (100,500) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 116200 (21200,211000) | 53300 (9700,96800) | 13500 (2500,24500) | 2900 (500,5200) |
| Work Loss Days (Adults 18-65 years) | 410600 (347700,473500) | 136700 (115800,157700) | 38500 (32600,44400) | 6700 (5700,7700) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 78900 (30100,128500) | 29400 (11200,47900) | 7900 (3000,12900) | 1400 (500,2300) |

# Table A-9- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), 2000$, continued

| *Endpoint* | *AL* | *GA* | *KY* | *MS* | *NC* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 6244000 (478000,19245000) | 19986000 (1531000,61604000) | 8401000 (644000,25895000) | 1156000 (89000,3563000) | 48470000 (3714000,149402000) |
| Mortality (Infants less than 1 year of age) | 15600 (1300,46000) | 59500 (5000,175100) | 17100 (1400,50200) | 3800 (300,11300) | 123800 (10500,364000) |
| Acute Bronchitis (Children, ages 8-12) | 490 (-110,1100) | 2380 (-550,5340) | 690 (-160,1540) | 110 (-20,240) | 4520 (-1040,10120) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 20700 (5100,36300) | 75100 (18500,131800) | 23500 (5800,41200) | 3400 (800,6000) | 163000 (40100,285800) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 400 (-100,1800) | 1800 (-700,8900) | 400 (-200,2000) | 100 (0,300) | 3300 (-1200,16200) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 600 (100,1200) | 3200 (600,5800) | 700 (100,1300) | 100 (0,200) | 5800 (1100,10600) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 400 (0,800) | 2000 (0,4100) | 500 (0,900) | 100 (0,200) | 3600 (-100,7400) |
| Chronic Bronchitis (Adults 27 years and older) | 195500 (3600,922900) | 825600 (15200,3897500) | 278900 (5100,1316400) | 36900 (700,174100) | 1689200 (31200,7974400) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 100 (0,100) | 300 (100,400) | 100 (0,100) | 0 (0,0) | 500 (200,800) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 700 (100,1300) | 2300 (400,4200) | 800 (100,1400) | 100 (0,200) | 5500 (1000,10100) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 200 (-400,700) | 600 (-1200,2300) | 200 (-400,800) | 0 (-100,100) | 1300 (-2900,5500) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 600 (-300,1500) | 1900 (-1100,4800) | 600 (-400,1600) | 100 (-100,200) | 4400 (-2500,11300) |
| Hospital Admissions- Asthma (Population under 65 years) | 100 (100,200) | 700 (300,1100) | 200 (100,300) | 0 (0,0) | 1200 (500,1900) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1600 (900,2300) | 5300 (3000,7500) | 1800 (1000,2600) | 300 (100,400) | 12500 (7200,17900) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 900 (500,1400) | 3900 (2000,5800) | 1000 (500,1500) | 200 (100,200) | 7400 (3800,11000) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 300 (100,400) | 900 (400,1400) | 300 (100,500) | 0 (0,100) | 2100 (900,3300) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 100 (0,200) | 400 (200,700) | 100 (0,200) | 0 (0,0) | 900 (300,1400) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 1100 (200,2000) | 3600 (700,6600) | 1200 (200,2200) | 200 (0,300) | 8800 (1600,16000) |
| Work Loss Days (Adults 18-65 years) | 2600 (2200,3000) | 14500 (12200,16700) | 3100 (2600,3500) | 400 (400,500) | 24600 (20800,28400) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 700 (300,1100) | 3400 (1300,5500) | 800 (300,1300) | 100 (100,200) | 6000 (2300,9800) |

## Table A-10- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), 2000$, continued

| *Endpoint* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 20157000 (1545000,62132000) | 9840000 (754000,30332000) | 77320000 (5925000,238330000) | 10576000 (810000,32600000) |
| Mortality (Infants less than 1 year of age) | 39900 (3400,117400) | 19800 (1700,58200) | 171300 (14500,503600) | 17200 (1500,50600) |
| Acute Bronchitis (Children, ages 8-12) | 1550 (-360,3470) | 780 (-180,1740) | 7850 (-1810,17570) | 660 (-150,1480) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 70600 (17400,123900) | 31900 (7800,56000) | 221500 (54400,388200) | 23800 (5900,41800) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 1200 (-400,5800) | 500 (-200,2700) | 4300 (-1600,21000) | 300 (-100,1600) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 2100 (400,3800) | 1000 (200,1800) | 7500 (1400,13700) | 600 (100,1100) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 1300 (0,2700) | 600 (0,1200) | 4700 (-100,9600) | 400 (0,700) |
| Chronic Bronchitis (Adults 27 years and older) | 640300 (11800,3022900) | 316200 (5800,1492600) | 3164400 (58400,14936800) | 312600 (5800,1475800) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 200 (100,300) | 100 (0,100) | 700 (300,1100) | 100 (0,100) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 2400 (400,4400) | 1100 (200,2000) | 7200 (1300,13100) | 800 (100,1500) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 600 (-1300,2400) | 300 (-600,1100) | 1700 (-3800,7200) | 200 (-400,900) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1900 (-1100,5000) | 900 (-500,2300) | 5700 (-3300,14800) | 700 (-400,1800) |
| Hospital Admissions- Asthma (Population under 65 years) | 500 (200,700) | 200 (100,300) | 1700 (600,2700) | 100 (100,200) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 5500 (3200,7900) | 2500 (1400,3500) | 16300 (9400,23300) | 1900 (1100,2800) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 3100 (1600,4600) | 1400 (700,2100) | 10800 (5600,16000) | 1000 (500,1400) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 900 (400,1500) | 400 (200,700) | 2800 (1200,4400) | 300 (100,500) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 400 (100,600) | 200 (100,300) | 1200 (400,2000) | 100 (0,200) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 3800 (700,7000) | 1700 (300,3100) | 11400 (2100,20700) | 1300 (200,2400) |
| Work Loss Days (Adults 18-65 years) | 8900 (7500,10300) | 4200 (3600,4900) | 40800 (34600,47100) | 2500 (2100,2900) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 2200 (800,3600) | 1000 (400,1700) | 8000 (3000,13000) | 600 (200,1000) |

## Table A-11- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S1, Mean (95%CI), 2000$, continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 6558000 (503000,20214000) | 7405000 (567000,22824000) | 6956000 (533000,21442000) | 33124000 (2538000,102100000) | 966000 (74000,2979000) |
| Mortality (Infants less than 1 year of age) | 16830 (1420,49500) | 18520 (1570,54450) | 16910 (1430,49720) | 67220 (5680,197650) | 2070 (170,6080) |
| Acute Bronchitis (Children, ages 8-12) | 630 (-150,1410) | 710 (-160,1580) | 650 (-150,1460) | 2750 (-630,6150) | 90 (-20,200) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 16660 (4090,29230) | 23040 (5660,40420) | 21130 (5190,37070) | 101300 (24890,177680) | 1980 (490,3470) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 270 (-100,1320) | 380 (-140,1860) | 330 (-120,1610) | 1470 (-550,7240) | 30 (-10,140) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 470 (90,860) | 660 (130,1210) | 570 (110,1050) | 2580 (490,4730) | 50 (10,90) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 300 (-10,600) | 420 (-10,850) | 360 (-10,740) | 1630 (-30,3320) | 30 (0,70) |
| Chronic Bronchitis (Adults 27 years and older) | 235740 (4350,1112930) | 264000 (4870,1246300) | 253320 (4680,1195890) | 1103990 (20380,5211720) | 36630 (680,172920) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 50 (20,80) | 70 (30,110) | 60 (30,100) | 270 (130,430) | 10 (0,10) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 540 (90,980) | 710 (130,1290) | 660 (120,1210) | 3220 (570,5870) | 60 (10,110) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 130 (-270,530) | 170 (-370,720) | 160 (-340,660) | 770 (-1680,3210) | 10 (-30,60) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 390 (-230,1010) | 540 (-310,1400) | 490 (-280,1270) | 2410 (-1390,6200) | 50 (-30,120) |
| Hospital Admissions- Asthma (Population under 65 years) | 110 (40,180) | 160 (60,250) | 140 (50,230) | 630 (240,1020) | 10 (0,20) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1120 (640,1600) | 1520 (870,2170) | 1390 (800,1990) | 6810 (3900,9720) | 130 (80,190) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 510 (270,760) | 740 (380,1090) | 670 (350,990) | 3120 (1620,4620) | 60 (30,90) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 200 (80,310) | 270 (120,420) | 250 (110,390) | 1210 (510,1880) | 20 (10,40) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 80 (30,130) | 110 (40,190) | 100 (40,170) | 480 (170,790) | 10 (0,20) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 890 (160,1620) | 1180 (220,2150) | 1100 (200,2010) | 5350 (980,9720) | 100 (20,190) |
| Work Loss Days (Adults 18-65 years) | 2440 (2060,2810) | 3020 (2560,3480) | 3090 (2620,3570) | 12560 (10630,14480) | 250 (210,290) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 500 (190,810) | 700 (270,1150) | 620 (240,1010) | 2770 (1050,4520) | 60 (20,90) |

## Table A-12- Avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI)

| *Endpoint* | *CT* | *DE* | *DC* | *ME* | *MD* | *MA* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 3.68 (1.01,6.35) | 0.56 (0.15,0.97) | 0.5 (0.14,0.87) | 2.77 (0.76,4.78) | 3.58 (0.98,6.18) | 8.65 (2.37,14.93) |
| Mortality (Infants less than 1 year of age) | 0.01 (0,0.01) | 0 (0,0) | 0 (0,0) | 0 (0,0) | 0.01 (0,0.01) | 0.01 (0,0.01) |
| Acute Bronchitis (Children, ages 8-12) | 5.79 (-1.34,12.91) | 0.83 (-0.19,1.86) | 0.53 (-0.12,1.19) | 3.07 (-0.71,6.84) | 5.42 (-1.25,12.09) | 13.11 (-3.03,29.25) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1.1 (0.27,1.93) | 0.12 (0.03,0.22) | 0.09 (0.02,0.16) | 0.83 (0.2,1.45) | 0.74 (0.18,1.3) | 2.55 (0.63,4.47) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 6.32 (-2.36,31.13) | 0.91 (-0.34,4.49) | 0.55 (-0.2,2.69) | 3.29 (-1.23,16.22) | 5.67 (-2.12,27.93) | 14.12 (-5.28,69.61) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 11.05 (2.1,20.01) | 1.59 (0.3,2.89) | 0.96 (0.18,1.73) | 5.76 (1.09,10.43) | 9.92 (1.88,17.95) | 24.71 (4.69,44.74) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 6.99 (-0.14,14.12) | 1.01 (-0.02,2.04) | 0.6 (-0.01,1.22) | 3.64 (-0.07,7.36) | 6.27 (-0.13,12.67) | 15.63 (-0.31,31.58) |
| Chronic Bronchitis (Adults 27 years and older) | 2.42 (0.07,4.77) | 0.37 (0.01,0.73) | 0.3 (0.01,0.6) | 1.7 (0.05,3.36) | 2.44 (0.07,4.82) | 5.93 (0.16,11.7) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.33 (0.17,0.5) | 0.08 (0.04,0.11) | 0.05 (0.02,0.07) | 0.18 (0.09,0.26) | 0.49 (0.25,0.73) | 0.73 (0.37,1.09) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.12 (0.02,0.22) | 0.02 (0,0.03) | 0.01 (0,0.03) | 0.09 (0.02,0.16) | 0.11 (0.02,0.19) | 0.27 (0.05,0.5) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.04 (-0.08,0.16) | 0 (-0.01,0.02) | 0 (-0.01,0.01) | 0.03 (-0.06,0.12) | 0.03 (-0.05,0.11) | 0.09 (-0.19,0.36) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.06 (-0.04,0.16) | 0.01 (0,0.02) | 0.01 (0,0.02) | 0.05 (-0.03,0.13) | 0.05 (-0.03,0.13) | 0.15 (-0.09,0.39) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.08 (0.03,0.13) | 0.01 (0,0.01) | 0 (0,0.01) | 0.05 (0.02,0.08) | 0.04 (0.02,0.07) | 0.18 (0.07,0.29) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.22 (0.13,0.32) | 0.03 (0.02,0.04) | 0.02 (0.01,0.03) | 0.17 (0.1,0.24) | 0.17 (0.1,0.24) | 0.51 (0.29,0.73) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.11 (0.06,0.16) | 0.02 (0.01,0.02) | 0.01 (0.01,0.02) | 0.08 (0.04,0.12) | 0.1 (0.05,0.15) | 0.25 (0.13,0.38) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.05 (0.02,0.08) | 0.01 (0,0.01) | 0.01 (0,0.01) | 0.04 (0.02,0.06) | 0.05 (0.02,0.07) | 0.12 (0.05,0.19) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.03 (0.01,0.05) | 0 (0,0.01) | 0 (0,0) | 0.02 (0.01,0.03) | 0.03 (0.01,0.04) | 0.06 (0.02,0.11) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.16 (0.03,0.28) | 0.02 (0,0.04) | 0.02 (0,0.03) | 0.11 (0.02,0.2) | 0.14 (0.03,0.26) | 0.35 (0.06,0.63) |
| Work Loss Days (Adults 18-65 years) | 64.38 (54.51,74.26) | 9.86 (8.35,11.37) | 7.33 (6.2,8.45) | 41.52 (35.15,47.89) | 63.27 (53.57,72.97) | 154.17 (130.53,177.82) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 9.73 (3.71,15.75) | 1.41 (0.54,2.29) | 0.82 (0.31,1.32) | 5.22 (1.99,8.45) | 8.87 (3.38,14.36) | 21.19 (8.08,34.29) |

## Table A-13- Avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), continued

| *Endpoint* | *NH* | *NJ* | *NY* | *PA* | *RI* | *VT* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 1.15 (0.32,1.98) | 10.04 (2.76,17.33) | 25.96 (7.13,44.8) | 8.67 (2.38,14.95) | 2.46 (0.67,4.24) | 0.23 (0.06,0.39) |
| Mortality (Infants less than 1 year of age) | 0 (0,0) | 0.02 (0.01,0.03) | 0.05 (0.02,0.08) | 0.01 (0,0.02) | 0 (0,0) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 1.72 (-0.4,3.83) | 15.58 (-3.61,34.76) | 43.63 (-10.1,97.31) | 10.56 (-2.44,23.55) | 3.42 (-0.79,7.62) | 0.25 (-0.06,0.56) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.34 (0.08,0.59) | 2.85 (0.7,5) | 7.29 (1.79,12.78) | 2.35 (0.58,4.12) | 0.66 (0.16,1.16) | 0.06 (0.02,0.11) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 1.74 (-0.65,8.6) | 16.06 (-6.01,79.16) | 43.62 (-16.32,214.98) | 11.45 (-4.28,56.43) | 3.67 (-1.37,18.06) | 0.25 (-0.1,1.26) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 3.05 (0.58,5.53) | 28.11 (5.34,50.87) | 76.34 (14.5,138.18) | 20.03 (3.8,36.26) | 6.41 (1.22,11.61) | 0.45 (0.08,0.81) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 1.93 (-0.04,3.9) | 17.78 (-0.36,35.91) | 48.29 (-0.97,97.54) | 12.67 (-0.25,25.6) | 4.06 (-0.08,8.19) | 0.28 (-0.01,0.57) |
| Chronic Bronchitis (Adults 27 years and older) | 0.82 (0.02,1.61) | 6.92 (0.19,13.64) | 18.58 (0.52,36.64) | 4.92 (0.14,9.71) | 1.52 (0.04,2.99) | 0.14 (0,0.28) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.09 (0.05,0.14) | 0.85 (0.43,1.27) | 2.3 (1.17,3.43) | 0.6 (0.31,0.9) | 0.19 (0.1,0.28) | 0.01 (0.01,0.02) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.03 (0.01,0.06) | 0.3 (0.05,0.56) | 0.78 (0.14,1.42) | 0.27 (0.05,0.49) | 0.08 (0.01,0.14) | 0.01 (0,0.01) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.01 (-0.02,0.05) | 0.1 (-0.21,0.4) | 0.25 (-0.54,1.04) | 0.08 (-0.18,0.35) | 0.02 (-0.05,0.1) | 0 (0,0.01) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.02 (-0.01,0.05) | 0.17 (-0.1,0.43) | 0.42 (-0.25,1.1) | 0.14 (-0.08,0.36) | 0.04 (-0.02,0.1) | 0 (0,0.01) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.02 (0.01,0.04) | 0.21 (0.08,0.33) | 0.55 (0.21,0.89) | 0.15 (0.06,0.24) | 0.05 (0.02,0.07) | 0 (0,0.01) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.06 (0.04,0.09) | 0.56 (0.32,0.81) | 1.45 (0.83,2.07) | 0.49 (0.28,0.7) | 0.14 (0.08,0.19) | 0.01 (0.01,0.02) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.04 (0.02,0.05) | 0.29 (0.15,0.43) | 0.74 (0.38,1.09) | 0.22 (0.11,0.32) | 0.06 (0.03,0.09) | 0.01 (0,0.01) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.02 (0.01,0.02) | 0.13 (0.06,0.21) | 0.34 (0.15,0.53) | 0.11 (0.05,0.18) | 0.03 (0.01,0.05) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.01 (0,0.02) | 0.07 (0.03,0.12) | 0.19 (0.06,0.31) | 0.06 (0.02,0.09) | 0.02 (0.01,0.03) | 0 (0,0) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.04 (0.01,0.08) | 0.39 (0.07,0.7) | 0.99 (0.18,1.79) | 0.34 (0.06,0.61) | 0.1 (0.02,0.17) | 0.01 (0,0.02) |
| Work Loss Days (Adults 18-65 years) | 20.13 (17.04,23.21) | 177.79 (150.52,205.05) | 471.18 (398.92,543.43) | 123.99 (104.97,143) | 38.54 (32.63,44.46) | 3.12 (2.64,3.59) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 2.74 (1.04,4.43) | 25.06 (9.55,40.57) | 67.09 (25.58,108.56) | 17.69 (6.74,28.63) | 5.4 (2.06,8.74) | 0.39 (0.15,0.64) |

## Table A-14- Avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), continued

| *Endpoint* | *AL* | *GA* | *KY* | *MS* | *NC* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 0.11 (0.03,0.19) | 0.36 (0.1,0.62) | 0.13 (0.04,0.22) | 0.02 (0.01,0.03) | 0.85 (0.23,1.46) |
| Mortality (Infants less than 1 year of age) | 0 (0,0) | 0 (0,0) | 0 (0,0) | 0 (0,0) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 0.15 (-0.03,0.33) | 0.72 (-0.17,1.61) | 0.18 (-0.04,0.4) | 0.03 (-0.01,0.07) | 1.33 (-0.31,2.97) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.04 (0.01,0.06) | 0.13 (0.03,0.23) | 0.03 (0.01,0.06) | 0.01 (0,0.01) | 0.28 (0.07,0.48) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.26 (-0.1,1.27) | 1.32 (-0.49,6.49) | 0.25 (-0.09,1.23) | 0.05 (-0.02,0.24) | 2.35 (-0.88,11.59) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.45 (0.09,0.82) | 2.3 (0.44,4.17) | 0.44 (0.08,0.79) | 0.09 (0.02,0.16) | 4.12 (0.78,7.45) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.29 (-0.01,0.58) | 1.46 (-0.03,2.94) | 0.28 (-0.01,0.56) | 0.05 (0,0.11) | 2.6 (-0.05,5.26) |
| Chronic Bronchitis (Adults 27 years and older) | 0.06 (0,0.13) | 0.28 (0.01,0.54) | 0.08 (0,0.16) | 0.01 (0,0.02) | 0.55 (0.02,1.09) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.02 (0.01,0.03) | 0.11 (0.06,0.17) | 0.02 (0.01,0.03) | 0 (0,0.01) | 0.2 (0.1,0.3) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.005 (0.001,0.01) | 0.017 (0.003,0.031) | 0.005 (0.001,0.009) | 0.001 (0,0.002) | 0.041 (0.007,0.074) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.001 (-0.003,0.005) | 0.004 (-0.009,0.017) | 0.001 (-0.003,0.005) | 0 (0,0.001) | 0.01 (-0.021,0.04) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.003 (-0.001,0.006) | 0.008 (-0.005,0.021) | 0.002 (-0.001,0.006) | 0 (0,0.001) | 0.019 (-0.011,0.049) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.002 (0.001,0.003) | 0.01 (0.004,0.015) | 0.002 (0.001,0.003) | 0 (0,0.001) | 0.017 (0.007,0.028) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.009 (0.005,0.012) | 0.028 (0.016,0.04) | 0.008 (0.005,0.011) | 0.001 (0.001,0.002) | 0.066 (0.038,0.094) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.005 (0.002,0.007) | 0.019 (0.01,0.029) | 0.004 (0.002,0.006) | 0.001 (0,0.001) | 0.036 (0.019,0.054) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.002 (0.001,0.004) | 0.008 (0.003,0.012) | 0.002 (0.001,0.003) | 0 (0,0.001) | 0.018 (0.008,0.028) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.001 (0,0.002) | 0.005 (0.002,0.008) | 0.001 (0,0.002) | 0 (0,0) | 0.009 (0.003,0.015) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.01 (0,0.01) | 0.02 (0,0.04) | 0.01 (0,0.01) | 0 (0,0) | 0.06 (0.01,0.1) |
| Work Loss Days (Adults 18-65 years) | 2.71 (2.29,3.12) | 13.49 (11.42,15.56) | 2.67 (2.26,3.08) | 0.47 (0.4,0.54) | 24.47 (20.71,28.22) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.41 (0.15,0.66) | 2.05 (0.78,3.32) | 0.39 (0.15,0.63) | 0.08 (0.03,0.13) | 3.58 (1.36,5.79) |

## Table A-15- Avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), continued

| *Endpoint* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 0.36 (0.1,0.62) | 0.16 (0.05,0.28) | 1.36 (0.37,2.35) | 0.17 (0.05,0.3) |
| Mortality (Infants less than 1 year of age) | 0 (0,0) | 0 (0,0) | 0 (0,0) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 0.47 (-0.11,1.04) | 0.22 (-0.05,0.49) | 2.31 (-0.54,5.16) | 0.18 (-0.04,0.4) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.12 (0.03,0.21) | 0.05 (0.01,0.09) | 0.38 (0.09,0.66) | 0.04 (0.01,0.06) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.86 (-0.32,4.23) | 0.37 (-0.14,1.84) | 3.04 (-1.14,14.98) | 0.21 (-0.08,1.01) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 1.5 (0.29,2.72) | 0.65 (0.12,1.18) | 5.32 (1.01,9.63) | 0.36 (0.07,0.65) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.95 (-0.02,1.92) | 0.41 (-0.01,0.83) | 3.36 (-0.07,6.8) | 0.23 (0,0.46) |
| Chronic Bronchitis (Adults 27 years and older) | 0.21 (0.01,0.42) | 0.1 (0,0.19) | 1.05 (0.03,2.08) | 0.09 (0,0.19) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.07 (0.04,0.11) | 0.03 (0.02,0.05) | 0.27 (0.14,0.4) | 0.02 (0.01,0.03) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.018 (0.003,0.033) | 0.008 (0.001,0.014) | 0.053 (0.009,0.096) | 0.006 (0.001,0.01) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.004 (-0.009,0.018) | 0.002 (-0.004,0.008) | 0.013 (-0.027,0.052) | 0.001 (-0.003,0.006) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.009 (-0.005,0.022) | 0.004 (-0.002,0.009) | 0.025 (-0.014,0.064) | 0.003 (-0.002,0.007) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.007 (0.003,0.011) | 0.003 (0.001,0.005) | 0.024 (0.009,0.038) | 0.002 (0.001,0.003) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.03 (0.017,0.042) | 0.013 (0.007,0.018) | 0.086 (0.049,0.122) | 0.009 (0.005,0.013) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.016 (0.008,0.023) | 0.007 (0.004,0.01) | 0.053 (0.027,0.078) | 0.004 (0.002,0.006) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.008 (0.003,0.012) | 0.003 (0.001,0.005) | 0.023 (0.01,0.036) | 0.002 (0.001,0.004) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.004 (0.001,0.006) | 0.002 (0.001,0.003) | 0.013 (0.005,0.021) | 0.001 (0,0.002) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.02 (0,0.04) | 0.01 (0,0.02) | 0.07 (0.01,0.13) | 0.01 (0,0.01) |
| Work Loss Days (Adults 18-65 years) | 9.25 (7.83,10.67) | 4.01 (3.39,4.62) | 34.87 (29.52,40.22) | 2.39 (2.02,2.76) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 1.34 (0.51,2.16) | 0.58 (0.22,0.94) | 4.74 (1.8,7.67) | 0.32 (0.12,0.52) |

## Table A-16- Avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 0.11 (0.03,0.18) | 0.11 (0.03,0.19) | 0.09 (0.03,0.16) | 0.52 (0.14,0.89) | 0.02 (0,0.03) |
| Mortality (Infants less than 1 year of age) | 0 (0,0) | 0 (0,0) | 0 (0,0) | 0.001 (0,0.002) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 0.17 (-0.04,0.39) | 0.18 (-0.04,0.39) | 0.15 (-0.03,0.34) | 0.72 (-0.17,1.6) | 0.03 (-0.01,0.06) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.02 (0.01,0.04) | 0.03 (0.01,0.05) | 0.02 (0.01,0.04) | 0.14 (0.03,0.24) | 0.003 (0.001,0.005) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.16 (-0.06,0.77) | 0.21 (-0.08,1.02) | 0.16 (-0.06,0.79) | 0.84 (-0.31,4.12) | 0.02 (-0.01,0.09) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.27 (0.05,0.49) | 0.36 (0.07,0.65) | 0.28 (0.05,0.51) | 1.46 (0.28,2.65) | 0.03 (0.01,0.06) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.17 (0,0.35) | 0.23 (0,0.46) | 0.18 (0,0.36) | 0.92 (-0.02,1.87) | 0.02 (0,0.04) |
| Chronic Bronchitis (Adults 27 years and older) | 0.07 (0,0.14) | 0.07 (0,0.14) | 0.06 (0,0.13) | 0.32 (0.01,0.63) | 0.01 (0,0.02) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.02 (0.01,0.02) | 0.02 (0.01,0.03) | 0.02 (0.01,0.03) | 0.09 (0.04,0.13) | 0.002 (0.001,0.003) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.003 (0.001,0.006) | 0.004 (0.001,0.007) | 0.003 (0.001,0.006) | 0.02 (0,0.03) | 0 (0,0.001) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.001 (-0.002,0.003) | 0.001 (-0.002,0.004) | 0.001 (-0.002,0.003) | 0 (-0.01,0.02) | 0 (0,0) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.001 (-0.001,0.003) | 0.002 (-0.001,0.005) | 0.002 (-0.001,0.004) | 0.01 (0,0.02) | 0 (0,0.001) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.001 (0.001,0.002) | 0.002 (0.001,0.003) | 0.001 (0.001,0.002) | 0.007 (0.003,0.012) | 0 (0,0) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.005 (0.003,0.007) | 0.006 (0.004,0.009) | 0.005 (0.003,0.007) | 0.03 (0.02,0.04) | 0.001 (0,0.001) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.002 (0.001,0.003) | 0.003 (0.001,0.004) | 0.002 (0.001,0.003) | 0.01 (0.01,0.02) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.001 (0.001,0.002) | 0.002 (0.001,0.003) | 0.001 (0.001,0.002) | 0.01 (0,0.01) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.001 (0,0.001) | 0.001 (0,0.002) | 0.001 (0,0.001) | 0.004 (0.001,0.007) | 0 (0,0) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.004 (0.001,0.008) | 0.006 (0.001,0.01) | 0.005 (0.001,0.009) | 0.027 (0.005,0.048) | 0.001 (0,0.001) |
| Work Loss Days (Adults 18-65 years) | 1.61 (1.36,1.85) | 2.11 (1.79,2.43) | 1.7 (1.44,1.96) | 8.92 (7.55,10.29) | 0.2 (0.17,0.23) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.24 (0.09,0.39) | 0.32 (0.12,0.52) | 0.25 (0.1,0.41) | 1.31 (0.5,2.12) | 0.03 (0.01,0.05) |

**Table A-17- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), 2000$**

| *Endpoint* | *CT* | *DE* | *DC* | *ME* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 23189000 (1777000,71478000) | 3548000 (272000,10937000) | 3176000 (243000,9790000) | 17438000 (1336000,53749000) |
| Mortality (Infants less than 1 year of age) | 36100 (3100,106100) | 7500 (600,21900) | 6900 (600,20300) | 15700 (1300,46100) |
| Acute Bronchitis (Children, ages 8-12) | 2160 (-500,4850) | 310 (-70,700) | 200 (-50,450) | 1150 (-260,2570) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 72600 (17800,127300) | 8100 (2000,14300) | 6000 (1500,10600) | 54500 (13400,95600) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 990 (-370,4850) | 140 (-50,700) | 90 (-30,420) | 510 (-190,2520) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 1730 (330,3160) | 250 (50,460) | 150 (30,270) | 900 (170,1650) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 1090 (-20,2220) | 160 (0,320) | 90 (0,190) | 570 (-10,1160) |
| Chronic Bronchitis (Adults 27 years and older) | 816700 (15100,3855300) | 125100 (2300,590700) | 102500 (1900,483800) | 575200 (10600,2715100) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 90 (40,150) | 20 (10,30) | 10 (10,20) | 50 (20,80) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 1890 (330,3460) | 260 (50,480) | 210 (40,390) | 1340 (240,2450) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 590 (-1280,2460) | 60 (-140,270) | 50 (-110,210) | 430 (-950,1820) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1660 (-960,4270) | 210 (-120,550) | 160 (-90,420) | 1300 (-760,3360) |
| Hospital Admissions- Asthma (Population under 65 years) | 620 (240,1000) | 60 (20,90) | 40 (10,60) | 370 (140,590) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 4800 (2700,6800) | 600 (300,900) | 500 (300,700) | 3600 (2000,5100) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 2470 (1280,3660) | 380 (200,560) | 270 (140,390) | 1820 (950,2700) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 700 (300,1100) | 100 (40,160) | 80 (30,130) | 540 (230,840) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 300 (100,490) | 40 (20,70) | 30 (10,50) | 220 (80,360) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 2820 (510,5130) | 410 (80,750) | 340 (60,620) | 1980 (360,3610) |
| Work Loss Days (Adults 18-65 years) | 9920 (8400,11440) | 1290 (1090,1490) | 1080 (920,1250) | 4580 (3880,5280) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 1820 (690,2970) | 260 (100,430) | 150 (60,250) | 980 (370,1590) |

## Table A-18- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), 2000$, continued

| Endpoint | MD | MA | NH | NJ |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 22560000 (1729000,69539000) | 54507000 (4177000,168010000) | 7238000 (555000,22311000) | 63286000 (4849000,195073000) |
| Mortality (Infants less than 1 year of age) | 46000 (3900,135400) | 56600 (4800,166500) | 7100 (600,20900) | 104100 (8800,306100) |
| Acute Bronchitis (Children, ages 8-12) | 2030 (-470,4540) | 4900 (-1130,10970) | 640 (-150,1440) | 5830 (-1340,13040) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 49000 (12000,86000) | 168200 (41300,294900) | 22200 (5500,39000) | 187700 (46100,329200) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 890 (-330,4350) | 2210 (-820,10830) | 270 (-100,1340) | 2510 (-930,12320) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 1550 (290,2840) | 3860 (730,7080) | 480 (90,870) | 4390 (830,8050) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 980 (-20,1990) | 2440 (-50,4970) | 300 (-10,610) | 2780 (-60,5650) |
| Chronic Bronchitis (Adults 27 years and older) | 824300 (15200,3891500) | 2001500 (36900,9448000) | 276300 (5100,1304300) | 2334400 (43100,11019800) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 140 (70,220) | 200 (100,320) | 30 (10,40) | 240 (110,380) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 1640 (290,2990) | 4210 (740,7680) | 520 (90,940) | 4710 (830,8580) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 380 (-840,1610) | 1330 (-2920,5590) | 170 (-360,690) | 1480 (-3240,6200) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1270 (-730,3270) | 3910 (-2260,10090) | 490 (-280,1270) | 4300 (-2490,11100) |
| Hospital Admissions- Asthma (Population under 65 years) | 350 (130,560) | 1410 (540,2280) | 180 (70,300) | 1630 (630,2630) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 3700 (2100,5200) | 10900 (6200,15500) | 1400 (800,1900) | 12100 (6900,17200) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 2330 (1210,3450) | 5840 (3030,8650) | 830 (430,1230) | 6610 (3430,9790) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 630 (270,980) | 1640 (700,2550) | 200 (90,320) | 1810 (770,2820) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 270 (90,450) | 700 (240,1150) | 100 (30,160) | 790 (270,1300) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 2610 (480,4750) | 6240 (1140,11340) | 760 (140,1390) | 6990 (1280,12710) |
| Work Loss Days (Adults 18-65 years) | 9170 (7760,10580) | 22750 (19260,26240) | 2630 (2230,3040) | 27680 (23440,31930) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 1660 (630,2710) | 3960 (1510,6460) | 510 (190,830) | 4690 (1780,7640) |

## Table A-19- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), 2000$, continued

| Endpoint | NY | PA | RI | VT |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 163592000 (12536000,504254000) | 54605000 (4184000,168312000) | 15489000 (1187000,47744000) | 1426000 (109000,4395000) |
| Mortality (Infants less than 1 year of age) | 305900 (25900,899400) | 79200 (6700,232900) | 18500 (1600,54300) | 1600 (100,4700) |
| Acute Bronchitis (Children, ages 8-12) | 16320 (-3760,36510) | 3950 (-910,8840) | 1280 (-290,2860) | 90 (-20,210) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 480600 (118200,842400) | 154900 (38000,271600) | 43700 (10700,76600) | 4200 (1000,7400) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 6810 (-2540,33460) | 1790 (-670,8780) | 570 (-210,2810) | 40 (-10,200) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 11930 (2260,21860) | 3130 (590,5740) | 1000 (190,1840) | 70 (10,130) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 7550 (-150,15360) | 1980 (-40,4030) | 630 (-10,1290) | 40 (0,90) |
| Chronic Bronchitis (Adults 27 years and older) | 6270400 (115800,29598400) | 1661300 (30700,7842500) | 511800 (9500,2415900) | 47500 (900,224100) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 640 (310,1020) | 170 (80,270) | 50 (30,80) | 0 (0,10) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 11990 (2110,21860) | 4070 (720,7430) | 1150 (200,2090) | 100 (20,190) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 3790 (-8290,15870) | 1270 (-2790,5340) | 350 (-780,1490) | 30 (-70,140) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 11040 (-6400,28480) | 3660 (-2120,9430) | 1000 (-580,2570) | 100 (-60,260) |
| Hospital Admissions- Asthma (Population under 65 years) | 4320 (1660,6970) | 1140 (440,1850) | 360 (140,570) | 30 (10,40) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 30900 (17700,44100) | 10400 (5900,14800) | 2900 (1600,4100) | 300 (200,400) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 16850 (8740,24960) | 4990 (2590,7400) | 1450 (750,2150) | 140 (70,210) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 4630 (1970,7210) | 1540 (650,2400) | 420 (180,660) | 40 (20,60) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 1990 (690,3300) | 600 (210,990) | 170 (60,290) | 20 (10,30) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 17790 (3250,32330) | 6060 (1110,11010) | 1710 (310,3100) | 150 (30,270) |
| Work Loss Days (Adults 18-65 years) | 66020 (55900,76140) | 15440 (13080,17810) | 4890 (4140,5630) | 350 (300,410) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 12550 (4770,20460) | 3310 (1260,5390) | 1010 (380,1650) | 70 (30,120) |

## Table A-20- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), 2000$, continued

| Endpoint | AL | GA | KY | MS | NC |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 696100 (53300,2145800) | 2253100 (172600,6945000) | 814100 (62400,2509500) | 123900 (9500,382000) | 5328300 (408300,16423800) |
| Mortality (Infants less than 1 year of age) | 1700 (100,5100) | 6700 (600,19700) | 1700 (100,4900) | 411 (35,1208) | 13600 (1100,39900) |
| Acute Bronchitis (Children, ages 8-12) | 50 (-10,120) | 270 (-60,600) | 70 (-20,150) | 10 (0,30) | 500 (-110,1110) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 2300 (600,4100) | 8500 (2100,14900) | 2200 (500,3900) | 400 (100,700) | 18200 (4500,31900) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 40 (-20,200) | 210 (-80,1010) | 40 (-10,190) | 10 (0,40) | 370 (-140,1800) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 70 (10,130) | 360 (70,660) | 70 (10,120) | 10 (0,20) | 640 (120,1180) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 40 (0,90) | 230 (0,460) | 40 (0,90) | 10 (0,20) | 410 (-10,830) |
| Chronic Bronchitis (Adults 27 years and older) | 21800 (400,102800) | 93200 (1700,440000) | 27100 (500,127800) | 3900 (100,18600) | 186000 (3400,877900) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 10 (0,10) | 30 (20,50) | 10 (0,10) | 1 (1,2) | 60 (30,90) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 80 (10,150) | 260 (50,470) | 70 (10,130) | 13 (2,23) | 620 (110,1130) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 20 (-40,80) | 60 (-140,260) | 20 (-40,70) | 3 (-7,13) | 150 (-320,610) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 60 (-40,160) | 210 (-120,550) | 60 (-30,160) | 10 (-10,30) | 490 (-280,1260) |
| Hospital Admissions- Asthma (Population under 65 years) | 20 (10,20) | 70 (30,120) | 10 (10,20) | 3 (1,4) | 130 (50,210) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 200 (100,300) | 600 (300,900) | 200 (100,200) | 29 (16,41) | 1400 (800,2000) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 100 (100,200) | 400 (200,700) | 100 (100,100) | 17 (9,25) | 800 (400,1200) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 30 (10,50) | 100 (40,160) | 30 (10,50) | 5 (2,8) | 240 (100,370) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 10 (0,20) | 50 (20,80) | 10 (0,20) | 2 (1,3) | 100 (30,160) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 100 (0,200) | 400 (100,700) | 100 (0,200) | 20 (4,37) | 1000 (200,1800) |
| Work Loss Days (Adults 18-65 years) | 300 (300,300) | 1600 (1400,1900) | 300 (200,300) | 47 (40,54) | 2700 (2300,3200) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 100 (0,100) | 400 (100,600) | 100 (0,100) | 15 (6,24) | 700 (300,1100) |

## Table A-21- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), 2000$, continued

| Endpoint | SC | TN | VA | WV |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 2265500 (173600,6983100) | 1038900 (79600,3202200) | 8597700 (658800,26501500) | 1084300 (83100,3342400) |
| Mortality (Infants less than 1 year of age) | 4500 (400,13200) | 2100 (200,6100) | 19000 (1600,55900) | 1800 (100,5200) |
| Acute Bronchitis (Children, ages 8-12) | 170 (-40,390) | 80 (-20,180) | 870 (-200,1940) | 70 (-20,150) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 8000 (2000,14000) | 3400 (800,6000) | 24700 (6100,43400) | 2300 (600,4100) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 130 (-50,660) | 60 (-20,290) | 470 (-180,2330) | 30 (-10,160) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 230 (40,430) | 100 (20,190) | 830 (160,1520) | 60 (10,100) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 150 (0,300) | 60 (0,130) | 530 (-10,1070) | 40 (0,70) |
| Chronic Bronchitis (Adults 27 years and older) | 72000 (1300,339700) | 33300 (600,157200) | 356000 (6600,1680700) | 32000 (600,151200) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 20 (10,30) | 10 (0,10) | 70 (40,120) | 0 (0,10) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 270 (50,500) | 120 (20,210) | 800 (140,1470) | 80 (10,150) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 70 (-140,270) | 30 (-60,120) | 190 (-420,800) | 20 (-40,80) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 220 (-130,560) | 90 (-50,240) | 640 (-370,1650) | 70 (-40,170) |
| Hospital Admissions- Asthma (Population under 65 years) | 50 (20,80) | 20 (10,40) | 190 (70,300) | 10 (0,20) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 600 (400,900) | 300 (200,400) | 1800 (1000,2600) | 200 (100,300) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 400 (200,500) | 200 (100,200) | 1200 (600,1800) | 100 (0,100) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 110 (50,170) | 50 (20,70) | 310 (130,490) | 30 (10,50) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 40 (10,70) | 20 (10,30) | 140 (50,230) | 10 (0,20) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 400 (100,800) | 200 (0,300) | 1300 (200,2300) | 100 (0,200) |
| Work Loss Days (Adults 18-65 years) | 1000 (800,1200) | 400 (400,500) | 4600 (3900,5300) | 200 (200,300) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 200 (100,400) | 100 (0,200) | 900 (300,1400) | 100 (0,100) |

## Table A-22- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to S2, relative to S1, Mean (95%CI), 2000$, continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 661600 (50700,2039200) | 691800 (53000,2132400) | 597700 (45800,1842400) | 3262600 (250000,10056400) | 100100 (7700,308700) |
| Mortality (Infants less than 1 year of age) | 1760 (150,5170) | 1730 (150,5090) | 1450 (120,4260) | 6610 (560,19440) | 210 (20,620) |
| Acute Bronchitis (Children, ages 8-12) | 65 (-15,146) | 66 (-15,148) | 56 (-13,126) | 269 (-62,602) | 9 (-2,21) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1480 (360,2600) | 1970 (480,3460) | 1620 (400,2840) | 9000 (2210,15790) | 190 (50,340) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 24 (-9,119) | 32 (-12,158) | 25 (-9,123) | 130 (-49,641) | 3 (-1,14) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 43 (8,78) | 56 (11,103) | 44 (8,80) | 228 (43,418) | 5 (1,9) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 27 (-1,55) | 36 (-1,73) | 28 (-1,56) | 144 (-3,294) | 3 (0,6) |
| Chronic Bronchitis (Adults 27 years and older) | 24060 (440,113560) | 24610 (450,116180) | 21700 (400,102450) | 108410 (2000,511780) | 3820 (70,18020) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 4 (2,7) | 6 (3,9) | 5 (2,7) | 24 (12,38) | 1 (0,1) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 48 (8,87) | 61 (11,111) | 51 (9,93) | 286 (50,521) | 6 (1,11) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 11 (-24,47) | 15 (-32,61) | 12 (-26,50) | 68 (-149,286) | 1 (-3,6) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 35 (-20,90) | 47 (-27,120) | 38 (-22,97) | 214 (-124,552) | 5 (-3,12) |
| Hospital Admissions- Asthma (Population under 65 years) | 10 (4,16) | 13 (5,22) | 11 (4,17) | 56 (22,91) | 1 (0,2) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 100 (60,140) | 130 (70,190) | 110 (60,150) | 600 (350,860) | 10 (10,20) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 46 (24,68) | 63 (33,94) | 51 (26,76) | 277 (144,410) | 6 (3,9) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 17 (7,27) | 23 (10,36) | 19 (8,30) | 107 (46,167) | 2 (1,4) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 7 (2,12) | 10 (3,16) | 8 (3,13) | 42 (15,70) | 1 (0,2) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 80 (10,140) | 100 (20,180) | 80 (20,150) | 470 (90,860) | 10 (0,20) |
| Work Loss Days (Adults 18-65 years) | 220 (190,250) | 260 (220,300) | 240 (200,270) | 1110 (940,1280) | 20 (20,30) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 40 (20,70) | 60 (20,100) | 50 (20,80) | 250 (90,400) | 10 (0,10) |

## Table A-23- Avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI)

| *Endpoint* | *CT* | *DE* | *DC* | *ME* | *MD* | *MA* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 52 (14,90) | 18 (5,31) | 5 (1,9) | 8 (2,14) | 103 (28,177) | 77 (21,133) |
| Mortality (Infants less than 1 year of age) | 0.08 (0.03,0.13) | 0.04 (0.01,0.06) | 0.01 (0,0.02) | 0.01 (0,0.01) | 0.21 (0.08,0.33) | 0.08 (0.03,0.12) |
| Acute Bronchitis (Children, ages 8-12) | 81 (-19,180) | 26 (-6,58) | 6 (-1,13) | 9 (-2,20) | 159 (-37,353) | 112 (-26,248) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 18 (5,32) | 4 (1,7) | 1 (0,2) | 3 (1,5) | 24 (6,42) | 26 (6,45) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 106 (-40,519) | 28 (-10,137) | 9 (-3,43) | 11 (-4,57) | 188 (-70,924) | 139 (-52,681) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 185 (35,335) | 49 (9,88) | 15 (3,27) | 20 (4,36) | 329 (63,596) | 243 (46,439) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 117 (-2,236) | 31 (-1,62) | 10 (0,19) | 13 (0,26) | 208 (-4,420) | 153 (-3,310) |
| Chronic Bronchitis (Adults 27 years and older) | 34 (1,67) | 12 (0,23) | 3 (0,7) | 5 (0,10) | 71 (2,140) | 51 (1,101) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 6 (3,8) | 2 (1,3) | 1 (0,1) | 1 (0,1) | 16 (8,24) | 7 (4,11) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 2.1 (0.4,3.8) | 0.5 (0.1,1) | 0.2 (0,0.4) | 0.3 (0.1,0.6) | 3.5 (0.6,6.3) | 2.8 (0.5,5.2) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.6 (-1.4,2.7) | 0.1 (-0.3,0.5) | 0.1 (-0.1,0.2) | 0.1 (-0.2,0.4) | 0.8 (-1.8,3.4) | 0.9 (-2,3.8) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1.1 (-0.6,2.8) | 0.3 (-0.1,0.7) | 0.1 (-0.1,0.3) | 0.2 (-0.1,0.5) | 1.6 (-0.9,4.1) | 1.6 (-0.9,4) |
| Hospital Admissions- Asthma (Population under 65 years) | 1.3 (0.5,2.1) | 0.2 (0.1,0.4) | 0.1 (0,0.1) | 0.2 (0.1,0.3) | 1.5 (0.6,2.4) | 1.8 (0.7,2.8) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 3.7 (2.1,5.4) | 0.9 (0.5,1.2) | 0.4 (0.2,0.5) | 0.6 (0.3,0.8) | 5.6 (3.2,8) | 5.3 (3,7.5) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 1.81 (0.94,2.69) | 0.51 (0.27,0.76) | 0.19 (0.1,0.27) | 0.29 (0.15,0.42) | 3.38 (1.75,5) | 2.6 (1.35,3.84) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.87 (0.37,1.36) | 0.23 (0.1,0.37) | 0.09 (0.04,0.15) | 0.14 (0.06,0.22) | 1.51 (0.64,2.34) | 1.25 (0.53,1.94) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.46 (0.16,0.76) | 0.13 (0.04,0.21) | 0.05 (0.02,0.08) | 0.07 (0.03,0.12) | 0.83 (0.29,1.38) | 0.66 (0.23,1.09) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 2.62 (0.48,4.76) | 0.71 (0.13,1.29) | 0.3 (0.06,0.55) | 0.39 (0.07,0.7) | 4.71 (0.86,8.55) | 3.57 (0.65,6.48) |
| Work Loss Days (Adults 18-65 years) | 1081 (916,1247) | 303 (256,349) | 119 (101,137) | 143 (121,165) | 2082 (1764,2401) | 1505 (1274,1735) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 161 (62,260) | 43 (16,69) | 13 (5,21) | 18 (7,29) | 292 (112,470) | 208 (80,336) |

## Table A-24- Avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), continued

| *Endpoint* | *NH* | *NJ* | *NY* | *PA* | *RI* | *VT* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 8 (2,15) | 183 (50,316) | 274 (75,472) | 245 (67,422) | 18 (5,31) | 3 (1,4) |
| Mortality (Infants less than 1 year of age) | 0.01 (0,0.01) | 0.28 (0.11,0.45) | 0.46 (0.18,0.74) | 0.33 (0.13,0.54) | 0.02 (0.01,0.03) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 13 (-3,29) | 272 (-63,603) | 440 (-103,979) | 279 (-65,621) | 24 (-6,54) | 3 (-1,6) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 3 (1,5) | 57 (14,99) | 92 (23,160) | 66 (16,115) | 6 (1,10) | 0.8 (0.2,1.4) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 14 (-5,69) | 318 (-119,1565) | 545 (-204,2680) | 308 (-115,1514) | 30 (-11,149) | 3.3 (-1.2,16.4) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 25 (5,45) | 557 (106,1008) | 955 (181,1728) | 539 (102,975) | 53 (10,96) | 5.8 (1.1,10.5) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 16 (0,31) | 352 (-7,711) | 604 (-12,1218) | 341 (-7,688) | 34 (-1,68) | 3.7 (-0.1,7.4) |
| Chronic Bronchitis (Adults 27 years and older) | 6 (0,12) | 120 (3,236) | 189 (5,372) | 136 (4,268) | 11 (0,22) | 1.6 (0,3.1) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 1 (0,1) | 17 (9,25) | 29 (15,42) | 16 (8,24) | 2 (1,2) | 0.2 (0.1,0.3) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.3 (0,0.5) | 6.2 (1.1,11.3) | 10 (1.8,18.2) | 7.6 (1.3,13.9) | 0.6 (0.1,1.2) | 0.1 (0,0.2) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.1 (-0.2,0.4) | 2 (-4.3,8.2) | 3.2 (-6.9,13.2) | 2.4 (-5.2,10) | 0.2 (-0.4,0.8) | 0 (-0.1,0.1) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.1 (-0.1,0.4) | 3.4 (-2,8.7) | 5.4 (-3.2,14) | 4 (-2.3,10.4) | 0.3 (-0.2,0.9) | 0 (0,0.1) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.2 (0.1,0.3) | 4.1 (1.6,6.5) | 6.8 (2.6,11) | 4 (1.5,6.5) | 0.4 (0.1,0.6) | 0 (0,0.1) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.5 (0.3,0.7) | 11.5 (6.6,16.4) | 18.6 (10.6,26.5) | 14 (8,20) | 1.2 (0.7,1.7) | 0.2 (0.1,0.2) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.29 (0.15,0.43) | 5.75 (2.98,8.52) | 9.38 (4.87,13.89) | 6.19 (3.21,9.17) | 0.56 (0.29,0.83) | 0.08 (0.04,0.12) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.12 (0.05,0.19) | 2.71 (1.15,4.22) | 4.37 (1.86,6.81) | 3.28 (1.4,5.1) | 0.27 (0.12,0.42) | 0.04 (0.02,0.06) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.07 (0.03,0.12) | 1.46 (0.51,2.41) | 2.37 (0.82,3.91) | 1.59 (0.55,2.62) | 0.14 (0.05,0.24) | 0.02 (0.01,0.03) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.33 (0.06,0.6) | 7.88 (1.44,14.3) | 12.61 (2.31,22.88) | 9.68 (1.77,17.57) | 0.82 (0.15,1.48) | 0.11 (0.02,0.2) |
| Work Loss Days (Adults 18-65 years) | 161 (136,185) | 3450 (2922,3978) | 5778 (4893,6661) | 3406 (2885,3928) | 324 (274,373) | 41 (34,47) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 22 (8,36) | 493 (189,795) | 836 (321,1347) | 473 (181,762) | 45 (17,72) | 5 (2,8) |

**Table A-25- Avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), continued**

| *Endpoint* | *AL* | *GA* | *KY* | *MS* | *NC* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | -2 (0,-3) | -4 (-1,-8) | 121 (33,209) | 2 (1,3) | 32 (9,56) |
| Mortality (Infants less than 1 year of age) | 0 (0,-0.01) | -0.01 (-0.01,-0.02) | 0.25 (0.1,0.41) | 0.01 (0,0.01) | 0.08 (0.03,0.13) |
| Acute Bronchitis (Children, ages 8-12) | -2 (0,-4) | -9 (2,-21) | 169 (-39,374) | 3 (-1,7) | 50 (-12,112) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.9 (0.2,1.5) | 2.3 (0.6,3.9) | 31.4 (7.9,54.5) | 1 (0.2,1.7) | 10.7 (2.7,18.8) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 6 (-2,31) | 24 (-9,117) | 234 (-88,1150) | 9 (-3,43) | 88 (-33,434) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 11 (2,20) | 42 (8,76) | 410 (78,742) | 15 (3,28) | 154 (29,279) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 7 (0,14) | 26 (-1,53) | 259 (-5,523) | 10 (0,20) | 98 (-2,197) |
| Chronic Bronchitis (Adults 27 years and older) | -0.8 (0,-1.6) | -3.5 (-0.1,-6.9) | 75.6 (2.1,148.7) | 1.2 (0,2.4) | 21 (0.6,41.5) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.5 (0.3,0.8) | 2.1 (1.1,3.1) | 20.5 (10.5,30.3) | 0.8 (0.4,1.1) | 7.5 (3.8,11.2) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.1 (0,0.2) | 0.3 (0.1,0.6) | 4.7 (0.8,8.5) | 0.1 (0,0.3) | 1.6 (0.3,3) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.03 (-0.07,0.13) | 0.07 (-0.16,0.31) | 1.12 (-2.47,4.69) | 0.03 (-0.07,0.14) | 0.38 (-0.84,1.6) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.06 (-0.04,0.16) | 0.15 (-0.08,0.38) | 2.23 (-1.29,5.75) | 0.07 (-0.04,0.17) | 0.75 (-0.43,1.93) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.05 (0.02,0.08) | 0.17 (0.07,0.28) | 1.79 (0.69,2.88) | 0.06 (0.02,0.1) | 0.64 (0.25,1.04) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.22 (0.13,0.31) | 0.5 (0.29,0.72) | 7.66 (4.39,10.93) | 0.23 (0.13,0.33) | 2.62 (1.5,3.74) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.11 (0.06,0.17) | 0.35 (0.18,0.52) | 4.05 (2.1,5.99) | 0.13 (0.07,0.2) | 1.39 (0.72,2.07) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.06 (0.03,0.09) | 0.14 (0.06,0.21) | 2.1 (0.89,3.27) | 0.06 (0.03,0.1) | 0.71 (0.3,1.1) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.03 (0.01,0.05) | 0.09 (0.03,0.14) | 1.02 (0.35,1.68) | 0.03 (0.01,0.05) | 0.34 (0.12,0.57) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.18 (0.03,0.33) | 0.41 (0.07,0.74) | 6.29 (1.15,11.4) | 0.19 (0.03,0.34) | 2.2 (0.4,3.99) |
| Work Loss Days (Adults 18-65 years) | 66 (56,76) | 250 (212,288) | 2501 (2119,2883) | 83 (70,96) | 920 (779,1061) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 10 (4,16) | 37 (14,59) | 362 (139,581) | 14 (5,22) | 134 (51,216) |

## Table A-26- Avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), continued.

| *Endpoint* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 10 (3,18) | 57 (16,98) | 61 (17,106) | 45 (12,78) |
| Mortality (Infants less than 1 year of age) | 0.02 (0.01,0.03) | 0.14 (0.05,0.23) | 0.12 (0.05,0.19) | 0.07 (0.03,0.12) |
| Acute Bronchitis (Children, ages 8-12) | 13 (-3,30) | 83 (-19,184) | 99 (-23,220) | 44 (-10,98) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 3.6 (0.9,6.2) | 16.8 (4.2,29.3) | 19.3 (4.8,33.5) | 10 (2.5,17.4) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 26 (-10,128) | 134 (-50,661) | 153 (-57,753) | 57 (-21,279) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 46 (9,83) | 236 (45,426) | 268 (51,485) | 99 (19,180) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 29 (-1,58) | 149 (-3,300) | 170 (-3,342) | 63 (-1,127) |
| Chronic Bronchitis (Adults 27 years and older) | 6 (0.2,11.9) | 35.7 (1,70.2) | 44.6 (1.2,87.9) | 23.7 (0.7,46.7) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 2.2 (1.1,3.3) | 11.6 (5.9,17.2) | 13.3 (6.8,19.8) | 4.9 (2.5,7.3) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.5 (0.1,1) | 2.5 (0.4,4.5) | 2.8 (0.5,5) | 1.6 (0.3,2.9) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.13 (-0.28,0.53) | 0.59 (-1.3,2.48) | 0.66 (-1.44,2.75) | 0.38 (-0.83,1.59) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.25 (-0.15,0.65) | 1.18 (-0.68,3.04) | 1.3 (-0.75,3.35) | 0.75 (-0.43,1.93) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.2 (0.08,0.32) | 1 (0.39,1.62) | 1.18 (0.46,1.91) | 0.46 (0.18,0.74) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.88 (0.5,1.25) | 4.07 (2.33,5.81) | 4.51 (2.58,6.43) | 2.59 (1.48,3.69) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.47 (0.24,0.69) | 2.27 (1.18,3.36) | 2.7 (1.4,4) | 1.15 (0.6,1.7) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.24 (0.1,0.37) | 1.11 (0.47,1.72) | 1.22 (0.52,1.9) | 0.7 (0.3,1.1) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.12 (0.04,0.19) | 0.56 (0.19,0.93) | 0.66 (0.23,1.09) | 0.29 (0.1,0.48) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.73 (0.13,1.32) | 3.33 (0.61,6.05) | 3.71 (0.68,6.74) | 2.14 (0.39,3.88) |
| Work Loss Days (Adults 18-65 years) | 278 (235,320) | 1415 (1198,1631) | 1721 (1458,1984) | 662 (561,763) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 40 (15,65) | 207 (79,333) | 237 (91,382) | 87 (33,140) |

## Table A-27- Avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | -4 (-1,-7) | 101 (28,174) | 27 (7,47) | 225 (62,388) | -14 (-4,-25) |
| Mortality (Infants less than 1 year of age) | -0.04 (-0.02,-0.07) | 0.24 (0.09,0.39) | 0.07 (0.03,0.11) | 0.5 (0.19,0.8) | -0.03 (-0.01,-0.05) |
| Acute Bronchitis (Children, ages 8-12) | -23 (-5,-52) | 158 (-37,351) | 42 (-10,93) | 330 (-77,734) | -22 (-5,-48) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | -14 (-3,-24) | 24 (6,41) | -3 (-1,-6) | 53 (13,93) | -9 (-2,-16) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | -113 (-561,42) | 164 (-62,807) | -24 (-119,9) | 352 (-132,1728) | -55 (-273,21) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | -198 (-38,-359) | 288 (55,521) | -42 (-8,-75) | 616 (117,1114) | -97 (-18,-175) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | -125 (3,-254) | 182 (-4,367) | -26 (1,-53) | 389 (-8,786) | -61 (1,-124) |
| Chronic Bronchitis (Adults 27 years and older) | -7 (0,-13) | 67 (2,131) | 18 (1,36) | 145 (4,285) | -10 (0,-19) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | -12 (-6,-18) | 17 (9,25) | -2 (-1,-4) | 36 (19,54) | -6 (-3,-9) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | -1.7 (-0.3,-3.2) | 3.3 (0.6,5.9) | -0.4 (-0.1,-0.8) | 7.3 (1.3,13.3) | -1.3 (-0.2,-2.3) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | -0.4 (0.9,-1.7) | 0.8 (-1.7,3.3) | -0.1 (0.2,-0.4) | 1.7 (-3.8,7.3) | -0.3 (0.6,-1.2) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | -0.8 (0.4,-1.9) | 1.5 (-0.9,3.8) | -0.2 (0.1,-0.5) | 3.3 (-1.9,8.4) | -0.5 (0.3,-1.4) |
| Hospital Admissions- Asthma (Population under 65 years) | -0.9 (-0.4,-1.5) | 1.4 (0.5,2.2) | -0.2 (-0.1,-0.3) | 3 (1.2,4.8) | -0.5 (-0.2,-0.8) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | -2.6 (-1.5,-3.7) | 5 (2.9,7.2) | -0.6 (-0.4,-0.9) | 11.2 (6.4,15.9) | -1.9 (-1.1,-2.7) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | -1.3 (-0.7,-1.9) | 2.3 (1.2,3.4) | -0.3 (-0.2,-0.4) | 5 (2.6,7.4) | -0.8 (-0.4,-1.2) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | -0.7 (-1.1,-0.3) | 1.4 (0.6,2.2) | -0.2 (-0.3,-0.1) | 3.1 (1.3,4.9) | -0.5 (-0.8,-0.2) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | -0.4 (-0.1,-0.7) | 0.7 (0.3,1.2) | -0.1 (0,-0.2) | 1.6 (0.6,2.7) | -0.3 (-0.1,-0.4) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | -2.5 (-0.4,-4.5) | 4.6 (0.8,8.3) | -0.6 (-0.1,-1.1) | 10.3 (1.9,18.8) | -1.8 (-0.3,-3.2) |
| Work Loss Days (Adults 18-65 years) | -1126 (-953,-1299) | 1694 (1435,1953) | -231 (-196,-267) | 3744 (3171,4316) | -607 (-514,-700) |
| Lower Respiratory Symptoms (Children, ages 7-14) | -182 (-69,-298) | 251 (97,403) | -36 (-13,-60) | 544 (209,876) | -87 (-33,-142) |

**Table A-28- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), 2000$**

| *Endpoint* | *CT* | *DE* | *DC* | *ME* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 327304000 (25085000,1008885000) | 112467000 (8621000,346667000) | 33810000 (2591000,104216000) | 50146000 (3843000,154571000) |
| Mortality (Infants less than 1 year of age) | 501300 (42400,1473900) | 236700 (20000,695700) | 72200 (6100,212200) | 46100 (3900,135500) |
| Acute Bronchitis (Children, ages 8-12) | 30300 (-7000,67700) | 9800 (-2300,21900) | 2200 (-500,4800) | 3300 (-800,7400) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1206100 (299800,2098700) | 248000 (61600,431900) | 94500 (23500,164500) | 190900 (47200,333500) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 16500 (-6200,80800) | 4400 (-1600,21300) | 1400 (-500,6600) | 1800 (-700,8800) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 28900 (5500,52900) | 7600 (1400,14000) | 2400 (400,4300) | 3100 (600,5800) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 18300 (-400,37200) | 4800 (-100,9800) | 1500 (0,3000) | 2000 (0,4000) |
| Chronic Bronchitis (Adults 27 years and older) | 11548100 (213700,54488200) | 3975600 (73600,18759700) | 1124500 (20800,5306000) | 1664800 (30800,7857100) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 1540 (750,2450) | 650 (310,1040) | 210 (100,330) | 170 (80,270) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 31900 (5600,58100) | 8100 (1400,14800) | 3400 (600,6200) | 4700 (800,8500) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 9900 (-21700,41300) | 2000 (-4300,8200) | 800 (-1700,3300) | 1500 (-3300,6300) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 27900 (-16200,71900) | 6600 (-3800,16900) | 2600 (-1500,6600) | 4600 (-2700,11800) |
| Hospital Admissions- Asthma (Population under 65 years) | 10400 (4000,16700) | 1700 (700,2800) | 600 (200,1000) | 1300 (500,2100) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 80200 (45900,114500) | 18600 (10600,26500) | 7500 (4300,10700) | 12400 (7100,17700) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 41600 (21600,61600) | 11700 (6100,17300) | 4200 (2200,6300) | 6500 (3400,9600) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 11900 (5100,18500) | 3200 (1400,4900) | 1300 (500,2000) | 1900 (800,2900) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 5000 (1700,8200) | 1400 (500,2300) | 500 (200,800) | 800 (300,1300) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 47500 (8700,86200) | 12800 (2300,23200) | 5400 (1000,9900) | 6900 (1300,12500) |
| Work Loss Days (Adults 18-65 years) | 166600 (141100,192000) | 39500 (33500,45600) | 17600 (14900,20300) | 15800 (13400,18200) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 30200 (11600,49000) | 8000 (3100,13000) | 2400 (900,3900) | 3400 (1300,5600) |

## Table A-29- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), 2000$

| *Endpoint* | *MD* | *MA* | *NH* | *NJ* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 648227000 (49686000,1998100000) | 485515000 (37209000,1496558000) | 52956000 (4058000,163231000) | 1154042000 (88459000,3557229000) |
| Mortality (Infants less than 1 year of age) | 1303700 (110300,3832700) | 480100 (40600,1411400) | 53400 (4500,156900) | 1762000 (149000,5180100) |
| Acute Bronchitis (Children, ages 8-12) | 59500 (-13800,132700) | 41700 (-9700,93200) | 4900 (-1100,11000) | 101600 (-23600,226600) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1585800 (394800,2756200) | 1714300 (424700,2989400) | 175000 (43200,305900) | 3758500 (932700,6546500) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 29400 (-11000,143700) | 21600 (-8100,106000) | 2200 (-800,10800) | 49700 (-18600,243500) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 51400 (9700,94200) | 37900 (7200,69400) | 3900 (700,7100) | 87100 (16500,159500) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 32500 (-600,66100) | 24000 (-500,48700) | 2400 (0,5000) | 55000 (-1100,112000) |
| Chronic Bronchitis (Adults 27 years and older) | 23962200 (443600,113065800) | 17331800 (320600,81776200) | 2074900 (38300,9791700) | 40500200 (749900,191103700) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 4500 (2180,7160) | 1990 (960,3170) | 210 (100,330) | 4660 (2250,7420) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 53400 (9400,97300) | 43500 (7700,79400) | 4000 (700,7400) | 96200 (17000,175300) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 12500 (-27600,52500) | 13800 (-30300,57800) | 1300 (-2800,5400) | 30200 (-66400,126600) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 41400 (-24000,106700) | 40500 (-23500,104300) | 3900 (-2200,10000) | 87700 (-50900,226100) |
| Hospital Admissions- Asthma (Population under 65 years) | 11500 (4400,18500) | 13900 (5300,22500) | 1500 (600,2400) | 32000 (12300,51700) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 119600 (68500,170600) | 112700 (64500,160800) | 10600 (6100,15200) | 246600 (141200,351900) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 77400 (40100,114500) | 59500 (30800,88100) | 6700 (3500,9900) | 132000 (68500,195500) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 20500 (8700,31900) | 16900 (7200,26400) | 1600 (700,2500) | 37000 (15700,57600) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 9000 (3100,14800) | 7100 (2500,11800) | 800 (300,1300) | 15800 (5500,26100) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 85100 (15600,154300) | 64500 (11800,117200) | 6000 (1100,10800) | 142900 (26100,259300) |
| Work Loss Days (Adults 18-65 years) | 301800 (255600,347900) | 222000 (188000,256000) | 21000 (17800,24200) | 537100 (454900,619300) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 54600 (20900,88600) | 38900 (14900,63300) | 4100 (1600,6700) | 92300 (35300,150000) |

## Table A-30- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), 2000$

| *Endpoint* | *NY* | *PA* | *RI* | *VT* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 1723845000 (132127000,5313596000) | 1542445000 (118222000,4754444000) | 114756000 (8796000,353726000) | 15919320 (1219890,49069700) |
| Mortality (Infants less than 1 year of age) | 2914100 (246400,8567000) | 2097800 (177400,6167300) | 120500 (10200,354200) | 17880 (1510,52580) |
| Acute Bronchitis (Children, ages 8-12) | 164700 (-38200,367500) | 104400 (-24200,233000) | 9200 (-2100,20400) | 1080 (-250,2410) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 6072300 (1508000,10571400) | 4366100 (1083300,7605900) | 375200 (93100,653300) | 53950 (13300,94390) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 85200 (-31800,417100) | 48100 (-17900,235600) | 4700 (-1800,23200) | 520 (-190,2550) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 149200 (28200,273300) | 84200 (15900,154300) | 8300 (1600,15200) | 910 (170,1670) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 94300 (-1900,191800) | 53200 (-1100,108300) | 5200 (-100,10700) | 580 (-10,1170) |
| Chronic Bronchitis (Adults 27 years and older) | 63703800 (1179200,300586600) | 45967700 (850700,216897000) | 3807800 (70500,17966900) | 538140 (9940,2540010) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 7950 (3850,12650) | 4520 (2190,7200) | 430 (210,690) | 50 (20,80) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 153200 (27000,279100) | 116600 (20600,212500) | 9800 (1700,17900) | 1300 (230,2380) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 48400 (-106400,202800) | 36500 (-80100,152700) | 3000 (-6700,12800) | 420 (-930,1780) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 141600 (-82100,364800) | 105000 (-60900,270500) | 8600 (-5000,22200) | 1290 (-750,3320) |
| Hospital Admissions- Asthma (Population under 65 years) | 53700 (20600,86700) | 31200 (12000,50400) | 3000 (1200,4800) | 360 (140,580) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 395500 (226500,564500) | 297300 (170200,424200) | 24700 (14200,35300) | 3480 (1990,4970) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 214600 (111300,317800) | 141200 (73300,209100) | 12800 (6600,19000) | 1850 (960,2730) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 59300 (25300,92300) | 44100 (18800,68800) | 3600 (1600,5700) | 530 (220,820) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 25500 (8800,42100) | 17000 (5900,28100) | 1500 (500,2500) | 220 (80,370) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 227200 (41600,412300) | 173400 (31700,314700) | 14600 (2700,26500) | 1930 (350,3500) |
| Work Loss Days (Adults 18-65 years) | 809500 (685600,933400) | 424300 (359400,489300) | 41000 (34800,47300) | 4590 (3880,5290) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 156400 (59900,254000) | 88400 (33800,143600) | 8400 (3200,13600) | 960 (370,1570) |

## Table A-31- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), 2000$

| *Endpoint* | *AL* | *GA* | *KY* | *MS* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | -9492000 (-29256000,-727263) | -28128000 (-86701000,-2155281) | 762717000 (58475000,2350996992) | 12530000 (960000,38623240) |
| Mortality (Infants less than 1 year of age) | -28440 (-83610,-2400) | -89900 (-264340,-7600) | 1597300 (135080,4695390) | 45890 (3880,134930) |
| Acute Bronchitis (Children, ages 8-12) | -690 (-1540,160) | -3540 (-7920,810) | 63130 (-14710,140610) | 1240 (-290,2780) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 57700 (14460,99820) | 149220 (37450,257850) | 2072160 (517930,3591950) | 63670 (15770,111080) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 990 (-370,4820) | 3730 (-1390,18220) | 36580 (-13670,178920) | 1360 (-510,6690) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 1730 (330,3170) | 6540 (1240,11970) | 64120 (12140,117430) | 2390 (450,4380) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 1090 (-20,2220) | 4130 (-80,8390) | 40520 (-810,82370) | 1510 (-30,3070) |
| Chronic Bronchitis (Adults 27 years and older) | -275500 (-1300970,-5080) | -1183860 (-5589820,-21840) | 25510330 (473020,120382900) | 418780 (7730,1976740) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 150 (70,240) | 580 (280,920) | 5690 (2760,9060) | 210 (100,330) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 2040 (360,3710) | 4640 (820,8450) | 70760 (12490,128840) | 2120 (370,3870) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 490 (-1070,2030) | 1110 (-2450,4660) | 17060 (-37560,71400) | 510 (-1110,2120) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1630 (-950,4200) | 3780 (-2200,9740) | 57640 (-33460,148470) | 1700 (-990,4390) |
| Hospital Admissions- Asthma (Population under 65 years) | 370 (140,590) | 1360 (520,2190) | 13870 (5340,22390) | 470 (180,770) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 4640 (2660,6620) | 10670 (6110,15220) | 162040 (92810,231210) | 4840 (2770,6910) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 2590 (1340,3830) | 8040 (4170,11910) | 92040 (47760,136290) | 2990 (1550,4430) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 800 (340,1240) | 1840 (780,2860) | 28070 (11970,43720) | 830 (350,1290) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 300 (100,500) | 910 (320,1510) | 10850 (3770,17910) | 340 (120,570) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 3220 (590,5840) | 7320 (1340,13260) | 111910 (20490,202940) | 3360 (610,6100) |
| Work Loss Days (Adults 18-65 years) | 7200 (6100,8300) | 30400 (25800,35100) | 271500 (230000,313000) | 8300 (7000,9600) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 1800 (700,3000) | 6800 (2600,11000) | 67700 (26000,109700) | 2600 (1000,4200) |

## Table A-32- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), 2000$

| *Endpoint* | *NC* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 204749000 (15690000,631119104) | 64308000 (4928000,198222752) | 358900000 (27505000,1106278400) | 386244000 (29600000,1190563328) | 283661000 (21744000,874359488) |
| Mortality (Infants less than 1 year of age) | 506690 (42850,1489720) | 131040 (11080,385290) | 885310 (74870,2602760) | 732780 (61970,2154370) | 451950 (38220,1328600) |
| Acute Bronchitis (Children, ages 8-12) | 18720 (-4320,41870) | 5040 (-1160,11280) | 30870 (-7150,68970) | 37020 (-8570,82740) | 16470 (-3830,36740) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 707840 (175020,1236020) | 236230 (58560,411750) | 1110330 (276130,1931180) | 1269750 (315280,2210880) | 660130 (163920,1149370) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 13780 (-5140,67550) | 4070 (-1520,19960) | 21010 (-7840,102850) | 23920 (-8930,117140) | 8850 (-3300,43350) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 24130 (4560,44200) | 7130 (1350,13070) | 36800 (6970,67410) | 41900 (7930,76750) | 15510 (2930,28400) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 15260 (-300,31040) | 4510 (-90,9170) | 23260 (-460,47310) | 26490 (-530,53870) | 9800 (-200,19930) |
| Chronic Bronchitis (Adults 27 years and older) | 7098860 (131110,33505930) | 2037080 (37610,9615540) | 12032310 (222480,56774220) | 15051290 (278240,71022470) | 8008610 (148310,37789770) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 2100 (1010,3340) | 630 (300,1000) | 3220 (1560,5120) | 3700 (1790,5900) | 1360 (660,2170) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 24650 (4350,44930) | 8160 (1440,14870) | 37630 (6640,68540) | 42170 (7440,76840) | 23980 (4230,43680) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 5820 (-12770,24370) | 1940 (-4260,8130) | 9010 (-19820,37740) | 10040 (-22050,42020) | 5760 (-12650,24110) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 19340 (-11210,49860) | 6510 (-3780,16780) | 30490 (-17680,78560) | 33720 (-19550,86890) | 19350 (-11220,49870) |
| Hospital Admissions- Asthma (Population under 65 years) | 5010 (1920,8090) | 1540 (590,2480) | 7790 (2990,12570) | 9280 (3570,14980) | 3570 (1370,5760) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 55520 (31790,79240) | 18550 (10620,26470) | 86170 (49350,122970) | 95850 (54880,136790) | 54700 (31320,78060) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 31750 (16470,47030) | 10640 (5520,15760) | 51670 (26810,76520) | 61680 (32000,91340) | 26090 (13540,38640) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 9470 (4040,14760) | 3170 (1350,4940) | 14820 (6320,23080) | 16510 (7040,25730) | 9390 (4000,14630) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 3660 (1270,6050) | 1230 (430,2040) | 5970 (2070,9860) | 7100 (2470,11740) | 3090 (1070,5100) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 39170 (7160,71130) | 12930 (2360,23470) | 59370 (10860,107740) | 66710 (12200,121090) | 37970 (6950,68920) |
| Work Loss Days (Adults 18-65 years) | 103300 (87500,119100) | 30100 (25500,34700) | 157700 (133500,181800) | 226700 (192000,261300) | 67800 (57400,78200) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 25000 (9500,40700) | 7600 (2900,12300) | 38700 (14800,62800) | 44400 (17000,72100) | 16300 (6200,26500) |

# Table A-33- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to 167 EGU, Mean (95%CI), 2000$

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | -26290000 (-81022000,-2011000) | 634458000 (48636000,1955656000) | 172114000 (13190000,530526000) | 1417907000 (108688000,4370563000) | -91287000 (-281380000,-6995000) |
| Mortality (Infants less than 1 year of age) | -270000 (-794000,-22800) | 1524000 (128900,4480300) | 434300 (36700,1276900) | 3141600 (265700,9235400) | -189500 (-557300,-16000) |
| Acute Bronchitis (Children, ages 8-12) | -8700 (-19500,2000) | 59100 (-13800,131900) | 15600 (-3600,34900) | 123500 (-28700,275500) | -8100 (-18100,1900) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | -904900 (-1612800,-217000) | 1570000 (393200,2717500) | -222500 (-403700,-51900) | 3525600 (877700,6127600) | -604100 (-1064800,-147300) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | -17700 (-87300,6600) | 25700 (-9600,125500) | -3700 (-18500,1400) | 54900 (-20500,268900) | -8600 (-42400,3200) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | -30900 (-56700,-5800) | 45000 (8500,82400) | -6500 (-11900,-1200) | 96200 (18200,176300) | -15100 (-27700,-2900) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | -19600 (-39900,400) | 28400 (-600,57800) | -4100 (-8400,100) | 60800 (-1200,123700) | -9600 (-19500,200) |
| Chronic Bronchitis (Adults 27 years and older) | -2233300 (-10562400,-41000) | 22465400 (416200,106008700) | 6145400 (113600,28999600) | 48857200 (904900,230540900) | -3302600 (-15594300,-60900) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | -3400 (-5400,-1600) | 4600 (2200,7300) | -700 (-1100,-300) | 10100 (4900,16000) | -1600 (-2600,-800) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | -26600 (-48500,-4700) | 49600 (8800,90300) | -6300 (-11600,-1100) | 111400 (19700,203000) | -19200 (-35000,-3400) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | -6300 (-26300,13600) | 12000 (-26400,50100) | -1500 (-6400,3300) | 26600 (-58600,111500) | -4500 (-19000,9900) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | -19500 (-50400,11200) | 38300 (-22200,98600) | -4800 (-12400,2800) | 84200 (-48900,217100) | -14200 (-36600,8200) |
| Hospital Admissions- Asthma (Population under 65 years) | -7300 (-11900,-2800) | 10600 (4100,17100) | -1500 (-2400,-600) | 23500 (9000,37900) | -3800 (-6100,-1400) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | -55400 (-79100,-31700) | 106900 (61200,152600) | -13400 (-19200,-7700) | 237100 (135800,338400) | -40200 (-57400,-23000) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | -29900 (-44300,-15500) | 51900 (27000,76900) | -6900 (-10300,-3600) | 114100 (59200,169000) | -18200 (-27000,-9500) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | -9800 (-15300,-4200) | 19200 (8200,29800) | -2400 (-3700,-1000) | 42200 (18000,65700) | -7100 (-11100,-3000) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | -4500 (-7500,-1600) | 7800 (2700,13000) | -1100 (-1800,-400) | 17400 (6000,28700) | -2800 (-4700,-1000) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | -44300 (-80700,-8000) | 82300 (15100,149300) | -10600 (-19400,-1900) | 185300 (33900,336200) | -31900 (-58100,-5800) |
| Work Loss Days (Adults 18-65 years) | -154000 (-178000,-131000) | 207000 (175000,239000) | -32000 (-37000,-27000) | 468000 (396000,539000) | -74000 (-86000,-63000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | -34000 (-56000,-13000) | 47000 (18000,76000) | -7000 (-11000,-2000) | 102000 (39000,165000) | -16000 (-27000,-6000) |

## Table A-34- Avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI)

| *Endpoint* | *CT* | *DE* | *DC* | *ME* | *MD* | *MA* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 14 (3.9,24.5) | 2 (0.5,3.4) | 1 (0.3,1.7) | 6 (1.5,9.6) | 14 (3.9,24.8) | 24 (6.6,41.3) |
| Mortality (Infants less than 1 year of age) | 0.02 (0.01,0.04) | 0.004 (0.002,0.007) | 0.002 (0.001,0.003) | 0.006 (0.002,0.009) | 0.029 (0.011,0.047) | 0.024 (0.01,0.039) |
| Acute Bronchitis (Children, ages 8-12) | 22.3 (-5.2,49.6) | 3 (-0.7,6.6) | 1 (-0.2,2.3) | 6.3 (-1.5,14) | 22.8 (-5.3,50.7) | 35.6 (-8.3,79.4) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 4.4 (1.1,7.7) | 0.5 (0.1,0.9) | 0.2 (0.1,0.4) | 1.7 (0.4,3) | 3.6 (0.9,6.3) | 7.5 (1.8,13.1) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 25 (-9.3,123.1) | 3.7 (-1.4,18.4) | 1.4 (-0.5,6.9) | 7.1 (-2.6,34.8) | 28 (-10.5,138) | 40.5 (-15.1,199.5) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 43.7 (8.3,79.1) | 6.5 (1.2,11.9) | 2.5 (0.5,4.4) | 12.4 (2.3,22.4) | 49 (9.3,88.7) | 70.8 (13.5,128.2) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 27.7 (-0.6,55.9) | 4.1 (-0.1,8.4) | 1.6 (0,3.1) | 7.8 (-0.2,15.8) | 31 (-0.6,62.6) | 44.8 (-0.9,90.5) |
| Chronic Bronchitis (Adults 27 years and older) | 9.33 (0.26,18.4) | 1.33 (0.04,2.62) | 0.59 (0.02,1.17) | 3.44 (0.1,6.79) | 10.14 (0.28,19.99) | 16.12 (0.45,31.78) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 1.32 (0.67,1.96) | 0.32 (0.16,0.47) | 0.12 (0.06,0.18) | 0.37 (0.19,0.56) | 2.43 (1.24,3.62) | 2.1 (1.07,3.13) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.49 (0.09,0.89) | 0.07 (0.01,0.13) | 0.04 (0.01,0.07) | 0.18 (0.03,0.33) | 0.51 (0.09,0.93) | 0.8 (0.14,1.47) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.15 (-0.33,0.63) | 0.02 (-0.04,0.07) | 0.01 (-0.02,0.03) | 0.06 (-0.13,0.25) | 0.12 (-0.26,0.51) | 0.26 (-0.56,1.07) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.25 (-0.15,0.65) | 0.03 (-0.02,0.09) | 0.02 (-0.01,0.04) | 0.11 (-0.06,0.27) | 0.23 (-0.14,0.61) | 0.44 (-0.26,1.14) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.31 (0.12,0.5) | 0.03 (0.01,0.05) | 0.01 (0,0.02) | 0.1 (0.04,0.16) | 0.22 (0.08,0.35) | 0.51 (0.2,0.83) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.88 (0.51,1.26) | 0.12 (0.07,0.17) | 0.06 (0.03,0.08) | 0.35 (0.2,0.5) | 0.82 (0.47,1.18) | 1.5 (0.86,2.14) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.43 (0.22,0.63) | 0.07 (0.04,0.1) | 0.03 (0.02,0.04) | 0.17 (0.09,0.25) | 0.5 (0.26,0.74) | 0.75 (0.39,1.1) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.21 (0.09,0.32) | 0.03 (0.01,0.05) | 0.02 (0.01,0.02) | 0.08 (0.04,0.13) | 0.22 (0.09,0.35) | 0.35 (0.15,0.55) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.11 (0.04,0.18) | 0.02 (0.01,0.03) | 0.01 (0,0.01) | 0.04 (0.02,0.07) | 0.12 (0.04,0.21) | 0.19 (0.07,0.31) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.62 (0.11,1.12) | 0.09 (0.02,0.17) | 0.05 (0.01,0.09) | 0.23 (0.04,0.41) | 0.69 (0.13,1.26) | 1.02 (0.19,1.85) |
| Work Loss Days (Adults 18-65 years) | 255 (215.5,293.6) | 41 (34.4,46.9) | 19 (16.3,22.2) | 86 (72.8,99.2) | 311 (263,358.2) | 436 (369,502.6) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 38 (14.7,62.3) | 6 (2.2,9.4) | 2 (0.8,3.4) | 11 (4.3,18) | 44 (16.8,71.2) | 61 (23.3,98.8) |

## Table A-35- Avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), continued

| *Endpoint* | *NH* | *NJ* | *NY* | *PA* | *RI* | *VT* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 4 (1.1,6.8) | 33 (9,56.3) | 64 (17.6,110.7) | 41 (11.3,71.3) | 4 (1.1,7.2) | 2 (0.6,3.6) |
| Mortality (Infants less than 1 year of age) | 0.004 (0.002,0.006) | 0.051 (0.02,0.082) | 0.107 (0.042,0.172) | 0.059 (0.023,0.094) | 0.005 (0.002,0.008) | 0.002 (0.001,0.004) |
| Acute Bronchitis (Children, ages 8-12) | 6 (-1.4,13.3) | 50.8 (-11.8,113.3) | 102.5 (-23.8,228.6) | 49.7 (-11.5,110.7) | 5.8 (-1.3,12.9) | 2.3 (-0.5,5.1) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1.3 (0.3,2.2) | 9.7 (2.4,17.1) | 19.9 (4.9,34.9) | 10.9 (2.7,19) | 1.2 (0.3,2.2) | 0.7 (0.2,1.2) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 6.6 (-2.5,32.8) | 54.6 (-20.4,269) | 115.6 (-43.2,569.4) | 51.7 (-19.4,254.9) | 6.7 (-2.5,32.9) | 2.8 (-1,13.6) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 11.6 (2.2,21.1) | 95.5 (18.1,172.9) | 202.2 (38.4,366) | 90.6 (17.2,163.9) | 11.7 (2.2,21.1) | 4.8 (0.9,8.7) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 7.4 (-0.1,14.9) | 60.4 (-1.2,122.1) | 127.9 (-2.6,258.4) | 57.3 (-1.1,115.7) | 7.4 (-0.1,14.9) | 3.1 (-0.1,6.2) |
| Chronic Bronchitis (Adults 27 years and older) | 2.83 (0.08,5.59) | 22.27 (0.62,43.9) | 43.8 (1.21,86.34) | 23.63 (0.66,46.59) | 2.61 (0.07,5.14) | 1.28 (0.04,2.53) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.35 (0.18,0.53) | 2.9 (1.48,4.32) | 6.06 (3.08,9.02) | 2.73 (1.39,4.06) | 0.35 (0.18,0.51) | 0.14 (0.07,0.21) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.13 (0.02,0.23) | 1.04 (0.18,1.89) | 2.13 (0.38,3.89) | 1.23 (0.22,2.24) | 0.14 (0.02,0.25) | 0.07 (0.01,0.13) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.04 (-0.09,0.17) | 0.33 (-0.72,1.37) | 0.68 (-1.48,2.83) | 0.38 (-0.84,1.61) | 0.04 (-0.09,0.18) | 0.02 (-0.05,0.1) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.07 (-0.04,0.19) | 0.56 (-0.33,1.45) | 1.16 (-0.67,3) | 0.65 (-0.38,1.68) | 0.07 (-0.04,0.18) | 0.04 (-0.02,0.11) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.09 (0.03,0.14) | 0.7 (0.27,1.13) | 1.44 (0.55,2.33) | 0.66 (0.25,1.07) | 0.08 (0.03,0.14) | 0.04 (0.01,0.06) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.24 (0.14,0.35) | 1.92 (1.1,2.74) | 3.96 (2.27,5.66) | 2.25 (1.29,3.22) | 0.25 (0.14,0.36) | 0.14 (0.08,0.2) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.14 (0.07,0.21) | 0.99 (0.51,1.47) | 2 (1.04,2.97) | 1.02 (0.53,1.5) | 0.12 (0.06,0.18) | 0.07 (0.04,0.1) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.06 (0.02,0.09) | 0.45 (0.19,0.7) | 0.93 (0.4,1.45) | 0.53 (0.22,0.82) | 0.06 (0.02,0.09) | 0.03 (0.01,0.05) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.04 (0.01,0.06) | 0.25 (0.09,0.42) | 0.51 (0.18,0.84) | 0.26 (0.09,0.43) | 0.03 (0.01,0.05) | 0.02 (0.01,0.03) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.16 (0.03,0.29) | 1.31 (0.24,2.39) | 2.7 (0.49,4.9) | 1.56 (0.28,2.83) | 0.18 (0.03,0.32) | 0.09 (0.02,0.17) |
| Work Loss Days (Adults 18-65 years) | 76 (64.3,87.6) | 592 (501,682.4) | 1213 (1026.8,1398.8) | 562 (476.2,648.7) | 71 (60,81.7) | 34 (28.6,39) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 10 (4,16.9) | 86 (32.6,138.4) | 178 (68,288.3) | 80 (30.5,129.4) | 10 (3.8,16) | 4 (1.6,6.9) |

## Table A-36- Avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), continued

| *Endpoint* | *AL* | *GA* | *KY* | *MS* | *NC* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 1 (0.3,1.7) | 2.9 (0.8,5.1) | 1.5 (0.4,2.6) | 0.2 (0.1,0.3) | 7.5 (2,12.9) |
| Mortality (Infants less than 1 year of age) | 0.003 (0.001,0.004) | 0.009 (0.003,0.014) | 0.003 (0.001,0.005) | 0.001 (0,0.001) | 0.019 (0.007,0.03) |
| Acute Bronchitis (Children, ages 8-12) | 1.3 (-0.3,3) | 5.9 (-1.4,13.2) | 2.1 (-0.5,4.7) | 0.3 (-0.1,0.7) | 11.8 (-2.7,26.3) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.32 (0.08,0.56) | 1.04 (0.26,1.83) | 0.37 (0.09,0.64) | 0.05 (0.01,0.09) | 2.31 (0.57,4.05) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 2.32 (-0.87,11.44) | 10.62 (-3.97,52.33) | 2.71 (-1.02,13.38) | 0.46 (-0.17,2.26) | 19.65 (-7.35,96.87) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 4.06 (0.77,7.35) | 18.58 (3.53,33.63) | 4.75 (0.9,8.6) | 0.8 (0.15,1.45) | 34.39 (6.53,62.25) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 2.57 (-0.05,5.19) | 11.75 (-0.24,23.74) | 3 (-0.06,6.07) | 0.51 (-0.01,1.02) | 21.76 (-0.44,43.95) |
| Chronic Bronchitis (Adults 27 years and older) | 0.59 (0.02,1.17) | 2.26 (0.06,4.47) | 0.95 (0.03,1.88) | 0.11 (0,0.23) | 4.87 (0.14,9.61) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.2 (0.1,0.3) | 0.93 (0.47,1.38) | 0.24 (0.12,0.36) | 0.04 (0.02,0.06) | 1.69 (0.86,2.52) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.05 (0.01,0.09) | 0.14 (0.02,0.25) | 0.05 (0.01,0.1) | 0.01 (0,0.01) | 0.34 (0.06,0.62) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.01 (-0.02,0.05) | 0.03 (-0.07,0.14) | 0.01 (-0.03,0.05) | 0 (0,0.01) | 0.08 (-0.18,0.34) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.02 (-0.01,0.06) | 0.07 (-0.04,0.17) | 0.03 (-0.01,0.07) | 0 (0,0.01) | 0.16 (-0.09,0.41) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.02 (0.01,0.03) | 0.08 (0.03,0.12) | 0.02 (0.01,0.03) | 0 (0,0.01) | 0.14 (0.05,0.23) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.08 (0.04,0.11) | 0.23 (0.13,0.32) | 0.09 (0.05,0.12) | 0.01 (0.01,0.02) | 0.55 (0.32,0.79) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.04 (0.02,0.06) | 0.16 (0.08,0.23) | 0.05 (0.02,0.07) | 0.01 (0,0.01) | 0.3 (0.16,0.45) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.02 (0.01,0.03) | 0.06 (0.03,0.1) | 0.02 (0.01,0.04) | 0 (0,0.01) | 0.15 (0.06,0.23) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.01 (0,0.02) | 0.04 (0.01,0.06) | 0.01 (0,0.02) | 0 (0,0) | 0.07 (0.03,0.12) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.06 (0.01,0.12) | 0.19 (0.03,0.34) | 0.07 (0.01,0.13) | 0.01 (0,0.02) | 0.46 (0.08,0.84) |
| Work Loss Days (Adults 18-65 years) | 24.3 (20.6,28) | 108.8 (92.1,125.5) | 29.2 (24.7,33.6) | 4.4 (3.7,5) | 204.3 (173,235.7) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 3.6 (1.4,5.9) | 16.5 (6.3,26.8) | 4.2 (1.6,6.9) | 0.7 (0.3,1.2) | 29.9 (11.4,48.4) |

## Table A-37- Avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), continued

| *Endpoint* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 2.9 (0.8,5) | 1.7 (0.5,2.9) | 10.2 (2.8,17.6) | 2.5 (0.7,4.3) |
| Mortality (Infants less than 1 year of age) | 0.006 (0.002,0.009) | 0.003 (0.001,0.005) | 0.021 (0.008,0.034) | 0.004 (0.002,0.006) |
| Acute Bronchitis (Children, ages 8-12) | 3.8 (-0.9,8.5) | 2.2 (-0.5,4.9) | 17.5 (-4,39) | 2.6 (-0.6,5.9) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.96 (0.24,1.69) | 0.5 (0.12,0.87) | 2.96 (0.73,5.19) | 0.53 (0.13,0.93) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 6.86 (-2.57,33.83) | 3.53 (-1.32,17.39) | 24.16 (-9.04,119.08) | 3.15 (-1.18,15.53) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 12.01 (2.28,21.74) | 6.17 (1.17,11.17) | 42.28 (8.03,76.53) | 5.52 (1.05,9.99) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 7.6 (-0.15,15.35) | 3.9 (-0.08,7.89) | 26.75 (-0.54,54.02) | 3.49 (-0.07,7.05) |
| Chronic Bronchitis (Adults 27 years and older) | 1.73 (0.05,3.42) | 0.99 (0.03,1.96) | 7.65 (0.21,15.09) | 1.37 (0.04,2.7) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.6 (0.3,0.89) | 0.3 (0.16,0.45) | 2.12 (1.08,3.15) | 0.27 (0.14,0.41) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.14 (0.03,0.26) | 0.07 (0.01,0.13) | 0.41 (0.07,0.76) | 0.08 (0.01,0.15) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.03 (-0.07,0.14) | 0.02 (-0.04,0.07) | 0.1 (-0.22,0.41) | 0.02 (-0.04,0.08) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.07 (-0.04,0.17) | 0.03 (-0.02,0.09) | 0.2 (-0.11,0.5) | 0.04 (-0.02,0.1) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.05 (0.02,0.08) | 0.03 (0.01,0.04) | 0.19 (0.07,0.3) | 0.03 (0.01,0.04) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.23 (0.13,0.33) | 0.12 (0.07,0.17) | 0.68 (0.39,0.97) | 0.14 (0.08,0.19) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.12 (0.06,0.18) | 0.06 (0.03,0.09) | 0.42 (0.22,0.62) | 0.06 (0.03,0.09) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.06 (0.03,0.1) | 0.03 (0.01,0.05) | 0.18 (0.08,0.29) | 0.04 (0.02,0.06) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.03 (0.01,0.05) | 0.02 (0.01,0.03) | 0.1 (0.04,0.17) | 0.02 (0.01,0.03) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.19 (0.04,0.35) | 0.1 (0.02,0.18) | 0.56 (0.1,1.02) | 0.11 (0.02,0.2) |
| Work Loss Days (Adults 18-65 years) | 73.9 (62.6,85.3) | 38 (32.2,43.9) | 268.9 (227.7,310.2) | 36.4 (30.8,42) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 10.7 (4.1,17.3) | 5.5 (2.1,8.9) | 37.8 (14.4,61.3) | 4.9 (1.9,7.9) |

## Table A-38- Avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 1.7 (0.5,2.9) | 1.6 (0.4,2.8) | 1.3 (0.4,2.3) | 6.7 (1.8,11.5) | 0.3 (0.1,0.5) |
| Mortality (Infants less than 1 year of age) | 0.004 (0.002,0.007) | 0.004 (0.002,0.007) | 0.003 (0.001,0.005) | 0.014 (0.005,0.022) | 0.001 (0,0.001) |
| Acute Bronchitis (Children, ages 8-12) | 2.8 (-0.6,6.2) | 2.6 (-0.6,5.8) | 2.1 (-0.5,4.7) | 9.3 (-2.2,20.9) | 0.5 (-0.1,1) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.35 (0.08,0.61) | 0.42 (0.1,0.74) | 0.35 (0.09,0.62) | 1.83 (0.45,3.21) | 0.05 (0.01,0.09) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 2.4 (-0.9,11.6) | 2.9 (-1.1,14.5) | 2.3 (-0.9,11.5) | 11.3 (-4.2,55.5) | 0.3 (-0.1,1.5) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 4.1 (0.8,7.4) | 5.1 (1,9.3) | 4.1 (0.8,7.4) | 19.7 (3.7,35.7) | 0.5 (0.1,1) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 2.6 (-0.1,5.3) | 3.2 (-0.1,6.6) | 2.6 (-0.1,5.2) | 12.5 (-0.2,25.2) | 0.3 (0,0.7) |
| Chronic Bronchitis (Adults 27 years and older) | 1.15 (0.03,2.27) | 1.07 (0.03,2.11) | 0.9 (0.02,1.77) | 4.16 (0.12,8.2) | 0.21 (0.01,0.41) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.24 (0.12,0.36) | 0.3 (0.15,0.45) | 0.24 (0.12,0.36) | 1.17 (0.59,1.74) | 0.03 (0.02,0.05) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.05 (0.01,0.09) | 0.06 (0.01,0.1) | 0.05 (0.01,0.09) | 0.25 (0.04,0.46) | 0.01 (0,0.01) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.01 (-0.02,0.05) | 0.01 (-0.03,0.06) | 0.01 (-0.02,0.05) | 0.06 (-0.13,0.25) | 0 (0,0.01) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.02 (-0.01,0.05) | 0.03 (-0.01,0.07) | 0.02 (-0.01,0.05) | 0.11 (-0.06,0.29) | 0 (0,0.01) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.02 (0.01,0.03) | 0.02 (0.01,0.04) | 0.02 (0.01,0.03) | 0.1 (0.04,0.16) | 0 (0,0) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.07 (0.04,0.1) | 0.09 (0.05,0.12) | 0.07 (0.04,0.1) | 0.38 (0.22,0.54) | 0.01 (0.01,0.01) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.03 (0.02,0.05) | 0.04 (0.02,0.06) | 0.03 (0.02,0.05) | 0.16 (0.08,0.24) | 0 (0,0.01) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.02 (0.01,0.03) | 0.02 (0.01,0.04) | 0.02 (0.01,0.03) | 0.11 (0.05,0.17) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.01 (0,0.02) | 0.01 (0,0.02) | 0.01 (0,0.02) | 0.05 (0.02,0.09) | 0 (0,0) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.07 (0.01,0.12) | 0.08 (0.01,0.15) | 0.07 (0.01,0.12) | 0.36 (0.06,0.65) | 0.01 (0,0.02) |
| Work Loss Days (Adults 18-65 years) | 24.4 (20.7,28.2) | 29.9 (25.3,34.5) | 24.7 (20.9,28.4) | 120.2 (101.7,138.6) | 3.3 (2.8,3.9) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 3.6 (1.4,5.9) | 4.6 (1.7,7.4) | 3.7 (1.4,5.9) | 17.7 (6.7,28.6) | 0.5 (0.2,0.8) |

## Table A-39- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), 2000$

| *Endpoint* | *CT* | *DE* | *DC* | *ME* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 89620000 (6868000,276244000) | 12593000 (965000,38817000) | 6041000 (463000,18622000) | 35205000 (2698000,108517000) |
| Mortality (Infants less than 1 year of age) | 137600 (11640,404550) | 26400 (2230,77510) | 13000 (1100,38130) | 34400 (2910,101040) |
| Acute Bronchitis (Children, ages 8-12) | 8300 (-1900,18600) | 1100 (-300,2500) | 400 (-100,900) | 2400 (-500,5300) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 288000 (70800,504700) | 33600 (8200,58800) | 15500 (3800,27200) | 114200 (28100,200000) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 3900 (-1500,19200) | 600 (-200,2900) | 200 (-100,1100) | 1100 (-400,5400) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 6800 (1300,12500) | 1000 (200,1900) | 400 (100,700) | 1900 (400,3500) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 4300 (-90,8790) | 600 (-10,1320) | 200 (0,490) | 1200 (-20,2490) |
| Chronic Bronchitis (Adults 27 years and older) | 3149000 (58000,14863000) | 448000 (8000,2115000) | 200000 (4000,944000) | 1162000 (21000,5484000) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 366 (176,584) | 88 (42,140) | 34 (17,55) | 104 (50,166) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 7526 (1326,13724) | 1080 (190,1969) | 550 (97,1004) | 2754 (485,5022) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 2300 (-5100,9750) | 300 (-570,1100) | 100 (-280,540) | 900 (-1960,3750) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 6600 (-3810,16950) | 900 (-510,2250) | 400 (-240,1080) | 2700 (-1580,7020) |
| Hospital Admissions- Asthma (Population under 65 years) | 2400 (940,3940) | 200 (90,380) | 100 (40,160) | 800 (300,1240) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 18900 (10810,26960) | 2500 (1420,3530) | 1200 (700,1740) | 7400 (4210,10500) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 9800 (5090,14550) | 1600 (810,2320) | 700 (360,1020) | 3900 (2030,5790) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 2800 (1190,4360) | 400 (180,660) | 200 (90,330) | 1100 (480,1740) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 1200 (410,1940) | 200 (60,300) | 100 (30,130) | 500 (160,780) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 11200 (2050,20360) | 1700 (310,3090) | 900 (160,1600) | 4100 (740,7390) |
| Work Loss Days (Adults 18-65 years) | 39000 (33000,45000) | 5000 (4000,6000) | 3000 (2000,3000) | 9000 (8000,11000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 7000 (3000,12000) | 1000 (0,2000) | 0 (0,1000) | 2000 (1000,3000) |

## Table A-40- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), 2000$, continued

| *Endpoint* | *MD* | *MA* | *NH* | *NJ* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 90556000 (6939000,279129000) | 150694000 (11548000,464498000) | 24902000 (1908000,76758000) | 205688000 (15762000,634012000) |
| Mortality (Infants less than 1 year of age) | 183500 (15520,539640) | 152900 (12930,449650) | 24500 (2070,71920) | 322300 (27260,947610) |
| Acute Bronchitis (Children, ages 8-12) | 8500 (-2000,19000) | 13300 (-3100,29800) | 2200 (-500,5000) | 19000 (-4400,42500) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 237900 (58500,417000) | 493600 (121400,865100) | 84500 (20800,148200) | 642500 (158000,1126100) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 4400 (-1600,21500) | 6300 (-2400,31000) | 1000 (-400,5100) | 8500 (-3200,41900) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 7700 (1400,14000) | 11100 (2100,20300) | 1800 (300,3300) | 14900 (2800,27400) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 4800 (-100,9850) | 7000 (-140,14250) | 1100 (-20,2340) | 9400 (-190,19220) |
| Chronic Bronchitis (Adults 27 years and older) | 3422000 (63000,16151000) | 5440000 (100000,25676000) | 956000 (18000,4514000) | 7515000 (139000,35469000) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 677 (326,1080) | 584 (282,932) | 98 (47,157) | 806 (389,1286) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 7866 (1386,14345) | 12395 (2183,22603) | 1959 (345,3573) | 16037 (2825,29245) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 1900 (-4050,7750) | 3900 (-8600,16440) | 600 (-1380,2630) | 5000 (-11050,21140) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 6100 (-3540,15750) | 11500 (-6660,29660) | 1900 (-1090,4830) | 14700 (-8490,37790) |
| Hospital Admissions- Asthma (Population under 65 years) | 1700 (660,2770) | 4000 (1550,6520) | 700 (270,1130) | 5500 (2120,8910) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 17600 (10080,25130) | 32000 (18340,45730) | 5100 (2940,7340) | 41100 (23540,58710) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 11500 (5970,17040) | 17100 (8860,25300) | 3200 (1650,4710) | 22800 (11810,33740) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 3000 (1280,4700) | 4800 (2050,7510) | 800 (330,1210) | 6200 (2630,9610) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 1300 (460,2210) | 2000 (710,3380) | 400 (130,630) | 2700 (940,4500) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 12500 (2290,22760) | 18400 (3360,33400) | 2900 (530,5270) | 23800 (4350,43310) |
| Work Loss Days (Adults 18-65 years) | 45000 (38000,52000) | 64000 (54000,74000) | 10000 (8000,11000) | 92000 (78000,106000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 8000 (3000,13000) | 11000 (4000,19000) | 2000 (1000,3000) | 16000 (6000,26000) |

## Table A-41- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), 2000$, continued

| Endpoint | NY | PA | RI | VT |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 404392000 (30989000,1246498000) | 260371000 (19952000,802567000) | 26396000 (2023000,81363000) | 12996000 (996000,40058000) |
| Mortality (Infants less than 1 year of age) | 673700 (56970,1980690) | 368500 (31160,1083470) | 30200 (2560,88850) | 14500 (1220,42500) |
| Acute Bronchitis (Children, ages 8-12) | 38300 (-8900,85800) | 18600 (-4300,41600) | 2200 (-500,4800) | 900 (-200,1900) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1312500 (322800,2300300) | 715100 (176000,1252600) | 81600 (20100,143000) | 46100 (11300,80700) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 18100 (-6700,88600) | 8100 (-3000,39700) | 1000 (-400,5100) | 400 (-200,2100) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 31600 (6000,57900) | 14200 (2700,25900) | 1800 (300,3300) | 800 (100,1400) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 20000 (-400,40680) | 9000 (-180,18220) | 1200 (-20,2350) | 500 (-10,970) |
| Chronic Bronchitis (Adults 27 years and older) | 14780000 (273000,69762000) | 7976000 (147000,37644000) | 880000 (16000,4151000) | 433000 (8000,2044000) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 1685 (813,2688) | 759 (366,1211) | 96 (46,153) | 40 (19,64) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 32758 (5771,59738) | 18771 (3307,34229) | 2113 (372,3853) | 1120 (197,2042) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 10400 (-22680,43370) | 5900 (-12880,24620) | 700 (-1430,2740) | 400 (-800,1520) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 30200 (-17500,77930) | 16900 (-9810,43660) | 1800 (-1070,4770) | 1100 (-640,2850) |
| Hospital Admissions- Asthma (Population under 65 years) | 11300 (4350,18290) | 5200 (1990,8380) | 700 (250,1060) | 300 (120,490) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 84500 (48340,120560) | 47900 (27410,68350) | 5300 (3040,7590) | 3000 (1710,4260) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 45800 (23770,67910) | 23200 (12020,34330) | 2800 (1430,4080) | 1600 (810,2310) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 12700 (5390,19720) | 7100 (3030,11080) | 800 (330,1220) | 500 (190,710) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 5500 (1890,9020) | 2800 (970,4610) | 300 (110,540) | 200 (70,310) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 48600 (8870,88310) | 27900 (5100,50730) | 3200 (580,5720) | 1700 (300,3010) |
| Work Loss Days (Adults 18-65 years) | 170000 (144000,196000) | 70000 (59000,81000) | 9000 (8000,10000) | 4000 (3000,4000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 33000 (13000,54000) | 15000 (6000,24000) | 2000 (1000,3000) | 1000 (0,1000) |

## Table A-42- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), 2000$, continued

| *Endpoint* | *AL* | *GA* | *KY* | *MS* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 6387600 (489500,19689200) | 18476400 (1415800,56951300) | 9660800 (740300,29778300) | 1212800 (92900,3738400) |
| Mortality (Infants less than 1 year of age) | 15900 (1300,46800) | 55100 (4700,161900) | 19600 (1700,57800) | 4000 (300,11800) |
| Acute Bronchitis (Children, ages 8-12) | 500 (-120,1120) | 2210 (-510,4940) | 790 (-180,1780) | 110 (-30,250) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 20900 (5100,36700) | 68800 (16900,120600) | 24200 (6000,42500) | 3500 (800,6100) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 360 (-140,1780) | 1660 (-620,8140) | 420 (-160,2080) | 70 (-30,350) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 630 (120,1160) | 2900 (550,5320) | 740 (140,1360) | 130 (20,230) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 400 (-10,820) | 1840 (-40,3740) | 470 (-10,960) | 80 (0,160) |
| Chronic Bronchitis (Adults 27 years and older) | 200100 (3700,944800) | 764200 (14100,3607500) | 320900 (5900,1514900) | 38700 (700,182700) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 60 (30,90) | 260 (120,410) | 70 (30,110) | 10 (10,20) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 720 (130,1310) | 2100 (370,3830) | 800 (140,1470) | 120 (20,210) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 170 (-370,710) | 510 (-1110,2120) | 190 (-430,810) | 30 (-60,120) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 570 (-330,1470) | 1720 (-990,4430) | 660 (-380,1700) | 90 (-50,240) |
| Hospital Admissions- Asthma (Population under 65 years) | 130 (50,220) | 600 (230,970) | 160 (60,260) | 20 (10,40) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1630 (930,2320) | 4830 (2760,6890) | 1850 (1060,2640) | 260 (150,380) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 930 (480,1370) | 3580 (1860,5300) | 1080 (560,1590) | 160 (80,230) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 280 (120,430) | 830 (350,1300) | 320 (140,500) | 40 (20,70) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 110 (40,180) | 410 (140,670) | 130 (40,210) | 20 (10,30) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 1140 (210,2060) | 3310 (600,6020) | 1270 (230,2310) | 190 (30,340) |
| Work Loss Days (Adults 18-65 years) | 2700 (2200,3100) | 13200 (11200,15300) | 3200 (2700,3700) | 400 (400,500) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 700 (300,1100) | 3100 (1200,5000) | 800 (300,1300) | 100 (100,200) |

# Table A-43- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), 2000$, continued

| Endpoint | NC | SC | TN | VA | WV |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 46962100 (3598600,144755400) | 18355000 (1406500,56577300) | 10512100 (805500,32402300) | 64309600 (4927900,198227400) | 15553000 (1191800,47940500) |
| Mortality (Infants less than 1 year of age) | 119100 (10100,350300) | 36500 (3100,107400) | 20500 (1700,60300) | 134800 (11400,396300) | 25100 (2100,73800) |
| Acute Bronchitis (Children, ages 8-12) | 4410 (-1020,9870) | 1420 (-330,3170) | 820 (-190,1830) | 6530 (-1510,14620) | 980 (-230,2200) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 152300 (37400,267100) | 63500 (15600,111300) | 32600 (8000,57200) | 195200 (48000,342300) | 35100 (8600,61600) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 3070 (-1140,15080) | 1070 (-400,5260) | 550 (-210,2710) | 3770 (-1410,18530) | 490 (-180,2420) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 5370 (1020,9850) | 1880 (350,3440) | 960 (180,1770) | 6610 (1250,12110) | 860 (160,1580) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 3400 (-70,6920) | 1190 (-20,2420) | 610 (-10,1240) | 4180 (-80,8510) | 550 (-10,1110) |
| Chronic Bronchitis (Adults 27 years and older) | 1644800 (30400,7764900) | 584500 (10800,2759400) | 335100 (6200,1582100) | 2582300 (47700,12189700) | 461400 (8500,2178200) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 470 (230,750) | 170 (80,260) | 80 (40,140) | 590 (280,940) | 80 (40,120) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 5180 (910,9450) | 2180 (380,3970) | 1120 (200,2040) | 6350 (1120,11580) | 1250 (220,2270) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 1230 (-2690,5140) | 520 (-1140,2170) | 270 (-590,1120) | 1510 (-3310,6330) | 300 (-660,1260) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 4090 (-2370,10560) | 1740 (-1010,4480) | 900 (-520,2320) | 5080 (-2940,13090) | 1010 (-590,2610) |
| Hospital Admissions- Asthma (Population under 65 years) | 1110 (430,1800) | 410 (160,660) | 210 (80,340) | 1450 (560,2350) | 200 (80,320) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 11710 (6700,16710) | 4950 (2830,7060) | 2550 (1460,3640) | 14420 (8250,20580) | 2860 (1630,4080) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 6930 (3590,10270) | 2820 (1460,4170) | 1440 (750,2140) | 9490 (4920,14060) | 1420 (740,2100) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 2000 (850,3120) | 850 (360,1320) | 440 (190,680) | 2490 (1060,3880) | 490 (210,760) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 800 (280,1320) | 330 (110,540) | 170 (60,280) | 1090 (380,1800) | 170 (60,280) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 8220 (1500,14940) | 3450 (630,6270) | 1770 (320,3210) | 10040 (1830,18250) | 1970 (360,3580) |
| Work Loss Days (Adults 18-65 years) | 23000 (19400,26500) | 8000 (6800,9200) | 4200 (3600,4900) | 35400 (30000,40800) | 3700 (3200,4300) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 5600 (2100,9100) | 2000 (800,3300) | 1000 (400,1700) | 7100 (2700,11500) | 900 (300,1500) |

## Table A-44- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to BART, Mean (95%CI), 2000$, continued

| Endpoint | IL | IN | MI | OH | WI |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 10753000 (824000,33145000) | 10145000 (777000,31269000) | 8307000 (637000,25605000) | 42011000 (3219000,129493000) | 1838000 (141000,5665000) |
| Mortality (Infants less than 1 year of age) | 27950 (2360,82180) | 25400 (2150,74680) | 20020 (1690,58870) | 85560 (7240,251560) | 3910 (330,11490) |
| Acute Bronchitis (Children, ages 8-12) | 1040 (-240,2330) | 970 (-220,2170) | 790 (-180,1760) | 3500 (-810,7830) | 170 (-40,390) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 22780 (5590,39950) | 27910 (6860,48960) | 23270 (5720,40820) | 120760 (29670,211780) | 3230 (790,5660) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 370 (-140,1800) | 460 (-170,2250) | 360 (-140,1780) | 1760 (-660,8640) | 50 (-20,230) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 640 (120,1180) | 800 (150,1470) | 640 (120,1170) | 3080 (580,5650) | 80 (20,150) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 410 (-10,830) | 510 (-10,1030) | 400 (-10,820) | 1950 (-40,3970) | 50 (0,110) |
| Chronic Bronchitis (Adults 27 years and older) | 388550 (7170,1834300) | 361150 (6670,1704940) | 303120 (5590,1431020) | 1403610 (25910,6626160) | 69640 (1290,328790) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 70 (30,110) | 80 (40,130) | 70 (30,110) | 320 (160,520) | 10 (0,10) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 730 (130,1340) | 860 (150,1570) | 730 (130,1330) | 3830 (680,6990) | 100 (20,190) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 170 (-380,720) | 210 (-450,870) | 170 (-380,720) | 910 (-2000,3830) | 20 (-50,100) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 530 (-310,1380) | 660 (-380,1690) | 540 (-310,1400) | 2870 (-1660,7390) | 80 (-40,200) |
| Hospital Admissions- Asthma (Population under 65 years) | 150 (60,250) | 190 (70,310) | 160 (60,250) | 760 (290,1220) | 20 (10,30) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1530 (870,2180) | 1840 (1050,2620) | 1530 (880,2190) | 8100 (4640,11570) | 220 (120,310) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 700 (360,1040) | 890 (460,1320) | 740 (380,1090) | 3720 (1930,5510) | 100 (50,150) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 270 (110,420) | 330 (140,510) | 270 (120,420) | 1440 (610,2240) | 40 (20,60) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 110 (40,180) | 140 (50,230) | 110 (40,190) | 570 (200,940) | 20 (10,30) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 1220 (220,2220) | 1430 (260,2600) | 1210 (220,2200) | 6370 (1160,11570) | 170 (30,310) |
| Work Loss Days (Adults 18-65 years) | 3350 (2830,3860) | 3650 (3090,4210) | 3410 (2890,3930) | 15010 (12700,17310) | 410 (350,470) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 680 (260,1110) | 850 (320,1390) | 690 (260,1120) | 3310 (1260,5400) | 90 (30,150) |

## Table A-45- Avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI)

| *Endpoint* | *CT* | *DE* | *DC* | *ME* | *MD* | *MA* |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 98 (27,169) | 29 (8,49) | 10 (3,17) | 36 (10,63) | 154 (42,265) | 191 (53,329) |
| Mortality (Infants less than 1 year of age) | 0.15 (0.06,0.24) | 0.06 (0.02,0.09) | 0.02 (0.01,0.03) | 0.03 (0.01,0.05) | 0.31 (0.12,0.5) | 0.19 (0.08,0.31) |
| Acute Bronchitis (Children, ages 8-12) | 152 (-36,338) | 41 (-10,91) | 11 (-3,24) | 40 (-9,90) | 236 (-55,523) | 282 (-66,625) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 32 (8,56) | 6 (1,10) | 2 (1,4) | 11 (3,20) | 35 (9,61) | 59 (15,103) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 185 (-69,910) | 44 (-16,216) | 14 (-5,70) | 46 (-17,226) | 273 (-102,1340) | 324 (-122,1594) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 325 (62,587) | 77 (15,139) | 25 (5,45) | 80 (15,146) | 478 (91,864) | 568 (108,1028) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 205 (-4.1,413.9) | 49 (-1,98.2) | 16 (-0.3,31.8) | 51 (-1,102.6) | 302 (-6,609.2) | 359 (-7.2,724.8) |
| Chronic Bronchitis (Adults 27 years and older) | 64 (1.8,126.5) | 19 (0.5,36.6) | 6 (0.2,12.2) | 22 (0.6,44.1) | 106 (2.9,207.7) | 129 (3.6,253.7) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 10 (5,14.4) | 4 (1.9,5.5) | 1 (0.6,1.8) | 2 (1.2,3.6) | 23 (12,34.8) | 17 (8.5,24.8) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 3.6 (0.6,6.6) | 0.9 (0.2,1.5) | 0.4 (0.1,0.7) | 1.2 (0.2,2.2) | 5 (0.9,9.2) | 6.5 (1.1,11.8) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 1.1 (-2.5,4.7) | 0.2 (-0.5,0.9) | 0.1 (-0.2,0.4) | 0.4 (-0.9,1.6) | 1.2 (-2.6,5) | 2 (-4.5,8.6) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1.9 (-1.1,4.8) | 0.4 (-0.2,1) | 0.2 (-0.1,0.4) | 0.7 (-0.4,1.8) | 2.3 (-1.3,6) | 3.6 (-2.1,9.1) |
| Hospital Admissions- Asthma (Population under 65 years) | 2.3 (0.9,3.7) | 0.4 (0.1,0.6) | 0.1 (0,0.2) | 0.7 (0.3,1.1) | 2.1 (0.8,3.4) | 4.1 (1.6,6.6) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 6.6 (3.8,9.4) | 1.4 (0.8,2) | 0.6 (0.3,0.8) | 2.3 (1.3,3.3) | 8.1 (4.7,11.6) | 12.1 (6.9,17.2) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 3.2 (1.6,4.7) | 0.8 (0.4,1.2) | 0.3 (0.2,0.5) | 1.1 (0.6,1.7) | 4.9 (2.5,7.3) | 6 (3.1,8.9) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 1.5 (0.6,2.4) | 0.4 (0.2,0.6) | 0.2 (0.1,0.2) | 0.6 (0.2,0.9) | 2.2 (0.9,3.4) | 2.8 (1.2,4.4) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.8 (0.3,1.3) | 0.2 (0.1,0.3) | 0.1 (0,0.1) | 0.3 (0.1,0.5) | 1.2 (0.4,2) | 1.5 (0.5,2.5) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 4.6 (0.8,8.3) | 1.1 (0.2,2.1) | 0.5 (0.1,0.9) | 1.5 (0.3,2.8) | 6.8 (1.3,12.4) | 8.1 (1.5,14.8) |
| Work Loss Days (Adults 18-65 years) | 1892 (1603,2182) | 479 (406,552) | 194 (165,224) | 571 (484,659) | 3021 (2559,3483) | 3525 (2986,4064) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 282 (109,454) | 68 (26,109) | 21 (8,34) | 72 (28,116) | 423 (163,681) | 484 (186,778) |

# Table A-46- Avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI), continued

| Endpoint | NH | NJ | NY | PA | RI | VT |
|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 26 (7,44) | 293 (80,505) | 521 (143,899) | 371 (102,640) | 44 (12,76) | 9 (3,16) |
| Mortality (Infants less than 1 year of age) | 0.03 (0.01,0.04) | 0.46 (0.18,0.73) | 0.89 (0.35,1.43) | 0.52 (0.2,0.83) | 0.05 (0.02,0.08) | 0.01 (0,0.02) |
| Acute Bronchitis (Children, ages 8-12) | 39 (-9,86) | 438 (-103,971) | 835 (-196,1849) | 431 (-101,957) | 60 (-14,133) | 10 (-2,23) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 8 (2,14) | 89 (22,155) | 165 (41,287) | 100 (25,173) | 13 (3,22) | 3 (1,5) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 41 (-15,201) | 501 (-188,2461) | 979 (-367,4809) | 472 (-177,2323) | 69 (-26,340) | 11 (-4,55) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 72 (14,130) | 877 (167,1587) | 1714 (326,3102) | 827 (157,1497) | 122 (23,220) | 20 (4,35) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 45 (-0.9,91.4) | 554 (-11.1,1118.8) | 1084 (-21.7,2186.6) | 523 (-10.5,1055.7) | 77 (-1.5,154.9) | 12 (-0.2,25) |
| Chronic Bronchitis (Adults 27 years and older) | 18 (0.5,36.3) | 194 (5.4,380.8) | 359 (10,705.8) | 208 (5.8,409) | 27 (0.8,53.8) | 6 (0.2,11.3) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 2 (1.1,3.2) | 26 (13.5,39.1) | 51 (26.2,75.8) | 25 (12.7,36.9) | 4 (1.8,5.3) | 1 (0.3,0.9) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.8 (0.1,1.4) | 9.7 (1.7,17.7) | 18 (3.2,32.7) | 11.5 (2,20.9) | 1.4 (0.3,2.6) | 0.3 (0.1,0.5) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.3 (-0.6,1.1) | 3.1 (-6.7,12.8) | 5.7 (-12.5,23.8) | 3.6 (-7.9,15) | 0.4 (-1,1.9) | 0.1 (-0.2,0.4) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.4 (-0.3,1.1) | 5.3 (-3,13.5) | 9.8 (-5.7,25.3) | 6.1 (-3.5,15.7) | 0.7 (-0.4,1.9) | 0.2 (-0.1,0.4) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.5 (0.2,0.9) | 6.4 (2.5,10.3) | 12.3 (4.7,19.8) | 6.1 (2.3,9.8) | 0.9 (0.3,1.4) | 0.2 (0.1,0.3) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1.5 (0.8,2.1) | 18 (10.3,25.7) | 33.4 (19.1,47.7) | 21 (12,30) | 2.6 (1.5,3.7) | 0.6 (0.3,0.8) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.9 (0.4,1.3) | 9 (4.7,13.4) | 16.8 (8.7,24.9) | 9.4 (4.9,13.9) | 1.3 (0.6,1.9) | 0.3 (0.1,0.4) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.4 (0.2,0.5) | 4.2 (1.8,6.6) | 7.9 (3.4,12.3) | 4.9 (2.1,7.7) | 0.6 (0.3,0.9) | 0.1 (0.1,0.2) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.2 (0.1,0.4) | 2.3 (0.8,3.8) | 4.3 (1.5,7) | 2.4 (0.8,4) | 0.3 (0.1,0.5) | 0.1 (0,0.1) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 1 (0.2,1.8) | 12.3 (2.2,22.3) | 22.7 (4.2,41.2) | 14.5 (2.7,26.4) | 1.8 (0.3,3.3) | 0.4 (0.1,0.7) |
| Work Loss Days (Adults 18-65 years) | 468 (397,540) | 5430 (4599,6261) | 10378 (8790,11965) | 5186 (4392,5979) | 735 (623,848) | 137 (116,158) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 64 (24,103) | 775 (298,1248) | 1495 (574,2405) | 725 (278,1167) | 101 (39,163) | 17 (7,28) |

**Table A-47- Avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI) continued**

| *Endpoint* | *AL* | *GA* | *KY* | *MS* | *NC* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 0.6 (0.2,1) | 2 (0.5,3.4) | 124 (34.1,213.8) | 2.4 (0.7,4.1) | 48.5 (13.3,83.6) |
| Mortality (Infants less than 1 year of age) | 0 (0,0) | 0.01 (0,0.01) | 0.26 (0.1,0.42) | 0.01 (0,0.01) | 0.12 (0.05,0.2) |
| Acute Bronchitis (Children, ages 8-12) | 1 (-0.2,2.1) | 3.5 (-0.8,7.9) | 172.9 (-40.5,383.3) | 3.9 (-0.9,8.8) | 75.2 (-17.4,167.6) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1.5 (0.4,2.7) | 4.6 (1.1,8) | 32.2 (8,55.8) | 1.1 (0.3,1.9) | 15.8 (3.9,27.5) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 11.2 (-4.2,55) | 47.4 (-17.8,232.9) | 239.8 (-89.9,1177.1) | 9.7 (-3.6,47.7) | 131.2 (-49.1,646) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 19.6 (3.7,35.5) | 83 (15.8,150.2) | 420.2 (79.9,760) | 17 (3.2,30.7) | 229.8 (43.6,415.8) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 12.4 (-0.2,25) | 52.5 (-1.1,105.9) | 265.5 (-5.3,535.6) | 10.7 (-0.2,21.7) | 145.3 (-2.9,293.3) |
| Chronic Bronchitis (Adults 27 years and older) | 0.4 (0,0.8) | 1.5 (0,2.9) | 77.4 (2.2,152.3) | 1.5 (0,2.9) | 31.5 (0.9,62) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 1 (0.5,1.4) | 4.1 (2.1,6.1) | 20.9 (10.7,31) | 0.8 (0.4,1.2) | 11.2 (5.7,16.7) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.2 (0,0.4) | 0.6 (0.1,1.1) | 4.8 (0.8,8.7) | 0.2 (0,0.3) | 2.4 (0.4,4.3) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.06 (-0.12,0.23) | 0.15 (-0.32,0.61) | 1.15 (-2.53,4.8) | 0.04 (-0.08,0.16) | 0.56 (-1.23,2.34) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.11 (-0.06,0.28) | 0.29 (-0.17,0.75) | 2.28 (-1.33,5.88) | 0.07 (-0.04,0.19) | 1.09 (-0.63,2.82) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.08 (0.03,0.14) | 0.34 (0.13,0.55) | 1.83 (0.7,2.95) | 0.07 (0.03,0.11) | 0.96 (0.37,1.55) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.4 (0.2,0.5) | 1 (0.6,1.4) | 7.8 (4.5,11.2) | 0.3 (0.1,0.4) | 3.8 (2.2,5.5) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.2 (0.1,0.3) | 0.7 (0.4,1) | 4.1 (2.1,6.1) | 0.1 (0.1,0.2) | 2.1 (1.1,3.1) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.1 (0.04,0.16) | 0.27 (0.12,0.43) | 2.15 (0.92,3.34) | 0.07 (0.03,0.11) | 1.03 (0.44,1.61) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.05 (0.02,0.08) | 0.17 (0.06,0.28) | 1.04 (0.36,1.73) | 0.04 (0.01,0.06) | 0.51 (0.18,0.84) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 0.32 (0.06,0.57) | 0.82 (0.15,1.49) | 6.43 (1.18,11.67) | 0.21 (0.04,0.38) | 3.21 (0.59,5.82) |
| Work Loss Days (Adults 18-65 years) | 116.9 (99,134.7) | 491 (415.8,566.1) | 2561.2 (2169.6,2952.4) | 92.1 (78,106.2) | 1367 (1157.6,1576.3) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 17.5 (6.7,28.1) | 73.1 (28.1,117.7) | 370.6 (142.8,595.2) | 15.3 (5.9,24.7) | 199 (76.1,321.2) |

# Table A-48- Avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI) continued

| *Endpoint* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 16.7 (4.6,28.8) | 60.4 (16.6,104.1) | 85.1 (23.4,146.8) | 49.3 (13.6,85.1) |
| Mortality (Infants less than 1 year of age) | 0.03 (0.01,0.05) | 0.15 (0.06,0.24) | 0.17 (0.07,0.27) | 0.08 (0.03,0.13) |
| Acute Bronchitis (Children, ages 8-12) | 21.9 (-5.1,48.8) | 87 (-20.2,193.6) | 139.5 (-32.4,310.4) | 48.6 (-11.3,107.8) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 5.7 (1.4,10) | 17.9 (4.4,31.1) | 25.9 (6.4,45.1) | 10.9 (2.7,19) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 41.4 (-15.5,203.7) | 141.9 (-53.2,697.3) | 207.7 (-77.8,1021) | 62.1 (-23.3,305.4) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 72.5 (13.8,131.2) | 248.5 (47.2,449.6) | 363.7 (69.1,658) | 108.8 (20.7,196.8) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 45.8 (-0.9,92.5) | 157.1 (-3.1,317) | 229.9 (-4.6,464) | 68.8 (-1.4,138.8) |
| Chronic Bronchitis (Adults 27 years and older) | 9.9 (0.3,19.5) | 37.7 (1,74.2) | 62.6 (1.7,123.4) | 26.1 (0.7,51.4) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 3.6 (1.8,5.3) | 12.2 (6.2,18.1) | 18.1 (9.2,26.8) | 5.4 (2.7,8) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.9 (0.2,1.6) | 2.6 (0.5,4.8) | 3.7 (0.7,6.7) | 1.7 (0.3,3.1) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.2 (-0.45,0.85) | 0.63 (-1.38,2.63) | 0.88 (-1.93,3.68) | 0.41 (-0.91,1.73) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.4 (-0.23,1.04) | 1.25 (-0.73,3.22) | 1.74 (-1.01,4.48) | 0.82 (-0.47,2.11) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.31 (0.12,0.51) | 1.06 (0.41,1.71) | 1.6 (0.62,2.59) | 0.5 (0.19,0.81) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 1.4 (0.8,2) | 4.3 (2.5,6.2) | 6 (3.5,8.6) | 2.8 (1.6,4) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.7 (0.4,1.1) | 2.4 (1.2,3.6) | 3.6 (1.9,5.4) | 1.3 (0.7,1.9) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.38 (0.16,0.59) | 1.17 (0.5,1.83) | 1.64 (0.7,2.55) | 0.77 (0.33,1.2) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.18 (0.06,0.31) | 0.59 (0.21,0.98) | 0.89 (0.31,1.47) | 0.32 (0.11,0.53) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | 1.16 (0.21,2.11) | 3.54 (0.65,6.42) | 4.98 (0.91,9.04) | 2.33 (0.43,4.23) |
| Work Loss Days (Adults 18-65 years) | 442.7 (374.9,510.5) | 1494.4 (1265.7,1722.9) | 2334.1 (1976.8,2691.2) | 725.3 (614.3,836.2) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 64.2 (24.6,103.5) | 218.3 (83.8,351.4) | 322.1 (123.5,518.8) | 95.5 (36.6,153.8) |

## Table A-49- Avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI) continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | -1.3 (-0.4,-2.3) | 103.6 (28.5,178.6) | 29.8 (8.2,51.5) | 237.5 (65.2,409.4) | -14 (-3.8,-24.2) |
| Mortality (Infants less than 1 year of age) | 0 (0,-0.1) | 0.2 (0.1,0.4) | 0.1 (0,0.1) | 0.5 (0.2,0.8) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | -19 (-4,-42) | 163 (-38,361) | 46 (-11,102) | 347 (-81,772) | -21 (-5,-47) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | -13 (-3,-23) | 25 (6,43) | -3 (-1,-5) | 57 (14,99) | -9 (-2,-16) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | -109 (-540,41) | 170 (-64,834) | -19 (-96,7) | 373 (-140,1834) | -55 (-270,20) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | -191 (-36,-345) | 298 (57,539) | -34 (-6,-61) | 654 (124,1183) | -96 (-18,-173) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | -121 (2,-244) | 188 (-4,380) | -21 (0,-43) | 413 (-8,834) | -61 (1,-122) |
| Chronic Bronchitis (Adults 27 years and older) | -5 (0,-9) | 68 (2,135) | 20 (1,39) | 152 (4,300) | -9 (0,-19) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | -12 (-6,-17) | 17 (9,25) | -2 (-1,-3) | 38 (20,57) | -6 (-3,-9) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | -1.6 (-0.3,-3) | 3.4 (0.6,6.1) | -0.3 (-0.1,-0.6) | 7.8 (1.4,14.2) | -1.2 (-0.2,-2.3) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | -0.4 (0.8,-1.6) | 0.8 (-1.8,3.4) | -0.1 (0.2,-0.3) | 1.9 (-4.1,7.8) | -0.3 (0.6,-1.2) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | -0.7 (0.4,-1.8) | 1.5 (-0.9,3.9) | -0.1 (0.1,-0.4) | 3.5 (-2,8.9) | -0.5 (0.3,-1.4) |
| Hospital Admissions- Asthma (Population under 65 years) | -0.9 (-0.3,-1.5) | 1.4 (0.5,2.3) | -0.1 (-0.1,-0.2) | 3.2 (1.2,5.1) | -0.5 (-0.2,-0.8) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | -2.5 (-1.4,-3.5) | 5.2 (3,7.4) | -0.5 (-0.3,-0.7) | 11.9 (6.8,17) | -1.9 (-1.1,-2.7) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | -1.3 (-0.6,-1.9) | 2.4 (1.2,3.5) | -0.2 (-0.1,-0.4) | 5.3 (2.8,7.9) | -0.8 (-0.4,-1.2) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | -0.7 (-1.1,-0.3) | 1.5 (0.6,2.3) | -0.1 (-0.2,-0.1) | 3.3 (1.4,5.2) | -0.5 (-0.8,-0.2) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | -0.4 (-0.1,-0.7) | 0.8 (0.3,1.3) | -0.1 (0,-0.1) | 1.7 (0.6,2.9) | -0.3 (-0.1,-0.4) |
| Hospital Admissions- Pneumonia (Adults 65 years and above) | -2.3 (-0.4,-4.3) | 4.8 (0.9,8.6) | -0.5 (-0.1,-0.8) | 11 (2,20) | -1.8 (-0.3,-3.2) |
| Work Loss Days (Adults 18-65 years) | -1082 (-916,-1249) | 1750.7 (1483,2018) | -182 (-154,-211) | 3973 (3366,4581) | -601 (-509,-693) |
| Lower Respiratory Symptoms (Children, ages 7-14) | -176 (-66,-287) | 259 (100,416) | -29 (-11,-48) | 578 (222,930) | -87 (-33,-141) |

## Table A-50- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI), 2000$

| *Endpoint* | *CT* | *DE* | *DC* | *ME* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 617654000 (47353000,1903854000) | 180054000 (13806000,554998000) | 63508000 (4868000,195757000) | 229339000 (17581000,706916000) |
| Mortality (Infants less than 1 year of age) | 950200 (80400,2793200) | 370300 (31300,1088400) | 136500 (11500,401300) | 211200 (17900,621000) |
| Acute Bronchitis (Children, ages 8-12) | 57000 (-13300,127000) | 15300 (-3600,34100) | 4000 (-900,9000) | 15100 (-3500,33600) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 2106200 (524600,3659700) | 395400 (98400,687400) | 155400 (38600,270600) | 750000 (186400,1304900) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 28900 (-10800,141700) | 6900 (-2600,33600) | 2200 (-800,10900) | 7200 (-2700,35100) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 50700 (9600,92900) | 12000 (2300,22000) | 3900 (700,7100) | 12600 (2400,23000) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 32100 (-600,65200) | 7600 (-200,15500) | 2500 (0,5000) | 7900 (-200,16200) |
| Chronic Bronchitis (Adults 27 years and older) | 21711000 (403000,102456000) | 6291000 (117000,29687000) | 2087000 (39000,9848000) | 7567000 (140000,35707000) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 2700 (1300,4300) | 1000 (500,1600) | 300 (200,500) | 700 (300,1100) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 55800 (9900,101700) | 13000 (2300,23700) | 5600 (1000,10200) | 18500 (3300,33700) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 17300 (-38000,72300) | 3200 (-6900,13200) | 1300 (-2900,5400) | 6000 (-13200,25100) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 48800 (-28300,125800) | 10500 (-6100,27100) | 4200 (-2500,10900) | 18100 (-10500,46700) |
| Hospital Admissions- Asthma (Population under 65 years) | 18100 (7000,29300) | 2800 (1100,4400) | 1000 (400,1600) | 5100 (1900,8200) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 140300 (80400,200300) | 29800 (17100,42600) | 12300 (7100,17600) | 49200 (28200,70300) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 72900 (37800,107900) | 18600 (9700,27600) | 7000 (3600,10300) | 25600 (13300,38000) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 20800 (8900,32400) | 5100 (2200,7900) | 2100 (900,3300) | 7400 (3200,11600) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 8700 (3000,14400) | 2200 (800,3600) | 800 (300,1300) | 3100 (1100,5100) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 83100 (15200,150700) | 20500 (3800,37200) | 8900 (1600,16200) | 27300 (5000,49500) |
| Work Loss Days (Adults 18-65 years) | 292000 (247000,336000) | 63000 (53000,72000) | 29000 (24000,33000) | 63000 (53000,73000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 53000 (20000,86000) | 13000 (5000,21000) | 4000 (2000,6000) | 14000 (5000,22000) |

## Table A-51-Value of avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI), 2000$, continued

| *Endpoint* | *MD* | *MA* | *NH* | *NJ* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 967523000 (74174000,2982292000) | 1203805000 (92297000,3710604000) | 162268000 (12438000,500176000) | 1844299000 (141406000,5684858000) |
| Mortality (Infants less than 1 year of age) | 1953900 (165200,5743800) | 1222800 (103400,3594400) | 160500 (13600,471800) | 2868600 (242600,8432500) |
| Acute Bronchitis (Children, ages 8-12) | 88100 (-20500,196400) | 105400 (-24600,234800) | 14500 (-3400,32400) | 163900 (-38200,364900) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 2303000 (573200,4003700) | 3904500 (972200,6785700) | 513800 (127300,895900) | 5861300 (1458100,10192400) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 42600 (-15900,208500) | 50700 (-18900,248000) | 6400 (-2400,31300) | 78200 (-29200,383000) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 74600 (14100,136700) | 88800 (16800,162600) | 11200 (2100,20500) | 137000 (25900,251000) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 47200 (-900,95900) | 56100 (-1100,114100) | 7100 (-100,14400) | 86600 (-1700,176200) |
| Chronic Bronchitis (Adults 27 years and older) | 35634000 (660000,168153000) | 43546000 (808000,205493000) | 6226000 (115000,29380000) | 65367000 (1212000,308470000) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 6500 (3200,10400) | 4600 (2300,7400) | 600 (300,1000) | 7300 (3500,11700) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 77700 (13700,141500) | 99400 (17500,181000) | 12000 (2100,21900) | 149900 (26500,273100) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 18200 (-40100,76400) | 31500 (-69200,131800) | 3800 (-8400,16100) | 47100 (-103600,197300) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 60200 (-34900,155200) | 92400 (-53600,238100) | 11500 (-6700,29600) | 136900 (-79400,352700) |
| Hospital Admissions- Asthma (Population under 65 years) | 16600 (6400,26800) | 32500 (12500,52400) | 4300 (1600,6900) | 50400 (19400,81400) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 173800 (99600,248100) | 257300 (147400,367200) | 31500 (18100,45000) | 384600 (220300,548900) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 112100 (58200,166100) | 137000 (71100,202900) | 19500 (10100,28900) | 207400 (107600,307100) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 29700 (12700,46300) | 38700 (16500,60300) | 4800 (2000,7400) | 57600 (24600,89800) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 13000 (4500,21500) | 16400 (5700,27100) | 2300 (800,3800) | 24800 (8600,40900) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 123600 (22600,224400) | 147300 (27000,267200) | 17800 (3200,32200) | 222700 (40700,404000) |
| Work Loss Days (Adults 18-65 years) | 438000 (371000,505000) | 520000 (441000,600000) | 61000 (52000,71000) | 845000 (716000,975000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 79000 (30000,129000) | 90000 (35000,147000) | 12000 (5000,19000) | 145000 (56000,235000) |

# Table A-52- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI), 2000$, continued

| Endpoint | NY | PA | RI | VT |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 3285020000 (251872000,10125727000) | 2337684000 (179210000,7205678000) | 279698000 (21449000,862137000) | 57702000 (4422000,177863000) |
| Mortality (Infants less than 1 year of age) | 5617700 (475100,16513100) | 3249400 (274800,9552200) | 313600 (26500,921800) | 64400 (5400,189400) |
| Acute Bronchitis (Children, ages 8-12) | 312100 (-72900,694800) | 161300 (-37600,359500) | 22500 (-5300,50100) | 3800 (-900,8500) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 10895400 (2711500,18941300) | 6566200 (1630900,11430300) | 834700 (208500,1447300) | 182700 (45200,319100) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 152900 (-57100,748400) | 73800 (-27500,361500) | 10800 (-4000,53000) | 1700 (-700,8600) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 267900 (50700,490600) | 129300 (24500,236800) | 19000 (3600,34800) | 3100 (600,5600) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 169300 (-3400,344300) | 81700 (-1600,166200) | 12000 (-200,24400) | 1900 (0,3900) |
| Chronic Bronchitis (Adults 27 years and older) | 121162000 (2248000,571776000) | 70162000 (1300000,331084000) | 9244000 (172000,43625000) | 1930000 (36000,9107000) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 14200 (6900,22600) | 6900 (3300,11000) | 1000 (500,1600) | 200 (100,300) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 276000 (48700,502700) | 175200 (30900,319200) | 22100 (3900,40300) | 4500 (800,8100) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 87200 (-191700,365100) | 54800 (-120300,229300) | 6800 (-15100,28700) | 1400 (-3200,6100) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 254800 (-147800,656500) | 157700 (-91400,406300) | 19400 (-11200,49800) | 4400 (-2500,11300) |
| Hospital Admissions- Asthma (Population under 65 years) | 96300 (37000,155500) | 47700 (18300,76900) | 6800 (2600,11000) | 1200 (500,2000) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 712300 (407900,1016400) | 446600 (255700,637300) | 55700 (31900,79400) | 11900 (6800,17000) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 385400 (200000,570700) | 213600 (110800,316300) | 28600 (14800,42300) | 6200 (3200,9200) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 106700 (45500,166200) | 66300 (28300,103300) | 8200 (3500,12700) | 1800 (800,2800) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 45800 (15900,75600) | 25700 (8900,42400) | 3400 (1200,5600) | 800 (300,1200) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 409200 (74900,742500) | 260400 (47600,472700) | 32900 (6000,59700) | 6600 (1200,12000) |
| Work Loss Days (Adults 18-65 years) | 1454000 (1232000,1676000) | 646000 (547000,745000) | 93000 (79000,107000) | 15000 (13000,18000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 280000 (107000,454000) | 136000 (52000,220000) | 19000 (7000,31000) | 3000 (1000,5000) |

# Table A-53- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI), 2000$, continued

| *Endpoint* | *AL* | *GA* | *KY* | *MS* |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 3829000 (293000,11802000) | 12578000 (964000,38771000) | 781527000 (59918000,2408975000) | 15020000 (1151000,46297000) |
| Mortality (Infants less than 1 year of age) | 4900 (400,14300) | 31400 (2700,92200) | 1635600 (138300,4807800) | 54200 (4600,159200) |
| Acute Bronchitis (Children, ages 8-12) | 400 (-100,800) | 1300 (-300,3000) | 64700 (-15100,144000) | 1500 (-300,3300) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 101500 (25200,176500) | 301200 (74900,524000) | 2121100 (530100,3677000) | 70900 (17500,123700) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 1700 (-700,8600) | 7400 (-2800,36300) | 37500 (-14000,183200) | 1500 (-600,7400) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 3100 (600,5600) | 13000 (2500,23800) | 65600 (12400,120200) | 2700 (500,4900) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 1900 (0,3900) | 8200 (-200,16700) | 41500 (-800,84300) | 1700 (0,3400) |
| Chronic Bronchitis (Adults 27 years and older) | 141600 (2600,668300) | 498300 (9200,2351800) | 26131800 (484600,123316200) | 498200 (9200,2351500) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 300 (100,400) | 1100 (600,1800) | 5800 (2800,9300) | 200 (100,400) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 3500 (600,6500) | 9300 (1600,16900) | 72400 (12800,131900) | 2400 (400,4300) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 800 (-1900,3500) | 2200 (-4900,9300) | 17500 (-38400,73100) | 600 (-1200,2400) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 2800 (-1600,7300) | 7600 (-4400,19600) | 59000 (-34200,152000) | 1900 (-1100,4900) |
| Hospital Admissions- Asthma (Population under 65 years) | 700 (300,1000) | 2700 (1000,4300) | 14200 (5500,22900) | 500 (200,800) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 8100 (4600,11500) | 21400 (12200,30500) | 165800 (95000,236600) | 5400 (3100,7700) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 4500 (2400,6700) | 16000 (8300,23700) | 94300 (48900,139600) | 3300 (1700,4900) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 1400 (600,2200) | 3700 (1600,5700) | 28700 (12200,44700) | 900 (400,1400) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 500 (200,900) | 1800 (600,3000) | 11100 (3900,18300) | 400 (100,600) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 5600 (1000,10200) | 14700 (2700,26600) | 114500 (21000,207700) | 3700 (700,6800) |
| Work Loss Days (Adults 18-65 years) | 13000 (11000,15000) | 60000 (51000,69000) | 278000 (236000,321000) | 9000 (8000,11000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 3000 (1000,5000) | 14000 (5000,22000) | 69000 (27000,112000) | 3000 (1000,5000) |

## Table A-54- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI), 2000$, continued

| *Endpoint* | *NC* | *SC* | *TN* | *VA* | *WV* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 305459000 (23408000,941548000) | 105085000 (8053000,323914000) | 380250000 (29141000,1172086000) | 536326000 (41103000,1653176000) | 310822000 (23827000,958080000) |
| Mortality (Infants less than 1 year of age) | 763100 (64500,2243700) | 212000 (17900,623400) | 927600 (78400,2727100) | 1057700 (89400,3109500) | 496000 (41900,1458000) |
| Acute Bronchitis (Children, ages 8-12) | 28100 (-6500,62900) | 8200 (-1900,18300) | 32500 (-7500,72700) | 52200 (-12100,116500) | 18200 (-4200,40500) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 1039300 (256900,1815300) | 377600 (93500,658900) | 1177900 (292800,2049400) | 1707000 (423600,2973500) | 720800 (179000,1255100) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 20500 (-7600,100500) | 6500 (-2400,31700) | 22200 (-8300,108500) | 32400 (-12100,158900) | 9700 (-3600,47500) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 35900 (6800,65800) | 11300 (2100,20800) | 38800 (7300,71100) | 56800 (10800,104100) | 17000 (3200,31100) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 22700 (-500,46200) | 7200 (-100,14600) | 24500 (-500,49900) | 35900 (-700,73100) | 10700 (-200,21900) |
| Chronic Bronchitis (Adults 27 years and older) | 10614400 (196100,50094600) | 3333300 (61600,15733400) | 12714400 (235100,59992100) | 21135200 (390900,99722000) | 8809900 (163200,41571700) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 3100 (1500,5000) | 1000 (500,1600) | 3400 (1600,5400) | 5000 (2400,8000) | 1500 (700,2400) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 36000 (6300,65600) | 13000 (2300,23800) | 39900 (7000,72800) | 56500 (10000,103000) | 26100 (4600,47600) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 8500 (-18700,35600) | 3100 (-6800,13000) | 9600 (-21000,40100) | 13400 (-29500,56300) | 6300 (-13800,26300) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 28300 (-16400,73000) | 10400 (-6000,26800) | 32400 (-18800,83400) | 45200 (-26200,116400) | 21100 (-12200,54400) |
| Hospital Admissions- Asthma (Population under 65 years) | 7400 (2900,12000) | 2400 (900,3900) | 8200 (3200,13300) | 12600 (4800,20300) | 3900 (1500,6300) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 81100 (46500,115800) | 29600 (17000,42300) | 91500 (52400,130500) | 128400 (73500,183300) | 59700 (34200,85200) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 46900 (24300,69500) | 16900 (8800,25100) | 54700 (28400,81000) | 83100 (43100,123100) | 28600 (14800,42300) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 13900 (5900,21600) | 5100 (2200,7900) | 15700 (6700,24500) | 22100 (9400,34500) | 10200 (4400,16000) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 5400 (1900,8900) | 2000 (700,3200) | 6300 (2200,10400) | 9600 (3300,15800) | 3400 (1200,5600) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 57100 (10400,103800) | 20700 (3800,37500) | 63000 (11500,114400) | 89400 (16400,162300) | 41400 (7600,75200) |
| Work Loss Days (Adults 18-65 years) | 154000 (130000,177000) | 48000 (41000,55000) | 167000 (141000,192000) | 307000 (260000,354000) | 74000 (63000,86000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 37000 (14000,61000) | 12000 (5000,20000) | 41000 (16000,66000) | 60000 (23000,98000) | 18000 (7000,29000) |

## Table A-55- Value of avoided incidences attributed to reduced $PM_{2.5}$ due to all four regional haze programs, Mean (95%CI), 2000$, continued

| *Endpoint* | *IL* | *IN* | *MI* | *OH* | *WI* |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | -8361000 (-25774000,-636000) | 652657000 (50032000,2011750000) | 188019000 (14409000,579553000) | 1496098000 (114684000,4611578000) | -88385000 (-272434000,-6772000) |
| Mortality (Infants less than 1 year of age) | -223600 (-657600,-18900) | 1569600 (132700,4614300) | 472800 (40000,1390200) | 3300700 (279100,9703100) | -183300 (-539000,-15500) |
| Acute Bronchitis (Children, ages 8-12) | -6900 (-15600,1600) | 60900 (-14200,135700) | 17100 (-4000,38300) | 130000 (-30200,289800) | -7800 (-17500,1800) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | -864400 (-1542300,-207000) | 1622000 (406100,2807900) | -176600 (-323600,-40600) | 3753600 (934300,6524600) | -598700 (-1055500,-146000) |
| Asthma Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | -17000 (-84100,6300) | 26500 (-9900,129800) | -3000 (-15000,1100) | 58300 (-21800,285300) | -8500 (-42100,3200) |
| Asthma Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | -29800 (-54600,-5600) | 46500 (8800,85200) | -5200 (-9600,-1000) | 102100 (19300,187100) | -15000 (-27400,-2800) |
| Asthma Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | -18900 (-38400,400) | 29400 (-600,59800) | -3300 (-6800,100) | 64600 (-1300,131300) | -9500 (-19300,200) |
| Chronic Bronchitis (Adults 27 years and older) | -1587000 (-7510600,-29100) | 23111400 (428200,109057600) | 6724900 (124300,31734500) | 51456900 (953200,242810000) | -3192500 (-15074400,-58900) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | -3200 (-5200,-1500) | 4800 (2300,7600) | -500 (-900,-300) | 10700 (5200,17000) | -1600 (-2500,-800) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | -25200 (-46100,-4400) | 51200 (9000,93300) | -4900 (-9000,-900) | 118800 (21000,216300) | -19000 (-34700,-3300) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | -6000 (-25000,12900) | 12400 (-27300,51800) | -1200 (-4900,2500) | 28400 (-62400,118800) | -4500 (-18800,9800) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | -18500 (-47900,10700) | 39500 (-23000,101800) | -3700 (-9700,2100) | 89700 (-52000,231200) | -14100 (-36300,8100) |
| Hospital Admissions- Asthma (Population under 65 years) | -7100 (-11400,-2700) | 11000 (4200,17700) | -1200 (-1900,-400) | 24900 (9600,40200) | -3700 (-6000,-1400) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | -52700 (-75200,-30100) | 110400 (63200,157500) | -10400 (-14800,-5900) | 252600 (144700,360500) | -39900 (-56900,-22800) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | -28600 (-42400,-14800) | 53600 (27800,79400) | -5500 (-8100,-2800) | 121200 (62900,179500) | -18100 (-26800,-9400) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | -9300 (-14500,-4000) | 19800 (8400,30800) | -1900 (-2900,-800) | 44900 (19200,70000) | -7000 (-11000,-3000) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | -4300 (-7200,-1500) | 8100 (2800,13400) | -900 (-1400,-300) | 18500 (6400,30500) | -2800 (-4600,-1000) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | -42100 (-76700,-7600) | 85100 (15600,154200) | -8200 (-15100,-1500) | 197400 (36100,358200) | -31600 (-57600,-5800) |
| Work Loss Days (Adults 18-65 years) | -148000 (-171000,-125000) | 214000 (181000,247000) | -25000 (-29000,-21000) | 496000 (420000,572000) | -74000 (-85000,-62000) |
| Lower Respiratory Symptoms (Children, ages 7-14) | -33000 (-54000,-12000) | 49000 (19000,79000) | -5000 (-9000,-2000) | 108000 (41000,175000) | -16000 (-26000,-6000) |

# Appendix B: State Level Benefits for CAIR+

## CAIR+ Reductions in Ozone

**Table B-1- Reduced incidences of morbidity due to CAIR+ reductions in ozone, Mean (95% CI)**

| | *ER Visits, Asthma* | *Hospital Admissions >64 Years, Pneumonia and COPD added* | *Hospital Admission All Respiratory >64 years* | *Hospital Admissions Resp <2 Years* | *School Loss Days* | *Worker Productivity* |
|---|---|---|---|---|---|---|
| CT | 2 (0.6, 5.1) | 14 (8, 19) | 12 (0, 35) | 7 (3, 11) | 3350 (809, 8488) | 52694 (52694, 52694) |
| DE | 0.3 (0.1, 0.6) | 1 (0, 1) | 1 (0, 1) | 2 (1, 2) | 642 (159, 1344) | 14732 (14732, 14732) |
| DC | 1.1 (0.3, 3.3) | 9 (5, 13) | 8 (0, 23) | 4 (2, 6) | 1438 (344, 3819) | 11115 (11115, 11115) |
| ME | 0.5 (0.2, 1.5) | 5 (3, 7) | 4 (0, 12) | 2 (1, 3) | 865 (213, 1923) | 102753 (102753, 102753) |
| MD | 9.5 (2.8, 23.3) | 61 (35, 85) | 54 (-1, 150) | 36 (16, 56) | 14531 (3477, 38691) | 255691 (255691, 255691) |
| MA | 0.6 (0.1, 1.1) | -6 (-9, -4) | -6 (-16, 0) | 4 (2, 6) | 1625 (438, 2897) | -44271 (-44271, -44271) |
| NH | 0.5 (0.2, 1) | 3 (1, 4) | 2 (0, 6) | 2 (1, 3) | 893 (220, 1993) | 22557 (22557, 22557) |
| NJ | 3.5 (1.1, 6.2) | 10 (6, 15) | 9 (0, 26) | 13 (6, 21) | 6221 (1541, 13264) | 45732 (45732, 45732) |
| NY | 11.9 (3.5, 28.6) | 75 (42, 105) | 69 (-2, 191) | 39 (17, 61) | 19439 (4712, 47998) | 356131 (356131, 356131) |
| PA | 6.2 (1.9, 10.9) | 24 (14, 34) | 22 (-1, 62) | 22 (10, 35) | 10681 (2650, 22436) | 311259 (311259, 311259) |
| RI | 0.4 (0.1, 0.7) | 0 (0, 0) | 0 (0, 0) | 1 (1, 2) | 712 (180, 1308) | 2558 (2558, 2558) |
| VT | 0.2 (0.1, 0.7) | 2 (1, 3) | 2 (0, 5) | 1 (0, 1) | 326 (80, 761) | 31347 (31347, 31347) |
| VA | 10.5 (3.1, 23.5) | 62 (37, 87) | 55 (-1, 154) | 42 (18, 65) | 16470 (3996, 40437) | 544941 (544941, 544941) |
| **OTR Total** | 47.4 (13.8, 106.5) | 259 (144, 368) | 234 (-21, 665) | 174 (75, 272) | 77191 (18819, 185358) | 1707240 (1707240, 1707240) |

**Table B-2- Reduced incidences of mortality due to CAIR+ reductions in ozone, Mean (95% CI)**

| | *Mortality Bell 2004* | *Mortality Bell 2005* | *Mortality Huang 2005* | *Mortality Ito 2005* | *Mortality Levy 2005* |
|---|---|---|---|---|---|
| CT | 1.3 (0.4, 2.1) | 2.9 (0, 5.7) | 2.2 (0.8, 3.6) | 2.7 (1.8, 3.6) | 2.9 (2.2, 3.6) |
| DE | 0.1 (0, 0.1) | 0.1 (0, 0.3) | 0.1 (0, 0.2) | 0.6 (0.4, 0.8) | 0.6 (0.5, 0.8) |
| DC | 0.9 (0.3, 1.5) | 2 (0, 4.1) | 1.4 (0.5, 2.2) | 1.7 (1.1, 2.2) | 1.8 (1.4, 2.3) |
| ME | 0.5 (0.2, 0.8) | 1 (0, 2.1) | 0.7 (0.3, 1.2) | 1 (0.7, 1.4) | 1.1 (0.8, 1.4) |
| MD | 5.8 (1.9, 9.6) | 13.1 (0, 26.2) | 9.1 (3.5, 14.8) | 11.8 (8, 15.6) | 12.8 (9.7, 16) |
| MA | -0.6 (-0.2, -1) | -1.3 (0, -2.6) | -0.9 (-0.4, -1.5) | 1.7 (1.2, 2.3) | 1.8 (1.4, 2.3) |
| NH | 0.3 (0.1, 0.4) | 0.6 (0, 1.1) | 0.4 (0.2, 0.7) | 0.8 (0.5, 1) | 0.8 (0.6, 1) |
| NJ | 1 (0.3, 1.6) | 2.1 (0, 4.2) | 1.6 (0.6, 2.6) | 5.6 (3.8, 7.4) | 6 (4.5, 7.4) |
| NY | 7.2 (2.4, 12) | 16.2 (0, 32.3) | 13.3 (5, 21.5) | 16.9 (11.4, 22.4) | 18 (13.7, 22.4) |
| PA | 2.3 (0.8, 3.8) | 5 (0, 10) | 4.3 (1.6, 7) | 12.5 (8.4, 16.6) | 13.4 (10.1, 16.6) |
| RI | 0 (0, 0) | 0 (0, 0) | 0 (0, 0) | 0.7 (0.5, 0.9) | 0.8 (0.6, 0.9) |
| VT | 0.2 (0.1, 0.3) | 0.4 (0, 0.8) | 0.3 (0.1, 0.5) | 0.4 (0.2, 0.5) | 0.4 (0.3, 0.5) |
| VA | 5.7 (1.9, 9.4) | 12.9 (0, 25.7) | 9.6 (3.7, 15.6) | 14.3 (9.6, 18.9) | 15.5 (11.7, 19.3) |
| **OTR Total** | 24.4 (8.2, 40.6) | 55 (0, 110) | 42.2 (16, 68.3) | 70.7 (47.8, 93.6) | 76 (57.5, 94.5) |

**Table B-3- Value of reduced incidences of morbidity due to CAIR+ reductions in ozone, Mean (95% CI), 2000$**

| | *ER Visits, Asthma* | *Hospital Admissions >64 Years, Pneumonia and COPD added* | *Hospital Admission All Respiratory >64 years* | *Hospital Admissions Resp <2 Years* | *School Loss Days* | *Worker Productivity* |
|---|---|---|---|---|---|---|
| CT | 600 (200, 1300) | 186400 (105700, 260700) | 233200 (-5600, 649400) | 54600 (23500, 85600) | 251000 (61000, 637000) | 52694 (52694, 52694) |
| DE | 100 (0, 200) | 8200 (4700, 11500) | 9700 (-200, 26800) | 12400 (5400, 19500) | 48000 (12000, 101000) | 14732 (14732, 14732) |
| DC | 300 (100, 900) | 123800 (70900, 173900) | 151700 (-3700, 421100) | 28800 (12400, 45000) | 108000 (26000, 286000) | 11115 (11115, 11115) |
| ME | 200 (0, 400) | 64200 (37400, 89300) | 79800 (-1900, 222200) | 13900 (6000, 21800) | 65000 (16000, 144000) | 102753 (102753, 102753) |
| MD | 2700 (700, 6100) | 824800 (472400, 1150600) | 1005200 (-24200, 2795900) | 282500 (121900, 442300) | 1090000 (261000, 2902000) | 255691 (255691, 255691) |
| MA | 200 (0, 300) | -85500 (-119700, -50200) | -103700 (-290500, 2500) | 27900 (12100, 43600) | 122000 (33000, 217000) | -44271 (-44271, -44271) |
| NH | 100 (0, 300) | 34200 (19500, 48100) | 42700 (-1000, 119000) | 14600 (6300, 23000) | 67000 (16000, 149000) | 22557 (22557, 22557) |
| NJ | 1000 (300, 1800) | 142100 (82500, 198300) | 177100 (-4300, 491700) | 103900 (44800, 162700) | 467000 (116000, 995000) | 45732 (45732, 45732) |
| NY | 3300 (900, 7600) | 1020400 (571400, 1428900) | 1273000 (-30600, 3544300) | 306300 (132000, 480200) | 1458000 (353000, 3600000) | 356131 (356131, 356131) |
| PA | 1700 (500, 3300) | 326100 (191800, 454700) | 409300 (-9900, 1136900) | 172600 (74500, 270200) | 801000 (199000, 1683000) | 311259 (311259, 311259) |
| RI | 100 (0, 200) | 400 (200, 500) | 400 (0, 1000) | 11500 (5000, 18000) | 53000 (14000, 98000) | 2558 (2558, 2558) |
| VT | 100 (0, 200) | 27000 (15900, 38000) | 33500 (-800, 93400) | 5000 (2200, 7900) | 24000 (6000, 57000) | 31347 (31347, 31347) |
| VA | 3000 (800, 6300) | 844100 (497700, 1178100) | 1022900 (-24700, 2842500) | 324400 (140200, 507400) | 1235000 (300000, 3033000) | 544941 (544941, 544941) |
| **OTR Total** | 13300 (3600, 28900) | 3516400 (1950400, 4982300) | 4334800 (-397400, 12346700) | 1358400 (586400, 2127100) | 5789000 (1411000, 13902000) | 1707240 (1707240, 1707240) |

## Table B-4- Value of reduced incidences of mortality due to CAIR+ reductions in ozone, Mean (95% CI), 2000$

| | *Mortality Bell 2004* | *Mortality Bell 2005* | *Mortality Huang 2005* | *Mortality Ito 2005* | *Mortality Levy 2005* |
|---|---|---|---|---|---|
| CT | 7998000 (653000, 24054000) | 17971000 (-9000, 60292000) | 13983000 (1177000, 41247000) | 17259000 (1616000, 46980000) | 18520000 (1773000, 49886000) |
| DE | 347000 (28000, 1045000) | 805000 (0, 2700000) | 633000 (53000, 1866000) | 3606000 (337000, 9814000) | 3915000 (375000, 10545000) |
| DC | 5644000 (461000, 16972000) | 12903000 (-7000, 43282000) | 8599000 (724000, 25360000) | 10548000 (987000, 28713000) | 11522000 (1103000, 31035000) |
| ME | 2901000 (237000, 8726000) | 6514000 (-3000, 21853000) | 4687000 (395000, 13824000) | 6456000 (604000, 17573000) | 6921000 (663000, 18642000) |
| MD | 36277000 (2960000, 109097000) | 82569000 (-43000, 276996000) | 57533000 (4845000, 169694000) | 74519000 (6975000, 202843000) | 81013000 (7757000, 218214000) |
| MA | -3672000 (-11045000, -300000) | -8228000 (-27614000, 4000) | -5954000 (-17569000, -501000) | 10787000 (1010000, 29364000) | 11461000 (1097000, 30870000) |
| NH | 1578000 (129000, 4746000) | 3544000 (-2000, 11891000) | 2584000 (218000, 7622000) | 4909000 (460000, 13364000) | 5266000 (504000, 14183000) |
| NJ | 6064000 (495000, 18236000) | 13338000 (-7000, 44740000) | 10240000 (863000, 30201000) | 35266000 (3301000, 95994000) | 37573000 (3597000, 101204000) |
| NY | 45617000 (3722000, 137192000) | 101737000 (-53000, 341320000) | 83756000 (7052000, 247053000) | 106855000 (10002000, 290865000) | 113905000 (10906000, 306815000) |
| PA | 14224000 (1161000, 42775000) | 31629000 (-16000, 106095000) | 27078000 (2281000, 79861000) | 78862000 (7382000, 214666000) | 84447000 (8086000, 227463000) |
| RI | 41000 (3000, 124000) | 92000 (0, 307000) | 61000 (5000, 179000) | 4475000 (419000, 12182000) | 4761000 (456000, 12824000) |
| VT | 1179000 (96000, 3545000) | 2653000 (-1000, 8900000) | 1928000 (162000, 5686000) | 2299000 (215000, 6257000) | 2471000 (237000, 6655000) |
| VA | 35661000 (2910000, 107240000) | 81041000 (-42000, 271850000) | 60653000 (5108000, 178889000) | 90057000 (8430000, 245139000) | 97776000 (9362000, 263362000) |
| **OTR Tota** | 153862000 (1810000, 473451000) | 346569000 (-27799000, 1190232000) | 265780000 (5313000, 800981000) | 445898000 (41739000, 1213754000) | 479551000 (45916000, 1291700000) |

# CAIR+ Reductions in $PM_{2.5}$

## Table B-5- Reduced incidences of mortality and morbidity due to CAIR+ reductions in $PM_{2.5}$, Mean (95% CI)

| | CT | DE | DC | ME | MD | MA | NH |
|---|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 6 (2,11) | 6 (2,10) | 2 (0,3) | 1 (0,2) | 27 (7,46) | -8 (-2,-13) | 1 (0,2) |
| Mortality (Infants less than 1 year of age) | 0.01 (0,0.02) | 0.01 (0,0.02) | 0 (0,0.01) | 0 (0,0) | 0.05 (0.02,0.09) | -0.01 (0,-0.01) | 0 (0,0) |
| Acute Bronchitis (Children, ages 8-12) | 10 (-2,22) | 8 (-2,18) | 2 (0,4) | 2 (0,4) | 42 (-10,94) | -9 (2,-21) | 2 (0,4) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 13 (3,23) | 8 (2,15) | 2 (1,4) | 3 (1,5) | 41 (10,72) | -16 (-4,-29) | 2 (1,4) |
| Astham Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 75 (-28,371) | 61 (-23,299) | 14 (-5,70) | 12 (-5,60) | 318 (-119,1567) | -73 (-362,27) | 13 (-5,66) |
| Astham Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 132 (25,239) | 106 (20,192) | 25 (5,45) | 21 (4,38) | 556 (106,1007) | -128 (-24,-232) | 24 (4,43) |
| Astham Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 83 (-2,168) | 67 (-1,136) | 16 (0,32) | 13 (0,27) | 352 (-7,711) | -81 (2,-164) | 15 (0,30) |
| Chronic Bronchitis (Adults 27 years and older) | 4 (0,8) | 4 (0,7) | 1 (0,2) | 1 (0,2) | 19 (1,37) | -5 (0,-9) | 1 (0,2) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 4 (2,6) | 5 (3,8) | 1 (1,2) | 1 (0,1) | 28 (14,41) | -4 (-2,-6) | 1 (0,1) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 1 (0,3) | 1 (0,2) | 0 (0,1) | 0 (0,1) | 6 (1,11) | -2 (0,-3) | 0 (0,0) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0 (-1,2) | 0 (-1,1) | 0 (0,0) | 0 (0,0) | 1 (-3,6) | -1 (1,-2) | 0 (0,0) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 1 (0,2) | 1 (0,1) | 0 (0,0) | 0 (0,0) | 3 (-2,7) | -1 (1,-2) | 0 (0,0) |
| Hospital Admissions- Asthma (Population under 65 years) | 1 (0,2) | 0 (0,1) | 0 (0,0) | 0 (0,0) | 2 (1,4) | -1 (0,-2) | 0 (0,0) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 3 (2,4) | 2 (1,3) | 1 (0,1) | 1 (0,1) | 9 (5,13) | -3 (-2,-5) | 0 (0,1) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 1 (1,2) | 1 (1,2) | 0 (0,0) | 0 (0,0) | 6 (3,8) | -2 (-1,-2) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 1 (0,1) | 1 (0,1) | 0 (0,0) | 0 (0,0) | 3 (1,4) | -1 (-1,0) | 0 (0,0) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0 (0,1) | 0 (0,0) | 0 (0,0) | 0 (0,0) | 1 (0,2) | 0 (0,-1) | 0 (0,0) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 2 (0,3) | 2 (0,3) | 0 (0,1) | 0 (0,1) | 8 (1,14) | -2 (0,-4) | 0 (0,1) |
| Work Loss Days (Adults 18-65 years) | 765 (648,882) | 662 (561,764) | 197 (167,228) | 145 (122,167) | 3525 (2985,4065) | -825 (-698,-951) | 152 (129,176) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 116 (44,188) | 94 (36,152) | 21 (8,34) | 19 (7,31) | 499 (190,807) | -113 (-43,-184) | 22 (8,35) |

## Table B-6- Reduced incidences of mortality and morbidity due to CAIR+ reductions in $PM_{2.5}$ Mean (95% CI),continued

| | NJ | NY | PA | RI | VT | VA | OTC Total |
|---|---|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 32 (9,55) | 40 (11,70) | 62 (17,107) | -6 (-2,-10) | 0 (0,1) | 64 (18,110) | 228 (62,393) |
| Mortality (Infants less than 1 year of age) | 0.05 (0.02,0.08) | 0.07 (0.03,0.11) | 0.08 (0.03,0.14) | -0.01 (0,-0.01) | 0 (0,0) | 0.11 (0.04,0.18) | 0.38 (0.15,0.62) |
| Acute Bronchitis (Children, ages 8-12) | 47 (-11,105) | 63 (-15,141) | 71 (-16,158) | -8 (2,-17) | 1 (0,1) | 90 (-21,199) | 319 (-74,711) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 65 (16,113) | 85 (21,149) | 118 (29,207) | -12 (-3,-22) | 1 (0,2) | 94 (23,164) | 404 (100,708) |
| Astham Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 360 (-135,1773) | 489 (-183,2408) | 547 (-205,2694) | -62 (-306,23) | 4 (-1,20) | 689 (-258,3392) | 2446 (-1634,12770) |
| Astham Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 630 (120,1140) | 855 (162,1548) | 957 (182,1732) | -108 (-21,-196) | 7 (1,13) | 1205 (229,2182) | 4282 (813,7750) |
| Astham Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 398 (-8,805) | 541 (-11,1093) | 605 (-12,1222) | -69 (1,-139) | 4 (0,9) | 762 (-15,1540) | 2708 (-54,5469) |
| Chronic Bronchitis (Adults 27 years and older) | 21 (1,41) | 27 (1,54) | 35 (1,68) | -4 (0,-7) | 0 (0,1) | 41 (1,82) | 145 (4,285) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 19 (10,28) | 26 (13,38) | 29 (15,43) | -3 (-2,-5) | 0 (0,0) | 60 (30,89) | 166 (84,247) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 7 (1,13) | 9 (2,17) | 14 (2,25) | -1 (0,-3) | 0 (0,0) | 14 (2,25) | 50 (9,91) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 2 (-5,9) | 3 (-6,12) | 4 (-9,18) | 0 (1,-2) | 0 (0,0) | 3 (-7,14) | 14 (-31,59) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 4 (-2,10) | 5 (-3,13) | 7 (-4,18) | -1 (0,-2) | 0 (0,0) | 6 (-4,17) | 25 (-15,65) |
| Hospital Admissions- Asthma (Population under 65 years) | 5 (2,7) | 6 (2,10) | 7 (3,11) | -1 (0,-1) | 0 (0,0) | 5 (2,9) | 26 (10,41) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 13 (7,19) | 17 (10,24) | 25 (14,35) | -2 (-1,-4) | 0 (0,0) | 22 (13,32) | 87 (50,125) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 6 (3,10) | 8 (4,13) | 11 (6,16) | -1 (-1,-2) | 0 (0,0) | 12 (6,18) | 45 (23,66) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 3 (1,5) | 4 (2,6) | 6 (2,9) | -1 (-1,0) | 0 (0,0) | 6 (3,9) | 22 (8,35) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 2 (1,3) | 2 (1,4) | 3 (1,5) | 0 (0,0) | 0 (0,0) | 3 (1,5) | 11 (4,19) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 9 (2,16) | 12 (2,21) | 17 (3,31) | -2 (0,-3) | 0 (0,0) | 19 (3,34) | 65 (12,118) |
| Work Loss Days (Adults 18-65 years) | 3819 (3234,4405) | 5141 (4353,5930) | 6040 (5114,6966) | -670 (-567,-773) | 49 (41,56) | 7715 (6532,8897) | 26716 (22620,30811) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 562 (214,909) | 751 (286,1215) | 843 (322,1364) | -93 (-35,-150) | 6 (2,10) | 1066 (407,1723) | 3793 (1448,6133) |

## Table B-7- Value of reduced incidences of mortality and morbidity due to CAIR+ reductions in $PM_{2.5}$, Mean (95% CI), Millions of 2000$

| | CT | DE | DC | ME |
|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 39.1205 (2.9977,120.5846) | 34.7264 (2.6612,107.0408) | 10.3544 (0.7935,31.9163) | 8.7409 (0.6698,26.9428) |
| Mortality (Infants less than 1 year of age) | 0.0615 (0.0052,0.181) | 0.0705 (0.006,0.2072) | 0.0221 (0.0019,0.0649) | 0.0094 (0.0008,0.0275) |
| Acute Bronchitis (Children, ages 8-12) | 0.0037 (-0.0008,0.0082) | 0.003 (-0.0007,0.0066) | 0.0007 (-0.0002,0.0015) | 0.0006 (-0.0001,0.0013) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 0.8597 (0.2119,1.5045) | 0.5539 (0.1365,0.9694) | 0.1571 (0.0386,0.2755) | 0.1902 (0.0467,0.3333) |
| Astham Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.0118 (-0.0044,0.0578) | 0.0095 (-0.0035,0.0465) | 0.0022 (-0.0008,0.0109) | 0.0019 (-0.0007,0.0093) |
| Astham Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.0206 (0.0039,0.0378) | 0.0166 (0.0031,0.0304) | 0.0039 (0.0007,0.0071) | 0.0033 (0.0006,0.0061) |
| Astham Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.013 (-0.0003,0.0265) | 0.0105 (-0.0002,0.0213) | 0.0025 (0,0.005) | 0.0021 (0,0.0043) |
| Chronic Bronchitis (Adults 27 years and older) | 1.3729 (0.0253,6.4806) | 1.2165 (0.0225,5.7411) | 0.3487 (0.0064,1.6458) | 0.2895 (0.0053,1.3666) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.0011 (0.0005,0.0018) | 0.0014 (0.0007,0.0023) | 0.0003 (0.0002,0.0006) | 0.0002 (0.0001,0.0003) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.0225 (0.004,0.0411) | 0.018 (0.0032,0.0328) | 0.0056 (0.001,0.0102) | 0.0046 (0.0008,0.0083) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.007 (-0.0153,0.0292) | 0.0044 (-0.0096,0.0183) | 0.0013 (-0.0028,0.0054) | 0.0015 (-0.0033,0.0062) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.0197 (-0.0114,0.0508) | 0.0146 (-0.0084,0.0375) | 0.0042 (-0.0024,0.0109) | 0.0045 (-0.0026,0.0117) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.0074 (0.0028,0.0119) | 0.0038 (0.0015,0.0062) | 0.001 (0.0004,0.0016) | 0.0013 (0.0005,0.0021) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.0566 (0.0324,0.0807) | 0.0413 (0.0236,0.0589) | 0.0123 (0.0071,0.0176) | 0.0122 (0.007,0.0175) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.0294 (0.0152,0.0436) | 0.0257 (0.0133,0.038) | 0.007 (0.0036,0.0103) | 0.0065 (0.0034,0.0096) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.0084 (0.0036,0.0131) | 0.007 (0.003,0.011) | 0.0021 (0.0009,0.0033) | 0.0019 (0.0008,0.0029) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.0035 (0.0012,0.0058) | 0.003 (0.001,0.005) | 0.0008 (0.0003,0.0013) | 0.0008 (0.0003,0.0013) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 0.0335 (0.0061,0.0609) | 0.0284 (0.0052,0.0516) | 0.0089 (0.0016,0.0162) | 0.0068 (0.0012,0.0123) |
| Work Loss Days (Adults 18-65 years) | 0.1179 (0.0998,0.1359) | 0.0865 (0.0732,0.0998) | 0.0292 (0.0247,0.0336) | 0.016 (0.0135,0.0184) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.0217 (0.0083,0.0354) | 0.0176 (0.0067,0.0287) | 0.0039 (0.0015,0.0064) | 0.0036 (0.0014,0.0058) |

## Table B-8- Value of reduced incidences of mortality and morbidity due to CAIR+ reductions in $PM_{2.5}$ , Mean (95% CI), Millions of 2000$, continued

| | MD | MA | NH | NJ | NY |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 167.7971 (12.8584,517.2181) | -47.4149 (-146.1475,-3.6328) | 7.0159 (0.5376,21.6258) | 200.9525 (15.399,619.4159) | 254.7955 (19.5246,785.3798) |
| Mortality (Infants less than 1 year of age) | 0.3402 (0.0288,1.0003) | -0.0439 (-0.1292,-0.0037) | 0.007 (0.0006,0.0205) | 0.3105 (0.0263,0.913) | 0.4262 (0.036,1.2532) |
| Acute Bronchitis (Children, ages 8-12) | 0.0157 (-0.0036,0.0351) | -0.0035 (-0.0079,0.0008) | 0.0007 (-0.0002,0.0015) | 0.0177 (-0.0041,0.0395) | 0.0236 (-0.0054,0.0528) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 2.706 (0.6658,4.7409) | -1.0669 (-1.8825,-0.2599) | 0.1631 (0.0401,0.2859) | 4.2669 (1.0504,7.4732) | 5.597 (1.3765,9.8094) |
| Astham Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.0497 (-0.0185,0.2438) | -0.0115 (-0.0564,0.0043) | 0.0021 (-0.0008,0.0103) | 0.0562 (-0.021,0.276) | 0.0763 (-0.0285,0.3748) |
| Astham Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.087 (0.0164,0.1593) | -0.02 (-0.0367,-0.0038) | 0.0037 (0.0007,0.0067) | 0.0984 (0.0186,0.1804) | 0.1336 (0.0253,0.2449) |
| Astham Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.055 (-0.0011,0.1119) | -0.0127 (-0.0258,0.0003) | 0.0023 (0,0.0047) | 0.0623 (-0.0012,0.1267) | 0.0845 (-0.0017,0.172) |
| Chronic Bronchitis (Adults 27 years and older) | 6.3011 (0.1164,29.7397) | -1.5943 (-7.5305,-0.0294) | 0.2794 (0.0052,1.3189) | 6.9329 (0.128,32.7231) | 9.1619 (0.1692,43.2477) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.0077 (0.0037,0.0122) | -0.0011 (-0.0017,-0.0005) | 0.0002 (0.0001,0.0003) | 0.0053 (0.0025,0.0084) | 0.0071 (0.0034,0.0114) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.0896 (0.0158,0.1635) | -0.0266 (-0.0486,-0.0047) | 0.0037 (0.0007,0.0067) | 0.1083 (0.0191,0.1975) | 0.1406 (0.0248,0.2564) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.0211 (-0.0462,0.0883) | -0.0084 (-0.0354,0.0184) | 0.0012 (-0.0026,0.005) | 0.034 (-0.0746,0.1426) | 0.0444 (-0.0973,0.1861) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.0696 (-0.0403,0.1794) | -0.0248 (-0.0639,0.0143) | 0.0036 (-0.0021,0.0092) | 0.0988 (-0.0572,0.2548) | 0.1297 (-0.0751,0.3344) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.0194 (0.0075,0.0313) | -0.0077 (-0.0124,-0.0029) | 0.0014 (0.0005,0.0023) | 0.0358 (0.0138,0.0579) | 0.0479 (0.0184,0.0774) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.2006 (0.1148,0.2863) | -0.0688 (-0.0983,-0.0394) | 0.0097 (0.0056,0.0139) | 0.2775 (0.1589,0.3962) | 0.3624 (0.2075,0.5173) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.1309 (0.0679,0.1939) | -0.036 (-0.0533,-0.0187) | 0.0063 (0.0033,0.0093) | 0.1482 (0.0768,0.2195) | 0.1936 (0.1004,0.2868) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.0343 (0.0146,0.0535) | -0.0104 (-0.0162,-0.0044) | 0.0015 (0.0006,0.0023) | 0.0416 (0.0177,0.0649) | 0.0543 (0.0231,0.0846) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.0152 (0.0053,0.0252) | -0.0044 (-0.0072,-0.0015) | 0.0008 (0.0003,0.0012) | 0.0177 (0.0062,0.0293) | 0.023 (0.008,0.0381) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 0.1427 (0.0261,0.2594) | -0.0395 (-0.0718,-0.0072) | 0.0055 (0.001,0.0099) | 0.1609 (0.0294,0.2924) | 0.2085 (0.0381,0.3789) |
| Work Loss Days (Adults 18-65 years) | 0.5108 (0.4325,0.5892) | -0.1217 (-0.1404,-0.103) | 0.0199 (0.0169,0.023) | 0.5947 (0.5035,0.6858) | 0.7204 (0.6099,0.8308) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.0933 (0.0355,0.1521) | -0.0211 (-0.0346,-0.008) | 0.004 (0.0015,0.0066) | 0.1051 (0.04,0.1713) | 0.1405 (0.0534,0.229) |

**Table B-9-Value of reduced incidences of mortality and morbidity due to CAIR+ reductions in $PM_{2.5}$, Mean (95% CI), Millions of 2000$, continued**

| | PA | RI | VT | VA | OTR Total |
|---|---|---|---|---|---|
| Mortality (Adults ages 30 and older) | 390.2875 (29.9078,1203.0222) | -37.3088 (-114.9983,-2.8586) | 2.7761 (0.2127,8.557) | 401.8214 (30.7933,1238.5797) | 1433.6644 (-144.7903,4673.7917) |
| Mortality (Infants less than 1 year of age) | 0.5319 (0.045,1.564) | -0.0358 (-0.1052,-0.003) | 0.0029 (0.0002,0.0086) | 0.715 (0.0605,2.1021) | 2.4176 (-0.0232,7.3356) |
| Acute Bronchitis (Children, ages 8-12) | 0.0265 (-0.0061,0.0593) | -0.0029 (-0.0065,0.0007) | 0.0002 (0,0.0004) | 0.0335 (-0.0077,0.0749) | 0.1193 (-0.0435,0.2827) |
| Acute Myocardial Infarctions (Adults ages 18 and older) | 7.8021 (1.9204,13.666) | -0.8077 (-1.4215,-0.1974) | 0.0633 (0.0156,0.111) | 6.1694 (1.5197,10.8006) | 26.6541 (3.7183,49.5125) |
| Astham Exacerbation Symptoms, Cough (asthmatic children, 6 to 18) | 0.0854 (-0.0318,0.4192) | -0.0097 (-0.0476,0.0036) | 0.0006 (-0.0002,0.0031) | 0.1076 (-0.0401,0.528) | 0.3821 (-0.2543,1.9874) |
| Astham Exacerbation Symptoms, Wheeze (asthmatic children, 6 to 18) | 0.1495 (0.0283,0.274) | -0.0169 (-0.0311,-0.0032) | 0.0011 (0.0002,0.002) | 0.1883 (0.0356,0.3451) | 0.669 (0.0658,1.2867) |
| Astham Exacerbation Symptoms, Shortness of Breath (asthmatic children, 6 to 18) | 0.0946 (-0.0019,0.1924) | -0.0107 (-0.0218,0.0002) | 0.0007 (0,0.0014) | 0.1191 (-0.0024,0.2424) | 0.4231 (-0.0566,0.9093) |
| Chronic Bronchitis (Adults 27 years and older) | 11.647 (0.2151,54.972) | -1.2273 (-5.7964,-0.0226) | 0.0957 (0.0018,0.4516) | 13.9799 (0.2584,65.9692) | 48.8038 (-12.3733,243.6043) |
| Emergency Room Visits for Asthma (Children 17 years and younger) | 0.0081 (0.0039,0.0129) | -0.0009 (-0.0014,-0.0004) | 0.0001 (0,0.0001) | 0.0166 (0.008,0.0265) | 0.0461 (0.02,0.0757) |
| Hospital Admissions- Congestive Heart Failure (Adults 65 years and older) | 0.2064 (0.0364,0.3763) | -0.021 (-0.0382,-0.0037) | 0.0015 (0.0003,0.0028) | 0.2104 (0.0371,0.3837) | 0.7637 (0.0561,1.4709) |
| Hospital Admissions- Dysrythmia (Adults 65 years and older) | 0.0645 (-0.1414,0.2703) | -0.0065 (-0.0272,0.0142) | 0.0005 (-0.0011,0.0021) | 0.05 (-0.1096,0.2096) | 0.215 (-0.5663,0.9957) |
| Hospital Admissions- Ischemic Heart Disease (Adults 65 years and older) | 0.1858 (-0.1076,0.479) | -0.0184 (-0.0474,0.0106) | 0.0015 (-0.0009,0.0039) | 0.1677 (-0.0971,0.4323) | 0.6565 (-0.5164,1.8289) |
| Hospital Admissions- Asthma (Population under 65 years) | 0.0554 (0.0213,0.0895) | -0.0062 (-0.01,-0.0024) | 0.0004 (0.0002,0.0007) | 0.0417 (0.016,0.0673) | 0.2016 (0.0604,0.3428) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 65 years and older) | 0.5257 (0.301,0.7505) | -0.0527 (-0.0753,-0.0302) | 0.0041 (0.0023,0.0058) | 0.4772 (0.2732,0.6812) | 1.8581 (0.9597,2.7564) |
| Hospital Admissions- All Cardiovascular not including Myocardial Infarction (Adults 18 to 64 years) | 0.2503 (0.1298,0.3708) | -0.0267 (-0.0396,-0.0138) | 0.0022 (0.0011,0.0032) | 0.2824 (0.1464,0.4183) | 1.0196 (0.4684,1.5708) |
| Hospital Admissions- Chronic Lung Disease (Adults 65 years and older) | 0.0781 (0.0333,0.1217) | -0.0078 (-0.0121,-0.0033) | 0.0006 (0.0003,0.001) | 0.0822 (0.035,0.1281) | 0.2939 (0.1047,0.4786) |
| Hospital Admissions- Chronic Lung Disease (Adults 18-64 years) | 0.0301 (0.0104,0.0498) | -0.0032 (-0.0053,-0.0011) | 0.0003 (0.0001,0.0004) | 0.0327 (0.0113,0.054) | 0.1204 (0.0318,0.2089) |
| Hospital Admissions- Puemonia (Adults 65 years and above) | 0.307 (0.0561,0.5578) | -0.0312 (-0.0568,-0.0057) | 0.0022 (0.0004,0.0041) | 0.3332 (0.0609,0.6054) | 1.167 (0.0974,2.2359) |
| Work Loss Days (Adults 18-65 years) | 0.7524 (0.637,0.8678) | -0.0849 (-0.098,-0.0719) | 0.0055 (0.0046,0.0063) | 1.0159 (0.8602,1.1717) | 3.6625 (3.0375,4.2874) |
| Lower Respiratory Symptoms (Children, ages 7-14) | 0.1578 (0.0601,0.2571) | -0.0173 (-0.0283,-0.0066) | 0.0012 (0.0004,0.0019) | 0.1993 (0.0759,0.3248) | 0.7095 (0.2218,1.2044) |