EXECUTIVE SUMMARY

Purpose

The Clean Air Act (CAA) directs the Environmental Protection Agency (EPA) to identify and set national standards for pollutants which cause adverse effects to public health and the environment. The EPA is also required to review these health and welfare-based standards at least once every five years to determine whether, based on new research, revisions to the standards are necessary to continue to protect public health and the environment. Recent evidence indicates that two pollutants, ground level ozone and particulate matter (PM), (specifically fine particles which are smaller than 2.5µm in diameter, termed $PM_{2.5}$) are associated with significant health and welfare effects below current regulated levels. As a result of the most recent review process, EPA is revising the primary (health-based) and secondary (welfare-based) National Ambient Air Quality Standards (NAAQS) for both of these pollutants. In addition, in the final action on PM, EPA recognized that visibility impairment is an important effect of PM on public welfare. The EPA concluded that the most appropriate approach for addressing visibility impairment is the establishment of secondary standards for PM identical to the suite of primary standards, in conjunction with a revised visibility protection program to address regional haze in certain large national parks and wilderness areas.

To some degree, the problems of ground level ozone, PM and regional haze all result from commonly shared elements. Pollutants which are precursors to ozone formation are also precursors to the formation of fine PM. Both ozone and fine PM are components of regional haze. These similarities clearly provide management opportunities for optimizing and coordinating monitoring networks, emission inventories and air quality models, and for creating opportunities for coordinating and minimizing the regulatory burden for sources that would otherwise be required to comply with separate controls for each of these pollutants. Thus, these new standards are likely to be considered jointly by the various authorities responsible for their implementation. With this in mind, EPA has developed an economic impact analysis which looks at the coordinated implementation of all of these new rules. Pursuant to Executive Order

12866, this Regulatory Impact Analysis (RIA) assesses the potential costs, economic impacts, and benefits associated with illustrative implementation scenarios of these NAAQS for ozone and PM, including monitoring for these pollutants. It also assesses the costs, economic impacts, and benefits associated with the implementation of alternative regional haze programs.

In setting the primary air quality standards, EPA's first responsibility under the law is to select standards that protect public health. In the words of the CAA, for each criteria pollutant EPA is required to set a standard that protects public health with "an adequate margin of safety." As interpreted by the Agency and the courts, this decision is a *health-based* decision that specifically is *not* to be based on cost or other economic considerations. However, under the CAA, cost can be considered in establishing an alternative regional haze program.

This reliance on science and prohibition against the consideration of cost in setting of the primary air quality standard does not mean that cost or other economic considerations are not important or should be ignored. The Agency believes that consideration of cost is an essential decision making tool for the cost-effective implementation of these standards. Over time, EPA will continue to update this economic analysis as more information on the implementation strategies becomes known. However, under the health-based approach required by the CAA, the appropriate place for cost and efficiency considerations is during the development of implementation strategies, strategies that will allow communities, over time, to meet the health-based standards. The implementation process is where decisions are made -- both nationally and within each community -- affecting how much progress can be made, and what time lines, strategies and policies make the most sense. For example, the implementation process includes the development of national emissions standards for cars, trucks, fuels, large industrial sources and power plants, and through the development of appropriately tailored state and local implementation plans.

In summary, this RIA and associated analyses are intended to generally inform the public about the potential costs and benefits that may result when the promulgated revisions to the ozone and PM NAAQS are implemented by the States, but are not relevant to establishing the standards themselves. This RIA also presents the benefits and costs of alternative regional haze goals which may be relevant to establishing provisions of the regional haze rule.

General Limitations of this Analysis

Cost-benefit analysis provides a valuable framework for organizing and evaluating information on the effects of environmental programs. When used properly, cost-benefit analysis helps illuminate important potential effects of changes in policy and helps set priorities for closing information gaps and reducing uncertainty. However, nonmonetized benefits are not included here. Executive Order 12866 is clear that unquantifiable or nonmonetizable categories of both costs and benefits should not be ignored. It is particularly important to note that there are many unquantifiable and nonmonetizable benefits categories. Including many health and welfare effects.

Several specific limitations need to be mentioned. The state of atmospheric modeling is not sufficiently advanced to adequately account for all the interactions between these pollutants and the implementation strategies which may be used to control them.   Additionally, significant shortcomings exist as to the data available for these analyses. While containing uncertainties, the models used by EPA and the assumptions in the analysis are thought to be reasonable based on the available evidence.

Another major limitation is the illustrative implementation scenario which EPA uses in this analysis to measure the cost of meeting the new standards. The strategies used are limited in part because of our inability to predict the breadth and depth of the creative approaches to implementing these new NAAQS, and in part by technical limitations in modeling capabilities. These limitations, in effect, force costs to be developed based on compliance strategies that may reflect suboptimal approaches to implementation, and therefore, may reflect higher potential costs for attaining the new standards. This approach renders the result specifically useful as an incentive to pursue lower cost options, but not as a precise indicator of likely costs.

Another dimension adding to the uncertainty of this analysis is time. In the case of air pollution control, thirteen years is a very long time over which to carry assumptions. Pollution control technology has advanced considerably in the last thirteen years and can be expected to continue to advance in the future. Yet there is no clear way model this advance for use in this analysis.

Furthermore, using 2010 as the analytical year for our analysis may not allow sufficient time for all areas to reach attainment. This analysis recognizes this by not arbitrarily assuming all areas reach attainment in 2010. Because 2010 is earlier than many areas are likely to be required to attain, especially for $PM_{2.5}$, the result is a snapshot in time, reflecting progress and partial attainment but not complete attainment.

What we know about 2010 is limited by several factors. This is because EPA's modeling was not able to identify specific measures sufficient to attain the standards in all areas by the analytical year. Further, in EPA's effort to realistically model control measures which might actually be put into practice, our analysis excludes control measures which historically have been seen to be cost-ineffective.

However, even though the control measures identified in our models may be insufficient to reduce pollutants to reach the standards in all areas, there is sufficient evidence to predict that technological innovation and innovative policy mechanisms over the 13 years will make substantial progress towards improving techniques to remove pollutants in these areas in a cost-effective fashion. Chapter 9 of the RIA provides examples of how technological innovation has improved air pollution control measures over the last 10 years and lists emerging technologies which may be available in the year 2010. It also provides a rough estimate of full attainment costs that might result from the implementation of these and other control technologies yet to be developed.

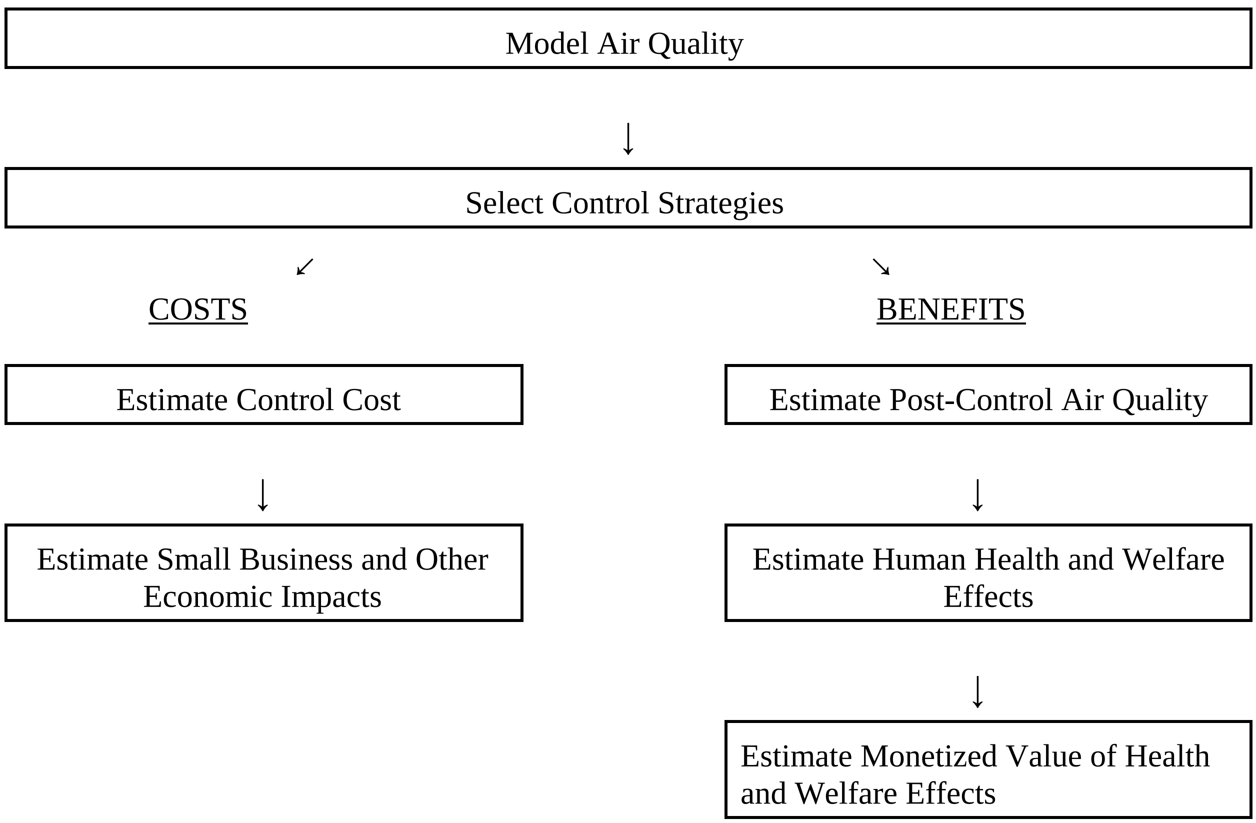
It is important to recognize that with the finalization of the new ozone and PM standards, the Act, and the implementation package accompanying the standards, allow for flexibility in the development of implementation strategies, both for control strategies as well as schedules. The actual determination of how areas or counties will meet the standards is done by States during the development of their State Implementation Plans (SIPs). These SIPs are generally based on the results from more detailed area specific models using more complete information than is available to EPA for the development of its national analysis. For this reason, while EPA believes that this RIA is a good approximation of the national costs and benefits of these rules (subject to the limitations described elsewhere), this analysis cannot accurately predict what will occur account for what happens in individual areas. In addition, this RIA does not take into account all the creativity and flexibility which a State will have when actually implementing these standards. Thus, cheaper ways of implementing the new standards and obtaining the same amount of benefits may well be found.

Qualitative and more detailed discussions of the above and other uncertainties and limitations are included in the analysis. Where information and data exists, quantitative characterizations of these and other uncertainties are included. However, data limitations prevent an overall quantitative estimate of the uncertainty associated with final estimates. Nevertheless, the reader should keep all of these uncertainties and limitations in mind when reviewing and interpreting the results.

Overview of RIA Methodology: Inputs and Assumptions

The potential costs, economic impacts and benefits have been estimated for each of the three rules. The flow chart below summarizes the analytical steps taken in developing the results presented in this RIA.

FIGURE ES-1: Flowchart of Analytical Steps



The assessment of costs, economic impacts and benefits consists of multiple analytical components, dependent upon emissions and air quality modeling. In order to estimate baseline air quality in the year 2010, emission inventories are developed for 1990 and then projected to 2010, based upon estimated national growth in industry earnings and other factors. Current CAA-mandated controls (e.g., Title I reasonably available control measures, Title II mobile source controls, Title III air toxics controls, Title IV acid rain sulfur dioxide (SO_2) controls) are applied to these emissions to take account of emission reductions that should be achieved in 2010 as a result of implementation of the current PM and ozone requirements. These 2010 CAA emissions in turn are input to an air quality model that relates emission sources to county-level pollutant concentrations. This modeled air quality is used to identify projected counties, based on these assumptions, that exceed the alternative pollutant concentration levels[1]. A cost optimization model is then employed to determine, based on a range of assumptions, the least cost control strategies to achieve the alternatives in violating counties. Given the estimated costs of attaining alternative standards, the potential economic impacts of these estimated costs on potentially affected industry sectors is subsequently analyzed. Potential health and welfare benefits are also estimated from modeled changes in air quality as a result of control strategies applied in the cost analysis. Finally, benefits and costs are compared.

This RIA presents results for the coordinated implementation of these three rules as well as providing an estimate of their costs and benefits separately. Due to the lack of an integrated air quality model, it is impossible to concurrently estimate the joint impacts. In an attempt to provide as much information as possible regarding joint impacts, EPA is able to model the two NAAQS sequentially by assuming first the imposition of controls to meet the new ozone standard, followed by the new PM standard and regional haze target but was unable to sufficiently model adequately the imposition of controls to meet the new PM standard, followed by the new ozone and regional haze standards. Neither approach correctly models the actual process which would be used by decision makers trying to simultaneously develop an optimal program to control all three pollutants. The coordinated implementation national results do not show much difference from the sum of the three rules. This is thought to occur due more to model limitations than a true result.

This analysis estimates the potential costs, economic impacts and benefits for three PM standard options, three ozone standard options and two regional haze options. The alternatives analyzed include:

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1 For the purposes of this RIA, the term "attain" or "attainment" is used to indicate that the air quality level specified by the standard alternative is achieved. Because the analyses in this RIA are based on one-year of air quality data, they are only estimates of actual attainment; all standard alternatives are specified as 3-year averages.

For PM_{10}

- the promulgated PM_{10} standard set at 50µg/m^3 annual mean, and 150µg/m ^{3}, 99th percentile 24-hour average

For $PM_{2.5}$

- the promulgated $PM_{2.5}$ standard set at 15µg/m^3, spatially averaged annual mean, and 65 µg/m ^{3}, 98th percentile 24-hour average and two alternatives: 1) an annual standard set at 15µg/m^3, in combination with a 24-hour standard set at 50µg/m^3; and 2) an annual standard set at 16µg/m^3, in combination with a 24-hour standard set at 65µg/m^3.

For Ozone

- the promulgated ozone standard set at .08 parts per million (ppm) in an eight hour concentration based fourth highest average daily maximum form, and two alternatives: 1) .08 ppm in an eight hour concentration based third highest average daily maximum form; and 2) .08 ppm in an eight hour concentration based fifth highest average daily maximum form.

For Regional Haze

- a regional haze visibility target reduction of 0.67 and 1 deciview. These reductions are analyzed incremental to the implementation of the new $PM_{2.5}$ standard.

The RIA analyses have been constructed such that benefits and costs are estimated incremental to those derived from the combined effects of implementing both the 1990 CAA Amendments and the current PM_{10} and ozone NAAQS as of the year 2010. These analyses provide a "snapshot" of potential benefits and costs of the new NAAQS and regional haze rule in the context of (1) implementation of CAA requirements between now and 2010, (2) the effects on air quality that derive from economic and population growth, and (3) the beneficial effects on air quality that the Agency expects will result from a series of current efforts to provide regional-level strategies to manage the long range transport of NOx and SO_2. It should be kept in mind that 2010 is earlier than attainment with the new standards will be required.

This RIA does not attempt to force its models to project full attainment of the new standards in areas not predicted to achieve attainment by 2010. However, further calculations are performed to attempt to project full attainment benefits and costs in this RIA. For the benefit estimates, the same general methodology used in our base analysis is extended to derive the estimates and are reported within this RIA. For the cost estimates a limited methodology is used to predict potential costs of full attainment, with the last increment of reductions being "achieved" through the use of unspecified measures having an average emission cost-effectiveness of $10,000 per ton. It is important to recognize that EPA has much less confidence in these cost estimates because of the length of time over which full attainment would be achieved.

In that regard, the $10,000 cost estimate for these reductions is intended to provide an ample margin to account for unknown factors associated with future projections, and may tend to overestimate the final costs of attainment. In fact, EPA will encourage, and expects that States will utilize, market based approaches that would allow individual sources to avoid incurring costs greater than $10,000/ton. Chapter 9 discusses EPA's particular interest in applying the concept of a Clean Air Investment Fund that would allow individual sources to avoid incurring costs greater than $10,000 per ton. Based on this analysis, EPA believes that a large number of emissions reductions are available at under $10,000 a ton; sources facing higher control costs could finance through such a fund. Compliance strategies like this will likely lower costs of compliance through more efficient allocation, and can serve to stimulate technology innovation.

The estimation of benefits from environmental regulations poses special challenges. The include the difficulty of quantifying the incidence of health, welfare, environmental endpoints of concern, and the difficulty of assigning monetized values to these endpoints. As a result, many categories of potential benefits have not been monetized at all, and those that have been are given in ranges. Specifically, this RIA has adopted the approach of presenting a "plausible range" of monetized benefits to reflect these uncertainties by selecting alternative values for each of several key assumptions. Taken together, these alternative sets of assumptions define a "high end" and a "low end" estimate for the monetized benefits categories.

In choosing alternative assumptions, EPA has tried to be responsive to the many comment it received on the RIAs that accompanied the proposed rules. It should be emphasized, however, that the high and low ends of the plausible range are not the same as upper and lower bounds. For many of the quantitative assumptions involved in the analysis, arguments could be made for an even higher or lower choice, which could lead to an even greater spread between the high end and low end estimates. The analysis attempts to present a plausible range of monetized benefits for the categories that have been analyzed. Again, it must be stressed that many benefits categories have not been monetized at all, because of both conceptual and technical difficulties in doing so. These benefits are in addition to the plausible range of monetized benefits considered here.

SUMMARY OF RESULTS

Direct Cost and Economic Impact Analyses

Potential annual control costs (in 1990 dollars) are estimated for attainment of each alternative standard. Potential administrative costs of revising the PM_{10} monitoring network and the costs of a new $PM_{2.5}$ monitoring network as well as the administrative costs of implementing the new rules are also reported.

Possible economic impacts based on these control costs are estimated for the same alternative standards. This impacts analysis also include a screening analysis providing estimated annual average cost-to-sales ratios for all potentially affected industries.

Key Results and Conclusions

<u>OZONE</u>

- Estimated annual identifiable control costs corresponding to the partial attainment of the promulgated ozone standard is $1.1 billion per year incremental to the current standard. This estimate is based on the adoption, where needed, of all currently identifiable reasonably available control technologies for which EPA has cost data, and which cost less than $10,000/ton.

- Under the partial attainment scenario, there are estimated to be 17 potential residual nonattainment areas, 7 of which are also in residual nonattainment for the current ozone standard.

- The implication of residual nonattainment is that areas with a VOC or NOx deficit will likely need more time beyond 2010; new control strategies (e.g., regional controls or economic incentive programs); and/or new technologies in order to attain the standard.

- Under the illustrative scenario selected, at least one or more establishments (e.g. industrial plant) in up to 227 of U.S. industries (as defined by 3-digit SIC codes) which are estimated to have cost-to-sales ratios of at least 0.01 percent by the chosen standard. Approximately 25 of these are industries which have some establishments which are estimated to have cost-to-sales ratios exceeding 3 percent, and therefore may experience potentially significant impacts. These results are highly sensitive to the choice of control strategy.

- A very small proportion of establishments are potentially affected for most of the SIC codes affected by the new ozone standard. The number of establishments potentially affected is 0.13 percent of all establishments in affected SIC codes for the selected standard.

- This RIA does not attempt to force its models to project full attainment of the new standard in areas not predicted to achieve attainment by 2010. However, full attainment costs of the selected standard are estimated at $9.6 billion per year incremental to the current standard. It is important to recognize that EPA has much less confidence in these cost estimates because of the inherent uncertainties in attributing costs to new technologies.

PM

- Estimated annual identifiable control costs corresponding to the partial attainment of the selected PM standard are $8.6 billion per year incremental to the current PM_{10} standard. This estimate is based on the adoption of the majority of currently identifiable control measures for which EPA had cost-effectiveness data. For the PM analysis, a $1 billion/$\mu g/m^3$ cut-off is used to limit the adoption of control measures. Control measures providing air quality improvements are less than $1 billion/$\mu g/m^3$ are adopted where the air quality model and cost analysis identify control measures as being necessary.

- Under the partial attainment scenario, an estimated 30 potential residual nonattainment counties, 11 of which are also in residual nonattainment for the current PM_{10} standard.

- The implication of residual nonattainment is that counties with $PM_{2.5}$ levels above the standard will likely need more time beyond 2010; new control strategies (e.g., regional controls or economic incentive programs); and/or new technologies in order to attain the standard.

- Under the illustrative scenario selected, at least one or more establishments (e.g. industrial plant) in up to 198 of U.S. industries (as defined by 3-digit SIC codes) which are estimated to have cost-to-sales ratios of at least 0.01 percent by the chosen standard. Approximately 86 of these are industries which have some establishments which are estimated to have cost-to-sales ratios exceeding 3 percent, and therefore may experience potentially significant impacts. These results are highly sensitive to the choice of control scenario.

- A small proportion of establishments are potentially affected for most of the SIC codes affected by the new PM standards. The average number of establishments potentially affected is about 2.7 percent in total affected SIC codes for the selected standard.

- The year 2010 is prior to the time that full attainment is required under the CAA. This RIA does not attempt to force its models to project full attainment of the new standard in areas not predicted to achieve attainment by 2010. However, full attainment costs of the selected $PM_{2.5}$ standard in 2010 are estimated at $37 billion per year incremental to the current standard. It is important to recognize that EPA has much less confidence in these cost estimates because of the inherent uncertainties in attributing costs to new technologies.

Regional Haze

- The expected annual control cost for the year 2010 associated with the proposed regional haze rule ranges from $0 to a maximum of $2.7 billion. The additional cost of implementation of the proposed regional haze rules will vary depending on the visibility targets selected by States. If targets are adjusted through that process to parallel the implementation programs for the new ozone and PM standards, the costs for meeting the adjusted targets in those areas will be borne by the ozone and PM programs. The proposed rule, however, includes a presumptive target of 1.0 Deciview improvement over either 10 or 15 years (on the 20 percent worst days); any adjustments to this target must be justified by States on a case-by-case basis. The high end costs in this analysis assume that 76 mandated Class I areas will need additional reductions to meet the 10 year presumptive target from 2000 to 2010. The additional control cost associated with meeting the presumptive 1.0 deciview target in 10 years in 48 of these areas, and partial achievement in 28 areas is estimated to be $2.7 billion. If the 1.0 deciview improvement in 15 years target is promulgated, this analysis projects that 58 Class I areas would not meet this target with NAAQS controls alone. To fully attain a 0.67 deciview improvement between 2000 and 2010 in 41 of these areas and partially attain the 0.67 target in 17 areas would cost an estimated $2.1 billion.

Benefit Analysis

Health and welfare benefits are estimated for attainment of the PM and ozone standards and visibility improvements resulting from the proposed regional haze program. The estimated change in incidence of health and welfare effects is estimated for each air quality change scenario as defined by the 2010 baseline and post-attainment air quality distributions. These estimated changes in incidence are then monetized by multiplying the estimated change in incidence of each endpoint by its associated dollar value of avoiding an occurrence of an adverse effect. These endpoint-specific benefits are then summed across all counties to derive an estimate of total benefit. Because there are potentially significant categories for which health and welfare benefits are not quantified or monetized due to a lack of scientific and economic data, the benefit estimates presented in this analysis are incomplete.

Tables ES-1 and ES-2 list the anticipated health and welfare benefit categories that are reasonably associated with reducing PM and ozone in the atmosphere, specifying those for which sufficient quantitative information exists to permit benefit calculations. Because of the inability to monetize some existing benefit categories, such as changes in pulmonary function and altered host defense mechanisms, some categories are not included in the calculation of the monetized benefits.

Table ES-1 PM and Regional Haze Benefits Categories

	PM Health and Welfare Benefit Categories	
	Unquantified Benefit Categories	**Quantified Benefit Categories (incidences reduced and/or dollars)**
Health Categories	Changes in pulmonary function Morphological changes Altered host defense mechanisms Cancer Other chronic respiratory disease Infant Mortality Mercury Emission Reductions	Mortality (acute and long-term) Hospital admissions for: all respiratory illnesses congestive heart failure ischemic heart disease Acute and chronic bronchitis Lower, upper, and acute respiratory symptoms Respiratory activity days Minor respiratory activity days Shortness of breath Moderate or worse asthma Work loss days

Welfare Categories	Materials damage (other than consumer cleaning cost savings) Damage to ecosystems (e.g., acid sulfate deposition) Nitrates in drinking water Brown Clouds	Consumer Cleaning Cost Savings Visibility Nitrogen deposition in estuarine and coastal waters

Table ES-2 Ozone Benefits Categories

<table>
<tr><th rowspan="2"></th><th colspan="2">Ozone Health and Welfare Benefit Categories</th></tr>
<tr><th>Unquantified Health Benefit Categories</th><th>Quantified Benefit Categories (in terms of incidences reduced or dollars)</th></tr>
<tr><td>Health Categories</td><td>Airway responsiveness
Pulmonary inflammation
Increased susceptibility to respiratory infection
Acute inflammation and respiratory cell damage
Chronic respiratory damage/ Premature aging of lungs</td><td>Coughs
Pain upon deep inhalation
Mortality
Hospital admissions for:
all respiratory illnesses
pneumonia
chronic obstructive pulmonary disease (COPD)
Acute respiratory symptoms
Restricted activity days
Lower respiratory symptoms
Self-reported asthma attacks
Cancer from air toxics
Change in lung function</td></tr>
<tr><td>Welfare Categories</td><td>Ecosystem and vegetation effects in Class I areas (e.g., national parks)
Damage to urban ornamentals (e.g., grass, flowers, shrubs, and trees in urban areas)
Reduced yields of tree seedlings and non-commercial forests
Damage to ecosystems
Materials damage (other than consumer cleaning cost savings)
Nitrates in drinking water
Brown Clouds</td><td>Commodity crops
Fruit and vegetable crops
Commercial forests
Consumer Cleaning Cost Savings
Visibility
Nitrogen deposition in estuarine and coastal waters
Worker productivity</td></tr>
</table>

Key Results and Conclusions

There are a number of uncertainties inherent in the underlying functions used to produce quantitative estimates. Some important factors influencing the uncertainty associated with the benefits estimates are: whether a threshold concentration exists below which associated health risks are not likely to occur, the valuation estimate applied to premature mortality and the estimation of post-control air quality. Additionally, there is greater uncertainty about the existence and the magnitude of estimated excess mortality and other effects associated with exposures as one considers increasingly lower concentrations approaching background levels. The high and low end benefits estimates, as discussed above, attempt to bracket a plausible range that accounts for some of these uncertainties.

<u>OZONE</u>

- Partial attainment of the selected ozone standard results in estimated monetized annual benefits in a range of $0.4 and $2.1 billion per year incremental to the current ozone standard. The estimate includes from 0 to 330 incidences of premature mortality avoided.

- The major benefit categories that contribute to the quantified benefits include mortality, hospital admissions, acute respiratory symptoms and welfare effects. Mortality benefits represent about 90% of the high end benefits estimates. However, this analysis excludes a number of other benefit categories.

- Full attainment of the preferred ozone standard results in estimated monetized benefits of in a range of $1.5 to $8.5 billion per year incremental to the current ozone standard. The estimate includes 0 to 1300 incidences of premature mortality avoided (corresponding to long-term mortality, respectively).

- There are benefits from ozone control that could not be monetized in the benefits analysis, which in turn, affect the benefit-cost comparison. Nonmonetized potential benefits categories include: effects in lung function; chronic respiratory damage and premature aging of the lungs; increased susceptibility to respiratory infection; protection of ornamental plants, mature trees, seedlings, Class I areas, and ecosystems; reduced nitrates in drinking water, and reduced brown cloud effects. The effect of our inability to monetize these benefits categories leads to an underestimation of the monetized benefits presented in this RIA.

<u>PM</u>

- Partial attainment of the selected $PM_{2.5}$ standard results in estimated monetized annual benefits in a range of $19 to $104 billion per year incremental to the current PM_{10} standard, including 3,300 to 15,600 incidences of premature mortality avoided.

- The major benefit categories that contribute to the quantified benefits include mortality, hospital admissions, acute respiratory symptoms and welfare effects.   Mortality benefits represent about 12% to 70% of the benefits estimates. However, this analysis excludes a number of other benefit categories.

- Full attainment of the preferred $PM_{2.5}$ standard results in estimated monetized benefits of in a range of $20 and $110 billion per year incremental to the current PM_{10} standard, including 3,700 to 16,600 incidences of premature mortality avoided (corresponding to short-term and long-term mortality, respectively). These numbers are significant underestimates because EPA has no procedure to predict full attainment benefits outside nonattainment county boundaries for $PM_{2.5}$.

- There are benefits from PM control that could not be monetized in the benefits analysis, which in turn affect the benefit-cost comparison. Nonmonetized potential benefits categories include: effects in pulmonary function; increased susceptibility to respiratory infection; cancer; infant mortality; effects associated with exposure to mercury; protection of ecosystems; reduced acid sulfate deposition; reduced materials damage;

reduced nitrates in drinking water; and reduced brown cloud effects. The effect of our inability to monetize these benefit categories leads to an underestimation of the monetized benefits presented in this RIA.

Regional Haze

- The expected visibility and associated health and welfare annual benefits for the year 2010 associated with the proposed regional haze rule ranges from $0 to a maximum of $5.7 billion. The amount of benefits from implementation of the proposed regional haze rules will vary depending on the visibility targets selected by States. If targets are adjusted through that process to parallel the implementation programs for the new ozone and PM standards, the benefits for meeting the adjusted targets in those areas will not exceed those calculated for ozone and PM programs. The proposed rule, however, includes a presumptive target of a 1.0 Deciview improvement over either 10 or 15 years (on the 20 percent worst days); any adjustments to this target must be justified by States on a case-by-case basis. The high end benefits in this analysis assume that 76 mandated Class I areas will need additional emissions reductions to meet the 10 year presumptive target from 2000 to 2010. The additional benefits, resulting from 48 of the 76 areas meeting the presumptive 1.0 deciview target, and 28 of the 76 areas having partial achievement, are estimated to range from $1.7 to $5.7 billion. The additional benefits resulting from 41 Class I areas meeting the presumptive 0.67 deciview improvement target between 2000 and 2010, and 17 areas partially meeting the 0.67 deciview target range from $1.3 to $3.2 billion.

Monetized Benefit-Cost Comparison

Comparing the benefits and the costs provides one framework for comparing alternatives in the RIA. As noted above, both the Agency and the courts have defined the NAAQS standard setting decisions, both the initial standard setting and each subsequent review, as *health-based* decisions that specifically are *not* to be based on cost or other economic considerations. This benefit-cost comparison is intended to generally inform the public about the potential costs and benefits that may result when revisions to the ozone and PM NAAQS are implemented by the States. Costs and benefits of the proposed regional haze rule are also presented. Monetized benefit-cost comparisons are presented for both the full and partial attainment scenarios nonmonetized effects by definition cannot be included. In considering these estimates, it should be stressed that these estimates contain significant uncertainties as discussed throughout this analysis.

Estimated quantifiable partial attainment (P/A) benefits of implementation of the particulate matter (PM) and ozone NAAQS exceed estimated P/A costs. Estimated quantifiable net P/A benefits (P/A benefits minus P/A costs) for the combined $PM_{2.5}$ 15/65 and ozone 0.08 ppm 4th max standards range from approximately $10 to $96 billion.

Considered separately, estimated quantifiable P/A benefits of $PM_{2.5}$ standard far outweigh estimated P/A costs. Estimated quantifiable net P/A benefits of the selected $PM_{2.5}$ 15/65 standard range from $10 to $95 billion. Estimated quantifiable full-attainment (F/A) benefits may or may not exceed estimated F/A costs for PM depending on whether the low end or high end estimates are used. Net benefits for the $PM_{2.5}$ F/A scenario range from negative $18 billion to positive $67 billion . Estimated quantifiable P/A benefits of the ozone standard also exceed estimated quantifiable P/A costs, though by a smaller margin. Estimated quantifiable net P/A benefits of the ozone 0.08 ppm 4th max standard range from negative $0.7 to positive $1.0 billion. The full range of F/A benefit estimates are smaller than the F/A costs for ozone with net benefits ranging from negative $1.1 billion to negative $8.1 billion. Estimated quantifiable net benefits from the proposed regional haze program range from $0 to $3.0 billion.

Table ES-3. Comparison of Annual Benefits and Costs of PM-Only Alternatives in 2010[a] (1990$)

$PM_{2.5}$ Alternative ($\mu g/m^3$)	Annual Benefits of Partial Attainment[b] (billion $) (A)	Annual Costs of Partial Attainment (billion $) (B)	Net Benefits of Partial Attainment (billion $) (A - B)	Number of RNA Counties
16/65 (high end estimate)[c]	**90**	**5.5**	**85**	**19**
15/65 low end estimate[d] high end estimate[c]	**19** **104**	**8.6**	**10** **95**	**30**
15/50 (high end estimate)[c]	**107**	**9.4**	**98**	**41**

a All estimates are measured incremental to the baseline of the current ozone standard (0.12ppm , 1 expected exceedance per year) and current PM_{10} standard (PM_{10} $\mu g/m^3$ annual/150 $\mu g/m^3$ daily, 1 expected exceedance per year).

b Partial attainment benefits based upon post-control air quality as defined in the control cost analysis.

c The high end estimates are based on assumptions of effects down to 12 $\mu g/m^3$ for PM mortality, down to background for chronic bronchitis, and a valuation approach to mortality benefits based on averting premature statistical deaths valued at $4.8 million each.

d The low-end estimates are based on assumptions of a threshold at 15 $\mu g/m^3$ for PM mortality and chronic bronchitis, an assumption that two-thirds of short-term deaths are premature by only days or weeks, a valuation approach to mortality benefits based on life-years valued at $120,000 each, and an adjustment to visibility benefits derived from a contingent valuation survey.

Table ES-4. Comparison of Annual Benefits and Costs of Ozone-Only Alternatives in 2010[a] (1990$)

Ozone Alternative (ppm)	Annual Benefits of Partial Attainment (billion $)[b] (A)	Annual Costs of Partial Attainment (billion $) (B)	Net Benefits of Partial Attainment (billion $) (A - B)	Number of RNA Areas
0.08 5th Max (high end estimate)[c]	**1.6**	**0.9**	**0.7**	**12**
0.08 4th Max low end estimate[d] high end estimate[c]	**0.4** **2.1**	**1.1**	**-0.7** **1.0**	**17**
0.08 3rd Max (high end estimate)[c]	**2.9**	**1.4**	**1.5**	**27**

a All estimates are measured incremental to the baseline current ozone standard (0.12ppm , 1 expected exceedance per year).

b Partial attainment benefits based upon post-control air quality estimates as defined in the control cost analysis.

c The high-end estimates use a meta-analysis of epidemiological studies of associations between ozone and short-term mortality, and PM related benefits of ozone controls.

d The low-end estimates are based on assumptions of no ozone mortality, and no ancillary PM-related benefits from ozone controls.