PROPOSED LEAD NAAQS
REGULATORY IMPACT ANALYSIS

U.S. EPA
Office of Air Quality Planning and Standards
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EXECUTIVE SUMMARY

ES.1 Overview

This Regulatory Impact Analysis (RIA) estimates the incremental costs and monetized human health benefits of attaining a revised primary lead (Pb) National Ambient Air Quality Standard (NAAQS) nationwide. There are important overall data limitations and uncertainties in these estimates. They are described in section E.S.4 below. Hypothetical control strategies were developed for five alternative Pb standards encompassing the proposed range of 0.1 $\mu g/m^3$ to 0.3 $\mu g/m^3$, as well as alternative standards of 0.5 $\mu g/m^3$ and 0.05 $\mu g/m^3$. For the RIA to be issued with the final rulemaking, the agency will analyze at least one more stringent and one less stringent alternative than the selected standard consistent with the OMB Circular A-4 Guidelines. This summary outlines the basis for and approach used for estimating the incremental costs and monetized benefits of these standards, presents the key results of the analysis, and highlights key uncertainties and limitations.

This Regulatory Impact Analysis (RIA) provides illustrative estimates of the incremental costs and monetized human health benefits of attaining a revised primary lead (Pb) National Ambient Air Quality Standard (NAAQS) within the current monitoring network[1]. Many of the highest-emitting Pb sources do not have nearby Pb-TSP monitors, and it is important to note that there may be many more potential nonattainment areas than have been analyzed in this RIA. Because of time and data constraints, in this RIA, estimates of costs and benefits employed different techniques for estimating future air quality. This results in benefits estimates that represent full attainment, and cost estimates that do not represent full attainment. These differences will be addressed in the final RIA, and further improvements to estimation techniques will be explored.

It is important to note at the outset that overall data limitations are very significant for this analysis, compared to other NAAQS reviews. One critical area of uncertainty is the limited TSP-Pb monitoring network (discussed in chapter 2). Because monitors are present in only 86 counties nationwide, the universe of monitors exceeding the various target NAAQS levels is very small; only 36 counties above 0.05 $\mu g/m^3$, and only 24 counties exceeding the lowest proposed NAAQS level of 0.10 $\mu g/m^3$. Because we know that many of the highest-emitting Pb sources in the 2002 NEI do not have nearby Pb-TSP monitors (see section 2.1.7), it is likely that there may be many more potential nonattainment areas than have been analyzed in this RIA. It is also important to note that the addition of unidentified controls to sources above a specific level of emissions (see section 4.4.3) does not bring all areas all the way to attainment for four of the five alternative standards analyzed. Because benefits were calculated assuming that each monitor just attains each standard alternative, this creates a potential mismatch between the costs and benefits calculated for each projected non-attainment area.

In addition, EPA would prefer to use a detailed air quality model that simulates the dispersion and transport of lead to estimate local ambient lead concentrations with the

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[1] There are currently 189 monitors representing 86 counties, but only 36 counties have monitors which exceed 0.05 ug/m^3.

hypothetical alternative emission control strategies expected under the proposed NAAQS. Although models with such capabilities are available for pollutants for which EPA frequently conducts air quality analyses (e.g., particulate matter and ozone), regional scale models are currently neither available nor appropriate for Pb[2] As discussed in more detail below, EPA developed an air quality assessment tool to estimate the air quality impacts of each lead emissions control strategy. Finally, our initial analysis of control costs employs a simple fixed cost-per-ton methodology for unidentified point source controls. These cost estimates will be revised and improved during development of the RIA for the final Pb NAAQS, and we intend to find ways to value unidentified controls that do no use a single constant cost per ton.

In setting primary ambient air quality standards, EPA's responsibility under the law is to establish standards that protect public health, regardless of the costs of implementing a new standard. The Clean Air Act requires EPA, for each criteria pollutant, to set a standard that protects public health with "an adequate margin of safety." As interpreted by the Agency and the courts, the Act requires EPA to create standards based on health considerations only.

The prohibition against the consideration of cost in the setting of the primary air quality standard, however, does not mean that costs or other economic considerations are unimportant or should be ignored. The Agency believes that consideration of costs and benefits is essential to making efficient, cost effective decisions for implementation of these standards. The impacts of cost and efficiency are considered by states during this process, as they decide what timelines, strategies, and policies are most appropriate. This RIA is intended to inform the public about the potential costs and benefits associated with a hypothetical scenario that may result when a new lead standard is implemented, but is not relevant to establishing the standards themselves.

The analysis year for this regulatory impact analysis is 2020, consistent with the previously completed $PM_{2.5}$ NAAQS RIA analysis which also used 2020 as its analysis year. For the purposes of this analysis, we assess attainment by 2020 for all areas. Some areas for which we assume 2020 attainment may in fact need more time to meet one or more of the analyzed standards, while others will need less time. This analysis does not prejudge the attainment dates that will ultimately be assigned to individual areas under the Clean Air Act, which provides flexibility to postpone compliance dates, provided that the date is as expeditious as practicable.

This analysis is preliminary and only attempts to assess a hypothetical scenario. In addition to the data limitations discussed earlier in this summary, the methods limitations affect the usefulness of this analysis. For the RIA to be issued with the final rulemaking, the agency will be refining the analysis presented in this RIA and undertaking additional analyses, including multiple approaches to estimating the cost of needed reductions when the sources are not clearly identified. While the final RIA will not specifically quantify effects of changing the ambient air Pb on adults, it will contain suggestions on where additional information and data would be useful to help characterize the adult benefits for the next 5-year review. EPA will also

[2] U.S. Environmental Protection Agency (2007c), Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, section 2.4, EPA-452/R-07-013, Office of Air Quality Planning and Standards, RTP, NC.

investigate doing a cost-effectiveness analysis and more formal uncertainty analysis as part of the final RIA.

As a result of some of the methodological considerations and uncertainties in developing this analysis, this draft RIA does not present a comparison of the estimated benefits and costs, or a net benefits calculation associated with each of the standard level alternatives under consideration. EPA has activities underway to make improvements to both cost and benefit calculations for the final RIA, recognizing that there will remain significant data gaps and uncertainties. EPA plans to present a net benefits calculation in the final RIA.

EPA presents this RIA pursuant to Executive Order 12866 and the guidelines of OMB Circular A-4.[3] These documents present guidelines for EPA to assess the benefits and costs of the selected regulatory option, as well as one less stringent and one more stringent option. OMB circular A-4 also requires both a benefit-cost, and a cost-effectiveness analysis for rules where health is the primary effect. Within this RIA we provide a benefit-cost analysis.

ES.2 Summary of Analytic Approach

Our assessment of the proposed lead NAAQS includes several key elements, including specification of baseline lead emissions and concentrations; development of illustrative control strategies to attain the alternative standards in 2020; development of an air quality assessment tool to assess the air quality impacts of these control strategies; and analyses of the incremental impacts of attaining the alternative standards. Figure ES-1 provides an illustration of the methodological framework of this RIA. Additional information on the methods employed by the Agency for this RIA is presented below.

Overview of Baseline Emissions Forecast and Baseline Lead Concentrations

The baseline lead emissions and lead concentrations for this RIA are based on lead emissions data from the 2002 National Emissions Inventory (NEI) and lead concentration values for 36 lead monitors included in the 2003-2005 Pb-TSP NAAQS-review database. Consistent with the $PM_{2.5}$ NAAQS RIA and ozone RIA, no growth factors were applied to the 2002 NEI emissions estimates to generate the emissions or air quality projections for 2020. Where possible, however, we adjusted these values to reflect the estimated control efficiency of MACT standards with post-2002 compliance deadlines, because the 2002 NEI and observed lead concentrations during the 2003-2005 period would not reflect the impact of MACT controls reasonably anticipated to be in place by 2020. The analysis includes similar adjustments for compliance measures required by the September 2006 revision to the $PM_{2.5}$ NAAQS (as included in the illustrative $PM_{2.5}$ control strategy described in the $PM_{2.5}$ NAAQS RIA) and measures listed in the 2007 Missouri Lead SIP revisions.[4]

[3] U.S. Office of Management and Budget. Circular A-4, September 17, 2003. Found on the Internet at <http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf>.

[4] U.S. Environmental Protection Agency. (2006). *Final Regulatory Impact Analysis: $PM_{2.5}$ NAAQS*. Office of Air and Radiation, Research Triangle Park, NC. The Missouri lead SIP was finalized by EPA on April 14, 2006 with a

It should be noted again that overall data limitations are very significant for this analysis. One critical area of uncertainty is the limited TSP-Pb monitoring network. Because monitors are present in only 86 counties nationwide, the universe of monitors exceeding the various target NAAQS levels is very small; only 36 counties above 0.05 $\mu g/m^3$, and only 24 counties exceeding the lowest proposed NAAQS level of 0.10 $\mu g/m^3$. Because we know that many of the highest-emitting Pb sources in the 2002 NEI do not have nearby Pb-TSP monitors, it is likely that there may be many more potential nonattainment areas than have been analyzed in this RIA.

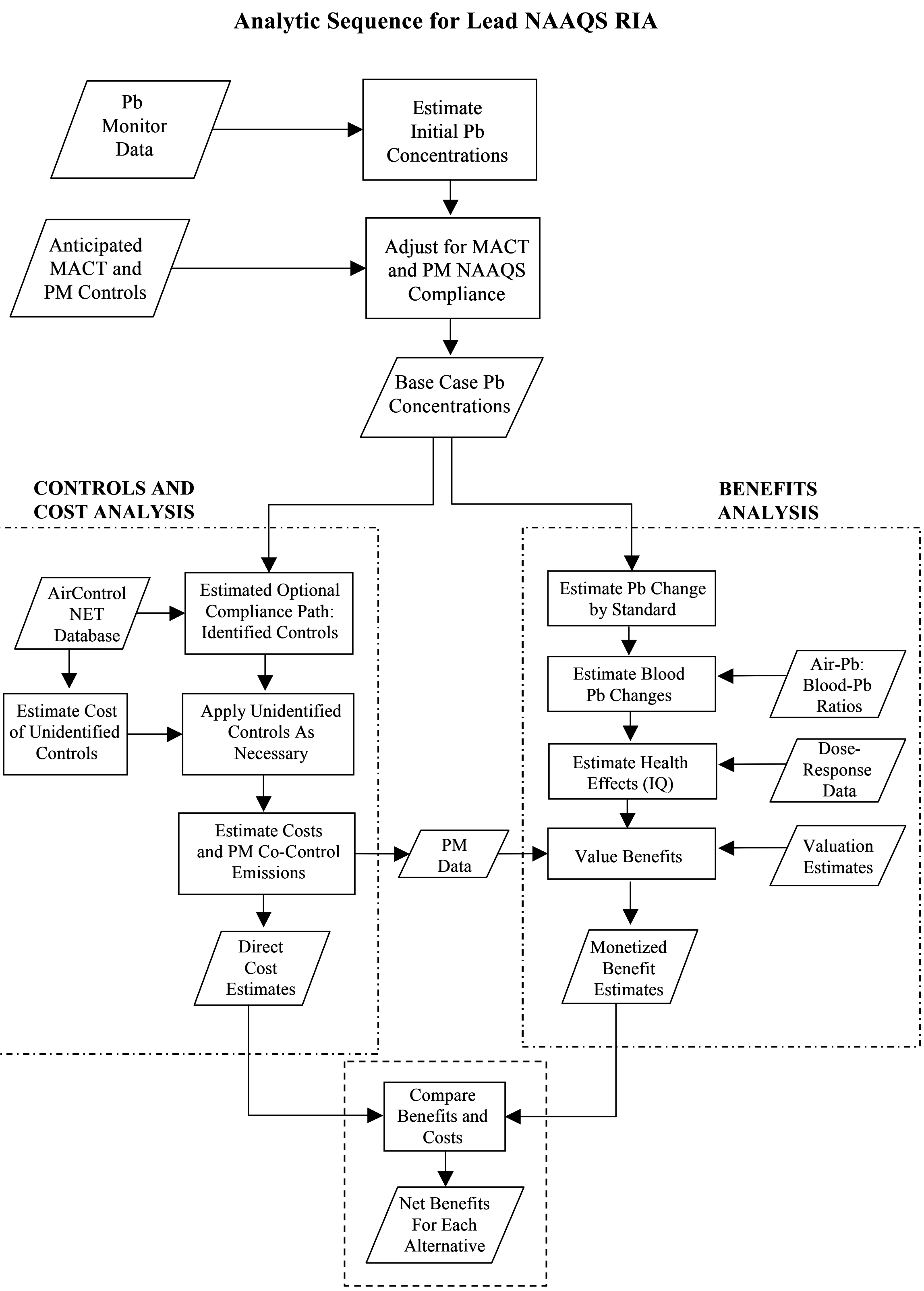
Development of Illustrative Control Strategies

Our analysis of the emissions control measures required to meet the proposed and alternative standards is limited to controls for point source emissions at active sources inventoried in the 2002 NEI. To identify point source lead emissions controls for our analysis, we collected information on PM control technologies, assuming that the control efficiency for PM would also apply to lead emissions. Most of this information was obtained from EPA's AirControlNET database, but a limited number of controls were identified from New Source Performance Standards and operating permits that apply to facilities with similar Source Classification Codes as the point sources included in our analysis.[5] Controls identified through this process include major emissions controls, such as fabric filters, impingement-plate scrubbers, and electrostatic precipitators; and minor controls, such as increased monitoring frequency, upgrades to continuous emissions monitors, and diesel particulate filters for stationary sources.

requirement that this SIP will provide attainment with the current lead standard by April 7, 2008. The SIP is available at: http://www.dnr.mo.gov/env/apcp/docs/2007revision.pdf.

[5] Source Classification Codes are the identifiers that EPA uses to classify different types of emissions activity.

Figure ES-1.
THE PROCESS USED TO CREATE THIS RIA



To identify the least-cost approach for reaching attainment in each area, EPA developed a linear programming optimization model that systematically evaluates the changes in air quality and costs associated with controlling each source to find the optimal control strategy for each area. The optimization model first identifies the measures that each source would implement if it were controlled as part of a local lead attainment strategy. Based on these controls, the optimization model then identifies sources to control such that each area would reach attainment at the least aggregate cost possible for the area.

Some monitor areas are not projected to reach attainment with the proposed NAAQS or alternative standard through the application of identified controls alone. In order to bring these monitor areas into attainment, we simulated the application of unidentified emissions controls on "large" emissions sources, defined as those sources emitting 0.05 tons/year or more in the 2002 NEI. We limited our consideration of unidentified controls to these sources in order to target facilities that will likely be the focus of efforts of local air quality managers to comply with the new NAAQS. Of the 2,230 point sources (excluding airports) in our analysis, 7.8 percent (174 sources) satisfy the 0.05 annual tpy (100 pound) or greater criteria, but they account for more than 97 percent of total adjusted baseline emissions. Based on the estimated control efficiency of identified controls, our analysis assumes that unidentified controls have a control efficiency of 90 percent. For each standard, we selected all monitor areas that failed to reach attainment and applied unidentified controls to large sources until attainment was reached.

Air Quality Assessment Tool

To assess the air quality impact of the emissions controls implemented under the proposed NAAQS, EPA would ideally use a detailed air quality model that simulates the dispersion and transport of lead to estimate local ambient lead concentrations. Although models with such capabilities are available for pollutants for which EPA frequently conducts air quality analyses (e.g., particulate matter and ozone), regional scale models are currently neither available nor appropriate for Pb.[6] Dispersion, or plume-based, models are recommended for compliance with the Pb NAAQS; however, dispersion models are data –intensive and more appropriate for local scale analyses of emissions from individual sources. It was not feasible to conduct such a large-scale data-intensive analysis for this RIA.

Our air quality assessment tool, developed for the purposes of this analysis, employs a source-apportionment approach to estimate the extent to which each of the following emissions sources contribute to observed lead concentrations in each monitor area:

- Background lead
- Miscellaneous, re-entrained dust
- Emissions from area non-point sources

[6] See Chapter 2 of U.S. Environmental Protection Agency. (2007). Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information – OAQPS Staff Paper. Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA-452/R-07-013.

- Indirect fugitive emissions from active industrial sites
- Point source emissions[7]

After allocating a portion of the observed lead concentration for each monitor area to the first four categories listed above, the assessment tool apportions the remaining concentration among all inventoried point sources within ten kilometers of each monitor location by distance-weighting individual source contributions to ambient Pb concentrations.[8] Through this process, the tool establishes a point source influence factor that can be used to translate changes in the lead emissions of individual point sources to changes in the lead concentration for each monitor area.

Analysis of Benefits

Our analysis of the benefits associated with the proposed Lead NAAQS includes benefits related to reducing ambient lead concentrations and the ancillary benefits of reducing direct emissions of particulate matter. To assess benefits specific to reduced lead concentrations, we created a spreadsheet model that provides a screening-level assessment of health benefits occurring as a result of implementing alternative NAAQS levels. The model uses various simplifying assumptions and is intended only to provide an approximate, preliminary estimate of the potential health benefits. For the purposes of this analysis, the model estimates the adverse health impact of blood lead levels on cognitive function (which is most often measured as changes in IQ) in young children below seven years of age. Cognitive effects are thought to strongly relate to a child's future productivity and earning potential.[9]

The model was constructed in Microsoft Excel™ and provides an integrated tool to complete five benefits estimation steps: 1) estimate lead in air concentrations for the "base case" and "control scenarios"; 2) estimate population exposures to air lead concentrations for each scenario; 3) estimate blood lead levels in the population for each scenario; 4) estimate avoided cases of health effects due to changes in blood lead levels; and 5) apply an economic unit value to each avoided case to calculate total monetized benefits. EPA plans to refine the model as it progresses towards a final NAAQS level for lead.

Because most of the point source measures implemented to achieve the NAAQS standards are focused on controlling emissions of lead in particulate form, virtually all of these measures also have a significant impact on emissions of directly emitted particulate matter. To

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[7] For the purposes of this analysis, airports servicing piston-engine aircraft that use leaded aviation gasoline are treated as point sources.

[8] Note that although the air quality assessment tool distinguishes between the portion of the observed lead concentration attributable to point source emissions and that attributable to indirect fugitive emissions from active point sources, this analysis assumes that the two contributions are directly related, and any reduction in the air quality impact of point source emissions would produce a corresponding reduction in the air quality impact of indirect fugitive emissions from point sources in that monitor area. The process used to relate the contributions of these two categories is described in further detail in Chapter 3 of this RIA.

[9] U.S. Environmental Protection Agency. (2006b). *Economic Analysis for the Renovation, Repair, and Painting Program Proposed Rule*. Office of Pollution Prevention and Toxics. Washington, DC.

estimate the value of these $PM_{2.5}$ emissions reductions, EPA utilized $PM_{2.5}$ benefit-per-ton estimates. These $PM_{2.5}$ benefit-per-ton estimates provide the total monetized human health benefits (the sum of premature mortality and premature morbidity) of reducing one ton of $PM_{2.5}$ from a specified source. EPA has used a similar technique in previous RIAs, including the recent ozone NAAQS RIA.[10] The complete methodology for creating the benefit per-ton estimates used in this analysis is available in the Technical Support Document (TSD) accompanying the recent final ozone NAAQS RIA.[11]

Analysis of Costs

Consistent with our development of the illustrative control strategies described above, our analysis of the costs associated with the proposed lead NAAQS focuses on point source PM controls. For the purposes of this analysis, these controls largely include measures from the AirControlNET control technology database, but also include additional measures associated with operating permits and/or New Source Performance Review standards applicable to sources similar to those included in our analysis. For controls identified in AirControlNET, we estimated costs based on the cost equations included in AirControlNET. Our cost estimates for controls associated with operating permits and/or New Source Performance Review standards are based on cost data compiled by EPA for previous analyses.

As indicated in the above discussion on illustrative control strategies, implementation of the PM control measures identified from AirControlNET and other sources does not result in attainment with the proposed or alternative lead standards in several areas. In these areas, additional unidentified measures will likely be necessary to reach attainment. To estimate the costs associated with unidentified measures, we assume an annual fixed cost of \$32 million/ton, or \$16,000/pound. This value represents the 98th percentile of the cost/ton for identified controls at large point sources of lead (i.e., sources emitting at least 0.05 tons of lead per year).[12]

ES.3 <u>Results of Analysis</u>

Air Quality

Table ES-1 summarizes the number of monitor sites that reach attainment with the proposed NAAQS and alternative standards in 2020 following the implementation of identified and unidentified controls. According to the data presented in Table ES-2, 20 of the 36 monitor areas are expected to reach attainment with any target NAAQS in the proposed range of 0.1 to

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[10] U.S. Environmental Protection Agency. (2008). *Final Ozone NAAQS Regulatory Impact Analysis*. Office of Air and Radiation. Research Triangle Park, NC, March.

[11] The Technical Support Document, entitled: *Calculating Benefit Per-Ton Estimates*, can be found in EPA Docket EPA-HQ-OAR-2007-0225-0284.

[12] The fixed cost estimate for unidentified controls was developed based on the cost of controls with a 3 percent discount rate. Because it is a fixed cost, however, when applied to estimate the costs of unidentified controls it is assumed not to be affected by the discount rate assumption. That is, costs for *unidentified* controls are assumed to be the same for the 3 and 7 percent discount rate.

0.3 μg/m^3 following implementation of identified controls. For some areas, however, identified controls are not sufficient to reach attainment with one or more of the target alternatives in the proposed range. For the alternative of 0.05 μg/m^3, only 10 of the 36 monitors are able to reach attainment from application of identified controls. By comparison, all but one monitor area reach attainment through the implementation of identified controls under the 0.5 μg/m^3 standard.

Table ES-1.
NUMBER OF MONITOR SITES REACHING ATTAINMENT WITH EACH ALTERNATIVE STANDARD USING IDENTIFIED AND UNIDENTIFIED CONTROLS

Standard	Number of Sites Analyzed	Number of Sites in Attainment with No Additional Controls	Number of Sites in Attainment with Identified Point Source Controls	Number of Sites in Attainment with Unidentified and Identified Point Source Controls	Number of Sites not in Attainment in this Analysis
0.5 μg/m3 Second Maximum Monthly Mean	36	27	35	36	0
0.3 μg/m3 Second Maximum Monthly Mean		24	30	35	1
0.2 μg/m3 Second Maximum Monthly Mean		20	26	35	1
0.1 μg/m3 Second Maximum Monthly Mean		13	20	30	6
0.05 μg/m3 Second Maximum Monthly Mean		1	10	19	17

The failure of certain areas to reach attainment with identified controls may partially reflect the lack of control information for point sources in these areas. Sources for which the AirControlNET analysis identified no controls make up a significant portion of the ambient lead concentration in many of the areas not projected to reach attainment with the proposed standard. For such sources in nonattainment areas, we assume that unidentified controls will be applied.

In addition to the lack of point source control information, some areas fail to reach attainment with the 0.05 μg/m^3 target NAAQS following the implementation of identified controls because the fraction of the ambient lead concentration associated with area nonpoint sources and miscellaneous re-entrained dust exceeds the standard itself. As indicated above, our analysis relies only on point source controls, which have no effect on the ambient lead fraction associated with nonpoint sources or miscellaneous re-entrained dust. Therefore, even if point source emissions were reduced to zero in these areas, they would not reach attainment.

When unidentified point source controls are implemented in addition to identified controls, we project more widespread attainment with the alternative standards. As indicated above, we assume that these controls have a control efficiency of 90 percent and that they may be installed by any large point source (i.e., a point source emitting more than 0.05 tons of lead per year, as indicated in the 2002 NEI). Following the application of unidentified controls, all monitor areas but one are projected to reach attainment with the 0.3 $\mu g/m^3$ proposed standard and the 0.2 $\mu g/m^3$ proposed standard. For the 0.1 $\mu g/m^3$ proposed standard, six monitor areas are not projected to reach attainment with the application of unidentified controls, either because control efficiencies greater than 90 percent would be required at large sources or because small sources would need to be controlled to sufficiently reduce ambient lead concentrations. For the 0.05 $\mu g/m^3$ alternative standard, seventeen monitor areas are not projected to reach attainment with any application of unidentified controls, for the reasons given above and because the fraction of the ambient concentration associated with area nonpoint sources and miscellaneous re-entrained dust at some areas exceeds the standard itself. In contrast, all 36 monitor areas are projected to reach attainment with the 0.5 $\mu g/m^3$ standard following the implementation of unidentified controls.

Benefit and Cost Estimates

Tables ES-2 and ES-3 summarizes the benefits and costs associated with the proposed and alternative NAAQS standards in 2020, based on both 3 percent and 7 percent discount rates. Additional analysis of benefits under alternative assumptions is available as a memo in the docket titled: *Supplemental IQ Gain Calculations Using Two Additional Concentration-Response Functions*.

The results in Table ES-2 show that unidentified controls represent the majority of costs incurred by affected sources. This reflects the limited information available to EPA on the control measures that lead sources may implement. It is important to remember that, compared to recent NAAQS RIAs, our current knowledge of the costs and nature of lead emissions controls is relatively poor. Lead in ambient air has not been a focus for all but a few areas of the country for the last decade or more; the alternative standards represent a substantial tightening of the existing NAAQS. As a result, although AirControlNET contains information on a large number of different point source controls, we would expect that State and local air quality managers would have access to additional information on the controls available to the most significant sources.

Table ES-3 presents the benefits of the proposed and alternative standards as a range to account for uncertainties associated with the benefits of the standards. The range in the benefits estimates related to IQ gains reflects two estimates of the earnings impacts associated with such gains. The low end of the range reflects an analysis by Schwartz, which estimated that a 1-point increase in IQ would increase earnings by 1.76 percent, while the high end of the range reflects the results of Salkever, which found that earnings increase by 2.38 percent for each 1-point increase in IQ.[13] The range of estimates presented for PM-related benefits is based on the upper

[13] Schwartz, J. (1994). Societal Benefits of Reducing Lead Exposure. *Environmental Research* 66: 105-124 and Salkever, D.S. (1995). Updated Estimates of Earnings Benefits from Reduced Exposure of Children to Environmental Lead. *Environmental Research* 70:1-6.

and lower ends of the range of $PM_{2.5}$ premature mortality functions obtained by EPA through its expert elicitation study on the PM-mortality relationship, as first reported by Industrial Economics and interpreted for benefits analysis in EPA's final RIA for the PM NAAQS, published in September 2006.[14]

[14] Industrial Economics, Inc. (2006). *Expanded Expert Judgment Assessment of the Concentration-Response Relationship between* $PM_{2.5}$ *Exposure and Mortality*. Prepared for: Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC; U.S. Environmental Protection Agency. (2006). *Final Regulatory Impact Analysis:* $PM_{2.5}$ *NAAQS*. Office of Air and Radiation, Research Triangle Park, NC.

Table ES-2.
SUMMARY OF COSTS FOR REGULATORY ALTERNATIVES (Millions of 2006$)

	Summary of Annual Costs in 2020 (Millions of 2006$)									
	Alternative Standard: 0.5 µg/m^3 2nd Maximum Monthly Mean		**Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean**		**Proposed NAAQS: 0.2 µg/m^3 2nd Maximum Monthly Mean**		**Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean**		**Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean**	
	3% Discount rate	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**
Identified Controls	$11	$12	$47	$49	$55	$57	$63	$66	$84	$88
Unidentified Controls*	$0.6		$400		$790		$1,600		$2,000	
Total Engineering Costs	**$12**	**$12**	**$450 + C**	**$450 + C**	**$840 + C**	**$840 + C**	**$1,600 + C**	**$1,600 + C**	**$2,100 + C**	**$2,100 + C**
Monitoring Costs	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**

- All estimates rounded to two significant figures. As such, columns may not sum. Costs reflect application of reasonable identified and unidentified controls, which achieve full attainment in all but a, b, c ,and d areas for the 0.3, 0.2. 0.1, and 0.05 standards, respectively. Unquantified costs are indicated with a "C" to represent the additional sum of unquantified costs of full attainment.
- The actual monitoring burden will vary depending on the level and the averaging time for the final standard. In the draft ICR, we have estimated the potential burden for the lowest option proposed (i.e. 0.1ug/m^3; 2nd max monthly). A more specific estimate will be provided in the final rule package. Although we have not estimated the costs of the monitoring network at different levels of the standard, based on the information we had at the time of issuance of the proposed rule, there are approximately 704 facilities that would require monitoring at a level of 0.1ug/m^3, as compared to 194 facilities that would require monitoring at a level of 0.3ug/m^3 (see: http://www.epa.gov/oar/lead/pdfs/20080502_maps4.pdf).

Table ES-3.
SUMMARY OF BENEFITS FOR REGULATORY ALTERNATIVES (Millions of 2006$)

Summary of Annual Benefits in 2020 (Millions of 2006$)										
	Alternative Standard: 0.5 µg/m^3 2nd Maximum Monthly Mean		**Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean**		**Proposed NAAQS: 0.2 µg/m^3 2nd Maximum Monthly Mean**		**Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean**		**Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean**	
	3% Discount rate	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**
Annualized Benefit - IQ Gains (Range)**	$970 to $1,400	$120 to $240	$1,700 to $2,500	$220 to $430	$2,500 to $3,500	$310 to $610	$3,900 to $5,500	$480 to $950	$6,100 to $8,700	$760 to $1,500
Annualized Benefit - PM Co-control (Range)***	$150 to $1,300	$140 to $1,100	$410 to $3,500	$380 to $3,100	$560 to $4,700	$520 to $4,300	$690 to $5,800	$640 to $5,200	$1,100 to $8,900	$1,000 to $8,000
Total Benefits	**$1,100 to $2,700**	**$260 to $1,400**	**$2,100 to $6,000**	**$600 to $3,500**	**$3,100 to $8,200**	**$830 to $4,900**	**$4,600 to $11,000**	**$1,100 to $6,200**	**$7,200 to $18,000**	**$1,800 to $9,500**

* All estimates rounded to two significant figures. As such, columns may not sum. Benefits are for full attainment scenario.

** Range for benefits associated with IQ gains reflects two separate estimates of the effect of IQ on earnings. The low end of the range reflects an analysis by Schwartz (1994), which estimated that a 1-point increase in IQ would increase earnings by 1.76 percent. The high end of the range reflects the results of Salkever (1995), which found that earnings increase by 2.38 percent for each 1-point increase in IQ.

*** Range for PM co-control benefits is based on the lower and upper ends of the range of the $PM_{2.5}$ premature mortality functions characterized in the expert elicitation. Range for total benefits was developed by adding monetized lead IQ benefits to the ends of the co-control benefits range. Tables exclude all adult health effects benefits, as well as unquantified and nonmonetized benefits.

To provide additional context for the results presented in Table ES-3, Table ES-4 presents the total number of IQ points expected to be gained in the US in the year 2020 by achieving each of the alternate NAAQS level options, relative to the "base case" (i.e., the lead NAAQS remains at its current level). The results presented in the table demonstrate that lowering the current (1.5 µg/m^3 maximum quarterly mean) lead NAAQS to one of the proposed or alternative NAAQS would be expected to have a significant impact on the IQ of young children. More specifically, the results indicate that the number of IQ points gained in 2020 ranges from 110,000 if a 0.5 µg/m^3 second maximum monthly mean NAAQS is achieved up to 700,000 for a 0.05 µg/m^3 second maximum monthly mean NAAQS.

Table ES-4.
NUMBER OF IQ POINTS GAINED IN 2020

Standard	IQ Points Gained
0.5 µg/m^3 Second Maximum Monthly Mean	110,000
0.3 µg/m^3 Second Maximum Monthly Mean	200,000
0.2 µg/m^3 Second Maximum Monthly Mean	280,000
0.1 µg/m^3 Second Maximum Monthly Mean	440,000
0.05 µg/m^{3}Second Maximum Monthly Mean	700,000

Our analysis suggests that the benefits presented in Table ES-4 will be concentrated in a small number of counties. Table ES-5 below is an example of the distribution of total benefits due to IQ points gained for the 0.2 µg/m^3 second maximum monthly mean NAAQS alternative. For this standard, approximately 60 percent of the total benefits are due to changes in lead air concentrations in three counties: Hillsborough, Florida; Delaware, Indiana; and Berks, PA. In these areas, sources of lead exposure and the monitors that measure ambient lead appear to be in relatively close proximity to exposed populations.

Table ES-5.
PERCENTAGE OF BENEFITS BY MONITOR
(0.2 µg/m^3 Second Maximum Monthly Mean NAAQS)

County	State	Population of Children in Affected Area	Affected Population (%)	Percentage of Benefits (%)
Hillsborough	FL	46,923	18	31
Delaware	IN	9,236	3	19
Berks	PA	23,977	9	10
Collin	TX	16,593	6	7
Adams	CO	25,746	10	6
Denver	CO	40,395	15	5
Pike	AL	2,342	1	4
Denton	TX	6,301	2	4
Cuyahoga	OH	35,680	13	3
Jefferson	CO	8,689	3	2
Jefferson	MO	7,358	3	1
Note: There were several other counties that constituted less than 1 percent of benefits that are not included in this table.				

The costs of the proposed and alternative lead NAAQS are also expected to be concentrated in a limited number of areas, as summarized in chapter 6. Many of the monitor sites listed in the exhibit represent areas with the largest sources of lead emissions, such as primary or secondary lead smelters, mining operations, or battery manufacturers.

ES.4 Caveats and Limitations

Air Quality Data, Modeling and Emissions

- ***Limited TSP-Pb monitoring network.*** Because monitors are present in only 86 counties nationwide, the universe of monitors exceeding the various target NAAQS levels is very small; only 36 counties above 0.05 $\mu g/m^3$, and only 24 counties exceeding the lowest proposed NAAQS level of 0.10 $\mu g/m^3$. Because we know that many of the highest-emitting Pb sources in the 2002 NEI do not have nearby Pb-TSP monitors (see section 2.1.7), it is likely that there may be many more potential nonattainment areas than have been analyzed in this RIA.

- ***Simplified Air Quality Assessment Approach***. Dispersion, or plume-based models are recommended for compliance with the Pb NAAQS; however, dispersion models are data–intensive and more appropriate for local scale analyses of emissions from individual sources. It was not feasible to conduct such a large-scale data intensive analysis for this RIA. As a result, the simplified analysis developed for this RIA while distance-weighting individual source contributions to ambient Pb concentrations, could not account for such locally critical variables as meteorology and source stack height.

- ***Analysis Only Considers Controls on Point Source Emission Reductions.*** Because the available data are not sufficiently detailed to assess the impact of indirect fugitive or area nonpoint source controls, the analysis of air quality impacts does not account for the potential implementation of such controls in areas where they might be effective. Although the analysis estimates the impact of point source controls on indirect fugitives, it does not consider the impact of controlling these emissions directly. This and the lack of control information for area nonpoint sources may have contributed to our projection of nonattainment in some areas. Additionally, for this analysis we have not modeled the effect of any potential changes in emissions at airports with lead emissions associated with use of leaded aviation gasoline by piston-engine powered aircraft. (EPA received a petition from Friends of the Earth requesting that the Agency find that aircraft lead emissions may reasonably be anticipated to endanger the public health or welfare, and to take action to control lead emissions from piston-engine aircraft. EPA, in coordination with FAA, is analyzing the petition.)

- ***Limited Point Source Controls Considered***. As discussed above, we were not able to obtain emissions control information for a large number of point sources in our analysis. Although these sources collectively accounted for less than one fourth of all lead emissions considered, many of those sources were located in areas that were not able to reach attainment with one or more of the standards using identified controls alone.

- ***Actual State Implementation Plans May Differ from our Simulation***. In order to reach attainment with the proposed NAAQS, each state will develop its own implementation plan implementing a combination of emissions controls that may differ from those simulated in this analysis. This analysis therefore represents an approximation of the emissions reductions that would be required to reach attainment and should not be treated as a precise estimate.

- ***Emissions Reduction from Unidentified Controls***. In this RIA, we report emissions reductions from both identified and unidentified emissions controls. We have taken care to report these separately, in recognition of the greater uncertainty associated with achieving emissions reductions from measures that may not be currently in use or known to EPA. Nonetheless, EPA believes it is reasonable to project that, with at least 10 years of lead time before a 2020 compliance deadline, a large number of existing measures will be adapted to be applicable to additional sources, and new measures may be developed that are specifically focused on cost-effectively reducing PM emissions with high lead content. Because the current standard is attained in all but a few areas of the country, and has been for many years since the phase down of lead in gasoline, it is likely that very little effort has been devoted to development of lead emissions control technologies except for industries where regulations have been imposed to reduce lead (e.g., large MWC standard, primary and secondary lead smelter MACTs, etc.).

Costs

- ***Uncertainty associated with unidentified measures.*** As indicated above, many areas are expected to rely heavily on unidentified controls to reach attainment with the standards. The cost of implementing these measures, though estimated here based on the costs for identified controls, is uncertain. Many of these sources are already well-controlled for particulate matter, and additional control for the remaining increment of Pb might be difficult to achieve. Many other sources are boilers fired by natural gas, whose emissions we are currently investigating and which are likely to be overstated. Some sources have very low particulate matter (PM) emissions overall, and therefore controls are generally not found at that emissions level.

Benefits

- ***Exposure.*** The benefits of IQ point gains in children were very sensitive to the method employed for estimating exposures to the population. When comparing the default method, which involved concentrations that were interpolated from multiple monitors, to the method assuming a uniform concentration within a 10 km radius around an individual monitor, the results increase by 31 percent. Increasing the radius to include the entire county in which the monitor resides results in roughly 3-fold increase in benefits. Decreasing the radius size also has a large impact on benefits, decreasing the value by as much as 98 percent when a radius of 1 km is used.

- ***Dose-response relationship***. The dose-response function selected for quantifying the number of IQ points gained as a result of achieving the alternative NAAQS levels affected the results. Utilizing alternate epidemiological studies decreased the primary estimate by as much as 74 percent.

- ***Earnings-based metric of IQ.*** The earnings-based value-per-IQ-point lost that we apply in this analysis most likely represents a lower bound on the true value of a lost IQ point, because it is essentially a cost-of-illness measure, not a measure of an individual's willingness-to-pay (WTP) to avoid the loss of an IQ point. Welfare economics emphasizes WTP measures as the more complete estimate of economic value.

- ***Co-control benefits related to PM.*** Co-control benefits estimated here reflect the application of a national dollar benefit per ton estimate of the benefits of reducing directly emitted fine particulates from point sources. Because they are based on national-level analysis, the benefit-per-ton estimates used here do not reflect local meteorology, exposure, baseline health incidence rates, or other local factors that might lead to an over-estimate or under-estimate of the actual benefits of controlling directly emitted fine particulates.

ES.5 Conclusions and Insights

Our analysis has estimated the health benefits of reductions in ambient concentrations of lead resulting from a set of illustrative control strategies to reduce emissions of lead at point sources. The results suggest there will be significant additional health benefits arising from reducing emissions from a variety of sources in and around projected nonattaining counties in 2020. While 2020 is the latest date by which states would generally need to demonstrate attainment with the revised standards, it is expected that benefits (and costs) may begin occurring earlier, as states begin implementing control measures to show progress towards attainment.

There are several important factors to consider when evaluating either the benefits or the costs of the attainment strategies for the four alternative standards assessed in this RIA:

- Our estimates of costs of attainment in 2020 assume a particular trajectory of what might be aggressive technological change. This trajectory leads to a particular level of emissions reductions and costs which we have estimated based on costs of identified controls. An alternative storyline might hypothesize a much less optimistic technological change path, such that emissions reductions technologies for industrial sources would be more expensive or would be unavailable, so that emissions reductions from many smaller sources might be required for 2020 attainment, at a potentially greater cost per ton. Under this alternative storyline, two outcomes are hypothetically possible: Under one scenario, total costs associated with full attainment might be substantially higher. Under the second scenario, states may choose to take advantage of flexibility in the Clean Air Act to adopt plans with later attainment dates to allow for additional technologies to be developed and for other programs be fully implemented. If states were to submit plans with attainment dates beyond our 2020 analysis year, benefits would clearly be lower than we have estimated under our analytical storyline.

- Benefits and costs are distributed differently across potential non-attainment counties. As presented in Table ES-5, most of the primary lead benefits of the standards are expected to be realized in a small number of areas. These are areas where the sources of lead exposure and the monitors that measure ambient lead appear to be in relatively close proximity to exposed populations. The identified control costs, on the other hand, are greatest in those areas with the largest sources of lead emissions - usually around primary or secondary lead smelters, mining operations, or battery manufacturers. PM co-control benefits tend to be distributed in better correlation to control costs. In general, PM co-control benefits tend to be highest in those areas where our attainment strategy suggests controls on combustion sources, rather than metals processing, are necessary.

- Because of the limitations and uncertainties in the emissions and air quality components of our assessment, the specific control strategies that might be the most effective in helping areas to reach attainment are still very uncertain. For example, we employ a fairly simple distance-weighted dispersion approach to approximate the effect of controls on specific point sources in reducing concentrations at current monitor locations.

As part of the development of the final RIA, EPA has activities underway to make improvements to both cost and benefit calculations, recognizing that there will remain significant data gaps and uncertainties. As outlined above and in the individual chapters, we plan to investigate changes which will: better match locations of monitors and sources, refine our estimates of population exposures, broaden the number of concentration-response functions in the primary analysis, improve our estimates of emission reductions due to known controls, and improve the comparability of the costs and benefits.

CHAPTER 1. INTRODUCTION AND BACKGROUND

Synopsis

This document estimates the incremental costs and monetized human health benefits of attaining a revised primary lead (Pb) National Ambient Air Quality Standard (NAAQS) nationwide. This document contains illustrative analyses that consider limited emission control scenarios that states, tribes and regional planning organizations might implement to achieve a revised lead NAAQS. In some cases, EPA weighed the available empirical data to make judgments regarding the proposed attainment status of certain urban areas in the future. According to the Clean Air Act, EPA must use health-based criteria in setting the NAAQS and cannot consider estimates of compliance cost. This Regulatory Impact Analysis (RIA) is intended to provide the public a sense of the benefits and costs of meeting new alternative lead NAAQS, and to meet the requirements of Executive Order 12866 and OMB Circular A-4 (described below in Section 1.2.2).

This RIA provides illustrative estimates of the incremental costs and monetized human health benefits of attaining a revised primary lead (Pb) National Ambient Air Quality Standard (NAAQS) within the current monitoring network[15]. Many of the highest-emitting Pb sources do not have nearby Pb-TSP monitors, and it is important to note that there may be many more potential nonattainment areas than have been analyzed in this RIA. Because of time and data constraints, in this RIA, estimates of costs and benefits employed different techniques for estimating future air quality. This results in benefits estimates that represent full attainment, and cost estimates that do not represent full attainment. These differences will be addressed in the final RIA, and further improvements to estimation techniques will be explored.

1.1 Background

Two sections of the Clean Air Act ("Act") govern the establishment and revision of NAAQS. Section 108 (42 U.S.C. 7408) directs the Administrator to identify pollutants which "may reasonably be anticipated to endanger public health or welfare," and to issue air quality criteria for them. These air quality criteria are intended to "accurately reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare which may be expected from the presence of [a] pollutant in the ambient air." Lead is one of six pollutants for which EPA has developed air quality criteria.

Section 109 (42 U.S.C. 7409) directs the Administrator to propose and promulgate "primary" and "secondary" NAAQS for pollutants identified under section 108. Section 109(b)(1) defines a primary standard as "the attainment and maintenance of which in the judgment of the Administrator, based on [the] criteria and allowing an adequate margin of safety, [are] requisite to protect the public health." A secondary standard, as defined in section 109(b)(2), must "specify a level of air quality the attainment and maintenance of which in the

[15] There are currently 189 monitors representing 86 counties, but only 36 counties have monitors which exceed 0.05 ug/m^3.

judgment of the Administrator, based on [the] criteria, [are] requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of [the] pollutant in the ambient air.” Welfare effects as defined in section 302(h) [42 U.S.C. 7602(h)] include but are not limited to “effects on soils, water, crops, vegetation, manmade materials, animals, wildlife, weather, visibility and climate, damage to and deterioration of property, and hazards to transportation, as well as effects on economic values and on personal comfort and well-being.”

Section 109(d) of the Act directs the Administrator to review existing criteria and standards at 5-year intervals. When warranted by such review, the Administrator is to retain or revise the NAAQS. After promulgation or revision of the NAAQS, the standards are implemented by the States.

1.2 Role of the Regulatory Impact Analysis in the NAAQS Setting Process

1.2.1 Legislative Roles

In setting primary ambient air quality standards, EPA’s responsibility under the law is to establish standards that protect public health, regardless of the costs of implementing a new standard. The Clean Air Act requires EPA, for each criteria pollutant, to set a standard that protects public health with “an adequate margin of safety.” As interpreted by the Agency and the courts, the Act requires EPA to create standards based on health considerations only.

The prohibition against the consideration of cost in the setting of the primary air quality standard, however, does not mean that costs or other economic considerations are unimportant or should be ignored. The Agency believes that consideration of costs and benefits are essential to making efficient, cost effective decisions for implementation of these standards. The impact of cost and efficiency are considered by states during this process, as they decide what timelines, strategies, and policies make the most sense. This RIA is intended to inform the public about the potential costs and benefits that may result when a new lead standard is implemented, but is not relevant to establishing the standards themselves.

1.2.2 Role of Statutory and Executive Orders

There are several statutory and executive orders that dictate the manner in which EPA considers rulemaking and public documents. This document is separate from the NAAQS decision making process, but there are several statutes and executive orders that still apply to any public documentation. The analysis required by these statutes and executive orders is presented in Chapter 8.

EPA presents this RIA pursuant to Executive Order 12866 and the guidelines of OMB Circular A-4.[16] These documents present guidelines for EPA to assess the benefits and costs of

[16] U.S. Office of Management and Budget. Circular A-4, September 17, 2003. Found on the Internet at <http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf>.

the selected regulatory option, as well as one less stringent and one more stringent option. OMB circular A-4 also requires both a benefit-cost, and a cost-effectiveness analysis for rules where health is the primary effect. Within this RIA we provide a benefit-cost analysis EPA will undertake doing a cost-effectiveness analysis and more formal uncertainty analysis as part of the final RIA to the extent practicable.

1.2.3 Market Failure or Other Social Purpose

OMB Circular A-4 indicates that one of the reasons a regulation such as the NAAQS may be issued is to address market failure. The major types of market failure include: externality, market power, and inadequate or asymmetric information. Correcting market failures is one reason for regulation, but it is not the only reason. Other possible justifications include improving the function of government, removing distributional unfairness, or promoting privacy and personal freedom.

An externality occurs when one party's actions impose uncompensated benefits or costs on another party. Environmental problems are a classic case of externality. For example, the smoke from a factory may adversely affect the health of local residents while soiling the property in nearby neighborhoods. If bargaining was costless and all property rights were well defined, people would eliminate externalities through bargaining without the need for government regulation. From this perspective, externalities arise from high transaction costs and/or poorly defined property rights that prevent people from reaching efficient outcomes through market transactions.

Firms exercise market power when they reduce output below what would be offered in a competitive industry in order to obtain higher prices. They may exercise market power collectively or unilaterally. Government action can be a source of market power, such as when regulatory actions exclude low-cost imports. Generally, regulations that increase market power for selected entities should be avoided. However, there are some circumstances in which government may choose to validate a monopoly. If a market can be served at lowest cost only when production is limited to a single producer of local gas and electricity distribution services, a natural monopoly is said to exist. In such cases, the government may choose to approve the monopoly and to regulate its prices and/or production decisions. Nevertheless, it should be noted that technological advances often affect economies of scale. This can, in turn, transform what was once considered a natural monopoly into a market where competition can flourish.

Market failures may also result from inadequate or asymmetric information. Because information, like other goods, is costly to produce and disseminate, an evaluation will need to do more than demonstrate the possible existence of incomplete or asymmetric information. Even though the market may supply less than the full amount of information, the amount it does supply may be reasonably adequate and therefore not require government regulation. Sellers have an incentive to provide information through advertising that can increase sales by highlighting distinctive characteristics of their products. Buyers may also obtain reasonably adequate information about product characteristics through other channels, such as a seller offering a warranty or a third party providing information.

There are justifications for regulations in addition to correcting market failures. A regulation may be appropriate when there are clearly identified measures that can make government operate more efficiently. In addition, Congress establishes some regulatory programs to redistribute resources to select groups. Such regulations should be examined to ensure that they are both effective and cost-effective. Congress also authorizes some regulations to prohibit discrimination that conflicts with generally accepted norms within our society. Rulemaking may also be appropriate to protect privacy, permit more personal freedom or promote other democratic aspirations.

From an economics perspective, setting an air quality standard is a straightforward case of addressing an externality, in this case where firms are emitting pollutants, which cause health and environmental problems without compensation for those suffering the problems. Setting a standard with a reasonable margin of safety attempts to place the cost of control on those who emit the pollutants and lessens the impact on those who suffer the health and environmental problems from higher levels of pollution.

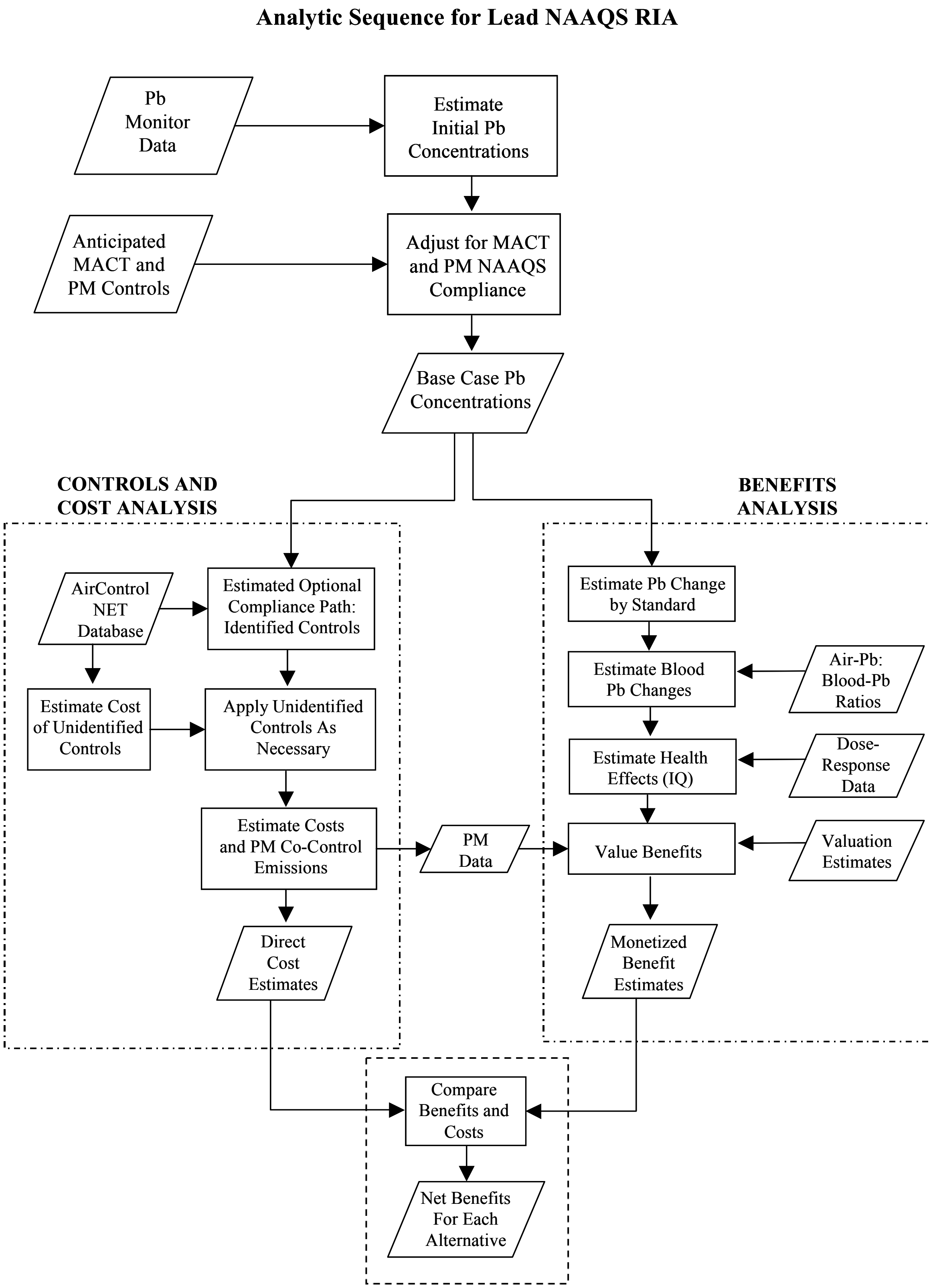
1.2.4 Illustrative Nature of the Analysis

This Pb NAAQS RIA is an illustrative analysis that provides useful insights into a limited number of emissions control scenarios that states might implement to achieve a revised lead NAAQS. Because states are ultimately responsible for implementing strategies to meet any revised standard, the control scenarios in this RIA are necessarily hypothetical in nature. They are not forecasts of expected future outcomes. Important uncertainties and limitations are documented in the relevant portions of the analysis.

The illustrative goals of this RIA are somewhat different from other EPA analyses of national rules, or the implementation plans states develop, and the distinctions are worth brief mention. This RIA does not assess the regulatory impact of an EPA-prescribed national or regional rule such as the Clean Air Interstate Rule, nor does it attempt to model the specific actions that any state would take to implement a revised lead standard. This analysis attempts to estimate the costs and human and welfare benefits of cost-effective implementation strategies which might be undertaken to achieve national attainment of new standards. These hypothetical strategies represent a scenario where states use one set of cost-effective controls to attain a revised lead NAAQS. Because states—not EPA—will implement any revised NAAQS, they will ultimately determine appropriate emissions control scenarios. State implementation plans would likely vary from EPA's estimates due to differences in the data and assumptions that states use to develop these plans.

The illustrative attainment scenarios presented in this RIA were constructed with the understanding that there are inherent uncertainties in projecting emissions and controls. Furthermore, certain emissions inventory, control, modeling and monitoring limitations and uncertainties inhibit EPA's ability to model full attainment in all areas. Despite these limitations, EPA has used the best available data and methods to produce this RIA.

Figure 1-1.
THE PROCESS USED TO CREATE THIS RIA



1.3 Overview and Design of the RIA

This Regulatory Impact Analysis evaluates the costs and benefits of hypothetical national strategies to attain several potential revised primary lead standards. The document is intended to be straightforward and written for the lay person with a minimal background in chemistry, economics, and/or epidemiology. Figure 1-1 provides an illustration of the framework of this RIA.

1.3.1 Baseline and Years of Analysis

The analysis year for this regulatory impact analysis is 2020, which allows EPA to be consistent with the previously completed PM NAAQS RIA analysis which also used 2020 as its analysis year. Many areas will reach attainment of any alternative Pb standard by 2020. For purposes of this analysis, we assess attainment by 2020 for all areas. Some areas for which we assume 2020 attainment may in fact need more time to meet one or more of the analyzed standards, while others will need less time. This analysis does not prejudge the attainment dates that will ultimately be assigned to individual areas under the Clean Air Act, which contains a variety of potential dates and flexibility to move to later dates (up to 20 years), provided that the date is as expeditious as practicable.

The methodology first estimates what baseline lead levels might look like in 2020 with existing Clean Air Act programs, including application of controls to meet the current Pb NAAQS, various maximum achievable control technology (MACT) standards, and the newly revised PM NAAQS standard, and then predicts the change in Pb levels following the application of additional controls to reach tighter alternative standards. This allows for an analysis of the incremental change between the current standard and alternative standards. This timeline is also consistent with expected attainment in 2020 of the revised Particulate Matter (PM) NAAQS covered in the PM NAAQS RIA issued in September 2006. Since Pb is also a component of PM, it is important that we account for the impact on Pb concentrations of PM controls used in the hypothetical control scenario in the PM NAAQS RIA, so as to avoid double counting the benefits and costs of these controls.

1.3.2 Control Scenarios Considered in this RIA

Hypothetical control strategies were developed for four alternative Pb standards encompassing the proposed range of 0.10 $\mu g/m^3$ to 0.30 $\mu g/m^3$, as well as alternative standards of 0.05 $\mu g/m^3$ and 0.5 $\mu g/m^3$, in order to illustrate how tighter standards might be met. (For the RIA to be issued with the final rulemaking, the agency will analyze at least one more stringent and one less stringent alternative than the selected standard consistent with the OMB A-4 Guidelines). First, EPA developed an air quality assessment tool to estimate air quality changes that would result from the application of emissions control options that are known to be available to different types of sources in areas with monitoring levels currently exceeding the alternative standards. However, given the limitations of current technology and the amount of improvement in air quality needed to reach some alternative standards in some areas, it was also expected that applying these known controls would not reduce lead concentrations sufficiently to allow all areas to reach the more stringent standards. We then estimated the control efficiency of unidentified future controls based on the distribution of known control efficiencies at large industrial sources. We then hypothetically applied those controls in an iterative fashion to areas exceeding each alternative standard, until the alternative standard could be reached.

1.3.3 Evaluating Costs and Benefits

Applying a two step methodology for estimating emission reductions needed to reach full attainment enabled EPA to evaluate nationwide costs and benefits of attaining a tighter Pb standard using hypothetical strategies, albeit with substantial additional uncertainty regarding the second step estimates. First, the costs associated with applying known controls were quantified. Second, EPA estimated costs of the additional tons of extrapolated emission reductions estimated which were needed to reach full attainment.

It is important to note that this analysis did not estimate any separate costs or benefits of attaining a secondary NAAQS standard due to resource and time constraints. Since the secondary is being set to be equivalent to the primary standard, no additional costs and benefits are expected.

To streamline this RIA, this document refers to several previously published documents, including three technical documents EPA produced to prepare for the Pb NAAQS proposal. The first was a Criteria Document created by EPA's Office of Research and Development (published in 2006), which presented the latest available pertinent information on atmospheric science, air quality, exposure, dosimetry, health effect, and environmental effects of lead. The second was a "Staff Paper" (published in 2007) that evaluated the policy implications of the key studies and scientific information contained in the Criteria Document. The third was a risk assessment for various standard levels. The Staff Paper also includes staff conclusions and recommendations to the Administrator regarding potential revisions to the standards.

1.4 <u>Pb Standard Alternatives Considered</u>

EPA has performed an illustrative analysis of the potential costs and human health and visibility benefits of nationally attaining proposed alternative Pb standards of 0.10 ug/m3, 0.20 ug/m3, and 0.30 ug/m3, as well as alternative standards of 0.05 $\mu g/m^3$ and 0.5 $\mu g/m^3$. Per Executive Order 12866 and the guidelines of OMB Circular A-4, this Regulatory Impact Analysis (RIA) also presents analyses of a more stringent option of 0.05 ug/m3. The benefit and cost estimates below are calculated incremental to a 2020 baseline that incorporates air quality improvements achieved through the projected implementation of existing regulations and full attainment of the existing Pb and particulate matter (PM) National Ambient Air Quality Standards (NAAQS). The baseline also includes the MACT program, which will help many areas move toward attainment of the current lead standard.

1.5 References

Henderson, R. 2006. October 24, 2006. Letter from CASAC Chairman Rogene Henderson to EPA Administrator Stephen Johnson, EPA-CASAC-07-001.

U.S. EPA. 1970. Clean Air Act. 40CFR50.

U.S. EPA. 2006. Air Quality Criteria for Lead and Related Photochemical Oxidants (Final). U.S. Environmental Protection Agency, Washington, DC, EPA-452/R-07-013.

U.S. EPA. 2007. Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information. OAQPS Staff Paper. North Carolina. EPA-452/R-07-013, Office of Air Quality Planning and Standards, RTP, NC.

CHAPTER 2. CHARACTERIZING PB AIR QUALITY AND EMISSIONS DATA

This chapter describes the available Pb air quality and emission data used to inform and develop the controls strategies outlined in this RIA. We first describe data sources for air quality measurement. We then provide an overview of data on Pb emission sources contained in available EPA emission inventories. For a more in-depth discussion of Pb air quality and emissions data, see the OAQPS Staff Paper for the Pb NAAQS.[17]

2.1 Air Quality Monitoring Data

Ambient air Pb concentrations are measured by four monitoring networks in the United States, all funded in whole or in part by EPA. These networks provide Pb measurements for three different size classes of airborne particulate matter (PM): total suspended PM (TSP), PM less than or equal to 2.5 µm in diameter ($PM_{2.5}$), and PM less than or equal to 10 µm in diameter (PM_{10}). The networks include the Pb TSP network, the $PM_{2.5}$ Chemical Speciation Network (CSN), the Interagency Monitoring of Protected Visual Environments (IMPROVE) network, and the National Air Toxics Trends Stations (NATTS) network. The subsections below describe each network and the Pb measurements made at these sites.

In addition to these four networks, various organizations have operated other sampling sites yielding data on ambient air concentrations of Pb, often for limited periods and/or for primary purposes other than quantification of Pb itself. Most of these data are accessible via EPA's Air Quality System (AQS): http://www.epa.gov/ttn/airs/airsaqs/. In an effort to gather as much air toxics data, including Pb, into one database, the EPA and State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) created the Air Toxics Data Archive. The Air Toxics Data Archive can be accessed at: http://vista.cira.colostate.edu/atda/.

2.1.1 Ambient Pb Measurement Methods

A number of methods are used to collect Pb and measure Pb concentrations in the atmosphere. Most methods use similar sample collection approaches. Ambient air is drawn through an inlet for a predetermined amount of time (typically 24 hours) and the PM is collected on a suitable filter media. After the sample has been collected, the filter may be used to determine the mass of PM collected prior to then being used for determination of Pb. The filter is chemically extracted and analyzed to determine the Pb concentration in the particulate material. The concentration of Pb found in the atmosphere, in $\mu g/m^3$, is calculated based on the concentration of Pb in the volume extracted, the size of the collection filter, and the volume of air drawn through the filter.

[17] U.S. Environmental Protection Agency (2007c), Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, Chapter 2, EPA-452/R-07-013, Office of Air Quality Planning and Standards, RTP, NC.

The primary factors affecting the measurements made are the sampling frequency, duration of sampling, type of inlet used, volume of air sampled, and the method of analyzing the filter for Pb content. The following paragraphs describe how these factors affect the Pb measurements.

2.1.2 Inlet Design

In ambient air monitors, a number of inlet designs have been developed that allow certain particle size ranges to be sampled. The inlets use either impaction or cyclone techniques to remove particles larger than a certain size (the size cutpoint) from the sample stream. Three particle size cutpoints are used in ambient Pb measurements including TSP, $PM_{2.5}$, PM_{10}. The TSP inlet is designed to allow as much suspended particulate into the sampling device as possible while protecting against precipitation and direct deposition on to the filter (nominally 25 to 45 micrometers) (USEPA, 2004c).

Sampling systems employing inlets other than the TSP inlet will not collect Pb contained in the PM larger than the size cutpoint. Therefore, they do not provide an estimate of the total Pb in the ambient air. This is particularly important near sources which may emit Pb in the larger PM size fractions (e.g., fugitive dust from materials handling and storage).

2.1.3 Volume of Air Sampled

The amount of Pb collected is directly proportional to the volume of air sampled. Two different sampler types have evolved for PM and Pb sampling – a high-volume and a low-volume sampler. High-volume samplers draw between 70 and 100 m^3/hr of air through an 8 inch by 10 inch filter (0.05 m^2 filter area). Low-volume samplers typically draw 1 m^3/hr through a 47 mm diameter filter (0.002 m^2 filter area). Currently all Federal Reference Method (FRM) and Federal Equivalence Method (FEM) for Pb-TSP are based on high-volume samplers.

2.1.4 Sampling Frequency

The frequency of Pb sampling used in the U.S. varies between one sample every day (1 in 1 sampling) to the more common frequency of one sample every 6 days (1 in 6 sampling). Semi-continuous methods for the measurement of ambient metals (including Pb) are currently being explored which would allow for more frequent sampling (as frequent as 1 sample per hour), but much more work is needed on these methods before they can be deployed in a network setting.

More frequent sampling reduces the uncertainty in estimates of quarterly or annual averages associated with temporal variations in ambient concentrations. However, the costs of sampling and analysis are directly tied to sample frequency. As such, it is necessary to evaluate the reduction in measurement error versus the increase in sampling and analysis costs when selecting the required sampling frequency. A discussion of the observed temporal variation of Pb measurements is given later in this section.

2.1.5 Sample Analysis

After the samples have been collected on filters and the filters have been weighed, the filters are analyzed for Pb content. A number of analytical methods can be used to analyze the filters for Pb content including x-ray fluorescence analysis (XRF), proton-induced x-ray emission (PIXE), neutron activation analysis (NAA), atomic absorption (AA), or inductively-coupled plasma mass spectrometry (ICP/MS) (CD, pp. 2-80 to 2-81). A detailed discussion of these methods was given in the 1986 CD (USEPA, 1986), and the reader is referred to that document for more information on these analytical methods. A search conducted on the AQS database[18] shows that the method detection limits for all of these analytical methods (coupled with the sampling methods) are very low, ranging from 0.01 $\mu g/m^3$ to as low as 0.00001 $\mu g/m^3$, and are more than adequate for determining compliance with the current NAAQS.

2.1.6 Pb-TSP

This network is comprised of state and locally managed Pb monitoring stations which measure Pb in TSP, i.e., particles up to 25 to 45 microns. These stations use samplers and laboratory analysis methods which have either FRM or FEM status. The FRM and FEM method descriptions can be found in the U.S. Code of Federal Regulations, Section 40 part 50, Appendix G. Sampling is conducted for 24-hour periods, with a typical sampling schedule of 1 in 6 days. Some monitoring agencies "composite" samples by analyzing several consecutive samples together to save costs and/or increase detection limits.

2.1.7 Monitor Locations

The locations of Pb-TSP sites in operation between 2003 and 2005 are shown in Figure 2-1. The state and local agencies which operate these sites report the data to EPA's AQS where they are accessible via several web-based tools. EPA's series of annual air quality trends reports have used data from this network to quantify trends in ambient air Pb concentrations. The most recent Trends report for Pb-TSP can be found at http://www.epa.gov/airtrends/lead.html.

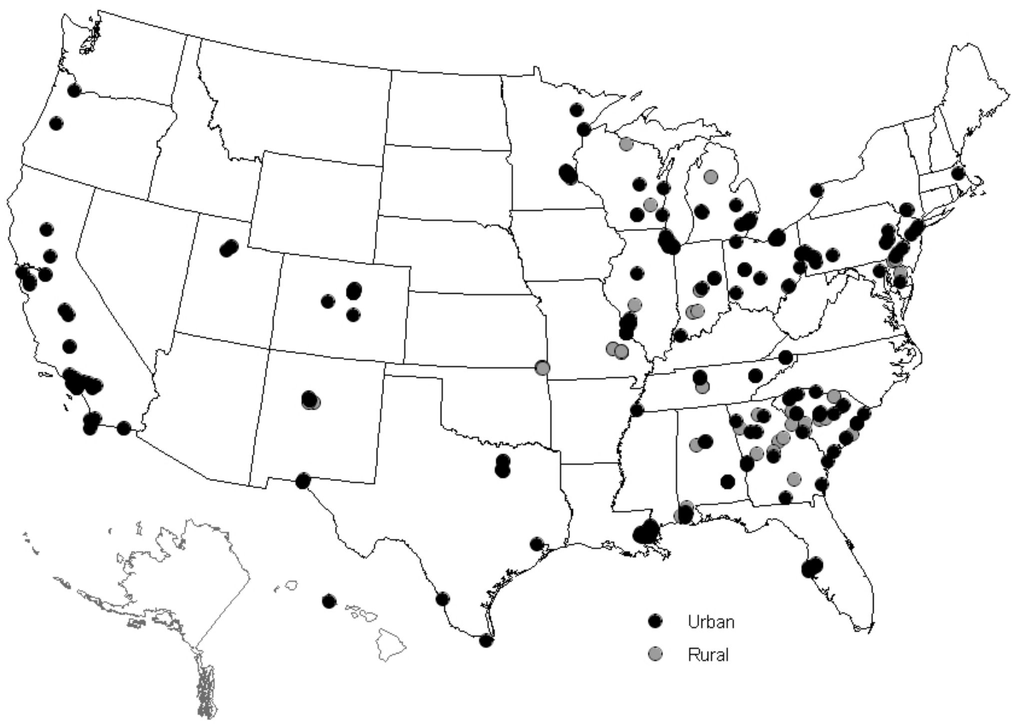
A review of the Pb-TSP network's coverage of the highest Pb emitting sources (as identified in the current version of the 2002 NEI) was conducted as part of preparing this document. This review indicates that many of the highest Pb emitting sources in the 2002 NEI do not have nearby Pb-TSP monitors. This review indicates that only 2 of 26 facilities (both Pb smelters[19]) identified as emitting greater than 5 tpy have a Pb-TSP monitor within 1 mile. The lack of monitors near large sources indicates we are likely currently underestimating the extent of occurrences of relatively higher Pb concentrations. Additionally, none of the 189 Pb-TSP are located within a mile of airports identified in the NEI as an airport where piston-engine aircraft operate (i.e., aircraft that still use leaded aviation fuel). However, there are historical data for 12 Pb-TSP monitoring sites operating within 1 mile of such airports (going back to 1993). Nine of

[18] EPA's AQS can be accessed at http://www.epa.gov/ttn/airs/airsaqs/

[19] Primary and secondary smelters were the source types given particular priority at the time of the last Pb NAAQS review (USEPA, 1990; USEPA, 1991).

these sites reported maximum quarterly mean values (for 1993-2002) that ranged from 0.03 to 0.06 µg/m^3 and across all 12 sites, the maximum quarterly mean values ranged from 0.004 to 0.15 µg/m^3.

Figure 2-1.
Pb-TSP MONITORING SITES: 2003-2005



The number of sites in the Pb-TSP network has decreased significantly since the 1980s. The number of sites in the network reached its highest point in 1981 (946 sites). About 250 sampling sites operated during 2005. This decline in the number of Pb-TSP sites is attributable to the dramatic decrease in Pb concentrations observed since the 1980s and the need to fund new monitoring objectives (e.g., $PM_{2.5}$ and ozone monitoring). Lead-TSP sites in lower concentration areas were shut down to free up resources needed for monitoring of other pollutants such as $PM_{2.5}$ and ozone.

2.2 Air Quality Modeling

As part of the Agency's national air toxics assessment (NATA) activities, a national scale assessment of hazardous air pollutants including Pb compounds has been performed twice over the past few years (USEPA 2006c, 2002c, 2001a). These two assessments included the use of the NEI for the years 1996 and 1999, respectively, with atmospheric dispersion modeling to predict associated annual average Pb air concentrations across the country. A national scale assessment is not yet available based on the 2002 NEI. A number of limitations are associated with the 1996 and 1999 ambient concentration estimates and the underlying emissions estimates.

Historical studies show that Gaussian dispersion models, such as ASPEN, typically agree with monitoring data within a factor of 2 most of the time. In the case of Pb in the NATA assessment, model estimates at monitor locations were generally lower than the monitor averages for Pb, suggesting that the modeling system (i.e., emissions estimates, spatial allocation estimates, dispersion modeling) may be systematically underestimating ambient concentrations. This may be particularly true for Pb as metals tend to deposit rapidly with distance from the source according to their particle size and weight. The model-to-monitor analysis is described in detail at http://www.epa.gov/ttn/atw/nata1999/99compare.html. The modeling system underestimation may also be due in part to a lack of accounting for emissions re-entrainment (these "re-entrained" particles may be observed by the monitors, but they are not accounted for in the emissions inventory, and thus would not contribute to the model estimate). For more details on the limitations of the 1999 NATA national scale assessment, see http://www.epa.gov/ttn/atw/nata1999/limitations.html.

For more information on Pb modeling, see section 2.4 of the OAQPS Staff Paper for the Pb NAAQS.[20] For reasons discussed in section 3.1.1, we did not use an air quality model for this analysis.

2.3 Sources of Pb Emissions to Ambient Air

The primary data source for this discussion is the National Emissions Inventory (NEI) for 2002 (USEPA, 2007a). As a result of Clean Air Act requirements, emissions standards promulgated for many source categories that have taken effect since 2002 are projected to result in much lower emissions at the current time or in the near future. For a more comprehensive discussion of Pb sources, see section 2.2 of the OAQPS Staff Paper for the Pb NAAQS.[21]

2.3.1 Types of Pb Sources

Lead is emitted from a wide variety of source types, some of which are small individually but the cumulative emissions of which are large, and some for which the opposite is true. The categories of Pb sources estimated via the 2002 NEI to emit –as a category- more than 5 tons per year (tpy) of Pb are listed in Table 2-2.

[20] U.S. Environmental Protection Agency (2007c), Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, section 2.4, EPA-452/R-07-013, Office of Air Quality Planning and Standards, RTP, NC.

[21] *Ibid*., section 2.2.

2.3.1.1 Stationary Sources

The main sources of emissions in the 2002 NEI are comprised primarily of combustion-related emissions and industrial process-related emissions. Point source emissions account for about 66% of the national Pb emissions in the 2002 NEI. The point source emissions are roughly split between combustion and industrial processes, while mobile, non-road sources (e.g. piston-engine aircraft using leaded fuel) account for 29%.

Table 2-1 presents emissions estimates for stationary sources grouped into descriptive categories. Presence and relative position of a source category on this list does not necessarily provide an indication of the significance of the emissions from individual sources within the source category. A source category, for example, may be composed of many small (i.e., low-emitting) sources, or of just a few very large (high-emitting) sources.

Table 2-1.
SOURCE CATEGORIES EMITTING GREATER THAN 5 TPY OF Pb

ALL CATEGORIES - Total tons	1371	**% of Total**
Mobile sources	623	45.44
Iron and Steel Foundries	83	6.05
Primary Lead Smelting	59	4.30
Industrial/Commercial/ Institutional Boilers & Process Heaters	53	3.87
Hazardous Waste Incineration	47	3.43
Secondary Lead Smelting	44	3.21
Municipal Waste Combustors	33	2.41
Military Installations	27	1.97
Pressed and Blown Glass and Glassware Manufacturing	26	1.90
Utility Boilers	23	1.68
Secondary Nonferrous Metals	22	1.60
Portland Cement Manufacturing	18	1.31
Integrated Iron & Steel Manufacturing	17	1.24
Lead Acid Battery Manufacturing	17	1.24
Stainless and Nonstainless Steel Manufacturing (EAF)	17	1.24
Mining	15	1.09
Primary Metal Products Manufacturing	13	0.95
Waste Disposal - Solid Waste Disposal	10	0.73
Primary Copper Smelting	10	0.73
Secondary Aluminum Production	9	0.66
Fabricated Metal Products Manufacturing	9	0.66
Pulp & Paper Production	9	0.66
Transportation Equipment Manufacturing	8	0.58
Electrical and Electronics Equipment Manufacturing	8	0.58
Sewage Sludge Incineration	7	0.51
Nonferrous Foundries	7	0.51
Ferroalloys Production	7	0.51
Industrial Inorganic Chemical Manufacturing	7	0.51
Industrial and Commercial Machinery Manufacturing	7	0.51
Residential Heating	6	0.44
Secondary Copper Smelting	6	0.44
Miscellaneous Metal Parts & Products (Surface Coating)	6	0.44

ALL CATEGORIES - Total tons	1371	**% of Total**
Commercial and Industrial Solid Waste Incineration	6	0.44
Autobody Refinishing Paint Shops	5	0.36
Coke Ovens	5	0.36
Stationary Reciprocating Internal Combustion Engines	5	0.36
Other	97	7.08

There are some 13,067 point sources (industrial, commercial or institutional) in the 2002 NEI, each with one or more processes that emit Pb to the atmosphere. Most of these sources emit less than 0.1 tpy Pb. There are approximately 1300 point sources of Pb in the NEI with estimates of emissions greater than or equal to 0.1 tpy and these point sources, combined, emit 1058 tpy, or 94% of the Pb point source emissions. In other words, 94% of Pb point source emissions are emitted by the largest 10% of these sources.

Chapter 3 of this RIA discusses our methodology for characterizing the relative contributions of stationary point sources (defined in this analysis as sources emitting > 1 ton per year of Pb), area nonpoint sources (defined in this analysis as sources emitting less than 1 ton per year), and mobile sources.

2.3.1.2 Mobile Sources

Thirty-five years ago, combustion of leaded gasoline was the main contributor of Pb to the air. In the early 1970s, EPA set national regulations to gradually reduce the Pb content in gasoline. In 1975, unleaded gasoline was introduced for motor vehicles equipped with catalytic converters. EPA banned the use of leaded gasoline in highway vehicles after December 1995. Currently, tetraethyl lead (TEL) is still added to aviation gasoline (avgas) which is used in most piston-engine powered aircraft. TEL is added to avgas to increase octane, prevent knock[22], and prevent valve seat recession and subsequent loss of compression for engines without hardened valves. The 2002 National Emissions Inventory (NEI) estimates that lead emissions from the use of leaded aviation gasoline (commonly referred to as avgas) are 491 tons; this accounts for 29% of the air emission inventory for lead. These estimates are based on the volume of avgas supplied nationally, the concentration of lead in avgas and the retention of some lead in the engine and engine oil of these aircraft. The Department of Energy estimates that about 281 million gallons of avgas were supplied in the U.S. in 2002.[23] In 2006 the volume was about 280 million gallons. The majority of avgas contains up to 0.56 grams of lead per liter (2.12 grams of lead/ gallon); this is referred to as 100 Low Lead (100LL). There is another grade of 100 octane avgas that contains 1.12 grams of lead per liter, but this product is not widely available. Based on newly available information, the retention of lead in the engine and oil of piston-engine aircraft was recently revised from a value of 25% which was more related to lead retention in

[22] Knocking is the sound produced when some of the unburned fuel in the cylinder ignites spontaneously resulting in rapid burning and a precipitous rise in cylinder pressure that creates the characteristic knocking or pinging sound (Chevron 2005 available at: http://www.chevronglobalaviation.com/docs/aviation_tech_review.pdf).

[23] data available at http://tonto.eia.doe.gov/dnav/pet/hist/mgaupus1A.htm

light-duty vehicles operating on leaded fuel to 5% retention for piston-engine aircraft.[24] Using these recently available data on lead retention, EPA now estimates that lead emissions from the use of avgas in 2002 were approximately 623 tons or 35% of the national inventory. This estimate is based on all leaded avgas used in the U.S. This estimate does not account for the fact that some lead is emitted in the local area of an airport facility and some lead is emitted at altitude. EPA's method for estimating airport-specific lead inventories is discussed in detail elsewhere.[25]

Lead is also present as a trace contaminant in gasoline and diesel fuel and is a component of lubricating oil (CD, pp. 2-45 to 2-48). Inventory estimates from these sources are not currently available. Additional mobile sources of Pb include brake wear, tire wear, and loss of Pb wheel weights (CD, pp. 2-48 to 2-50). Emission rates for Pb from brake wear have been published but inventory estimates have not yet been developed from these data (Schauer et al., 2006). Robust estimates of Pb from tire wear and wheel weights are not available. Currently, Pb from combustion of leaded avgas is the only mobile source of Pb included in the 2002 NEI.

[24] For more information see the memo to the docket titled 'Revised Methodology for Estimating Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline.'

[25] See memo to the docket titled 'Revised Methodology for Estimating Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline.'

CHAPTER 3. AIR QUALITY ASSESSMENT

This chapter presents the methods used to estimate the air quality impacts of the emissions control strategies outlined in Chapter 4 of this document. To begin, we first describe the air quality assessment tool developed by EPA to relate lead emissions to ambient lead concentrations. We then explain how this tool was used to estimate the air quality impacts of each hypothetical emissions control strategy. Following this discussion, we summarize the air quality impacts of these hypothetical control strategies and indicate where they result in attainment with the alternative target NAAQS levels outlined in Chapter 1. For areas where the controls identified in Chapter 4 are insufficient to reach attainment of each alternative, we also examine the potential air quality impacts of unidentified controls.

3.1 Methodology

3.1.1 Air Quality Assessment Tool

To assess the air quality impact of the hypothetical emissions controls implemented under the proposed NAAQS, EPA would ideally use a detailed air quality model that simulates the dispersion and transport of lead to estimate local ambient lead concentrations. Although models with such capabilities are available for pollutants for which EPA frequently conducts air quality analyses (e.g., particulate matter and ozone), regional scale models are currently neither available nor appropriate for Pb.[26] Dispersion, or plume-based models, are recommended for compliance with the Pb NAAQS and were used for the Pb NAAQS risk assessment case studies. However, dispersion models are data –intensive and more appropriate for local scale analyses of emissions from individual sources. It was not feasible to conduct such a large-scale data intensive analysis for this RIA. As a result, the simplified analysis developed for this RIA, while distance-weighting individual source contributions to ambient Pb concentrations, could not account for such locally critical variables as meteorology and source stack height. Instead of using a data-intensive modeling approach, EPA developed a more simplified air quality assessment tool to estimate the air quality impacts of each lead emissions control strategy.

In general, air quality analyses conducted in support of the current Agency Pb NAAQS review focused on the Pb-TSP monitoring sites represented in the Air Quality System (AQS) database with sufficient 1-, 2-, or 3-year data records for the years 2003-2005; this database encompasses 189 monitoring sites located in 86 distinct counties. For this particular analysis, we concentrated on county maxima monitors exceeding the lowest alternative target NAAQS level (0.05 ug/m3). The identification of the county maxima monitors and subsequent processing were based on the alternative NAAQS form of second maximum monthly Pb-TSP average over a 3-year period (in this case, 2003-2005).[27] Specifically, we identified 36 monitors (located in 36

[26] U.S. Environmental Protection Agency (2007c), Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, section 2.4, EPA-452/R-07-013, Office of Air Quality Planning and Standards, RTP, NC.

[27] Monitors / counties were initially selected based on an alternative NAAQS form of maximum monthly Pb-TSP average. The Agency focus switched to second maximum monthly after considerable effort had already been made

counties) which we analyzed with the hereto described air quality assessment tool. This assessment tool employs a source-apportionment approach to estimate the extent to which each of the following emissions sources contribute to observed lead concentrations in the proximate areas of those 36 monitors:

- Background lead
- Miscellaneous, re-entrained dust
- Emissions from area non-point sources
- Indirect fugitive emissions from active industrial sites
- Point source emissions[28]

After allocating a portion of the observed lead concentration for each monitor area to the first four categories listed above, the assessment tool apportions the remaining concentration among all inventoried point sources within ten kilometers of each monitor location.[29] Through this process, the tool establishes a point source influence factor that can be used to translate changes in the lead emissions of individual point sources to changes in the lead concentration for each monitor area. To apportion the ambient lead concentration for each monitor area to the five categories presented above, the air quality assessment tool employs the following approach:

Step 1: Estimate baseline air quality value. Drawing from the 2003-2005 Pb-TSP NAAQS-review database, the air quality assessment tool records the second maximum monthly mean ambient lead concentration for the 36 monitor locations where this concentration exceeds 0.05 ug/m^3, the most stringent of the NAAQS alternatives considered in this document. These concentrations, adjusted for the expected implementation of MACT controls implemented after 2002, $PM_{2.5}$ NAAQS controls included as part of the illustrative PM2.5 control strategy described in the PM2.5 NAAQS RIA [*insert ref*.], and the controls listed in the 2007 Missouri Lead SIP revisions, serve as the baseline air quality values for this analysis.[30]

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in the RIA assessment. Although the metric values were switched for the 36 selected monitors and reprocessed accordingly, the initial monitor selection was not repeated using the different metric. Thus, in some isolated instances, a monitor utilized in this assessment was not the one with the county highest second maximum monthly average (albeit it was the one with the county highest maximum monthly average).

[28] For the purposes of this analysis, airports servicing piston-engine aircraft that use leaded aviation gasoline are treated as point sources. The volume of avgas produced in the U.S. in 2002 was 6,682 thousand barrels or 280,644,000 gallons. This information is provided by the DOE Energy Information Administration. Fuel production volume data obtained from http://tonto.eia.doe.gov/dnav/pet/hist/mgaupus1A.htm accessed November 2006.

[29] Note that although the air quality assessment tool distinguishes between the portion of the observed lead concentration attributable to point source emissions and that attributable to indirect fugitive emissions from active point sources, this analysis assumes that the two contributions are directly related, and any reduction in the air quality impact of point source emissions would produce a corresponding reduction in the air quality impact of indirect fugitive emissions from point sources in that monitor area. The process used to relate the contributions of these two categories is described in further detail below.

[30] Note also that to estimate the value of the point source influence factor described above, the air quality assessment tool uses lead concentration data from 2003 through 2005 and lead emissions data for 2002. Ideally, this factor would be estimated based on concentration and emissions data for the same time period.

***MACT controls*:** For most point sources, lead emissions as specified in the 2002 National Emissions Inventory (NEI) served as the base case emissions for our 2020 analysis; as with the PM2.5 NAAQS RIA and ozone RIA, no growth factors were applied to the 2002 NEI emissions estimates for industrial sources to generate our emissions estimates for 2020. In general, lead emissions from these source categories are trending downward over time due to various factors including lack of growth in particular industrial sectors, implementation of alternative lower-emitting production practices at facilities, and/or recent regulations coming into effect. However, where possible, we adjusted the 2002 NEI lead emissions values to reflect the estimated control efficiency of MACT standards with post-2002 compliance deadlines, because the 2002 NEI would not reflect the impact of those controls reasonably anticipated to be in place by 2020.

We identified 42 existing MACT rules with post-2002 compliance deadlines that affect sources included in this analysis. Of these, we focused on rules affecting the 20 industries responsible for the largest lead emissions according to the 2002 NEI. Ideally, we would apply control efficiency data for each of these rules to the 2002 lead emissions estimates for the corresponding emissions sources. Consulting Federal Register documentation for these rules, as well as EPA's internal MACT rule summary data, we were able to identify control efficiency information for just 11 of these rules. The sources affected by these 11 rules, however, represent 70 percent of the lead emissions from sources affected by MACT rules with post-2002 compliance deadlines. For four of these rules, EPA expects no incremental reduction in lead emissions. For two of these rules (integrated iron & steel and pressed & blown glass), the control efficiency information that we identified is specific to metal Hazardous Air Pollutants (HAPs, e.g., lead). For the remaining five rules, we obtained information on their overall HAP control efficiency from the Federal Register and from EPA's internal MACT summary data. Table 3-1 summarizes the control efficiencies found for each of the eleven MACT rules with available control efficiency data. Due to the uncertainty that future MACT rules may cover sources of Pb emissions, this analysis does not assume the promulgation of future MACT rules.

***$PM_{2.5}$ NAAQS controls*:** In addition to adjustments for MACT rules, we also adjusted the 2002 NEI emissions estimates to account for compliance measures required by the September 2006 revision to the $PM_{2.5}$ NAAQS included as part of the illustrative PM2.5 control strategy described in the PM2.5 NAAQS RIA. [*insert ref.*] Because EPA expects PM emissions controls to be implemented at certain of these sources in order to reach attainment with the $PM_{2.5}$ standard by 2020, we incorporated them into the base case emissions values used in our analysis.

Table 3-1.
CONTROL EFFICIENCIES FOR POST-2002 MACT RULES AFFECTING SOURCES OF LEAD EMISSIONS

MACT Rule	Data Source	Control Efficiency	Observed Pollutant
Integrated Iron and Steel Manufacturing	1	65.4%	Metal HAP
Iron and Steel Foundries	2,3	36.5%	HAP
Petroleum Refineries	4	86.6%	HAP
Secondary Aluminum Production	4	68.6%	HAP
Industrial/Commercial/Institutional Boilers & Heaters – Coal	4	33.3%	HAP
Lime Manufacturing	4	2.8%	HAP
Pressed and Blown Glass and Glassware Manufacturing	5	97.6%	Metal HAP
Primary Nonferrous Metals – Zinc, Cadmium, and Beryllium	6	0%	N/A
Secondary Nonferrous Metals	5	0%	N/A
Primary Copper Smelting	6	0%	N/A
Secondary Copper Smelting	6	0%	N/A

Key to Data sources:

1. Economic Impact Analysis of Final Integrated Iron and Steel NESHAP, Center for Regulatory Economics and Policy Research, September 2002
2. 67 FR 78273
3. Economic Impact Analysis of Final Iron and Steel Foundries NESHAP, RTI International, August 2003
4. EPA's internal MACT summary data
5. 72 FR 73179
6. 72 FR 2929

Of the 36 lead monitor areas considered in this RIA, 15 are located in counties predicted to be in nonattainment with the revised $PM_{2.5}$ standard in 2020, as specified in the $PM_{2.5}$ NAAQS RIA. For 59 point sources in these areas, EPA identified PM controls from the control technology database used in the controls and cost analysis for the PM NAAQS RIA. The controls anticipated to be applied consisted of fabric filters (with a 99 percent expected control efficiency), upgrades to electrostatic precipitators (67 percent), upgrades to continuous emissions monitoring systems (7.7 percent), and the installation of capture hoods vented to a baghouse (85 percent). For each source with controls identified in the PM NAAQS RIA, we applied the control efficiency for the appropriate control technology to its 2002 NEI emissions to produce the new, PM NAAQS-adjusted baseline emissions for that source. For this analysis, we assume that these expected control efficiencies to remain constant throughout the relevant time period.

Step 2: Estimate background lead concentration: EPA estimates that the average background lead concentration is so small (0.0005 $\mu g/m^3$) as to be irrelevant for the purposes of this analysis. Given the resolution of the lead monitoring devices supporting this analysis, the air quality assessment tool assumes that background lead concentrations have no measurable contribution to violations at the design value monitors. However, given the nature of the conducted analysis for estimating "miscellaneous re-entrained dust" (see Step 3 below), background concentrations are, in fact, encompassed in that category.

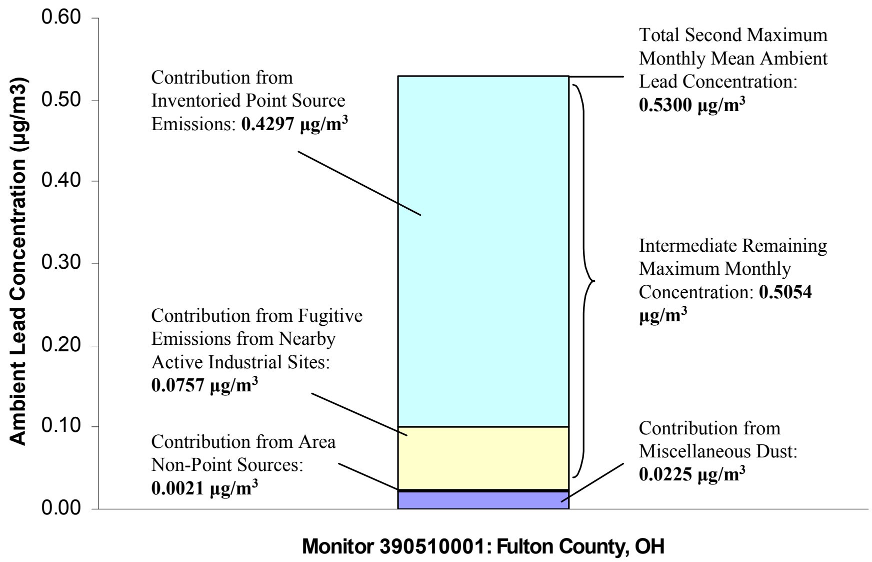
Step 3: Estimate the contribution of miscellaneous re-entrained dust. Although the lead emissions constituting the miscellaneous re-entrained dust category are of uncertain origin, they are believed to encompass 1) re-entrained dust emitted from past stationary and past mobile sources (e.g., leaded gas), including the contribution from transport; and 2) dust emitted from demolition, construction, and/or sandblasting activities, and 3) uninventoried mobile-related emissions (e.g., from Pb wheel weights, brake wear and trace Pb from gas/diesel and lube oil consumption) . Rather than estimating the site-by-site contribution of miscellaneous re-entrained dust, the air quality assessment tool applies a national estimate of the central tendency of the contribution of miscellaneous re-entrained dust to ambient lead concentrations. EPA developed this national estimate by evaluating data from ambient TSP monitors with a negligible impact from NEI lead emission sources. For the purposes of this analysis, EPA defines "negligible impact" to mean that NEI point and non-point lead-emitting sources, with associated fugitive emissions, have no contribution to the measured ambient lead concentration. Accordingly, EPA judged the ambient lead concentration measured at these TSP monitors to be entirely due to miscellaneous re-entrained dust.

Of the 189 sites included in the 2003-2005 TSP NAAQS-review database, EPA deemed 90 sites to have negligible impact from active sources based on two criteria: 1) each site was not identified as "source oriented" in previous EPA analysis; and 2) each site had cumulative point and area non-point emissions of 0.01 tons per year or less within a one-mile radius of the monitor.[31] As a central tendency of the contribution of miscellaneous, re-entrained dust, EPA found the median ambient lead concentration at these sites to be 0.0225 $\mu g/m^3$. Although this represents the average concentration at the national level, actual concentrations associated with miscellaneous re-entrained dust may vary by area. Nevertheless, in general this value typically represents a small portion of the baseline concentration at each monitor, as indicated by Figure 3-1, which illustrates the composition of the baseline lead concentration at the Fulton County, Ohio monitor.

Step 4: Estimate the contribution of area non-point sources. A portion of observed lead concentrations results from emissions from area non-point sources (e.g., households). The air quality assessment tool estimates the contribution of lead-emitting area non-point sources to ambient lead concentrations based on data from the 2002 area non-point lead emission inventory. This inventory is generally summarized at the county level, and EPA assumes that each county's area non-point emissions were uniformly distributed within each county. Based on this assumption, the air quality assessment tool also assumes that the extent to which area non-point sources contribute to ambient lead concentrations is proportional to the ratio of county-level area non-point lead emissions to total county-level lead emissions. Because this ratio differs by county, the area non-point source contribution to ambient lead concentrations also differs for each monitor site, but it generally composes a small portion of the overall concentration, as illustrated by the Fulton County, Ohio example in Figure 3-1.

[31] Sites classified as source oriented in previous EPA analysis were identified via a reference list used in EPA Trends Report analyses. This list encompasses 119 sources and was last updated in 2003.

Figure 3-1.
APPORTIONMENT OF THE BASELINE SECOND MAXIMUM MONTHLY MEAN LEAD CONCENTRATION AMONG SOURCE CATEGORIES IN FULTON COUNTY, OHIO



Step 5: Estimate the residual concentration after removing the contributions of miscellaneous re-entrained dust and area non-point source emissions. Based on the results of the four previous steps, the air quality assessment tool estimates the intermediate remaining second maximum monthly mean (hereafter, "residual concentration") lead concentration by subtracting the contributions of miscellaneous re-entrained dust and area non-point source emissions from the baseline air quality value. The residual concentration represents the total concentration fraction associated with emissions from inventoried point sources and indirect fugitive emissions from industrial sites. In the case of Fulton County, Ohio, the residual concentration is 0.5054 $\mu g/m^3$, or the baseline concentration of 0.5288 $\mu g/m^3$ less the 0.0225 $\mu g/m^3$ and 0.0009 $\mu g/m^3$ concentration fractions associated with miscellaneous dust and area non-point sources, respectively.

Step 6: Estimate the contribution of indirect fugitive emissions from nearby active industrial sites. The air quality assessment tool attributes the residual concentration derived in Step 5 to point source emissions and indirect fugitive emissions from active industrial sites near each monitor.[32] The latter category is thought to result from materials handling and on-site activities that re-entrain previously deposited lead-containing dust. Unlike area non-point source emissions, indirect fugitive emissions are linked to point sources and are not captured in the 2002 NEI. Indirect fugitive emissions, however, do not include fugitives associated with industrial processes at point sources, as these direct, process-based fugitive emissions are reflected in the

[32] Airport emissions are also reflected in the residual concentration. For the purposes of this analysis, airports are treated as point sources, although as discussed further in chapter 4, no controls are applied at airports.

2002 NEI point source inventory. The contribution of indirect fugitive emissions to observed lead concentrations was estimated as follows:

- First EPA estimated the average share of the residual concentration surrounding active industrial sites attributable to indirect fugitive emissions.

- For each lead monitor, the air quality assessment tool pro-rated this average according to the prevalence of emissions from nearby active industrial sites relative to the total 10 km radius distance-weighted emissions

- To estimate the contribution of indirect fugitive emissions to the ambient lead concentration for each area, the air quality assessment tool then multiplied the residual concentration by this pro-rated percentage.

Additional information on each of these bulleted steps is presented below.

To estimate the extent to which indirect fugitive emissions contribute to ambient lead concentrations near active industrial sites, EPA conducted an analysis of nine sites where previously active lead-emitting sources had ceased or paused production. Assuming that activities conducive to re-entrainment continue for a short period after production has ceased, EPA compared ambient lead concentrations before and after these production stoppages. After subtracting the contribution from un-inventoried miscellaneous dust (as in Step 3 above) and from area non-point sources (as in Step 4 above), EPA found that the average post-stoppage lead concentration represented approximately 15 percent of the average pre-stoppage concentration. From this analysis, EPA estimated that the contribution of indirect fugitive emissions from active industrial sites represents approximately 15 percent of the lead concentration attributable to indirect fugitives and point sources combined (i.e., the residual concentration).

When applying this 15 percent factor to each monitor area, the air quality assessment tool makes further site-specific adjustments. Relative to point source emissions, fugitive emissions tend to consist of coarser particles that are emitted closer to the ground and are therefore assumed to have a more localized effect on ambient air quality. Reflecting this consideration, the air quality assessment tool pro-rates the 15 percent adjustment factor based on the percentage of distance-weighted point source emissions originating from point sources within one mile of the monitor, and specifically, the adjustment is only made only in situations where the cumulative emissions of such nearby sources are "significant" (i.e., typically where the aggregate 1 mile radius point emissions are greater than one ton). For each source, the tool calculates distance-weighted emissions using the following equation:

(Equation 3-1) $DWE_S = \dfrac{E_S}{D_S^{3/2}}$

where:

- DWE_S = Distance-weighted 2002 NEI emissions for source *S*,
- E_S = 2002 NEI emissions for source *S*, and
- D_S = Distance between source *S* and the monitor location.

For those areas where significant point emissions are present within a one-mile radius of the monitor, the air quality assessment tool estimates the contribution to ambient lead concentrations from indirect fugitive emissions at each nearby point source by multiplying the pro-rated percentage by the residual concentration. If, for example, 80 percent of a monitor area's distance-weighted point source emissions originated from significant point sources within one mile of the monitor, the air quality assessment tool would apply a 12 percent (0.15 * 0.80 = 0.12) factor to the residual concentration. For monitor areas with no significant point emissions within one mile of the monitor location, the tool assumes that indirect fugitive emissions make no contribution to observed ambient lead concentrations. Thus, the contribution of indirect fugitive emissions from inventoried point sources for each monitor area ranges from 0 percent to nearly 15 percent of the total contribution of emissions from these sources.

Step 7: Determine the contribution of each inventoried point source to the ambient lead concentration at each monitor. Subtracting the contribution of indirect fugitives estimated in Step 6 from the residual concentration estimated in Step 5 yields the portion of the ambient lead concentration in each area attributable to inventoried point source emissions. For example, in the Fulton County example depicted in Figure 3-1, the 0.4297 $\mu g/m^3$ attributable to point source emissions represents the difference between the residual concentration of 0.5054 $\mu g/m^3$ and the 0.0757 $\mu g/m^3$ contribution of indirect industrial fugitives. For each monitor area, the air quality assessment tool further apportions this remaining concentration to each point source according to its lead emissions as well as its distance from the monitor. To account for the fact that lead emissions closer to the monitor have a greater impact on ambient lead concentrations, the tool assumes that each source's contribution to the concentration is proportional to its share of the total distance-weighted point source emissions for the monitor area. [Note that the tool does not contain data sufficient to assess the influence of other factors, such as stackheight and local meteorological conditions, that could affect the relative contribution of each point source to monitored Pb concentrations.]

To estimate the distance-weighted emissions for each source, the tool uses the formula presented in Equation 3-1 above.

After calculating the distance-weighted emissions for each source using Equation 3-1, the air quality assessment tool estimates each source's contribution to the ambient lead concentration as follows:

(Equation 3-2) $$C_S = C_P \cdot \frac{DWE_S}{DWE_P}$$

where:

- C_S = The portion of that monitor area's ambient lead concentration attributable to source S,
- C_P = Total contribution of point source emissions to the ambient lead concentration (i.e., the remaining concentration after subtracting indirect fugitive and area source contributions from the baseline air quality value),
- DWE_S = Distance-weighted 2002 NEI emissions for source S, and

- DWE_P = Sum of distance-weighted 2002 NEI emissions for all point sources in the monitor area.

Rearranging this equation slightly yields:

(Equation 3-3) $C_S = DWE_S \cdot \dfrac{C_P}{DWE_P}$

where the ratio of total point source contributions (C_P) to the sum of all distance-weighted 2002 NEI point source emissions (DWE_P) is the point source influence factor that translates distance-weighted point source emissions to ambient lead concentrations. Using the same monitor area as in Table 3-1, Table 3-2 illustrates the process by which each point source's contribution is apportioned based on its emissions and distance from the monitor location.

Table 3-2.
APPORTIONMENT OF THE TOTAL POINT SOURCE CONTRIBUTION TO THE AMBIENT LEAD CONCENTRATION AMONG INVENTORIED POINT SOURCES IN FULTON COUNTY, OHIO

Monitor Location	**Fulton County, OH**	
Total Point Source Contribution to Ambient Lead Concentration ($\mu g/m^3$) **[C_P]**	0.4297	
Source	Source A	Source B
2002 NEI Emissions (tpy) **[E_S]**	0.1500	0.338
Distance from Monitor to Source (km) **[D_S]**	3.4707	0.0554
2002 NEI Distance-Weighted Emissions ($tpy/km^{3/2}$) **[DWE_S]**	0.0232	25.8982
Total Distance-Weighted Emissions ($tpy/km^{3/2}$) **[DWE_P]**	25.9214	
Share of Total Distance-Weighted Emissions **[DWE_S / DWE_P]**	0.0895%	99.9105%
Source Contribution to ambient lead concentration ($\mu g/m^3$) **[$C_S = DWE_S * C_P/DWE_P$]**	0.0004	0.4293

In this analysis, airports were treated as point sources. Among the 36 monitors in this analysis, there are 19 monitors with at least one airport located within ten kilometers of the monitor. This analysis estimates that the contribution of leaded aviation gasoline to lead measured at the monitors ranges from 0.00004 to 0.11 $\mu g/m^3$. Currently, lead from combustion of leaded aviation fuel is allocated to airports in a manner that is likely to overestimate the airport-specific inventory for lead provided in the 2002 NEI. We are improving the method used to calculate airport-specific lead emissions from the consumption of leaded aviation gasoline.

This new method will be used to provide revised airport-specific lead inventories for this analysis in the final RIA.[33] Currently, there are 3,410 aviation facilities in the NEI of which, 25 are included in this analysis due to their proximity to one of the 36 monitors that were identified using the criteria described in Section 3.1. Among the 25 airports in this analysis, lead emission estimates for 18 of them are in the 75th percentile for lead emissions from general aviation and air taxi facilities in the NEI. While this analysis includes airports that are considered representative of the more active airports servicing piston-engine aircraft, there are currently no TSP lead monitors located within one mile of an airport servicing aircraft that operate on leaded aviation gasoline. In addition to the 25 airport facilities within 10km of the monitors in this analysis, there are heliport and airport facilities where piston-engine aircraft might operate that are not currently in the NEI. We are evaluating the potential emissions of lead from these facilities.

3.1.2. Using the Air Quality Assessment Tool to Estimate Impacts of Point Source Emissions Controls

Through the process described in Chapter 4, we estimated the extent to which point source lead emissions could decline under the proposed NAAQS and the alternative standards summarized in Chapter 1.[34] To estimate the air quality impact of these reductions, we developed a five-step process for estimating ambient lead concentrations based on the air quality assessment tool described above. This process is as follows:

1. For each policy scenario, we calculated the distance-weighted lead emissions of each point source according to Equation 3-1.

2. After estimating the distance-weighted emissions of each point source, we multiplied each source's distance-weighted lead emissions by the point source influence factor derived in Equation 3-3 to estimate each source's contribution to ambient lead concentrations. Note that the influence factor for each monitor is derived from baseline emissions and concentration data; our analysis assumes that this factor would remain constant in the policy case.

3. For each monitor area, we summed the individual point source contributions estimated in Step 2 to obtain the total ambient lead concentration attributable to inventoried point sources.

[33] The full description of the current and new methods for generating airport-specific lead inventories is described in the following memo to the docket along with a table comparing the airport-specific inventories using both methods:

Memo to the Docket from Marion Hoyer 2 April 08 {details on docket # etc}

[34] As described in Chapter 4, our analysis did not consider controls on lead emissions from airports. Therefore, we kept lead emissions from airports constant in both the baseline and policy scenarios.

4. As indicated above, the air quality assessment tool estimates that indirect fugitives associated with active industrial sites make up a pro-rated 15 percent of the portion of the ambient lead concentration associated with point source and indirect fugitive emissions (i.e., the residual concentration). We applied this percentage to the total contribution of point sources in each monitor area to estimate the contribution of indirect industrial fugitives to the area's ambient lead concentration.[35]

5. Holding the contributions from area non-point sources and miscellaneous re-entrained dust constant between the baseline and policy case, we added these to the total contribution from point source and fugitive emissions to yield the new estimate for the total ambient lead concentration.

[35] As stated above, the 15 percent value represents the percentage of the residual concentration attributable to indirect fugitive emissions. Because we use this 15 percent value to derive the indirect fugitive component of the residual concentration, it was necessary to convert this 15 percent estimate into a value that could be multiplied by the contribution of point source emissions alone to estimate the indirect fugitives fraction of the lead concentration. Such a value may be estimated based on the relationship stated above that $F=0.15(F+P)$, where P is the concentration associated with point source emissions and F is the contribution associated with re-entrained fugitives. Rearranging this equation yields $F = (0.15/0.85) *P$, or $F = P * 17.6$ percent. Thus, while indirect fugitives represent between 0 and 15 percent of the total lead fraction associated with indirect fugitives *and* point source emissions combined, they represent between 0 and 17.6 percent of the contribution of point source emissions alone.

CHAPTER 4. EMISSIONS CONTROL ANALYSIS: DESIGN AND ANALYTIC RESULTS

This chapter documents the illustrative emission control strategy we applied to simulate attainment with the revised NAAQS and alternative standard. Section 4.1 describes the approach we followed to select cost-effective emissions controls to simulate attainment in each projected nonattainment area. Section 4.2 summarizes the emission reductions we simulated in each projected nonattainment area based on current knowledge of emissions controls applicable to existing sources of lead emissions, while Section 4.3 presents the air quality impacts of these emissions reductions.. Section 4.4 discusses the application of additional "unidentified" controls, beyond those already known to be available, that we estimate will be necessary to reach attainment in certain monitor areas. Section 4.5 discusses key limitations in the approach we used to estimate the optimal control strategies for each standard.

4.1. Estimation of Optimal Emissions Control Strategies

Our analysis of the emissions control measures required to meet the proposed NAAQS and alternative standard is limited to controls for point source emissions at active sources inventoried in the 2002 NEI. [Note that while airports are included as point sources in the NEI, our analysis considers the impact of emissions from use of leaded aviation gasoline (avgas) at airports, but does not consider controls on those emissions as a strategy for NAAQS compliance. EPA received a petitioned from Friends of the Earth requesting that the Agency find that aircraft lead emissions may reasonably be anticipated to endanger the public health or welfare, and to take action to control lead emissions from piston-engine aircraft. We published a Federal Register notice discussing the petition and requested comment on specific aspects of the use of leaded avgas and potential control of lead emissions from the consumption of avgas.[36]] Finally, as discussed in Chapter 3, a portion of ambient lead concentrations can also be attributed not to point sources but to miscellaneous re-entrained dust and area nonpoint emissions. Nevertheless, this RIA deals only with the application of controls on emissions at active non-aviation point sources, including stack emissions and fugitive emissions from industrial processes.

[36] The petition requested that EPA find that such emissions cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. And, if EPA makes such a finding, the petitioner requested that EPA take steps to reduce lead emissions under the authority of the Clean Air Act Section 231 Approximately 70 different parties commented on the petition and the questions presented in the notice (72 FR 64570, November 16, 2007). These comments can be found in EPA public docket OAR-2007-0294 (at www.regulations.gov). A clear theme in many of the comments was the dependence of much of the current piston-powered aircraft fleet on leaded avgas either because of engine design, performance demands, or lack of mogas availability at airports. However, several comments identified potential near and longer term measures to reduce these lead emissions. These potential measures fall into five general categories: (1) Continued work on identifying fuel blends or additives which would provide the octane and other performance characteristics needed for a transparent fuel replacement, (2) Measures to ensure greater availability of ethanol-free unleaded avgas at airports for those aircraft which otherwise could use it, (3) Laboratory and field work to assess the potential to reduce the amount of lead now added to current leaded avgas, (4) Add-on engine technology or fuel management technology to allow for equivalent engine performance at lower avgas octane ratings and (5) Long-term measures or standards for new engines which provide the needed and desired performance characteristics using modified engine designs and calibrations on fuels or fuel blends not containing lead. For more information about the petition, see http://www.epa.gov/otaq/aviation.htm.

To simulate attainment of the four regulatory alternatives considered in all 36 monitor areas, we first modeled the most cost-effective application of identified emissions controls in each area, using the following three step process:

1. Specification of baseline emissions for inventoried point sources in each nonattainment area.

2. Identification of potential controls for inventoried point sources.

3. Identification of the least cost strategy for using point source controls.

In areas where identified emissions controls were not sufficient to reach attainment with one or more of the standards considered, we also simulated the application of unidentified emissions controls to inventoried point sources. Further discussion of the application of unidentified controls is presented in Section 4.4.

Step 1: Specification of Baseline Lead Emissions for Inventoried Point Sources. For most sources, lead emissions as specified in the 2002 National Emissions Inventory (NEI) served as the baseline for our analysis. As discussed in Chapter 2, we did not apply growth factors to the 2002 NEI emissions estimates to predict emissions in 2020 (the analysis year for this RIA) because we believe that the number of Pb emitting sources will not increase with population growth as assumed in Chapter 5. We did, however, adjust the 2002 NEI lead emissions values to reflect anticipated emissions controls necessary to comply with other regulations that have compliance deadlines after 2002, wherever possible. These adjustments included application of MACT for air toxics rules with post 2002 compliance deadlines[37], PM controls at sources in designated nonattainment areas in the 2006 revisions to the $PM_{2.5}$ NAAQS as modeled in the illustrative control strategy in the $PM_{2.5}$ NAAQS RIA[38], and controls planned for the Doe Run Herculaneum lead smelter as part of the 2007 Missouri lead SIP (at the one current nonattainment area for ambient lead under the Federal CAA).[39] After applying these adjustments to all affected point sources, the remaining lead emissions served as our baseline for the application of identified controls. Table 4-1 illustrates the process used to specify the baseline lead emissions for inventoried point sources in the analysis.

[37] The MACT standards included covered the following industries: Integrated Iron and Steel Manufacturing, Iron and Steel Foundries, Petroleum Refineries, Secondary Aluminum Production, Industrial/Commercial/Institutional Boilers & Heaters – Coal, Lime Manufacturing, Pressed and Blown Glass and Glassware Manufacturing, Primary Nonferrous Metals – Zinc, Cadmium, and Beryllium, Secondary Nonferrous Metals, Primary Copper Smelting, Secondary Copper Smelting.

[38] Available at http://www.epa.gov/ttn/ecas/ria.html

[39] This lead SIP was finalized by EPA on April 14, 2006 with a requirement that this SIP will provide attainment with the current lead standard by April 7, 2008. The SIP is available at: http://www.dnr.mo.gov/env/apcp/docs/2007revision.pdf

Table 4-1.
TOTAL BASELINE LEAD EMISSIONS FOR ALL INVENTORIED POINT SOURCES IN 36 DESIGNATED MONITOR AREAS

Original Baseline: 2002 NEI Emissions (point sources, excluding airports)	159.0 tons/year (tpy)
2002 NEI Emissions with PM NAAQS controls	157.8 tpy
2002 NEI Emissions with PM NAAQS and Herculaneum SIP controls	146.9 tpy
Final Baseline: 2002 NEI Emissions with MACT, PM NAAQS, and Herculaneum SIP controls	132.5 tpy

Following the same process as described above, we also specified baseline PM_{10} and $PM_{2.5}$ emissions for all inventoried point sources. Although the non-lead fraction of PM emissions did not play a role in simulating attainment with the lead NAAQS and alternative standard, we did use these baseline values to estimate the ancillary benefits of co-controlling PM emissions in the process of implementing lead control strategies, as discussed in Chapter 5. Recent promulgation of mobile source rules that reduce PM is not relevant for this analysis.

Step 2: Identification of Potential Controls for Point Sources in each Nonattainment Area. To identify point source lead emissions controls for our analysis, we collected information on PM control technologies, assuming that the control efficiency for PM would also apply to lead emissions. We collected this information in the following way:

1. We queried EPA's AirControlNET database for information on potential PM controls available for each source, accounting for any control measures already in place, according to the 2002 NEI.[40]

2. For sources with Standard Industrial Classifications (SICs) but without identified NEI Source Classification Codes (SCCs), we used the SIC/SCC crosswalk in Appendix C of AirControlNET's Documentation Report to identify SCCs for those sources.[41] We then found controls in AirControlNET's database associated with these SCCs.

3. EPA identified additional controls from New Source Performance Standards and operating permits that apply to facilities with similar SCC codes as the point sources in our analysis.

Completion of the procedure outlined above yielded identified controls for about 28 percent of the total inventoried point sources in our analysis. However, because of the skewed distribution of lead emissions in the 2002 NEI (the top 10 percent of inventoried point sources

[40] Documentation Available at http://www.epa.gov/ttnecas1/models/DocumentationReport.pdf. AirControlNET's database of PM controls normally excludes sources emitting fewer than 10 tons/year of PM_{10}. Because many of the point sources included in our analysis fall below this threshold and because this analysis focuses entirely on obtaining emission reductions from point sources, we effectively reduced the threshold from 10 tons/year to zero in order to identify controls for a larger number of inventoried point sources.

[41] Available at http://www.epa.gov/ttnecas1/models/DocumentationReport.pdf.

account for over 98 percent of total lead emissions), these sources accounted for more than 75 percent of total lead emissions, as shown in Table 4-2.

Table 4-2.
PROFILE OF INVENTORIED POINT SOURCES, WITH AND WITHOUT IDENTIFIED CONTROLS

	Count	Percent of Total	Emissions (tons/year)	Percent of Total
Sources with Identified Controls	642	28.2%	100.4	75.8%
Sources without Identified Controls	1,634	71.8%	32.1	24.2%
Total	**2,276**	**100.0%**	**132.5**	**100.0%**

Controls identified through this process include major emissions controls, such as fabric filters, impingement-plate scrubbers, and electrostatic precipitators; and minor controls, such as increased monitoring frequency, upgrades to continuous emissions monitors, and diesel particulate filters. For each identified control, we identified both the expected control efficiency for the technology and the annualized cost of installing and operating the control.[42] For those point sources where the 2002 NEI indicated that control measures were already in place, we estimated the effective emissions control efficiency for each identified control by estimating the emissions reductions that would result if the pre-existing control were replaced by the identified control technology. Thus, while a fabric filter might have an expected control efficiency of 90 percent when installed in the absence of pre-existing controls, for example, if it were applied at a source that already had an electrostatic precipitator with an 80 percent control efficiency, the *effective* control efficiency of the Fabric Filter would be 50 percent.[43] We also assumed that each identified control technology would be installed in addition to any controls required under the 2006 $PM_{2.5}$ NAAQS and any MACT rules with enforcement dates after 2002, but before 2020. We therefore applied each control's effective control efficiency to the adjusted baseline lead emissions at each inventoried point source.[44]

Step 3: Identification of the Optimal Strategy for Using Point Source Controls to Reach Attainment in Each Area. To identify the least-cost approach for reaching attainment in each area, EPA developed a linear programming optimization model that systematically evaluates the air quality and cost information discussed below and in Chapter 6 to find the optimal control strategy for each area. The optimization model first identifies the measures that each source would implement if it were controlled as part of a local lead attainment strategy. Based on these controls, the optimization model then identifies sources to control such that each area would reach attainment at the least aggregate cost possible for the area. Minimizing total

[42] See Chapter 6 for a detailed discussion of how annualized control costs were estimated.

[43] With the electrostatic precipitator, 20 percent of the source's original, uncontrolled emissions would remain uncontrolled, but with the fabric filter, only 10 percent of the source's original emissions would remain uncontrolled. Thus, replacing the electrostatic precipitator with the fabric filter would represent a 50 percent (10/20 = 0.5) decrease in uncontrolled emissions. For the purpose of estimating costs, EPA counted the full replacement cost.

[44] The one exception to this assumption is the installation of capture hoods vented to baghouses, a control included at some sites as part of the control strategies applied for the 2006 $PM_{2.5}$ revised NAAQS RIA. Because baghouses are major controls which would be replaced by the installation of any other major control, we applied the effective control efficiency of major controls to the *unadjusted* baseline emissions at any site with a capture hood installed. For the purpose of estimating costs, EPA counted the full replacement cost.

costs is not always equivalent to minimizing marginal costs, as described in greater detail below. Therefore, although the model selects major controls for each source by minimizing the marginal cost/ton of lead controlled at the source, the objective at the nonattainment area level is to minimize total costs to reach attainment.

Rather than considering all emissions controls at every inventoried point source, the optimization model utilizes a three-stage filtering process to select only the most cost-effective controls at sources making a significant impact on ambient air quality. The stages are as follows:

1. ***Stage 1 filter:*** First, the model selects all controls at sources deemed "relevant" by virtue of the fact that they account for at least 0.001 percent of all point source contributions to the ambient lead concentration in their monitor area. This stage mostly affects monitor areas with large numbers of inventoried point sources, such as Los Angeles, where 156 out of 266 inventoried sources do not meet the 0.001 percent threshold.

2. ***Stage 2 filter:*** Because we identified multiple major emissions controls for many sources, the second stage of the model assumes that the most cost-effective major control for each relevant source would be installed, as determined by cost/ton of lead emissions reduced. For example, consider a source that could install either an electrostatic precipitator (ESP) that would reduce lead emissions by 0.1 tons/year with an annualized cost of $1 million or a fabric filter that would reduce lead emissions by 0.11 tons/year at a cost of $2 million/year. Because the cost/ton is lower for the ESP, the optimization model assumes that the source would (potentially) install the ESP rather than the fabric filter.[45] Unlike major controls, all minor controls identified can be implemented in conjunction with other controls, so the model selects all minor controls as well.

3. ***Stage 3 filter:*** In the third and final stage, we remove from consideration all controls with a cost/ton higher than the 98th percentile of control costs at large emission sources, through a process described in Section 4.4.2 below. This will in effect sweep in more sources that are assumed to control lead emission than those identified in Stages 1 and 2.

After selecting the most cost-effective emissions controls at all relevant point sources for each monitor area, the model then proceeds to evaluate every possible combination of control technologies until the monitor area reaches attainment with the selected NAAQS or alternative standard at the lowest possible cost. If the monitor area is already in attainment with the selected standard, the model applies no controls. On the other hand, if the monitor area is unable to reach attainment with the selected standard when all cost-effective controls at relevant sources are applied, then the model is re-run without a lower threshold on source contribution to ambient Pb concentration (i.e. the model eliminates the stage 1 filter described above and thus sweeps in smaller sources).

[45] If there are two available control options, the least-cost approach chooses the option with a lower cost/ton. It does this even if a slightly more expensive control option can achieve greater emission reduction. It is unlikely that a large amount of potential emission reduction is missed by this approximation, because the control efficiencies of major controls do not differ significantly.

As indicated above, this approach is not the equivalent of moving up the marginal abatement cost curve for lead. If the control strategy were selected based on the marginal cost/$\mu g/m^3$ reduced, we would not necessarily identify the least-cost strategy for attainment in each area.

4.2. Lead Emissions Reductions Achieved with each Control Strategy

Utilizing the optimization model described above, we determined the most cost-effective control strategies required to meet attainment at the largest number of monitor areas.[46] Table 4-3 presents the lead emissions reductions realized at each monitor area under the control strategies followed for each standard.

[46] As will be discussed below, the application of identified controls was insufficient to bring all monitor areas into compliance with the proposed NAAQS and the alternative standard.

TABLE 4-3.
REDUCTION IN LEAD EMISSIONS UNDER ALTERNATIVE NAAQS AT EACH MONITOR AREA, IDENTIFIED CONTROLS ONLY

Monitor State	Monitor County	Baseline Lead Emissions in 2020	Reduction in Lead Emissions (tpy) under Proposed NAAQS and Alternative Standard			
			Proposed NAAQS: 0.30 µg/m^3 2nd Maximum Monthly Mean	Proposed NAAQS: 0.20 µg/m^3 2nd Maximum Monthly Mean	Proposed NAAQS: 0.10 µg/m^3 2nd Maximum Monthly Mean	Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean
AL	Pike	4.45	4.03	4.13	4.40	4.40
CA	Los Angeles	0.72	0.00	0.00	0.00	0.00*
CA	San Bernardino	0.12	0.00	0.00	0.00	0.00*
CO	Adams	2.44	0.04*	0.04*	0.04*	0.04*
CO	Denver	2.77	0.04	0.08*	0.08*	0.08*
CO	El Paso	0.95	0.00	0.00	0.00*	0.00*
FL	Hillsborough	1.73	1.10	1.19	1.26	1.26
GA	DeKalb	0.03	0.00	0.00	0.00	0.00*
GA	Muscogee	0.47	0.00	0.00	0.00	0.23*
IL	Cook	0.90	0.00	0.00	0.00	0.49*
IL	Madison	0.53	0.00	0.00	0.10*	0.10*
IL	St. Clair	1.71	0.00	0.00	0.10	0.41*
IN	Delaware	1.53	1.37*	1.37*	1.37*	1.37*
IN	Lake	7.26	0.00	0.00	0.00	1.51
IN	Marion	5.65	0.00	0.00	0.00	1.49
MN	Dakota	4.51	0.00	0.00	3.07	3.07
MO	Iron	27.84	12.20	12.28*	12.28*	12.28*
MO	Jefferson	47.89	9.69*	9.69*	9.69*	9.69*
MO	St. Louis	0.02	0.00	0.00	0.00	0.00
NJ	Middlesex	1.72	0.00	0.00	0.00*	0.00*
NY	Orange	1.80	0.00	1.40	1.40	1.49*
OH	Cuyahoga	1.20	0.22	0.32*	0.32*	0.32*
OH	Fulton	0.49	0.11*	0.11*	0.11*	0.11*
OH	Logan	0.12	0.00*	0.00*	0.00*	0.00*
OK	Ottawa	0.00	0.00	0.00	0.00*	0.00*
PA	Allegheny	0.22	0.00	0.00	0.00	0.14
PA	Beaver	5.02	0.00	0.55	0.88*	0.88*
PA	Berks	2.18	1.57*	1.57*	1.57*	1.57*
PA	Cambria	0.01	0.00	0.00	0.00	0.00*
PA	Carbon	0.46	0.00	0.00*	0.00*	0.00*
TN	Sullivan	0.38	0.00	0.00	0.00*	0.00*
TN	Williamson	2.55	1.97	2.07	2.31	2.53
TX	Collin	3.18	2.24	2.70	2.95	3.14
TX	Dallas	0.03	0.00	0.00	0.00	0.00*
TX	El Paso	0.18	0.00	0.00	0.00	0.00*
UT	Salt Lake	4.41	0.00	0.00	0.74	3.56
Total**		132.5	34.6	37.5	42.7	50.2

* Indicates monitor area does not reach attainment using identified controls.

** Total values do not equal the sum of emissions and reductions values for each monitor area, as some sources are within 10 kilometers of two monitors, and therefore the single emissions reduction is counted in each relevant monitor area. Note also that total lead emissions values do not represent nationwide totals, but rather the total baseline emissions at the 36 potential nonattainment areas considered in this analysis.

4.3. Impacts Using Identified Controls

Following the steps described in Section 2.1.2, we estimated the overall change in ambient air quality achieved as a result of each of the control strategies identified in the AirControlNET based emissions analysis. Table 4-4 presents a detailed breakdown of the estimated ambient lead concentrations in 2020 at each of the 36 monitor sites under the four alternative standards described in Chapter 1.

- According to the data presented in Table 4-4, 20 of the 36 monitor areas are expected to reach attainment with any target NAAQS in the proposed range of 0.10 to 0.30 ug/m^3 following implementation of the controls identified in the AirControlNET analysis (i.e., identified controls). For some areas, however, identified controls are not sufficient to reach attainment with one or more of the target alternatives in the proposed range. For the alternative of 0.05 ug/m3, only 10 of the 36 monitors are able to reach attainment from application of identified controls.

- The failure of certain areas to reach attainment with identified controls partially reflects the lack of control information for point sources in these areas. As indicated in Table 4-5, sources for which the AirControlNET analysis identified no controls make up a significant portion of the ambient lead concentration in many of the areas not projected to reach attainment with the proposed standard. For such sources in nonattainment areas, we assume that unidentified controls will be applied, as discussed further below.

- Table 4-5 also shows that in the case of the 0.05 ug/m3 target NAAQS, some areas fail to reach attainment in our analysis because the fraction of the ambient concentration associated with area nonpoint sources and miscellaneous re entrained dust exceeds the standard itself. Therefore, even if point source emissions were reduced to zero in these areas, they would not reach attainment.

- The projected nonattainment for some areas reflects the combined effect of the two factors described above.

Table 4-4.
AMBIENT LEAD CONCENTRATIONS ACHIEVED WITH IDENTIFIED CONTROLS UNDER THE ALTERNATIVE NAAQS IN 2020

Monitor State	Monitor County	Ambient Lead Concentration ($\mu g/m^3$) attained under Proposed NAAQS and Alternative Standards				
		Baseline Lead Concentration in 2020	0.30 $\mu g/m^3$ Second Maximum Monthly Mean	0.20 $\mu g/m^3$ Second Maximum Monthly Mean	0.10 $\mu g/m^3$ Second Maximum Monthly Mean	0.05 $\mu g/m^3$ Second Maximum Monthly Mean
AL	Pike	2.420	0.250	0.196	0.051	0.050
CA	Los Angeles	0.076	0.076	0.076	0.076	0.075*
CA	San Bernardino	0.068	0.068	0.068	0.068	0.068*
CO	Adams	0.440	0.434*	0.434*	0.434*	0.434*
CO	Denver	0.229	0.226	0.225*	0.225*	0.225*
CO	El Paso	0.131	0.131	0.131	0.131*	0.131*
FL	Hillsborough	1.380	0.214	0.123	0.048	0.048
GA	DeKalb	0.100	0.100	0.100	0.100	0.100*
GA	Muscogee	0.100	0.100	0.100	0.100	0.096*
IL	Cook	0.097	0.097	0.097	0.097	0.067*
IL	Madison	0.128	0.128	0.128	0.106*	0.106*
IL	St. Clair	0.093	0.093	0.093	0.093	0.070*
IN	Delaware	5.022	0.391*	0.391*	0.391*	0.391*
IN	Lake	0.053	0.053	0.053	0.053	0.049
IN	Marion	0.079	0.079	0.079	0.079	0.038
MN	Dakota	0.192	0.192	0.192	0.039	0.039
MO	Iron	1.454	0.232	0.224*	0.224*	0.224*
MO	Jefferson	0.527	0.425*	0.425*	0.425*	0.425*
MO	St. Louis	0.036	0.036	0.036	0.036	0.036
NJ	Middlesex	0.143	0.143	0.143	0.143*	0.143*
NY	Orange	0.240	0.240	0.084	0.084	0.074*
OH	Cuyahoga	0.377	0.279	0.260*	0.260*	0.260*
OH	Fulton	0.530	0.530*	0.530*	0.530*	0.530*
OH	Logan	0.360	0.360*	0.360*	0.360*	0.360*
OK	Ottawa	0.114	0.114	0.114	0.114*	0.114*
PA	Allegheny	0.064	0.064	0.064	0.064	0.047
PA	Beaver	0.224	0.224	0.200	0.191*	0.191*
PA	Berks	0.517	0.336*	0.336*	0.336*	0.336*
PA	Cambria	0.056	0.056	0.056	0.056	0.056*
PA	Carbon	0.294	0.294	0.294*	0.294*	0.294*
TN	Sullivan	0.154	0.154	0.154	0.154*	0.154*
TN	Williamson	0.820	0.206	0.174	0.100	0.031
TX	Collin	0.891	0.288	0.164	0.096	0.045
TX	Dallas	0.084	0.084	0.084	0.084	0.084*
TX	El Paso	0.054	0.054	0.054	0.054	0.054*
UT	Salt Lake	0.107	0.107	0.107	0.093	0.040

* Indicates that this monitor area did not reach attainment with the alternative standard.

TABLE 4-5.
BASELINE LEAD CONCENTRATIONS IN μG/M³ IN AREAS WITH MONITORED CONCENTRATIONS GREATER THAN ANY OF THE ALTERNATIVE NAAQS USING ONLY IDENTIFIED CONTROLS

Monitor State	Monitor County	Baseline Pb Concentration in 2020	Pb Concentration related to area non-point emissions and misc. re-entrained dust	Baseline Pb Concentration related to indirect fugitive and point source emissions		Total concentration associated with sources for which no control information available
				Point sources with no Identified Controls	Point sources with Identified Controls	
CA	Los Angeles	0.076	0.024	0.051	0.000	0.075
CA	San Bernardino	0.068	0.025	0.043	0.000	0.068
CO	Adams	0.440	0.024	0.342	0.073	0.366
CO	Denver	0.229	0.029	0.128	0.072	0.157
CO	El Paso	0.131	0.024	0.101	0.006	0.125
GA	DeKalb	0.100	0.057	0.043	0.000	0.100
GA	Muscogee	0.100	0.045	0.051	0.004	0.096
IL	Cook	0.097	0.024	0.033	0.040	0.057
IL	Madison	0.128	0.023	0.000	0.104	0.024
IL	St. Clair	0.093	0.023	0.039	0.032	0.061
IN	Delaware	5.022	0.050	0.001	4.970	0.051
MO	Iron	1.454	0.023	0.189	1.242	0.212
MO	Jefferson	0.527	0.023	0.000	0.504	0.023
NJ	Middlesex	0.143	0.024	0.118	0.000	0.143
NY	Orange	0.240	0.035	0.029	0.176	0.064
OH	Cuyahoga	0.377	0.025	0.219	0.133	0.244
OH	Fulton	0.530	0.025	0.505	0.000	0.530
OH	Logan	0.360	0.027	0.333	0.000	0.360
OK	Ottawa	0.114	0.023	0.091	0.000	0.114
PA	Beaver	0.224	0.026	0.000	0.199	0.026
PA	Berks	0.517	0.036	0.277	0.205	0.313
PA	Cambria	0.056	0.031	0.025	0.000	0.056
PA	Carbon	0.294	0.032	0.263	0.000	0.294
TN	Sullivan	0.154	0.023	0.131	0.000	0.154
TX	Dallas	0.084	0.029	0.054	0.001	0.083
TX	El Paso	0.054	0.028	0.024	0.002	0.052

4.4. Unidentified Controls

As discussed above, some monitor areas did not reach attainment with the proposed NAAQS or alternative standard through the application of identified controls alone in these illustrative control scenarios. In order to bring these monitor areas into attainment, we simulated the application of unidentified emissions controls on "large" emissions sources, defined as those sources emitting 0.05 tons/year or more in the 2002 NEI. Unidentified emission controls are hypothetical control technologies yet to be determined..[47] We limited our consideration of unidentified controls to these sources in order to target facilities that will likely be the focus of efforts of local air quality managers to comply with the new NAAQS. Of the 2,230 point sources (excluding airports) in our analysis, 7.8 percent (174 sources) satisfy the 0.05 annual tpy (100 pound) or greater criteria, but they account for more than 97 percent of total adjusted baseline emissions.

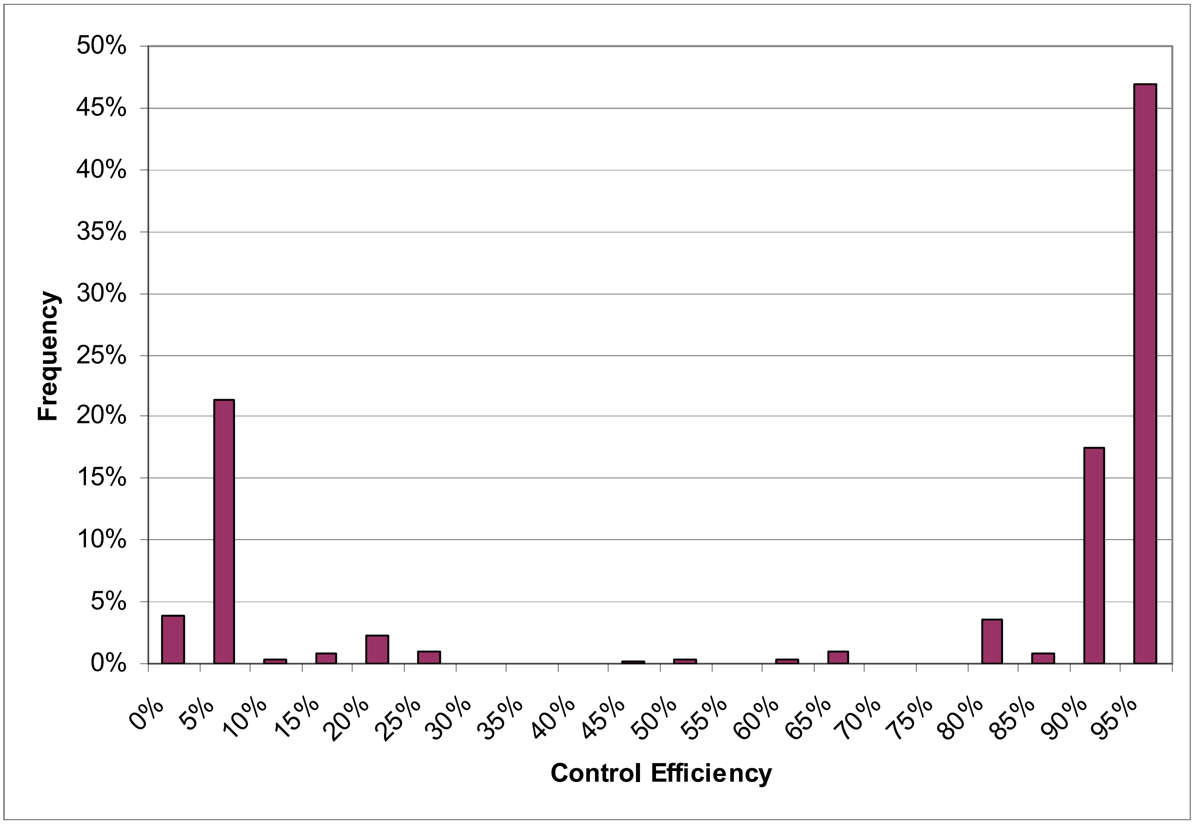
In this section we discuss how we estimated the control efficiency of unidentified controls, how we applied these controls to point sources in our analysis, and the emissions reductions achieved with these controls. More in depth discussions of the air quality impacts of unidentified controls and the method of estimating the costs of these controls will be presented below and in Chapter 6.

4.4.1 Estimating the Control Efficiency for Unidentified Controls

We identified an appropriate central tendency measure of the efficiency of identified controls which could be applied to unidentified controls by examining the distribution of the control efficiencies of identified controls at large sources, as defined above. As Figure 4-1 indicates, the distribution of control efficiencies is bimodal, with a mean at 70.2 percent and a median at 95.0 percent. Based on this distribution, we chose 90 percent as a central tendency measure to be applied to the control efficiency of unidentified controls. We assumed that unidentified controls would be applied in addition to any identified emissions controls already installed at each source, meaning that the 90 percent control efficiency for unidentified controls would be applied to the emissions for each source. For the final RIA, we intend to revisit the choice of 90% as a representative control efficiency because of the underlying uncertainties associated with unidentified control technologies.

[47] For the final RIA, we intend to explore finding more identified controls for some of these point sources in order to reduce the number of sources to which unidentified controls are applied. We may find that for a subset of these point sources, we would be assuming some level of technological progress in the design of controls.

Figure 4-1.
HISTOGRAM OF CONTROL EFFICIENCY FOR IDENTIFIED CONTROLS AT POINT SOURCES WITH 2002 NEI EMISSIONS OF 0.05 TONS/YEAR OR HIGHER



4.4.2. Applying Unidentified Controls to Large Point Sources

In the process of estimating the cost/ton of unidentified controls, we set a cost cap at the 98th percentile along the cumulative density function of the per ton costs of identified controls at "large" point sources, as shown in Figure 4-2. With the cost cap set at $32 million, we then determined that a nonattainment area would not implement any identified controls with per ton costs above this cost-effectiveness threshold.[48] This is a simplifying approach that will be refined in the final RIA. Removing all such controls from our database did not significantly impact emissions reductions or air quality impacts of the control strategies required for each standard.

For each standard, we selected all monitor areas that failed to reach attainment and applied unidentified controls to large sources until attainment was reached. We applied an additional control efficiency of 90 percent to large sources closest to the monitor in an iterative fashion until the minimum lead emissions reductions required for attainment were reached.

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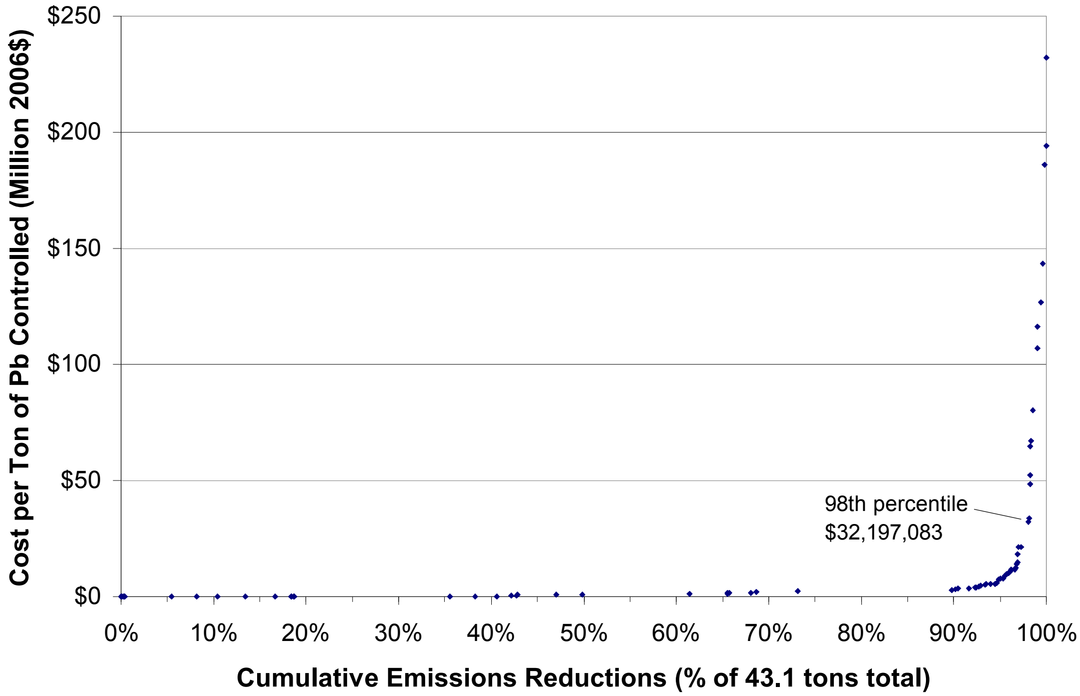
[48] The use of the 98th percentile as a cost cutoff for identified controls is consistent with the method used in EPA's Final Ozone NAAQS Regulatory Impact Analysis, March 2008, available at http://www.epa.gov/ttnecas1/ria.html

Figure 4-2.
CUMULATIVE DENSITY FUNCTION OF PER TON COSTS OF IDENTIFIED CONTROLS AT POINT SOURCES EMITTING 0.05 TONS/YEAR OR MORE (Millions of 2006$)



4.4.3. Lead Emissions Reductions Achieved with Unidentified Controls

After applying unidentified controls using the process described above, all monitor areas but one reached attainment with the 0.3 $\mu g/m^3$ proposed standard and the 0.2 $\mu g/m^3$ proposed standard. For the 0.1 $\mu g/m^3$ proposed standard, six monitor areas did not reach attainment with the application of unidentified controls, either because control efficiencies greater than 90 percent were required at large sources or because small sources needed to be controlled in order to sufficiently reduce ambient lead concentrations. For the 0.05 $\mu g/m^3$ alternative standard, seventeen monitor areas could not reach attainment with any application of unidentified controls, for the reasons given above and because the fraction of the ambient concentration associated with area nonpoint sources and miscellaneous re entrained dust at some areas exceeds the standard itself, as mentioned in Section 4.3. Table 4-6 presents the lead emissions reductions required to bring the maximum number of monitor areas into attainment with each standard. Table 4-7 presents the lead emissions reductions realized for each monitor area using both identified and unidentified controls. Tables 4-8 and 4-9 present the air quality impacts of these emissions reductions and summarize the number of areas reaching attainment with the application of identified and unidentified controls.

Table 4-6.
TOTAL LEAD EMISSIONS REMAINING AND LEAD EMISSIONS REDUCTIONS REQUIRED WITH UNIDENTIFIED CONTROLS TO REACH ATTAINMENT WITH THE ALTERNATIVE NAAQS

Standard	Lead emissions Remaining after applying identified controls (Tons/Year)	Reduction in Lead Emissions with unidentified controls (Tons/Year)	Emissions remaining after applying identified and unidentified controls (Tons/Year)
0.3 $\mu g/m^3$ 2^{nd} Maximum Monthly Mean	98.0	12.2	85.5*
0.2 $\mu g/m^3$ 2^{nd} Maximum Monthly Mean	95.0	24.4	70.6*
0.1 $\mu g/m^3$ 2^{nd} Maximum Monthly Mean	90.0	48.2	41.8**
0.05 $\mu g/m^3$ 2^{nd} Maximum Monthly Mean	82.5	61.6	20.9***

* 35 out of 36 monitor areas reached attainment with this standard using identified and unidentified point source emissions controls.

** 30 out of 36 monitor areas reached attainment with this standard using identified and unidentified point source emissions controls.

*** 19 out of 36 monitor areas reached attainment with this standard using identified and unidentified point source emissions controls

Table 4-7.
REDUCTION IN LEAD EMISSIONS UNDER ALTERNATIVE NAAQS AT EACH MONITOR AREA WITH IDENTIFIED AND UNIDENTIFIED CONTROLS

Monitor State	Monitor County	Baseline Lead Emissions in 2020	Reduction in Lead Emissions (tpy) under Alternative NAAQS			
			Proposed NAAQS: 0.30 $\mu g/m^3$ 2nd Maximum Monthly Mean	Proposed NAAQS: 0.20 $\mu g/m^3$ 2nd Maximum Monthly Mean	Proposed NAAQS: 0.10 $\mu g/m^3$ 2nd Maximum Monthly Mean	Alternative Standard: 0.05 $\mu g/m^3$ 2nd Maximum Monthly Mean
AL	Pike	4.45	4.03	4.13	4.40	4.40
CA	Los Angeles	0.72	0.00	0.00	0.00	0.41*
CA	San Bernardino	0.12	0.00	0.00	0.00	0.04
CO	Adams	2.44	0.37	0.73	1.45	2.15*
CO	Denver	2.77	0.04	0.32	1.51	2.37*
CO	El Paso	0.95	0.00	0.00	0.56	0.78*
FL	Hillsborough	1.73	1.10	1.19	1.26	1.26
GA	DeKalb	0.03	0.00	0.00	0.00	0.00*
GA	Muscogee	0.47	0.00	0.00	0.00	0.42*
IL	Cook	0.90	0.00	0.00	0.00	0.71*
IL	Madison	0.53	0.00	0.00	0.13	0.39
IL	St. Clair	1.71	0.00	0.00	0.10	0.93
IN	Delaware	1.53	1.38*	1.38*	1.38*	1.38*
IN	Lake	7.26	0.00	0.00	0.00	1.51
IN	Marion	5.65	0.00	0.00	0.00	1.49
MN	Dakota	4.51	0.00	0.00	3.07	3.07
MO	Iron	27.84	12.20	13.53	21.74	25.84
MO	Jefferson	47.89	21.53	31.04	40.54	44.01*
MO	St. Louis	0.02	0.00	0.00	0.00	0.00
NJ	Middlesex	1.72	0.00	0.00	0.61	1.33
NY	Orange	1.80	0.00	1.40	1.40	1.70
OH	Cuyahoga	1.20	0.22	0.58	0.92*	0.92*
OH	Fulton	0.49	0.27	0.34	0.40	0.42*
OH	Logan	0.12	0.02	0.06	0.07*	0.07*
OK	Ottawa	0.00	0.00	0.00	0.00*	0.00*
PA	Allegheny	0.22	0.00	0.00	0.00	0.14
PA	Beaver	5.02	0.00	0.55	2.93	4.15
PA	Berks	2.18	1.62	1.78	1.97	1.97*
PA	Cambria	0.01	0.00	0.00	0.00	0.00*
PA	Carbon	0.46	0.00	0.16	0.27*	0.27*
TN	Sullivan	0.38	0.00	0.00	0.15	0.30
TN	Williamson	2.55	1.97	2.07	2.31	2.53
TX	Collin	3.18	2.24	2.70	2.95	3.14
TX	Dallas	0.03	0.00	0.00	0.00	0.00*
TX	El Paso	0.18	0.00	0.00	0.00	0.05
UT	Salt Lake	4.41	0.00	0.00	0.74	3.56
Total**		132.5	46.96	61.91	90.73	111.57

* Indicates monitor area does not reach attainment using identified and unidentified controls.

** Total values do not equal the sum of emissions and reductions values for each monitor area, as some sources are within 10 kilometers of two monitors, and therefore their emissions are counted once in each monitor area.

Table 4-8.
AMBIENT LEAD CONCENTRATIONS ACHIEVED WITH IDENTIFIED AND UNIDENTIFIED CONTROLS UNDER ALTERNATIVE NAAQS IN 2020

Monitor State	Monitor County	Ambient Lead Concentration ($\mu g/m^3$) attained under Alternative NAAQS				
		Baseline Maximum Monthly Mean	0.30 $\mu g/m^3$ Second Maximum Monthly Mean	0.20 $\mu g/m^3$ Second Maximum Monthly Mean	0.10 $\mu g/m^3$ Second Maximum Monthly Mean	0.05 $\mu g/m^3$ Second Maximum Monthly Mean
AL	Pike	2.420	0.250	0.196	0.051	0.050
CA	Los Angeles	0.076	0.076	0.076	0.076	0.072*
CA	San Bernardino	0.068	0.068	0.068	0.068	0.050
CO	Adams	0.440	0.300	0.200	0.100	0.065*
CO	Denver	0.229	0.226	0.200	0.100	0.053*
CO	El Paso	0.131	0.131	0.131	0.100	0.091*
FL	Hillsborough	1.380	0.214	0.123	0.048	0.048
GA	DeKalb	0.100	0.100	0.100	0.100	0.100*
GA	Muscogee	0.100	0.100	0.100	0.100	0.056*
IL	Cook	0.097	0.097	0.097	0.097	0.061*
IL	Madison	0.128	0.128	0.128	0.100	0.050
IL	St. Clair	0.093	0.093	0.093	0.093	0.050
IN	Delaware	5.022	0.352*	0.352*	0.352*	0.352*
IN	Lake	0.053	0.053	0.053	0.053	0.049
IN	Marion	0.079	0.079	0.079	0.079	0.038
MN	Dakota	0.192	0.192	0.192	0.039	0.039
MO	Iron	1.454	0.232	0.200	0.100	0.050
MO	Jefferson	0.527	0.300	0.200	0.100	0.064*
MO	St. Louis	0.036	0.036	0.036	0.036	0.036
NJ	Middlesex	0.143	0.143	0.143	0.100	0.050
NY	Orange	0.240	0.240	0.084	0.084	0.050
OH	Cuyahoga	0.377	0.279	0.200	0.143*	0.143*
OH	Fulton	0.530	0.300	0.200	0.100	0.075*
OH	Logan	0.360	0.300	0.200	0.159*	0.159*
OK	Ottawa	0.114	0.114	0.114	0.114*	0.114*
PA	Allegheny	0.064	0.064	0.064	0.064	0.047
PA	Beaver	0.224	0.224	0.200	0.100	0.050
PA	Berks	0.517	0.300	0.200	0.103*	0.103*
PA	Cambria	0.056	0.056	0.056	0.056	0.056*
PA	Carbon	0.294	0.294	0.200	0.140*	0.140*
TN	Sullivan	0.154	0.154	0.154	0.100	0.050
TN	Williamson	0.820	0.206	0.174	0.100	0.031
TX	Collin	0.891	0.288	0.164	0.096	0.045
TX	Dallas	0.084	0.084	0.084	0.084	0.084*
TX	El Paso	0.054	0.054	0.054	0.054	0.050
UT	Salt Lake	0.107	0.107	0.107	0.093	0.040

Table 4-9.
NUMBER OF MONITOR SITES REACHING ATTAINMENT WITH EACH ALTERNATIVE STANDARD USING IDENTIFIED AND UNIDENTIFIED CONTROLS

Standard	Number of Sites Analyzed	Number of Sites in Attainment with No Additional Controls	Number of Sites in Attainment with Identified Point Source Controls	Number of Sites in Attainment with Unidentified and Identified Point Source Controls
0.30 µg/m3 Second Maximum Monthly Mean	36	24	30	35
0.20 µg/m3 Second Maximum Monthly Mean		20	26	35
0.10 µg/m3 Second Maximum Monthly Mean		13	20	30
0.05 µg/m3 Second Maximum Monthly Mean		1	10	19

We do not model full attainment for the above monitored counties in bold for various reasons. Only one county does not meet the 0.030 and 0.020 ug/m3 alternative standards. Delaware County, IN only has one large point source to control, which was controlled as part of our identified and unidentified controls analysis, a reduction of over 4 ug/m3 was achieved. With respect to the 0.10 ug/m3 alternative standard five additional counties do not attain. Ottawa County, OK has a large lead superfund site, and no point sources in the area. The remaining four counties have sources which have all been controlled through our identified & unidentified controls analysis. We intend to investigate these areas more completely to assess local conditions as well as attempt to identify any additional identified controls to achieve attainment of these areas for the final RIA.

Table 4.10
AMBIENT LEAD CONCENTRATIONS (µg/m^3) FOR MONITORED COUNTIES UNABLE TO ATTAIN 0.30 µg/m^3 SECOND MAXIMUM MONTHLY MEAN WITH IDENTIFIED CONTROLS, OR WITH BOTH IDENTIFIED AND UNIDENTIFIED CONTROLS

Monitor State	Monitor County	Baseline Maximum Monthly Mean	Post Identified Controls	Post Identified & Unidentified Controls	Amount Needed to Attain
IN	Delaware	5.022	0.391	**0.352**	**0.052**
MO	Jefferson	0.527	0.425	0.300	0
OH	Fulton	0.530	0.530	0.300	0
OH	Logan	0.360	0.360	0.300	0

Table 4.11
AMBIENT LEAD CONCENTRATIONS (µg/m^3) FOR MONITORED COUNTIES UNABLE TO ATTAIN 0.20 µg/m^3 SECOND MAXIMUM MONTHLY MEAN WITH IDENTIFIED CONTROLS, OR WITH BOTH IDENTIFIED AND UNIDENTIFIED CONTROLS

Monitor State	Monitor County	Baseline Maximum Monthly Mean	Post Identified Controls	Post Identified & Unidentified Controls	Amount Needed to Attain
CO	Adams	0.440	0.434	0.200	0
CO	Denver	0.229	0.225	0.200	0
IN	Delaware	5.022	0.391	**0.352**	**0.152**
MO	Iron	1.454	0.224	0.200	0
MO	Jefferson	0.527	0.425	0.200	0
OH	Cuyahoga	0.377	0.260	0.200	0
OH	Fulton	0.530	0.530	0.200	0
OH	Logan	0.360	0.360	0.200	0
PA	Carbon	0.294	0.294	0.200	0

Table 4.12
AMBIENT LEAD CONCENTRATIONS (µg/m^3) FOR MONITORED COUNTIES UNABLE TO ATTAIN 0.10 µg/m^3 SECOND MAXIMUM MONTHLY MEAN WITH IDENTIFIED CONTROLS , OR WITH BOTH IDENTIFIED AND UNIDENTIFIED CONTROLS

Monitor State	Monitor County	Baseline Maximum Monthly Mean	Post Identified Controls	Post Identified & Unidentified Controls	Amount Needed to Attain
CO	Adams	0.440	0.434	0.100	0
CO	Denver	0.229	0.225	0.100	0
CO	El Paso	0.131	0.131	0.100	0
IL	Madison	0.128	0.106	0.100	0
IN	Delaware	5.022	0.391	**0.352**	**0.252**
MO	Iron	1.454	0.224	0.100	0
MO	Jefferson	0.527	0.425	0.100	0
NJ	Middlesex	0.143	0.143	0.100	0
OH	Cuyahoga	0.377	0.260	**0.143**	**0.043**
OH	Fulton	0.530	0.530	0.100	0
OH	Logan	0.360	0.360	**0.159**	**0.059**
OK	Ottawa	0.114	0.114	**0.114**	**0.014**
PA	Beaver	0.224	0.191	0.100	0
PA	Berks	0.517	0.336	**0.103**	**0.003**
PA	Carbon	0.294	0.294	**0.140**	**0.040**
TN	Sullivan	0.154	0.154	0.100	0

Table 4.13
AMBIENT LEAD CONCENTRATIONS (µg/m^3) FOR MONITORED COUNTIES UNABLE TO ATTAIN 0.05 µg/m^3 SECOND MAXIMUM MONTHLY MEAN WITH IDENTIFIED CONTROLS, OR WITH BOTH IDENTIFIED AND UNIDENTIFIED CONTROLS

Monitor State	Monitor County	Baseline Maximum Monthly Mean	Post Identified Controls	Post Identified & Unidentified Controls	Amount Needed to Attain
CA	Los Angeles	0.076	0.075	**0.072**	**0.022**
CA	San Bernardino	0.068	0.068	0.050	0
CO	Adams	0.440	0.434	**0.065**	**0.015**
CO	Denver	0.229	0.225	**0.053**	**0.003**
CO	El Paso	0.131	0.131	**0.091**	**0.041**
GA	DeKalb	0.100	0.100	**0.100**	**0.050**
GA	Muscogee	0.100	0.096	**0.056**	**0.006**
IL	Cook	0.097	0.067	**0.061**	**0.011**
IL	Madison	0.128	0.106	0.050	0
IL	St. Clair	0.093	0.070	0.050	0
IN	Delaware	5.022	0.391	**0.352**	**0.302**
MO	Iron	1.454	0.224	0.050	0
MO	Jefferson	0.527	0.425	**0.064**	**0.014**
NJ	Middlesex	0.143	0.143	0.050	0
NY	Orange	0.240	0.074	0.050	0
OH	Cuyahoga	0.377	0.260	**0.143**	**0.093**
OH	Fulton	0.530	0.530	**0.075**	**0.025**
OH	Logan	0.360	0.360	**0.159**	**0.109**
OK	Ottawa	0.114	0.114	**0.114**	**0.064**
PA	Beaver	0.224	0.191	0.050	0
PA	Berks	0.517	0.336	**0.103**	**0.053**
PA	Cambria	0.056	0.056	**0.056**	**0.006**
PA	Carbon	0.294	0.294	**0.140**	**0.090**
TN	Sullivan	0.154	0.154	0.050	0
TX	Dallas	0.084	0.084	**0.084**	**0.034**
TX	El Paso	0.054	0.054	0.050	0

Table 4.14
MONITORED COUNTIES THAT ATTAIN ALTERNATIVE NAAQS IN 2020 WITH NO CONTROLS NEEDED OR IDENTIFIED CONTROLS ONLY

		0.30 µg/m^3 Second Maximum Monthly Mean		0.20 µg/m^3 Second Maximum Monthly Mean		0.10 µg/m^3 Second Maximum Monthly Mean		0.05 µg/m^3 Second Maximum Monthly Mean	
Monitor State	Monitor County	No Control Needed	Identified Control	No Control Needed	Identified Control	No Control Needed	Identified Control	No Control Needed	Identified Control
AL	Pike		✓		✓		✓		✓
CA	Los Angeles	✓		✓		✓			
CA	San Bernardino	✓		✓		✓			
CO	Denver	✓							
CO	El Paso	✓		✓					
FL	Hillsborough		✓		✓		✓		✓
GA	DeKalb	✓		✓		✓			
GA	Muscogee	✓		✓		✓			
IL	Cook	✓		✓		✓			
IL	Madison	✓		✓					
IL	St. Clair	✓		✓		✓			
IN	Lake	✓		✓		✓			✓
IN	Marion	✓		✓		✓			✓
MN	Dakota	✓		✓			✓		✓
MO	Iron		✓						
MO	St. Louis	✓		✓		✓		✓	✓
NJ	Middlesex	✓		✓					
NY	Orange	✓					✓		
OH	Cuyahoga		✓						
OK	Ottawa	✓		✓					
PA	Allegheny	✓		✓		✓			✓
PA	Beaver	✓			✓				
PA	Cambria	✓		✓		✓			
PA	Carbon	✓							
TN	Sullivan	✓		✓					
TN	Williamson		✓		✓		✓		✓
TX	Collin		✓		✓		✓		✓
TX	Dallas	✓		✓		✓			
TX	El Paso	✓		✓		✓			
UT	Salt Lake	✓		✓			✓		✓

4.5 Key Limitations

The estimates of emission reductions associated with the control strategies described above are subject to important limitations and uncertainties. We summarize these limitations as follows:

- ***Analysis Only Considers Controls on Point Source Emission Reductions.*** Because the available data are not sufficiently detailed to assess the impact of indirect fugitive or area nonpoint source controls, the analysis of air quality impacts does not account for the potential implementation of such controls in areas where they might be effective. Although the analysis estimates the impact of point source controls on indirect fugitives, it does not consider the impact of controlling these emissions directly. This and the lack of control information for area nonpoint sources may have contributed to our projection of nonattainment in some areas.

- ***Actual State Implementation Plans May Differ from our Simulation***: In order to reach attainment with the proposed NAAQS, each state will develop its own implementation plan implementing a combination of emissions controls that may differ from those simulated in this analysis. This analysis therefore represents an approximation of the emissions reductions that would be required to reach attainment and should not be treated as a precise estimate.

- ***Limited Emissions Controls Considered***: Because limited data are available on fugitive and area source emissions and the extent to which these emissions contribute to ambient lead concentrations, our analysis does not consider fugitive and area source controls that may be implemented to comply with the revised NAAQS. Additionally, for this analysis we have not modeled the effect of any potential changes in emissions at airports with lead emissions associated with use of leaded aviation gasoline. As discussed above, we were not able to obtain emissions control information for a large number of point sources in our analysis. Although these sources collectively accounted for less than one fourth of all lead emissions considered, many of those sources were located in areas that were not able to reach attainment with one or more of the standards using identified controls alone. If more emissions control information were available, it may not be necessary to rely on estimated emissions reductions from unidentified point sources in order to simulate attainment with the alternative NAAQS.

- ***Emissions Reduction from Unidentified Controls***: In this chapter we report emissions reductions from both identified and unidentified emissions controls. We have taken care to report these separately, in recognition of the greater uncertainty associated with achieving emissions reductions from measures that may not be currently in use or known to EPA. Nonetheless, EPA believes it is reasonable to project that, with at least 10 years of lead time before a 2020 compliance deadline, a large number of existing measures will be adapted to be applicable to additional sources, and new measures may be developed that are specifically focused on cost-effectively reducing PM emissions with high lead content. Because the current standard is attained in all but a few areas of the country, and has been for many years since the phase down of lead in gasoline, it is likely that very little effort has been devoted to development of lead emissions control technologies except for industries where regulations have been imposed to reduce lead (e.g., large MWC standard, primary and secondary lead smelter MACTs, etc.). As a result, EPA believes that application of unidentified controls is particularly appropriate for compliance with a more stringent lead NAAQS.

- ***Using the Entire Marginal Cost Curve***: The marginal cost curve for this analysis was derived from the costs to the larger sources for which we had identified controls. To estimate the costs of unidentified controls, we chose a constant cost equal to the 98th percentile of the marginal cost curve. We recognize that valuing all unidentified tons at the same cost per ton is an oversimplification. We also recognize that as we add additional levels of control to well-controlled sources to capture an ever smaller increment of emissions, the marginal cost of the additional emission control generally increases. In these instances, taking into account the entire marginal cost curve may more fully capture the increasing cost. Note also that in this analysis, unidentified controls include not only additional levels of control for well-controlled sources, but also sources that were not matched with known controls. We do not know whether this second level of uncertainty will lead to higher costs per ton. For the final RIA we intend to explore both finding more identified controls, and also finding ways to value unidentified controls that do not use a single constant cost per ton.

CHAPTER 5. BENEFITS ANALYSIS APPROACH AND RESULTS

Synopsis

This chapter describes our initial analysis of the benefits associated with attaining the proposed National Ambient Air Quality Standard (NAAQS) for lead and the alternative standards outlined in Chapter 1.[49] Benefits estimates will be revised and improved during development of the RIA for the final Pb NAAQS. The estimates outlined in this initial benefits analysis indicate that achieving a lower National Ambient Air Quality Standard (NAAQS) for lead from its current level of 1.5 $\mu g/m^3$ maximum quarterly mean to one of the proposed alternative second maximum monthly mean values could result in significant reductions in adverse health effects due to reduced exposure from lead and fine particles ($PM_{2.5}$). We estimate a potential increase in intelligence quotient (IQ) points across the population (between 110,000 and 700,000) with the proposed alternative NAAQS under various assumptions, including baseline blood lead levels at 2002 levels.

This draft Regulatory Impact Analysis (RIA) seeks to estimate benefits for the year 2020; however this draft represents initial estimates using a 2002 baseline blood lead level, resulting in a possible overestimate of benefits in the year 2020. Prior to completion of the final draft, assumptions will be revisited and, to the extent technically feasible, EPA will update the baseline to reflect expected effects on blood lead levels from other lead rules and potentially from an anticipated decline in population blood lead levels.

This draft Regulatory Impact Analysis (RIA) provides illustrative estimates of the incremental costs and monetized human health benefits of attaining a revised primary lead (Pb) National Ambient Air Quality Standard (NAAQS) within the current monitoring network[50]. Many of the highest-emitting Pb sources do not have nearby Pb-TSP monitors, and it is important to note that there may be many more potential nonattainment areas than have been analyzed in this RIA. Because of time and data constraints, in this draft RIA, estimates of costs and benefits employed different techniques for estimating future air quality. This results in benefits estimates that represent full attainment, and cost estimates that do not represent full attainment. These differences will be addressed in the final RIA, and further improvements to estimation techniques will be explored.

It should be noted again that overall data limitations are very significant for this analysis. One critical area of uncertainty is the limited TSP-Pb monitoring network (discussed in chapter 2). Because monitors are present in only 86 counties nationwide, the universe of monitors exceeding the various target NAAQS levels is very small; only 36 counties above 0.05 ug/m3, and only 24 counties exceeding the lowest proposed NAAQS level of 0.10 ug/m3. Because we know that many of the highest-emitting Pb sources in the 2002 NEI do not have nearby Pb-TSP monitors (see section 2.1.7), it is likely that there may be many more potential nonattainment

[49] Additional analysis of benefits under alternative assumptions is available as a memo in the docket titled: *Supplemental IQ Gain Calculations Using Two Additional Concentration-Response Functions*.

[50] There are currently 189 monitors representing 86 counties, but only 36 counties have monitors which exceed 0.05 ug/m^3.

areas than have been analyzed in this RIA. We should also emphasize that these benefit estimates are based on controlling Pb emissions using hypothetical control strategies, assuming no technological advances in emission control technology. As noted in the discussion of uncertainties below, the benefit and cost methods employed different air quality modeling techniques, which resulted in inconsistencies between the two values; that is, for certain standard alternatives the benefits and costs were estimated assuming different air quality changes.

As shown in Table 5-1 below, when applying a 3 percent discount rate, these IQ point benefits translate into monetary benefits for the least stringent standard alternative (0.5 $\mu g/m^3$) ranging between $1 and $1.4 billion (all values in 2006$). If blood levels continue to the observed decline, benefits could be lower. For the most stringent standard alternative (0.05 $\mu g/m^3$), monetary benefits range from $6.1 to $8.7 billion. Additional co-control benefits of reduced PM emissions are expected to range between $0.2 and $1.3 billion for the least stringent standard alternative, up to a range of $1.1 to $8.9 billion for the most stringent standard alternative. Therefore, the combined monetized health benefits from reductions in both lead and PM exposures as a result of lowering the current NAAQS range from $1.1 to $2.7 billion for the least stringent standard alternative, up to a range of $7.2 to $18 billion for the most stringent standard alternative.

When applying a 7 percent discount rate, the monetary benefits for changes in IQ the least stringent standard alternative (0.5 $\mu g/m^3$) range between $0.1 and $0.2 billion. For the most stringent standard alternative (0.05 $\mu g/m^3$), monetary benefits of IQ gains range from $0.8 to $1.5 billion. Additional co-control benefits of reduced PM emissions are expected to range between $0.1 and $1.1 billion for the least stringent standard alternative, up to a range of $1.0 to $8.0 billion for the most stringent standard alternative. Therefore, the combined monetized health benefits from reductions in both lead and PM exposures as a result of lowering the current NAAQS range from $0.3 to $1.4 billion for the least stringent standard alternative, up to a range of $1.8 and $9.5 billion for the most stringent standard alternative.

Figures 5-1 and 5-2 below display the health benefits from both lead and $PM_{2.5}$ exposure reductions for each of the four alternative standards using a 3 percent and 7 percent discount rate, respectively.[51] Figures 5-3 and 5-4 below display some examples of the total health benefits from both lead and $PM_{2.5}$ exposure reductions using different input assumptions for each of the four alternative standards using a 3 percent and 7 percent discount rate, respectively.

[51] Note that these figures present the lead benefits results that incorporate valuation estimates from Schwartz (1994b) and PM co-control benefits using the Pope et al. (2002) epidemiological study and therefore do not represent the full range of uncertainty in the expected benefits.

Table 5-1.
MONETARY BENEFITS OF ALTERNATE LEAD NAAQS (in millions of 2006$) IN 2020

Standard Alternative[1]	***Estimated Net Present Value of IQ Points Gained***[23]		***Monetized Benefits of Co-Controlled $PM_{2.5}$ Emissions***[4]		***Total Benefits***[5]	
	3% Discount Rate	**7% Discount Rate**	**3% Discount Rate**	**7% Discount Rate**	**3% Discount Rate**	**7% Discount Rate**
0.5 μg/m³	$970 - $1,400	$120 - $240	$150 - $1,300	$140 - $1,100	$1,100 - $2,700	$260 - $1,400
0.3 μg/m³	$1,700 - $2,500	$220 - $430	$410 - $3,500	$380 - $3,100	$2,200 - $6,000	$600 - $3,500
0.2 μg/m³	$2,500 - $3,500	$310 - $610	$560 - $4,700	$520 - $4,300	$3,000 - $8,200	$830 - $4,900
0.1 μg/m³	$3,900 - $5,500	$480 - $950	$690 - $5,800	$640 - $5200	$4,600 - $11,000	$1,100 - $6,200
0.05 μg/m³	$6,100 - $8,700	$760 - $1,500	$1,100 - $8,900	$970 - $8,000	$7,100 - $18,000	$1,700 - $9,500

1 All standard alternatives are for a second maximum monthly mean concentration.
2 Results reflect the use a 2002 derived non-air background blood lead applied to analysis year of 2020. To the extent that state and federal interventions such as the Renovation and Repair Rule (EPA, 2008c) reduce future non-air blood lead levels, the estimate of IQ change above may be overstated.
3 The lower end of the range of presented values was calculated using the Schwartz (1994b) valuation estimate; the upper end was calculated using the Salkever (1995) valuation estimate.
4 The range of presented values represent 14 different estimates from the PM epidemiological literature and an expert judgment study.
5 Numbers are rounded to two significant figures. Therefore, the sums in these columns may not total.

Figure 5-1.
LEAD AND PM $_{2.5}$ BENEFITS BY STANDARD ALTERNATIVE
(3% Discount Rate)

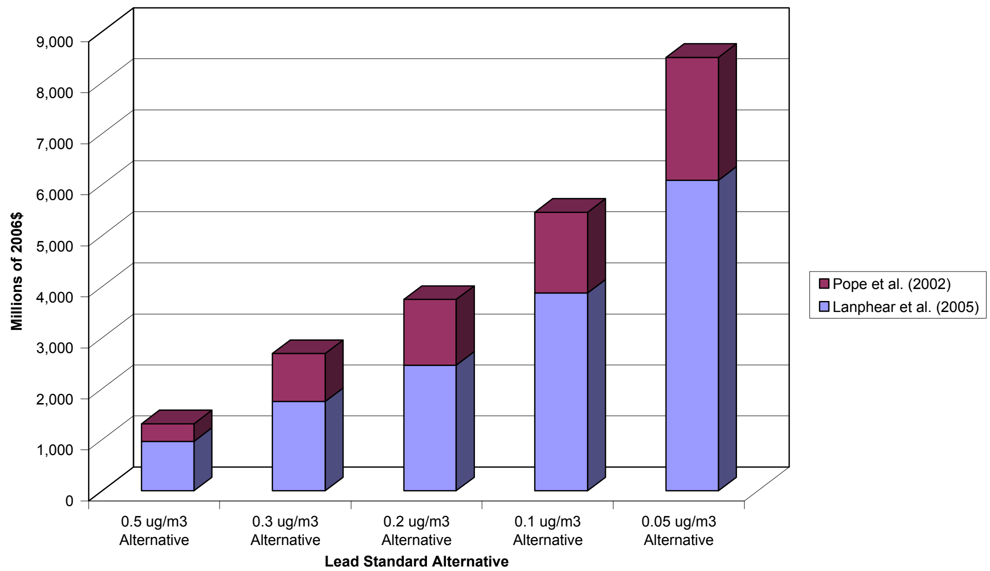


Figure 5-2.
LEAD AND PM$_{2.5}$ BENEFITS BY STANDARD ALTERNATIVE
(7% Discount Rate)

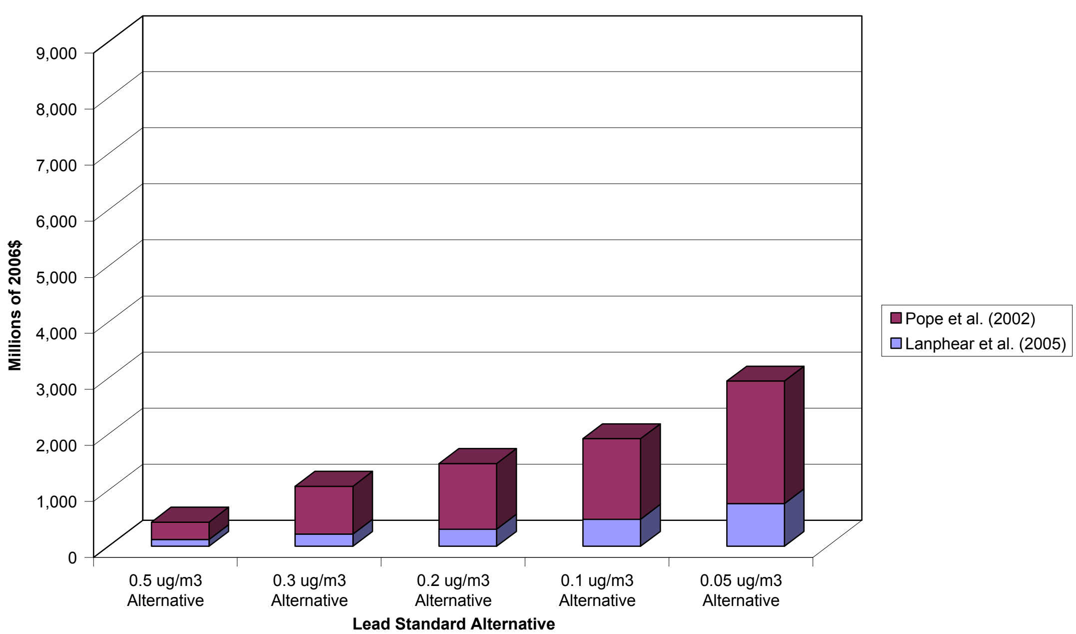


Figure 5-3.
EXAMPLE COMBINED LEAD AND TOTAL $PM_{2.5}$ MONETIZED BENEFITS ESTIMATES BY STANDARD ALTERNATIVE (3% Discount Rate)

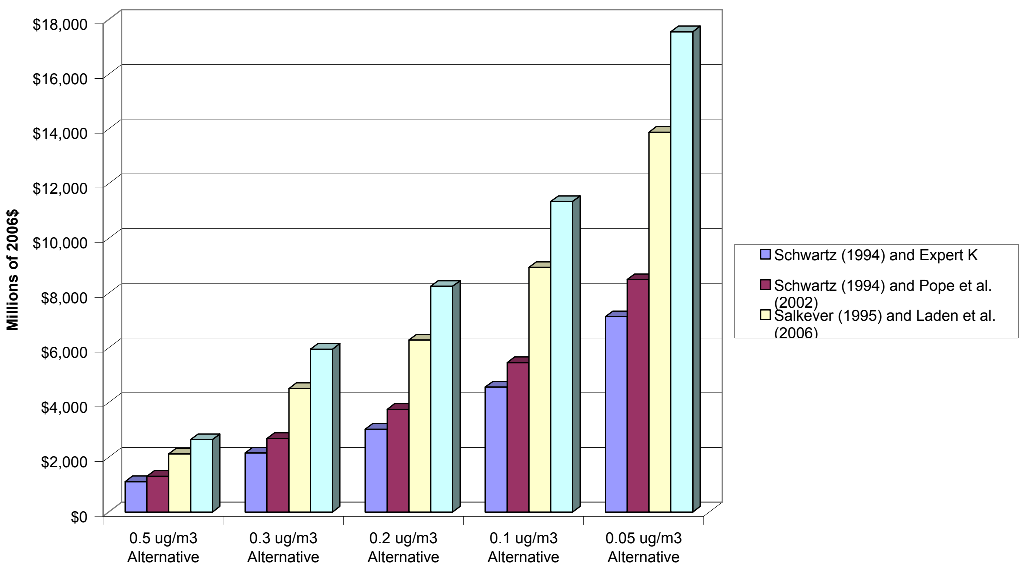
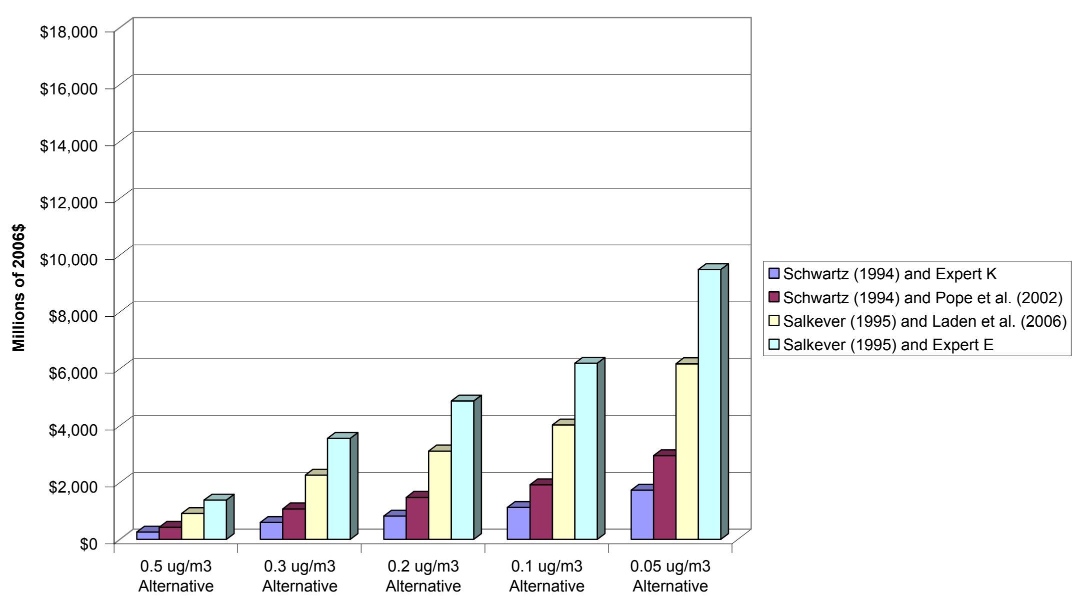


Figure 5-4.
EXAMPLE COMBINED LEAD AND TOTAL $PM_{2.5}$ MONETIZED BENEFITS ESTIMATES BY STANDARD ALTERNATIVE (7% Discount Rate)



5.1 Introduction

This chapter documents our analysis of health benefits expected to result from achieving alternative levels of the lead NAAQS, relative to base case ambient air lead levels. We first describe our approach for estimating and monetizing the health benefits associated with reductions of lead in air. Next, we provide a summary of our results, including an analysis of the sensitivity of the benefits model. We then review our approach to and results from estimating benefits from co-control of direct $PM_{2.5}$ emissions associated with implementing measures necessary to achieve alternative levels of the proposed lead NAAQS. Finally, we discuss the key results of the benefits analysis and indicate areas of uncertainty in our approach.

5.2 Benefits Approach

This section presents our approach for estimating avoided adverse health effects in humans resulting from achieving alternative levels of the lead NAAQS, relative to a base case ambient air lead level. We first review the epidemiological evidence concerning potential health effects of lead exposure and present the health endpoints we selected for our primary benefits estimate. We then describe our screening-level spreadsheet benefits model, including the data used and key assumptions. Finally, we describe our approach for assigning an economic value to the health benefits.

5.2.1 Benefits Scenario

We calculated the economic benefits from annual avoided health effects expected to result from achieving alternative levels of the lead NAAQS (the "control scenarios") in the year 2020. We measured benefits in the control scenarios relative to the incidence of health effects consistent with ambient lead levels in air expected under the current standard (1.5 $\mu g/m^3$ maximum quarterly mean; the "base case") in 2020. Note that this "base case" reflects emissions reductions and ambient air quality improvements that we anticipate will result from implementation of other air quality rules, including compliance with all relevant Maximum Achievable Control Technology (MACT) rules and the recently revised NAAQS for $PM_{2.5}$.[52] We compared benefits across four alternative second maximum monthly mean NAAQS levels of 0.5, 0.3, 0.2, 0.1, and 0.05 $\mu g/m^3$.

5.2.2 Selection of Health Endpoints

Epidemiological researchers have associated lead exposure with adverse health effects in numerous studies, as described in the *Air Quality Criteria for Lead* (USEPA, 2006a; hereafter, *Lead Criteria Document*). Young children are particularly sensitive to lead exposures; neurobehavioral effects of lead exposure in infants and young children (less than 7 years of age) have been observed consistently across multiple studies that control for an array of confounding factors (USEPA, 2006a).

[52] Development of this base case is described further in Chapter 4.

The Criteria Document provides a comprehensive review of the current evidence of health and environmental effects of Pb. With regard to health effects, the Criteria document summarizes the evidence as follows (CD, Section 8.4.1):

> "…Pb has been shown to exert a broad array of deleterious effects on multiple organ systems via widely diverse mechanisms of action. Truly remarkable progress has been made during the past several decades with regard to (a) more fully delineating over time the wide variety of pathophysiologic effects associated with Pb exposure of human population groups and laboratory animals and (b) the characterization of applicable exposure durations and dose-response relationships for the induction of the multifaceted Pb effects. This progress has been well documented by the previous Pb NAAQS criteria reviews carried out by EPA in the late 1970s and during the 1980s, as well as being well reflected by previous chapters of this document.
>
> The 1977 Lead AQCD (U.S. Environmental Protection Agency, 1977) that provided key scientific bases for the setting in 1978 of the current Pb NAAQS included discussion of both: (a) historical literature accumulated during several preceding decades that established Pb encephalopathy and other signs and symptoms of persisting severe central and/or peripheral nervous system damage, as well as renal and hepatic damage, and anemia as typifying the classic syndrome of acute and/or chronic high-level Pb poisoning among human pediatric and /or adult population groups, and (b) evaluation of then newly-emerging evidence for more subtle and difficult-to-detect "subclinical" Pb effects on IQ, other neurological endpoints, and moderate blood hemoglobin deficits or other erythropoietic indicators of heme synthesis impairment, which collectively were judged to constitute an array of adverse Pb health effects associated with Pb exposures indexed by blood Pb concentrations ranging down to ~30 µg/dL. The next Pb NAAQS criteria review during the 1980's, as contained in the 1986 Lead AQCD/Addendum and its 1990 Supplement (U.S. Environmental Protection Agency, 1986a, b, 1990) documented further rapid advances in Pb health effects research that provided (a) increasingly stronger evidence that substantiated still lower fetal and/or postnatal Pb-exposure levels (indexed by blood-Pb levels extending to as low as 10 to 15 µg/dL or, possibly, below) as being associated with slowed physical and neurobehavioral development, lower IQ, impaired learning, and/or other indicators of adverse neurological impacts and (b) other pathophysiological effects of Pb on cardiovascular function, immune system components, calcium and vitamin D metabolism, and other selected health endpoints.
>
> Newly available scientific information published since the 1986 Lead AQCD/Addendum and the 1990 Supplement, as assessed in previous chapters of this document, further expands our understanding of a wide array of Pb-induced health effects, underlying mechanisms, and factors that enhance or lessen susceptibility to Pb effects. Very importantly, the newly available toxicologic and epidemiologic information, as integrated below, includes assessment of new evidence substantiating risks of deleterious effects on certain health endpoints being induced by distinctly lower than previously demonstrated Pb exposures indexed by blood-Pb levels extending well below 10 µg/dL in children and/or adults.

The ensuing subsections *[of the CD]* provide concise summarization and integrative synthesis of the most salient health-related findings and conclusions derived from the current criteria assessment. This includes discussion of new toxicologic and/or epidemiologic evidence concerning Pbinduced (a) effects on neurobehavioral development and other indicators of nervous system effects; (b) cardiovascular effects; (c) heme synthesis effects; (d) renal effects; (e) immune system functions; (f) effects on calcium and vitamin D metabolism; (g) inter-relationships to bone and teeth formation and demineralization; (h) effects on reproduction and other neuroendocrine effects; and (i) genotoxicity and carcinogenic effects."

The differing evidence and associated strength of the evidence for these different effects is described in detail in the Criteria Document. The evidence with regard to adverse effects on plants and animals is also described in the Criteria Document.

Although a number of adverse health effects have been found to be associated with lead exposure, this benefits analysis only includes a subset, due to limitations in understanding and quantifying the dose-response relationship for some of these health endpoints and the fact that for some of these endpoints the science is less certain. We analyzed only those endpoints with sufficient evidence to support a quantified dose-response relationship. This determination was made using the information presented in the *Lead Criteria Document*, which contains an extensive literature review for several health endpoints related to lead exposure. However, this document only included studies published or accepted for publication through December 2005. Therefore, we performed supplemental searches in the online search engine PubMed to identify studies published between January 2006 and the present (see Appendix A for more information). Finally, we reviewed previous EPA lead benefits analyses to identify dose-response relationships that have been used previously (USEPA, 1997, 2006b & 2007a).

Our analysis focuses primarily on children's health effects due to our use of child-specific data to convert air quality data to a blood lead level, which is the most common biomarker of exposure used in dose-response functions.

This human health benefits analysis does not attempt to estimate the changes in lead-related health effects among adults. Several key data limitations prevented EPA from quantifying these important endpoints:

- *The available peer reviewed air:blood ratios to estimate adult blood lead changes are dated.* Previous EPA analysis of the costs and benefits of the Clean Air Act (USEPA, 1997) utilized air:blood ratios for adults from based on Snee et al. (1981), a meta-analysis of several studies, including Johnson et al..(1976), Fugas et al.(1973), and Nordman (1975). While these studies do provide insight into the responsiveness of adult blood lead levels to changes in lead concentrations in air, the age of these studies suggests that these ratios may not be appropriate for application in 2020. The more-recent peer-reviewed estimates of air:blood ratios have been derived for children.Applying these ratios to adults would be inappropriate given the important differences between the two populations in their ambient exposure to Pb.

- *There is a lack of current, peer reviewed non-air-related blood lead background estimates for adults*. Quantification of adult endpoints would require a non-air-related blood background for adults. CASAC recommends a range of values for children in their review of the Lead Risk Assessment. However, due to differences between adults and children in the routes of exposure to lead, it is possible that background levels would differ between these two receptor groups. Therefore, applying the child-specific non-air-related background blood lead levels to adults could mis-estimate the true adult background levels.

- *The adult health impact functions relating changes in blood lead to health outcomes are dated*. Certain adult health impact functions, such as those quantifying the relationship between blood lead and diastolic blood pressure (Nawrot, 2002) are current. However, the functions relating changes in blood pressure to changes in premature mortality, chronic heart disease and stroke were each drawn from studies published in the 1970's; advances in the treatment of high blood pressure suggest that these functions may over-predict of changes in these health effects in the current population. One newer study, Schober et al. (2006), quantifies the relationship between blood lead and cardiovascular mortality. However, according to the *Lead Criteria Document,* "…until the Schober et al. findings are replicated and more fully understood, the Schober et al. (2006) estimates for Pb-induced cardiovascular mortality should probably not be used for quantitative risk assessment" USEPA, 2006a, page 8-89.

Taken together, these data limitations make a credible quantified assessment of adult endpoints very challenging and subject to considerable uncertainty. The Agency is working to addressing these data limitations so that it may be possible to provide a quantitative estimate of the adult endpoints for the next Pb NAAQS review in approximately 5 years. In the final RIA EPA will include a more detailed discussion of the types of information and data that would improve its ability to provide quantitative health benefit estimates for adults.

Table 5-2 below presents the health effects related to exposure to lead in the air that are quantified in this benefits analysis. In addition, the table includes a list of other endpoints that potentially are linked to lead exposure, but which do not have dose-response functions available for quantifying benefits.

As shown in Table 5-2, our primary estimate is based on the effect of IQ loss on lifetime earnings. There are several recent epidemiological analyses that have found potential adverse health impacts of blood lead levels on cognitive function (most often measured as changes in IQ) in young children under 7 years of age, as described in the *Lead Criteria Document*. However, as also noted in that document, there has been conflicting evidence as to whether there exists a discrete period of neurological vulnerability to lead exposure during childhood.

For instance, the first three years of life represent the maximal period of lead ingestion as well as a period of time when important development of the central nervous system is occurring, which suggests that biologically, this could be a vulnerable period (USEPA, 2006a). In addition, there are two major meta-analyses that focused on the association between school age IQ and blood lead concentrations at two years of age or average blood lead concentrations up to three years of age (Pocock et al, 1994; Schwartz, 1994a). However, several recent prospective epidemiological studies have found concurrent blood lead level (i.e., blood lead measured at the same time as school age IQ) or lifetime average blood lead level (i.e., a mean of blood lead level from infancy to measurement of school age IQ) to be more strongly associated with school age IQ and other measures of neurodevelopment (Canfield et al., 2003; Dietrich et al, 1993; Tong et al. 1996, Wasserman et al., 2000). In addition, a large, international meta-analysis by Lanphear et al. (2005) included four measures of blood lead level: concurrent, peak, lifetime average, and early childhood. The authors found that the concurrent and lifetime blood lead levels were the strongest predictors of IQ deficits associated with lead exposure.

A study by Chen et al. (2005) specifically evaluated whether a window of enhanced susceptibility to lead exists. This study examined whether cross-sectional associations observed in school age children represent residual effects from two years of age or "new" effects emerging among these children (USEPA, 2006a). Chen et al. found that the blood lead metric with the strongest association with IQ was concurrent, and this relationship grew stronger with age. The authors did not find any association between peak blood lead level and IQ measured at seven years of age. In addition, a stronger relationship was found between IQ at seven years of age and blood lead level at seven years of age compared with blood lead at two years of age. The *Lead Criteria Document* concluded that "[t]hese results support the idea that lead exposure continues to be toxic to children as they reach school age, and do not lend support to the interpretation that all damage is done by the time the child reaches two to three years of age" (USEPA, 2006a, page 6-63). Based on this evidence, it is reasonable to assume that all children under seven years of age in the study area for this analysis will experience some cognitive benefit (i.e., IQ loss avoided) from reduced ambient air lead in 2020. Therefore, we have designed our benefits analysis to measure benefits to all children under seven in our study area.

Table 5-2.
HUMAN HEALTH EFFECTS OF LEAD

Quantified Health Effects	***Unquantified Health Effects***[a]
-Intelligence Quotient (IQ) loss effect on lifetime earnings	-Other neurobehavioral and physiological effects -Delinquent and anti-social behavior -IQ loss effects on compensatory education -Hypertension -Non-fatal coronary heart disease -Non-fatal strokes -Premature mortality -Other cardiovascular diseases -Neurobehavioral function -Renal effects -Reproductive effects -Fetal effects from maternal exposure (including diminished IQ)

[a] The categorization of unquantified toxic health effects is not exhaustive. Health endpoints in this column include both a) those for which there is not consensus; and b) those for which associations, to various degrees, has been determined but empirical data are not available to allow calculation of benefits.

5.3 Benefits Estimation Model

5.3.1 Overview

For this benefits analysis, we created a spreadsheet model to provide a screening-level assessment of health benefits occurring as a result of implementing alternative NAAQS levels. The model uses various simplifying assumptions and is intended only to provide an approximate, preliminary estimate of the potential health benefits. EPA plans to refine the model as it progresses towards a final NAAQS level for lead.

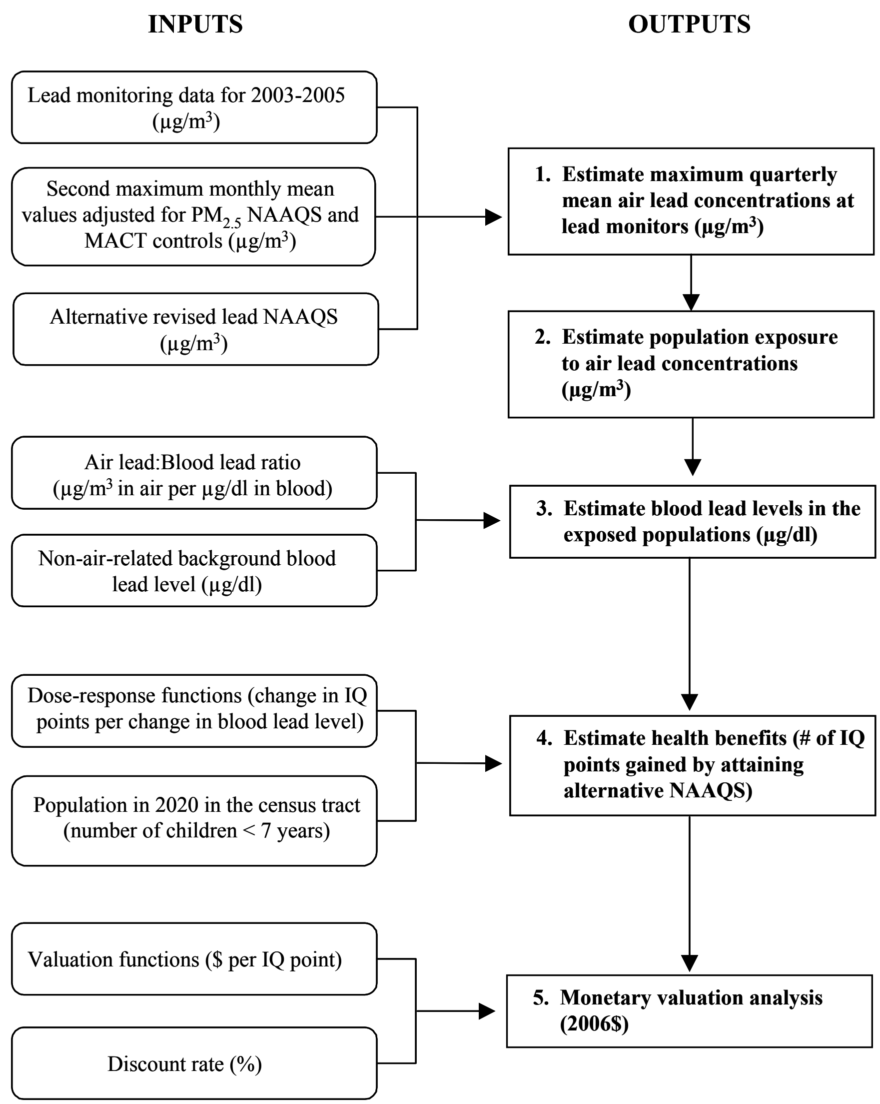
The model was constructed in Microsoft Excel™ and provides an integrated tool to complete five benefits estimation steps: 1) estimate lead in air concentrations for the "base case" and "control scenarios"; 2) estimate population exposures to air lead concentrations for each scenario; 3) estimate blood lead levels in the population for each scenario; 4) estimate avoided cases of health effects due to changes in blood lead levels; and 5) apply an economic unit value to each avoided case to calculate total monetized benefits. These steps and the data inputs required are shown in Figure 5-5 and are discussed in further detail below.

5.3.2 Estimating Lead in Air Concentrations

We used estimates of the second maximum monthly mean lead total suspended particles (TSP) for each monitor included in our study to characterize ambient air lead concentrations for the "base case" in 2020 (USEPA, 2007b). These estimates were calculated by adjusting second maximum monthly mean lead TSP monitoring values for the years 2003 to 2005 to account for emissions reductions due to compliance with MACT requirements and the NAAQS for $PM_{2.5}$ occurring by 2020 (see Chapter 4 for additional information). We assumed that under the "control scenario," every monitor would meet the alternative NAAQS in 2020 and therefore, assigned the proposed alternative NAAQS level as the second maximum monthly mean to all monitors.

The benefits model used estimates of maximum quarterly mean lead concentrations in order to calculate avoided cases of health endpoints. This decision was based on a number of studies outlined in EPA's 2007 Staff Paper (USEPA, 2007c; Section 5.5.2), which indicate that changes in blood lead levels resulting from changes in air lead concentrations occur within a relatively short timeframe (i.e., within a few weeks to months). This finding is also supported by a simulation of changes in urban residential dust lead levels following a change in ambient air lead using the hybrid mechanistic empirical model developed for the *Lead Risk Assessment*. That analysis showed that changes in indoor dust lead levels (the primary source of children's exposure) tracked closely with changes in ambient lead air concentrations. The hybrid model developed for the general urban case study suggested that 90% of steady-state impacts will be recognized within the three months and take up to one year for a full change to be realized.

Figure 5-5.
OVERVIEW OF LEAD BENEFITS MODEL



Note: This model is run for each census tract separately. Results are then aggregated across all census tracts.

Therefore, for the "base case" estimates of lead air concentrations used in the model, we estimated the expected maximum quarterly mean air lead concentration in 2020 at each monitor based on the second maximum monthly mean values for the "base case." This was achieved by calculating monitor-specific ratios of the second maximum monthly mean to the maximum quarterly mean for the period 2003-2005 and then dividing the second maximum monthly mean for the "base case" by this ratio.

For the "control scenario" we estimated the maximum quarterly mean lead in air concentration that would be expected in 2020, based on the second maximum monthly mean NAAQS concentration. As in the "base case," we used monitor-specific ratios of the second maximum monthly means to maximum quarterly means for 2003-2005 and then divided the selected NAAQS by this ratio.

5.3.3 Estimating Population Exposure

The first input to any benefits assessment is the estimated changes in ambient air quality expected to result from simulated attainment of a NAAQS. EPA typically relies upon air quality modeling to generate these data. For this analysis, time and technical limitations prevented us from performing formal air quality modeling. Instead, EPA employed two alternate approaches to approximate the air quality change resulting from attainment of alternate lead NAAQS. Each approach relies upon the lead monitoring network as the basis for subsequent air quality estimates. The first approach, which we employed to generate our primary benefits estimate, uses an interpolation method utilized in previous RIA's to estimate changes in lead concentrations in projected non-attainment areas. The second approach, which we utilized as a sensitivity analysis, applies a radius of a fixed size around each non-attaining lead monitor and estimates a fixed concentration of lead within that radius. We describe the process for using each approach below.

5.4 Interpolation Method

This approach applies an interpolation method to generate an air quality surface from available lead monitoring data to better represent the spatial heterogeneity of lead concentrations in a projected non-attainment area. It utilizes both the lead monitoring network as well as the lead-speciating TSP monitoring network; we added the lead-speciating monitors to increase the number of data points available for the interpolation. We interpolated lead concentrations to the census tract, rather than census block group, to increase the computational efficiency of the model.

To create an air quality surface of ambient lead values we applied the Voronoi Neighborhood Averaging (VNA) method.[53] The VNA is an inverse-distance-weighting technique that interpolates point monitor data to a user-defined grid cell for the purpose of

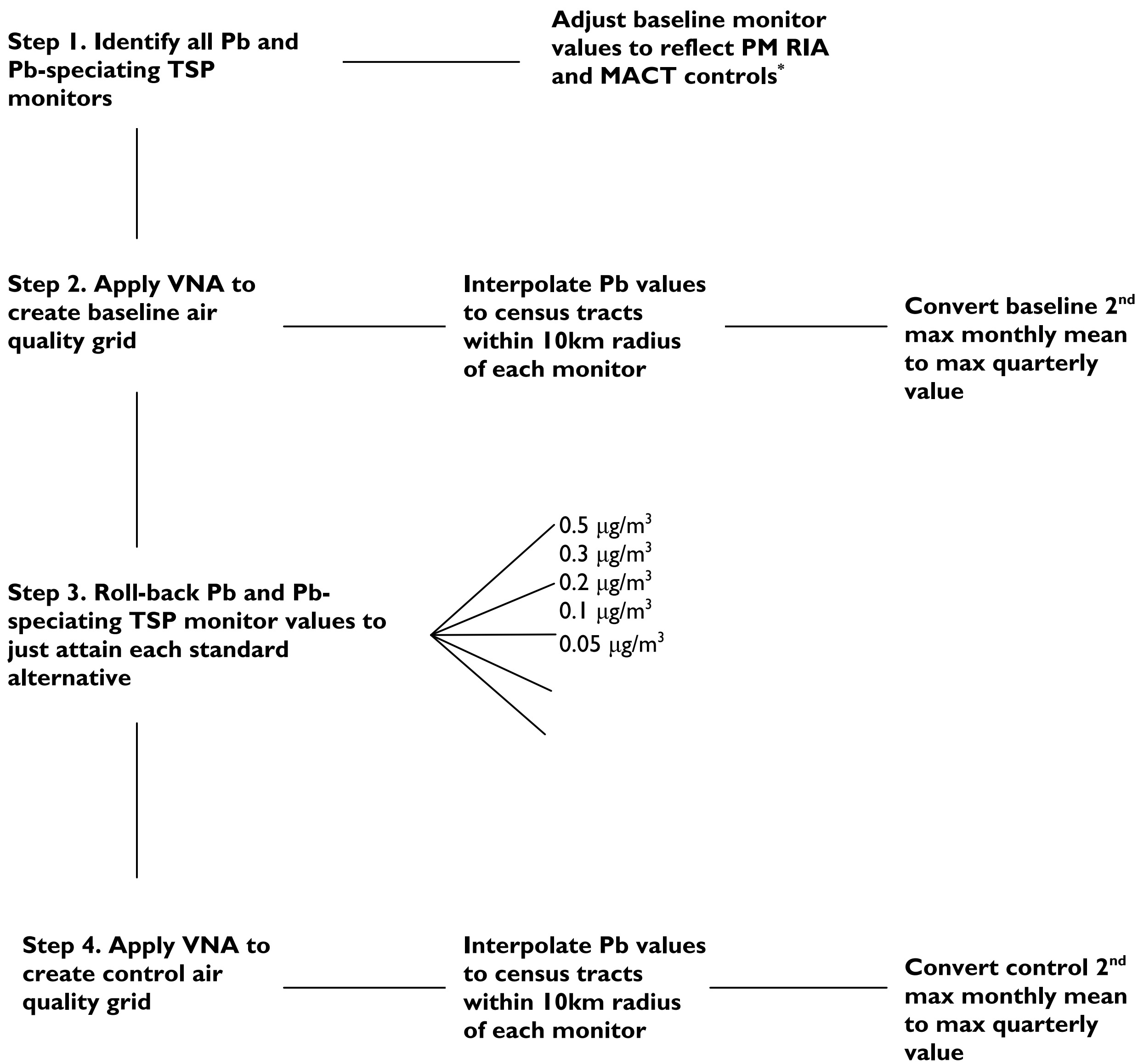
[53] Readers interested in reviewing the technical details of the VNA approach may consult the technical appendices to the BenMAP User manual, found at: http://www.epa.gov/air/benmap/models/BenMAPTechnicalAppendicesDraftMay2005.pdf

creating an air quality surface. The VNA approach is well suited for this type of analysis because the inverse distance weighting approach can approximate the gradient of ambient lead surrounding each monitor. VNA is a well-established technique that EPA has used in combination with modeled air quality changes to estimate the air quality change associated with full attainment of $PM_{2.5}$ and Ozone NAAQS (USEPA, 2006c & 2008a).

Figure 5-6 below summarizes how we applied the VNA method in this analysis.

The VNA approach is expected to provide a better representation of the gradient of ambient lead around each monitor as compared to the radius approach. For this reason, we utilized this approach to generate our primary benefits estimate. However, this validity of this method is to some extent contingent upon the availability of a sufficient number of monitors to support an interpolation. In certain locations, such as Hillsborough County, FL, there are a sufficient number of lead and TSP monitors to generate an interpolation with a pronounced gradient around each monitor (see Figure 5-7). The lead and TSP monitoring network in other non-attainment areas can in some cases be sparse, and the resulting interpolation does not appear to generate a meaningful gradient, such as in Delaware County, IN (see Figure 5-8). To the extent that there was a denser lead monitoring network in such locations, the interpolation approach would produce a gradient that better represents actual ambient lead concentrations. While both the VNA and radius approaches exhibit limitations, we hold more confidence in the results of the interpolation approach and so rely upon it as our primary method of simulating air quality changes. As a means of acknowledging the limitations to the interpolation method we also provide sensitivity estimates using the radius method.

Figure 5-6.
STEPS IN THE VNA INTERPOLATION METHOD



***This step required us to adjust the Pb-speciating TSP monitors to reflect the presence of PM RIA and MACT emission controls. The emissions controls team performed this adjustment for the Pb monitors. To make a conforming adjustment to the Pb-speciating TSP monitors, we used VNA to interpolate the PM RIA and MACT-related air quality improvement from the Pb monitors to the Pb-speciating TSP monitors.**

Figure 5-7.
AIR LEAD CONCENTRATION GRADIENT IN HILLSBOROUGH COUNTY, FLORIDA

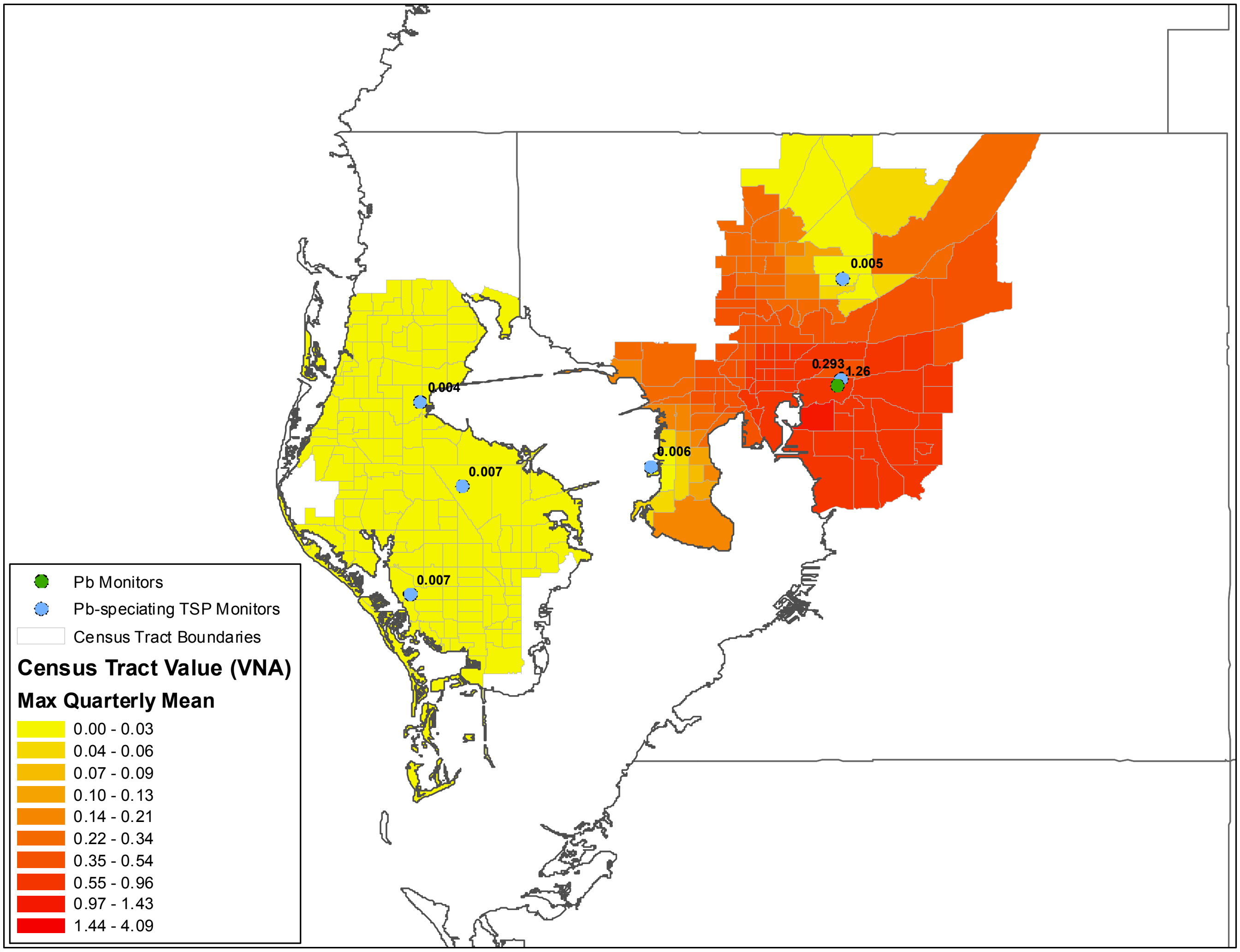
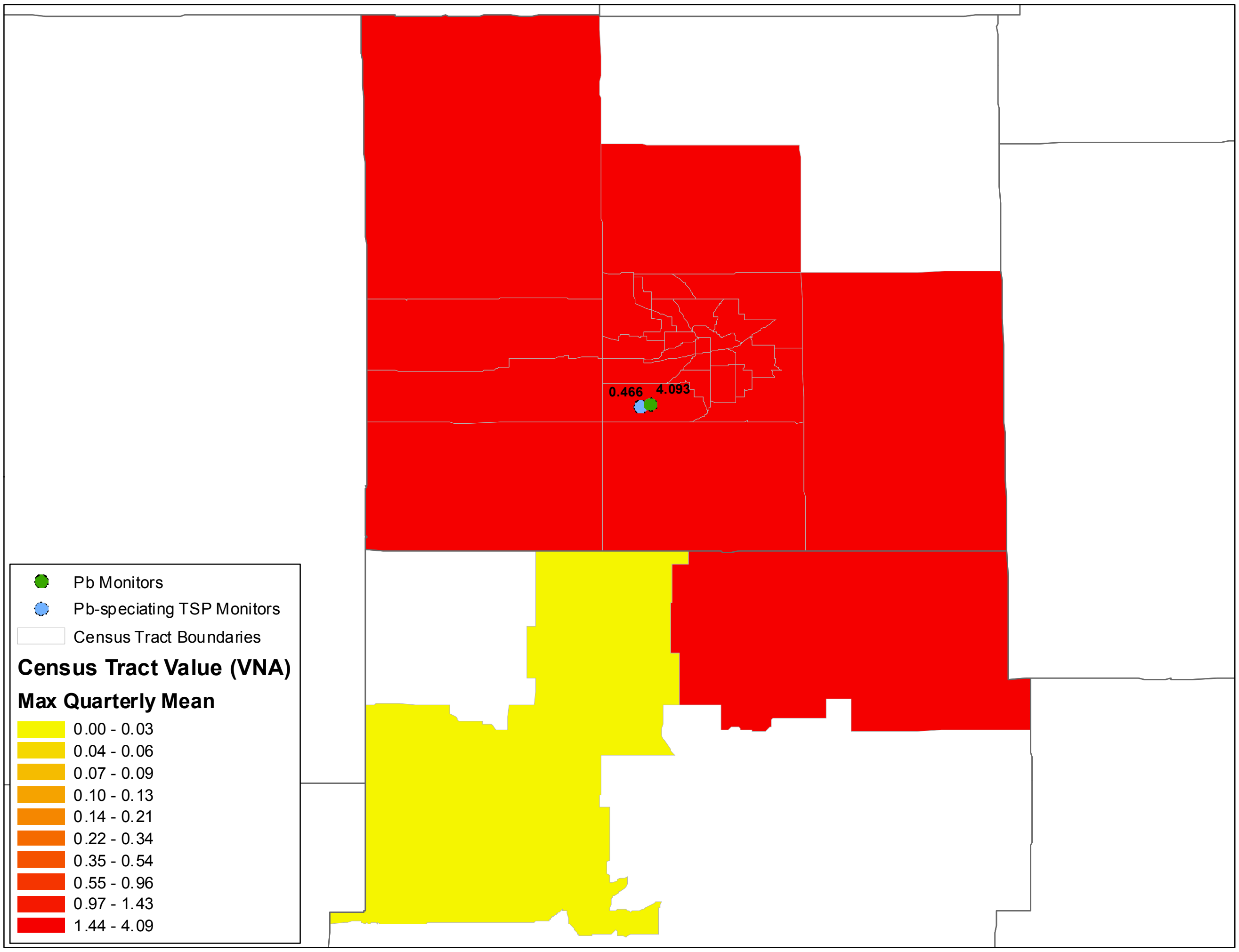


Figure 5-8.
AIR LEAD CONCENTRATION GRADIENT IN DELAWARE COUNTY, INDIANA



5.5 Radius Method

In this approach we focused on the 36 monitors in counties that potentially could be designated as non-attainment areas under at least one of these alternative lead NAAQS levels. These monitor concentration values likely only apply to the population of people living within the vicinity of these monitors, especially if the monitor is oriented near a source of lead contamination (e.g., a primary or secondary lead smelter). As a default, we defined the affected population as those individuals living within a 10-kilometer radius around the monitor. The 10-kilometer radius is consistent with source-specific modeling in the EPA *Lead Risk Assessment* case studies for primary and secondary sources (USEPA, 2007a). In the absence of detailed air quality modeling for the lead sources in the vicinity of each monitor, we assumed in this screening-level analysis that the lead concentrations in air measured at each monitor are uniform throughout the specified radius. To develop a conservative upper-bound estimate of lead benefits, we assumed the entire population of the county was exposed to the concentration measured at the monitor (the geographic extent of a county generally exceeds 10 km). Also, for the 19 source-oriented monitors in our dataset we performed sensitivity analysis using alternate, smaller radii of one, two, and five kilometers, since lead air concentrations can in some cases display significant gradients with distance from a source-oriented monitor. For example, second maximum monthly mean values measured at monitors in close proximity to the Herculaneum, MO lead smelter drop off 40 percent within roughly 1 km of the source and decrease by an additional 95 percent within 2 km.[54]

We used ArcGIS to establish the radii around each monitor. Our spatial dataset contained US Census population data at the block group level for the year 2000. We calculated the total population within each radius in 2000 by adding the population of each Census block group that resided completely within the radius and the relative fraction of the population of block groups only partially falling within the radius, assuming that the population was uniformly distributed throughout the block group.[55] For instance, if 50 percent of the block group was located inside the radius, we added 50 percent of its population to the total population of that radius.

We next took the estimate of the total population for each radius in 2000 and distributed it into gender- and age-specific groups (in five-year increments, consistent with the age ranges reported by the Census) according to the county-level Census data for the county in which the monitor resides.[56] In a few instances where a radius extended into a neighboring county, we assumed the age and gender-specific proportions would be the same as the county in which the monitor resides.

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[54] This was assessed using second maximum monthly mean monitoring data between 2003-2005 for eight monitors located near the Herculaneum Lead Smelter (operated by the Doe Run Company) (USEPA, 2007b).

[55] In two instances, the radius drawn around one monitor overlapped with the radius drawn around another monitor. The first case affected monitors located in Adams and Denver counties in Colorado and the second affected monitors located in Madison and St. Claire counties in Illinois. We assigned the highest measured concentration at the two monitors to the population residing in the overlapping area.

[56] The five-year age groups were 0-4, 5-9, 10-14, … up to 85 and above.

5.6 Population Projections

For both the interpolation and radius methods, we extrapolated the 2000 age- and gender-specific population data to 2020, using Woods and Poole county-level projection data (Woods and Poole, 2001). We calculated a growth rate for each gender and age group combination by taking the ratio of the 2020 estimate from Woods and Poole to the corresponding 2000 county-level estimates from the Census. We applied the calculated growth rates to each gender and age group to estimate the total population in 2020 residing within each census tract or radius. This approach to population projection is consistent with previous EPA RIA's that estimate future-year human health benefits (USEPA 2006c, 2007c, 2008a). However EPA does not assume that the number of Pb emitting sources will grow correspondingly with the population growth as discussed in the Chapter 4.

In order to determine the number of children aged six and under, we added the population of children in the 0-4 age group for both genders and then added two-fifths of the population in the 5-9 age group, assuming the population was uniformly distributed across all five ages in that group.

5.7 Estimating Blood Lead Levels

The concentration-response functions we employ in this benefits analysis require estimates of blood lead levels in the exposed population to calculate avoided incidence of adverse health effects. We chose to develop a first approximation of the blood lead levels associated with reductions in air lead concentrations for each of the alternative NAAQS by using the air lead to blood lead ratio ("air:blood ratio") approach applied by EPA in deriving the current NAAQS in 1978 (43 FR 46246). These ratios predict geometric blood lead levels due to direct lead exposure via inhalation as well as indirect exposures via ingestion of dust and soils contaminated by lead deposition, based on comparisons of historical data on lead in ambient air and measured or modeled geometric mean blood lead levels in an exposed population. Table 5-3 lists the ratios considered for the current NAAQS analysis; for its primary estimate, EPA chose a ratio of 1:5 $\mu g/m^3$ to µg/dl. That is, for every one microgram per cubic meter reduction in air lead, EPA assumed that geometric mean blood lead levels would be reduced by five micrograms per deciliter. We selected this value based on advice from the Clean Air Scientific Advisory Committee (CASAC) and analysis conducted as part of EPA's *Lead Risk Assessment* (USEPA, 2007a & 2007d).

CASAC in its March 2007 review of EPA's *Lead Risk Assessment* recommended that EPA apply these ratios as part of a population level lead risk analysis to inform alternative proposals for a new lead NAAQS (USEPA, 2007d; see Appendix D). In its previous NAAQS analysis, EPA used a ratio of 1:2 $\mu g/m^3$ to µg/dl; however, CASAC suggested that ratios higher than 1:2 may be appropriate based on more recent literature. CASAC cites the use of a ratio of 1:5 by the World Health Organization (WHO) in 2000 to better account for lead deposition from air to dust and soil, and they cite a ratio of 1:9-1:10 based on the data in Schwartz and Pitcher (1989) on blood lead changes resulting from the phase-out of lead in gasoline. This ratio is not considered further in this analysis due to the differences between that analysis and this RIA in the exposure environment considered.

As part of its *Lead Risk Assessment*, EPA calculated air:blood ratios based on the extensive modeling conducted for its case studies and compared these ratios to values reported in the literature (USEPA, 2007a). For the benefits analysis, we focused on the ratios in Table 5-7 of the *Lead Risk Assessment* that compare the incremental reduction in air concentrations required to meet lower alternative NAAQS levels to the corresponding incremental change in blood lead. The ratios for the general urban and primary lead smelter case studies range from 1:2 to 1:6 for scenarios ranging from the current NAAQS to an alternative NAAQS of 0.05 $\mu g/m^3$ maximum monthly mean. EPA found these values to be similar to ratios available in the literature, specifically to ratios reported in a 1984 meta-analysis by Brunekreef (1:3 to 1:6) and to values calculated from a more recent 2003 study by Hilts (1:7). More recently, a study of changes in children's blood Pb levels associated with reduced Pb emissions and associated air concentrations near a Pb smelter in Canada (for children through age six in age) reports a ratio of 1:6 and additional analysis of the data by EPA for the initial time period of the study resulted in a ratio of 1:7 (CD, pp. 3-23 to 3-24; Hilts, 2003).[57] Ambient air and blood Pb levels associated with the Hilts (2003) study range from 1.1 to 0.03 µg/m3, and associated population mean blood Pb levels range from 11.5 to 4.7 µg/dL, which are lower than levels associated with the older studies cited in the 1986 Criteria Document (USEPA, 1986).

We selected as our default estimate a 1:5 air:blood ratio, which represented the ratio for the change in the urban case study from current (mean) conditions to an alternative NAAQS of 0.2 $\mu g/m^3$ maximum monthly mean. According to the Notice of Proposed Rulemaking, "There are a number of sources of uncertainty associated with these model-derived ratios. The hybrid indoor dust Pb model, which is used in estimating indoor dust Pb levels for the urban case studies, uses a HUD dataset reflecting housing constructed before 1980 in establishing the relationship between dust loading and concentration, which is a key component in the hybrid dust model (see Section Attachment G-1 of the Risk Assessment, Volume II). Given this application of the HUD dataset, there is the potential that the non-linear relationship between indoor dust Pb loading and concentration (which is reflected in the structure of the hybrid dust model) could be driven more by the presence of indoor Pb paint than contributions from outdoor ambient air Pb. We also note that only recent air pathways were adjusted in modeling the impact of ambient air Pb reductions on blood Pb levels in the urban case studies, which could have implications for the air-to-blood ratios." (US EPA, 2008b).

[57] This study considered changes in ambient air Pb levels and associated blood Pb levels over a five-year period which included closure of an older Pb smelter and subsequent opening of a newer facility in 1997 and a temporary (3 month) shutdown of all smelting activity in the summer of 2001. The author observed that the air-to-blood ratio for children in the area over the full period was approximately 1:6. The author noted limitations in the dataset associated with exposures in the second time period, after the temporary shutdown of the facility in 2001, including sampling of a different age group at that time and a shorter time period (3 months) at these lower ambient air Pb levels prior to collection of blood Pb levels. Consequently, EPA calculated an alternate air-to blood Pb ratio based on consideration for ambient air Pb and blood Pb reductions in the first time period (after opening of the new facility in 1997).

For sensitivity analysis, we selected a lower bound of the 1:2 ratio from the previous NAAQS and an upper bound of 1:7 as upper bound of the Hilts study-based estimates.

According to the Notice of Proposed Rulemaking, "…in EPA's view, the current evidence in conjunction with the results and observations drawn from the exposure assessment, including related uncertainties, supports consideration of a range of air-to-blood ratios for children ranging from 1:3 to 1:7, reflecting multiple air-related pathways beyond simply inhalation and the lower air and blood Pb levels pertinent to this review" (US EPA, 2008b)

We divided the maximum quarterly mean lead in air concentrations for each scenario by the air:blood ratio to estimate the blood lead level in the population due solely to exposure to ambient air. We then added an estimate of non-air-related background blood lead level (e.g., from ingestion of indoor dust or outdoor soil contaminated by lead paint) to calculate the total geometric mean blood lead level expected in the population.[58] For our estimate of non-air-related background, we selected the midpoint from a range of values reported by CASAC as being most appropriate for children under 7 years of age (USEPA, 2007d).[59] We apply this estimate of current-year non-air background blood lead for an analysis year of 2020. State and federal interventions such as the Renovation and Repair Rule (EPA, 2008c) may reduce future non-air blood lead to a level below this estimate. Recognizing that future levels of non-air background among exposed populations may be lower than the estimates applied in this analysis, EPA is committed to exploring the technical feasibility of projecting background blood lead levels for the final RIA.

The air:blood ratio provided us with an estimate of the geometric mean blood lead level across the population of exposed children, which we then used to estimate the magnitude of health effects benefits. We assumed that the blood lead level changes in 2020 estimated in this way are a reasonable representation of lifetime average blood lead level for children under seven years of age in our study and were used with the selected dose-response functions without further adjustment.

[58] We estimated total blood lead level to be consistent with the epidemiological studies underlying the dose-response functions we used for estimating changes in IQ due to changes in lead exposure, which are based on total blood lead level.

[59] CASAC provided a range of non-air-related background geometric mean concentrations of 1.0 – 1.4 µg/dl in their comments on EPA's *Lead Risk Assessment* (USEPA, 2007a). We selected the midpoint of this range, 1.2 µg/dl, for this analysis.

Table 5-3.
AIR LEAD TO BLOOD LEAD RATIOS

Ratio	***Source***	***Description***
1:2	USEPA, 1978	Air:blood ratio applied in EPA's previous NAAQS RIA. More recent evidence suggests blood lead more sensitive to air concentrations than previously thought, particularly at lower exposure levels; thus, a higher ratio may be appropriate for changes from current conditions.
1:2 to 1:6	USEPA, 2007a	Ratios in Table 5-7 of EPA's current *Lead Risk Assessment* (USEPA, 2007a) estimated from modeling of exposures in urban areas and areas near lead smelters. These ratios compare the incremental reduction in air concentrations required to meet lower alternative NAAQS levels to the corresponding incremental change in blood lead. This ratio is likely to provide the best estimate of blood lead associated with recent changes in air lead concentrations. These ratios for the general urban and primary lead smelter case studies range from 1:2 to 1:6 for scenarios ranging from the current NAAQS to an alternative NAAQS of 0.05 $\mu g/m^3$ maximum monthly mean, respectively.
1:5	USEPA, 2007a WHO, 2005	Ratio applied by WHO to establish current lead Air Quality Guideline for Europe. Also reported in Table 5-7 of EPA's *Lead Risk Assessment* (USEPA, 2007a; see above) for the ratio for the change in the urban case study from current (mean) conditions to an alternative NAAQS of 0.2 $\mu g/m^3$ maximum monthly mean. Selected as default air:blood ratio because it represents reasonable central estimate of the change from current conditions to a proposed alternative NAAQS level.
1:3 to 1:6	Brunekreef, 1984	Ratios reported in a meta-analysis of surveys of smelters and urban areas. Based on older studies that typically reflect ratios for children with blood lead levels > 10 μg/dl.
1:6 to 1:7	Hilts, 2003[60]	Ratio calculated from more recent study of air concentrations and blood lead levels for children living near a British Columbia smelter during a period of decreasing lead emissions. Blood lead levels in this study (4 – 10 μg/dl) are lower than in the Brunekreef studies, but still higher than those modeled in EPA's 2007 *Lead Risk Assessment*.

5.8 Estimating Avoided Health Effects

The following section presents the approach we used to quantify the health benefits of lead due to reductions in the blood lead levels in the population resulting from lowering the NAAQS.

This analysis estimates the adverse health impact of blood lead levels on changes in IQ in young children below seven years of age. Cognitive effects are thought to strongly relate to a child's future productivity and earning potential (USEPA, 2006b).

[60] This study considered changes in ambient air Pb levels and associated blood Pb levels over a five-year period which included closure of an older Pb smelter and subsequent opening of a newer facility in 1997 and a temporary (3 month) shutdown of all smelting activity in the summer of 2001. The author observed that the air-to-blood ratio for children in the area over the full period was approximately 1:6. The author noted limitations in the dataset associated with exposures in the second time period, after the temporary shutdown of the facility in 2001, including sampling of a different age group at that time and a shorter time period (3 months) at these lower ambient air Pb levels prior to collection of blood Pb levels. Consequently, EPA calculated an alternate air-to blood Pb ratio based on consideration for ambient air Pb and blood Pb reductions in the first time period (after opening of the new facility in 1997).

According to the CDC, "[t]he data demonstrating that no 'safe' threshold for blood lead levels (BLLs) in young children has been identified" (CDC, 2005; page ix). Therefore, we did not incorporate a threshold in our analysis. Many epidemiological studies examining the link between blood lead level and children's IQ have found an inverse relationship (i.e., increases in blood lead levels are associated with decreases in children's IQ), with more potent effects occurring at lower blood lead levels (e.g., Lanphear et al., 2005; Canfield et al., 2003). The Workgroup of the Advisory Committee on Childhood Lead Poisoning Prevention to the Centers for Disease Control and Prevention (CDC) concluded that overall, the weight of available evidence supports an inverse association between blood lead levels and cognitive function in children in the low range of blood lead levels (i.e., below 10 µg/dl) (CDC, 2005). The CDC workgroup document also indicates that, "[a] steeper slope in the dose-response curve was observed at lower rather than higher [blood lead levels] BLLs" (page iv of the Appendix). In addition, EPA's Integrated Risk Information System (IRIS) concluded the following: "by comparison to most other environmental toxicants, the degree of uncertainty about the health effects of lead is quite low. It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold" (USEPA, 2004).

In order to quantify the expected changes in IQ points in the population of children due to the implementation of alternative NAAQS, we utilized available dose-response functions in the literature. For our primary estimate, we selected a dose-response relationship from a pooled analysis of seven prospective studies in North America and Europe examining the effect of lead on full-scale IQ in children (Lanphear et al., 2005).[61,62] Blood lead levels were measured in each study five times over early childhood (at 6, 12 (or 15), 36, 48, and 60 months). Full-scale IQ was measured when the children were between 4 and 10 years of age. Four measures of blood lead were examined by the authors: concurrent blood lead (defined as the blood lead measured closest to the IQ test), maximum blood lead (defined as the peak blood lead measured at any time before the IQ test), average lifetime blood lead (defined as the mean blood lead from six months to concurrent blood lead tests), and early childhood blood lead (defined as the mean blood lead from 6 to 24 months). The authors found that the concurrent and lifetime blood lead levels were the strongest predictors of IQ deficits associated with lead exposure.

We used an estimate from this study based on a log-linear relationship between lifetime blood lead level and IQ score.[63] The log-linear relationship was found to be the best fit for the data and the lifetime blood lead levels exhibited a strong relationship with IQ. In addition, we found this measure to be the most consistent with the benefits scenario (see the section in this chapter entitled "Selection of Health Endpoints for further information). Lanphear reports an IQ decrement of 6.2 points for an increase in lifetime blood lead level from 6.1 to 47.0 µg/dl for the selected model. However, the lowest measured lifetime blood lead level represented in the Lanphear pooled analysis was 1.47 µg/dl. To estimate IQ effects at blood lead levels below this

[61] Full-scale IQ is a composite score of verbal and performance tests. Children were administered a version of the Wechsler Intelligence Scales for Children under uniform conditions within each study (Lanphear et al., 2005).

[62] The seven cohort studies included in this analysis include sites in Boston, Massachusetts (Bellinger et al., 1992); Cincinnati and Cleveland, Ohio (Dietrich et al., 1993 and Ernhart et al., 1989); Mexico City, Mexico (Schnaas et al., 2000); Rochester, New York (Canfield et al., 2003); and Yugoslavia (Wasserman et al., 1997).

[63] The natural log of the blood lead levels were used for this analysis.

"cutpoint," we used a linearized slope, obtained by taking the tangent to the log-linear function at the point of departure (USEPA, 2007a).

To estimate IQ benefits from blood lead reductions, we first calculated the expected IQ point loss per child under each of the two scenarios (the "base case" and the "control scenarios") for each monitor (Equation 1). We then subtracted the "base case" IQ loss from the "control scenario" IQ loss and multiplied by the population of children six years of age and younger living within the radius of influence of each monitor to estimate the total number of IQ points that would be gained by reducing the NAAQS (Equation 2).

Equation 1

<u>For blood lead levels ≥ cutpoint:</u>

$$\text{IQ loss} = \beta_1 \times \ln(\text{PbB}/\text{cutpoint}) + \beta_2 \times \text{cutpoint}$$

<u>For blood lead levels < cutpoint:</u>

$$\text{IQ loss} = \beta_2 \times \text{PbB}$$

Where:

Cutpoint = 1.47 μg/dl (i.e., the lowest observed lifetime blood lead level);

β_1 = -3.04 (log-linear regression coefficient from Lanphear (2005), Table 4);

β_2 = -2.1 (linear slope); and

PbB = blood lead level (μg/dl).

Equation 2

$$\Delta\ \text{IQ} = (\text{IQ loss}_{\text{Control}} - \text{IQ loss}_{\text{Base}}) \times P$$

Where:

Δ IQ = total number of IQ points gained under the "control scenario" in comparison with the "base case" in 2020;

IQ loss $_{\text{Control}}$ = IQ point loss under the "control scenario" per child;

IQ loss $_{\text{Base}}$ = IQ point loss under the "base case" per child; and

P = the population of children aged 0 – 6 within the monitor's radius of influence.

We also assessed the sensitivity of the IQ benefits to the epidemiological study selected, using alternative estimates from a meta-analysis of seven studies (Schwartz, 1993) and a study of 172 children in Rochester, New York (Canfield et al, 2003). The Schwartz study calculated an overall estimate by linearizing coefficients from included studies that used natural logarithms of lead as the exposure index. Regression coefficients for studies with untransformed blood lead levels were used directly. The Schwartz analysis found a decrease of 0.25 IQ points per 1 μg/dl increase in blood lead level. Using a linear model between lifetime blood lead level and IQ score, Canfield et al. (2003) found a decrement of 0.46 IQ points per 1 μg/dl increase in blood lead level. We used the following equation (Equation 3) for these two linear dose-response functions:

Equation 3

$$\Delta \text{IQ} = [\beta \times (PbB_1 - PbB_2)] \times P$$

Where:

Δ IQ = total number of IQ points gained under the "control scenario" in comparison with the "base case" in 2020;

β = linear regression coefficient (-0.25 for Schwartz and -0.46 for Canfield);

PbB_1 = blood lead level under the "control scenario" (μg/dl);

PbB_2 = blood lead level under the "base case" (μg/dl); and

P = the population of children aged 0 – 6 within the monitor's radius of influence.

Table 5-4 below summarizes a range of studies quantifying the relationship between changes in blood lead and IQ that was included in the Lead NAAQS NPRM (EPA, 2008b).

Table 5-4.
SUMMARY OF QUANTITATIVE RELATIONSHIPS OF IQ AND BLOOD Pb REFERENCED IN NPRM

Study/Analysis	Study Cohort	Analysis Dataset	N	Range BLL (µg/dL) [5th-95th percentile]	Geometric Mean BLL (µg/dL)	Form of Model from which Average Slope Derived	Average Linear Slope[A] (points per µg/dL)
Set of studies from which steeper slopes are drawn							
Tellez-Rojo <5 subgroup	Mexico City, age 24 mo	Children - BLL<5 µg/dL	193	0.8 – 4.9	2.9	Linear	-1.71
based on Lanphear et al 2005[B], Log-linear with low-exposure linearization (LLL)[B]	*Dataset from which the log-linear function is derived is the pooled International dataset of 1333 children, age 6-10 yr, having median blood Pb of 9.7 µg/dL and 5th -95th percentile of 2.5-33.2 µg/dL. Slope presented here is the slope at a blood Pb level of 2 µg/dL. [C]*					*LLL[C]*	*-2.29 at 2 µg/dL[C]*
Lanphear et al 2005[B], <7.5 peak subgroup	Pooled International, age 6-10 yr	Children - peak BLL <7.5 µg/dL	103	[1.3-6.0]	3.24	Linear	-2.94
Set of studies with shallower slopes (Criteria Document, Table 6-1)[D]							
Canfield et al 2003[B], <10 peak subgroup	Rochester, age 5 yr	Children- peak BLL <10 µg/dL	71	Unspecified	3.32	Linear	-1.79
Bellinger and Needleman 2003[B]	Boston [A,E]	Children - peak BLL <10 µg/dL	48	1 - 9.3 [E]	3.8[E]	Linear	-1.56
Tellez-Rojo et al 2006	Mexico City, age 24 mo	Full dataset	294	0.8 - <10	4.28	Linear	-1.04
Tellez-Rojo et al 2006 full – loglinear	Mexico City, age 24 mo	Full dataset	294	0.8 - <10	4.28	Log-linear	-0.94
Lanphear et al 2005[B], <10 peak[F] subgroup	Pooled International, age 6-10 yr	Children - peak BLL <10 µg/dL	244	[1.4-8.0]	4.30	Linear	-0.80
Al-Saleh et al 2001 full – loglinear	Saudi Arabia, age 6-12 yr	Full dataset	533	2.3– 27.36 [G]	7.44	Log-linear	-0.76
Kordas et al 2006, <12 subgroup	Torreon, Mexico, age 7 yr	Children - BLL<12 µg/dL	377	2.3 - <12	7.9	Linear	-0.40
Lanphear et al 2005[B] full – loglinear	Pooled International, age 6-10 yr	Full dataset	1333	[2.5-33.2]	9.7 (median)	Log-linear	-0.41
						Median value	**-0.9[D]**

[A] Average slope for change in IQ from 10th percentile to 10 µg/dL Slope estimates here are for relationship between IQ and concurrent blood Pb levels (BLL), except for Bellinger & Needleman which used 24 month BLLs with 10 year old IQ.
[B] The Lanphear et al 2005 pooled International study includes blood Pb data from the Rochester and Boston cohorts, although for different ages (6 and 5 years, respectively) than the ages analyzed in Canfield et al 2003 and Bellinger and Needleman 2003.
[C] The LLL function (described in section II.C.2.b) was developed from Lanphear et al 2005 loglinear model with a linearization of the slope at BLL below 1 µg/dL. The slope shown is that at 2 µg/dL. In estimating IQ loss with this function in the risk assessment (section II.C) and in the evidence-based considerations in section II.E.3, the nonlinear form of the model was used, with varying slope for all BLL above 1 µg/dL.
[D] These studies and quantitative relationships are discussed in the Criteria Document (CD, sections 6.2, 6.2.1.3 and 8.6.2).
[E] The BLL for Bellinger and Needleman (2003) are for age 24 months.
[F] As referenced above and in section II.C.2.b, the form of this function derived for lifetime average blood Pb was used in the economic analysis for the RRP rule. The slope for that function was -0.88 IQ points per µg/dL lifetime averaged blood Pb.
[G] 69% of children in Al-Saleh et al (2001) study had BLL<10 µg/dL

5.9 Benefit Valuation

5.9.1 Value Of Avoided IQ Decrements

The valuation approach we apply for assessing monetary losses associated with IQ decrements is based on an approach applied in previous EPA analyses (USEPA, 1997, 2005 & 2006b). The approach expresses the loss to an affected individual resulting from IQ decrements in terms of foregone future earnings for that individual.

To estimate the expected monetary value of these effects, we first estimated the median present value of future earnings at time of birth for a person born in the U.S., based on earnings and labor force participation rate data from the 2006 Current Population Survey (CPS).[64] When calculating the lifetime earnings estimate, we assumed an individual born today would begin working at age 16 and retire at age 67. We assumed a real growth rate for wages of one percent per year, as assumed in EPA's Section 812 retrospective analysis (US EPA, 1997); adjusted for survival probabilities based on current US vital statistics from the CDC's National Center for Health Statistics;[65] and adjusted for labor force participation by age. We then discounted the expected lifetime stream of wages using a three percent annual rate. As in EPA's *Economic Analysis for the Renovation, Repair, and Painting Program Proposed Rule* (EPA, 2008c), we assumed children will be affected by lead at age three, the midpoint of the range during which children are thought to be most susceptible to lead. Therefore, we discounted lifetime earnings back to age three. We estimated present value median lifetime earnings to be $606,930 in 2006 dollars.

In the previous EPA analyses cited above, the Agency has applied an average estimate of the effect of IQ on earnings of 2.379 percent per IQ point from an analysis by Salkever (1995).[66] An analysis by Schwartz (1994b) estimated that a 1-point increase in IQ would increase earnings by 1.76 percent. The percentage increases in both studies reflect both direct impact of IQ on hourly wages and indirect effects on annual earnings as the result of additional schooling and increased labor force participation. A recent review of literature from the labor economics and environmental health fields by CDC economist Scott Grosse suggests that both of these studies may have overestimated the association of IQ with earnings (2007). Specifically, he found the Salkever estimate of direct impacts of IQ on wages to be higher than estimates reported in the labor economics literature. Grosse also found that the Schwartz study overestimates the cognitive impact of lead exposure on earnings, but he argues that the Schwartz estimate may still be appropriate for estimating the total effect of lead on earnings, because it includes the effects of lead on education and earnings that result from both cognitive and non-cognitive changes. Thus, it may be a more comprehensive estimate than one based on cognitive changes alone.

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[64] See http://www.bls.gov/cps/home.htm - data.

[65] See http://www.cdc.gov/nchs/data/nvsr/nvsr54/nvsr54_14.pdf.

[66] The 812 Retrospective analysis also included an estimate based on older work by Needleman et al. (1990).

In recognition of the fact that the economics literature continues to evolve, and because EPA has traditionally relied upon the Salkever (1995) estimate to value changes in IQ, for this analysis we provide a range of valuation estimates based on both the Salkever (1995) and the Schwartz (1994b) functions. Below we describe how we estimate the cost per IQ decrement using each function.

The 1.76 percent estimate from Schwartz represents a gross impact on earnings; it does not account for the costs of additional schooling. EPA's Clean Air Mercury Rule (CAMR) RIA (USEPA, 2005) reported an estimate of $16,425 per additional year of schooling in 1992 dollars, based on U.S. Department of Education data reflecting both direct annual expenditures per student and annual average opportunity cost (i.e., lost income from being in school). Consistent with the CAMR analysis, we assume that these costs are incurred when an individual born today turns 19, based on an average 12.9 years of education among people aged 25 and over in the U.S. We discount the educational costs back to a present value at age 3, to be consistent with the present value of lifetime earnings. We then adjust this value to 2006 dollars, resulting in an estimated $14,700 per additional year of schooling. Schwartz reports an increase of 0.131 years of schooling per IQ point (1994b); thus the change in average education costs per IQ point is $14,700 × 0.131 = $1,930.

Using the Schwartz function, we calculated the present value of the median net earnings loss associated with one IQ point as the present value of median lost earnings per IQ point lost ($606,930 × 0.0176 = $10,682) minus the change in average education costs per IQ point ($1,930). These calculations yield a value of $8,760 of net earnings lost per a one-point decrease in IQ using a 3% discount rate and a value of $1,094 at a 7% discount rate.

To estimate the cost per IQ point using Salkever (1995), we followed the same set of steps as above, substituting the Salkever estimate of the change in lifetime earnings. These calculations yield a value of $12,512 of net earnings lost per a one point decrease in IQ using a 3% discount rate and a value of $2,156 at a 7% discount rate.

5.10 Results

This section presents the health effects results and the associated monetary benefits. We first present the expected IQ point gains in 2020, comparing each of the "control scenarios" to the "base case." We then provide the expected monetized value of those gains in IQ in 2020. We also describe an analysis we performed to assess the sensitivity of the model to the various inputs used and assumptions made. Finally, we explain the methodology we applied for estimating monetized health benefits from co-control of $PM_{2.5}$ and the results of that analysis.

5.10.1 Changes in IQ

Table 5-5 below presents the total number of IQ points expected to be gained in the US in the year 2020 by achieving each of the alternate NAAQS level options, when compared to the "base case" (i.e., the lead NAAQS remains at its current level). Our results indicate that the number of IQ points gained in 2020 ranges from 110,000 if a 0.5 second maximum monthly mean NAAQS is achieved up to 700,000 for a 0.05 second maximum monthly mean NAAQS.

These IQ point gains are valued at between \$1.0 and \$8.7 billion at a 3% discount rate and between \$0.2 and \$1.5 billion at a 7% discount rate (2006\$).

Table 5-5.
Number of IQ Points Gained and Monetary Benefits (in Millions of 2006$) in 2020

Standard Alternative	***IQ Points Gained***	***Estimated Net Present Value of IQ Points Gained****	
		3% Discount Rate	**7% Discount Rate**
0.5 Second Maximum Monthly Mean	110,000	\$960--\$1,400	\$120--\$240
0.3 Second Maximum Monthly Mean	200,000	\$1,700--\$2,500	\$220--\$430
0.2 Second Maximum Monthly Mean	280,000	\$2,500--\$3,500	\$310--\$610
0.1 Second Maximum Monthly Mean	440,000	\$3,900--\$5,500	\$480--\$950
0.05 Second Maximum Monthly Mean	700,000	\$6,100--\$8,700	\$760--\$1,500

* Lower end of range calculated using Schwartz (1994b) estimate; upper end calculated using Salkever (1995) estimate.

** Results reflect the use a 2002 derived non-air background blood lead applied to analysis year of 2020. To the extent that state and federal interventions such as the Renovation and Repair Rule (EPA, 2008c) reduce future non-air blood lead levels, the estimate of IQ change above may be overstated.

We also assessed the geographic distribution of these benefits. We found that the benefits were concentrated in a small number of counties. Table 5-6 below is an example of the distribution of total benefits due to IQ points gained for the 0.2 $\mu g/m^3$ second maximum monthly mean NAAQS alternative. For this standard, approximately 60 percent of the total benefits are due to changes in lead air concentrations in three counties: Hillsborough, Florida; Delaware, Indiana; and Berks, PA. Please see Appendix B for tables providing the percentage of total health benefits by county for all of the four alternative NAAQS levels.

Table 5-6.
PERCENTAGE OF BENEFITS BY COUNTY (0.2 µg/m^3 Second Maximum Monthly Mean NAAQS)

County	*State*	*Population of Children in Affected Area*	*Affected Population (%)*	*Percentage of Benefits (%)*
Hillsborough	FL	46,923	18	31
Delaware	IN	9,236	3	19
Berks	PA	23,977	9	10
Collin	TX	16,593	6	7
Adams	CO	25,746	10	6
Denver	CO	40,395	15	5
Pike	AL	2,342	1	4
Denton	TX	6,301	2	4
Cuyahoga	OH	35,680	13	3
Jefferson	CO	8,689	3	2
Jefferson	MO	7,358	3	1
Note: There were several other counties that constituted less than 1 percent of benefits that are not included in this table.				

5.10.2 IQ Sensitivity Analysis

We performed a sensitivity analysis on the benefits model in order to assess the total range of potential benefits and to determine the sensitivity of the primary model results to various data inputs and assumptions. We used the model to calculate the total monetary benefits due to gains in children's IQ for the 0.2 second maximum monthly mean NAAQS option using our default model input assumptions.[67] We then changed each default input one at a time and recalculated the total benefits to assess the percent change from the default. Table 5-7 below presents the results of this sensitivity analysis. The table indicates for each input parameter the value used as the default (in bold) and the values for the sensitivity analyses. It then provides the total monetary benefits for each input and the percent change from the default value.

Our sensitivity analysis results indicate that the benefits model is most sensitive to the method used for assigning air lead exposure concentrations to the population of exposed children. Our primary estimate relied on an interpolation method, where several monitor concentrations were used in determining the exposure concentration. When the radius method was employed as part of the sensitivity analysis, the results varied. We assumed that monitor concentration applied to the population residing within a 10 km radius as a best estimate of the exposed population, which as we noted above, produces a conservative upper-bound estimate of

[67] Note that for the sensitivity analysis, we relied on the results that incorporated the valuation estimate for IQ from Schwartz (1994b).

exposure. When compared with the interpolation method, this increased results by 31 percent. The size of the radius assumed when using the radius method also had a large impact on the results. When the radius size was reduced to 5, 2, and 1 km for monitors associated with a lead source, the benefits are significantly reduced (i.e., total monetary benefits are reduced by 66, 94, and 98 percent, respectively). In addition, if the monitor concentration is assumed to apply to the population of the entire county in which that monitor resides, the benefits increase significantly (323 percent).

The discount rate also had a significant impact on results, because the benefits of lead on earnings occur over a lifetime, and the net present value of those earnings is highly sensitive to the discount rate applied. When the discount rate was changed from the default (3 percent) to a rate of 7 percent, the benefits fell by 88 percent.

Table 5-7.
SENSITIVITY ANALYSIS FOR THE PRIMARY ESTIMATE OF HEALTH BENEFITS
(for the 0.2 μg/m^3 Second Maximum Monthly Mean Results)*

	Model Input	**Total Benefits (in Millions of 2006$)**	**Percent Change from Default**
Exposure Estimation Method	**Interpolation**	**$2,500**	**N/A**
	County Radius	$11,000	340%
	10 km Radius	$3,400	36%
	5 km Radius	$890	-64%
	2 km Radius	$150	-94%
	1 km Radius	$65	-97%
Discount Rate	**3 Percent**	**$2,500**	**N/A**
	7 Percent	$310	-88%
Epidemiological Study for IQ	**Lanphear et al. (2005)**	**$2,500**	**N/A**
	Canfield et al. (2003)	$1,200	-52%
	Schwartz (1993)	$650	-74%
Air:Blood Ratios (μg/m^3 in air:μg/dl in blood)	**1:5**	**$2,500**	**N/A**
	1:7	$2,800	12%
	1:2	$1,500	-40%
Non-Air-Related Background Geometric Mean Blood Lead Level (μg/dl)	**1.2**	**$2,500**	**N/A**
	1.0	$2,700	8%
	1.4	$2,300	-8%

The results were also found to be sensitive to the epidemiological study selected for calculating IQ point gains in 2020, with results decreasing by between 54 and 74 percent when dose-response functions derived from the Canfield et al. (2003) and Schwartz (1993) studies are used, as compared to the default function from Lanphear et al. (2005).

Inputs that had a moderate impact on the benefits results include the air:blood ratio selected to convert lead air concentrations into blood lead levels in the population and the non-air-related geometric mean blood lead level used.

5.11 PM Co-Control Benefits – Methodology and Results

As outlined in Chapter 4, most of the point source measures implemented to achieve the NAAQS standards are focused on controlling emissions of lead in particulate form. As a result, virtually all of these measures also have a significant impact on emissions of directly emitted particulate matter. Table 5-8 lists the PM-related health effects that are included in our monetized benefits estimate incorporating PM co-benefits.[68]

In Chapter 4 we identified control technologies to reduce emissions of lead that also reduce $PM_{2.5}$. However, in some areas, more emission reductions are needed than can be achieved through identified control options (i.e., unidentified controls). The identified and unidentified controls are shown in Table 5-9 below. These emission reduction estimates are incremental to a baseline that reflects emission reductions from MACT controls and the $PM_{2.5}$ NAAQS RIA.

Table 5-8.
HEALTH EFFECTS OF $PM_{2.5}$

Effect	***Quantified Health Effects***	***Unquantified Health Effects***[e]
Health[a,b]	-Premature mortality based on both cohort study estimates and on expert elicitation[c,d] -Bronchitis: chronic and acute -Hospital admissions: respiratory and cardiovascular -Emergency room visits for asthma -Nonfatal heart attacks (myocardial infarction) -Lower and upper respiratory illness -Minor restricted-activity days -Work loss days -Asthma exacerbations (asthmatic population)	-Subchronic bronchitis cases -Low birth weight -Pulmonary function -Chronic respiratory diseases other than chronic bronchitis -Non-asthma respiratory emergency room visits

[68] Because the PM co-benefits are estimated on a $-per-ton basis, we do not report quantitative estimates for individual PM health effects.

Effect	*Quantified Health Effects*	*Unquantified Health Effects*[e]
	-Respiratory symptoms (asthmatic population) -Infant mortality	

[a] Because the PM co-benefits are estimated on a $-per-ton basis, we do not report quantitative estimates for individual PM health effects.
[b] In addition to primary economic endpoints, there are a number of biological responses that have been associated with PM health effects, including morphological changes and altered host defense mechanisms. The public health impact of these biological responses may be partly represented by our quantified endpoints.
[c] Cohort estimates are designed to examine the effects of long-term exposures to ambient pollution, but relative risk estimates may also incorporate some effects due to shorter-term exposures (see Kunzli et al., 2001).
[d] While some of the effects of short-term exposure are likely to be captured by the cohort estimates, there may be additional premature mortality from short-term PM exposure not captured in the estimates included in the primary analysis.
[e] The categorization of unquantified toxic health effects is not exhaustive. Health endpoints in this column include both a) those for which there is not consensus on causality; and b) those for which causality has been determined but empirical data are not available to allow calculation of benefits.

Table 5-9.
SUMMARY OF ESTIMATED CO-CONTROLLED $PM_{2.5}$ EMISSIONS REDUCTIONS (in Tons)

Alternate NAAQS (Second Maximum Monthly Mean)	*Identified Controls*	*Unidentified Controls*	*All Controls*
0.5 $\mu g/m^3$	2,252	2	**2,254**
0.3 $\mu g/m^3$	6,073	46	**6,120**
0.2 $\mu g/m^3$	8,134	248	**8,382**
0.1 $\mu g/m^3$	9,065	1,237	**10,302**
0.05 $\mu g/m^3$	9,648	6,044	**15,692**

To estimate the value of these $PM_{2.5}$ emissions reductions, EPA utilized $PM_{2.5}$ benefit-per-ton estimates. These $PM_{2.5}$ benefit-per-ton estimates provide the total monetized human health benefits (the sum of premature mortality and premature morbidity) of reducing one ton of $PM_{2.5}$ from a specified source. EPA has used a similar technique in previous RIAs, including the recent ozone NAAQS RIA (USEPA, 2008a). The fourteen estimates presented below derive from the application of three alternative methods:

- One estimate is based on the concentration-response (C-R) function developed from a study of the American Cancer Society (ACS) cohort reported in Pope et al. (2002), which has previously been reported as the primary estimate in recent RIAs (USEPA, 2006c).

- One estimate is based on Laden et al.'s (2006) reporting of the extended Six Cities cohort study; this study is a more recent PM epidemiological study that was used as an alternative in the PM NAAQS RIA.

- The other twelve estimates are based on the results of EPA's expert elicitation study on the PM-mortality relationship, as first reported in Industrial Economics (2006) and interpreted for benefits analysis in EPA's final RIA for the PM NAAQS, published in September 2006 (USEPA, 2006c). For that study, twelve experts (labeled A through L) provided independent estimates of the PM-mortality C-R function. EPA practice has been to develop independent estimates of PM-mortality estimates corresponding to the C-R function provided by each of the twelve experts.

Readers interested in reviewing the complete methodology for creating the benefit per-ton estimates used in this analysis can consult the Technical Support Document (TSD) accompanying the recent final ozone NAAQS RIA (USEPA 2008a).[69]

As described in the documentation for the benefit per-ton estimates cited above, national per-ton estimates are developed for selected pollutant/source category combinations. The per ton values calculated therefore apply only to tons reduced from those specific pollutant/source combinations (e.g., SO_2 emitted from electric generating units; NO_x emitted from mobile sources). Emissions controls modeled in this RIA are all applied to point sources; a few are at electric generating units (EGUs), but most are at industrial facilities involved in handling lead as a manufacturing product, byproduct, or input. From among the list of pollutant/source combinations outlined in the TSD referenced above, the combination most appropriate for valuation of $PM_{2.5}$ emissions reductions from the sources controlled for lead emissions is the combination for $PM_{2.5}$ from EGU and non-EGU point sources. Estimates of this per-ton value for a 3 percent discount rate vary from a low of $67,000 per ton to a high of $560,000 per ton (based on a change in emissions of 25 percent or less from a 2015 PM emissions base, in 2006$). Our estimate of $PM_{2.5}$ co-control benefits is therefore based on the total $PM_{2.5}$ emissions controlled multiplied by this per-ton value. The results of this calculation are provided in Table 5-10 below. Figures 5-9 and 5-10 provide a graphical representation of the 14 estimates of PM co-control benefits for $PM_{2.5}$, using both a 3 percent and 7 percent discount rate.

[69] The Technical Support Document, entitled: *Calculating Benefit Per-Ton Estimates*, can be found in EPA Docket EPA-HQ-OAR-2007-0225-0284.

Table 5-10.
MONETIZED BENEFITS OF CO-CONTROLLED $PM_{2.5}$ EMISSIONS (in Millions of 2006$)

Alternative	*Pope et al. (2002)*	*Laden et al. (2006)*	*Expert A*	*Expert B*	*Expert C*	*Expert D*	*Expert E*	*Expert F*	*Expert G*	*Expert H*	*Expert I*	*Expert J*	*Expert K*	*Expert L*
							3 Percent Discount Rate							
0.5 µg/m^3	350	740	1,000	790	780	560	1,300	720	470	590	780	630	150	580
0.3 µg/m^3	940	2,000	2,800	2,200	2,100	1,500	3,500	1,900	1,300	1,600	2,100	1,700	410	1,600
0.2 µg/m^3	1,300	2,800	3,800	3,000	2,900	2,100	4,700	2,700	1,700	2,200	2,900	2,400	560	2,100
0.1 µg/m^3	1,600	3,400	4,700	3,600	3,600	2,500	5,800	3,300	2,100	2,700	3,500	2,900	690	2,600
0.05 µg/m^3	2,400	5,200	7,200	5,500	5,500	3,900	8,900	5,000	3,300	4,100	5,400	4,400	1,100	4,000
							7 Percent Discount Rate							
0.5 µg/m^3	320	670	930	720	710	500	1,100	650	430	540	700	570	140	520
0.3 µg/m^3	850	1,800	2,500	1,900	1,900	1,400	3,100	1,800	1,200	1,500	1,900	1,600	380	1,400
0.2 µg/m^3	1,200	2,500	3,500	2,700	2,600	1,900	4,300	2,400	1,600	2,000	2,600	2,100	520	1,900
0.1 µg/m^3	1,400	3,100	4,200	3,300	3,200	2,300	5,200	3,000	1,900	2,400	3,200	2,600	640	2,400
0.05 µg/m^3	2,200	4,700	6,500	5,000	4,900	3,500	8,000	4,500	3,000	3,700	4,900	4,000	1,000	3,600

Note: All estimates have been rounded to two significant figures. All estimates are incremental to the 2006 PM NAAQS RIA. These estimates do not include confidence intervals because they were derived through a scaling technique described in the text.

Figure 5-9.
DISTRIBUTION OF TOTAL $PM_{2.5}$ MONETIZED CO-BENEFITS BY LEAD STANDARD ALTERNATIVE (3% Discount Rate)

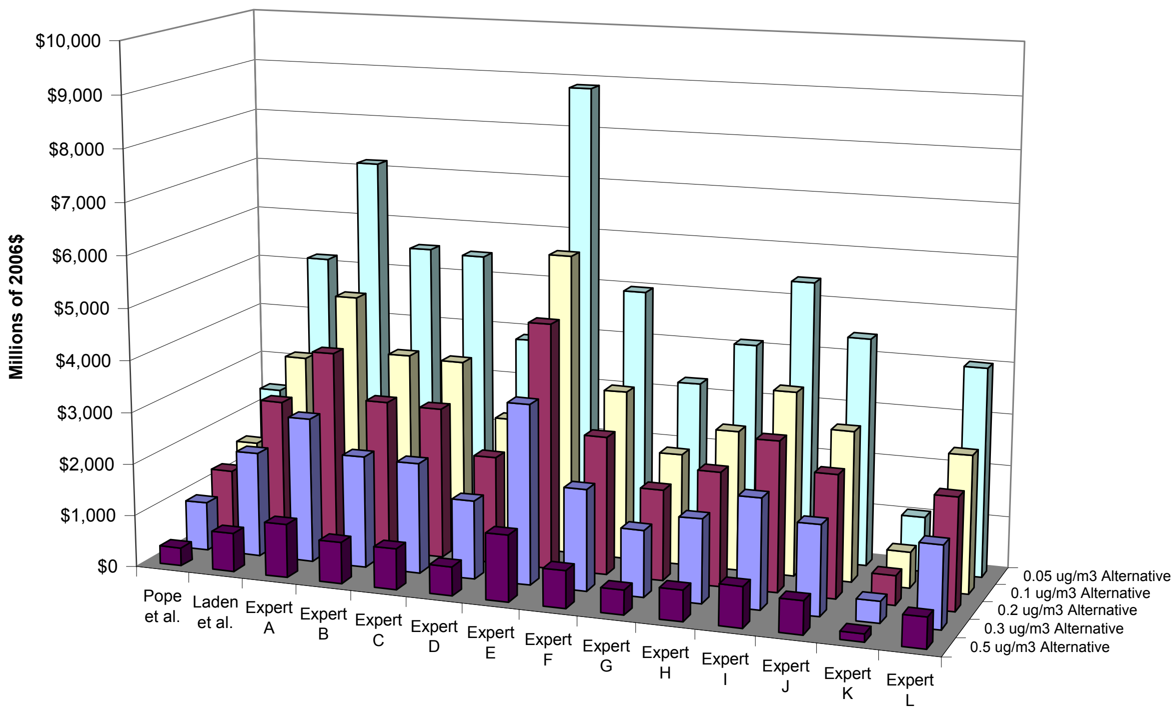
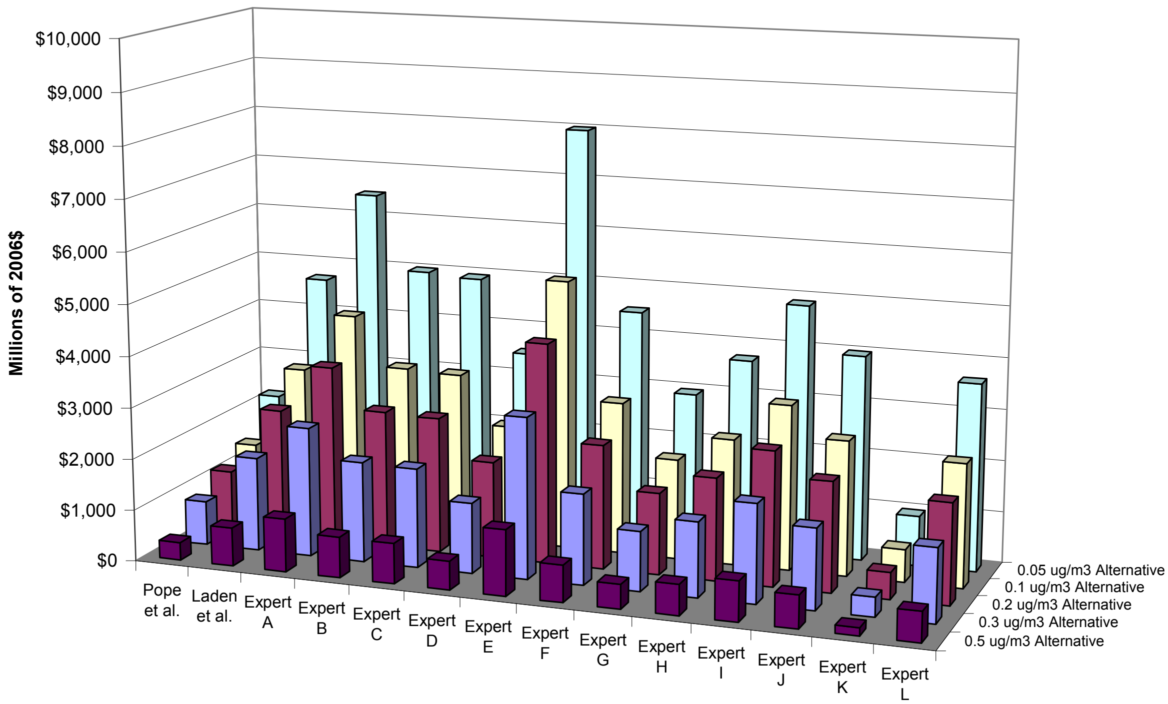


Figure 5-10.
DISTRIBUTION OF TOTAL $PM_{2.5}$ MONETIZED CO-BENEFITS BY LEAD STANDARD ALTERNATIVE (7% Discount Rate)



5.12 Discussion

The results of this benefits analysis demonstrate that lowering the current (1.5 $\mu g/m^3$ maximum quarterly mean) lead NAAQS to one of the proposed alternative NAAQS would be expected to have a significant impact on the IQ of young children. Lowering the standard could cause an increase in total IQ points by between 110,000 and 700,000 points in 2020, which would be valued at between 1.0 and 8.7 billion 2006$. In addition, controls installed to achieve the lead NAAQS standards will also reduce emissions of fine particulates. As a result, this analysis includes a screening level calculation that indicates each of the alternatives considered could have a significant benefit in terms of improved particulate air quality, reduced health effects, and increased economic welfare of currently exposed individuals.

This benefits analysis is intended to be an initial screening investigation to provide a first estimate of the potential magnitude of the benefits of reducing the lead NAAQS. Therefore, the results of this analysis are associated with a number of uncertainties. The benefits of IQ point gains in children were very sensitive to the method employed for estimating exposures to the population. When comparing the default method, which involved concentrations that were interpolated from multiple monitors, to the method assuming a uniform concentration within a 10 km radius around an individual monitor, the results increase by 31 percent. Increasing the radius to include the entire county in which the monitor resides results in roughly 3-fold increase in benefits. Decreasing the radius size also has a large impact on benefits, decreasing the value by as much as 98 percent when a radius of 1 km is used. The results were also fairly sensitive to the discount rate selected. When a 7 percent discount rate was used in place of the default rate of 3 percent, results decreased by 88 percent. This is in part because the benefits of lead on earnings occur over a lifetime, and the net present value of those earnings is highly sensitive to the discount rate applied. The dose-response function selected for quantifying the number of IQ points gained as a result of achieving the alternative NAAQS levels affected the results. Utilizing alternate epidemiological studies decreased the primary estimate by as much as 74 percent. However, we believe the Lanphear et al. (2005) study was the best choice for our primary estimate. This study was a meta-analysis that synthesized a range of existing information and is based on more recent data than the studies included in the Schwartz (1993) study. In addition, the log-linear model was the most robust estimate from this study, in that it was the best fit for the data.

Additional uncertainties related to the benefits estimates include the following:

- For our primary estimate of the benefits due to gains in children's IQ, we used a log-linear estimate from a recently published pooled analysis of seven studies (Lanphear et al., 2005). Using alternate estimates from other epidemiological studies examining the link between blood lead level and children's IQ has significant impact on benefits results. We found the benefits to decrease by as much as 74 percent when an alternate estimate from a paper by Schwartz (1993) is used. This is due in part to the underlying shape of the dose-response relationship assumed by each of the functions. In the Lanphear study, a log-linear relationship was found to be the best fit for the data (i.e., the natural log-transformed blood lead level is used to predict changes in IQ score). This model implies that the magnitude of changes in IQ increases with lower blood lead levels. However, in the Schwartz (1993) and Canfield et al. (2003) studies, a single linear model is assumed (i.e., untransformed blood lead levels are used to predict changes in IQ score). The single linear model implies that the magnitude of change in IQ is constant over the entire range of blood lead levels. Therefore, at lower blood lead levels, the log-linear model predicts larger changes in IQ than the linear model. Note that CASAC, in their review of EPA's *Lead Risk Assessment* indicated that "studies show that the decrements in intellectual (cognitive) functions in children are proportionately greater at PbB concentrations <10 μg/dl" (USEPA, 2007d, page 3). However, if the true dose-response relationship is linear, than our primary estimate of benefits is an overestimation.

- Some uncertainty is involved in the estimates of maximum quarterly mean lead air concentrations used for the benefits model. We used ratios of second maximum monthly mean values to maximum quarterly mean values from lead monitoring data from 2003-2005 to convert the second maximum monthly mean values in 2020 into a maximum quarterly mean for the "base case" as well as to convert the alternative second maximum monthly mean NAAQS into a maximum quarterly mean for the "control scenarios." If the true ratio between the second maximum monthly means to the maximum quarterly mean is different in 2020 than in 2003-2005 because the pattern and distribution of daily values differs, then our results could be either over- or underestimated.

- The interpolation method of estimating exposure concentrations that we used for our primary estimate is associated with some uncertainty. The validity of this method is to some extent contingent upon the availability of a sufficient number of monitors to support an interpolation. In certain locations, such as Hillsborough County, FL, there are a sufficient number of lead and TSP monitors to generate an interpolation with a pronounced gradient around each monitor. The lead and TSP monitoring network in other non-attainment areas can in some cases be sparse, and the resulting interpolation does not appear to generate a meaningful gradient, such as in Delaware County, IN.

- The application of the monitor rollback technique to estimate full attainment air quality changes introduces some uncertainty to the analysis. This technique simulates the air quality change associated with an emissions control strategy that is capable of just attaining each standard alternative at each monitor. This approach to estimating air quality changes is different from the reduced-form air quality model employed to develop the emissions control strategy. When utilizing this reduced-form model to identify control strategies for each standard alternative, in certain cases emission controls achieved reductions in ambient lead below the standard alternative under analysis. In other cases, the modeled control strategies were insufficient to model full attainment with all monitors. The monitor rollback approach used to estimate full attainment benefits does not reflect this variability in attainment status, because it adjusts the violating monitor value down to, but not below, the standard alternative. Thus, where the control strategy attains air quality improvements below the standard at violating monitors, the monitor rollback approach will not reflect the additional benefits associated with this air quality improvement. Conversely, where the control strategy does not fully attain the standard alternative at a given monitor, the rollback technique would overstate benefits because it adjusts the monitor value all the way down to the standard, below a level actually achieved by the control strategy.

- The estimation of the population to which the benefits apply when using the radius method of exposure estimation is uncertain. We made a number of assumptions in the process of estimating the population living within the 10 km radius around each monitor which generated a conservative upper-bound exposure estimate. First, we assumed that the population within each census block group is uniformly distributed, and therefore, that the fraction of the block group geographically that overlapped with the radius corresponded to the fraction of the population living within the radius. In addition, we used 2000 Census data to calculate the population living within each radius and distributed it into five-year age groups by gender using the 2000 Census data for the county in which the monitor resides. We assumed that block groups falling inside the radius that reside in neighboring counties had the same age and gender distributions as the county in which the monitor resides. If these assumptions are inaccurate, the benefits results could potentially be under- or overestimated.

- We assumed that the IQ point effects of a change in concurrent blood lead (i.e., the effects of a change in 2020) apply to all children in our study population that were under seven years of age in 2020. If there is a critical window of exposure for IQ effects (e.g., between the ages of one and two), then we could potentially be overestimating benefits in 2020 because we would have overestimated the population affected by reduced lead exposure in that year. However, if partial or full achievement of the alternative NAAQS levels might occur earlier than 2020, the children in our 0-6 age cohort who are past any critical window in 2020 would have realized the partial or full benefits of reduced lead exposures in those earlier years. Thus, the issue of a potential critical developmental window reflects uncertainty in both the timing and size of benefits.

- The use of air:blood ratios represents a first approximation to the impact of changes in ambient air concentrations of lead on concurrent blood lead levels, applied in the absence of modeling data on lead transport and deposition and the on direct and indirect human exposures. While the values we apply match fairly well with available literature, there are relatively few studies that report such values or provide sufficient data to calculate such ratios. Further, the lead concentrations in those studies tend to be higher than those modeled here (USEPA, 2007a); thus uncertainty remains as to whether the same ratios would be expected at lower levels, or whether air exposures are more or less efficient at changing concurrent blood lead levels at these lower concentrations.

- If the air:blood ratio we apply for children or a similar value is also valid for estimating adult exposures, then our primary benefits understate the true health benefits accruing to the lead-exposed populations because they exclude impacts on morbidity and mortality impacts on adults as well as impacts on prenatal mortality. Additional research is needed to improve our understanding of the impacts of adult air exposure on adult blood lead levels.

- The earnings-based value-per-IQ-point lost that we apply in this analysis most likely represents a lower bound on the true value of a lost IQ point, because it is essentially a cost-of-illness measure, not a measure of an individual's willingness-to-pay (WTP) to avoid the loss of an IQ point. Welfare economics emphasizes WTP measures as the more complete estimate of economic value.

- The earnings-based estimate of the value-per-IQ-point lost is based on current data on labor-force participation rates, survival probabilities, and assumptions about educational costs and real wage growth in the future. To the extent these factors diverge from these values in the future, our lifetime earnings estimate may be under- or overestimated.

- Co-control benefits estimated here reflect the application of a national dollar benefit per ton estimate of the benefits of reducing directly emitted fine particulates from point sources. Because they are based on national-level analysis, the benefit-per-ton estimates used here do not reflect local meteorology, exposure, baseline health incidence rates, or other local factors that might lead to an over-estimate or under-estimate of the actual benefits of controlling directly emitted fine particulates.

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CHAPTER 6. COST ANALYSIS APPROACH AND RESULTS

This chapter describes our initial analysis of the engineering costs and monitoring costs associated with attaining the proposed National Ambient Air Quality Standard (NAAQS) for lead and the alternative standards outlined in Chapter 1.[70] Cost estimates will be revised and improved during development of the RIA for the final Pb NAAQS. We present in this draft our initial analysis of these costs (using a simple fixed cost-per-ton methodology for unidentified costs, as discussed below) in separate sections. To begin, Section 6.1 presents the cost estimates and is broken out into four subsections. The first subsection summarizes the data and methods that we employed to estimate the costs associated with the control strategies outlined in Chapter 4. As indicated in Chapter 4, these strategies rely exclusively on the application of point source controls. The second subsection presents county level estimates of the costs of identified controls associated with the regulatory alternatives examined in this RIA. Following this discussion, the third subsection describes unidentified controls that may be implemented to comply with the proposed lead NAAQS, and discusses the additional incremental costs that remain unquantified to reach full attainment in all areas. The fourth subsection gives a brief discussion of the monitoring costs. This section concludes with a summary of the preliminary estimates of total costs for the regulatory alternatives examined (using the illustrative control scenario and the draft fixed cost-per-ton approach for unidentified cost portion of the analysis). Sections 6.2 and 6.3 summarize the economic and energy impacts of the Proposed Rule, respectively, while Section 6.4 outlines the main limitations of the analysis. (Note that for the final RIA we intend to explore alternative ways to value unidentified controls including approaches which incorporate increasing marginal cost with increasing stringency of control.)

As noted earlier, this draft Regulatory Impact Analysis (RIA) provides illustrative estimates of the incremental costs and monetized human health benefits of attaining a revised primary lead (Pb) National Ambient Air Quality Standard (NAAQS) within the current monitoring network[71]. Many of the highest-emitting Pb sources do not have nearby Pb-TSP monitors, and it is important to note that there may be many more potential nonattainment areas than have been analyzed in this RIA. Because of time and data constraints, in this draft RIA, estimates of costs and benefits employed different techniques for estimating future air quality. This results in benefits estimates that represent full attainment, and cost estimates that do not represent full attainment. These differences will be addressed in the final RIA, and further improvements to estimation techniques will be explored.

It should be noted again that overall data limitations are very significant for this analysis. One critical area of uncertainty is the limited TSP-Pb monitoring network (discussed in chapter 2). Because monitors are present in only 86 counties nationwide, the universe of monitors exceeding the various target NAAQS levels is very small; only 36 counties above 0.05 $\mu g/m^3$, and only 23 counties exceeding the lowest proposed NAAQS level of 0.10 $\mu g/m^3$. Because we know that many of the highest-emitting Pb sources in the 2002 NEI do not have nearby Pb-TSP

[70] The costs presented in this chapter represent the direct pollution control expenditures associated with NAAQS compliance. As such, they do not reflect the general equilibrium impacts of the proposed rule.

[71] There are currently 189 monitors representing 86 counties, but only 36 counties have monitors which exceed 0.05 ug/m^3.

monitors (see section 2.1.7), it is likely that there may be many more potential nonattainment areas than have been analyzed in this draft RIA. We should also emphasize that these cost estimates represent controlling Pb emissions using hypothetical control strategies, assuming no technological advances in emission control technology.

It is important also to note that this chapter presents initial cost estimates associated with both identified and unidentified point source measures. Identified point source controls include known measures to known sources that may be implemented to attain the proposed NAAQS, whereas unidentified controls include hypothetical additional measures that may be implemented in areas that would remain in nonattainment with the NAAQS following the implementation of identified controls to known sources. The marginal cost curve for this analysis was derived from the costs to the larger sources for which we had identified controls. To estimate the costs of unidentified controls, we chose a constant cost equal to the 98th percentile of the marginal cost curve. We recognize that valuing all unidentified tons at the same cost per ton is an oversimplification. We also recognize that as we add additional levels of control to well-controlled sources to capture an ever smaller increment of emissions, the marginal cost of the additional emission control generally increases. Therefore increasingly stringent standards lead to increasing marginal costs. In these instances, taking into account the entire marginal cost curve may more fully capture the increasing cost. Note also that in this analysis, unidentified controls include not only additional levels of control for well-controlled sources, but also sources that were not matched with known controls. We do not know whether this second level of uncertainty will lead to higher costs per ton. For the final RIA we intend to explore both finding more identified controls, and also finding ways to value unidentified controls that do not use a single constant cost per ton. Note also that the addition of unidentified controls to sources above a specific level of emissions (see section 4.4.3) does not bring all areas all the way to attainment for four of the five alternative standards analyzed. Because benefits were calculated assuming that each monitor just attains each standard alternative, this creates a potential mismatch between the costs and benefits calculated for each projected non-attainment area. However, on balance, the influence of this inconsistency is very small.

It is also important to here that the universe of sources to which unidentified controls are added is a known universe; note however we are not able to identify a known control device or work practice. There are several reasons why identified controls may not be sufficient to reach attainment in a given area:

1. The area might be characterized by emissions from several very large sources. This is true in only a few areas (e.g., Jefferson and Iron Counties in MO). In these areas, there may be large reductions achieved with identified or even pre-existing controls, but there are no further known controls available to reduce the remaining emissions after those identified controls are applied.

2. Identified controls exist, but their cost-effectiveness exceeds $16,000 per pound, and therefore they are not implemented. This is true in areas characterized by many small point sources (e.g., Los Angeles, CA and a few other urban areas).

3. Point source controls could be identified for some sources, but could not be identified for enough of the emissions sources that contribute to ambient lead in

the area. This is true in areas where there is a metals processing industry, but no one source or industry dominates (e.g., in Cuyahoga County, OH and in some parts of PA).

4. In some cases, identified controls are sufficient to reach one or more of the alternatives (e.g., Beaver, PA), but unidentified controls are necessary to reach more stringent alternatives. In general, unidentified controls are applied in more areas under the more stringent alternatives.

The sections that follow describe our approach for estimating the costs of both types of controls.

As is discussed throughout this report, the technologies and control strategies selected for this analysis are illustrative of one approach that nonattainment areas may employ to comply with the revised lead standard. Potential control programs may be designed and implemented in a number of ways, and EPA anticipates that State and Local governments will consider those programs that are best suited for local conditions. As such, the costs described in this chapter generally cover the annualized costs of purchasing, installing, and operating the referenced technologies. Because we are uncertain of the specific actions that State Agencies will take to design State Implementation Plans to meet the revised standard, we do not estimate the costs that government agencies may incur to implement these control strategies.

6.1 Engineering Cost Estimates

6.1.1 Data and Methods: Identified Controls

Consistent with the emissions analysis presented in Chapter 3, our analysis of the costs associated with the proposed lead NAAQS focuses on point source particulate matter (PM) controls. For the purposes of this analysis, these controls largely include measures from the AirControlNET control technology database. The analysis also includes additional measures associated with operating permits and/or New Source Performance Review standards applicable to sources similar to those included in our analysis.

6.1.1.1 AirControlNET Controls

AirControlNET, a PC based database tool that EPA has used extensively for previous analyses of air pollution control costs, served as the primary source of cost information for our analysis of the proposed lead NAAQS. The program includes a detailed database of PM control measures (and measures for other pollutants) that can readily be linked to the 2002 National Emissions Inventory (NEI) to generate source specific estimates of the costs associated with air pollution policy. The controls included in AirControlNET represent proven retrofit technologies with control efficiencies and costs documented extensively by EPA and other sources. When using this information to estimate the costs for a specific source, AirControlNET compares these data with information from the 2002 NEI on the source's existing controls. In those cases where a new control identified by AirControlNET would replace an existing control, the program estimates the incremental cost as the difference between the costs of the new control and the costs associated with the existing control.

For the analysis of the proposed lead NAAQS, AirControlNET used one of three methods to estimate the costs of a given control:

1) ***Detailed cost function based on source specific engineering parameters.*** AirControlNET estimates the costs of some technologies as a function of several key engineering parameters, such as the source's capacity or stack flow rate;

2) ***Dollar per ton of PM_{10} controlled.*** For minor PM controls (i.e., increased monitoring frequency for PM controls and improvements to continuous emissions monitoring systems), AirControlNET estimates costs by applying a fixed cost per ton value (approximately \$6,300 per ton for CEMs in 2006 dollars) to the tonnage of PM controlled.[72]

3) ***Hybrid.*** For several PM controls, AirControlNET includes a detailed cost equation but only uses it if a source's stack flow rate is at least 5 cubic feet/minute. If the stack flow rate is below this threshold, AirControlNET applies a fixed cost per ton value to the tonnage of PM_{10} controlled.[73] AirControlNET employs this hybrid approach for most of the major PM controls included in our analysis.[74]

To estimate costs based on the cost per ton values described under items 2 and 3 above, it was necessary to first estimate the reduction in $PM_{2.5}$ or PM_{10} emissions for each relevant source. Where possible, we developed these estimates based on the baseline PM emissions of each source, as adapted from the 2002 NEI, and the estimated control efficiency of each measure.[75] The 2002 NEI, however, does not include baseline PM emissions data for many of the sources included in our analysis. For each of these sources, we employed one of two approaches to estimate baseline PM emissions:

1) ***SPECIATE approach.*** EPA's SPECIATE database includes sample PM speciation profiles for a variety of sources and maps these profiles to individual source classification codes (SCCs). For lead sources with SCCs represented by these profiles, we estimated baseline $PM_{2.5}$ and PM_{10} emissions based on the baseline lead emissions of these sources and the corresponding PM speciation profile in SPECIATE. For example, if a source has baseline lead emissions of 0.02 tons/year and the SPECIATE database suggests that lead, on average,

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[72] In some cases, this cost/ton value is specific to $PM_{2.5}$, while in other cases it is specific to all PM.

[73] This stands in contrast to the cost/ton values for the controls summarized under method 2, which are estimated as a cost/ton of $PM_{2.5}$ controlled or cost/ton of total PM controlled.

[74] By major controls, we mean all controls except for increased monitoring frequency and improvements to continuous monitoring systems.

[75] Chapter 3 describes the adjustments that we made to the 2002 NEI to account for controls expected to be implemented prior to the 2020 target year for this analysis.

represents two percent of the PM_{10} emissions for other sources that share its SCC, we assume that the source emits one ton of PM_{10}/year in the baseline. We used this approach to estimate the baseline $PM_{2.5}$ and PM_{10} emissions of all sources for which the 2002 NEI includes no PM emissions data but that are represented by the speciation profiles in SPECIATE.[76]

2) ***Average speciation approach***. Although SPECIATE includes speciation profiles for a wide range of sources, the database does not include profiles applicable to all of the sources included in our analysis. Therefore, we were unable to use SPECIATE to estimate the baseline $PM_{2.5}$ and PM_{10} emissions for several of the lead sources for which the 2002 NEI includes no PM data. For these sources, we estimated baseline $PM_{2.5}$ and PM_{10} emissions based on the PM speciation profile of those lead sources included in our analysis for which the 2002 NEI includes PM emissions data. Our analysis of these sources suggests that lead represents approximately 1.1 percent of their PM_{10} emissions and 1.5 percent of their $PM_{2.5}$ emissions. We assume that these values apply to all lead sources for which the 2002 NEI includes no PM emissions estimates and for which SPECIATE includes no relevant PM speciation profiles.

Within AirControlNET's standard format, the tool provides estimates of control costs for direct PM controls only for those sources emitting 10 or more tons of PM_{10} per year. Because many of the point sources included in our analysis fall below this emissions threshold, we have changed this standard format so that ACN can apply direct PM controls to sources emitting any amount of PM_{10}.[77] The cost equations and cost per ton values for major controls, however, do not necessarily apply with great accuracy to such controls for sources below this PM emissions threshold.

To better estimate the costs of direct PM controls for such small point sources, we used ACN's technology-specific cost and emission reduction estimates for these sources in order to estimate cost per ton values for small sources. Such costs may be quite high on a per ton basis; for example, applying a pulse-jet fabric filter on a PM_{10} source with less than 10 tons per year yields a cost per ton of $368,000. We expect that application of these point source controls to such small PM sources will be highly limited in actual practice for lead SIPs. More information on these point source controls can be found in the AirControlNET control measures documentation.[78]

[76] U.S. EPA, SPECIATE Version 4.0, updated January 18, 2007, http://www.epa.gov/ttn/chief/software/speciate/index.html>.

[77] In this analysis, we apply controls to small point sources with emissions below the 10 tons per year PM_{10} ACN application threshold, up to the 98^{th} percentile of marginal costs as described in Chapter 4. We apply controls to small point sources due to the extent of lead nonattainment associated with the alternative standards examined in this RIA and the lack of identified point source and other controls available to examine attainment with these standards as noted in Chapter 4.

[78] Available at http://www.epa.gov/ttnecas1/models/DocumentationReport.pdf.

6.1.1.2 Controls Identified from New Source Performance Standards and Recent Operating Permits

In addition to controls included in AirControlNET, our analysis of the costs associated with the proposed lead NAAQS reflects the potential implementation of controls identified from other sources. These include measures enumerated in recent operating permits for sources similar to those included in our draft RIA as well as measures that new and modified/reconstructed sources of PM emissions are expected to implement for compliance with New Source Performance Standards. The specific measures identified for these sources include the following:

- Increased electrostatic precipitator (ESP) collector plate area for EGU boilers.

The most common way to upgrade an ESP is to increase the specific collector area (SCA), which is an important variable in characterizing ESP performance. One of the most common routes by which to increase SCA is to simply increase the collector plate area by adding additional collector plates. The ESP modifications considered as control measures in this draft RIA include adding enough collection plate area to be equivalent to one or two new fields. The $PM_{2.5}$ reductions from adding 1 plate are about 44%, and about 67% from adding 2 plates. These levels will vary depending on how much SCA resides in each field. If an ESP designer has installed a large number of fields, with a relatively low amount of surface area in each field, the additional $PM_{2.5}$ reductions obtained by adding additional fields would be relatively low.

The costs of these upgrades vary by the capacity of the unit with the ESP. This variance enters into the equations to estimate capital and fixed operating and maintenance (O&M) costs. Variable O&M costs are constant for all unit capacities. The equations for estimating the costs of adding 2 collector plates are the following:

Capital Cost in \$/kW = 17.5 x $(250/MW)^{0.3}$ (MW is unit capacity in megawatts)

Variable O&M cost in mills/kWh = 0.013 (same for all unit capacities)

Fixed O&M Cost in \$/kW-yr = 0.31 x $(250/MW)^{0.3}$ (MW is unit capacity in megawatts)[79]

Two important assumptions that underlie these equations are a capacity factor of 85% (i.e., the unit is operating 85% of the time in a typical year), and a capital recovery factor of 0.12. The capital recovery factor reflects the expected economic life of the additional collector plates and the interest rate used to annualize the capital costs. In this case, the interest rate is the same as that employed in the current IPM.[80]

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[79] Email from Khan, Sikander, U.S. EPA/OAP/CAMD, to Sorrels, Larry, U.S. EPA/OAQPS/HEID. March 16, 2006.

[80] Personal communication of Sikander Khan, U.S. EPA/OAP/CAMD with Larry Sorrels, U.S. EPA/OAQPS/HEID. March 16, 2006.

An important caveat for these costs is that they only appropriate for ESP modifications at EGUs. While there is no technical reason why these modifications cannot take place at industrial boilers or other non-EGU units, these equations and data are based on information taken from EGU operations and hence is not appropriate for application to non-EGU units.

- Capture hoods vented to a baghouse at iron and steel mills.

Virtually all iron and steel mills have some type of PM control measure, but there is additional equipment that could be installed to reduce emissions further. Capture hoods that route PM emissions from a blast furnace casthouse to a fabric filter can provide 80% to 90% additional emission reductions from an iron or steel mill. We estimate the annualized costs for this control measure at \$5,000/ton of $PM_{2.5}$ emission reduction.[81]

- Diesel particulate filter (for stationary sources such as diesel generators);

This control incorporates directly-emitted $PM_{2.5}$ reductions from stationary internal combustion engines that will be affected by the compression-ignition internal combustion engine new source performance standard (NSPS) promulgated on June 28, 2006. Diesel particulate filters (DPF) are likely to be the control technology required for these engines to meet the NSPS requirements. The control is applied here as a retrofit to existing stationary internal combustion engines in our inventory.

We have taken the control efficiency and cost data from technical support documents prepared for the U.S. EPA as part of analyses undertaken for the final compression-ignition NSPS.[82] The control efficiency for $PM_{2.5}$ reductions from applying DPF is 90 percent at an annualized cost of \$9,000/ton. A major assumption in this analysis is that engines to which a DPF is applied will be use ultra-low sulfur fuel (ULSD) in the future. To the extent that these existing engines are not using ULSD, the level of control is likely to be lower than estimated in this draft RIA since DPFs will clog if the engine being controlled uses a higher-sulfur fuel than ULSD (15 ppm sulfur) and thus yield lower reductions of $PM_{2.5.}$

- Upgrade of CEMs and increased monitoring frequency of PM controls (for sources where not already identified as a control by ACN).

This control is an upgrade to existing control measures or an improvement in control efficiency due to how existing control measures operate from increases in monitoring. Such controls can lead to small reductions in PM (5% to 7%) at annualized costs ranging from \$600 to \$5,200/ton of $PM_{2.5.}$ This control is applicable to ESPs and baghouses at both EGU and non-

[81] U.S. Environmental Protection Agency. Regulatory Impact Analysis for the Particulate Matter NAAQS. October, 2006. Chapter 3, p. 3-13. This document is available at http://www.epa.gov/ttn/ecas/regdata/RIAs/Chapter%203--Controls.pdf.

[82] U.S. Environmental Protection Agency. "Emission Reduction Associated with NSPS for Stationary CI ICE." Prepared by Alpha-Gamma, Inc. June 3, 2005, and U.S. Environmental Protection Agency. "Cost per Ton for NSPS for Stationary CI ICE." Prepared by Alpha-Gamma, Inc. June 9, 2005.

EGU sources.[83] This control was applied to existing sources identified as having ESPs and baghouses according to their operating permits.

6.1.2 Engineering Cost Estimates for Identified Controls

Based on the data and methods outlined above, we estimated the costs associated with implementing the control strategies presented in Chapter 3. Table 6-1 summarizes these costs by monitor area. As indicated in the table, the annual costs of these controls range from $11 million under the 0.5 μg/m^3 standard to $84 million under the 0.05 μg/m^3 standard, assuming a discount rate of three percent. If we apply a seven percent discount rate, these values increase to $12 million and $88 million for the 0.5 and 0.05 μg/m^3 standards, respectively. Consistent with Chapter 4's summary of the air quality impacts associated with identified controls, the cost estimates in Table 6-1 reflect partial attainment with both the proposed and alternative standards. For the 0.3 μg/m^3 end of the proposed standard, the costs in Table 6-1 reflect attainment in 30 of the 36 monitor areas included in this analysis. For the 0.1 μg/m^3 target, the estimates in Table 6-1 reflect attainment in 20 monitor areas.

The results in Table 6-1 illustrate that the costs of the proposed NAAQS are likely to vary by monitor area. With the exception of the 0.5 μg/m^3 and 0.3 μg/m^3 standards, the costs of identified measures are expected to be highest in Jefferson County and Iron County, Missouri. As indicated in Chapter 3, the baseline lead emissions for these two counties are higher than the emissions of any other county in the U.S. This reflects the presence of major lead smelting operations in both counties. Following Jefferson and Iron Counties, the costs of identified measures are expected to be highest in Berks County, Pennsylvania. Similar to Jefferson and Iron Counties, emissions from lead smelting operations contribute significantly to the ambient concentration of lead in Berks County.

Table 6-2 presents the costs of identified controls/pound of lead emissions avoided in each monitor area. The estimates presented in this table suggest that, in general, the cost/pound of avoided lead emissions increases significantly for a given monitor as the standard becomes more stringent. For example, the cost/pound for Williamson County, Tennessee steadily increases from $300/pound under the 0.5 μg/m^3 standard to $900/pound under the 0.05 μg/m^3 standard. This is consistent with local areas first targeting sources where relatively low cost reductions may be achieved and subsequently achieving reductions from sources that are more costly to control (i.e., moving up the area's marginal abatement cost curve).

[83] U.S. Environmental Protection Agency. Regulatory Impact Analysis for the Particulate Matter NAAQS. October, 2006. Appendix E, pp. E-16 to E-24. This document is available at http://www.epa.gov/ttn/ecas/regdata/RIAs/Appendix%20E--Controls%20List.pdf.

Table 6-1.
ANNUAL COSTS RELATED TO IDENTIFIED CONTROLS

Monitor State	Monitor County	Annual Cost of Identified Controls in 2020 (Millions of 2006$)									
		Alternative Standard: 0.5 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean		Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
AL	Pike	2.7	2.9	2.7	2.9	3.5	3.7	4.6	4.9	4.8	5.1
CA	Los Angeles	-	-	-	-	-	-	-	-	<0.1	<0.1
CA	San Bernardino	-	-	-	-	-	-	-	-	<0.1	<0.1
CO	Adams	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
CO	Denver	-	-	-	-	0.9	0.9	0.9	0.9	0.9	0.9
CO	El Paso	-	-	-	-	-	-	<0.1	<0.1	<0.1	<0.1
FL	Hillsborough	<0.1	<0.1	0.3	0.4	0.7	0.8	1.3	1.3	1.3	1.3
GA	DeKalb	-	-	-	-	-	-	-	-	-	-
GA	Muscogee	-	-	-	-	-	-	<0.1	<0.1	2.5	2.6
IL	Cook	-	-	-	-	-	-	-	-	1.4	1.5
IL	Madison	-	-	-	-	-	-	0.1	0.1	0.1	0.1
IL	St. Clair	-	-	-	-	-	-	-	-	2.1	2.2
IN	Delaware	1.6	1.7	1.7	1.8	1.7	1.8	1.7	1.8	1.7	1.8
IN	Lake	-	-	-	-	-	-	-	-	1.5	1.5
IN	Marion	-	-	-	-	-	-	-	-	5.0	5.2
MN	Dakota	-	-	-	-	-	-	2.1	2.2	2.1	2.2
MO	Iron	5.7	6.0	5.7	6.0	6.9	7.3	6.9	7.3	6.9	7.3
MO	Jefferson	<0.1	<0.1	26.5	27.6	26.5	27.6	26.5	27.6	26.5	27.6
MO	St. Louis	-	-	-	-	-	-	-	-	-	-
NJ	Middlesex	-	-	-	-	-	-	-	-	-	-
NY	Orange	-	-	-	-	<0.1	<0.1	<0.1	<0.1	2.4	2.5
OH	Cuyahoga	-	-	3.1	3.2	4.4	4.5	4.4	4.5	4.4	4.5
OH	Fulton	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Monitor State	Monitor County	Annual Cost of Identified Controls in 2020 (Millions of 2006$)									
		Alternative Standard: 0.5 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 μg/m^3 2nd Maximum Monthly Mean		Alternative Standard: 0.05 μg/m^3 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
OH	Logan	-	-	-	-	-	-	-	-	-	-
OK	Ottawa	-	-	-	-	-	-	-	-	-	-
PA	Allegheny	-	-	-	-	-	-	-	-	<0.1	<0.1
PA	Beaver	-	-	-	-	0.5	0.6	2.7	3.0	2.7	3.0
PA	Berks	<0.1	<0.1	5.9	6.2	5.9	6.2	5.9	6.2	5.9	6.2
PA	Cambria	-	-	-	-	-	-	-	-	-	-
PA	Carbon	-	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
TN	Sullivan	-	-	-	-	-	-	-	-	-	-
TN	Williamson	0.9	0.9	1.2	1.2	1.7	1.8	3.0	3.2	4.4	4.6
TX	Collin	<0.1	<0.1	<0.1	<0.1	1.8	1.9	3.0	3.2	6.8	7.2
TX	Dallas	-	-	-	-	-	-	-	-	-	-
TX	El Paso	-	-	-	-	-	-	-	-	<0.1	<0.1
UT	Salt Lake	-	-	-	-	-	-	<0.1	<0.1	0.5	0.5
Total		**$11.0**	**$11.6**	**$47.2**	**$49.4**	**$54.6**	**$57.1**	**$63.3**	**$66.3**	**$83.9**	**$87.9**

Table 6-2.
ANNUAL COST/POUND OF REDUCED LEAD EMISSIONS: IDENTIFIED CONTROLS

Monitor State	Monitor County	Annual Cost/Pound for Identified Controls in 2020 (2006$)									
		Alternative Standard: 0.5 $\mu g/m^3$ 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 $\mu g/m^3$ 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 $\mu g/m^3$ 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 $\mu g/m^3$ 2nd Maximum Monthly Mean		Alternative Standard: 0.05 $\mu g/m^3$ 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
AL	Pike	300	400	300	400	400	500	500	600	500	600
CA	Los Angeles	-	-	-	-	-	-	-	-	<100	<100
CA	San Bernardino	-	-	-	-	-	-	-	-	3,100	3,100
CO	Adams	-	-	<100	<100	<100	<100	<100	<100	<100	<100
CO	Denver	-	-	-	-	5,400	5,600	5,400	5,600	5,400	5,600
CO	El Paso	-	-	-	-	-	-	11,400	11,400	11,400	11,400
FL	Hillsborough	<100	<100	200	200	300	300	500	500	500	500
GA	DeKalb	-	-	-	-	-	-	-	-	-	-
GA	Muscogee	-	-	-	-	-	-	500	500	5,400	5,600
IL	Cook	-	-	-	-	-	-	-	-	1,500	1,500
IL	Madison	-	-	-	-	-	-	700	700	700	700
IL	St. Clair	-	-	-	-	-	-	-	-	2,500	2,700
IN	Delaware	600	600	600	600	600	600	600	600	600	600
IN	Lake	-	-	-	-	-	-	-	-	500	500
IN	Marion	-	-	-	-	-	-	-	-	1,700	1,800
MN	Dakota	-	-	-	-	-	-	300	400	300	400
MO	Iron	200	200	200	200	300	300	300	300	300	300
MO	Jefferson	<100	<100	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,400
MO	St. Louis	-	-	-	-	-	-	-	-	-	-
NJ	Middlesex	-	-	-	-	-	-	-	-	-	-
NY	Orange	-	-	-	-	<100	<100	<100	<100	800	900
OH	Cuyahoga	-	-	7,000	7,200	6,800	7,000	6,800	7,000	6,800	7,000
OH	Fulton	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100

Monitor State	Monitor County	Annual Cost/Pound for Identified Controls in 2020 (2006$)									
		Alternative Standard: 0.5 µg/m³ 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 µg/m³ 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 µg/m³ 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 µg/m³ 2nd Maximum Monthly Mean		Alternative Standard: 0.05 µg/m³ 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
OH	Logan	-	-	-	-	-	-	-	-	-	-
OK	Ottawa	-	-	-	-	-	-	-	-	-	-
PA	Allegheny	-	-	-	-	-	-	-	-	<100	<100
PA	Beaver	-	-	-	-	500	500	1,500	1,700	1,500	1,700
PA	Berks	<100	<100	1,900	2,000	1,900	2,000	1,900	2,000	1,900	2,000
PA	Cambria	-	-	-	-	-	-	-	-	-	-
PA	Carbon	-	-	-	-	500	500	500	500	500	500
TN	Sullivan	-	-	-	-	-	-	-	-	-	-
TN	Williamson	300	400	300	300	400	400	700	700	900	900
TX	Collin	<100	<100	<100	<100	300	400	500	500	1,100	1,100
TX	Dallas	-	-	-	-	-	-	-	-	-	-
TX	El Paso	-	-	-	-	-	-	-	-	500	500
UT	Salt Lake	-	-	-	-	-	-	<100	<100	<100	<100
Total		**$200**	**$200**	**$700**	**$700**	**$700**	**$800**	**$700**	**$800**	**$800**	**$900**

6.1.3 Engineering Cost Estimates for Unidentified Controls

As indicated above, the identified measures reflected in Tables 6-1 and 6-2 do not result in attainment with the proposed or alternative lead standards in several areas. In these areas, additional unidentified measures will likely be necessary to reach attainment. Chapters 3 and 4 describe our assumptions about the control efficiency of these measures and their effect on ambient lead concentrations. To estimate the costs associated with unidentified measures, we assume a fixed cost of \$32 million/ton or \$16,000/pound in 2006 dollars.[84] This is consistent with the 98th percentile of the cost/ton for identified controls at large point sources discussed in Chapter 4.[85] Post the application of unidentified controls there remains an additional increment to attainment in some geographic areas. This additional increment is represented throughout this section as "+C".

Table 6-3 presents the costs of unidentified controls by monitor area. As indicated in the table, these costs range from \$0.6 million +C under the 0.5 $\mu g/m^3$ standard to approximately \$2 billion +C under the 0.05 $\mu g/m^3$ standard. As suggested by Tables 6-1 and 6-3, the extent to which these costs exceed those associated with identified controls alone increases with the stringency of the standard. This is consistent with the emissions analysis presented in Chapter 4, which suggests that local areas' reliance on unidentified controls would increase as the standard becomes more stringent.

[84] This estimate reflects a discount rate of three percent. The identified controls have explicit capital costs that are annualized, as well as annual operating costs. The discount rate influences the annualization of the capital costs. For the unidentified controls, pure annualized costs were used; explicit capital and annual costs were not broken out. While the derivation of the fixed cost for unidentified controls used a marginal cost curve calculated at a discount rate of 3%, it is impossible to determine what difference use of a 7% discount rate would make without making additional assumptions about the breakdown of capital versus annual costs for unidentified controls.

[85] The fixed cost estimate for unidentified controls was developed based on the cost of controls with a 3 percent discount rate. Because it is a fixed cost, however, when applied to estimate the costs of unidentified controls it is assumed not to be affected by the discount rate assumption. That is, costs for *unidentified* controls are assumed to be the same for the 3 and 7 percent discount rate.

Table 6-3.
ANNUAL COSTS UNIDENTIFIED CONTROLS FOR EACH MONITOR AREA

Monitor State	Monitor County	Annual Cost of Unidentified Controls in 2020 (Millions of 2006$) Alternative Standard: 0.5 µg/m^3 2nd Maximum Monthly Mean	Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean	Proposed NAAQS: 0.2 µg/m^3 2nd Maximum Monthly Mean	Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean	Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean
AL	Pike	-	-	-	-	-
CA	Los Angeles	-	-	-	-	$13.2+C
CA	San Bernardino	-	-	-	-	$1.2
CO	Adams	-	$10.6	$22.2	$45.5	$68.0+C
CO	Denver	-	-	$7.6	$46.0	$73.7+C
CO	El Paso	-	-	-	$18.0	$25.0+C
FL	Hillsborough	-	-	-	-	-
GA	DeKalb	-	-	-	-	-+C
GA	Muscogee	-	-	-	-	$6.1+C
IL	Cook	-	-	-	-	$7.3+C
IL	Madison	-	-	-	$0.9	$9.2
IL	St. Clair	-	-	-	-	$16.9
IN	Delaware	-	$0.4+C	$0.4+C	$0.4+C	$0.4+C
IN	Lake	-	-	-	-	-
IN	Marion	-	-	-	-	-
MN	Dakota	-	-	-	-	-
MO	Iron	-	-	$40.2	$304.4	$436.5
MO	Jefferson	-	$381.3	$687.3	$993.3	$1,105.0+C
MO	St. Louis	-	-	-	-	-
NJ	Middlesex	-	-	-	$19.8	$42.9
NY	Orange	-	-	-	-	$6.9
OH	Cuyahoga	-	-	$8.3	$19.4+C	$19.4+C
OH	Fulton	$0.6	$4.9	$7.1	$9.3	$9.8+C
OH	Logan	-	$0.7	$1.9	$2.3+C	$2.3+C
OK	Ottawa	-	-	-	-+C	-+C
PA	Allegheny	-	-	-	-	-
PA	Beaver	-	-	-	$66.0	$105.2
PA	Berks	-	$1.8	$6.7	$12.8+C	$12.8+C
PA	Cambria	-	-	-	-	-+C
PA	Carbon	-	-	$5.3	$8.7+C	$8.7+C
TN	Sullivan	-	-	-	$5.0	$9.6
TN	Williamson	-	-	-	-	-
TX	Collin	-	-	-	-	-
TX	Dallas	-	-	-	-	-+C
TX	El Paso	-	-	-	-	$1.7
UT	Salt Lake	-	-	-	-	-
Total		**$0.6**	**$399.7+C**	**$786.9+C**	**$1,551.7+C**	**$1,981.8+C**

6.1.4 Monitoring Costs

Consistent with the scope of this rulemaking, which includes monitoring provisions, monitoring costs are included here. As part of the regulatory package accompanying the revised standard, revised Pb monitoring requirements being proposed. The rule proposes revisions to the network design requirements, QA requirements, and the minimum sampling frequency for Pb monitoring. These changes are being proposed to ensure adequate Pb monitoring will be performed to determine compliance with the proposed Pb NAAQS. A number of options are being proposed as part of the Pb NAAQS revision including the level of the standard and the averaging time for the standard which directly affect the associated monitoring burden. The final decisions on these options will not be made until promulgation of the final rule. Total costs for expansion of the monitoring network is estimated to be $8.3 million.

The actual monitoring burden will vary depending on the level and the averaging time for the final standard. In the draft ICR, we have estimated the potential burden for the lowest option proposed (i.e. 0.1ug/m^3; 2nd max monthly). A more specific estimate will be provided in the final rule package. Although we have not estimated the costs of the monitoring network at different levels of the standard, based on the information we had at the time of issuance of the proposed rule, there are approximately 704 facilities that would require monitoring at a level of 0.1ug/m^3, as compared to 194 facilities that would require monitoring at a level of 0.3ug/m^3 (see: http://www.epa.gov/oar/lead/pdfs/20080502_maps4.pdf). For more detail, see OMB 2060-0084, ICR #940.21.

6.1.5 Summary of Cost Estimates

The difference between the county level results presented in Tables 6-4 and 6-1 suggests that, in some local areas, unidentified measures will represent the majority of the costs incurred by affected sources. For example in Iron County, MO, we estimate costs of $6.9 million for identified measures in Iron County, Missouri for the 0.1 μg/m^3 standard (assuming a discount rate of three percent). As indicated in Table 6-3, unidentified measures would increase the county's estimated costs for this standard by $304 million to approximately $311 million. Note also that in Iron County, MO, identified controls for the 0.1 μg/m^3 standard, using a three percent discount rate, cost on average $300 per pound (see Table 6-2), but we assume all unidentified controls cost $16,000 per pound.

The significant difference between the costs of identified controls alone and the cost of achieving attainment (i.e. including both identified and unidentified controls) in this and other areas reflects the limited information available to EPA on the control measures that sources may implement. It is important to remember that, compared to recent NAAQS RIAs, our current knowledge of the costs and nature of lead emissions controls is relatively poor. Lead in ambient air has not been a focus for all but a few areas of the country for the last decade or more; the alternative standards represent a substantial tightening of the existing NAAQS. As a result, although AirControlNET contains information on a large number of different point source controls, we would expect that State and local air quality managers would have access to additional information on the controls available to the most significant sources.

The cost estimates in Table 6-4 show that the costs associated with the 0.5 μg/m^3 alternative standard are significantly lower than the estimated costs associated with the proposed range of 0.1 to 0.3 μg/m^3. This largely reflects the extent to which unidentified controls would be necessary for lead NAAQS compliance under the 0.5 μg/m^3 standard versus the proposed standard of 0.1 to 0.3 μg/m^3. As indicated in Chapter 4, the emissions reductions achieved with identified controls alone would be sufficient for attainment with the 0.5 μg/m^3 standard for all but one of the 36 monitor areas analyzed as part of this assessment. In the one area where unidentified measures would be necessary for compliance with the 0.5 μg/m^3 standard, unidentified controls would need to reduce lead emissions by just 0.02 tons. By comparison, under the 0.3 standard, 12.41 tons of reductions from unidentified controls are necessary for areas to reach attainment. At a cost of more than $32 million per ton, this 12.39 ton difference accounts for approximately $400 million of the difference in costs between the 0.5 and 0.3 μg/m^3

standards. It is also important to note that most of the incremental costs associated with the 0.3 $\mu g/m^3$ standard relative to the 0.5 $\mu g/m^3$ standard are associated with the implementation of unidentified controls in Jefferson County, Missouri.

Table 6-5 presents the cost/pound of lead emissions reduced for identified and unidentified measures. The values shown in this exhibit are generally less variable than the corresponding values for identified measures presented in Table 6-2. This reflects our assumption of a fixed cost of $16,000 per pound ($32 million per ton) for all unidentified measures. Table 6-6 provides a summary of total costs to achieve each alternative standard through application of controls to point sources.

Table 6-4.
ANNUAL TOTAL COSTS FOR EACH MONITOR AREA

Monitor State	Monitor County	Annual Cost of Identified and Unidentified Controls in 2020 (Millions of 2006$)									
		Alternative Standard: 0.5 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean		Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
AL	Pike	2.7	2.9	2.7	2.9	3.5	3.7	4.6	4.9	4.8	5.1
CA	Los Angeles	-	-	-	-	-	-	-	-	13.2+C	13.2+C
CA	San Bernardino	-	-	-	-	-	-	-	-	1.2	1.2
CO	Adams	-	-	10.6	10.6	22.2	22.2	45.5	45.5	68.0+C	68.0+C
CO	Denver	-	-	-	-	8.4	8.5	46.9	46.9	74.6+C	74.6+C
CO	El Paso	-	-	-	-	-	-	18.0	18.0	25.0+C	25.0+C
FL	Hillsborough	<0.1	<0.1	0.3	0.4	0.7	0.8	1.3	1.3	1.3	1.3
GA	DeKalb	-	-	-	-	-	-	-	-	-+C	-+C
GA	Muscogee	-	-	-	-	-	-	<0.1	<0.1	8.7+C	8.8+C
IL	Cook	-	-	-	-	-	-	-	-	8.8+C	8.8+C
IL	Madison	-	-	-	-	-	-	1.1	1.1	9.3	9.3
IL	St. Clair	-	-	-	-	-	-	-	-	19.0	19.1
IN	Delaware	1.6	1.7	2.1+C	2.1+C	2.1+C	2.1+C	2.1+C	2.1+C	2.1+C	2.1+C
IN	Lake	-	-	-	-	-	-	-	-	1.5	1.5
IN	Marion	-	-	-	-	-	-	-	-	5.0	5.2
MN	Dakota	-	-	-	-	-	-	2.1	2.2	2.1	2.2
MO	Iron	5.7	6.0	5.7	6.0	47.1	47.4	311.3	311.6	443.4	443.7
MO	Jefferson	<0.1	<0.1	407.8	408.9	713.8	714.9	1,019.8	1,020.9	1,131.5+C	1,132.6+C
MO	St. Louis	-	-	-	-	-	-	-	-	-	-
NJ	Middlesex	-	-	-	-	-	-	19.8	19.8	42.9	42.9
NY	Orange	-	-	-	-	<0.1	<0.1	<0.1	<0.1	9.3	9.5
OH	Cuyahoga	-	-	3.1	3.2	12.6	12.8	23.8+C	23.9+C	23.8+C	23.9+C
OH	Fulton	0.7	0.7	5.0	5.0	7.1	7.1	9.3	9.3	9.8+C	9.8+C

Monitor State	Monitor County	Annual Cost of Identified and Unidentified Controls in 2020 (Millions of 2006$)									
		Alternative Standard: 0.5 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean		Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
OH	Logan	-	-	0.7	0.7	1.9	1.9	2.3+C	2.3+C	2.3+C	2.3+C
OK	Ottawa	-	-	-	-	-	-	-+C	-+C	-+C	-+C
PA	Allegheny	-	-	-	-	-	-	-	-	<0.1	<0.1
PA	Beaver	-	-	-	-	0.5	0.6	68.7	69.0	107.9	108.2
PA	Berks	<0.1	<0.1	7.7	8.0	12.7	13.0	18.7+C	19.0+C	18.7+C	19.0+C
PA	Cambria	-	-	-	-	-	-	-	-	-+C	-+C
PA	Carbon	-	-	-	-	5.3	5.3	8.7+C	8.7+C	8.7+C	8.7+C
TN	Sullivan	-	-	-	-	-	-	5.0	5.0	9.6	9.6
TN	Williamson	0.9	0.9	1.2	1.2	1.7	1.8	3.0	3.2	4.4	4.6
TX	Collin	<0.1	<0.1	<0.1	<0.1	1.8	1.9	3.0	3.2	6.8	7.2
TX	Dallas	-	-	-	-	-	-	-	-	-+C	-+C
TX	El Paso	-	-	-	-	-	-	-	-	1.7	1.7
UT	Salt Lake	-	-	-	-	-	-	<0.1	<0.1	0.5	0.5
Total		**11.7**	**12.3**	**446.9**+C	**449.0**+C	**841.5**+C	**844.0**+C	**1,614.9**+C	**1,618.0**+C	**2,065.7**+C	**2,069.7**+C

Table 6-5.
ANNUAL COST/POUND OF REDUCED LEAD EMISSIONS: IDENTIFIED & UNIDENTIFIED CONTROLS

Monitor State	Monitor County	Annual Cost/Pound for Identified and Unidentified Controls (2006$)									
		Alternative Standard: 0.5 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 μg/m^3 2nd Maximum Monthly Mean		Alternative Standard: 0.05 μg/m^3 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
AL	Pike	300	400	300	400	400	500	500	600	500	600
CA	Los Angeles	-	-	-	-	-	-	-	-	15,900+C	15,900+C
CA	San	-	-	-	-	-	-	-	-	16,100	16,100
CO	Adams	-	-	14,400	14,400	15,200	15,200	15,700	15,700	15,800+C	15,800+C
CO	Denver	-	-	-	-	13,400	13,400	15,500	15,500	15,700+C	15,700+C
CO	El Paso	-	-	-	-	-	-	16,100	16,100	16,100+C	16,100+C
FL	Hillsborough	<100	<100	200	200	300	300	500	500	500	500
GA	DeKalb	-	-	-	-	-	-	-	-	-+C	-+C
GA	Muscogee	-	-	-	-	-	-	500	500	10,200+C	10,300+C
IL	Cook	-	-	-	-	-	-	-	-	6,100+C	6,200+C
IL	Madison	-	-	-	-	-	-	4,100	4,100	12,000	12,000
IL	St. Clair	-	-	-	-	-	-	-	-	10,200	10,200
IN	Delaware	600	600	700+C	800+C	700+C	800+C	700+C	800+C	700+C	800+C
IN	Lake	-	-	-	-	-	-	-	-	500	500
IN	Marion	-	-	-	-	-	-	-	-	1,700	1,800
MN	Dakota	-	-	-	-	-	-	300	400	300	400
MO	Iron	200	200	200	200	1,700	1,800	7,200	7,200	8,600	8,600
MO	Jefferson	<100	<100	9,500	9,500	11,500	11,500	12,600	12,600	12,900+C	12,900+C
MO	St. Louis	-	-	-	-	-	-	-	-	-	-
NJ	Middlesex	-	-	-	-	-	-	16,100	16,100	16,100	16,100
NY	Orange	-	-	-	-	<100	<100	<100	<100	2,700	2,800
OH	Cuyahoga	-	-	7,000	7,200	10,900	11,100	12,900+C	12,900+C	12,900+C	12,900+C

Monitor State	Monitor County	Annual Cost/Pound for Identified and Unidentified Controls (2006$)									
		Alternative Standard: 0.5 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 μg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 μg/m^3 2nd Maximum Monthly Mean		Alternative Standard: 0.05 μg/m^3 2nd Maximum Monthly Mean	
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate
OH	Fulton	2,400	2,400	9,300	9,300	10,600	10,600	11,500	11,500	11,700+C	11,700+C
OH	Logan	-	-	16,100	16,100	16,100	16,100	16,100+C	16,100+C	16,100+C	16,100+C
OK	Ottawa	-	-	-	-	-	-	-+C	-+C	-+C	-+C
PA	Allegheny	-	-	-	-	-	-	-	-	<100	<100
PA	Beaver	-	-	-	-	500	500	11,700	11,800	13,000	13,000
PA	Berks	<100	<100	2,400	2,500	3,600	3,600	4,800+C	4,800+C	4,800+C	4,800+C
PA	Cambria	-	-	-	-	-	-	-	-	-+C	-+C
PA	Carbon	-	-	-	-	16,100	16,100	16,100+C	16,100+C	16,100+C	16,100+C
TN	Sullivan	-	-	-	-	-	-	16,100	16,100	16,100	16,100
TN	Williamson	300	400	300	300	400	400	700	700	900	900
TX	Collin	<100	<100	<100	<100	300	400	500	500	1,100	1,100
TX	Dallas	-	-	-	-	-	-	-	-	-+C	-+C
TX	El Paso	-	-	-	-	-	-	-	-	15,900	15,900
UT	Salt Lake	-	-	-	-	-	-	<100	<100	<100	<100
Total		**200**	**200**	**4,800**+C	**4,800**+C	**6,800**+C	**6,800**+C	**8,900**+C	**8,900**+C	**9,300**+C	**9,300**+C

Table 6-6.
SUMMARY OF TOTAL COSTS FOR REGULATORY ALTERNATIVES

	Annual Cost of Identified and Unidentified Controls in 2020 (Millions of 2006$)									
	Alternative Standard: 0.5 µg/m³ 2nd Maximum Monthly Mean		**Proposed NAAQS: 0.3 µg/m³ 2nd Maximum Monthly Mean**		**Proposed NAAQS: 0.2 µg/m³ 2nd Maximum Monthly Mean**		**Proposed NAAQS: 0.1 µg/m³ 2nd Maximum Monthly Mean**		**Alternative Standard: 0.05 µg/m³ 2nd Maximum Monthly Mean**	
	3% Discount rate	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**	**3% Discount rate**	**7% Discount rate**
Identified Controls	**$11**	**$11**	**$47**	**$49**	**$55**	**$57**	**$63**	**$66**	**$84**	**$88**
Unidentified Controls*	**$0.6**		**$400**		**$790**		**$1,600**		**$2,000**	
Total draft RIA Engineering Costs	**$12**	**$12**	**$450+C**	**$450+C**	**$840+C**	**$840+C**	**$1,600+C**	**$1,600+C**	**$2,100+C**	**$2,100+C**
Total ICR Monitoring Costs**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**	**$8.3**

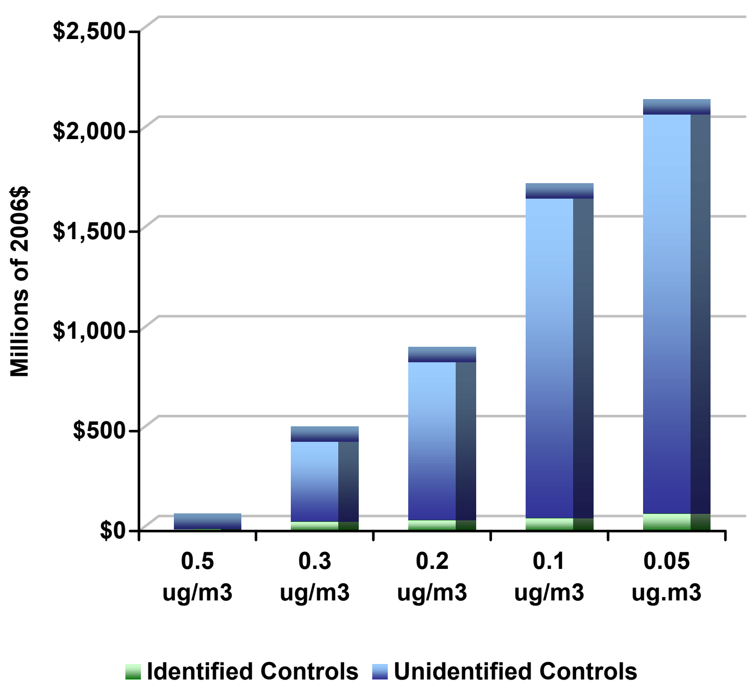
* Costs of unidentified controls are estimated using a fixed cost assumption of $16,000 per pound regardless of the discount rate assumption.

** Consistent with the scope of this rulemaking, which includes monitoring provisions, monitoring costs are included here. See OMB 2060-0084, ICR #940.21 for a complete discussion.

Unquantified costs are indicated with a "+C" to represent the additional sum of unquantified costs of full attainment. Full attainment costs were not calculated for some monitor areas for a few reasons. One such location is Ottawa County, OK where there are no existing sources of lead emissions, yet there is a large Superfund site and the federal government is buying out the remaining residents.[86] Another example is Logan County, OH, where we will investigate the application of additional known control measures to smaller sources for the final RIA.

Figure 6-1 shows the relative costs estimated from identified controls (in green) vs. unidentified controls (in blue) for each alternative standard.

Figure 6-1.
RELATIVE COSTS FROM IDENTIFIED VS. UNIDENTIFIED CONTROLS*



* The additional increment to attainment "+C" is not represented in this figure.

[86] See http://www.washingtonpost.com/wp-dyn/content/article/2007/01/12/AR2007011201692.html and http://www.dispatch.com/live/content/insight/stories/2008/05/11/Farewell_to_a_Town_1.ART_ART_05-11-08_G3_36A50UE.html.

6.2 Economic Impacts

The assessment of economic impacts was conducted simply based on those source categories which are controlled in this analysis. The impacts presented here are an extension of the engineering costs, where engineering costs are allocated to specific source categories by standard industrial classification (SIC) code. Although the costs outlined in the previous section may affect a range of industries, we expect that most of the costs associated with the proposed lead NAAQS will be concentrated in a limited number of industry sectors. As indicated in Table 6-7, we estimate that the primary metals industries (excluding sources with SIC codes 331 and 335) will incur costs of $431 million to $1.2 billion (2006 dollars) under the proposed standard of 0.1 to 0.3 $\mu g/m^3$, assuming a discount rate of 3 percent. This represents 75 to 96 percent of the total costs associated with the standard and 1.2 to 3.3 percent of the industry's sales in 2005. Table 6-7 also shows that other industry sectors expected to incur significant costs include electric utilities (SIC 4911); blast furnaces and steel mills (SIC 3312); and nonferrous metals rolling, drawing, and extrusion (SIC 335). The projected compliance costs for all of these industries represent a smaller fraction of sales than the corresponding costs for the primary metals industry (SIC 33 excluding SIC codes 331 and 335).

Table 6-8 presents capital and O&M costs by industry for identified measures under the 0.1 and 0.3 $\mu g/m^3$ standards (i.e., both the low and high ends of the proposed range).[87] Costs associated with unidentified controls are not reflected in the table because the distribution of costs between capital and O&M is uncertain for these measures. As indicated in the table, O&M represents most of the costs associated with identified controls. This implies that although the upfront capital costs associated with the proposed standard may be significant for affected industries, these costs are expected to represent a fraction of the standard's total costs.

[87] The costs presented in the table reflect a discount rate of three percent. Because the purpose of the table is to show the approximate distribution of costs between capital and O&M, the table presents costs based on just one discount rate for ease of presentation.

Table 6-7.
ANNUAL COSTS OF IDENTIFIED AND UNIDENTIFIED CONTROLS BY INDUSTRY

SIC Code	Industry Description	Total Cost with Identified and Unidentified Controls (Millions of 2006$)										Industry Revenues in 2005 (millions of 2006$)[1]
		Alternative Standard: 0.5 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.2 µg/m^3 2nd Maximum Monthly Mean		Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean		Alternative Standard: 0.05 µg/m^3 2nd Maximum Monthly Mean		
		3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	3% Discount rate	7% Discount rate	
10, excl. 104	Metal mining, excl. Gold and Silver Ores	<0.1	<0.1	<0.1	<0.1	36.9	36.9	301.1	301.1	433.2	433.2	6,025
3312	Steel Works, Blast Furnaces, and Rolling Mills	<0.1	<0.1	3.2	3.3	3.2	3.3	4.3	4.4	14.0	14.1	38,863
335	Primary Metal Industries, Nonferrous Rolling, Drawing, and Extruding	-	-	-	-	8.2	8.2	14.5	14.5	21.8	21.8	12,720
33, excl. 331 and 335	Other Primary Metal Industries	11.7	12.3	431.1	433.0	763.9	766.1	1,206.6	1,209.3	1,386.5	1,390.0	36,613
369	Miscellaneous Electrical Equipment, Machinery, and Supplies	<0.1	<0.1	0.4	0.5	0.4	0.5	26.7	26.8	60.4	60.4	2,357
4911	Electricity Generation, Transmission, and Distribution	-	-	<0.1	<0.1	<0.1	<0.1	2.0	2.3	34.0	34.3	273,296
75	Auto Repair, Services, and Parking	-	-	10.6	10.6	19.0	19.0	26.4	26.4	38.0	38.0	5,161
Other Industries		<0.1	<0.1	1.6	1.7	9.9	10.0	33.2	33.3	77.8	77.9	
Total		**11.7+C**	**12.3+C**	**446.9+C**	**449.0+C**	**841.5+C**	**844.0+C**	**1,614.9+C**	**1,618.0+C**	**2,065.7+C**	**2,069.7+C**	

Notes:
1. Source: Ibbotson Associates, *2006 Cost of Capital Yearbook*, 2006.

Table 6-8.
ANNUAL CAPITAL AND O&M COSTS BY INDUSTRY FOR IDENTIFIED CONTROLS
(3 percent discount rate)

		Annual Cost of Identified Controls in 2020 (Millions of 2006$)					
		Proposed NAAQS: 0.3 µg/m^3 2nd Maximum Monthly Mean			**Proposed NAAQS: 0.1 µg/m^3 2nd Maximum Monthly Mean**		
SIC Code	**Description**	**Capital**	**O&M**	**Total Annual Cost**	**Capital**	**O&M**	**Total Annual Cost**
10, excl. 104	Metal mining, excl. Gold and Silver Ores	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
3312	Steel Works, Blast Furnaces, and Rolling Mills	0.4	2.8	3.2	0.4	2.9	3.3
335	Primary Metal Industries, Nonferrous Rolling, Drawing, and Extruding	-	-	-	<0.1	<0.1	<0.1
33, excl. 331 and 335	Other Primary Metal Industries	14.8	27.8	42.7	17.5	37.2	54.7
369	Miscellaneous Electrical Equipment, Machinery, and Supplies	<0.1	0.3	0.4	<0.1	0.3	0.4
4911	Electricity Generation, Transmission, and Distribution	<0.1	<0.1	<0.1	0.9	1.1	2.0
75	Auto Repair, Services, and Parking	-	-	-	-	-	-
Other		0.1	0.8	0.9	0.3	2.4	2.7
Total		**15.4+C**	**31.8+C**	**47.2+C**	**19.3+C**	**44.0+C**	**63.3+C**

6.3 Energy Impacts

This section summarizes the energy consumption impacts of the proposed and alternative lead NAAQS. The proposed Pb NAAQS revisions do not constitute a "significant energy action" as defined in Executive Order 13211; this information merely represents impacts of the illustrative control strategies applied in the draft RIA.

For this draft RIA, implementation of the control measures needed for attainment with the alternative standards will likely lead to increased energy consumption among lead emitting facilities. To control emissions effectively, these measures require a significant amount of electricity that affected facilities are not expected to consume under baseline conditions. The available information on these controls suggests that they are not typically powered by natural gas or other fossil fuels; therefore, our analysis of energy impacts focuses exclusively on electricity consumption. In addition, because the energy intensity of unidentified controls is uncertain, we only consider the energy impacts associated with identified controls.

To assess the electricity consumption impacts associated with identified controls, we relied on the AirControlNET outputs generated for this analysis. For most identified controls, AirControlNET estimates electricity costs separately from other operating and maintenance (O&M) costs. Therefore, for sources expected to implement these controls, AirControlNET provides direct estimates of the additional electricity costs expected under the standards. We calculate the electricity consumption associated with these costs based on the unit cost of electricity assumed by AirControlNET (7.8 cents/kilowatt hour in 2006 dollars).

For a number of identified controls, AirControlNET does not separate the cost of electricity from other O&M costs. Similarly, the cost data for several controls identified from sources other than AirControlNET do not distinguish between electricity and other O&M costs. We estimate the electricity costs associated with these measures based on electricity's assumed share of total O&M, which we estimate based on AirControlNET's results for those controls where it separates electricity costs from other O&M costs. For some controls, O&M costs are not estimated separately from capital costs. In these cases, we assume that O&M represents a fixed share of annual costs based on the cost data for those controls where O&M and capital are calculated separately.

Table 6-9 summarizes the estimated energy impacts associated with the proposed and alternative standards. As indicated in the table, we estimate that sources installing identified controls under the proposed rule will increase their electricity consumption in 2020 by approximately 3,900 to 27,400 megawatt-hours (MWh). By comparison, the iron and steel industry alone is projected to purchase 67.6 million MWh of electricity in 2020.[88]

Table 6-9.
SUMMARY OF ENERGY IMPACTS*

	0.5 µg/ m³ 2nd Max Monthly Mean	**0.3 µg/m³ 2nd Max Monthly Mean**	**0.2 µg/ m³ 2nd Max Monthly Mean**	**0.1 µg/ m³ 2nd Max Monthly Mean**	**0.05 µg/ m³ 2nd Max Monthly Mean**
Electricity Cost (millions of year 2006$)	$0.3	$1.5	$1.9	$2.1	$3.1
Electricity Consumption (Megawatt-hours consumed in 2020)	3,900	19,800	25,000	27,400	40,200

* Additional increment to attainment "+C" is not represented in this table.

6.4 Limitations

Although the cost analysis presented in this chapter provides a reasonable approximation of the costs associated with the proposed lead NAAQS using hypothetical control scenario given the available information, we note the following limitations of the analysis:

[88] U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2007*, February 2007.

- ***Analysis limited to point source controls.*** Because limited data are available on fugitive and area source emissions, our analysis of the costs associated with the proposed and alternative lead NAAQS does not consider area source and direct fugitive controls that may be implemented to comply with these standards.[89] Therefore, in those areas where point source controls are insufficient to attain the standard, we were unable to model full compliance with the revised NAAQS and, in all likelihood, underestimated costs. However, for areas where point source controls are sufficient to reach attainment, we may have overestimated costs if more cost effective fugitive or area source controls are likely to be available in these areas.

- ***Incomplete information for point source controls.*** To assess the cost of reducing point source lead emissions, this analysis relies upon PM control cost information from AirControlNET. For several sources, however, AirControlNET contains no information on the PM controls available, and we are unable to estimate costs for these sources. Such sources represent approximately 24 percent of the point source lead emissions included in our analysis (i.e., AirControlNET contains control measure data for those lead sources that represent 76 percent of the lead emissions included in the analysis). Costs to control lead emissions from these sources may be less than or greater than costs to control emissions from other sources.

- ***Uncertainty about methods for reaching tighter control levels in the future.*** It is not known whether industrial sources will in the future make improvements to existing particulate matter controls to control Pb emissions, whether there will be further application of existing control technology in series with controls that might already be employed at a source, or whether we might expect new control technology to be developed.

- ***Uncertainty associated with unidentified measures.*** As indicated above, many areas are expected to rely heavily on unidentified controls to reach attainment with the standards. The cost of implementing these measures, though estimated here based on the costs for identified controls, is uncertain. Many of these sources are already well-controlled for particulate matter, and additional control for the remaining increment of Pb might be difficult to achieve. Many other sources are boilers fired by natural gas. We are currently investigating these boilers further, and are finding that Pb emissions for many of them are likely significantly overstated, and should not remain in the inventory for this draft RIA. We expect to make these types of changes to the inventory for the RIA for the final Pb NAAQS.

[89] Although our analysis considers the impact of point source controls on certain fugitive emissions, as described in Chapter 4, it does not consider direct fugitive controls.

- ***Some costs remained unquantified.*** In some geographic areas there remains an additional sum of unquantified costs to reach full attainment. Full attainment costs were not calculated for some monitor areas for a few reasons. One such location is Ottawa County, OK where there are no existing sources of lead emissions, yet there is a large Superfund site and the federal government is buying out the remaining residents.[90] Another example is Logan County, OH, where we will investigate the application of additional known control measures to smaller sources for the final RIA.

[90] See http://www.washingtonpost.com/wp-dyn/content/article/2007/01/12/AR2007011201692.html and http://www.dispatch.com/live/content/insight/stories/2008/05/11/Farewell_to_a_Town_1.ART_ART_05-11-08_G3_36A50UE.html.

CHAPTER 7. ESTIMATES OF BENEFITS AND COSTS

EPA has performed an illustrative analysis to estimate the costs and human health benefits of nationally attaining alternative lead National Ambient Air Quality Standards (NAAQS). This analysis serves both to satisfy the requirements of E.O. 12866 and to provide the public with an estimate of the potential costs and benefits of attaining alternative lead standards. This chapter presents our estimates of the primary benefits and the costs expected to result from achieving four alternative levels of the lead NAAQS, relative to baseline ambient air lead levels. Our approach to estimating benefits (Chapter 5) and costs (Chapter 6) is described elsewhere in this document. This chapter first presents benefits and costs for scenarios using consistent assumptions. We then discuss key uncertainties and limitations. Finally, we provide a summary of key conclusions, considering both the primary results and key uncertainties.

This Regulatory Impact Analysis (RIA) provides illustrative estimates of the incremental costs and monetized human health benefits of attaining a revised primary lead (Pb) National Ambient Air Quality Standard (NAAQS) within the current monitoring network[91]. Many of the highest-emitting Pb sources do not have nearby Pb-TSP monitors, and it is important to note that there may be many more potential nonattainment areas than have been analyzed in this RIA. Because of time and data constraints, in this RIA, estimates of costs and benefits employed different techniques for estimating future air quality. This results in benefits estimates that represent full attainment, and cost estimates that do not represent full attainment. These differences will be addressed in the final RIA, and further improvements to estimation techniques will be explored.

In addition, this draft Regulatory Impact Analysis (RIA) seeks to estimate both costs and benefits for the year 2020; however this draft represents initial estimates using a 2002 baseline blood lead level, resulting in a possible overestimate of benefits in the year 2020. Prior to completion of the final draft, assumptions will be revisited and, to the extent technically feasible, EPA will update the baseline to reflect expected effects on blood lead levels from other lead rules and potentially from an anticipated decline in population blood lead levels.

It should be noted again that overall data limitations are very significant for this analysis. One critical area of uncertainty is the limited TSP-Pb monitoring network (discussed in chapter 2). Because monitors are present in only 86 counties nationwide, the universe of monitors exceeding the various target NAAQS levels is very small; only 36 counties above 0.05 µg/m3, and only 24 counties exceeding the lowest proposed NAAQS level of 0.10 µg/m3. Because we know that many of the highest-emitting Pb sources in the 2002 NEI do not have nearby Pb-TSP monitors (see section 2.1.7), it is likely that there may be many more potential nonattainment areas than have been analyzed in this RIA. It is also important to note that the addition of unidentified controls to sources above a specific level of emissions (see section 4.4.3) does not bring all areas all the way to attainment for four of the five alternative standards analyzed. Because benefits were calculated assuming that each monitor just attains each standard alternative, this creates a potential mismatch between the costs and benefits calculated for each projected non-attainment area.

[91] There are currently 189 monitors representing 86 counties, but only 36 counties have monitors which exceed 0.05 ug/m^3.

In addition, as discussed in chapter 3 it is not appropriate to conduct regional scale modeling for Pb similar to the regional scale modeling conducted for PM and ozone. Dispersion, or plume-based, models are recommended for compliance with the Pb NAAQS; however, dispersion models are data –intensive and more appropriate for local scale analyses of emissions from individual sources. It was not feasible to conduct such a large-scale data intensive analysis for this RIA. As a result, the simplified analysis developed for this RIA, while distance-weighting individual source contributions to ambient Pb concentrations, could not account for such locally critical variables as meteorology and source stack height. Note also that the emissions inventory has limitations for Pb sources with very low emissions; for the final RIA we will be reviewing and making improvements to the inventory used in this analysis, and incorporating those improvements.

As a result of some of the methodological considerations and uncertainties in developing this analysis, this draft RIA does not present a comparison of the estimated benefits and costs, or a net benefits calculation associated with each of the standard level alternatives under consideration. EPA has activities underway to make improvements to both cost and benefit calculations for the final RIA, recognizing that there will remain significant data gaps and uncertainties. EPA plans to present a net benefits calculation in the final RIA.

7.1 Benefits and Costs

The estimates of benefits and costs presented here reflect illustrative scenarios of future lead NAAQS compliance. In all cases, estimates are based on a 2020 compliance date; as a result, such inputs as population and baseline emissions and air quality compliance with existing Clean Air Act requirements (including MACT rules affecting lead emissions and the recently promulgated PM NAAQS revision) are consistently applied in all estimates presented here. In addition, the two alternative discount rates - 3% and 7% - are used in all relevant components of both benefit and cost calculations, for all estimates presented here. On the other hand, as noted above, the draft benefit estimates are developed using a 2002 baseline blood lead level. Finally, EPA's intention is to present all benefit and cost estimates for scenarios that reflect full implementation of the lead NAAQS. For some alternatives our emissions controls (Chapter 4) and cost analyses (Chapter 5) do not reflect full attainment of those standards. As described more fully in those chapters, in this analysis we apply controls only on point sources, and in a few areas those controls are not sufficient to attain the alternative standard. In that respect, our estimates of benefits and costs for the two most stringent alternatives reflect slightly different levels of attainment. The variable C is used to represent unestimated costs associated with the additional incremental controls required to attain each standard.

Table 7.1 and 7.2 presents total national primary estimates of costs and benefits for a 3% discount rate; Tables 7.3 and 7.4 present the same information for a 7% discount rate.

Table 7-1.
SUMMARY OF COSTS
(All Estimates Assume a 3% Discount Rate (Millions of 2006$))

	0.5 µg/m³ 2nd Max Monthly	0.3 µg/m³ 2nd Max Monthly	0.2 µg/m³ 2nd Max Monthly	0.1 µg/m³ 2nd Max Monthly	0.05 µg/m³ 2nd Max Monthly
Annualized Cost - Identified Controls	$11	$47	$55	$63	$84

Annualized Cost - Unidentified Controls	$1	$400	$790	$1,600	$2,000
Total Cost	**$12**	**$450 + C**	**$840 + C**	**$1,600 + C**	**$2,100 + C**

* All estimates rounded to two significant figures. As such, columns may not sum. Costs reflect application of reasonable identified and unidentified controls, which achieve full attainment in all but 1, 1, 6, and 17 areas for the 0.3, 0.2. 0.1, and 0.05 standards, respectively. Unquantified costs are indicated with a "C" to represent the additional sum of unquantified costs of full attainment.

Table 7-2.
Summary of Benefits
(All Estimates Assume a 3% Discount Rate (Millions of 2006$))

	0.5 μg/m³ 2nd Max Monthly	**0.3 μg/m³ 2nd Max Monthly**	**0.2 μg/m³ 2nd Max Monthly**	**0.1 μg/m³ 2nd Max Monthly**	**0.05 μg/m³ 2nd Max Monthly**
Annualized Benefit - IQ Gains	$970 to $1,400	$1,700 to $2,500	$2,500 to $3,500	$3,900 to $5,500	$6,100 to $8,700
Annualized Benefit - PM Co-control (Range)	$150 to $1,300	$410 to $3,500	$560 to $4,700	$690 to $5,800	$1,100 to $8,900
Total Benefits	**$1,100 to $2,700**	**$2,100 to $6,000**	**$3,100 to $8,200**	**$4,600 to $11,000**	**$7,200 to $18,000**

* All estimates rounded to two significant figures. As such, columns may not sum. Benefits are for full attainment scenario, costs reflect application of reasonable identified and unidentified controls, which achieve full attainment in all but 1, 1, 6, and 17 areas for the 0.3, 0.2. 0.1, and 0.05 standards, respectively.

** Range for PM co-control benefits is based on the lower and upper ends of the range of the PM2.5 premature mortality functions characterized in the expert elicitation. Range for total benefits was developed by adding monetized lead IQ benefits to the ends of the co-control benefits range. Tables exclude all adult health effects benefits, as well as unquantified and nonmonetized benefits.

Table 7-3.
SUMMARY OF COSTS
(All Estimates Assume a 7% Discount Rate (Millions of 2006$))

	0.5 μg/m^3 2nd Max Monthly	**0.3 μg/m^3 2nd Max Monthly**	**0.2 μg/m^3 2nd Max Monthly**	**0.1 μg/m^3 2nd Max Monthly**	**0.05 μg/m^3 2nd Max Monthly**
Annualized Cost - Identified Controls	$11	$49	$57	$66	$88
Annualized Cost - Unidentified Controls	$1	$400	$790	$1,600	$2,000
Total Cost	**$12**	**$450 + C**	**$840 + C**	**$1,600 + C**	**$2,100 + C**

* All estimates rounded to two significant figures. As such, columns may not sum. Costs reflect application of reasonable identified and unidentified controls, which achieve full attainment in all but 1, 1, 6, and 17 areas for the 0.3, 0.2. 0.1, and 0.05 standards, respectively. Unquantified costs are indicated with a "C" to represent the additional sum of unquantified costs of full attainment.

Table 7-4.
SUMMARY OF BENEFITS
(All Estimates Assume a 7% Discount Rate (Millions of 2006$))

	0.5 μg/m^3 2nd Max Monthly	**0.3 μg/m^3 2nd Max Monthly**	**0.2 μg/m^3 2nd Max Monthly**	**0.1 μg/m^3 2nd Max Monthly**	**0.05 μg/m^3 2nd Max Monthly**
Annualized Benefit - IQ Gains	$120 to $240	$220 to $430	$310 to $610	$480 to $950	$760 to $1,500
Annualized Benefit - PM Co-control (Range)	$140 to $1,100	$380 to $3,100	$520 to $4,300	$640 to $5,200	$1,000 to $8,000
Total Benefits	**$260 to $1,400**	**$600 to $3,500**	**$830 to $4,900**	**$1,100 to $6,200**	**$1,800 to $9,500**

* All estimates rounded to two significant figures. As such, columns may not sum. Benefits are for full attainment scenario, costs reflect application of reasonable identified and unidentified controls, which achieve full attainment in all but 1, 1, 6, and 17 areas for the 0.3, 0.2. 0.1, and 0.05 standards, respectively.

** Range for PM co-control benefits is based on the lower and upper ends of the range of the PM2.5 premature mortality functions characterized in the expert elicitation. Range for total benefits was developed by adding monetized lead IQ benefits to the ends of the co-control benefits range. Tables exclude all adult health effects benefits, as well as unquantified and nonmonetized benefits.

The ranges of benefits presented reflect uncertainty about the earnings impact associated with IQ gains and variability in the estimates of the PM mortality co-benefits across the available effects estimates. The total benefits range of estimates was developed by first adding the low and high ends of the range of monetized lead IQ benefits to the low and high ends of the range of PM co-benefits, and then subtracting the total cost estimate from the low and high end of the resulting range of total benefits.

7.2 Discussion of Uncertainties and Limitations

As with other NAAQS RIAs, it should be recognized that all estimates of future costs and benefits are not intended to be forecasts of the actual costs and benefits of implementing revised standards. Ultimately, states and urban areas will be responsible for developing and implementing emissions control programs to reach attainment of the lead NAAQS, with the timing of attainment being determined by future decisions by states and EPA. Our estimates are intended to provide information on the general magnitude of the costs and benefits of alternative standards, rather than precise predictions of control measures, costs, or benefits. With these caveats, we expect that this analysis can provide a reasonable picture of the types of emissions controls that are currently available, the direct costs of those controls, the levels of emissions reductions that may be achieved with these controls, the air quality impact that can be expected to result from reducing emissions, and the public health benefits of reductions in ambient lead levels, as well as coincident reductions in ambient fine particulates. This analysis identifies those areas of the U.S. where our existing knowledge of control strategies is not sufficient to allow us to model attainment, and where additional data or research may be needed to develop strategies for attainment.

Compared to recent NAAQS RIAs, however, our current knowledge of the costs and nature of lead emissions controls and the effects of changes in emissions on air quality and exposure is less robust. Lead in ambient air has not been a focus for all but a few areas of the country for the last decade or more. The proposed standards, while supported by and consistent with EPA's review of recent scientific research, represent a substantial tightening of the existing NAAQS. As a result, many of the analyses conducted for this RIA could be significantly improved through enhanced research and data in these areas. Perhaps the greatest need is for research on available pollution control technology, work practice changes, and pollution prevention options to most cost-effectively control lead emissions directly, rather than as a component of lead-bearing PM emissions.

It should be noted again that overall data limitations are very significant for this analysis. One critical area of uncertainty is the limited TSP-Pb monitoring network (discussed in chapter 2). Because monitors are present in only 86 counties nationwide, the universe of monitors exceeding the various target NAAQS levels is very small; only 36 counties above 0.05 μg/m3, and only 24 counties exceeding the lowest proposed NAAQS level of 0.10 μg/m3. Because we know that many of the highest-emitting Pb sources in the 2002 NEI do not have nearby Pb-TSP monitors (see section 2.1.7), it is likely that there may be many more potential nonattainment areas than have been analyzed in this RIA.

In addition, as discussed in chapter 3 it is not appropriate to conduct regional scale modeling for Pb similar to the regional scale modeling conducted for PM and ozone. Dispersion, or plume-based, models are recommended for compliance with the Pb NAAQS; however, dispersion models are data –intensive and more appropriate for local scale analyses of emissions from individual sources. It was not feasible to conduct such a large-scale data intensive analysis for this RIA. As a result, the simplified analysis developed for this RIA, while distance-weighting individual source contributions to ambient Pb concentrations, could not account for such locally critical variables as meteorology and source stack height. Note also that the emissions inventory has limitations for Pb sources with very low emissions; for the final RIA we will be reviewing and making improvements to the inventory used in this analysis, and incorporating those improvements.

In the remainder of this section we re-state the most important limitations and uncertainties in the cost and benefit estimates.

Uncertainties specifically related to the cost estimates include the following:

- Because limited data are available on fugitive and area source emissions, our analysis of the costs associated with the proposed and alternative lead NAAQS does not consider fugitive and area source controls that may be implemented to comply with these standards. Therefore, in those areas where point source controls are insufficient to attain the standard, we were unable to model full compliance with the revised NAAQS, and it is therefore likely that we underestimate costs. However, for areas where point source controls are sufficient to reach attainment, we may have overestimated costs if more cost-effective fugitive or area source controls are likely to be available in these areas.

- To assess the cost of reducing point source lead emissions, this analysis relies upon PM control cost information from AirControlNET. EPA's database of lead-focused controls is very limited, however, and there are no lead-specific controls in AirControlNET. In addition, for several sources AirControlNET contains no information on PM controls either. Such sources represent approximately 24 percent of the point source lead emissions included in our analysis (i.e., AirControlNET contains control measure data for those lead sources that represent 76 percent of the lead emissions included in the analysis). Costs to control lead emissions from these sources may be less than or greater than costs to control emissions from other sources.

- As indicated above, many areas are expected to rely heavily on unidentified controls to reach attainment with the standards. The cost of implementing these measures, though estimated here based on the costs for identified controls, is uncertain. Many of these sources are already well-controlled for particulate matter, and additional control for the remaining increment of Pb might be difficult to achieve. Many other sources are boilers fired by natural gas. We are currently investigating these boilers further, and are finding that Pb emission s for many of them are likely significantly overstated, and should not remain in the inventory for this RIA. We expect to make these types of changes to the inventory for the RIA for the final Pb NAAQS.

Uncertainties related to the benefits estimates include the following:

- For our primary estimate of the benefits due to gains in children's IQ, we used a log-linear estimate from a recently published pooled analysis of seven studies (Lanphear et al., 2005). Using alternate estimates from other epidemiological studies examining the link between blood lead level and children's IQ has significant impact on benefits results. We found the benefits to decrease by as much as 74 percent when an alternate estimate from a paper by Schwartz (1993) is used. This is due in part to the underlying shape of the dose-response relationship assumed by each of the functions. In the Lanphear study, a log-linear relationship was found to be the best fit for the data (i.e., the natural log-transformed blood lead level is used to predict changes in IQ score). This model implies that the magnitude of changes in IQ increases with lower blood lead levels. However, in the Schwartz (1993) and Canfield et al. (2003) studies, a single linear model is assumed (i.e., untransformed blood lead levels are used to predict changes in IQ score). The single linear model implies that the magnitude of change in IQ is constant over the entire range of blood lead levels. Therefore, at lower blood lead levels, the log-linear model predicts larger changes in IQ than the linear model. Note that CASAC, in their review of EPA's *Lead Risk Assessment* indicated that "studies show that the decrements in intellectual (cognitive) functions in children are proportionately greater at PbB concentrations <10 µg/dl" (USEPA, 2007d, page 3). However, if the true dose-response relationship is linear, than our primary estimate of benefits is an overestimation.

- Some uncertainty is involved in the estimates of maximum quarterly mean lead air concentrations used for the benefits model. We used ratios of second maximum monthly mean values to maximum quarterly mean values from lead monitoring data from 2003-2005 to convert the baseline second maximum monthly mean values in 2020 into maximum quarterly mean for the "base case" as well as to convert the alternative second maximum monthly mean NAAQS into a maximum quarterly mean for the "control scenarios." If the true ratio between the second maximum monthly means to the maximum quarterly mean is different in 2020 than in 2003-2005 because the pattern and distribution of daily values differs, then our results could be either over- or underestimated.

- The interpolation method of estimating exposure concentrations that we used for our primary estimate is associated with some uncertainty. The validity of this method is to some extent contingent upon the availability of a sufficient number of monitors to support an interpolation. In certain locations, such as Hillsborough County, FL, there are a sufficient number of lead and TSP monitors to generate an interpolation with a pronounced gradient around each monitor. The lead and TSP monitoring network in other non-attainment areas can in some cases be sparse, and the resulting interpolation does not appear to generate a meaningful gradient, such as in Delaware County, IN.

- The application of the monitor rollback technique to estimate full attainment air quality changes benefits introduces some uncertainty to the analysis. This technique simulates the air quality change associated with an emissions control strategy that is capable of just attaining each standard alternative at each monitor. This approach to estimating air quality changes is different from the reduced-form air quality model employed to develop the emissions control strategy. When utilizing this reduced-form model to identify control strategies for each standard alternative, in certain cases emission controls achieved reductions in ambient lead below the standard alternative under analysis,. In other cases, the modeled control strategies were insufficient to model full attainment with all monitors. The monitor rollback approach used to estimate full attainment benefits does not reflect this variability in attainment status, because it adjusts the violating monitor value down to, but not below, the standard alternative. Thus, where the control strategy attains air quality improvements below the standard at violating monitors, the monitor rollback approach will not reflect the additional benefits associated with this air quality improvement. Conversely, where the control strategy does not fully attain the standard alternative at a given monitor, the rollback technique would overstate benefits because it adjusts the monitor value all the way down to the standard, below a level actually achieved by the control strategy. The estimation of the population to which the benefits apply when using the radius method of exposure estimation is uncertain. First, we assumed that the population within each census block group is uniformly distributed, and therefore, that the fraction of the block group geographically that overlapped with the radius corresponded to the fraction of the population living within the radius. In addition, we used 2000 Census data to calculate the population living within each radius and distributed it into five-year age groups by gender using the 2000 Census data for the county in which the monitor resides. We assumed that block groups falling inside the radius that reside in neighboring counties had the same age and gender distributions as the county in which the monitor resides. If these assumptions are inaccurate, the benefits results could potentially be under- or overestimated.

- We assumed that the IQ point effects of a change in concurrent blood lead (i.e., the effects of a change in 2020) apply to all children in our study population that were under seven years of age in 2020. If there is a critical window of exposure for IQ effects (e.g., between the ages of one and two), then we could potentially be overestimating benefits in 2020 because we would have overestimated the population affected by reduced lead exposure in that year. However, if partial or full achievement of the alternative NAAQS levels might occur earlier than 2020, the children in our 0-6 age cohort who are past any critical window in 2020 would have realized the partial or full benefits of reduced lead exposures in those earlier years. Thus, the issue of a potential critical developmental window reflects uncertainty in both the timing and size of benefits.

- The use of air:blood ratios represents a first approximation to the impact of changes in ambient air concentrations of lead on concurrent blood lead levels, applied in the absence of modeling data on lead transport and deposition and the on direct and indirect human exposures. While the values we apply match fairly well with available literature, there are relatively few studies that report such values or provide sufficient data to calculate such ratios. Further, the lead concentrations in those studies tend to be higher than those modeled here (EPA, 2007a); thus uncertainty remains as to whether the same ratios would be expected at lower levels, or whether air exposures are more or less efficient at changing concurrent blood lead levels at these lower concentrations.

- If the air:blood ratio we apply for children or a similar value is also valid for estimating adult exposures, then our primary benefits understate the true health benefits accruing to the lead-exposed populations because they exclude impacts on morbidity and mortality impacts on adults as well as impacts on prenatal mortality. Additional research is needed to improve our understanding of the impacts of adult air exposure on adult blood lead levels.

- The earnings-based value-per-IQ-point lost that we apply in this analysis most likely represents a lower bound on the true value of a lost IQ point, because it is essentially a cost-of-illness measure, not a measure of an individual's willingness-to-pay (WTP) to avoid the loss of an IQ point. Welfare economics emphasizes WTP measures as the more complete estimate of economic value; for example, the earnings-based value does not include losses in utility due to pain and suffering, nor does it assess the costs of averting behaviors that may be undertaken by households to avoid or mitigate IQ loss from lead exposure.

- The earnings-based estimate of the value-per-IQ-point lost is based on current data on labor-force participation rates, survival probabilities, and assumptions about educational costs and real wage growth in the future. To the extent these factors diverge from these values in the future, our lifetime earnings estimate may be under- or overestimated. Another factor suggesting that our lifetime earnings estimate may be an underestimate is that it does not account for the value of productive services occurring outside the labor force (e.g., child rearing and housework).

- Because of the relatively strong relationship between $PM_{2.5}$ concentrations and premature mortality, PM co-benefits resulting from reductions in fine particulate emissions can make up a large fraction of total monetized benefits, depending on the specific PM mortality impact function used, and to a lesser extend on the relative magnitude of direct lead benefits. The lower end of the range assumes $PM_{2.5}$ benefits are based on the PM-mortality concentration-response relationship provided by Expert K; the upper end of the range assumes the relationship provided by Expert E. The relative share of co-control to primary lead benefits varies only modestly across the four alternative standards.

- Co-control benefits estimated here reflect the application of a national dollar benefit per ton estimate of the benefits of reducing directly emitted fine particulates from point sources. Because they are based on national-level analysis, the benefit-per-ton estimates used here do not reflect local meteorology, exposure, baseline health incidence rates, or other local factors that might lead to an over-estimate or under-estimate of the actual benefits of controlling directly emitted fine particulates.

7.3 Conclusions and Insights

EPA's analysis has estimated the benefits of reductions in ambient concentrations of lead resulting from a set of illustrative control strategies to reduce emissions of lead at point sources. The results suggest there will be significant additional benefits arising from reducing emissions from a variety of sources in and around projected nonattaining counties in 2020. While 2020 is the latest date by which states would generally need to demonstrate attainment with the revised standards, it is expected that benefits (and costs) will begin occurring earlier, as states begin implementing control measures to show progress towards attainment.

There are several important factors to consider when evaluating the relative benefits and costs of the attainment strategies for the four alternative standards assessed in this RIA:

- Our estimates of costs of attainment in 2020 assume a particular trajectory of what might be aggressive technological change. This trajectory leads to a particular level of emissions reductions and costs which we have estimated based on costs of identified controls. An alternative storyline might hypothesize a much less optimistic technological change path, such that emissions reductions technologies for industrial sources would be more expensive or would be unavailable, so that emissions reductions from many smaller sources might be required for 2020 attainment, at a potentially greater cost per ton. Under this alternative storyline, two outcomes are hypothetically possible: Under one scenario, total costs associated with full attainment might be substantially higher. Under the second scenario, states may choose to take advantage of flexibility in the Clean Air Act to adopt plans with later attainment dates to allow for additional technologies to be developed and for other programs be fully implemented. If states were to submit plans with attainment dates beyond our 2020 analysis year, benefits would clearly be lower than we have estimated under our analytical storyline. However, in this case, state decision makers, seeking to maximize economic efficiency, would not impose costs, including potential opportunity costs of not meeting their attainment date, when they exceed the expected health benefits that states would realize from meeting their modeled 2020 attainment date. In this case, upper bound costs are difficult to estimate because we do not have an estimate of the point where marginal costs are equal to marginal benefits plus the costs of nonattainment.

- Benefits and costs are distributed differently across potential non-attainment counties. As presented in Chapter 5, most of the primary lead benefits of the standards are expected to be realized in a small number of areas. These are areas where the sources of lead exposure and the monitors that measure ambient lead appear to be in relatively close proximity to exposed populations. The identified control costs, on the other hand, are greatest in those areas with the largest sources of lead emissions - usually around primary or secondary lead smelters, mining operations, or battery manufacturers. PM co-control benefits tend to be distributed in better correlation to control costs. In general, PM co-control benefits tend to be highest in those areas where our attainment strategy suggests controls on combustion sources, rather than metals processing, are necessary.

- Our analysis considers controls on point source emissions only. Local areas might find that controls of area sources would be more cost-effective or better demonstrated than the point source controls we model. In addition, at this time we have not considered whether Federal action might reduce the contribution of leaded aviation gasoline to local lead concentrations, particularly in areas where we find it difficult or impossible to reach attainment based on point sources controls alone.

- Because of the limitations and uncertainties in the emissions and air quality components of our assessment, the specific control strategies that might be the most effective in helping areas to reach attainment are still very uncertain. For example, we employ a fairly simple distance-weighted dispersion approach to approximate the effect of controls on specific point sources in reducing concentrations at current monitor locations.

- Similar to the recent ozone and PM NAAQS RIAs, our analysis sets a 98th percentile cost per ton limit for the source-specific cost-effectiveness of controls to be employed to reach attainment. However, we also apply a controls application optimization algorithm that effectively uses a cost per microgram ranking in modeling attainment strategies. Our approach provides greater confidence that, within the significant uncertainties presented by application of a large complement of unidentified controls and the simplified air quality estimation procedure, our modeled attainment strategies reflect a least-cost approach that could be feasible for local areas to implement in pursuing attainment with a significantly lower lead NAAQS than the current standard.

As part of the development of the final RIA, EPA has activities underway to make improvements to both cost and benefit calculations, recognizing that there will remain significant data gaps and uncertainties. As outlined above and in the individual chapters, we plan to investigate changes which will: better match locations of monitors and sources, refine our estimates of population exposures, broaden the number of concentration-response functions in the primary analysis, improve our estimates of emission reductions due to known controls, and improve the comparability of the costs and benefits.

CHAPTER 8. STATUTORY AND EXECUTIVE ORDER REVIEWS

8.1. Executive Order 12866: Regulatory Planning and Review

Under section 3(f)(1) of Executive Order (EO) 12866 (58 FR 51735, October 4, 1993), this action is an "economically significant regulatory action" because it is likely to have an annual effect on the economy of $100 million or more. Accordingly, EPA submitted the proposed lead NAAQS revisions to the Office of Management and Budget (OMB) for review under EO 12866 and any changes made in response to OMB recommendations have been documented in the docket for this action (EPA-HQ-OAR-2006-0735). In addition, EPA prepared this Regulatory Impact Analysis (RIA) of the potential costs and benefits associated with this action. This RIA and related material is available for public review in docket EPA-HQ-OAR-2008-0253.

The RIA estimates the costs and monetized human health and welfare benefits of attaining four alternative Pb NAAQS nationwide. Specifically, the RIA examines the alternatives of 0.30 $\mu g/m^3$, 0.20 $\mu g/m^3$, 0.10 $\mu g/m^3$ and 0.05 $\mu g/m^3$. The RIA contains illustrative analyses that consider a limited number of emissions control scenarios that States and Regional Planning Organizations might implement to achieve these alternative Pb NAAQS. However, the CAA and judicial decisions make clear that the economic and technical feasibility of attaining ambient standards are not to be considered in setting or revising NAAQS, although such factors may be considered in the development of State plans to implement the standards. Accordingly, although this RIA has been prepared, the results of the RIA have not been considered in issuing the proposed rule.

8.2. Paperwork Reduction Act

The information collection requirements in this proposed rule have been submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. The Information Collection Request (ICR) document prepared by EPA for these proposed revisions to part 58 has been assigned EPA ICR numbers 0940.21.

The information collected under 40 CFR part 53 (e.g., test results, monitoring records, instruction manual, and other associated information) is needed to determine whether a candidate method intended for use in determining attainment of the National Ambient Air Quality Standards (NAAQS) in 40 CFR part 50 will meet the design, performance, and/or comparability requirements for designation as a Federal reference method (FRM) or Federal equivalent method (FEM). While this proposed rule amends the requirements for Pb FRM and FEM determinations, they merely provide additional flexibility in meeting the FRM/FEM determination requirements. Furthermore, we do not expect the number of FRM or FEM determinations to increase over the number that is currently used to estimate burden associated with Pb FRM/FEM determinations provided in the current ICR for 40 CFR part 53 (EPA ICR numbers 0559.12). As such, no change in the burden estimate for 40 CFR part 53 has been made as part of this rulemaking.

The information collected and reported under 40 CFR part 58 is needed to determine compliance with the NAAQS, to characterize air quality and associated health and ecosystem impacts, to develop emissions control strategies, and to measure progress for the air pollution program. The proposed amendments would revise the technical requirements for Pb monitoring sites, require the siting and operation of additional Pb ambient air monitors, and the reporting of the collected ambient Pb monitoring data to EPA's Air Quality System (AQS). Because this rulemaking includes a range of proposals for the level and averaging time, it is not possible accurately predict the size of the final network, and its associated burden. Rather we have estimated the upper range of burden possible based on the regulatory options being proposed which would result in a higher reporting burden (i.e., a final level for the standard of 0.1 $\mu g/m^3$ with a 2^{nd} maximum monthly averaging form). Based on these assumptions, the annual average reporting burden for the collection under 40 CFR part 58 (averaged over the first 3 years of this ICR) for 150 respondents is estimated to increase by a total of 96,080 labor hours per year with an increase of $6,775,022 per year. Burden is defined at 5 CFR 1320.3(b). State, local, and tribal entities are eligible for State assistance grants provided by the Federal government under the CAA which can be used for monitors and related activities.

An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control numbers for EPA's regulations in 40 CFR are listed in 40 CFR part 9.

8.3. Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of this rule on small entities, small entity is defined as: (1) a small business that is a small industrial entity as defined by the Small Business Administration's (SBA) regulations at 13 CFR 121.201; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.

After considering the economic impacts of this proposed rule on small entities, I certify that this action will not have a significant economic impact on a substantial number of small entities. This proposed rule will not impose any requirements on small entities. Rather, this rule establishes national standards for allowable concentrations of Pb in ambient air as required by section 109 of the CAA. *American Trucking Ass'ns v. EPA,* 175 F. 3d 1027, 1044-45 (D.C. cir. 1999) (NAAQS do not have significant impacts upon small entities because NAAQS themselves impose no regulations upon small entities). Similarly, the proposed amendments to 40 CFR part 58 address the requirements for States to collect information and report compliance with the NAAQS and will not impose any requirements on small entities. We continue to be interested in the potential impacts of the proposed rule on small entities and welcome comments on issues related to such impacts.

8.4. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), Public Law 104-4, establishes requirements for Federal agencies to assess the effects of their regulatory actions on State, local, and tribal governments and the private sector. Unless otherwise prohibited by law, under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "Federal mandates" that may result in expenditures to State, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is required under section 202, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and to adopt the least costly, most cost-effective or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes with the final rule an explanation why that alternative was not adopted. Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

This action is not subject to the requirements of sections 202 and 205 of the UMRA. EPA has determined that this proposed rule does not contain a Federal mandate that may result in expenditures of $100 million or more for State, local, and tribal governments, in the aggregate, or the private sector in any one year. The revisions to the Pb NAAQS impose no enforceable duty on any State, local or Tribal governments or the private sector. The expected costs associated with the increased monitoring requirements are described in EPA's ICR document, but those costs are not expected to exceed $100 million in the aggregate for any year. Furthermore, as indicated previously, in setting a NAAQS EPA cannot consider the economic or technological feasibility of attaining ambient air quality standards. Because the Clean Air Act prohibits EPA from considering the types of estimates and assessments described in section 202 when setting the NAAQS, the UMRA does not require EPA to prepare a written statement under section 202 for the revisions to the Pb NAAQS.

With regard to implementation guidance, the CAA imposes the obligation for States to submit SIPs to implement the Pb NAAQS. In this proposed rule, EPA is merely providing an interpretation of those requirements. However, even if this rule did establish an independent obligation for States to submit SIPs, it is questionable whether an obligation to submit a SIP revision would constitute a Federal mandate in any case. The obligation for a State to submit a SIP that arises out of section 110 and section 191 of the CAA is not legally enforceable by a court of law, and at most is a condition for continued receipt of highway funds. Therefore, it is possible to view an action requiring such a submittal as not creating any enforceable duty within the meaning of 2 U.S.C. 658 for purposes of the UMRA. Even if it did, the duty could be viewed as falling within the exception for a condition of Federal assistance under 2 U.S.C. 658.

EPA has determined that this proposed rule contains no regulatory requirements that might significantly or uniquely affect small governments because it imposes no enforceable duty on any small governments. Therefore, this rule is not subject to the requirements of section 203 of the UMRA.

8.5. Executive Order 13132: Federalism

Executive Order 13132, entitled "Federalism" (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure "meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications." "Policies that have federalism implications" is defined in the Executive Order to include regulations that have "substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government."

This proposed rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132. The rule does not alter the relationship between the Federal government and the States regarding the establishment and implementation of air quality improvement programs as codified in the CAA. Under section 109 of the CAA, EPA is mandated to establish NAAQS; however, CAA section 116 preserves the rights of States to establish more stringent requirements if deemed necessary by a State. Furthermore, this rule does not impact CAA section 107 which establishes that the States have primary responsibility for implementation of the NAAQS. Finally, as noted in section E (above) on UMRA, this rule does not impose significant costs on State, local, or tribal governments or the private sector. Thus, Executive Order 13132 does not apply to this rule.

8.6. Executive Order 13175: Consultation and Coordination with Indian Tribal Governments

Executive Order 13175, entitled "Consultation and Coordination with Indian Tribal Governments" (65 FR 67249, November 9, 2000), requires EPA to develop an accountable process to ensure "meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications." This proposed rule does not have tribal implications, as specified in Executive Order 13175. It does not have a substantial direct effect on one or more Indian Tribes, since Tribes are not obligated to adopt or implement any NAAQS. Thus, Executive Order 13175 does not apply to this rule.

8.7. Executive Order 13045: Protection of Children from Environmental Health & Safety Risks

This action is subject to EO (62 FR 19885, April 23, 1997) because it is an economically significant regulatory action as defined by EO 12866, and we believe that the environmental health risk addressed by this action has a disproportionate effect on children. The proposed rule will establish uniform national ambient air quality standards for Pb; these standards are designed to protect public health with an adequate margin of safety, as required by CAA section 109. However, the protection offered by these standards may be especially important for children because neurological effects in children are among if not the most sensitive health endpoints for Pb exposure. Because children are considered a sensitive population, we have carefully evaluated the environmental health effects of exposure to Pb pollution among children. These effects and the size of the population affected are summarized in chapters 6 and 8 of the Criteria Document and sections 3.3 and 3.4 of the Staff Paper, and the results of our evaluation of the effects of Pb pollution on children are discussed in sections II.B and II.C of the preamble to the proposed rule.

8.8. Executive Order 13211: Actions that Significantly Affect Energy Supply, Distribution or Use

This rule is not a "significant energy action" as defined in Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 FR 28355 (May 22, 2001)) because it is not likely to have a significant adverse effect on the supply, distribution, or use of energy. The purpose of this rule is to establish revised NAAQS for Pb. The rule does not prescribe specific control strategies by which these ambient standards will be met. Such strategies will be developed by States on a case-by-case basis, and EPA cannot predict whether the control options selected by States will include regulations on energy suppliers, distributors, or users. Thus, EPA concludes that this rule is not likely to have any adverse energy effects.

8.9. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Public Law No. 104-113, §12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This proposed rulemaking involves technical standards. EPA proposes to use low-volume PM_{10} samplers coupled with XRF analysis as the FRM for Pb-PM_{10} measurement. While EPA identified the ISO standard "Determination of the particulate lead content of aerosols collected on filters" (ISO 9855: 1993) as being potentially applicable, we do not propose to use it in this rule. The use of this voluntary consensus standard would be impractical because the analysis method does not provide for the method detection limits necessary to adequately characterize ambient Pb concentrations for the purpose of determining compliance with the proposed revisions to the Pb NAAQS.

8.10. Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Executive Order 12898 (59 FR 7629; Feb. 16, 1994) establishes federal executive policy on environmental justice. Its main provision directs federal agencies, to the greatest extent practicable and permitted by law, to make environmental justice part of their mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations in the United States.

EPA has determined that this proposed rule will not have disproportionately high and adverse human health or environmental effects on minority or low-income populations because it increases the level of environmental protection for all affected populations without having any disproportionately high and adverse human health or environmental effects on any population, including any minority or low-income population. The proposed rule will establish uniform national standards for Pb in ambient air.

EPA is continuing to assess the impact of Pb air pollution on minority and low- income populations, and plans to prepare a technical memo as part of its assessment to be placed in the docket by the date of publication of the proposed rule in the Federal Register.