Executive Summary - NO_2 NAAQS RIA

ES.1 Overview

This Regulatory Impact Analysis (RIA) provides illustrative estimates of the incremental costs and monetized human health benefits of attaining a revised short-term Nitrogen Dioxide (NO_2) National Ambient Air Quality Standard (NAAQS) within the current community-wide monitoring network of 409 monitors. Because this analysis only considers counties with NO_2 monitors, the possibility exists that there may be many more potential nonattainment areas than have been analyzed in this RIA.

The final NAAQS is a new short-term NO_2 standard based on the 3-year average of the 98^{th} percentile of 1-hour daily maximum concentrations, establishing a new standard of 100 ppb. We also analyzed a lower level of 80 parts per billion (ppb) and an upper level of 125 ppb. It is important to reiterate that this analysis does not attempt to estimate attainment or nonattainment for any areas of the country other than those counties currently served by one of the 409 monitors in the current network. Chapter 2 explains that the current network is focused on community-wide ambient levels of NO_2, and not near-roadway levels, which may be significantly higher. The final rule also contains requirements for an NO_2 monitoring network that would include monitors near major roadways. We recognize that once a network of near-roadway monitors is put in place, more areas could find themselves exceeding the new hourly NO_2 NAAQS. However for this RIA analysis, we lack sufficient data to predict which additional counties might exceed the new NAAQS after implementation of a near-roadway monitoring network if they do not currently have a monitor. (Regional scale models such as the Community Multi-scale Air Quality Modeling System (CMAQ) do not provide a sufficient level of sub-grid detail to estimate near-road concentrations, and local-scale models such as AERMOD cannot model large regions with appropriate characterization of the near-road component of ambient air quality).

In this RIA, we projected current area-wide monitor values to future year monitor values directly, using future year CMAQ modeling outputs that take into account expected changes in emissions from 2006 to 2020. Because a near-roadway monitoring network does not currently exist, it was not possible to do this same direct projection into the future for near-roadway peaks. Because short-term peak exposures may occur near roadways, we conducted an analysis to approximate such peak exposures. This analysis relies on current and future estimated air quality concentrations at area-wide monitors, making adjustments to future year projections using derived estimates of the relationship between future year area-wide air quality peaks and current near-roadway peaks. This analysis, which effectively extrapolates future year near-roadway air quality from projected area-wide concentrations, represents a screening level approximation with significant additional uncertainties.

The RIA for the proposed NAAQS included an analysis based on community level exposure, represented by the current area-wide monitoring network. Because the final NAAQS is based on expected near-roadway (peak) exposures, the RIA for the final NAAQS focuses on the near-roadway analysis (which was included in the RIA for the proposed NAAQS as an alternative analysis). It is important to note that no current monitors in the (area-wide) network are projected to violate either the final NAAQS level of 100 ppb, or the lower bound of 80 ppb, in 2020, assuming a baseline of no additional control beyond the controls expected from rules that are already in place (including the current $PM_{2.5}$ and ozone NAAQS).[1] As noted above, we recognize that once a network of near-roadway monitors is put in place, more areas could find themselves exceeding the new hourly NO_2 NAAQS.

This RIA chiefly serves two purposes. First, it provides the public with an estimate of the expected costs and benefits of attaining a new NO_2 NAAQS. Second, it fulfills the requirements of Executive Order 12866 and the guidelines of OMB Circular A-4. [2] 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. As stated above, we chose 80 ppb as an analytic lower bound, and 125 ppb as an analytic upper bound.

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

[1] For this RIA, we chose an analysis year of 2020. Although the actual attainment year is likely to be 2017, time and resource limitations dictated use of pre-existing model runs, which all focused on 2020. In addition, we do not have emission inventory projections for 2017; such projections are done for 5-year intervals.
[2] U.S. Office of Management and Budget. Circular A-4, September 17, 2003. Available at http://www.whitehouse.gov/omb/circulars/a004/a-4.pdf.

result when a new NO_2 standard is implemented, but is not relevant to establishing the standards themselves.

ES.2 Summary of Analytic Approach for the Analysis of Approximated Future Near-Roadway NO_2 Exceedances of Target NAAQS

Our assessment of the NO_2 NAAQS and lower and upper bounds includes several key elements, including specification of baseline NO_2 emissions and concentrations; development of illustrative control strategies to attain the standard in 2020; and analyses of the control costs and health benefits of reaching each level. Additional information on the methods employed by the Agency for this RIA is presented below.

Overview of Baseline Emissions Forecast and Baseline NO_2 Concentrations

The baseline emissions and concentrations for this RIA are based on NOx emissions data from the 2002 National Emissions Inventory (NEI), and baseline NO_2 concentration values from 2005-2007 across the community-wide monitoring network. We used results from the community multi-scale air quality model (CMAQ) simulations from the ozone NAAQS RIA to calculate the expected reduction in ambient NO_2 concentrations between the 2002 base year and 2020. More specifically, design values (i.e. air quality concentrations at each monitor) were calculated for 2020 using monitored air quality concentrations from 2002 and modeled air quality projections for 2020, countywide emissions inventory data for 2002 and 2005-7, and emissions inventory projections for 2020. These data were used to create ratios between emissions and air quality, and those ratios (relative response factors, or RRFs) were used to estimate air quality monitor design values for 2020.

Because a near-roadway monitoring network does not currently exist, it was not possible to do the same direct projection into the future for near-roadway peaks as was done for the area-wide analysis in the proposal RIA, to analyze the standard levels of 80 ppb, 100 ppb, and 125 ppb (98^{th} percentile value). Therefore, the near-roadway analysis represents a much more uncertain screening level approximation of future year near-roadway air quality. We first select “area-wide” monitors to adjust to approximate near-roadway conditions. The monitors included in this analysis are those considered to be representative of “area-wide” conditions; i.e. those monitors to which it would be appropriate to apply the gradient to scale from area-wide to near-roadway conditions. To reflect the expected roadway gradient discussed in the preamble to the final rule (i.e., near road monitors can be between 30% to 100% greater than the area wide monitors), we adjust our estimated design values at area-wide locations for the future year of 2020 by 130%, 165%, and 200%. The analytic method we used to determine the 2020 design values and the tons needed to attain the alternate standard levels incorporates the near roadway gradient adjustment with a modification to future CMAQ air quality levels. While the modification is conceptually sound, it is a relatively new methodology. We discuss the methodology in detail in chapter 2.

Development of Illustrative Control Strategies

For the final RIA, we analyzed the impact that additional emissions controls would have on predicted ambient NO_2 concentrations, incremental to the baseline set of controls. Thus the modeled analysis for a revised standard focuses specifically on incremental improvements beyond the current standards, and uses control options that might be available to states for application by 2020. The hypothetical modeled control strategy presented in this RIA is one illustrative option for achieving emissions reductions to move towards a national attainment of a tighter standard. It is not a recommendation for how a tighter NO_2 standard should be implemented, and states will make all final decisions regarding implementation strategies once a final NAAQS has been set.

Generally, we expect that many states would be able to attain the NO_2 NAAQS without the addition of new controls beyond those already being planned for the attainment of existing $PM_{2.5}$ and ozone standards by the year 2020. As States develop their plans for attaining these existing standards, they are likely to consider adding controls to reduce NOx, as NOx is a precursor to both $PM_{2.5}$ and ozone. These controls will also directly help areas meet a tighter NO_2 standard.

Analysis of Benefits

Our analysis of the benefits associated with the NO_2 NAAQS includes the ancillary benefits of reducing concentrations of particulate matter (PM). Because NO_x is also a precursor to $PM_{2.5,}$ reducing NO_x emissions in the projected non-attainment areas will also reduce $PM_{2.5}$ formation, human exposure, and the incidence of $PM_{2.5}$-related health effects. In this analysis, we estimated the co-benefits of reducing $PM_{2.5}$ exposure for the alternative standards.

Due to analytical limitations, it was not possible to provide a comprehensive estimate of $PM_{2.5}$-related benefits. Instead, we used the "benefit-per-ton" method to estimate these benefits. The $PM_{2.5}$ benefit-per-ton estimates provide the total monetized human health benefits (the sum of premature mortality and premature morbidity) of reducing one ton of a $PM_{2.5}$ precursor from a specified source category. For this analysis, the $PM_{2.5}$ co-benefits only represent NO_x emission reductions from the mobile sector because data limitations in the control strategy preclude estimating co-emission reductions from directly emitted $PM_{2.5}$ or $PM_{2.5}$ precursors. We assume that all fine particles, regardless of their chemical composition, are equally potent. These estimates reflect EPA's most current interpretation of the scientific literature on $PM_{2.5}$ and mortality, including our updated benefits methodology (i.e., a no-threshold model that calculates incremental benefits down to the lowest modeled $PM_{2.5}$ air quality levels and incorporates two technical updates) compared to the estimates in previous RIAs that did not include these changes. EPA has used a similar technique in previous RIAs, including the recent Ozone NAAQS RIA (U.S. EPA, 2008a) and Portland Cement NESHAP RIA (U.S. EPA, 2009). For the near-roadway benefits, we were unable to estimate NO_2 benefits based on the data available for this analysis. This is discussed further in Chapter 4. Although this benefit in unquantified in this analysis, the area-wide analysis for the proposed NAAQS RIA showed that the monetized NO_2 benefits accounted for only 2% of the total monetized benefits.

Analysis of Costs

Because this analysis examines emissions and air quality approximating near-roadway conditions, we assume that unspecified controls are applied to mobile source emissions. We have estimated that the annualized average cost of controls to attain the NO_2 NAAQS would be in the range of $3,000 to $6,000 per ton. This estimate is based upon previous estimates of controls for mobile sources.

For onroad and nonroad mobile sources, costs, in terms of dollars per ton emissions reduced, were applied to emission reductions calculated for the onroad and nonroad mobile sectors that had previously been generated using the National Mobile Inventory Model (NMIM). NMIM is an EPA model for estimating air emissions from highway vehicles and nonroad mobile equipment. NMIM uses current versions of EPA's model for onroad mobile sources, MOBILE6, and nonroad mobile sources, NONROAD, to calculate emission inventories.[1]

ES.3. Results from Screening Level Near-Roadway Analysis

Air Quality and Emissions

For the revised standard of 100 ppb and the less stringent level of 125 ppb there were no projected exceedances in 2020. For the more stringent level of 80 ppb, exceedances

[1] More information regarding the National Mobile Inventory Model (NMIM) can be found at http://www.epa.gov/otaq/nmim.htm

totaling were projected in 4 counties, with 21,230 tons of emissions reductions needed for attainment.

Benefits and Costs

Tables ES-1 and ES-2 present the counties in nonattainment, tons of NOx reduction, costs, and benefits for compliance with the NO_2 NAAQS in 2020 for this near-roadway analysis, using the near road gradient adjustment at discount rates of 3% and 7% respectively. The selected standard of 100 ppb at the mean expected gradient of 65% is highlighted.

Table ES-1: 2020 Benefit Cost Comparison (in millions of 2006$, 3% discount rate for Benefits only)

	Standard Level	# Counties in Nonattainment	Tons of NOx Reduction	Total Costs *			Total Benefits **			Net Benefits		
30% Gradient	80 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	100 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	125 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
65% Gradient	80 ppb	1	680	$5.6	to	$7.7	$3.5	to	$8.6	-$4.1	to	$3.0
	100 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	125 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
100% Gradient	80 ppb	4	21,000	$67	to	$130	$110	to	$270	-$21	to	$200
	100 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	125 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6

* Total Cost estimates are shown as a range from $3,000/ton to $6,000/ton. Results include monitoring costs of $3.6m. Costs estimates were only available for a 3% discount rate. All estimates have been rounded to two significant figures.

**Total Benefit estimates are actually $PM_{2.5}$ co-benefits, shown as a range from Pope et al to Laden et al, at a 3% discount rate, using no-threshold functions, assuming NOx emission reductions from the mobile sector.

Table ES-2: 2020 Benefit Cost Comparison (in millions of 2006$, 7% discount rate)

	Standard Level	# Counties in Nonattainment	Tons of NOx Reduction	Total Costs *			Total Benefits **			Net Benefits		
30% Gradient	80 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	100 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	125 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
65% Gradient	80 ppb	1	680	$5.6	to	$7.7	$3.2	to	$7.8	-$4.5	to	$2.1
	100 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	125 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
100% Gradient	80 ppb	4	21,000	$67	to	$130	$100	to	$240	-$31	to	$180
	100 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6
	125 ppb	0	0	$3.6	to	$3.6	$0	to	$0	-$3.6	to	-$3.6

* Total Cost estimates are shown as a range from $3,000/ton to $6,000/ton. Results include monitoring costs of $3.6m. Costs estimates were only available for a 3% discount rate. All estimates have been rounded to two significant figures.
**Total Benefit estimates are actually $PM_{2.5}$ co-benefits, shown as a range from Pope et al to Laden et al, at a 3% discount rate, using no-threshold functions, assuming NOx emission reductions from the mobile sector.

ES.4. Caveats and Limitations

General

- Due to the absence of a near-roadway monitoring network, this is a screening level analysis with several simplifying assumptions. It is provided to give a rough projection of the costs and benefits of attaining a revised NO_2 standard based on a yet to be established monitoring network.

- This analysis does not take into account a large variety of localized conditions specific to individual monitors; instead, the analysis attempts to account for some local parameters by adjusting future design values based on average localized impacts near roads from onroad emissions.

- The process of adjusting from a specific 12 km CMAQ receptor to a near-road air quality estimate represents an uncertain approximation at the specific monitor level.

- This analysis is an approximation in that it derives future year (2020) peak air quality concentrations in specific locations by relying on CMAQ estimates that are averages over a 12 km grid square.

- This analysis cannot predict air quality in locations for which there is no current NO_2 monitor, or where current monitoring data is incomplete. There are 142 CBSAs for which we are proposing to add new near-road monitors. Of these, 73 either have no existing monitor in the CBSA, or have a monitor with data not complete enough to include in the near-roadway analysis. In these CBSAs, extrapolation to near-roadway levels is not possible.

- This analysis assumes area-wide monitors remain in the same location; however concentrations are adjusted to reflect near-roadway conditions.

- This analysis omits certain unquantified effects due to lack of data, time and resources. These unquantified endpoints include NO_2 health effects, ozone co-benefits, ecosystem effects, and visibility.

Air Quality Data, Modeling and Emissions

- Current $PM_{2.5}$ and Ozone Controls in Baseline: Our 2020 analysis year baseline assumes that States will put in place the necessary control strategies to attain the current $PM_{2.5}$ and ozone standards. Some of the control strategies employed as part of the ozone RIA, in particular, were unspecified. As States develop their plans for attaining these standards, their NOx control strategies may differ significantly from our analysis.

- Use of Existing CMAQ Model Runs: This analysis represents a screening level analysis. We did not conduct new regional scale modeling specifically targets to NO_2; instead we relied upon impact ratios developed from model runs used in the analysis underlying the ozone NAAQS.

- Analysis Year of 2020: Data limitations necessitated the choice of an analysis year of 2020, as opposed to the presumptive implementation year of 2017. Emission inventory projections are available for 5-year increments; i.e. we have inventories for 2015 and 2020, but not 2017. In addition, the CMAQ model runs upon which we relied were also based on an analysis year of 2020.

- Limited monitoring network: For the current monitoring community-wide monitoring network, the universe of monitors exceeding the target NAAQS levels is very small. Once a network of near-roadway monitors is put in place, there could be more potential nonattainment areas than have been analyzed in this RIA.

- Actual State Implementation Plans May Differ from our Simulation: In order to reach attainment with each selected 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.

- Climate change impacts of NOx or NO_2 emissions, which have not been extensively studied with regard to their impacts on net warming, are only now beginning to be investigated. Since work on this issue is only beginning, an analysis of the quantified impacts of reduction in NO_2 on climate cannot yet be provided.

Costs

- There are some unquantified costs that are not adequately captured in this illustrative analysis. These costs include the costs of federal and State administration of control programs, which we believe are less than the alternative of States developing approvable SIPs, securing EPA approval of those SIPs, and Federal/State enforcement. Additionally, control measure costs referred to as “no cost” may require limited government agency resources for administration and oversight of the program not included in this analysis; those costs are generally outweighed by the saving to the industrial, commercial, or private sector. The Agency also did not consider transactional costs and/or effects on labor supply in the illustrative analysis.

- Known control costs used were derived from data on a variety of known controls, and not based on any one specific control strategy tailored to specific geographic areas that may violate the NAAQS.

Benefits

- There are many uncertainties associated with the health impact functions used in this modeling effort. These include: within study variability; across study variation; the application of concentration-response (C-R) functions nationwide; extrapolation of impact functions across population; and various uncertainties in the C-R function, including causality and thresholds. These uncertainties may under- or over-estimate benefits.

- This analysis is for the year 2020, and projecting key variables introduces uncertainty. Inherent in any analysis of future regulatory programs are uncertainties in projecting atmospheric conditions and source level emissions, as well as population, health baselines, incomes, technology, and other factors.

- This analysis omits certain unquantified effects due to lack of data, time and resources. These unquantified endpoints include other health effects, ecosystem effects, and visibility. EPA will continue to evaluate new methods and models and select those most appropriate for estimating the benefits of reductions in air pollution. Enhanced collaboration between air quality modelers, epidemiologists, toxicologists, ecologists, and economists should result in a more tightly integrated analytical framework for measuring benefits of air pollution policies.

- $PM_{2.5}$ mortality co-benefits represent a substantial proportion of total monetized benefits (over 90%), and these estimates are subject to a number of assumptions and uncertainties.

    1. $PM_{2.5}$ co-benefits were derived through benefit per-ton estimates, which do not reflect local variability in population density, 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.

    2. We assume that all fine particles, regardless of their chemical composition, are equally potent in causing premature mortality. This is an important assumption, because $PM_{2.5}$ produced via transported precursors emitted from EGUs may differ significantly from direct $PM_{2.5}$ released from diesel engines and other industrial sources, but no clear scientific grounds exist for supporting differential effects estimates by particle type.

    3. We assume that the health impact function for fine particles is linear within the range of ambient concentrations under consideration. Thus, the estimates include health benefits from reducing fine particles in areas with varied concentrations of $PM_{2.5,}$ including both regions that are in attainment with fine particle standard and those that do not meet the standard down to the lowest modeled concentrations.

4. To characterize the uncertainty in the relationship between $PM_{2.5}$ and premature mortality, we include a set of twelve estimates based on results of the expert elicitation study in addition to our core estimates. Even these multiple characterizations omit the uncertainty in air quality estimates, baseline incidence rates, populations exposed and transferability of the effect estimate to diverse locations. As a result, the reported confidence intervals and range of estimates give an incomplete picture about the overall uncertainty in the $PM_{2.5}$ estimates. This information should be interpreted within the context of the larger uncertainty surrounding the entire analysis.