Alliance OF AUTOMOBILE MANUFACTURERS

November 12, 2010

U.S. Environmental Protection Agency
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1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Policy Assessment for Secondary NOx and SOx NAAQS - Second External Review Draft

Docket ID number EPA-HQ-OAR-2007-1145

Submitted Electronically

The Alliance of Automobile Manufacturers appreciates the opportunity to provide comments on the Second External Review Draft “Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for NOx and SOx."

Attached please find our comments prepared by Jon Heuss and George Wolff of AIR Improvement Resource, Inc.

If you should have any questions, please contact Giedrius at (248) 915-8836.

Sincerely,

Giedrius Ambrozaitis
Director, Environmental Affairs

Attachment

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Comments on EPA's Second External Review Draft
"Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for NOx and SOx"

Prepared for the
Alliance of Automobile Manufacturers

Jon M. Heuss and George T. Wolff
Air Improvement Resource, Inc.
November 5, 2010

Executive Summary

The second draft Policy Assessment (PA) fails to fulfill its stated role of bridging the gap between the relevant scientific, technical, and policy issues. Based on AIR's review, the proposed approach is a regional deposition standard dressed up and sold as a national ambient air quality standard (NAAQS). The approach is incompatible with the NAAQS provisions of the Clean Air Act. Previous decisions by EPA and Congress support the conclusion that a secondary NAAQS is not an appropriate mechanism for regulating acidifying deposition. The fundamental limitations that led to those conclusions still apply.

AIR and other public commenters have identified fundamental scientific issues with the formulation that EPA proposes. In particular, because of the dominant role of wet deposition, the assumption that ground-based ambient measurements are an appropriate indicator of total acidifying deposition is scientifically unsound.

The draft PA is incomplete. It does not address many important questions concerning how the regional nature of sensitivity to deposition effects would be dealt with, how the beneficial effects of N deposition would be weighed against adverse effects, how the uncertainty in the needed data and modeling would affect the results, and how the formulation developed in the PA would be implemented.

Finally, there are control programs underway that will achieve major NOx and SOx emission reductions that will dramatically reduce acidifying deposition in sensitive areas before any controls due to the proposed formulation could be implemented. The impact of these control programs on deposition must be considered with regard to the need for a new secondary standard.

The final PA should include, as an alternative, a recommendation to retain the existing secondary NAAQS, while seeking authority from Congress to establish deposition standards. EPA should revise the PA to address public and CASAC comments and turn the information from the review into a Report to Congress as an update of the 1995 Report to Congress on the feasibility of acid deposition standards under Title IV.

Introduction

The U. S Environmental Protection Agency (EPA) is in the process of reviewing the secondary (or welfare-based) National Ambient Air Quality Standards for Oxides of Nitrogen (NOx) and Oxides of Sulfur (SOx). The Integrated Science Assessment for Oxides of Nitrogen and Sulfur: Ecological Criteria[1] (ISA), which reviews the relevant science, was completed in December 2008. As part of the review. EPA has issued the second draft Policy Assessment[2] that is intended to help "bridge the gap" between the relevant scientific information and the judgments required of the Administrator in determining whether, and if so, how, it is appropriate to revise the standards. Air Improvement Resource, Inc. (AIR) participated in public comments to EPA and the Clean Air Scientific Advisory Committee (CASAC) during the review.[3] AIR reviewed the draft PA, focusing on the way the relevant science is interpreted in the document, how that information bears on the question of the adequacy of the current secondary (welfare-based) standards, and the appropriateness and feasibility of setting secondary NAAQS to address effects resulting from deposition. We identified a number of major concerns with the draft that are summarized in the following sections.

Background and Summary of the EPA Proposal for Using an Atmospheric Acidification Protection Index as a Secondary Air Quality Standard

The introduction for the PA quotes a NAPAP (National Acid Precipitation Assessment Program) 2005 report concluding that the emission reductions achieved by Title IV-Acid Deposition Control of the Clean Air Act are not sufficient to allow recovery of acid-sensitive ecosystems. The PA goes on to indicate:

> Given the state of the science as described in the ISA and in other recent reports, such as the NAPAP's above, EPA believes it is appropriate, in the context of evaluating the adequacy of the current NO_2 and SO_2 secondary standards in this review, to revisit the question of the appropriateness and the feasibility of setting a secondary NAAQS to address remaining known or anticipated adverse public welfare effects resulting from the acidic and nutrient deposition of these criteria pollutants.[4]

As the PA revisits the appropriateness and feasibility of setting secondary NAAQS to

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[1] U. S. Environmental Protection Agency, Integrated Science Assessment for Oxides of Nitrogen and Sulfur: Ecological Criteria, EPA/600/R-08/082F, December 2008.

[2] U. S. Environmental Protection Agency, Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for NOx and SOx, Second External Review Draft, EPA 452/P-10-008, September, 2010.

[3] J. M. Heuss, Comments on First External Review Draft of "Integrated Science Assessment for Oxides of Nitrogen and Sulfur: Ecological Criteria" Prepared for the Alliance of Automobile Manufacturers, March 17, 2008.

[4] PA, supra note 2, at page 1-16.

address effects resulting from deposition, a number of facts need to be borne in mind. In contrast to the situation with human health effects where we are dealing with the direct effect of concentrations in the ambient air on human subjects, the effects on soils, forests, and aquatic ecosystems are of an indirect nature. They involve the deposition of SOx and NOx species followed by the interactions of those deposited species with the ecosystem in complex ways that result in effects that are removed in time and space from the ambient concentrations that led to the effects. As discussed in the Ecological ISA, the parameters that can be used to measure or assess such effects are not ambient concentrations, but rather biological, chemical, ecological, or biogeochemical indicators. In addition, the sensitivity of various ecosystems to such effects varies dramatically over the U. S., so the level of deposition that that will potentially harm the most sensitive ecosystem will not affect the vast bulk of the country. Furthermore, there are substantial benefits from nitrogen deposition (and to a lesser degree sulfur deposition) in many ecosystems, so there must be a balancing of beneficial and adverse effects in the NAAQS review. A last complication is that both oxidized and reduced forms of nitrogen contribute to the effects discussed in the ISA, but reduced nitrogen (NH_x) is not a pollutant currently regulated under the Clean Air Act.

As a result of these complications, there is an important threshold question as to whether the secondary standard provisions of the Act are an appropriate mechanism for addressing the key welfare effects discussed in the ISA. For example, based on the Clean Air Act a strong case can be made that both primary and secondary NAAQS must be nationally uniform and that deposition effects should be addressed through Title IV of the Act or other regional efforts. Public comments on the first draft PA raised these issues in detail,[5] but the second draft does not address the arguments made in the public comments. The final PA must address this aspect of the threshold question.

Instead of a nationally uniform ambient standard, the draft PA describes a complex formulation called an atmospheric acidification protection index (AAPI), which includes considerations of the underlying ecosystem characteristics such as buffering capacity and nitrogen uptake, along with estimates of the annual cumulative deposition of oxidized forms of nitrogen and sulfur. The nationally-uniform aspect of the standard would be the intent to provide protection against aquatic acidification as reflected in effects on an ecologic indicator, the chronic Acid Neutralizing Capacity (ANC)[6] of aquatic systems. ANC is not itself a casual agent for effects but it tends to correlate with pH and other indicators that do affect fish

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[5] Comments by the Utility Air Regulatory Group on the First External Draft Policy Assessment, Docket No.. EPA-HQ-OAR-2007-1145- 0070.1; Comments by the American Petroleum Institute on the First External Draft Policy Assessment, Docket No. EPA-HQ-OAR-2007-1145-0069.1.

[6] ANC, defined as the total amount of strong base cations minus the total amount of strong acid anions, is an indicator of the ability of water to neutralize the acid or acidifying inputs it receives.

populations. Although the AAPI would essentially be a deposition standard not an ambient standard, the EPA plan would use an atmospheric model to develop factors to translate the ambient concentrations of NO_y (total oxidized nitrogen) and SO_2 + SO_4 (total oxidized sulfur) into deposition loads. Since the sensitivity of ecosystems to acidification varies widely, the AAPI would be evaluated in an as yet undefined regional manner. A major complication in the development and implementation of such an approach is that deposition of reduced nitrogen (gaseous ammonia and particulate ammonium) is also acidifying. Reduced nitrogen is included in the AAPI but it would not be subject to control in the current formulation of the AAPI.

The way the standard would work is that measurements of ambient NO_y and SO_2 + SO_4 would be made in sensitive areas and used with the AAPI equations to determine if the target ANC is achieved. If not, non-attainment would be triggered and an attainment plan would be required. The spatial extent of the region where additional controls would be required is not known or even considered in the PA. The PA also discusses the probability that similar complex formulations could be used in subsequent reviews to establish secondary standards to protect against acidification in sensitive terrestrial ecosystems. AIR is concerned that promulgation of a secondary standard of the type discussed in the PA would be a major expansion of EPA's regulatory authority.

There are many unanswered issues and questions concerning the regulatory authority for such a formulation as well as with the formulation itself, the extensive use of modeling in the determination of the relation between ambient concentrations and deposition, and how such a complicated scheme could be implemented. The issues and questions identified by AIR are discussed in greater detail in the following sections.

Both EPA and Congress have historically decided that secondary NAAQS are not an appropriate approach to address regionally variable welfare effects

In previous reviews, EPA decided the secondary national air quality standards were not an appropriate approach to address deposition effects. Instead both EPA and Congress have regulated deposition through Title IV of the Clean Air Act. Nothing has changed to alter the fundamental limitations that led to those decisions. The PA glosses over or omits the reasons given in past reviews as to why secondary NAAQS cannot adequately address deposition issues.

The basic understanding of the causes and effects of acidic deposition and eutrophication has been available to legislative and regulatory bodies for many years. Over those years, the appropriate mechanisms and approaches to address the concern that the PA focuses on – the acidifying effects of NOx and SOx - has been debated and decided several times by EPA, Congress, and the States. The PA summarizes some of this history but leaves out relevant material. For example, the

Utility Air Regulatory Group noted[7] that when EPA last decided the secondary SOx standard, the Administrator indicated:

> The 1990 Amendments and the legislative history indicate, however, that Congress *reserved judgment* as to whether further action might be necessary or appropriate in the longer term and, if so, what form it should take. *Congress seems to have viewed these as questions it would itself address in the future*, based on further studies and research to be conducted by the EPA and other agencies. Consistent with the 1988 proposal notice, *Congress does not seem to have expected that the EPA would set a secondary standard for acidic deposition …. in the interim*. To the contrary, in section 404 of the 1990 Amendments, Congress specifically required the EPA to conduct a study of the feasibility and effectiveness of an acid deposition standard or standards, and to report to Congress by November 15, 1993 on the role that a deposition standard might play in supplementing the acidic deposition control program adopted in title IV, and what measures would be needed to integrate it with that program. [8]

The PA also leaves out relevant material from the Clean Air Act charge to EPA to conduct the section 404 Study noted above and the results of the study that was transmitted to Congress in 1995.[9] The Section 404 Study was required to report on the feasibility and effectiveness of an acid deposition standard or standards to protect sensitive and critically sensitive aquatic and terrestrial resources. Protecting those resources is essentially what EPA is seeking to do through the secondary NAAQS process. The study was to include identification of the sensitive aquatic and terrestrial resources in the United States which may be affected by the deposition of acidic compounds, describe the nature and numerical value of a deposition standard or standards that would be sufficient to protect such resources, and describe the measures that would need to be taken to integrate such standard or standards with the control program required by Title IV of the Clean Air Act, and describe the cost-effectiveness of deposition standards compared to other control strategies including ambient air quality standards, new source performance standards and the requirements of Title IV of the Clean Air Act.

Both the way Congress set up the requirements of the section 404 study and the study report itself presume that deposition standards would be carried out under Title IV and that EPA's existing authority under Title I was not well-suited to the issue. The study evaluated a regional target approach and a national emission reduction approach for establishing deposition standards (in likely units of kg/hectare). In both cases, the report discusses the need for further legislative action by Congress. The report recommended against setting acid deposition

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[7] UARG comments on first draft PA, supra note 5.

[8] 58 Fed. Reg. at 21356 (April, 21, 1993)(emphasis added) (citation omitted).

[9] U.S. EPA, Acid Deposition Standard Feasibility Study: Report to Congress, EPA 430-R-95-001a, October 1995.

standards at the time because of uncertainties, with the uncertainty in the rate of nitrogen effects on the watershed the most important impediment. The report also concluded that setting a uniform national deposition standard would not be appropriate. The PA should draw on the section 404 report as it informs the decisions in the current review.

The previous review of the secondary NOx standard[10] also provides an important perspective that must be included in the PA. In the final rule the Administrator, acknowledged the concerns about acid deposition (particularly in the Adirondacks) and eutrophication (particularly in the Chesapeake Bay). With regard to acidification, the Administrator referred to one commenter who "recognized EPA's concern that revision of the secondary NAAQS may not be the best mechanism for addressing the effects of acid rain and supported regionally-targeted regulatory efforts." The final rule also refers to the section 404 report concerning deposition standards and indicates that the Agency will continue, as appropriate, to assess the feasibility of developing regionally-targeted tools and policy initiatives.

With regard to eutrophication, the rule indicated:

> Given the complexities associated with estimating the contribution of nitrogen deposition to the eutrophication of estuarine and coastal waters and the limited data currently available, the Administrator again concludes that there is not sufficient quantitative information to establish a national secondary standard to protect sensitive ecosystems from the eutrophication effects caused by nitrogen deposition. The Administrator also concludes that regional control strategies which consider all of the factors contributing to eutrophication are more likely to be effective in mitigating this problem than a national standard which addresses only atmospheric deposition of nitrogen compounds.

The rule concludes:

> Given the multiple causes and regional character of these problems, the Administrator also concludes that adoption of a nationally-uniform secondary standard would not be an effective approach to addressing them. Therefore, the Administrator has determined, pursuant to section 109(d)(1) of the Act, as amended, that it is not appropriate to revise the current secondary standard for NOx to protect against welfare effects at this time.

The final rule goes on to indicate that, in the interim, the EPA and the States are in the process of achieving significant reductions in NOx emissions from both mobile and stationary sources in response to the Act's 1990 Amendments and local or regional initiatives. The Administrator points out that the NOx emissions reductions achieved through these actions will provide additional protection against the

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[10] 61 Fed. Reg. 52852, October 8, 1996.

environmental impacts associated with various pollution issues including eutrophication and acid deposition.

A Panel of the National Research Council (NRC) has also addressed the issue of regionally different welfare standards. The PA notes that the NRC Panel recommended that EPA consider multiple pollutants, as appropriate, in forming the scientific basis for the NAAQS.[11] However, the Panel also acknowledged that concentration-based standards are inappropriate for some resources at risk, such as soils, groundwater, forests, surface water, and coastal eco-systems from air pollutants, such as sulfur and nitrogen.[12] For such resources, the Panel indicated that deposition-based standards would be more appropriate. The Panel also indicated that if acceptable exposure levels vary significantly from one region of the nation to another, consideration should be given to the promulgation of regionally distinct secondary standards. But the Panel noted that a move to regional secondary standards may require an amendment of the Clean Air Act.

The relevant history discussed above must be included and considered in the PA and in the Administrator's decisions. Based on the various previous findings, any decision on regulatory action to address acid deposition is reserved to the Congress. Such a conclusion is based on Congress's prior actions, the legislative history of the relevant statutes, and EPA's own prior findings.

A secondary NAAQS, even a combined NOx and SOx secondary standard, is still not an appropriate approach to address regionally variable welfare effects that involve substances other than the criteria pollutants themselves

Even with the increased understanding of deposition issues, as summarized in the ISA, there are still fundamental obstacles to using secondary NAAQS to address deposition concerns.

First, acid deposition is a regional, not a national concern. Therefore, a uniform national ambient standard is not appropriate.

Second, the ecological indicator the PA recommends, ANC, is a measure of water quality, with units of μeq/L, and cannot substitute for a uniform national ambient standard. Promulgation of a secondary standard of the type discussed in the PA would be a major expansion of EPA's regulatory authority. The PA also discusses the probability that similar complex formulations could be used in subsequent reviews to establish secondary standards to protect against acidification in sensitive terrestrial ecosystems. While the PA recommends against using a similar approach to regulate eutrophication at this time, there is no reason why the justification for

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[11] National Research Council. 2004. *Air Quality Management in the United States*. National Academies Press, Washington, D.C.

[12] Ibid. at page 312.

establishing a water quality standard and designating it as an air quality standard could not be stretched and used for any number of other welfare issues.

Third, the criteria pollutants NOx and SOx cover only a portion of the S and N compounds that are known to cause deposition-related effects. All the relevant conclusions concerning causality in the ISA refer to the evidence being sufficient to infer a causal relationship between acidifying deposition or N (or reactive N) deposition. In particular, reduced N is important and included in the acidification index but is not subject to regulation as a criteria pollutant. This can lead to the situation where sources of NOx or SOx emissions could be driven to zero while sources of reduced N would be totally uncontrolled and even allowed to increase.

Fourth, the air quality indicator discussed in the scheme described in the PA, NOy, also includes both regulated and unregulated compounds. The PA indicates that the term "NOy" refers to the complete set of oxidized nitrogen compounds, noting that "NOy includes all nitrogen oxides, including NO, NO2, HNO3, peroxyacetyl nitrate (PAN), 2N2O5, HONO, NO3, organic nitrates, and particulate NO3."

Fifth, the beneficial effects of N deposition need to be weighed along with any adverse impacts in the Administrator's decision. The PA acknowledges that nitrogen is a fundamental nutrient for primary production in both managed and unmanaged ecosystems. The nutrients deposited from atmospheric sources on both managed and un-managed ecosystems are often referred to as passive fertilization. The PA acknowledges that increases in the availability of nitrogen in N-limited forests via atmospheric deposition could increase forest production over large non-managed areas. However, the PA refers to the ISA noting that the evidence is mixed, with some studies showing increased production and others showing little effect on wood production.[13] To the extent there is increased production in all ecosystems (managed and un-managed) there will be increased carbon sequestration. This is a benefit that EPA must consider and weigh against potential adverse effects.[14] EPA acknowledges that it must assess the net impact on public health and/or welfare of a pollutant.[15] The final PA, therefore, must provide a framework within which the net impacts of N deposition can be evaluated.

The PA attempts to minimize the benefits with statements such as "In certain limited situations, additions of nitrogen can increase rates of growth, and these

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[13] ISA, supra note 1, at section 3.9.9

[14] See March 6, 2008 Office of Management and Budget memo from Susan Dudley to Administrator Johnson at footnote 1, quoting the Court's decision in American Trucking Association v. EPA that legally EPA must consider positive identifiable effects of a pollutants presence in ambient air in formulating air quality criteria under section 108 and NAAQS under section 109 of the Clean Air Act.

[15] See March 7, 2008 U. S EPA memo from Marcus Peacock to Susan Dudley of OMB at page 2, indicating that EPA agrees that it must consider the beneficial effects of an air pollutant as well as its adverse effects, and that it must assess the net impact of a pollutant.

increases can have short term benefits in certain managed ecosystems."[16] However, the benefits of passive fertilization will occur in both managed and un-managed ecosystems and should be fully evaluated in the review. Because of EPA's interest in climate change, the extent of carbon sequestration due to atmospheric nutrient deposition should be of great interest to the Agency. In fact, other government agencies and national laboratories have major research programs evaluating possible ways to increase carbon sequestration. Determining the role of N and the optimal inputs of N in that effort is one of the major research strategies in that regard. The Agency and the PA should not ignore or downplay benefits from N deposition just because it gets in the way of EPA's favored approach.

Sixth, there is no unique link between ground-level NOx and SOx concentrations and the deposition that may lead to effects. This is discussed in greater detail below. The PA indicates that the model is used to provide the link between atmospheric measurements and deposition because the current measurements of the important constituents in sensitive areas are limited or non-existent. For example, EPA states "we are unable to use current ambient monitoring data to adequately link measured current atmospheric concentrations to ecological effects transmitted through deposition."[17] However, there is no fundamental acidifying potential for the NOy indicator the Agency favors. The ground-level atmospheric concentrations of the individual components of NOy are the proximate cause of the dry deposition of those components, but ground-level concentrations of NOy are not a satisfactory link to wet deposition and are not even a satisfactory link to dry deposition since a different mix of NOy components will result in a different amount of N deposition since the deposition velocities for NOy component species vary widely.

In summary, there are still fundamental limitations and obstacles to using secondary NAAQS to address deposition effects. The PA must acknowledge and address these issues.

There are fundamental issues with the formulation the PA proposes

The AAPI is a complex scheme to link ambient air quality to deposition to ecosystem effects. In essence it is a regional deposition standard for total N and S deposition that is linked to ambient concentrations through a model-derived transformation ratio. A number of the issues regarding appropriateness noted above provide severe practical limitations to the approach. There is also significant uncertainty at each stage of the analysis. Detailed comments provided by Knipping[18] to the October 6, 2010 CASAC meeting show that the uncertainty associated with EPA's approach is so large that its use in defining the requisite level of a standard is questionable. Additional major concerns identified by AIR are discussed in the

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[16] PA, supra note 2, at page 4-45.

[17] PA, supra note 2, at page 4-13.

[18] E. M. Knipping, Electric Power Research Institute Comments to CASAC Panel on the Secondary NAAQS for SOx and NOx.

following sections.

A. EPA's Overreliance on Unproven Models to Determine Compliance with a Secondary NO_y/SO_x NAAQS is Scientifically Unsound

Unlike all other NAAQS where a single national ambient air quality indicator determines compliance, the secondary NO_x/SO_x standard being considered by EPA uses a single national Atmospheric Acidification Protection Index (AAPI) as the indicator for compliance. In addition, a numerical chemical-transport model, the US EPA Community Multiscale Air Quality (CMAQ) modeling system, would be employed to determine compliance. To determine if an area is in compliance or not, the local AAPI would be calculated from:

$$\mathrm{AAPI} = [(\mathrm{BC})_0{}^*]_{\%eco} + \mathrm{Neco}_{ave}/Q_{\%eco} - \mathrm{Dep}_{NHx}/Q_{\%eco} - (T_{NOy}\cdot C_{NOy} + T_{SOx}\cdot C_{SOx})/Q_{\%eco}$$

where $[(\mathrm{BC})_0{}^*]_{\%eco}$ is the preindustrial base cation concentration of a watershed, Neco_{ave} is the nitrogen assimilated by the ecosystem, Dep_{NHx} is the annual NH_x deposition rate, $Q_{\%eco}$ is the average annual runoff through the watershed, C_{NOy} and C_{SOx} are the measured ambient concentrations of NO_y and SO_x respectively, and T_{NOy} and T_{SOx} are the respective transformation functions that convert the measured NO_y and SO_x into annual deposition rates. $[(\mathrm{BC})_0{}^*]_{\%eco}$ is watershed-specific and it is calculated from a watershed model using local watershed chemistry. Neco_{ave} and $Q_{\%eco}$ are watershed specific and they are derived from observations. Dep_{NHx}, T_{NOy} and T_{SOx} are calculated for each watershed using the CMAQ model. Consequently, compliance is dependent not only upon the measured ambient NO_y and SO_x concentrations but also on the ability of CMAQ to accurately calculate Dep_{NHx}, T_{NOy} and T_{SOx} and the accuracy of the watershed model to calculate $[(\mathrm{BC})_0{}^*]_{\%eco}$.

B. CMAQ Lacks an Adequate Performance Evaluation

Because of the central role CMAQ plays in determining the allowable NO_y and SO_x concentrations, it should be required to pass rigorous performance evaluation tests. Unfortunately, EPA has not performed these evaluations in a comprehensive way and the few comparisons that they made with actual observations were not adequately evaluated.

A fundamental assumption in relating AAPI to an ambient air concentration is that the total deposition of oxidized N and S species at a given site is related to the measured surface ambient concentrations of NO_y and SO_x. For reasons that will be explained, there are no theoretical bases for this. At some locations, mountaintop and extremely remote sites, an empirical relationship could exist, but this has yet to be demonstrated in a rigorous manner and it would only be applicable to those limited areas.

In most areas of the world, deposition of pollutants occurs primarily by wet (from rain and snow) and dry (pollutant deposits directly on surface) deposition. At high elevations and in some coastal environments, occult deposition (deposition of cloud and fog droplets) could be significant, but our comments focus on wet and dry deposition which dominates over most US. In the US, the best information on wet and dry deposition is derived from EPA CASTnet[19]/NADP[20] monitoring network which is described in the Integrated Science Assessment (ISA).[21] The NADP has been in operation since 1979 and the CASTnet since 1989. The NADP collects weekly precipitation samples that are analyzed for SO_4^{-2}, NO_3^- and NH_4^+. The CASTnet measurements include weekly measurements of the gases, SO_2 and HNO_3 and the fine particulate species SO_4^{-2}, NO_3^- and NH_4^+. From these samples, weekly wet deposition of SO_4^{-2}, NO_3^- and NH_4^+ can be calculated directly from their concentrations in the precipitation and the precipitation volume.

In Section 2.8.3 of the ISA, EPA presents a limited comparison of CMAQ output versus annual average measurements of wet NO_3^- and SO_4^{-2} deposition at the NADP sites, summer particulate NO_3^- and SO_4^{-2} at IMPROVE,[22] STN[23] and CASTnet sites and summer SO_4^{-2} and NH_4^+ at the Eastern US IMPROVE, STN and CASTnet sites. Although the correlation coefficients between the predictions and the measurements are respectable (0.6 to 0.9), the mean errors range from ±16.6 to ±41.8%. These large errors are unacceptable for a tool that will be used to determine compliance with a NAAQS.

Unlike the wet deposition which is a straightforward calculation (concentration x precipitation volume), dry deposition estimates cannot be inferred directly from the measured concentrations because the dry deposition rates of fine particles, and to a lesser extent the gases, vary significantly as a function of the properties of the surface that is being deposited upon and micrometeorological variables. At present, the dry deposition amounts are estimated using a model that incorporates the measured concentrations of SO_4^{-2}, NO_3^-, SO_2 and HNO_3, micrometeorological measurements and dry deposition velocities to some average surfaces. Consequently, the dry deposition amounts are estimates whose uncertainties have been poorly characterized but would be expected to vary spatially and temporally. Nevertheless, these are the best estimates that are available to determine the relative importance of wet versus dry deposition. Thus CMAQ predictions can be compared to these estimates; however, EPA chose not to make these comparisons.

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[19] EPA's Clean Air Status and Trends (CASTnet) Network.

[20] National Acid Deposition Program (NADP) monitoring network.

[21] ISA, supra note 1.

[22] EPA's Interagency Monitoring of Protected Visual Environments (IMPROVE) Monitoring Network.

[23] EPA's Speciated Trends Network (STN).

The ISA does, however, present maps showing the spatial distribution of wet and dry deposition at the co-located CASTnet/NADP sites. The EPA maps (Figures 2-117 and 2-126 in the ISA) show the relative importance of wet versus dry deposition of $HNO_3 + NO_3^-$ and $SO_2 + SO_4^{-2}$. In Figure 2-118, they further break it down to show the relative contributions from dry HNO_3, dry NH_4^+, dry NO_3^-, wet NH_4^+, and wet NO_3^-. Similarly, in Figure 2-127, they show the relative contributions from dry SO_2, dry SO_4^{-2} and wet SO_4^{-2}. The most important conclusions drawn from the maps are: 1) at most sites wet deposition of both N and S are responsible for about 2/3 of the total deposition, 2) most of the wet N deposition is due to NO_3^-, 3) most of the dry N deposition is due to HNO_3, 4) most of the dry S deposition is due to SO_2 and, 5) the wet deposition of S is exclusively from SO_4^{-2}. In their comments on the first draft of the PA[24], Environ[25] made some comparisons of the information in EPA's maps with CMAQ estimates. Figures 3 and 4 of the Environ report show the CMAQ predictions for wet and dry deposition at several sites including the Great Smokey Mountains (GRS) and Shenandoah (SHN) which are important sites because they have been identified by EPA as being in acid sensitive areas. At the CASTnet/NADP sites in these areas, the ISA maps show that at GRS over 75% of the deposition is wet while at the SHN site it is about 65%. CMAQ predictions, however, are the reverse: 74% is from dry at GRS and 65% is from dry at SHN. Averaging over all the CASTnet sites in their modeling domain, Environ found that dry deposition from NO_y had a overall error of ±81% and a bias of +80% and for SO_x they were ±66% and +69%, respectively. For NO_y, the large positive bias in the dry deposition was somewhat compensated for with a negative (-12%) bias in the wet deposition but the overall error was still large (±32%). For wet SO_x the error was ±42% and the bias was +16%. In addition, CMAQ predicts that the wet NO_3^- deposition is due to the deposition of particulate NO_3^- when in reality it is due to HNO_3. Clearly, CMAQ fails any performance evaluation tests or standards that would justify its use as a tool to determine compliance with a secondary NAAQS.

In summary, the limited performance evaluations reveal large double-digit percent errors and biases between CMAQ outputs and observations. It further shows that CMAQ fails to identify wet deposition as the dominant deposition route and it erroneously attributes particulate nitrate as the main component of wet nitrate deposition. Even if EPA could demonstrate some statistical skill between annually and spatially averaged observations and CMAQ estimates, the above analyses indicate it would not be for the right reasons.

C. There Is No Basis for the Assumption that Ground-Based Ambient Air Measurements Are Related to Deposition

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[24] USEPA, (2010), "Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for NO_x and SO_x: First External Draft," EPA-452/P-10-006, March 2010.

[25] Morris, R., Emery, C., Parker, L. and Sakulyanontvittaya, T. (2010), "Preliminary Review of EPA's First External Draft " Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for NO_x and SO_x,"" Submitted May 13, 2010 to EPA by the American Petroleum Institute.

1. Wet Deposition is Not Related to Surface Ambient Measurements

Based on the above discussion, wet deposition of N and S species is more important than dry deposition at most sites in the US including the acid sensitive ecosystems in the eastern US. Consequently, we will focus on wet deposition first. In the 1980s a number of studies[26] focused on the use of scavenging or washout ratios in individual precipitation events. The washout ratio is the dimensionless ratio of the amount of a chemical species in precipitation to the amount measured in the ambient air. By comparing the washout ratios of NO_3^- and SO_4^{-2} to that of an inert fine particle like a metal, one can determine if the washout ratios of the NO_3^- and SO_4^{-2} are enhanced by in-cloud formation from precursor species. Collectively these studies came to a number of conclusions. All the studies found evidence of in-cloud SO_2 conversion and in some liquid precipitation events this was the dominant source of the SO_4^{-2} in the precipitation. All found evidence at times of enhanced NO_3^- that could not be explained by in-cloud scavenging of NO_3^- and HNO_3 suggesting that some other NO_y species like NO_2 was being oxidized in the cloud. There was considerable event-to-event variation in the scavenging ratio for both the S and N species suggesting that other factors besides their ambient air concentrations were important. The ratios exhibited variations between cloud type (i.e.: stratiform versus cumulus). The cumulus entrained air from below the cloud while the stratiform had lateral entrainment. This latter is important because horizontal entrainment occurs when the cloud is in an air mass above the surface air mass and hence would have different chemical properties than the air mass at the surface.

Because of the importance of in-cloud scavenging and oxidation, the ambient concentrations of NO_y and SO_x constituents at cloud level are more important in determining the composition of the precipitation than the concentrations measured at ground level. However, fundamental air pollution meteorology principles support the existence of vertical concentration gradients. The purpose of constructing tall stacks is to prevent these elevated emissions from mixing to the ground. The omnipresence of vertical wind shear ensures that emissions at different altitudes will be transported in different directions and at different speeds. Therefore it would need to be demonstrated that there are no significant concentration gradients between ground level and the level of the clouds in order to use surface measurements to predict wet deposition amounts. Recent

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[26] Hegg, D.A., Hobbs, P.V. and Radke, L.F. (1984), "Measurements of the scavenging of sulfate and nitrate in clouds," *Atmos. Environ.*​**18**:1939-1946; Barrie, L.A. (1985), "Scavenging ratios, wet deposition, and in-cloud oxidation: an application to the oxides of sulphur and nitrogen," *J. Geophys. Res,* **90**: 5789-5799; Misra, P.K., Chan, W.H., Chung, D. and Tang, A.J.S. (1985), "Scavenging ratios of acidic pollutants and their use in long-range transport models," *Atmos. Environ.* **19**: 1471-1475; Wolff, G. T., Church, T.M., Galloway, J.N. and Knapp, A.H. (1987), "An examination of SO_x, NO_x and trace metal washout ratios over the Western Atlantic Ocean," *Atmos. Environ.,* **21**: 2623-2628.

measurements of the vertical profiles of the relevant species indicate the frequent occurrence of significant gradients that are both positive and negative. Park et al.[27] measured the vertical profiles of SO_x, NO_3^- and total oxidized nitrate in the Asian outflow over the northwest Pacific Ocean from 0.5 to 6 km and observed significantly decreasing concentrations with altitude for all species. Koike et al.[28] reported significant but variable vertical profiles for SO_x and NO_y up to 6 km over the Sea of Japan. Over a rural site in Taiwan, Tseng et al.[29] observed highly variable but significant vertical gradients of SO_2, NO, and NO_2 up to 1.2 km. van Donkelaar et al.[30] made ground-based and aerial measurements up to 4.5 km of SO_4^{-2}, NO_3^- and NH_4^+ over eastern Pacific Ocean in air masses entering Canada and found variable but significant gradients for all three species. Lee et al.[31] analyzed vertical profiles of SO_2 over the Eastern US, the North Atlantic, Houston, the Northwest US, Mexico and the North Pacific and found significant but variable profiles. Held et al.[32] reported on SO_x profiles over North America that generally showed significant decreasing concentrations from 0.5 to 6 km. Finally, Zhang et al.[33] reported variable but generally decreasing concentrations with height for HONO over the northern Great Lakes region up to 2.5 km.

In summary, in-cloud scavenging and oxidation processes are most important in determining the chemical composition of wet deposition. Because there are significant vertical gradients in the constituents that contribute to in-cloud composition, there is no relationship between surface ambient concentrations and the composition of wet deposition.

2. Dry Deposition is Weakly Related to Surface Ambient Measurements

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[27] Park, R.J. et al. (2005), "Export efficiency of black carbon aerosol in continental outflow: Global implications," *J. Geophys. Res.,* **110**, D11205, doi:1029/2004JD005432.

[28] Koike, M. et al. (2003), "Export of anthropogenic reactive nitrogen and sulfur compounds from the East Asia region in the spring," *J. Geophys. Res.,* **108**, NO.D20,8789, doi:10.1029/2002JD0003284.

[29] Tseng, K-H. et al. (2009), "Vertical profile of ozone and accompanying air pollutant concentrations observed at a downwind foothill site of industrial and urban areas," *Aerosol and Air Quality Res.*doi:10.4209/aaqr.2009.04.0024.

[30] van Donkelaar, A. et al. (2008), Analysis of aircraft and satellite measurements from the Intercontinental Chemical Transport Experiment (INTEX-B) to quantify long-range transport of East Asian sulfur to Canada," *Atmos. Chem. Phys.,* **8**, 2999-3014.

[31] Lee, C. et al. (2009), "Retrieval of vertical columns of sulfur dioxide from SCIAMACHY and OMI: Air mass factor algorithm development, validation, and error analysis," *J. Geophys. Res.,* **114**, D22303,doi:10.1029/2009JD012123.

[32] Held, C.L. et al. (2006), "Concentrations and sources of organic carbon aerosols in the free troposphere over North America," *J. Geophys. Res.,***111**, D23S47, doi:1029/2006JD007705.

[33] Zhang et al. (2009), "Aircraft measurements of HONO vertical profiles over a forested region," *Geophys. Res. Lett.,* **36**, L15820, doi:10.1029/2009GL038999.

As discussed above, dry deposition of oxidized N and S species is estimated at the CASTnet sites by incorporating measurements of the weekly concentrations of SO_4^{-2}, NO_3^-, SO_2 and HNO_3, micrometeorological measurements and the deposition velocities to some average surfaces into a model. In the ISA, EPA states: " Under optimal conditions, when a model is exercised over a relatively small area where dry deposition measurements have been made, models still generally showed uncertainties on the order of ± 30%."[34] They further state: " Still larger uncertainties exist when the surface features in the built environment are not well known or when the surface comprises a patchwork of different surface types, as is common in the eastern U.S." Consequently this infers that the uncertainty is considerably large than ± 30%.

However, the NAAQS that is being considered is attempting to relate total deposition of the oxidized N and S species to the concentrations of NO_y and SO_2 not just the concentrations of SO_4^{-2}, NO_3^-, SO_2 and HNO_3. As a result, this adds additional uncertainties into the dry deposition calculations.

First of all, besides HNO_3, NO_y, as defined in the PA,[35] also includes NO, NO_2, N_2O_5, HONO, PAN and trace amounts of other oxidized species. The uncertainties of the deposition velocities for these species are larger than for HNO_3 and NO_3^- because they have been studied less. Although they likely have smaller contributions to the total dry deposition, the mere fact of their inclusion increases the uncertainty of the NO_y calculation. In addition because EPA is calling for the measurement of NO_y and not the individual NO_y constituents, further unknown uncertainty is introduced.

Finally, the uncertainty is further increased by ignoring both the fine and coarse particulate phase NO_3^- and the coarse particulate phase SO_4^{-2}. Based on EPA's analysis of the CASTnet data presented in the ISA, dry deposition of NO_3^- is essentially negligible, but they only considered the contribution from fine particle (d ≤ 2.5 μm) NO_3^-. It has been known for some time, that there can be a significant component of the nitrate in the coarse (2.5 - 10 μm) fraction in both inland[36] and coastal[37] environments. During the warmer part of the year in the East, the coarse fraction can be the dominant fraction. As EPA notes in the ISA, the dry deposition velocity of coarse particles can be up to 2 orders of magnitude greater than that for fine particles. Consequently, the failure to measure coarse NO_3^- and include its contribution to total oxidized N deposition greatly increases the uncertainty of the dry deposition estimates and will further increase the error associated with using

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[34] ISA, supra note 1, at page 2-66.

[35] USEPA, (2010), "Policy Assessment for the Review of the Secondary National Ambient Air Quality Standards for NO_x and SO_x: Second External Draft," EPA-452/P-10-008, September 2010.

[36] Wolff, G.T. (1984), "On the nature of nitrate in coarse continental aerosols," *Atmos. Environ.* **18**, 977-981.

[37] Savoie, D.L. and Prospero, J.M. (1982), "Particle size distribution of nitrate and sulfate in the marine atmosphere," *Geophys. Res. Lett.,* **9**, 1207-1210.

ambient NO_y measurements as a surrogate of dry N deposition. Similar errors and uncertainties are introduced by not including coarse measurements of SO_4^{-2} in the SO_x.

3. The transformation ratio used in the AAPI does not have a clear physical meaning

Given the complexities of the physical transport and chemical transformations that are involved in the relationships between NOx and SOx emissions and the subsequent deposition of acidifying species downwind, there is no reason that ground-based ambient measurements of NOy and SOx species in the receptor region would be the appropriate intermediate in the causal chain to relate NOx and SOx emissions with acid deposition. The transformation ratio as used in the AAPI is thus a clever way to get around an intractable problem. Of course, if one calculates the transformation ratio, one will get a number. But the relation is associational not cause and effect. If the mix of sources changes over time, the ground-based measurements may change while total deposition may stay the same or the deposition may change while the ground-based measurements stay the same.

Another way to think about this problem is to consider how EPA (and CASAC) would address the problem if Congress gave EPA authority to set regional deposition standards. EPA would re-evaluate the science in light of new information available since the section 404 study. If deemed feasible, EPA would establish appropriate deposition standards and use the best available measurements of wet and dry deposition to determine compliance. Although an atmospheric model would be used to develop an implementation plan, EPA would not determine compliance with the ground-based ambient measurements that EPA proposes in the AAPI.

Instead of just revisiting the appropriateness and feasibility of using secondary NAAQS to protect against acidifying deposition, EPA should use the NAAQS review process to consider revisiting the appropriateness and feasibility of directly establishing regional deposition standards.

C. The discussion of how the AAPI would be applied in a regional sense is inadequately described in the PA

While there is discussion of subdividing the nation into from 1to 83 different ecoregions and developing a deposition metric for each region, the PA offers no view on how many separate regions might be chosen by the Administrator. The supplemental material posted on September 23 does not answer this question. While there is some discussion of the measurements to be made in each ecoregion, there is no discussion of the extent and location where the appropriate ambient measurements should be made in an ecoregion. These issues are not details that can be worked out later but are parameters that are critical to understanding how the AAPI approach would work in practice.

The section 404 study concluded that to be successful, an implementation approach for a deposition standard “must be clear and unambiguous, and provide certainty as to the responsibilities of the regulated community, EPA, and the states.” The current description of the AAPI and the way it would work in practice is nether clear nor unambiguous. Thus, the PA is incomplete in this regard.

D. There are major issues with implementation that will delay any additional controls until after the next five year review is completed

If an AAPI standard were set, a new monitoring network would need to be put in place. The appropriate monitoring methods and appropriate standards are not in place so considerable work would be required before any monitoring could take place. Since the PA recommends three to five years of monitoring, any designations would not occur in the foreseeable future. It is also not clear how the spatial extent of the control area would be determined and a SIP would be developed. Depending on the number of ecoregions, a given State could be involved as a contributor to several different non-attainment areas. In the meantime, however, the PSD provisions of the Act would be triggered. The PA also notes that the CMAQ model will need to undergo revisions and updates to deal with known problems. Since CMAQ is constantly being revised, what version would be used in the AAPI? How would attainment be evaluated? Based on attaining the target atmospheric concentrations or on attaining the target ANC? All these issues will add complexity and confusion to the implementation of the standard and will of necessity delay any additional controls under the standard until after the next five year review is completed.

There are control programs underway that will achieve major NOx and SOx emission reductions that will dramatically reduce acidifying deposition that are not being considered with regard to the need for a new secondary standard

The section 404 study noted that there were several on-going or potential control programs that are likely to result in reductions in acidic deposition levels.[38] The study pointed out that it will be important that the N and S reductions achieved by other programs be integrated into the discussion of meeting acid deposition program goals. Since 1995, when the section 404 study was issued, there have been additional control programs implemented that have substantially reduced NOx and SOx emissions and acidic deposition from those emissions. All this has occurred without any deposition standards or secondary NAAQS to address acid deposition in place. The PA addresses the adequacy of the existing secondary standards based on ambient deposition in the recent past and on the amount of deposition that could occur upon just meeting the current secondary standards in Section 4.5. The Agency should also evaluate the reductions in deposition that will occur due to NOx and SOx

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[38] Section 404 study , supra note 9, at page 119.

emissions reductions that are forecast under various existing and already proposed control programs.

The Regulatory Impact Analysis (RIA) for the EPA Transport Rule[39] indicates that there will be NOx welfare benefits from the rule including aquatic and terrestrial acidification and nutrient enrichment benefits. The RIA also indicates that there will be SO_2 welfare benefits including aquatic and terrestrial acidification benefits. The RIA indicates:[40]

> Though models exist for quantifying these ecosystem impacts, time and resource constraints precluded us from quantifying most of those effects in this analysis.

Since the emission reductions modeled in the Transport Rule are very large, it is incumbent on the Agency to evaluate the impact on acidic deposition in sensitive areas before a complex rulemaking that may be redundant is undertaken. For example, on-road vehicle NOx emissions will be reduced by over 50 % from current (2005) levels by 2014. In addition, the EPA Transport Rule calls for a 70 % reduction in annual power plant SO_2 emissions and a 50 % reduction in annual NOx emissions in 2014 compared to 2005 baseline in a 28 state area. While there is controversy over the proposed Transport Rule, the controversy is primarily over the timing of the reductions not the total amount of reductions. For the lower 48 states in total, the Transport Rule RIA indicates that total man-made NOx emissions in 2014 will be reduced by 6.4 million tons per year compared to 2005 levels while total man-made SO_2 emissions will be reduced by 6.8 million tons. These reductions arise from both existing control programs and the proposed Transport Rule. These total NOx and SOx emission reductions are similar in size to the Title IV reductions mandated in the 1990 CAA amendments. The PA does not address the important question of whether all these programs are sufficient to adequately protect the public welfare. It should. Going forward there may also be additional reductions in acidifying deposition due to updates to the Regional Haze Rule, implementation of the new 1-hour primary SO_2 and NO_2 standards, and/or other new rules affecting NOx and SOx sources.

Conclusions

Based on AIR's review, the proposed approach is a regional deposition standard dressed up and sold as a national ambient air quality standard. The approach is incompatible with the NAAQS provisions of the Clean Air Act. Previous decisions by EPA and Congress support the conclusion that a secondary NAAQS is not an appropriate mechanism for regulating acidifying deposition. The fundamental limitations that led to those conclusions still apply.

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[39] U. S. EPA, Regulatory Impact Analysis for the Proposed Federal Transport Rule, June 2010.

[40] Ibid., at page 71.

AIR and other public comments have identified fundamental scientific issues with the formulation that EPA proposes. In particular, because of the dominant role of wet deposition, the assumption that ground-based ambient measurements are an appropriate indicator of total acidifying deposition is scientifically unsound.

The draft PA is incomplete. It does not address many important questions concerning how the regional nature of sensitivity to deposition effects would be dealt with, how the beneficial effects of N deposition would be weighed against adverse effects, how the uncertainty in the needed data and modeling would affect the results, and how the formulation developed in the PA would be implemented.

Finally, there are control programs underway that will achieve major NOx and SOx emission reductions that will dramatically reduce acidifying deposition in sensitive areas before any controls due to the proposed formulation could be implemented. The impact of these control programs on deposition must be considered with regard to the need for a new secondary standard.

The final PA should include, as an alternative, a recommendation to retain the existing secondary NAAQS, while seeking authority from Congress to establish deposition standards. The current draft fails to fulfill its role in bridging the gap between the relevant scientific, technical, and policy issues. EPA should revise the PA to address public and CASAC comments and turn the information from the review into a Report to Congress as an update of the 1995 Report to Congress on the feasibility of acid deposition standards under Title IV. In addition, nothing is keeping states from working together using regional agreements to address any remaining acid deposition concerns.