Review comments on the Integrated Science Assessment for Oxides of Nitrogen and Sulfur – Environmental Criteria

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I am charged primarily with Question 1, and so my comments are primarily on that question. However, since this Charge Question covers the Executive Summary and a "key findings" section, the review makes reference to other chapters where these materials are found. The specific Charge Question addressed is:

1. We have added an executive summary of the major findings and conclusions to the second draft ISA. We have also created a "key findings" section that is intended to provide highlights of these conclusions. We are seeking CASAC panel advice and comments on these additions to the ISA. To what extent do they provide an appropriate level of detail and convey the important scientific conclusions of the assessment?

The short answer is yes and yes. They provide the appropriate level of detail (with a few caveats noted below) and convey the most important conclusions from other chapters. As I will note below, however, it is less clear where this "key findings" section is located. Given the Charge Question, I had expected to find it in the Executive Summary or listed in the Table of Contents. It is in neither.

In the Executive Summary on Page 1, there is a segue-way needed between gas and deposition effects. The first section ends by saying that the existing NAAQS were set on the basis of direct exposure to gases. Then the next paragraph begins by stating that this document focuses on deposition of NOx and SOx, which will be dominated by the particulate phase. A reader will wonder whether the current document is therefore a supplement to the previous NAAQS, or has changed the focus of concern – and if so, why.

Then in the same area of the document, the authors state that understanding the ecological effects requires considering many reduced forms of N. While I agree with this, the statement does not say "in addition to the oxidized forms", and so the reader

will again be confused, wondering if the NAAQS has changed completely to deposition rather than gas phase, and to reduced rather than oxidized forms. It is simply a problem with the way this sentence is structured, not with the list of forms shown or the intent of the sentence.

In the next paragraph, there is a discussion of the extent of decrease in NOx and SOx. The numbers are correct given data in later chapters, but there needs to be clarity as to what the 35% and 50% figures refer to. Are these mean annual levels measured at monitors; mean levels of exposure (perhaps population-weighted)? Something else? A few words of explanation would resolve this problem.

And then later, the comment is made (correctly) that N deposition has been increased 10 fold over the past century. The problem with this statement is that it seems to contradict the finding that ambient levels have been in fact going down over the past decade. The problem lies, of course, in specifying the different periods of time over which the trends are being discussed. Surely N deposition has been going down as ambient levels have gone down, even if they went up quite a bit more prior to the recent decline. Or, is the difference between the two sections that the first refers specifically to NOx and the latter to all forms of N deposition, with perhaps the reduced forms continuing to go up (I doubt this is the case, but just want to be sure)? If I am confused, the average reader probably will be as well.

I fully support the conclusion on the inadequacy of the current monitoring network for deposition. Some more comment is needed on how that system might be better structured to resolve the specific areas of uncertainty found in the ISA.

I believe the later chapters support the conclusion that “available evidence is sufficient to infer a causal relationship between acidifying deposition at current levels and effects on the following aspects of ecosystem structure and function:
(1) biogeochemistry related to terrestrial and aquatic ecosystems;
(2) biota in terrestrial and aquatic ecosystems.”

As with the previous ISA, however, I remain less convinced that we can quantify this causal relationship sufficiently to determine an ambient concentration that would be

judged to produce an acceptable level of impact, and nothing in the subsequent chapters makes me more comfortable with this task. Surely the ecosystem effects must be treated somewhat like the human health effects, where a change in some measure of health is not in itself evidence of unacceptably high adversity of effect. At some point, the changes noted in ecosystem measures of health do become high enough to consider not just present but adverse, but the ISA is not yet able to establish where that might be in most cases. I suspect this will drive the regulatory process to rely on the primary standards, with the secondary effects providing supporting evidence for the need to further lower ambient levels – even if it cannot specify how far they should be lowered.

With respect to climate change, I disagree with the way the following statement is introduced and phrased: "N deposition often increases primary productivity. This does not necessarily increase C sequestration. C budgets are complicated by numerous factors that influence carbon exchange (e.g. climate)." The problem with the phrase is that in later chapters, the argument is made that nitrogen oxides can contribute to climate change both by being greenhouse gases and by reducing carbon storage in flora. The phrase "This does not necessarily increase C sequestration" is correct, but I would suggest that on average the increase in primary productivity will offset the adverse effects on plant growth. Perhaps I am wrong in this, but the later chapters don't provide any data to suggest the correct answer one way or the other, and so the statement in the Executive Summary strikes me as an off-hand way to disarm a possibility that runs counter to the story being told (that NOx is bad for climate change). A much better scientific analysis is needed in the document to provide any firm conclusions one way or the other, or the impression will be left that the EPA staff have deliberately chosen only some aspects of the N-climate change connection to bolster their case..

I agree completely with the focus on acidification and nitrogen enrichment as the two primary set of effects. There is sufficient evidence in later chapters to infer a causal relationship between current ambient levels in some geographic areas and adverse ecological effects. But I am less convinced by the methyl mercury argument. I don't mean I don't believe the case is made for sulfate leading to methyl mercury, but rather that I don't see sufficient evidence to suggest that current levels of sulfate are causing

methyl mercury concentrations that are of concern. I suppose the argument could be made that any methyl mercury increase is too much given current levels of methyl mercury in the food chain, but this argument isn't made or supported in later chapters.

On the issue of causal relationships, found in Chapter 1, the authors have done a good job of both classifying the causal categories and explaining the criteria for judging causality. As with previous ISAs, however, it is much less clear that any formal framework has been used to determine whether a given body of evidence does or does not satisfy these criteria, or how the criteria are to be balanced when one is satisfied but not another. The result is a purely subjective judgment of the strength of causality. I would agree that all judgments are in the end subjective, but there are judgments where the basis for that subjectivity is reached in a systematic fashion clearly elucidated, and judgments that result from reflection in a way that can't be – or isn't - described. I believe the current ISA falls into the latter group. I suspect, therefore, that different stakeholders would come to different judgments even when faced with the same information. Having said that, I still support the particular judgments of causality made in the ISA even if the document doesn't let me see clearly the thinking that led to them.

The Charge Question also mentions a "key findings" section. I can't locate that anywhere in the document. Is it intended to refer to Chapter 4, which does serve to summarize the results? If that is the case, then I agree that Chapter 4 does provide a proper summary of the earlier chapters. It focuses the reader's attention onto the findings that are most significant in terms of developing a NAAQS, and reports those findings accurately. It organizes the effects much better than the first draft of the ISA, resolving the problems of inconsistent format that I identified in my previous review.

A significant problem I continue to have is that the causal judgments are too generic. The question that seems to be asked is whether there is a causal connection between deposition and effect at some level of deposition, rather than at the levels of deposition that currently exist or might exist under alternative NAAQS. I always take it for granted that any substance will produce adverse effects at some level of exposure, and so I was looking for a bit more policy-relevant judgments of causal

connections in the current document. The levels of deposition at which the causal connection has been established needs to be specified for each effect.

Finally, there is a policy issue I would like to raise. I believe the ISA lays the appropriate groundwork for assessing whether current levels of N and S deposition are protective, and draws the right scientific conclusions on this issue. However, it is necessary to ask whether any continuing effects are due to the need for a lower NAAQS, or from a failure to fully enforce the current NAAQS. I see no discussion of that point, and would expect at least a sentence or two on this important issue. The policy solution is quite different depending on the answer.