Preliminary Comments from Members of the CASAC Oxides of Nitrogen Review Panel on EPA's Integrated Review Plan for the Primary National Ambient Air Quality Standards for Nitrogen Dioxide (External Review Draft)

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Mr. George A. Allen

These comments focus on Chapters 1 and 2 (Introduction and Schedule) and Chapter 6 (Ambient Air Monitoring)

Charge Questions

Overall organization and clarity: To what extent does the Panel find that the draft IRP clearly and appropriately communicates the plan for the current review of the primary NO2 NAAQS and the key scientific and policy issues that will guide the review? To what extent are the decisions made in the last review, including the rationales for those decisions, clearly articulated?

This draft of the IRP is very well organized. The plan for this current review is clearly presented. The history of the NO2 NAAQS and the summary of the decisions and the rationale for them in the last review are clear and concise.

Introduction (Chapter 1) and Schedule (Chapter 2): To what extent does the Panel find that Chapters 1 and 2 clearly communicate the NAAQS legislative requirements, summarize the steps in the review process, summarize the history of the NO2 NAAQS, and present the anticipated schedule for the current review?

These two chapters are well written, and meet the goals noted in this charge question.

Ambient Air Monitoring (Chapter 6): To what extent does Chapter 6 clearly and appropriately communicate, for the purposes of this plan, the key aspects of measurement methods and surveillance network requirements for the NO2 NAAQS?

Section 6.1, Consideration of Sampling and Analysis Methods, provides a clear summary of existing and new methods for measurement of NO2. Of most interest is the recent commercial availability of direct NO2 measurement methods using the cavity attenuated phase shift (CAPS) technique. One commercially available CAPS instrument has an FEM designation, and a second is in the final stages of FEM approval at ORD. These instruments are expected to be a practical alternative (in terms of cost and operational effort) to the traditional CL-moly converter FRM monitor.

This section raises an important question regarding the potential of routine network deployment of CAPS or any other method that only measures NO2 (e.g., does not measure NO). The potential loss of NOx data is of concern, since NOx is often the only widely available exposure surrogate for on-road pollutants. In addition, section 2.6.4.3 of the draft NO2 ISA discusses the development of an “Integrated Mobile Source Indicator” to improve exposure assessment to on-road air pollutants. This “Indicator” uses CO, EC or BC, and NOx as input parameters. The loss of NOx data in routine ambient measurement networks would have a substantial impact on the performance of this indicator approach.

Section 6.2, Consideration of Air Monitoring Network Requirements.

This section is a concise summary of the existing and planned NO2 monitoring networks. The Area-Wide and "susceptible and vulnerable communities" components of the monitoring network required by the 2010 NO2 rule are in place, since existing NO2 monitors met these requirements. Section 6.2 also summarizes the design and requirements of the new near-road network component that has just recently begun to be deployed. This summary covers the number of sites and time line for deployment, but could benefit from additional detail on what other measurements are required at these sites. Some near-road sites require CO and PM2.5 along with (NO and) NO2, and usually have optical black carbon and meteorological measurements also (some have particle number concentration too). These sites generate all the measurement inputs needed for the "Integrated Mobile Source Indicator" approach noted above and in the ISA. Other sites require only NO2 measurements.

Most of the "NO2 only" sites are in the third and final deployment phase, scheduled to be operational by January 2017. One of the near-road network goals is to support research; sites with only NO2 measurements have minimal value in this context.

Section 6.2 ends with a sentence (Pg 6-5, lines 3-5) that suggests the minimum near-road network requirements promulgated in the 2010 rule could be re-evaluated during this review:
"Considering the availability of new near-road NO2 monitoring data, the EPA may be in a position to re-evaluate the analyses underlying the minimum monitoring requirements promulgated in the 2010 revisions in this review."

Since it is unlikely that EPA would increase the minimum requirements, this sentence could be taken to mean that when sufficient data is available, EPA may be able to justify reducing the final near-road network size by reducing or eliminating the third phase of near-road site deployment. This would be consistent with the continued downward trend of primary on-road NO2 emissions due to both new (2010) controls on diesel emissions and the Tier 3 standards for both fuels (lower S gasoline) and automotive emissions controls that go into effect in 2017.

Thus, it is important that EPA commence to conduct analysis of NO2 data from the near-road network as soon as it becomes available (later this or early next year).

Dr. Matthew Campen

Comments on Chapter 4

To what extent does Chapter 4 clearly and adequately describe the scope, specific issues to be considered, and organization of the ISA? Please provide suggestions for any other issues that should be considered.

Literature search – are all search-retrieved documents recorded and rationale for why they are considered/not considered also recorded?

Comment on page 4-8: "In addition, consideration will be given to studies that investigate exposure to oxides of nitrogen separately and in combination with other pollutants such as ozone, PM, and sulfur dioxide."

It is generally understood that ozone and NOx are mutually exclusive. That is, they will react out and thus tend not to co-exist. I would consider just dropping "ozone" from this sentence. Certainly, it is a sentence of hypothetical options, but all the same…

In 4.3.3, at the end regarding in vitro studies, I think a statement to anatomical relevance would be nice to see – that is, we should not be studying direct exposures of NO2 on neurons or endothelial cells. Pretty much lung epithelia and other airway cells.

Comma after NAAQS review, bottom of 4-10 (very long sentence)

Please comment on the adequacy of the expanded discussion in Section 4.4 of issues that will be considered in the ISA related to:
(a) spatial heterogeneity in ambient concentrations of oxides of nitrogen, particularly near- and on-road gradients, and implications for human exposures and

There is strong language related to concerns about inadequacies of central site monitoring and an apparent appreciation for the roadway-associated nature of these exposures. I feel the approach is appropriate.

(b) various factors to consider in the evaluation of health effects associated with ambient NO2 exposure, including traffic, noise, indoor NO2 exposures, and copollutant exposures.

Certainly there are profound covariates to consider, but such is the case with most NAAQS pollutants. NOx should be treated in a consistent manner with other recent ISAs.

Dr. Ronald C. Cohen

Comments on Chapter 6

The Chapter should be more strongly connected to the overview of "Atmospheric science and ambient concentrations" in CH4 pgs 4-11-4-12

The Chapter overemphasizes the question of loss of NO measurements and underemphasizes the benefits of new FEM methods that are specific to NO2.

The substantial positive bias of the FRM NO2 should be explicitly acknowledged on pg 6-1 near line 30

on pg 6-23 lines 1-4 and 6-13

The lack of positive bias from higher oxides of N (PAN, RONO2 and HNO3) should be explicitly mentioned for all three new instruments.

pg 6-2 line 18-20 The tone of the question presumes a negative. It would be more appropriate to ask what the balance between the benefits of having interference free measurements and the costs of losing NO measurements. Also, it would be appropriate to ask whether losing NO measurements is necessary.

pgs 6-3-6-5

some discussion of what concurrent measurements are needed to support isolating exposure effects to NO2 as separate from other traffic related emissions would be pertinent here.

Dr. Philip M. Fine

Comments on Chapter 6

Page 6-1, Line 27
It is stated that the catalytic converter reduces ALL oxidized nitrogen species to NO. It may not be true that all oxidized nitrogen species are reduced, and the ISA discussion on this topic points to varying conversion efficiencies for different species, depending on temperature. The discussions in the two documents should be reconciled.

Dr. Panos Georgopoulos

Comments on Chapter 5

Chapter 5 (Quantitative Risk and Exposure Assessment) of "Integrated Review Plan for the Primary National Ambient Air Quality Standards for Nitrogen Dioxide" focuses on and describes the approach pursued during the prior review of 2008 (Section 5.1, pages 5-2 to 5-11). The consideration of "quantitative assessments for this review" is the subject of Section 5.2 (pages 5-11 to 5-12 and Tables 5-1 and 5-2). Section 5-1 includes a discussion of the uncertainties involved in the approach of the prior review, while Table 5-1, "Information (data, methods, models, etc.) identified as potentially important and/or newly available to inform the air quality characterization for the current review," and Table 5-2, "Information (data, methods, models, etc.) identified as potentially important and/or newly available to inform the exposure assessment for the current review," summarize, in the rightmost column, potential approaches for addressing components of the above uncertainties with this new information. However, it is not clear whether any of the methods for modeling air quality and exposure, which are applicable to oxides of nitrogen, that have evolved since the prior review, are going to be utilized in this context. For example, Özkaynak et al. (2013) summarized the findings of a series of presentations that took place at the International Society of Exposure Science 2011 Conference in Baltimore, MD. Symposium presenters considered a range of "alternative exposure metrics, including: central site or interpolated monitoring data, regional pollution levels predicted using the national scale Community Multiscale Air Quality model (CMAQ) or from measurements combined with local-scale (AERMOD) air quality models, hybrid models that included satellite data, statistically blended modeling and measurement data, concentrations adjusted by home infiltration rates, and population-based human exposure model (Stochastic Human Exposure and Dose Simulation, and Air Pollutants Exposure models) predictions." (See also Özkaynak et al., 2014.) In another study that also used complementary air quality models (Beevers et al., 2013) employed both KCLurban, which gives source apportionment information, and the Community Multi-scale Air Quality model (CMAQ)-urban to characterize NOx and NO_2 and evaluate the performance of the modeling approach. Given the fact that in recent years long-term (annual and multi-year) CMAQ simulations are becoming more commonly available for North America (e.g. Civerolo et al., 2010; Zhang et al., 2009), that can provide hourly estimates of NO and NO_2 concentrations at "background" level (typically 12x12 km resolution), it is strongly recommended that USEPA at least evaluate a hybrid modeling approach that would use a model such as AERMOD to "downscale" CMAQ estimates at point level (near-road, neighborhood, etc.) and use these estimates in conjunction with an exposure model such as APEX. It would also be useful, in such an enterprise, to consider dispersion models alternative to AERMOD, specifically CALPUFF which was used in the study of (Yu & Stuart, 2013), as this model may have more flexibility than AERMOD for applications relevant to the NOx system.

Another issue that should be addressed carefully in the context of exposure characterization is the issue of indoor NOx emissions. The IRP document states on page 5-9 that "… in a limited set of targeted exposure analyses, exposures were also modeled considering indoor source emissions. The characterization of indoor source emissions of NO_2 and estimated air exchange rates used to simulate indoor microenvironments were considered an important uncertainty." However, in footnote number 53

on the same page it is stated that "While potentially important in understanding health effects and the total exposure/health risk from NO_2, exposures resultant from indoor sources of NO_2 have limited relevance in understanding health risk associated with ambient concentrations." This statement should be modified/clarified in the context of the new review as it may be misleading with respect to the significance of indoor NOx sources and exposures. In fact, improving indoor emission inventories of NOx is needed in order to better characterize overall exposure and risk to these air pollutants.

References:

Beevers, S.D., Kitwiroon, N., Williams, M.L., Kelly, F.J., Ross Anderson, H., and Carslaw, D.C. 2013. Air pollution dispersion models for human exposure predictions in London. J Expo Sci Environ Epidemiol 23 (6):647-53. DOI:10.1038/jes.2013.6

Civerolo, K., Hogrefe, C., Zalewsky, E., Hao, W., Sistla, G., Lynn, B., Rosenzweig, C., and Kinney, P.L. 2010. Evaluation of an 18-year CMAQ simulation: Seasonal variations and long-term temporal changes in sulfate and nitrate. Atmospheric Environment 44 (31):3745-3752. DOI:10.1016/j.atmosenv.2010.06.056

Özkaynak, H., Baxter, L.K., Dionisio, K.L., and Burke, J. 2013. Air pollution exposure prediction approaches used in air pollution epidemiology studies. J Expo Sci Environ Epidemiol 23 (6):566-72. DOI:10.1038/jes.2013.15

Özkaynak, H., Isakov, V., Baxter, L., Graham, S., Sarnat, S., Sarnat, J., Mulholland, J., Turpin, B., Rich, D., and Lunden, M. 2014. Evaluating Alternative Exposure Metrics Used for Multipollutant Air Quality and Human Health Studies. In Air Pollution Modeling and its Application XXII, edited by D. G. Steyn, P. J. H. Builtjes and R. M. A. Timmermans: Springer Netherlands.

Yu, H.F., and Stuart, A.L. 2013. Spatiotemporal distributions of ambient oxides of nitrogen, with implications for exposure inequality and urban design. Journal of the Air & Waste Management Association 63 (8):943-955. DOI:Doi 10.1080/10962247.2013.800168

Zhang, Y., Vijayaraghavan, K., Wen, X.-Y., Snell, H.E., and Jacobson, M.Z. 2009. Probing into regional ozone and particulate matter pollution in the United States: 1. A 1 year CMAQ simulation and evaluation using surface and satellite data. Journal of Geophysical Research 114 (D22). DOI:10.1029/2009jd011898

Dr. Jack Harkema

No critical comments for Chapters 3 and 7. The plan is clearly stated with ample thoughtful and appropriate guiding questions for the review. The flow chart is helpful and could come earlier in the Chapter if so desired.

Dr. Tim Larson

General charge questions

Overall organization and clarity:

The February 2014 draft IRP is well organized and clearly written. Overall, the questions posed cover the main issues. Tables 5-1 to 5-3 are especially informative. Along those lines, I have suggested a few additional questions that follow.

Schedule:

One issue not specifically mentioned in this particular section is the timing of the roll-out of the new near road monitoring network relative to the timing of the REA (It is discussed later in the document). We struggled with this issue last time and made decisions based on a limited set of near road measurements in a limited set of cities. A comprehensive data set of both traditional and near road monitoring would greatly enhance the final decisions on the form of the standard. Is there a more detailed roll out plan that optimizes the choice of sites and therefore the relevant monitoring information used in the REA?

Policy Relevant Issues:

(1) The relevant averaging time is an issue given the results of the epidemiology. Will the consequences of such an averaging time(s) be examined?

(2) In the 2008 REA analysis, possible alternative standards were evaluated in part by predictions of the resulting 1-hr on-road concentration estimates. Is this still the plan and, if so, will a uniform gradient be used across all sites to make such predictions?

Risk and Exposure Assessment:

(1) Emphasis on U.S. and Canadian studies would presumably down weight the reported health associations from a number of European studies. Is this also true for the exposure information to help establish near-road gradients?

(2) The 2008 analysis pointed out the importance of on-road exposure estimates. Recent studies (e.g. Hudda et al Atmos. Environ. 59: 578-586, 2012; and Hudda and Fruin ES&T 47(19): 11048-11055, 2013) have shown, not surprisingly, that in-vehicle concentrations relative to those on the roadway are a strong function of the state of the cabin air circulation system (indoor air vs outdoor air setting) when windows are rolled up. Are the APEX model predictions consistent with the models derived from these recent studies?

Policy Assessment and Rulemaking:

The main issue here is again the timing of the near road monitoring network relative to the REA.

Dr. Jeremy Sarnat

Comments on Chapter 4

Generally, I feel that the Science Assessment does an adequate job of describing the most important questions and uncertainties related to NO2 exposure and health. The rewritten section 4.4 is strong, and properly stresses the importance of understanding the near-road environment. Data generated from the new near-road monitoring network should be able to address several key questions including gradients around roadways, associations between specific traffic species and NO2 near traffic sources, and the relationship between noise and NO2 in this microenvironment.

Understanding the specific role of NO2 as either an independent predictor of health response or as a marker for a suite or source of pollution, is adequately recognized within the IRP. I believe statements similar to the following reflect major issues that should be considered in the ISA:

> '*What new information exists regarding oxides of nitrogen measurements in a multipollutant context? To what extent do NO2 measurements serve as surrogates of exposure to other gaseous pollutants (e.g., carbon monoxide, nitrous acid), particle phase pollutants (e.g., ultrafine particles, black carbon, organic carbon, transition metals) generated by traffic or other combustion sources, or a mixture of traffic-related pollutants*?'

As noted in my review of the ISA, there appears to be inconsistency with regard to the particular role of NO2 as a traffic pollution surrogate. A more cohesive message should be developed linking the IRP directives to the ISA message.

Since total exposure to NO2, for many people, occurs while commuting, there should be greater attention paid to characterizing exposures and response occurring within the on-road microenvironment (page 1-9 of ISA mentions this briefly).

Comments on Chapter 5

One approach for strengthening the risk assessment would be to include greater amount of sensitivity analyses of the primary modeled input parameters to enhance the robustness of the findings. Using alternative, realistic C-R functions for the epidemiologic-based human health risk assessments would be useful (Page 5-17). Similarly, for both the air quality and human exposure components to the assessment, conducting formal uncertainty analyses, or presenting propagation of error findings would potentially inform the research and regulatory community on the largest sources of uncertainty.

Dr. Richard Schlesinger

Comments on Chapter 4

p.4-5, lines 33-36. While clearly studies that reduce uncertainty need to be evaluated, this suggests that studies that may show novel results that may add some additional information about health effects that may not be totally consistent with other studies will not be evaluated. The description here needs to be retooled.

p.4-8, lines 23-26. It is not clear what is meant by intake dose. Is that exposure concentration? If not, intake dose is not necessarily available in these studies, so perhaps an additional focus that should be listed here is "exposure concentration."

p.4-14, lines 1-2. NOx is also a direct acting irritant that can produce adverse health outcomes without production of secondary products.

p.4-14, line 18. Replace "internal NO2" with "endogenous NO2"

p.4-14, line 25. Should read, "...can be qualitatively and quantitatively compared...."

p.4-15, line 9 et seq. Many of these bullets are redundant and the list can be made more concise while not losing any of the concerns.

p.4-16, line 16. What is meant by other "disciplines?"

p. 4-15 to 4-17. Almost all of the bullets for short and long term exposures are the same, so the question is whether they need to be listed separately?

p.4-19, line 29. Is it not important to distinguish among risk due to intrinsic, acquired or extrinsic factors in determining relative susceptibility to exposure in different groups?

Dr. Ronald E. Wyzga

I have relatively few comments on the plan as I believe that the devil is in the detailed implementation of the plan. In general it provides a good outline.

Some specific comments:

Comments on Chapter 3

p. 3-16: at the conclusion of the last review, CASAC recommended and EPA implemented a program to undertake monitoring near roadways. My understanding is that results from these monitors are not yet available; however, should there be any discussion about how these data are to be used in interpreting/extrapolating from health studies or in the risk assessment to be undertaken.

Comments on Chapter 4

p. 4-6: ll. 30-31: In the case of NOx it is important to learn whether NOx itself is responsible for the associated health effects or whether NOx is a surrogate for another pollutant. As such it is important that studies address this issue by considering copollutants as well. In particular the co-pollutants that appear to be of greatest interest are PM, CO, EC, and OC.

p. 4-7, ll. 15-27: This is important, but the document needs to address how or what it will do with respect to the exposure error issue. Although it is not the end-all, statistical significance is noteworthy and should be a factor that is noted in presenting study results.

Comments on Chapter 5

p. 5-3, ll. 19-21: This statement needs further elaboration.

p. 5-7, l. 4: My understanding is that AERMOD does not incorporate any chemistry; is there an alternative model that considers chemistry that could be used to replace/supplement AERMOD?