State-of-the Science Review on the Roles of Stationary Source NO_x and PM in Western Regional Haze

A proposal to the
Western Regional Air Partnership (WRAP)
Attn: Lee Alter

From
Armistead G. Russell
Air Pollution Consultant
2809 Northbrook Drive
Atlanta, GA 30340
trussell@ce.gatech.edu

Background

Regional haze in the West is caused primarily by light scattering and light absorption by small particles, or particulate matter, suspended in the atmosphere, though a small fraction of the visibility limitation is due to gases. These particles typically have a complex chemical composition, which can differ among particles and across size ranges. Likewise, they are emitted from a myriad of sources and activities. A fraction is emitted directly (primary particulate matter), while part is formed by gas-to-particle conversions (secondary particulate matter). Effective emission management strategies to improve regional haze requires understanding of the emission sources, secondary particulate matter formation processes, atmospheric fate and transport, and the types of controls available.

Scope of Work

A report, approximately 20 pages in length, will be drafted and finalized after review by the project team. The first half of the report will offer a conceptual model of how stationary source NOx and (primary) PM emissions may contribute to regional haze,

including their physical and chemical transformations and fate at the regional scale. The unique atmospheric chemistry will be reviewed, including not only the transformation of NOx to nitrate, but the role that NOx and NOx byproducts (e.g., ozone) play in the formation of other aerosols, as well as how other chemical species (e.g., VOCs) affect the formation of nitrate.

Significant gaps remain in the scientific understanding of atmospheric aerosols (e.g., the chemical composition of emissions and the formation of secondary organics), and the conceptual model will highlighting these gaps. However, much is known, and the conceptual model will be particularly useful in bridging the gap between emissions, emission controls, and visibility. These relationships are not necessarily obvious when viewing modeling results alone, nor are the models a complete representation of what is known about atmospheric processes, especially for pollutants such as ammonium nitrate, whose absolute concentrations may not be accurately predicted by the model at this time.

One of the challenges of conducting such a study for the WRAP is the large geographical domain, and the very different conditions in parts of that region. For example, aerosols found in areas like San Gorgonio National Monument, downwind of Los Angeles, are found in much greater concentrations and with a different make-up than on the Colorado Plateau. Thus, there will need to be multiple conceptual models, or the conceptual model will have to have the flexibility to describe PM dynamics and response to controls in very different regimes (preferred).

The second half of the report, using the conceptual model as a backdrop, will focus more specifically on the potential effect of stationary source NOx and PM controls in the West. Assistance will be provided in interpreting and appropriately couching the results of WRAP modeling sensitivity runs. Lessons learned from similar exercises will provide a greater framework for interpretation, such as the BRAVO study in Texas and the Southern Appalachians Mountains Initiative, which was an integrated assessment of visibility, ozone, and deposition in the Class I areas of the Southern Appalachians. Also of use will be the recent results from the EPA Supersite program and the on-going

IMPROVE measurements. Finally, the recent NARSTO PM assessment provides a useful source of information and can help position the characteristics of regional haze in the West in terms of other areas in North America.

The second half of the report will also discuss the current scientific basis and uncertainty associated with multipollutant (e.g., NOx, SOx, and PM) and multisector emissions trading. This discussion is required in the SIPs to be submitted by several western states this year.

Finally, an attempt will be made to attend a project meeting in Denver near the end of March. The purpose of the meeting will be to share information with other project participants (i.e., the WRAP Regional Modeling Center and contractor hired to assess control technologies) and to coordinate our efforts such that a cohesive report can be compiled by WRAP staff to address current and long-term SIP requirements.

Schedule and Deliverables

A schedule for the major tasks is provided below. The schedule is shown in terms of the number of weeks following project approval.

1 week – Provide the WRAP with a report outline for immediate comment.
3 weeks – Complete review pertinent studies, including those identified above and those underway by other project participants.
4 weeks – Complete the conceptual model.
6 weeks – Submit a draft report.
Submit a final report (one week after receiving comments on draft).

Budget

My hourly rate for such a project is $100 per hour. It is expected that the above assessment would require approximately 60 hours to complete. After consideration of travel costs to Denver for a half-day meeting, a total budget of $6,500 is proposed.