Technical Review of Visibility Modeling for the Second Round of Regional Haze State Implementation Plans: State of California

By: D. Howard Gebhart, June 2022

Introduction and Background

This report provides a technical review of the visibility modeling and analysis effort conducted by the State of California to aid in development of the second-round regional haze State Implementation Plan (SIP).

Technical documents reviewed included the draft California regional haze SIP[1] and supporting technical appendices.[2]

The modeling and data analysis effort was used to inform the California Air Resource Board (CARB) about the emission sources contributing to visibility impairment at the twenty-nine (29) designated Class I areas within California. Stationary emission sources identified as contributing to visibility impairment were then subject to a review of additional emission control measures that could reduce visibility precursor emissions, known as the "four-factor analysis".

The US Environmental Protection Agency (EPA) has guidance stipulating the minimum requirements for an approvable regional haze SIP[3], EPA indicates that states should select an appropriate threshold for the four-factor analysis that captures "*a meaningful portion of the state's total contribution to visibility impairment at Class I areas*". In the draft California SIP, only a single in-state stationary emission source was identified for the four-factor emissions control analysis. California also limited proposed emissions controls to sources releasing nitrogen oxide (NOx) and did not evaluate the potential benefits of controlling sources of sulfur dioxide (SO_2) emissions.

General Comments

There are several overriding issues with the visibility modeling and data analysis effort conducted in support of the second-round California regional haze SIP, as discussed below.

In order to conform with EPA's regional haze guidance, California needed to identify a sufficient number of existing emission sources to capture a "meaningful portion" of the ongoing visibility impairment. California's Draft regional haze SIP has largely relied upon emission reductions from other regulatory programs, including controls on mobile sources, in its attempt to achieve reasonable progress toward visibility improvement. Under California's plan, additional controls on stationary sources were virtually non-existent given that California identified only one stationary emission source for review of

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[1] DRAFT California Regional Haze Plan for the Second Planning Period; May 13, 2022
[2] DRAFT California Regional Haze Plan for the Second Planning Period; May 13, 2022 - Appendices
[3] Clarifications Regarding Regional Haze State Implementation Plans for the Second Implementation Period, July 8, 2021

emission controls via the "four factor" emissions control analysis. The question is whether California was appropriately inclusive by not relying on additional emission controls at stationary sources, and among that group of stationary sources whether emission controls at a single stationary source was sufficient to identify a "meaningful portion" of the existing visibility impairment.

California has also claimed without adequate justification that other regulatory programs provide emission control benefits at stationary sources that are equal to or greater than the four-factor analysis required under the regional haze regulations. California has cited to its Best Available Retrofit Control Technology (BARCT) program promulgated under the California Clean Air Act (1988), which provides emission reductions for the purpose of combatting non-attainment for ozone and particulate matter pollution. Within the draft California regional haze SIP, forty-two (42) emission sources were initially identified using the emissions-to-distance (Q/D) ratio, and this group was reduced to twenty-five (25) stationary emission sources based on further consideration of "device-level" emission inventories. However, 24 of the 25 stationary emissions sources were later eliminated by California and only a single stationary emission source was carried forth to the four-factor emissions control analysis.[4] The single source reviewed under the four-factor analysis (Collins Pine Company) was in a location where the California BARCT requirements do not apply.

However, California's claim that BARCT is equivalent to the four-factor analysis of the regional haze regulations appears to be only an unsupported assertion. The Draft California regional haze SIP lacks adequate discussion of how BARCT provides stationary source emission control benefits equal to or greater than the four-factor analysis. Lacking a demonstration that the alternative BARCT program is equivalent, California's obligation was to conduct the four-factor emissions control analysis as required under the federal regional haze regulations.

In addition to limiting the four-factor emissions control analysis to a single emission source, California also erred by limiting the analysis of potential emission reductions to only NOx emissions. Anthropogenic visibility impairment from point source emissions is generally attributable to both sulfate (linked to SO_2 emissions) and nitrate (linked to NOx emissions). By ignoring the contribution of SO_2 emissions in the draft regional haze SIP, California has failed to meet the regulatory burden to control a "meaningful portion" of the existing visibility impairment.

California's approach was also improper in that the scope of the emissions control analysis excluded important emissions that also contribute to visibility impairment, especially SO_2 emissions. California asserts that it will capture SO_2 emissions in future planning phases. However, deferring SO_2 emissions controls to future planning phases was improper given that the current SO_2 emissions contribute to a "meaningful portion" of the visibility impairment at one or more Class I areas in California. In order to improve current visibility conditions and meet the national goal to eliminate all anthropogenic visibility impairment before 2064, California's SIP planning effort needed to identify all important contributing sources beyond just the top contributing sources. California would have accomplished this goal if it had simply expanded its analysis to capture a broader grouping of sources, especially larger SO_2 emission sources.

[4] DRAFT California Regional Haze Plan for the Second Planning Period – Appendix G (Stationary Source Screening)

Technical Discussion

Sulfate Extinction is Significant at California's Class I Areas

California attempts to justify its choice to focus only on NOx emission controls in part based on its evaluation of the existing visibility impairment at California's Class I areas. The visibility monitoring data from the Interagency Monitoring of Protection Visual Environments (IMPROVE) presented by California purport to show that the existing light extinction at California's Class I areas is presently dominated by nitrate extinction.[5]

However, while acknowledging that nitrate extinction may exceed sulfate extinction at many of California's Class I areas, the size of the nitrate extinction component does not equate to California's conclusion that sulfate extinction is unimportant. The sulfate extinction is still a significant contributor to visibility impairment and should have been addressed by California in the current planning phase. For example, California's Draft regional haze SIP shows that sulfate extinction is generally in the range of 10-20% of the overall contribution to visibility impairment at California's Class I areas, while at the REDW1 IMPROVE monitor, the sulfate contribution is on the order of 30%[6]. California cannot simply ignore a pollutant causing up to 30% of the visibility impairment at one of its Class I areas and still claim that it is meeting the legal requirement to address a "meaningful portion" of the visibility impairment.

The data in California's draft Regional Haze SIP also show that current SO_2 emissions are expected to increase going forward to the end of the current planning period (2028).[7] Based on the 2028 emission projections in the Draft regional haze SIP, California is one of only two states within the Western Regional Air Partnership (WRAP) that show SO_2 emission increases. Also, California's 2028 SO_2 emissions will rank third among the various WRAP states. California's proposal to defer SO_2 emission controls to future planning periods is misguided, especially given that SO_2 emissions are projected to increase from current levels during the current planning period.

It is also evident from closer review of the supporting data that sulfate extinction plays a greater role than acknowledged by California in its Draft regional haze SIP. The National Park Service (NPS) has presented IMPROVE monitoring data for the period 2015-19 which demonstrates that sulfate extinction on the most-impaired days actually exceeds nitrate extinction at thirteen (13) of the seventeen (17) California IMPROVE monitors.[8]

The above data and analysis lead to the reasonable conclusion that SO_2 emission controls have the potential to be effective at improving visibility conditions at Class I areas across California. However, the Draft California regional haze SIP has failed to consider such controls in the second-round strategies to improve regional haze and as such, California's regional haze program falls short of the legal requirement to address a "meaningful portion" of the ongoing visibility impairment.

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[5] DRAFT California Regional Haze Plan for the Second Planning Period – Appendix C (Description of California's Mandatory Federal Class I Areas)

[6] DRAFT California Regional Haze Plan, Figure 5-5.

[7] National Park Service (NPS) Feedback for the California Air Resources Board, April 11, 2022 - Table 3

[8] National Park Service (NPS) Feedback for the California Air Resources Board, April 11, 2022 - Table 4

WRAP Modeled Sulfate Levels are Biased Low for California Class I Areas

The draft California Regional Haze SIP has relied in part of the visibility modeling efforts conducted by WRAP.[9] WRAP's visibility modeling used the Comprehensive Air Quality Model with Extensions (CAMx) and was conducted by a WRAP contractor (Ramboll).

A very important part of the CAMx modeling effort is the Model Performance Evaluation (MPE) where the modeling results are compared against actual measurements for the important visibility impairment constituents, such as sulfate and nitrate. The MPE provides data on whether the CAMx modeling results for any particular visibility constituent are biased and also indicates the direction and magnitude of any such bias.

For California's Class I areas, the CAMx MPE demonstrates that the modeled sulfate concentrations are biased low for California's non-coastal Class I areas.[10] For example, the Ramboll CAMx July 2020 MPE summary provides time-series chart that documents a consistent and significant sulfate underprediction bias in the CAMx results at the SEQU1 IMROVE monitor.[11] In addition, the Ramboll CAMx MPE summary for the "most-impaired days" shows a significant sulfate underprediction bias for CAMx at both SEQU and AGTI IMPROVE monitors.[12]

The CAMx modeling biases with respect to sulfate underprediction was also noted in technical comments provided by NPS.[13] The NPS review of the CAMx MPE indicated that sulfate concentrations were underestimated by CAMx at six (6) of the eight (8) IMPROVE monitoring sites used to represent visibility conditions at California's Class I areas. At the SEQU1 IMPROVE monitor which represents both Sequoia National Park and Kings Canyon National Park, the sulfate concentrations were underestimated in CAMx by approximately a factor of three.

California should have not relied upon the biased CAMx modeling results as part of the technical basis for excluding consideration of SO_2 emission controls in the Draft regional haze SIP. The CAMx modeling bias leads to an incorrect conclusion that sulfate concentrations are not important contributors to visibility impairment in California. However, the actual sulfate measurements taken at IMPROVE monitors California's Class I areas demonstrate otherwise and indicate that controls on SO_2 emission sources are necessary for California to achieve reasonable progress toward visibility improvement.

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[9] DRAFT California Regional Haze Plan for the Second Planning Period – Appendix F (Modeling Scenarios References)
[10] Summary of WRAP-WAQS 2014v2 CAMx Model Performance Evaluation, Ramboll Updated July 2020
[11] Summary of WRAP-WAQS 2014v2 CAMx Model Performance Evaluation, Ramboll Updated July 2020, Pg 15
[12] Summary of WRAP-WAQS 2014v2 CAMx Model Performance Evaluation, Ramboll Updated July 2020, Pgs 108-109
[13] National Park Service (NPS) Feedback for the California Air Resources Board, April 11, 2022 - Table 5

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EDUCATION

M.S. Meteorology, University of Utah 1979
B.S. Professional Meteorology, Saint Louis University 1976

MEMBERSHIPS

Air & Waste Management Association
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EXPERIENCE SUMMARY

Mr. Gebhart has over 40 years' experience in air quality permitting and compliance specializing in issues technical and regulatory affecting regulated industries. Howard manages the environmental compliance section at ARS, where he provides technical studies and evaluations; and prepares models, client permit applications, air emission calculations, and performs multi-discipline environmental audits. He is very experienced in working with the federal Clean Water Act, Clean Air Act, Resource Conservation and Recovery Act (RCRA), and similar programs.

Howard also acts as an Expert Witness in legal proceedings involving the Clean Air Act and is a recognized technical expert in air dispersion modeling.

PROJECT EXPERIENCE

- Manages the Environmental Compliance Section team.
- Produces and manages quality assurance documents including quality management plans and quality assurance project plans.
- Provides technical studies and evaluations, including air dispersion modeling, permit application preparation, emissions inventories, regulatory analysis/interpretation, and environmental audits.
- Prepares applications for new source permits under federal Prevention of Significant Deterioration (PSD) and state construction and operating permit programs.
- Provides technical studies supporting Environmental Impact Statements (EISs) and Environmental Assessments (EAs) under the National Environmental Policy Act (NEPA).
- Performs air pathway evaluations for releases of hazardous air pollutants from Superfund sites, hazardous waste sites, and incinerators. Models the potential consequences of accidental releases of hazardous materials.

- Performs multi-discipline environmental audits at regulated industrial facilities.
- Manages air quality and environmental permitting studies for biofuel (ethanol and biodiesel), oil & gas exploration and production, mining and minerals, general manufacturing, and a variety of other industries with experience representing both government and private-sector clients.