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October 30, 2018

DELIVERED VIA E-MAIL

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Re: Utah Petroleum Association's Comments on "UPA's Major Stationary Source Precursor Demonstration for NOx, SOx, and NH3 in the Salt Lake City 24-hour PM2.5 Serious Nonattainment Area" and Proposed Rulemaking, Section IX, Control Measures for Area and Point Sources, Part A, Fine Particulate Matter and Amend R307-110-10

The Utah Petroleum Association (UPA) submits the enclosed comments on the "Major Stationary Source Precursor Demonstration for NOx, SOx, VOC, and NH3 in the Salt Lake City 24-hour PM2.5 Serious Nonattainment Area" and on the proposed revision to the Utah State Implementation Plan, Section IX, Control Measures for Area and Point Sources, Part A, Fine Particulate Matter, both proposals published in the Utah State Bulletin.[1]

UPA was founded in 1958 and its members comprise every segment of the petroleum industry in Utah. UPA's members include four companies that own and operate refineries – i.e., Big West Oil LLC, Chevron Products Company, HollyFrontier Woods Cross Refining

[1] Utah State Bulletin, October 01, 2018, Vol. 2018, No. 19, pages 1 and 31, respectively.

LLC, and Tesoro Refining & Marketing Company LLC – that are identified as major stationary sources subject to additional emission limitations and other requirements related to this rulemaking and specifically covered in the separate rulemaking for Part H of the proposed State Implementation Plan (SIP), which is intertwined with the information and conclusions in these proposals.

UPA appreciates the opportunity to provide these comments and appreciates the Utah Air Quality Board's (AQB) decision to seek public comment on the major stationary source precursor demonstration for NOx, SOx, Volatile Organic Compounds (VOC), and ammonia. Furthermore, UPA continues to appreciate the expertise, professionalism, and dialogue that the Utah Division of Air Quality (UDAQ) brings to its work in addressing the causes of nonattainment in the Salt Lake City $PM_{2.5}$ nonattainment area and, particularly, in working with UPA to provide the association with information critical to developing the major stationary source precursor demonstration and critical to forming these comments.

UPA realizes we have taken a different, and perhaps unusual, approach in the degree of effort to develop and the level of detail incorporated into our various comments regarding the $PM_{2.5}$ Serious nonattainment SIP. Our efforts reflect the importance of the SIP and of attaining and maintaining compliance with the standard, both to our quality of life as people who live in the Salt Lake City area and to our business and operations. We sincerely appreciate the support afforded to us by all of the staff and management at UDAQ.

UPA adopts and incorporates as part of these comments those parts of our August 15, 2018, comments that refer to the major stationary source precursor demonstration, specifically the first principal comment in Enclosure No. 1 to our August 15 letter[2] and accompanying attachments including the technical modeling report titled "Major Stationary Source Precursor Demonstration for NOx, SOx, VOC, and NH3 in the Salt Lake City 24-hour $PM_{2.5}$ Serious Nonattainment Area."

I. Executive Summary

We emphasize at the outset that UPA concurs with much of UDAQ's analysis and overall conclusions in support of its proposed attainment demonstration. In fact, UDAQ's work provides the foundation for the additional work that UPA has commissioned in an effort to inform a SIP that will be effective in achieving and maintaining attainment. Additionally, we agree with UDAQ's observations that overall, precursor emissions play a significant role in determining $PM_{2.5}$ levels in the Salt Lake City nonattainment area. Consistently, we also recognize that past steps taken by UDAQ to control precursor emissions – including controls imposed in the existing SIP Part H on major stationary sources – have made meaningful contributions to reducing $PM_{2.5}$ levels to the point where attainment is now projected. We note that our own modeling work shows an approximate 2.5 $\mu g/m^3$

[2] "Utah Petroleum Association's Comments on the Proposed Rulemaking, Revisions to Section IX, Control Measures for Area and Point Sources, Part H, Emissions Limits & Amend R-307-110-17, submitted on August 15, 2018, by Utah Petroleum Association, Jennette King, to Bryce Bird, Director, Utah Division of Air Quality.

reduction in peak episode ambient $PM_{2.5}$ resulting from recent SOx emission reductions at local major stationary sources owned/operated by UPA members.[3]

Importantly, current control efforts including all controls in the *existing* SIP Part H will not be affected by the precursor demonstration; those existing controls should and will remain in place in the event that Utah submits, and EPA approves a precursor demonstration. The precursor demonstration addresses only whether ***additional controls*** on major stationary sources ("additional controls") make sense in view of the fact that major stationary sources are now, and will remain, well-controlled based on existing requirements.[4] In fact, in the Moderate SIP as adopted, UDAQ recognized that existing control levels (adopted through the Moderate SIP process) already meet "best available control" in the following statement:

> In conducting the analysis, UDAQ found that, as a whole, the large stationary sources were already operating with a high degree of emission control. It follows that the percentage of SIP related emissions reductions is not large relative to the overall quantity of emissions. As stated before, many of these sources were required to reduce emissions to address nonattainment issues with SO_2, ozone and PM_{10}. Routine permitting in these areas of nonattainment already includes BACT as an ongoing standard of review, even for minor sources and modifications. In order to find additional emission reductions at these sources, UDAQ identified a level of emission control that goes beyond reasonable, or RACT, **and achieves the best available control**.[5]

UPA acknowledges and appreciates UDAQ's recent response to the Residential Wood Combustion rulemaking petition.[6] We look forward to participating in the stakeholder process that UDAQ recommended in its response.

UPA's comments demonstrate that the major stationary source precursor demonstration for NOx, SOx, VOC, and ammonia is consistent with the State's modeled attainment demonstration and with the proposed SIP. In summary, UPA presents the following comments in support of this conclusion:

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[3] Major Stationary Source Precursor Demonstration for NOx, SOx, VOC, and NH_3 in the Salt Lake City 24-hour $PM_{2.5}$ Serious Nonattainment Area, final report, prepared by Ramboll, August 2018, submitted as part of UPA August 15, 2018, comments as Attachment A.

[4] In addressing the possibility of additional controls pursuant to the current Part H rulemaking, it is important to note that, assuming that BACT is required, it is impossible to know exactly what those controls will be until the SIP is finalized first by the Board and later by EPA. At the time that these comments are being submitted, the proposed controls are subject to being revised pursuant to public and EPA comment or by motion of the Air Quality Board. Following final action by the Board, the rulemaking is subject to judicial challenge by "[a]ny person aggrieved by [the] rule." Utah Code Ann. § 63G-3-602(1)(a). Following completion of the State rulemaking process and submittal to EPA, the proposed BACT is subject to review and approval by EPA. See Clean Air Act § 100(k)(2), (3). Should EPA disagree with the BACT proposed by the State, EPA ultimately has the authority to act unilaterally in imposing SIP conditions including BACT. *See* Clean Air Act § 110(c)(1).

[5] Utah State Implementation Plan, Control Measures for Area and Point Sources, Fine Particulate Matter, $PM_{2.5}$ SIP for the Salt Lake City, UT Nonattainment Area, Section IX. Part A.21, adopted by the Utah Air Quality Board, December 3, 2014, page 55 (emphasis added)

[6] Letter, Bryce C. Bird to Jennette King, October 12, 2018.

- If the model is an appropriate tool for the attainment demonstration, it must necessarily be an appropriate tool for a precursor demonstration. Reliance on the model as a reliable predictor for future year attainment necessarily implies the model's capabilities for purposes of making a precursor demonstration.

- If UDAQ determines not to use the model to determine whether imposing additional controls on major stationary source precursor emissions are necessary, then it must provide some alternative basis for determining that additional controls are, in fact, necessary before it proceeds to adopt such controls.

- Two enhancements to the Rose Park monitoring data would close the gap between the model-predicted 35.9 $\mu g/m^3$ design value for the Rose Park monitor in 2019 and the required maximum predicted design value of 35.4 $\mu g/m^3$:

    1. Promote the discussion of the August 20, 2015, exceptional event for the Rose Park monitor to the principal future year attainment demonstration.

    2. Use a substitution of maximum second and third quarter measured values from the Rose Park monitor to fill in missing Rose Park sample measurements from those quarters, respectively, for the year 2016.

- UPA agrees that the majority of the ambient $PM_{2.5}$ problem in the Salt Lake City nonattainment area results from secondary $PM_{2.5}$ arising from precursor emissions. On the other hand, UPA finds that a substantial portion of the nonattainment area ambient $PM_{2.5}$ arises from direct $PM_{2.5}$ emissions.

- The proposed SIP and its accompanying Technical Support Documents provide numerous statements that the model performs well. UPA agrees.

- Notwithstanding its conclusion that the model performs well, the weight of evidence discussion ("WOE discussion" or "WOE") offered in the attainment demonstration seems to inconsistently and, in several instances, we believe incorrectly, question the model's capabilities. Ramboll, the developers of the CAMx model used for both the attainment demonstration and the major stationary source precursor demonstration, performed an evaluation of the WOE discussion which we include as part of these comments. UPA recommends modifying the WOE discussion in the proposed SIP in accordance with the Ramboll evaluation of it. We highlight two of Ramboll's observations in its evaluation of the WOE:

    1. The model replicates observed conditions well and its response to emission reduction may be considered reliable in view of the models overall performance evaluation.

    2. Model-measurement comparisons suggest that the model may be less NOx-saturated than actual conditions at times, suggesting that in reality, additional NOx controls in the Salt Lake City nonattainment area may be even *less* effective than the model predicts.

- The WOE discussion in the proposed SIP presents no concerns regarding SOx or VOC, and we see no other objection from UDAQ for these portions of the major stationary source precursor demonstration submitted by UPA.

- With major stationary sources providing only small contributions to the total emissions inventories of VOC, NOx, and ammonia, it stands to reason that major stationary source contributions to ambient $PM_{2.5}$ from these emissions would be small or insignificant.

For all of these reasons, we recommend that UDAQ adopt a major stationary source precursor demonstration for NOx, SOx, VOC, and ammonia, and advocate approval of these demonstrations to EPA.

Finally, UPA advocates not finalizing the proposed BACT unless and until EPA makes a final decision to disapprove the precursor demonstration.

II. The administrative record supports adoption of the precursor demonstration and, in turn, rejection of additional controls on major stationary source precursor emissions.

A. Introduction to Legal Comments

Before the Board imposes additional controls under state law, it must conclude, based on the evidence available to it, that those controls are "necessary."[7] In making that determination, UDAQ, and in turn the Board, are accorded discretion in exercising their judgment. But such judgment is not unfettered. The Board's decision must be grounded in "substantial evidence" when viewed in the entirety of the record.[8] Furthermore, basic principles of administrative rulemaking require that an agency must act in a rational and consistent manner when engaging in rulemaking.

As it stands, the record provides a strong basis for Utah making an attainment demonstration for the $PM_{2.5}$ NAAQS. UDAQ deserves credit for marshalling available data and applying state-of-the-art tools in making this demonstration. Importantly, UPA's submission of a precursor demonstration is not offered in the alternative to UDAQ's attainment demonstration; to the contrary, it is consistent with and complimentary to the attainment demonstration. The precursor demonstration builds on the very good work done by UDAQ – relying on the same data and inputs and modeling tool that underpin the attainment demonstration – to show that additional controls on major stationary source precursor emissions will not aid in a measurable or meaningful way towards lowering ambient $PM_{2.5}$ levels.

While UDAQ has appropriately indicated that it intends to conduct its own analysis to definitively confirm the results of the precursor demonstration that Ramboll, the developers of the CAMx model, performed for UPA, the Agency has acknowledged the quantitative reliability of these results.[9] In fact, UDAQ points out that the Ramboll precursor

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[7] Utah Code Ann. § 19-2-109(2)(a) ("The board may establish emission control requirements by rule that ***in its judgment may be necessary*** to prevent, abate, or control air pollution that may be statewide or may vary from area to area, taking into account varying local conditions.") (emphasis added).

[8] *Id.* at § 63G-3-602(4)(a)(ii).

[9] *See* UDAQ Memorandum to the Air Quality Board, from Bill Reiss through Bryce C. Bird Board, *PROPOSE FOR PUBLIC COMMENT: Amend SIP Subsection IX. Part H: Emission Limits and*

demonstration analysis was more conservative than required, noting that EPA's regulation governing such demonstrations "allows for a less conservative, sensitivity based analysis."[10]

Nonetheless, UDAQ has expressed some concern with advocating the precursor demonstration to EPA. UDAQ identifies two potential reservations. First, perhaps the model cannot be relied upon to accurately predict the benefit from further controlling NOx emissions. And second, even accepting that the model is responding correctly and that the benefits from controlling precursor emissions from major stationary sources are "insignificant," there's no more "low-hanging fruit," so Utah is reduced to taking whatever "marginal" reductions it can identify. These will be addressed in turn.

B. If the Model is Considered an Appropriate Tool for Purposes of Supporting an Attainment Demonstration, It Must Necessarily be Considered Appropriate for Purposes of Determining the Necessity of Additional Controls.

1. Summary

UDAQ's attainment demonstration is ultimately a quantitative demonstration. The standard is precisely expressed: 35 $\mu g/m^3$. The inventories are quantified precisely. Meteorological data are gathered. All these data are input into a computer model that uses complex algorithms to predict anticipated $PM_{2.5}$ concentration. Utah has invested hundreds of thousands of dollars in gathering these data and running the model. The model's results are the principal basis supporting the proposed attainment demonstration.

While UDAQ supplements its modeling results with a WOE discussion, the modeling analysis remains the foundation of the attainment demonstration: "Despite the ***heavy reliance of photochemical modeling***, there is other information that may be considered when determining whether attainment may be reached by the attainment date."[11] Consistently, in a memo to the Board, UDAQ explains that the principal modeling demonstration of attainment is "supplemented" by the WOE discussion,[12] again indicating the primary importance that UDAQ places in the quantitative modeling demonstration.

In advocating its attainment demonstration, UDAQ offers an overall positive endorsement of the model's capabilities in predicting $PM_{2.5}$ concentrations: "The model performance replicating the buildup and clear out of $PM_{2.5}$ is good overall."[13] At the same time, however, the Agency questions the "model's sensitivity to NOx controls," suggesting that capability

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Operating Practices. Specifically Proposed for Amendment are Requirements in Subparts H. 1, 2, 11, and 12 (Sept. 24, 2018) (hereinafter, *September Memo to the Board*), Attachment B, Response to H-10, page 6, lines 4-13 ("[UDAQ] would agree that the analysis has been conducted, in accordance with both the PM2.5 Implementation Rule and the EPA's draft Precursor Demonstration Guidance. * * * There are likely some things we would do somewhat differently, but given the conservative nature of the concentration based demonstrations, it appears that the conclusions would probably remain much the same.").

[10] *Id.*

[11] SIP Section IX. Part A.31 § 6.1, Page 51, lines 3-4 (as proposed) (emphasis added).

[12] Memo to Air Quality Board, from Bill Reiss through Bryce C. Bird, August 27, 2018.

[13] SIP Section IX. Part A.31 § 6.1, Page 49, line 1(as proposed). *See also* section III.C. of these comments.

"may be limited." Later in these comments, in Section III.D regarding the WOE, we address the specific concerns raised by UDAQ in this regard.

Here, in the sections that immediately follow, we address the overarching legal and policy implications for the precursor demonstration that result from UDAQ's reliance on modeling as the principal support for the attainment demonstration. In short, if the model is capable of accounting for changes in NOx emissions for purposes of making an attainment demonstration, it necessarily follows that the model – utilizing the same information and analytical tools – is capable of doing so for purposes of making a precursor demonstration and determining whether additional controls are necessary.

2. Results of UDAQ Attainment Demonstration

The proposed SIP provides the following summary table of its modeling results in support of the attainment demonstration:[14]

Monitor ID	Monitor Name	2016 Baseline DV	2017 Milestone FDV	2019 Future DV	2020 Horizon FDV
490030003	Box Elder	31.9	31.9	30.4	29.6
490110004	Bountiful	29.7	29.6	29.3	29.2
490351001	Magna	27.9	27.7	28.0	27.6
490353006	Hawthorne	34.3	34.4	33.8	33.8
490353010	Rose Park	36.3	36.2	35.9	35.6
490570002	Ogden #2	32.4	32.3	32.2	31.9

These results are expressed with precision to the tenth of a microgram per cubic meter. The proposed SIP explains that these results show that the model predicts attainment at "seven of the eight"[15] monitors and no further consideration is necessary for these modeled locations.

For the Rose Park monitor, the proposed SIP offers several reasons to conclude that, while the model predicted concentration (35.9 $\mu g/m^3$) is minimally higher than necessary to show outright attainment (35.4 $\mu g/m^3$), it is ***close enough*** to allow for a conclusion of attainment when considering other supporting information. In other words, even though the demonstration came up 0.5 $\mu g/m^3$ "short," UDAQ believes that attainment is more likely than not.

The proposed SIP offers several technical reasons as to why the model may tend to modestly over predict future $PM_{2.5}$ concentrations.[16] Ultimately, however, the proposed

[14] SIP Section IX. Part A.31 § 6.1, Page 50, Table 6.1 (as proposed).
[15] It appears that this should state, "five of the six" monitors, based on the table.
[16] As discussed later in these comments, we think most of the concerns raised by UDAQ over the model's capabilities can be readily addressed. Furthermore, a conclusion that the model tends to over predict future concentrations actually provides support that additional controls are not necessary. Finally, it is worth noting that UDAQ's own analysis indicates that if an "exceptional event" were properly accounted for, the modeling result would be attainment and no further (WOE)

SIP concludes that any concerns that it might have over the model's capabilities are not sufficient to disqualify it from being used as the principal basis to support an attainment demonstration. In so doing, UDAQ has necessarily endorsed the use of the model for purposes of making a precursor demonstration.

3. The CAMx Model – Whether Used to Make an Attainment Demonstration or a Precursor Demonstration – is Applied in a Functionally Equivalent Manner.

In response to the results of an essentially undisputed modeling analysis for the precursor demonstration[17] conducted by Ramboll, developers of CAMx, UDAQ has raised questions about the model's responsiveness to relatively small NOx emission reductions. UDAQ implies that there may be a difference between the Agency's reliance on the model for purposes of an attainment demonstration, on the one hand, and Ramboll's use of the same model for the precursor demonstration, on the other hand. As explained below, however, while the respective objectives of the two types of demonstrations may differ, the use of the model is either acceptable for both purposes or for neither purpose.

Our point is not that there are no differences between how an attainment demonstration and a precursor demonstration are conducted; in view of their respective objectives there are differences.[18] But such differences are not material differences that implicate the ability of the model to respond to changes in NOx emissions. Both modeling exercises rely on predicting future $PM_{2.5}$ levels based on modifications to the same emission inputs – including NOx.

To the extent there are limitations on the model's sensitivity to NOx emissions in predicting $PM_{2.5}$ concentrations, those limitations exist regardless of whether the model is used for an attainment demonstration or a precursor demonstration. Likewise, if the model produces a result that is "close enough" for purposes of making an attainment demonstration, why shouldn't it likewise be used to assess the necessity of additional controls? Indeed, in the case of the attainment demonstration, the model is used to predict the efficacy of control measures that have been, or are proposed to be, implemented. The precursor demonstration is simply a variation on the attainment demonstration, evaluating an alternative, hypothetical control strategy.

The attainment demonstration, like the precursor demonstration, is predicated on the model being competent to predict $PM_{2.5}$ concentrations given a specific projection of future emissions. UDAQ has made a very good case for relying on the model's predictive

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considerations would be necessary. *See* SIP Section IX. Part A.31 § 6.2, Page 68, lines 6-7 (as proposed).

[17] *See September Memo to the Board*, Attachment B, Response to H-10, page 6, lines 4-13 ("[W]e would agree that the [Ramboll] analysis has been conducted in accordance with both the PM2.5 Implementation Rule and the EPA draft Precursor Demonstration Guidance. * * * There are likely some things we would do somewhat differently, but given the conservative nature of the concentration based demonstrations, it appears that the conclusions would probably remain much the same.").

[18] For example, an attainment demonstration uses model results averaged over high days during the entire modeled episode to relativistically scale observed design values, while a precursor demonstration reports the modeled maximum absolute $PM_{2.5}$ impacts at monitor sites over the episode.

capabilities in making an attainment demonstration, including the model's ability to account for how projected NOx emissions will affect future $PM_{2.5}$ levels. If the model is sufficiently capable of accounting for changes in NOx emissions for purposes of making an attainment demonstration, it necessarily follows that the model is likewise capable of doing so for purposes of making a precursor demonstration. In other words, the model either can or cannot account for the role of NOx in predicting $PM_{2.5}$ levels. The model is either adequate for both purposes or for neither.

4. In Making an Attainment Demonstration, UDAQ has Accepted the Concept of "Insignificance" that Forms the Basis for the Precursor Demonstration.

By concluding that the small difference of 0.5 $\mu g/m^3$ can be considered "insignificant" for purposes of the attainment demonstration, UDAQ is implicitly endorsing the results of the precursor demonstration. This is analogous to the rationale for the precursor demonstration. For example, to pick one precursor, NOx, the model shows that eliminating all NOx ***completely*** from major stationary sources will result in a decrease of 0.4 $\mu g/m^3$ at the Rose Park monitor. This is less than the 0.5 $\mu g/m^3$ that UDAQ determined to be insignificant for purposes of its attainment demonstration and less than one third of the 1.5 $\mu g/m^3$ criterion that EPA established to identify a change so small that it is "in the noise" of measured ambient $PM_{2.5}$.

UDAQ has reasonably concluded that the CAMx modeling results support an attainment demonstration notwithstanding a small, predicted exceedance of the standard in view of the recognized limitations in the ability of the model to ***exactly*** predict concentrations. Of course, all models are limited, but they are the best tools that we have and must necessarily be relied upon by decision makers.

5. In View of the Conclusions Reached in making an Attainment Demonstration, UDAQ Must Act in a Consistent and Rational Manner when Evaluating the Precursor Demonstration

Fundamental principles of administrative law require that an agency act consistently when evaluating information and engaging in rulemaking. Where an agency evaluates technical information and reaches a reasoned conclusion based on information that is in the record, it will be accorded deference even if there are other, alternative conclusions that might be reached based on that same information.[19] However, an agency must act consistently. Once it reaches a specific conclusion, it may not turn around and reach the opposite conclusion based on the same information.[20]

In the current rulemaking, UDAQ has concluded that the CAMx model, despite "potential shortcomings in the model," is sufficiently reliable that it can support an attainment demonstration. It has concluded that a modest over prediction of 0.5 $\mu g/m^3$ is not

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[19] *See, e.g., Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983) (stating that "the agency must examine the relevant data and articulate a satisfactory explanation for its action," but "a court is not to substitute its judgment for that of the agency").

[20] *See, e.g., Skidmore v. Swift & Co.*, 323 U.S. 134, 139–40 (1944) ("The weight of [the Administrator's] judgment in a particular case will depend upon the thoroughness evident in its consideration, the validity of its reasoning, *its consistency with earlier and later pronouncements*, and all those factors which give it power to persuade ....") (emphasis added).

significant enough to defeat an attainment demonstration. UDAQ should not ignore these findings and should act consistently when evaluating the merits of a precursor demonstration.

C. UDAQ must have Some Basis for Determining Whether Additional Controls are Necessary.

As made clear from the preceding discussion, we do not believe there are technical or legal bases for UDAQ to rely on the results of a modeled attainment demonstration, on the one hand, while, at the same time, rejecting a comparable modeled precursor demonstration, on the other. Nonetheless, assuming, for arguments sake, the rejection and absence of a modeled precursor demonstration, there must be some alternative basis for concluding that the proposed additional precursor emission controls for major stationary sources are "necessary" in order to satisfy state rulemaking requirements.[21]

1. A Determination of whether Additional Controls are Necessary Requires a Determination of the Expected Reduction in $PM_{2.5}$ Levels.

Utah law does not specify how the Board is required to go about determining whether additional controls are "necessary." However, in the context of environmental regulation, such determinations are typically based on considerations of costs and benefits. For example, in a recent proposed rulemaking, EPA explains that, "[m]ost statutory provisions require or allow some consideration of cost and benefits when setting pollution standards, but there is variation in terminology and specificity provided in each law regarding the nature and scope of the cost and benefit considerations."[22] Furthermore, when undertaking significant regulatory actions, EPA must conduct an assessment of "benefits and costs expressed in quantitative terms to the extent feasible."[23]

In construing a statute similar to Utah's law governing the Board's rulemaking authority,[24] the United States Supreme Court explained why EPA, when making a determination of whether additional controls on power plants are "appropriate and necessary," must consider costs and benefits: "One would not say that it is even rational, never mind "appropriate," to impose billions of dollars in economic costs in return for a few dollars in ***health or environmental benefits***."[25] While acknowledging that the term "appropriate and necessary" "leaves agencies with flexibility," the Court nonetheless found that "an

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[21] UDAQ has acknowledged the requirement that the Board make an assessment of necessity before imposing additional controls in the current Part H rulemaking. *See September Memo to the Board*.

[22] 83 Fed. Reg. 27524 (June 13, 2018) (proposed rulemaking, *Increasing Consistency and Transparency in Considering Costs and Benefits in the Rulemaking Process*).

[23] *Id.* at 27525.

[24] *Compare* Clean Air Act § 112(n)(1)(A) ("The Administrator shall regulate electric utility steam generating units under this section, if the Administrator finds such regulation is ***appropriate and necessary*** after considering the results of the study required by this subparagraph.") (emphasis added) *with* Utah Code Ann. § 19-2-109(2)(a) ("The board may establish emission control requirements by rule that in its judgment ***may be necessary*** to prevent, abate, or control air pollution that may be statewide or may vary from area to area, taking into account varying local conditions.") (emphasis added).

[25] *Michigan v. EPA*, 576 U.S. at [6-7] (emphasis added).

agency may not entirely fail to consider an important aspect of the problem when deciding whether regulation is appropriate."[26] "[R]easonable regulation ordinarily requires paying attention to the advantages *and* the disadvantages of agency decisions. It also reflects the reality that too much wasteful expenditure devoted to one problem may well mean considerably fewer resources available to deal effectively with other (perhaps more serious) problems."[27]

In the rulemaking at issue in *Michigan v. EPA*, the benefits related to health and environmental benefits. In the case of the Part H rulemaking, the benefits are the ***potential*** reduction in $PM_{2.5}$ levels that might result from additional controls on major stationary source precursor emissions. Hence, in order to determine whether additional controls are necessary, there must be ***some*** assessment of the resultant reductions in $PM_{2.5}$ levels that are expected from imposing such controls.

2. Absent the Ramboll Precursor Demonstration the Rulemaking Record Contains no Consideration of the Expected Reduction in PM2.5 Levels from Imposing Additional Controls.

Our State's air quality problems are sufficiently challenging that decisions on control strategies should be based on the best information available. Using the information and tools that underpin UDAQ's attainment demonstration, UPA has offered a quantitative precursor demonstration prepared by Ramboll that is:

- Consistent with the Clean Air Act;
- Consistent with demonstrations made by other jurisdictions in consultation with EPA;[28] and
- Based on the same modeling tools and inputs that underpin UDAQ's attainment demonstration.

The results of the precursor demonstration show that an insignificant benefit – one that is in the "noise" – will be realized from targeting these sources which are already well-controlled.

In its evaluation of the Ramboll precursor demonstration, UDAQ has reasonably indicated its intention to perform its own precursor demonstration analysis rather than simply relying on Ramboll's precursor demonstration.[29] We are encouraged that the state has committed to completing its own precursor demonstration and urge the state to do so in order to assess the expected reduction in $PM_{2.5}$ levels that might be realized by any

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[26] *Id.* at [6] (internal quotations and brackets omitted).
[27] *Id.* at [7] (internal quotations and citations omitted).
[28] Demonstrations have been or are being developed for as follows: Ohio Environmental Protection Agency for the Cleveland nonattainment area; Alaska Department of Environmental Conservation for the Fairbanks nonattainment area; the Northern Sierra Air Quality Management District for the Plumas County nonattainment area in California; and the San Joaquin Valley Air Quality Management District for the San Joaquin nonattainment area. See UPA comments, Revisions to Section IX, Control Measures for Area and Point Sources, Part H, Emission Limits, Major Stationary Source Precursor Demonstration & BACM for Residential Wood Combustion, submitted August 15, 2018, Enclosure 1, Page 10, for further details.
[29] *September Memo to the Board* ("UDAQ would like to perform the [precursor demonstration] analysis with input and participation from the final arbiter, EPA, rather than accept the conclusions proffered by the commenter.").

additional controls on the diminishing inventory of major stationary source precursor emissions that has resulted from previous emission reduction control requirements.

The importance of this effort cannot be overstated. Absent the Ramboll precursor demonstration, there is ***no*** assessment in the rulemaking record of the benefits expected to result from the proposed additional controls other than an acknowledgement that they "may only produce marginal benefits."[30] UDAQ explains the reason for expecting only marginal benefits from additional control: "It has long been acknowledged that the 'low-hanging fruit' has already been picked."[31] "Considering Utah has previously implemented emissions controls that resulted in large reductions, Utah continues to look at controls that may only produce marginal benefits."[32]

The fact of diminishing returns makes the case for ***more, not less,*** rigor when it comes to assessing the necessity for imposing additional controls on sources that are already well-controlled. At a minimum, we believe that the State is obligated to evaluate the expected reduction in $PM_{2.5}$ levels that might result from imposing additional controls in order to ensure that the Board has adequate information to allow it to make a determination of whether such additional controls are necessary.

D. Timing of Precursor Demonstration Relative to the Part H Rulemaking.

In its response to comments on the Part H rulemaking contained in the October Board package, UDAQ made the very reasonable point that it "would appreciate the opportunity to perform our own analysis, in consultation with the EPA, before approval of any precursor demonstration."[33] At the same time, it expressed the need for the agency to continue with the rulemaking process required to implement BACT in ***the event that such additional controls are ultimately deemed necessary***.[34]

UPA acknowledges that much effort has been undertaken to date in evaluating potential additional BACT control measures in proposed Section IX, Control Measures for Area and Point Sources, Part H, Emission Limits. We also acknowledge the need for all necessary rulemaking to be completed timely. UPA believes that these efforts – UDAQ's completion of its precursor demonstration and continued development of potential BACT – can and should proceed on parallel tracks.

However, a final determination of whether to adopt the proposed Part H additional controls for major point source precursor emissions should wait until a final determination is made on the necessity of additional controls as shown by the precursor demonstration that UDAQ has indicated it is undertaking. Indeed, as discussed above, this is required to

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[30] *September Memo to the Board* ("Considering Utah has previously implemented emissions controls that resulted in large reductions, Utah continues to look at controls that may only produce marginal benefits.").
[31] *September Memo to the Board*, Attachment B, Response to H-10, page 7, line 29.
[32] *September Memo to the Board*.
[33] *September Memo to the Board*, Attachment B, Response to H-10, page 7, lines 41-42.
[34] *September Memo to the Board* ("UDAQ recommends that the Board move forward with the BACM/BACT provisions by approving UDAQ's recommendation in this memorandum. In addition to the procedural reasoning that the SIP is already behind the statutory due date for submittal, 2019 is the attainment year identified in the SIP.")

inform the Agency as to whether such additional controls are necessary. Adopting the major stationary source precursor demonstration would *leave all existing controls in place* and would only preclude adopting *new additional controls that would have an insignificant benefit* to ambient $PM_{2.5}$ concentrations and to achieving and maintaining attainment of the standard. Obviously, adoption of the additional controls would be inconsistent with a final determination that the controls are not necessary.

Accordingly, we request that the Agency not conclude a final rulemaking on the proposed amended Part H until it reaches a conclusion on the the precursor demonstration. To do otherwise would be contrary to the Utah requirement that the Board adopt only those controls determined to be necessary.[35]

E. Summary of Legal Analysis

UDAQ has concluded that the CAMx model provides a sufficiently reliable basis to support an attainment demonstration. It necessarily follows that CAMx model provides a reliable basis for supporting a precursor demonstration and, in turn, a determination of the necessity of additional controls for major stationary source precursor emissions. While we appreciate that UDAQ has committed to undertake an independent precursor demonstration, the rulemaking record, as currently constituted – in particular, the Ramboll precursor demonstration – supports a conclusion that such additional controls would result in an insignificant reduction in $PM_{2.5}$ levels, leading to a conclusion that they are not necessary. A final decision on the Part H rulemaking should be postponed (or done provisionally) pending a final decision on the Agency's to-be-completed precursor demonstration.

III. The major stationary source precursor demonstration for NOx, SOx, VOC, and ammonia submitted by UPA is compatible with the attainment demonstration.

A. Introduction to Technical Comments

The major stationary source precursor demonstration for NOx, SOx, VOC, and ammonia submitted by UPA is compatible with the attainment demonstration.

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[35] While we believe that a final decision on Part H should wait until UDAQ completes its precursor demonstration, should the Board nonetheless decide to take final action on Part H prior to that time, it should do so provisionally, making Part H effective contingent upon the outcome of a final decision on the precursor demonstration. The Agency could follow an approach similar to that taken when the Board provisionally adopted an alternative offset requirement as part of the PM_{10} SIP rulemaking. In adopting an alternative, more stringent PM_{10} offsetting provision, the Board included a "transition provision" that provided that, "[the new] rule will become effective … on the day that the EPA redesignates the county to attainment for PM_{10}. The [existing] PM_{10} nonattainment area offset provisions in R307-403 will continue to apply until the EPA redesignates each county to attainment for PM_{10}." *See* R307-421-5. For Part H, a similar transition provision could be used to make additional controls contingent upon final action taken on the precursor demonstration by the Board and, in turn, EPA (should the Board submit a precursor demonstration to EPA for approval).

The proposed SIP,[36] BACT response to comments,[37] and the Utah State Bulletin[38] all state that $PM_{2.5}$ in the Salt Lake City nonattainment area results from secondary $PM_{2.5}$ from precursor emissions and not from "primary" [direct] emissions. However, both the $PM_{2.5}$ analytical data during inversions, measured at the Hawthorne monitor[39], and results from the modeling show that Salt Lake City nonattainment area $PM_{2.5}$ originates from both precursor and direct $PM_{2.5}$ emissions. We discuss the direct $PM_{2.5}$ emissions contribution to the Salt Lake City nonattainment area $PM_{2.5}$ and the evidence for it in Section IV.B below.

The proposed SIP includes 2010 to 2011 data for the pie chart showing the relative amounts of $PM_{2.5}$ from various chemical constituents during winter inversion episodes[40]. The 2010/2011 pie chart shows 19% organic mass (of which the majority is direct, not secondary from precursor emissions), plus additional 3% crustal and 3% elemental carbon, in other words, up to 25% direct $PM_{2.5}$.

This demonstrates that a substantial portion of Salt Lake City nonattainment area ambient $PM_{2.5}$ during winter inversions results from direct $PM_{2.5}$ emissions, in addition to the larger contribution of secondary $PM_{2.5}$ from precursor emissions.

A determination that a substantial portion of the Salt Lake City nonattainment area $PM_{2.5}$ originates from precursor emissions is not incompatible with the results of the *major stationary source* precursor demonstration submitted by UPA showing that the precursor emissions from *major stationary sources* in the area do not contribute *significantly* to $PM_{2.5}$ formation. Both can be true. This is because the major stationary source emissions inventories comprise a relatively small portion of the total inventories of precursors. Based on the 2019 emissions inventory information in the proposed SIP[41], we note the following:

- Major stationary sources comprise 3% of the ammonia inventory. Major stationary sources are well-monitored and well-controlled, and thus this portion of the ammonia inventory is separate and distinct from the majority remainder of the ammonia inventory that is not well-understood.
- Major stationary sources comprise 7% of the volatile organic compound (VOC) inventory.
- Major stationary sources comprise approximately 9% of the total NOx inventory. We developed this estimate after subtracting certain nonroad tailpipe emissions which appear to be inappropriately categorized in the emissions inventory in the proposed SIP.[42]

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[36] SIP Section IX. Part A.31 § 3.6, page 20, Line 25 (as proposed).
[37] Memo to the Air Quality Board from Bill Reiss through Bryce C. Bird, September 24, 2018, Attachment B, Response to Comments Received During the Previous SIP Subsection IX. Part H Comment Period, Page 7, Line 34.
[38] Utah State Bulletin, October 1, 2018, Vol. 2018, No. 19, page 1.
[39] SIP Section IX. Part A.31 § 3.6 "Composition of Fine Particle Pollution – Speciated Monitoring Data", Page 21, Line 4 (as proposed).
[40] SIP Section IX, Part A.31 § 3.6, page 21, Line 4 (as proposed).
[41] SIP Section IX. Part A.31 § 4.3, Page 27, Line 7 and Page 28, Line 7 (as proposed).
[42] "The term 'stationary source' means generally any source of an air pollutant **except those emissions resulting directly from an internal combustion engine for transportation**

In other words, emissions from major stationary sources comprise less than 10% of the nonattainment area emissions inventories for each of ammonia, VOC, and NOx.

While the 2019 inventory for SOx emissions from major stationary sources still comprises 80% of the SOx inventory, recent large major stationary source emission reductions of SOx have resulted in a much smaller inventory of SOx emissions available for control and correspondingly diminished returns from additional controls on stationary source SOx emissions. The model estimates that recent SOx reductions from Utah petroleum refiners resulted in approximately 2.5 $\mu g/m^3$ reductions at the Hawthorne and Rose Park monitors.[43]

The relatively small contributions of major stationary source precursor emissions are consistent with the major stationary source precursor demonstration.

The proposed SIP includes a supplemental WOE discussion to justify attainment despite the model falling just short of predicting attainment, predicting 35.9 $\mu g/m^3$. Ramboll, who are the developers of the CAMx model used by UDAQ, identified specific concerns with aspects of the WOE discussion, including inaccurate assumptions and erroneous statements, summarized below in Section III.D regarding the WOE and detailed in the Ramboll evaluation report included in these comments as Attachment A. Importantly, Ramboll observations note that the model replicates observed conditions well and its response to emission reduction may be considered reliable in view of the models overall performance evaluation.

UPA recommends modifying the WOE discussion in the proposed SIP to address the evaluation of it provided by Ramboll as part of these comments.

Nonetheless, as detailed below in Section III.B.1 of these comments, two simple, quantitative changes in the handling of the Rose Park monitoring data support the attainment demonstration more than adequately.

UPA concludes that the major stationary source precursor demonstration for NOx, SOx, VOC, and ammonia submitted by UPA is compatible with the attainment demonstration. UPA further recommends that UDAQ adopt a major stationary source precursor demonstration for NOx, SOx, VOC, and ammonia, and advocate approval to EPA.

As noted, the following sections provide more detailed discussions of some of the key points in this technical summary.

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purposes or from a nonroad engine or nonroad vehicle as defined in section 7550 of this title." CAA § 302(z) [emphasis added]

[43] "Major Stationary Source Precursor Demonstration for NOx, SOx, VOC, and NH_3 in the Salt Lake City 24-hour $PM_{2.5}$ Serious Nonattainment Area, final report, prepared by Ramboll, August 2018, submitted as part of UPA August 15, 2018, comments as Attachment A.

B. UPA Recommends Making Two Enhancements to the Monitoring Data that Provide the Basis for the Attainment Demonstration.

1. Promote the August 20, 2015 exceptional event for the Rose Park monitor to the main attainment demonstration.

The modeled attainment test for the Rose Park monitor falls just short of attainment, predicting a 2019 future year design value of 35.9 $\mu g/m^3$, as shown in Table 6.1 of the proposed SIP[44]. In order to further support attainment in 2019, the proposed SIP relies on a WOE discussion, presented in section 6.2[45]. The WOE suggests the model does not accurately predict the impact of controls. However, as noted above and as discussed below in further detail in Section III.D of these comments regarding the WOE and the attached Ramboll WOE evaluation report, the WOE overstates any inherent shortfalls of the model and its response to controls.

On the other hand, the August 20, 2015 exceptional event provides substantial and sufficient evidence to predict attainment in 2019. The Supplemental Analyses section of the proposed SIP[46] discusses this event, the evidence for it, and the impact on the attainment demonstration. UDAQ documented the event in an exceptional event demonstration that included several other Utah monitors.[47] UPA understands that the demonstration does not include the Rose Park monitor because the monitor did not exceed the level of the standard on that date. The Supplemental Analysis notes that "smoke from wildfires filled all of Northern Utah". The exceptional event demonstration illustrates this with smoke maps shown; see **Figure 1. Smoke Map for August 20, 2015, from the Demonstration for August 2015 for Western Wildfires Exceptional Events**. Clearly, the Rose Park monitor had wildfire smoke impacts on August 20, 2015.

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[44] SIP Section IX. Part A.31 § 6.1, "Modeled Attainment Test", Page 50, Line 1 (as proposed).
[45] SIP Section IX. Part A.31 § 6.2, "Weight of Evidence", Starting on Page 51, Line 1 (as proposed).
[46] SIP Section IX. Part A.31 § 6.2, "Supplemental Analyses", Starting on Page 67, Line 1 (as proposed).
[47] Utah Division of Air Quality, Smoke from August 2015 Western Wildfires Exceptional Events, https://deq.utah.gov/legacy/programs/air-quality/exceptional-events/docs/2015/12dec/August2015report.pdf, Page 12 (accessed on October 19, 2019).

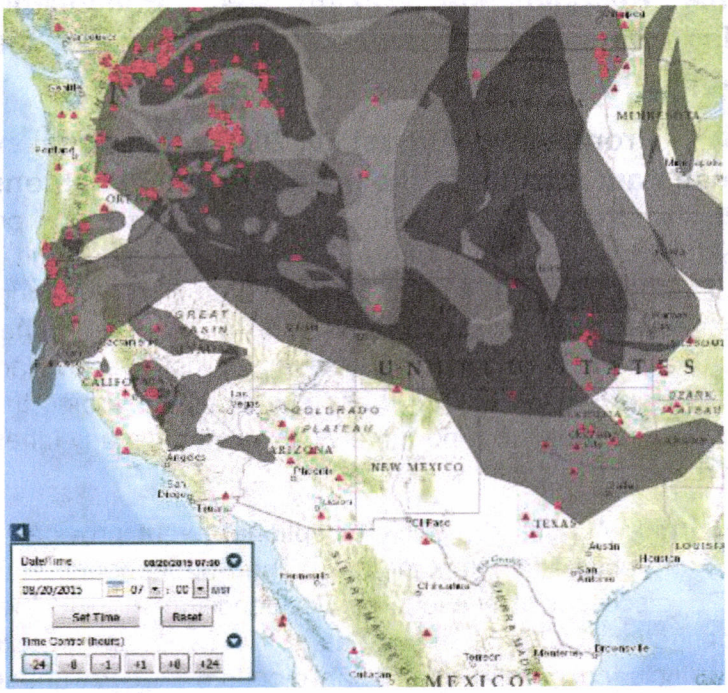

Figure 1. Smoke Map for August 20, 2015, from the Demonstration for August 2015 for Western Wildfires Exceptional Events

Even though the Rose Park monitor did not exceed the level of the standard on that date, the monitor result from that date could have been addressed in the formal exceptional event demonstration, as explained below. Furthermore, as evidence of future year attainment, the event for the Rose Park monitor can be addressed in the principle attainment demonstration for the SIP Part A. As the 8th high value and the 98th percentile value for the year 2015 at the Rose Park monitor, the event contributes to an exceedance of the NAAQS. EPA allows events that do not exceed the level of the NAAQS but contribute to an exceedance to be flagged as exceptional events and EPA guidance states they may approve such events.

EPA provided the following example in the preamble to the 2016 rule:

> [I]f an event were demonstrated to have caused **a 24-hour concentration** of SO2 **to exceed the level of the annual SO2 NAAQS**, the air agency and the EPA would consider this to be a demonstration that the event causes an 'exceedance or violation' **with respect to the 24-hour NAAQS and the annual NAAQS**. This would avoid the need to determine if the 1-day effect of the event was enough to cause the annual average concentration of SO2 to exceed the level of the annual SO2 NAAQS. **It would also allow the data from a day to be excluded from calculation of the design value for the 24-hour SO2 NAAQS even if the event did not cause an exceedance of the level of the 24-hour SO2 NAAQS.**[48] [emphasis added]

[48] 81 FR at 68260/3.

EPA further elaborated on approving flags for exceptional events that do not exceed the level of the standard in their response to question A.9. in the September 2018 update to the Frequently Asked Questions (FAQs) for the 2016 Exceptional Events Rule[49]:

> **Question.** "When is it appropriate for air agencies to flag concentration values that are equal to or less than the level of the relevant NAAQS? Under what circumstances will the EPA concur on such flags?"
>
> **Answer**: AQS currently allows an air agency to flag any measured concentration values it chooses, including values at or below the level of the relevant NAAQS. With respect to the circumstances when the EPA may concur on a flagged value below the level of a NAAQS, we offer the following clarifications:
>
> Clean Air Act section 319(b) and the definition of an exceptional event in the 2016 Exceptional Events Rule state that the event affected air quality in such a way that there exists a clear causal relationship between the specific event and the monitored exceedance or violation. The 2016 Exceptional Events Rule preamble states that "**the concentration values used in calculating a violating 3-year design value could be considered for exclusion under the Exceptional Events Rule only if the concentration** itself is an exceedance or **results in a violating design value**. If the elevated concentration is not itself an exceedance nor does it result in a violating design value, then the value in question could not be considered as an exceptional event."
>
> The EPA also finalized rule language that will allow an air agency to compare a 24-hour concentration of any NAAQS pollutant to the NAAQS for the same pollutant with a longer averaging period as part of a weight-of-evidence showing for the clear causal relationship with respect to the NAAQS with the longer period. Applying this rule revision to PM2.5 will allow an air agency to compare a 24-hour averaging period for PM2.5 that is greater than the relevant 12 or 15 µg/m3 annual PM2.5 NAAQS to either the 24-hour PM2.5 NAAQS (i.e., 35 µg/m3) or the relevant annual NAAQS (provided the air agency specifically requests exclusion for both NAAQS and assuming there is regulatory significance for both standards). For example, an agency could request to exclude a concentration of 32 µg/m3, which when excluded from the calculated 3-year average, could result in a 98th percentile value for the year of 29 µg/m3. When 29 µg/m3 is averaged with the 98th percentile value for the other two years, the resulting design value attains the 24-hour standard. [emphasis added]

As simple and quantitative evidence, this exceptional event provides the strongest evidence available for the future year 2019 attainment demonstration despite the model prediction shortfall. Even though EPA can approve the flag, as noted in the preamble and in the FAQ update, the Rose Park monitor does not need to be added into the demonstration for that date and it does not need to be submitted to EPA for approval. As part of showing future year attainment, the event does not need to adhere to the strict requirements of the exceptional events rule that would be required when calculating a

[49] https://www.epa.gov/sites/production/files/2018-09/documents/updated_faqs_for_exceptional_events_final_september_2018.pdf, Page 12, (accessed on October 19, 2018).

design value from historic data to determine whether the area attained the standard in the past.

Table 6.2 of the proposed SIP shows the impact of excluding Rose Park monitor data from August 20, 2015, on the future year attainment prediction, lowering the prediction from 35.9 µg/m^3 to 35.2 µg/m^3, **thus predicting attainment:**[50]

Rose Park Monitor	98th Percentile Values (µg/m3)			2016 Baseline DV	2019 Future DV
	2015	2016	2017		
As presented in Table 6.1	33.3	43.2	32.4	36.3	35.9
Excluding data from 8/20/15	**31.2**	43.2	32.4	35.6	**35.2**

UPA recommends that UDAQ elevate the August 20, 2015, exceptional event at the Rose Park monitor to the principal attainment demonstration of the SIP Part A.

2. Substitute maximum second and third quarter measured values from the Rose Park monitor for missing data points from those two quarters, respectively, for the year 2016.

In addition, substituting the high values measured in the second and third quarters (excluding exceptional events) for the missing data from those two quarters, respectively, in 2016 ("Q2/Q3 substitution" or "substitution") at the Rose Park monitor can further strengthen the attainment demonstration. Except for exceptional events (e.g., wildfires, fireworks, and windblown dust), high $PM_{2.5}$ values do not occur in the Salt Lake City nonattainment area in the second and third quarter of the year, as shown in the following **Figure 2. Pareto Charts of Second and Third Quarter Measured 24-hour $PM_{2.5}$ Values at the Rose Park Monitor for the Years 2013 through 2017.**

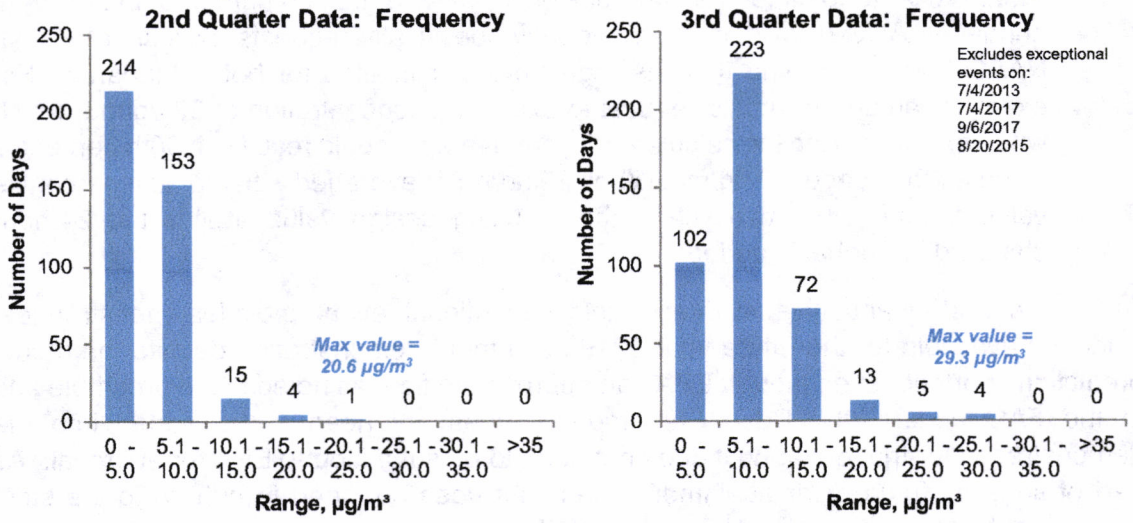

Figure 2. Pareto Charts of Second and Third Quarter Measured 24-hour $PM_{2.5}$ Values at the Rose Park Monitor for the Years 2013 through 2017

[50] SIP Section IX. Part A.31 § 6.2, "Supplemental Analyses", Page 67, Line 30 (as proposed).

These graphs provide clear evidence that measured values on the missing data dates in the second and third quarters, if they existed, would not exceed the level of the standard.

The Rose Park monitor has 43 missing samples for the year 2016. The Q2/Q3 substitution increases the number of creditable sample points for the year 2016 from 323 to 355. Thus, the substitution changes the 98th percentile value from the 7th high to 8th high measured value for the year and lowers the 98th percentile value to 40.7 µg/m^3 from 43.2 µg/m^3. This has a net effect of lowering the 2016 3-year design value by an additional 0.8 µg/m^3, and it will further lower the predicted 2019 future year design value accordingly:

Rose Park Monitor	98th Percentile Values (µg/m^3)			2016 Baseline DV	2019 Future DV
	2015	2016	2017		
Excluding data from 8/20/2015[51]	31.2	43.2	32.4	35.6	35.2
With 2016 Q2/Q3 Substitution Added	31.2	40.7	32.4	34.8	Not Determined

Similar to the August 20, 2015 exceptional event, this substitution provides further simple and quantifiable evidence of attainment for the future year attainment demonstration. EPA regulations allow this substitution for years with less than 75% data capture[52] when using the substitution to calculate the design value from historical data. However, as information for the predicting future year attainment, the regulatory 75% data capture maximum criteria would not apply.

UPA recommends substituting the maximum measured values for the second and third quarters of 2016 for missing data from those quarters at the Rose Park monitor, and using this substitution in the principal attainment demonstration.

UPA compliments UDAQ for resolving the fundamental issues that caused missing and invalid data historically at the Rose Park monitor by installing redundant monitoring capabilities at that monitor.

C. The proposed SIP and the Technical Support Document Provide an Apparent Contradiction in Both Defending and Calling into Question the Model's Capabilities. What is the Level of Support for the Model?

The proposed SIP and the Technical Support Documents (TSDs) provide an apparent contradiction in both defending and questioning the model's capabilities.

[51] As presented in SIP Section IX. Part A.31 § 6.2, "Supplemental Analyses", Page 67, Line 30 (as proposed).
[52] 40 CFR Part 50, Appendix N.

The model provides the best tool available to predict attainment. Without the model, there would be no way to test and validate control strategies. As discussed above, the model provides the quantitative basis for UDAQ's proposed demonstration of attainment.

The Episode Selection TSD describes the model episode selection process and selection of the 2010-2011 episode because the model performed the best for this episode. The TSD attributes the better agreement to calibration of the meteorological inputs from the WRF model:

> "When we visually examine $PM_{2.5}$ model performance for all three episodes, it's clear that CAMx performed best when we used the January, 2011 WRF output.[53] This is not too surprising since the University of Utah worked on calibrating the WRF [meteorological] model specifically to January, 2011 meteorological conditions. The University of Utah worked specifically on improving WRF performance for January, 2011 because this specific period coincided with the Persistent Cold Air Pool Study (PCAPS), an exhaustive field campaign focused exclusively on the Salt Lake Valley."[54]

The introduction to the TSD for model performance evaluation states that the model performance evaluation was conducted "to demonstrate that the model can reliably predict the change in pollution levels in response to changes in emissions." The modeling protocol also states that the model performance evaluation will include sensitivity to emission changes.[55] However, the model performance evaluation does not present this demonstration. By not completing this demonstration, a conclusion regarding the model reliably responding to future changes in emissions cannot be made.

Throughout the model performance evaluation discussion[56], the proposed SIP indicates the model performs well:

- "The gradual increase in $PM_{2.5}$ concentration and its transition back to low levels are generally well reproduced by the model."[57]
- "The model performance for particulate nitrate (NO_3), which is the major $PM_{2.5}$ component, was good . . ."[58]

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[53] The WRF model provides meteorological input data to the CAMx photochemical model used to predict ambient $PM_{2.5}$ concentrations.

[54] Technical Support Document for Episode Selection for the proposed SIP, https://documents.deq.utah.gov/air-quality/pm25-serious-sip/DAQ-2018-013366.pdf, page 8 (accessed on October 21, 2018).

[55] "Photochemical Modeling Protocol, Photochemical Modeling for Utah's 24-hour PM2.5 State Implementation Plans", prepared by Utah Division of Air Quality, prepared for United States Environmental Protection Agency Region VIII, June 12, 2017, Page 41.

[56] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Starting on page 44, Line 9 (as proposed).

[57] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 45, Line 6 (as proposed).

[58] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 46, Line 3 (as proposed).

- "Modeled and observed nitrate concentrations were also comparable . . ."[59]
- "The model performance for particulate sulfate was also reasonably good . . ."[60]
- "Conversely, the model performance for organic carbon was quite good for January 7 . . ."[61]
- "A comparison of measured and modeled ammonia shows that modeled ammonia at Hawthorne and Neil Armstrong Academy is well within the range observed in 2016."[62]

UPA agrees that the model performs well.

Throughout the model performance evaluation discussion in the proposed SIP, the discussion provides only a modicum of suggestion that in a few certain areas, the model underperformed:[63]

- "The model was . . . biased low for ammonium . . ."
- "The model . . . overestimated [elemental carbon] . . ."
- "Crustal material was also overestimated . . ."

Ammonia injection into the model addressed the low bias for ammonium. We note that two of these areas, elemental carbon and crustal material, comprise only a combined 3.5% of the chemical composition measured at the Hawthorne monitor during the peak day (January 7, 2011) of the episode, according to the proposed SIP.[64] On scrutiny, these limitations do not play a major role. Therefore, overall, the model performed very well.

The discussion in the proposed SIP has the following paragraph supporting the model performance overall in its conclusion[65], a paragraph copied verbatim from the concluding paragraph of the TSD for the model performance evaluation[66]:

> **The model performance replicating the buildup and clear out of $PM_{2.5}$ is good overall. The model captures well the temporal variation in $PM_{2.5}$.** The gradual increase in $PM_{2.5}$ concentration and its transition back to low levels are generally

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[59] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 46, Line 5 (as proposed).
[60] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 46, Line 6 (as proposed).
[61] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 46, Line 12 (as proposed).
[62] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 48, Line 11 (as proposed).
[63] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 46, Lines 9, 13, and 15 (as proposed).
[64] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 47, Line 1, Figure 6.7 (a) and (b) (as proposed).
[65] SIP Section IX. Part A.31 § 6.1, "Photochemical Model Performance Evaluation", Page 49, Line 1 (as proposed).
[66] Model Performance Evaluation portion of the Technical Support Document for the proposed SIP, Page 22, https://documents.deq.utah.gov/air-quality/pm25-serious-sip/DAQ-2018-013367.pdf (accessed on October 21, 2018).

well reproduced by the model. The model also predicts reasonably well $PM_{2.5}$ concentration on peak days. It also overall replicates well the composition of $PM_{2.5}$ on exceedance days, with good model performance for secondary nitrate and ammonium which account for over 50% of $PM_{2.5}$ mass. Simulated ammonia concentrations are also within the range of those observed, **further indicating that the model overall performs well.** [Emphasis added]

The model provides the basis for the attainment demonstration, and these statements provide clear support for the model. We concur with this assessment. Additionally, we believe it is contrary to and inconsistent with portions of the WOE discussion that calls into question the model capabilities.

The proposed SIP and its accompanying TSDs show UDAQ's strong support for the model and its output.

D. The Proposed SIP Includes a WOE Discussion, Part of Which Purports to Explain Why the Agency Believes the Model Does not Respond Well to NOx Controls. We Recommend Modifying the WOE Discussion in Accordance with an Evaluation of it Performed by Ramboll.

The proposed SIP includes a WOE discussion, part of which purports to explain why the agency believes the model does not respond well to NOx controls. The WOE emphasizes potential concerns regarding the ability of the model to predict ambient changes in $PM_{2.5}$ levels resulting from reductions in NOx emissions. Significantly, the WOE and the proposed SIP do not identify concerns with the model's capabilities with respect to VOC and SOx precursors.

Accordingly, and at a minimum, UPA recommends that UDAQ advocate for a major stationary source precursor demonstration for VOC and SOx precursors. And, considering the very small contribution of major stationary source ammonia emissions to the ammonia inventory (discussed above), UPA recommends that UDAQ advocate for a major stationary source precursor demonstration for ammonia in addition to VOC and SOx precursors.

UPA retained Ramboll, the developers of the CAMx model, to evaluate the WOE discussion in the proposed SIP[67]. The Ramboll evaluation report entitled, "Comments on Serious Area $PM_{2.5}$ State Implementation Plan for the Salt Lake City, UT Nonattainment Area: Section IX. Part A.31. Control Measures for Area and Point Sources, Fine Particulate Matter; Chapter 6, Attainment Demonstration; and Section 6.2, Weight of Evidence", included as part of these comments as Attachment A, provides additional discussion for the following points:

- The WOE offers insufficient evidence that the model's response is inconsistent with observed conditions and trends to support the hypothesis that the model does not respond appropriately to emission reductions due in part to model uncertainty associated with PM-forming chemical interactions.

[67] SIP Section IX. Part A.31 § 6.2, "Weight of Evidence", Starting on Page 51, Line 1 (as proposed).

- A calculation based on emission inventories and design values for the Salt Lake City nonattainment area suggests that model-estimated 2019 design value projections are consistent with observed trends in $PM_{2.5}$ concentrations and precursor emissions.

- The actual chemical environment appears to be influenced by the lack of oxidants relative to the abundant availability of NOx (an oxidant-limited condition). The model replicates observed conditions well and its response to emission reduction may be considered reliable in view of the models overall performance evaluation.

- Statements in the WOE about nitryl chloride chemistry are incorrect. The version of the model used by UDAQ does in fact include the formation of $ClNO_2$ and nitric acid (HNO_3) via heterogeneous nighttime reactions among hydrochloric acid (HCl) and dinitrogen pentoxide (N_2O_5), and the daytime photolysis of $CLNO_2$ generating nitrogen dioxide (NO_2) and chlorine radicals.

- Model-measurement comparisons suggest that the model may be less NOx-saturated than actual conditions at times, suggesting that in reality, NOx controls in the Salt Lake City nonattainment area may be even *less* effective than the model predicts.

- Given the WOE emphasis on ammonia uncertainty, the analysis needs a quantitative analysis of how the modeled nitrate reacts to the ad hoc ammonia "injection", an investigation into the effects of ammonia uncertainty on particulate matter formation, and quantification to provide context for the attainment demonstration results.

- Crustal matter is not inert. Over-predictions of crustal matter can affect the total nitrate budget and may slightly increase particulate nitrate reduction from NOx controls.

Based on the discussion in the Ramboll evaluation report, UPA recommends revising the WOE discussion in the proposed SIP accordingly.

IV. The Utah State Bulletin public notice for the precursor demonstration poses concerns to which UPA provides responses.

The Utah State Bulletin public notice for the major stationary source precursor demonstration includes several statements, including concerns, expressed by UDAQ with the precursor demonstration. The following provides UPA's responses to each statement.

A. UDAQ Should Perform its Own Analysis

Statement in Utah State Bulletin: "UDAQ feels it is prudent to perform our own analysis in consultation with its EPA partners instead of accepting the conclusions proffered by the commenter. UDAQ can then determine if controlling precursor emissions from major stationary sources is appropriate in the [Salt Lake City nonattainment area]."

Response to Statement: UPA agrees that UDAQ should perform its own major stationary source precursor demonstration analysis in conjunction with EPA.

B. Composition of $PM_{2.5}$

Statement in Utah State Bulletin: "Ambient $PM_{2.5}$ in the [Salt Lake City nonattainment area] airshed is largely composed of secondary $PM_{2.5}$ formed by precursors, not primary [direct] $PM_{2.5}$."

Response to Statement: We agree that ambient $PM_{2.5}$ in the Salt Lake City nonattainment area airshed is largely composed of secondary $PM_{2.5}$ formed by precursor emissions. Direct $PM_{2.5}$ also contributes *substantially* to nonattainment in the Salt Lake City nonattainment area.

The proposed SIP includes a 2010-2011 analysis of the chemical composition of $PM_{2.5}$ during episodes from the Hawthorne monitor.[68] It shows 19% organic mass, mostly direct $PM_{2.5}$ emissions, plus 3% of elemental carbon and 3% crustal, three forms of direct $PM_{2.5}$ emissions comprising a significant portion of the $PM_{2.5}$ composition. The organic mass component constitutes the second largest component to area $PM_{2.5}$ during inversions after the largest contribution, from nitrate, and constitutes a greater contribution than ammonium. UPA's comments submitted on August 15, 2018, included a CAMx modeling analysis of the residential wood combustion (RWC) contribution to the nonattainment area, performed by Ramboll, indicating a substantial contribution of direct $PM_{2.5}$ emissions.[69]

As described above, direct $PM_{2.5}$ contributes substantially to the Salt Lake City nonattainment area as well as precursor emissions and must be accounted for in order to develop an effective long-term attainment strategy. Accordingly, the stakeholder process to investigate potential RWC rulemaking that UDAQ committed to provides a good step in this direction.[70]

C. Declining $PM_{2.5}$ from Controlling Precursor Emissions

Statement in Utah State Bulletin: "In addition, as shown in the [Salt Lake City nonattainment area] SIP, empirical evidence points to the success in declining concentrations of ambient $PM_{2.5}$ from controlling precursor emissions."

Response to Statement: The *major stationary source* precursor demonstration submitted by UPA does not purport to make the case that controlling precursors has not contributed to a reduction in historic $PM_{2.5}$ levels. Furthermore, our comments do not address the contribution that ***all*** emissions of any particular precursor have on $PM_{2.5}$ levels; only a *comprehensive* precursor demonstration that takes into account *all* sources of precursor emissions would show this.

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[68] SIP Section IX. Part A.31 § 3.6, "Composition of Fine Particle Pollution – Speciated Monitoring Data", Page 21, Line 4 (as proposed).

[69] "Modeled Contributions of Residential Wood Combustion to $PM_{2.5}$ in the Salt Lake City 24-hour $PM_{2.5}$ Serious Nonattainment Area", final report by Ramboll (C. Emery et. al.), August 2018, based on modeling performed using UDAQ's model input files.

[70] Letter, Bryce C. Bird to Jennette King, October 12, 2018.

The *major stationary source* precursor demonstration shows only that current levels of precursor emissions from *major stationary sources* do not contribute significantly to $PM_{2.5}$ formation in the Salt Lake City nonattainment area and, therefore, consistent with the federal Clean Air Act and with Utah law, ought not be subject to additional controls over and above those required by the existing SIP Part H because of the insignificant benefit that would be realized from them, as discussed in Section II above.

As explained above in Section III.A of these comments, major stationary source precursor emissions contribute relatively small amounts to the total area inventories of each of NOx, VOC, and ammonia. With small contributions to the total, we would expect these sources to contribute insignificantly to total area $PM_{2.5}$. The modeled precursor demonstration quantitatively confirms this expectation.

Also explained above in Section III.A, although the 2019 inventory for SOx emissions from major stationary sources comprises 80% of the SOx inventory, recent large major stationary source emission reductions of SOx suggest diminishing returns from additional stationary source SOx emissions reductions.

Furthermore, the Ramboll evaluation of the WOE, summarized in Section III.D of these comments and provided in whole in Attachment A, indicates that the model performance regarding NOx emissions reflects actual chemistry in the airshed in the Salt Lake City nonattainment area.

Thus, while UPA agrees that precursors contribute generally to $PM_{2.5}$ levels in the airshed and that existing controls of those emissions have aided in the current attainment trajectory, the science shows that imposing additional controls on the diminishing inventory of precursor emissions from *major stationary sources* would make an insignificant contribution to reducing ambient $PM_{2.5}$ levels in the Salt Lake City nonattainment area. Accordingly, these sources should not be subject to additional controls for their precursor emissions.

D. Appropriateness of Significance Threshold in EPA Guidance

Statement in Utah State Bulletin: "UPA's precursor demonstration analysis was based on EPA's draft guidance, which identifies a threshold of 1.5 microgram/m^3. Considering Utah has previously implemented emissions controls that resulted in large reductions, Utah continues to look at controls that may only produce marginal benefits. Therefore, the threshold established in the draft guidance may not be appropriate in the [Salt Lake City nonattainment area], particularly when looking at the precursors cumulatively."

Response to Statement: The Clean Air Act directs EPA to establish the criteria for determining whether major stationary sources should be deemed to "contribute significantly to $PM_{2.5}$ levels" and therefore be subject to further control. EPA established these criteria based on a statistical analysis to identify a change so small that it is "in the noise" of measured ambient $PM_{2.5}$.

The EPA criteria for precursor demonstrations hold true for all $PM_{2.5}$ nonattainment areas, regardless of prior reductions in precursor emissions and regardless of how close or far from the level of the standard that the nonattainment area has progressed in its quest for

attainment. This approach ensures that states are not inappropriately forced to misdirect resources on controls that will not address the air quality problems that they seek to solve.

EPA cannot use one set of criteria to judge and approve a demonstration for one area of the country but a different, unpublished set of criteria for another area.

The EPA's regulations and guidance on precursor demonstrations establish the standards for States to develop precursor demonstrations and the criteria by which EPA approves the demonstrations.

UPA recommends that EPA existing precursor demonstration regulations and guidance serve as the standards and criteria for the major stationary source precursor demonstration in Utah.

E. Significance of the WOE to Using the Model for Precursor Demonstration

Statement in Utah State Bulletin: "Included in the SIP is a weight of evidence discussion that illustrates potential shortcomings in the model that affect its sensitivity to simulated reductions in precursor emissions. Considering this, UPA's analysis with the same model may have perpetuated these same shortcomings."

Response to Statement: UPA provided significant discussion regarding the consistent use of the model for both the attainment demonstration and precursor demonstration in Section II.B of these comments above, demonstrating UDAQ's satisfactory conclusions regarding model performance in Section III.C of these comments above, and of the shortcomings of the proposed SIP WOE discussion in Section III.D of these comments above. Please refer to these sections. The WOE, especially with modifications in accordance with the Ramboll evaluation, is compatible with the major stationary source precursor demonstration.

The model performs well, as stated throughout the TSD for the model performance evaluation and throughout the model performance evaluation section of the proposed SIP. UPA recommends modifying the WOE discussion in the proposed SIP in accordance with the evaluation regarding the WOE prepared by Ramboll and submitted as part of these comments.

V. Conclusions

UPA recommends that UDAQ adopt a major stationary source precursor demonstration for NOx, SOx, VOC, and ammonia. As described in these comments, the precursor demonstration is consistent with the proposed SIP. Adopting a major stationary source precursor demonstration for these precursor emissions would *leave all existing controls in place* and would only preclude adopting *new additional controls that would have an insignificant benefit* to ambient $PM_{2.5}$ concentrations and to achieving and maintaining attainment of the standard. Furthermore, simple enhancements to the monitoring data for the Rose Park monitor would firm up the future year attainment demonstration so that it meets the test of predicting future year attainment, thus reducing the need to rely on the WOE. If retained as part of the SIP, the WOE should be modified in accordance with the Ramboll evaluation of it. Finally, UPA advocates not finalizing the additional controls

proposed in Part H unless and until EPA makes a final decision disapproving the precursor demonstrations.

UPA appreciates the open dialogue with UDAQ throughout the process and UDAQ's and the AQB's consideration of these comments. UPA and its members are available to discuss these documents and attachments with you and your staff.

Sincerely,

Jennette King
Administrative Assistant

Enclosure: "Comments on Serious Area $PM_{2.5}$ State Implementation Plan for the Salt Lake City, UT Nonattainment Area: Section IX. Part A.31. Control Measures for Area and Point Sources, Fine Particulate Matter; Chapter 6, Attainment Demonstration; and Section 6.2, Weight of Evidence", evaluation report by Ramboll.

cc: Bill Reiss
Dave McNeill
Thomas Gunter

A. Attachment A

Comments on Serious Area $PM_{2.5}$ State Implementation Plan

For the Salt Lake City, UT Nonattainment Area:

Section IX. Part A.31. Control Measures for Area and Point Sources, Fine Particulate Matter;

Chapter 6, Attainment Demonstration; and Section 6.2, Weight of Evidence

Prepared by Ramboll

RAMBOLL

Comments on

Serious Area $PM_{2.5}$ State Implementation Plan
for the Salt Lake City, UT Nonattainment Area:
Section IX. Part A.31, Control Measures for Area and Point Sources, Fine Particulate Matter;
Chapter 6, Attainment Demonstration; and Section 6.2, Weight of Evidence

Summary

Ramboll has reviewed the draft State Implementation Plan Part A (SIP), Chapter 6 and all related Technical Support Documents (TSD) that pertain to the Utah Division of Air Quality's (UDAQ) modeled $PM_{2.5}$ attainment demonstration and Weight of Evidence (WOE) analysis for the Salt Lake City (SLC) nonattainment area.

Our comments and supporting information center on the following overarching theme. Both modeled and measured ozone and NOx indicate that the gas-phase chemical environment that generates secondary $PM_{2.5}$ compounds during exceedance events is NOx-saturated and oxidant-lean. This is a separate issue from whether $PM_{2.5}$ formation is ammonia- vs. nitrate-limited. In a NOx saturated environment, NOx emission reductions can raise oxidant levels, raise secondary PM formation rates, and produce $PM_{2.5}$ increases or smaller-than-expected decreases ("NOx dis-benefit"). The behavior of the model is consistent with this. Recent field studies and previous UDAQ analyses indicate the SLC atmosphere is typically in this regime during persistent cold air pool (PCAP) events. The model may therefore be responding appropriately to emission reductions with small reductions in $PM_{2.5}$, although its degree of response is affected by uncertainties noted in the WOE analysis.

Below we summarize our key comments, followed by more detailed supporting information.

1. The WOE states that the model does not respond appropriately to emission reductions due in part to model uncertainty associated with PM-forming chemical interactions, inferring that the model simulation of these chemical interactions is incomplete or incorrect. However, the WOE offers insufficient evidence that the model's response is inconsistent with observed conditions and trends to support this hypothesis.

2. A simple calculation based on emission inventories reported in the SIP and SLC design values (DV) reported by EPA's Air Quality System (AQS) suggests that model-estimated 2019 DV projections are consistent with observed trends in SLC $PM_{2.5}$ concentrations and precursor emissions.

    a. The Speciated Modeled Attainment Test (SMAT) relies on a $PM_{2.5}$ speciation based on 2011 measurements rather than speciation for 2016 consistent with the base year emission inventory. This is inconsistent with EPA modeling guidance, which recommends using speciated measurements from the base year for the SMAT. The design value projections could be sensitive to this choice.

3. Concerning the model's chemical uncertainty, while secondary $PM_{2.5}$ processes can be complex, the SLC basin's actual chemical environment is similarly NOx-saturated and oxidant-lean. The

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model performs well in replicating observed conditions and so the model response to emission reduction may be more reliable than the WOE suggests.

   a. Statements about the lack of nitryl chloride ($ClNO_2$) chemistry in CAMx are incorrect. The CB6r2h chemistry mechanism, which we have confirmed was used in the attainment demonstration modeling, includes the formation of $ClNO_2$ and nitric acid (HNO_3) via heterogeneous nighttime reactions among hydrochloric acid (HCl) and dinitrogen pentoxide (N_2O_5), and the daytime photolysis of $ClNO_2$ generating nitrogen dioxide (NO_2) and chlorine radicals.

4. Model-measurement comparisons suggest that the model may be less NOx-saturated than actual conditions at times, which suggests that in reality, NOx controls may be even less effective than the model predicts.

5. Given the WOE emphasis on ammonia uncertainty, a deeper quantitative analysis of how the modeled nitrate reacts to the ad hoc ammonia "injection" is needed, and the effects of inventory uncertainties on PM formation need to be investigated and quantified to provide context for the attainment demonstration results.

6. Crustal matter is not entirely inert: the model includes a pathway for a small fraction of nitric acid to condense onto dust particles and form particulate nitrate. This process does not require a neutralizing reagent such as ammonia. Over predictions of crustal matter can affect the total nitrate budget and may slightly increase particulate nitrate reductions from NOx controls.

Supporting Information by Comment

1. **The WOE states that the model does not respond appropriately to emission reductions due in part to model uncertainty associated with PM-forming chemical interactions, inferring that the model simulation of these chemical interactions is incomplete or incorrect. However, the WOE offers insufficient evidence that the model's response is inconsistent with observed conditions and trends to support this hypothesis.**

The SIP states **(SIP p. 44; MPE TSD p. 3)** that a model performance evaluation (MPE) was conducted to "...assess how accurately the model predicts observed concentrations *and to demonstrate that the model can reliably predict the change in pollution levels in response to changes in emissions...*" (emphasis added). The MPE TSD presents a thorough analysis demonstrating that the model adequately replicates in space and time observed $PM_{2.5}$ and secondary components (nitrate, ammonium, sulfate), which are the most important constituents during exceedance events, in addition to primary organic carbon. In fact, the model's ability to simulate secondary $PM_{2.5}$ components could be considered excellent based

on recent articles in the peer-reviewed literature[1,2] that assess the 10-year history of $PM_{2.5}$ model-measurement performance throughout North America.

However, the MPE TSD statement regarding the demonstrated model reliability in responding to emission changes contradicts several statements in the WOE concerning possible limitations in model responsiveness. In fact, the MPE TSD presents no analysis that demonstrates reliable responses to plausible emission reductions. We acknowledge that the ammonia injection analyses conducted early in the modeling exercise **(Model Modifications TSD p. 1-2)** comprised a type of emission sensitivity test, but the test involved a very large increase in ammonia emissions (relative to anticipated 3-year emission reductions in the DV projection) designed to remedy a shortcoming in model performance and may have shifted the modeled chemical environment from ammonia-limited to nitrate-limited (or perhaps nearly balanced). We also acknowledge the formaldehyde emissions test in the WOE **(SIP p. 60)**, which demonstrated very small impacts to ozone (~0.5 ppb maximum) and $PM_{2.5}$ (~0.5 $\mu g/m^3$ maximum).

EPA Modeling Guidance[3] recommends that quantitative assessment of the model's sensitivity to emissions changes be performed as part of the model performance evaluation. Diagnostic testing establishes expectations for the modeled attainment test, places the results in context, potentially provides physical/chemical explanations for unexpected results, and should prompt an assessment as to whether actual conditions would respond similarly. The WOE discusses sources of model uncertainty and makes qualitative inferences about oxidant sensitivity and ammonia- vs. nitrate-limited chemistry in the model, but these relationships were not quantified and established with simple emission sensitivity tests during the model performance evaluation process, as recommended by EPA Modeling Guidance.

The SIP shows 2000 to 2017 trends in annual 98th percentile $PM_{2.5}$ at sites throughout SLC **(SIP p. 61, Figure 6.14)**. We agree with the characterization of large interannual fluctuations as mainly driven by winter meteorological variability, yet the document presents a calculated -1.1 $\mu g/m^3$ per year trend at the Hawthorne site without stating whether that trendline is statistically significant. Examination of Figure 6.14 shows that the trend was steeper during 2000 to 2010 and has leveled off during 2010 to 2017. Annual high percentile NO_2 and SO_2 concentration trends **(SIP p. 63-64, Figures 6.17 and 6.18)** similarly show NO_2 and SO_2 concentration trends flattening since 2010. The estimated 18-year $PM_{2.5}$ trendline encompasses a long period during which substantial emissions reductions occurred and so the SLC atmosphere is likely in a different chemical regime today than in 2000. Extrapolation of future year design values based on this 18-year trendline without an estimate of statistical significance is highly speculative and does not yield reliable information for assessing model responsiveness to emission reductions.

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[1] Simon, H., K.R. Baker, S., Phillips, 2012: Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012. *Atmos. Environ.*, 61, 124-139.

[2] Emery, C., Z. Liu, A.G. Russell, M.T. Odman, G. Yarwood, N. Kumar, 2016: Recommendations on statistics and benchmarks to assess photochemical model performance. *J. Air Waste Manag. Assoc.*, DOI: 10.1080/10962247.2016.1265027.

[3] US Environmental Protection Agency, 2014. "Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5 and Regional Haze" (December 3). https://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf.

2. A simple calculation based on emission inventories reported in the SIP and SLC design values (DV) reported by EPA's Air Quality System (AQS) suggests that model-estimated 2019 DV projections are consistent with observed trends in SLC PM2.5 concentrations and precursor emissions.

We performed a simple $PM_{2.5}$ DV projection as a measurement-based check on whether the modeled response is consistent with observed trends. The approach combines primary $PM_{2.5}$ and precursor emission inventories with official $PM_{2.5}$ DVs and reported species fractions spanning the same years addressed by the attainment demonstration modeling (2011-2016-2019). We calculate a $PM_{2.5}$ concentration per ton response rate (or guide slope) between the 2011 base meteorological year and 2016 base emissions year. Assuming this response rate can be carried forward to near future years, we project the 2015 to 2017 $PM_{2.5}$ DV to 2019. Unlike the trendline in the SIP **(SIP p. 61, Figure 6.14)**, this approach involves a linear $PM_{2.5}$ concentration response to emissions reductions, which is only likely to be valid for short-term projections with relatively moderate emission reductions such as those estimated in the attainment demonstration. Our calculation results in a 2019 $PM_{2.5}$ DV of 36 $\mu g/m^3$, which is practically identical to the modeled SMAT attainment test of 35.9 $\mu g/m^3$ at Rose Park **(SIP p. 50, Table 6.1)**. This calculation suggests that the model is responding appropriately to emissions reductions; this finding is also consistent with the model performance evaluation, which indicates that the model successfully replicates the formation, transport and removal of $PM_{2.5}$ in the SLC area.

The DV projection approach is detailed below:

1) Define the $PM_{2.5}$ trend period to extend from 2011 (base meteorological year) through 2016 (base emissions year).

2) Estimate 2011 emissions from the SIP **(SIP p. 65, Figure 6.19)** at 157 NOx tons per winter weekday (TPWW) and 36 $PM_{2.5}$ TPWW; we ignore VOC as it has negligible secondary $PM_{2.5}$ impacts, we ignore ammonia emissions following the SIP assertion that PM chemistry should mostly be nitrate-limited, and we ignore SO_2 emissions as **Figure 6.19** shows them to be unchanging over 2011 to 2019.

3) Estimate 2016 emissions at 123 NOx TPWW and 20 $PM_{2.5}$ TPWW **(SIP p. 65, Figure 6.19)**.

4) Estimate 2019 emissions at 112 NOx TPWW and 20 $PM_{2.5}$ TPWW **(SIP p. 65, Figure 6.19)**.

5) Set the 2016 $PM_{2.5}$ DV at 36.3 $\mu g/m^3$ following approach in the SIP to use the 2015 to 2017 DV centered on 2016 **(SIP p. 50, Table 6.1).**

6) Set the 2011 $PM_{2.5}$ DV at 38 $\mu g/m^3$ (following the same rationale as for 2016, use the 2010 to 2012 DV centered on 2011); this value was taken from EPA data[4].

7) According to the SIP, $PM_{2.5}$ comprises about 40% nitrate and 28% primary $PM_{2.5}$ during the 2011 episode exceedance days **(SIP p. 47, Figure 6.7)**; note, however, that ***no similar breakdown is provided for the 2016 base year, which is a significant omission and may have an impact on the speciated model attainment test (see Comment 2a).***

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[4] https://www.epa.gov/air-trends/air-quality-design-values: AQS Data Query: 07/20/18; Last updated: 07/23/18

8) Assuming NOx emissions impact only nitrate concentrations, and primary $PM_{2.5}$ emissions impact only primary $PM_{2.5}$ concentrations, the 40%/28% split in (7) above translate to 59%/41% of the controllable fraction of $PM_{2.5}$ (again ignoring VOC impacts, assuming ammonia-insensitive chemistry, and zero SO_2 emission trends).

9) The 2011 to 2016 nitrate response rate is calculated to be 0.029 $\mu g/m^3$ per ton NOx: (38-36.3)/(157-123)x59%

10) The 2011 to 2016 primary $PM_{2.5}$ response rate is calculated to be 0.044 $\mu g/m^3$ per ton $PM_{2.5}$: (38-36.3)/(36-20)x41%

11) The 2016 to 2019 projected total $PM_{2.5}$ response is calculated to be 0.32 $\mu g/m^3$: 0.029x(123-112) + 0.044x(20-20)

12) The 2019 projected $PM_{2.5}$ DV is calculated to be 36.0 $\mu g/m^3$: (36.3-0.32)

3. Concerning the model's chemical uncertainty, while secondary PM2.5 processes can be complex, the SLC basin's actual chemical environment is similarly NOx-saturated and oxidant-lean. The model performs well in replicating observed conditions and so the model response to emission reduction may be more reliable than the WOE suggests.

Both modeling and measurements for the January 2011 episode indicate that NOx emissions are saturating the chemical environment, suppressing oxidant chemistry, and likely resulting in a "NOx dis-benefit" situation when NOx emissions are reduced. This gas-phase chemistry issue is separate from whether secondary $PM_{2.5}$ formation is nitrate- or ammonia-limited. The WOE appropriately attributes much of the model uncertainty to ammonia emissions, but gas-phase chemistry under NOx-rich, oxidant-limited conditions influences the potential for generating nitric acid that ultimately condenses to particulate nitrate when neutralized by ammonia. NOx insensitivity or even a slight dis-benefit in gas-phase chemistry may be limiting nitrate responses to emission reductions both in the model and in reality.

<u>NOx-Rich, Oxidant-Limited Gas-Phase Chemistry</u>

The chemistry of air trapped under the strong capping inversion involves many complex interactions among gas precursors, products, and volatile $PM_{2.5}$ components (i.e., those compounds that move between gas and aerosol form as ambient conditions change). In the gas phase, photochemical oxidant reactions among NOx, VOC and ozone are non-linear, and NOx reductions may increase ozone concentrations that would otherwise be consumed by NOx during oxidant (VOC) lean conditions – commonly referred to as a NOx dis-benefit. During elevated $PM_{2.5}$ episodes, air over SLC quickly reaches this oxidant-limited state[5], which inhibits the efficiency of NOx oxidation and lowers the rate of nitrate production. NOx reductions lift the NOx-inhibiting influence, raise the efficiency of oxidant chemistry, and can generate more nitrate and sulfate.

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[5] Baasandorj, M., et al., 2018. "2017 Utah Winter Fine Particulate Study Final Report." Prepared for the Utah Division of Air Quality (UDAQ), March 16, 2018. https://documents.deq.utah.gov/air-quality/planning/technical-analysis/research/northern-utah-airpollution/utah-winter-fine-particulate-study/DAQ-2018-004037.pdf.

Statements about the lack of nitryl chloride ($ClNO_2$) chemistry in CAMx are incorrect (see Comment 3a). The CB6r2h chemistry mechanism[6], which we have confirmed that UDAQ used in the attainment demonstration modeling, includes the formation of $ClNO_2$ and nitric acid (HNO_3) via heterogeneous nighttime reactions among hydrochloric acid (HCl) and dinitrogen pentoxide (N_2O_5), and the daytime photolysis of $ClNO_2$ generating nitrogen dioxide (NO_2) and chlorine radicals. The SIP states **(SIP p. 53, 57-58)** that a lack of chlorides and related chemistry may contribute to an oxidant-limited regime. While it is true that chloride chemistry can generate oxidants by the pathways described in the WOE, this is not the main factor controlling the model's insensitivity to NOx emission reductions: the model simulates oxidant-limited conditions because of the abundance of NOx.

The SIP conclusion states **(SIP p. 73)** that the model is "too sensitive to oxidant levels". Gas-phase chemistry is either sensitive to oxidants or it is not. We suggest that this statement be revised for clarity to say, "Oxidant levels in the model are uncertain and this impacts its ability to replicate the overall atmospheric reactivity during the cold air pool event".

Nitrate-Rich, Ammonia-Limited PM Chemistry

Once secondary products are generated via oxidation pathways, the balance among acids (nitrate, sulfate, chloride) and neutralizing cations (ammonia, sodium and crustal material such as calcium) is complex, and the resulting partitioning between gases and volatile aerosols depends on the relative amount of all of these species and on ambient temperature and humidity. Whenever the balance between nitrate, sulfate and ammonium is perturbed, equilibrium is restored by increasing concentrations of some components and lowering others. Therefore, increases or decreases may occur for nitrate, ammonium and/or sulfate. During our major stationary source precursor demonstration for NOx[7] we found that when major point source NOx emissions were removed, small increases among these three species occurred, sometimes independently and sometimes in combination. This occasionally resulted in a small net $PM_{2.5}$ increase. While the veracity of this particular modeling result cannot be determined directly, this effect is theoretically possible. This is on top of the NOx dis-benefit effect on gas-phase chemistry described above, which can increase the rate of nitrate and sulfate production. Both effects serve to limit $PM_{2.5}$ reductions from NOx emission controls.

4. Model-measurement comparisons suggest that the model may be less NOx-saturated than actual conditions at times, which suggests that in reality NOx controls may be even less effective than model predicts.

Modeled-measured comparisons of NOx and ozone **(MPE TSD p. 15-16, Figures 6.12 and 6.13)** indicate that NOx is under predicted and ozone is over predicted during nighttime hours in the middle of the episode (January 5-7). This feature in model performance is important. Measurements indicate that NOx reaches levels twice the modeled values at night, which reduces observed ozone concentrations to zero, suppresses the potential for next-day oxidant production, and likely limits the amount of nitrate produced. The lack of nightly modeled NOx and abundance of modeled ozone may be due to over-

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[6] CAMx User's Guide, v6.30. Appendix B, CAMx Mechanism 3: CB6r2 with Halogen Chemistry, reactions 21 and 22. http://www.camx.com/files/camxusersguide_v6-30.pdf

[7] "Major Stationary Source Precursor Demonstration for NOx, SOx, VOC, and NH3 in the Salt Lake City 24-hour PM2.5 Serious Nonattainment Area." Prepared for the Utah Petroleum Association by Ramboll Environment and Health (August 2018).

mixing vertically and/or underestimated emissions. Similar CO under predictions **(MPE TSD p. 15, Figure 6.12)** are consistent with over mixing, given CO's minimal chemical decay rate. The model modifications described in the TSD **(Model Modifications TSD p. 4)** include an artificial increase in vertical diffusion at night (referred to as "KVPATCH"), which is much stronger and deeper than we would recommend to characterize light nocturnal mixing. The modeled environment enhances oxidation and likely produces more nitrate and possibly $ClNO_2$ (ammonia-limited regime), at least at night. Nevertheless, both observed and measured patterns of NOx and ozone suggest a regime that would contribute to a NOx dis-benefit condition.

The WOE presents evidence that the model underestimates carbonyls, particularly formaldehyde, and reports results of a simple sensitivity test where they increased formaldehyde emissions by 50% in the 2019 future case **(SIP p. 58-60)**. The reported temporal mismatch between 2011 modeled and 2017 measured carbonyl concentrations may be related to: (1) different years between modeling and measurements; and (2) poor chemical representation in the model (UDAQ's hypothesis) leading to a different chemical regime. The WOE reports that the 2019 modeled formaldehyde emission increases result in rather small impacts to ozone (~0.5 ppb maximum) and $PM_{2.5}$ (~0.5 $\mu g/m^3$ maximum). Relative to total $PM_{2.5}$, the incremental $PM_{2.5}$ from this test is practically negligible. This small effect further suggests that the lack of oxidants is not the major issue, but rather the large concentrations of NOx that build up during cold pool events are the controlling factor.

5. **Given the WOE emphasis on ammonia uncertainty, a deeper quantitative analysis of how the modeled nitrate reacts to the ad hoc ammonia "injection" is needed, and the effects of inventory uncertainties on PM formation need to be investigated and quantified to provide context for the attainment demonstration results.**

The SIP correctly characterizes the importance of ammonia **(SIP p. 56)**, and raises the importance of correctly characterizing ammonia emission patterns. It states: "...where ammonia is concerned we see only a static quantity of homogenous distribution." It is unclear whether this refers to measurements or modeling, but if the reference is to measurements, the homogeneous distribution is not necessarily related to emission patterns but rather the buildup and diffusive transport of ammonia over a wide area throughout the SLC cold pool event. Injecting un-inventoried ammonia **(Model Modifications TSD p. 1-3; SIP, p. 55)** so that emissions are constant across each county (albeit for just low-elevation areas) produces an unrealistically smooth ammonia distribution inconsistent with UWFPS aircraft measurements. We believe a more defensible approach would be to scale up existing ammonia emission patterns to preserve spatial and temporal variations related to anthropogenic activity. The uniform injection approach could negatively impact modeled effects of ammonia- vs. nitrate-limited $PM_{2.5}$ formation in time and space. It is just as important to analyze patterns of modeled total ammonia (NH_3+NH_4) as well as total nitrate (HNO3 + PM NO_3) to understand how the model responds with respect to gas-particle partitioning, so that spatial/temporal patterns of modeled ammonia- vs. nitrate-limited PM chemistry can be characterized.

The SIP correctly states that the model does not include a bi-directional deposition/emissions module (ammonia is only deposited to the surface, never re-emitted). We agree that this could be a major source of uncertainty. However, emission factors/rates from known traditional sources need to be critically evaluated for accuracy. Ammonia emission rates are highly uncertain, particularly from agricultural sources that depend on specific animal husbandry practices, accurate head counts, fertilization schedules and application rates, and environmental conditions (e.g., soil moisture and snow

cover). Traditional anthropogenic sources (e.g., mobile sources) also exhibit significant uncertainties in ammonia emission estimates. A 2014 study by Sun et al.[8] using in-situ NH_3:CO measurements shows that mobile source emissions of ammonia may be under estimated by MOVES. In a modeling project in Los Angeles, we found MOVES may under estimate ammonia emissions by a factor of 5 based on the Sun et al. NH_3:CO results. Along the Wasatch Front, ammonia emissions from both diesel and gasoline vehicles may be exacerbated in cold, high-altitude environments and by a higher contribution of "off-cycle" emissions on highly sloped roads throughout the Wasatch Front area.

The SIP and MPE TSD state **(MPE TSD p. 7, Figure 6.3; SIP p. 46)**: "The low model bias in particulate ammonium (NH_4) can be attributed to an underestimation of ammonium chloride (NH_4Cl) in the model." We posit that the lack of NH_4Cl is most likely caused by a lack of total ammonia (NH_3+NH_4), which may be entirely used to preferentially neutralize SO_4 and NO_3. Again, it is important to analyze how total ammonia is distributed between gas and particle phase to assess how much is available to bond with sulfate, nitrate and chloride. A simple calculation can determine the modeled ammonium shortfall associated with the chloride under prediction bias. According to the speciated measurements on January 7 **(MPE TSD p. 8 and 10, Figures 6.3 and 6.6; SIP p. 47, Figure 6.9)** the model under estimates chloride by 0.6 $\mu g/m^3$ at Hawthorne and by 2.0 $\mu g/m^3$ at Bountiful Viewmont. Converting these differences to moles and then multiplying by the molecular weight of NH_4 results in an ammonium shortfall of 0.3 to 1.0 $\mu g/m^3$. These are far smaller than the 4.0 and 5.4 $\mu g/m^3$ NH_4 biases shown in the referenced figures. Therefore, the low bias in modeled particulate chloride cannot fully account for the ammonium under prediction.

6. **Crustal matter is not entirely inert: the model includes a pathway for a small fraction of nitric acid to condense onto dust particles and form particulate nitrate. This process does not require a neutralizing reagent such as ammonia. Over predictions of crustal matter can affect the total nitrate budget and may slightly increase particulate nitrate reductions from NOx controls.**

The TSD states **(MPE TSD p. 7)** "Modeled crustal matter (CM) was quite higher than measured for January 7, 2011." This has some ramifications for particulate nitrate because in CAMx, CM provides a pathway for a relatively small fraction of nitric acid gas to condense directly onto dust particles irrespective of ambient ammonia, and the amount of this condensation is counted as particulate nitrate. Therefore, since CM plays a minor role in PM chemistry it should not be discounted as inert. The modeled CM over prediction can affect the total PM nitrate budget by providing a chemical pathway for nitrate without the need for ammonia.

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[8] Sun, K., L. Tao, D.J. Miller, M.A. Kahn, M.A. Zondlo, 2014: On-Road Ammonia Emissions Characterized by Mobile, Open-Path Measurements. *Environ. Sci. Technol.*, 48, 3943–3950, dx.doi.org/10.1021/es4047704.