414 Nicollet Mall, 5th Floor
Minneapolis, Minnesota 55401

July 15, 2016

**--VIA ELECTRONIC FILING--**

Mr. Daniel P Wolf
Executive Secretary
Minnesota Public Utilities Commission
350 Metro Square Building
121 7th Place East
St. Paul, MN 55101

RE: *IN THE MATTER OF THE FURTHER INVESTIGATION INTO ENVIRONMENTAL AND SOCIOECONOMIC COSTS UNDER MINN. STAT. §216B.2422, SUBD. 3*
EXCEPTIONS TO ALJ'S FINDINGS OF FACT, CONCLUSIONS AND RECOMMENDATIONS
MPUC DOCKET NO. E999/CI-14-643
OAH DOCKET NO. 80-2500-31888

Dear Mr. Wolf:

Northern States Power Company, doing business as Xcel Energy, submits the enclosed Exceptions to the Administrative Law Judge's *Findings of Fact, Conclusions and Recommendations* issued April 15, 2016 related to the Criteria Pollutants portion of the above-referenced proceeding.

If you have questions or need additional information, please contact me at (612) 215-4656 or at james.r.denniston@xcelenergy.com .

Sincerely,

/s/

JAMES R. DENNISTON
ASSISTANT GENERAL COUNSEL

Enclosures
c: Service List

**STATE OF MINNESOTA**
**BEFORE THE OFFICE OF ADMINISTRATIVE HEARINGS**
**FOR THE**
**MINNESOTA PUBLIC UTILITIES COMMISSION**

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| In the Matter of the Further Investigation into Environmental and Socioeconomic Costs Under Minnesota Statute 216B.2422, Subdivision 3 | OAH Docket No. 80-2500-31888<br>MPUC Docket No. E-999/CI-14-643 |

# XCEL ENERGY EXCEPTIONS TO ALJ'S FINDINGS OF FACT, CONCLUSIONS AND RECOMMENDATIONS REGARDING CRITERIA POLLUTANTS

**July 15, 2016**

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# I. INTRODUCTION

Northern States Power Company, doing business as Xcel Energy, respectfully submits these Exceptions to the Administrative Law Judge's June 15, 2016 *Findings of Fact, Conclusions, and Recommendations: Criteria Pollutants* (the ALJ CP Report) in this proceeding. We recognize the magnitude and complexity of the evidentiary record and commend the ALJ for providing a comprehensive and thoughtful analysis. We agree with many aspects of the ALJ's conclusions and recommendations, and are pleased to note that she accepted several critical arguments and positions advanced by Xcel Energy. Our main exceptions relate to the ALJ's recommendations regarding the geographic scope of damages, adding two to three new source locations to the CAMx modeling, and the potential use of AP2 to estimate damages within Minnesota from many location sources.

A significant underlying theme in the ALJ CP Report is the importance of model accuracy; Xcel Energy completely agrees. It is a fundamental requirement that the air quality modeling results are reliable, because they form the first step and basis for estimating damage values. The ALJ found several problems with the Agencies' AP2 modeling and the Clean Energy Organizations' (CEOs) InMAP modeling. She rejected the InMAP model as unreliable and concluded that the AP2 model cannot be used to accurately model ambient air concentrations across the contiguous United States. The ALJ took a strong position regarding Xcel Energy's CAMx modeling, and confirmed that CAMx "is the most reliable and accurate model of the three models presented in this case."[1]

The ALJ made two alternative recommendations regarding the modeling approach. First, the ALJ recommended using CAMx as the most reliable model, if the Commission agrees it is reasonable to limit the number of source locations to a few

[1] ALJ CP Report, Conclusion 39 at 100.

representative sources.[2] Second, the ALJ suggested that the AP2 model could be used, but only to estimate damages within Minnesota, if the Commission determines it is necessary to model a large number of source locations.[3]

Since the ALJ accepted many of our concerns regarding AP2's application and accuracy in this case, and since she confirmed that CAMx is the most reliable model, we believe that she should have rejected using AP2 to model damages not only outside of Minnesota but also within Minnesota. The flaws in AP2's air quality modeling affect the results both within and outside of Minnesota. The ALJ recommends the potential use of AP2 only if the Commission determines a need to model a significant number of source locations to estimate damages within Minnesota. However, we disagree that this is reason enough to use a less reliable model, which, as acknowledged by the ALJ, provides questionable and inaccurate results.

The ALJ concluded that developing county-by-county values within Minnesota is not reasonable because nothing in the record indicates that this level of detail is needed in resource planning or related proceedings.[4] Xcel Energy agrees, and presented many relevant and persuasive reasons why there is no need to depart from the current practice of establishing externality values for three representative location types: urban, metropolitan-fringe, and rural. Similarly, we presented many credible and convincing factors that speak against nationwide air quality modeling and estimating national damages for externality values.

Consistent with her conclusions of fact, we would have preferred the ALJ to take an affirmative position on both the source location and geographic scope issues, and not leave these two important policy matters open and undetermined. Xcel

[2] ALJ CP Report, Recommendation 4a at 104.
[3] ALJ CP Report, Recommendation 4b at 104.
[4] ALJ CP Report, Conclusion 35 at 99.

Energy modeled three representative source locations with the state-of-the science air quality model CAMx, and there is no question that our results are the most reliable and accurate in this proceeding.

We take a limited exception to the ALJ's recommendations regarding the value of a statistical life (VSL) and concentration-response function. Considering the uncertainty involved in estimating human health impacts, we believe a range of values for both the VSL and concentration-response function would be appropriate, and suggest including an additional low-end VSL value. We can easily incorporate any modifications into our results to calculate new damage estimates. We respectfully request that the Commission accept our CAMx air quality modeling results as such, unchanged except for the incorporation of any changes to the VSL and concentration-response function, for the basis of estimating criteria pollutant externality values.

Our exceptions are limited to the ALJ's conclusions of fact (pages 94-103 of the ALJ CP Report) and recommendations (pages 103-105 of the ALJ CP Report), and do not separately address the findings of fact (pages 8-92 of the ALJ CP Report), which does not mean that we agree with all of the findings. The ALJ's findings of fact summarize the Parties' arguments and critiques of each other's positions, but it is unclear to us which of the arguments and critiques the ALJ accepted as relevant and persuasive, and which arguments and critiques she only summarized for the sake of the record. In addition, we would like to note that the ALJ's findings of fact are not complete and lack description of many of Xcel Energy's relevant responses to critiques offered by other Parties on our proposal. They also exclude the maps we have presented to demonstrate the inaccuracy of AP2 and InMAP modeling results.

The remainder of this document is organized as follows: Section II summarizes some of the most significant ALJ conclusions that we agree with, including

conclusions regarding the CAMx, InMAP, and AP2 models as well as the concentration-response function and VSL. Section III presents our exceptions to the ALJ's conclusions regarding the geographic scope of damages. Section IV discusses our exceptions to the ALJ's recommendation to add two or three new source locations to our CAMx modeling (Recommendation 4a). Section V presents our exceptions to the ALJ's alternative recommendation to use AP2 to model a large number of source locations to estimate damages within Minnesota (Recommendation 4b). Section VI concludes. Attachment A to this document provides our suggested redlines to the ALJ's Conclusions and Recommendations.

## II. SUMMARY OF SIGNIFICANT AGREEMENTS

### A. The ALJ Appropriately Concluded that CAMx Is the Most Accurate Model and Should Be Used

The ALJ confirmed what Xcel Energy has stated throughout this proceeding: CAMx is the most reliable and accurate model,[5] CAMx is more reliable than AP2,[6] and especially if damages are estimated outside of Minnesota, CAMx is the only model to use, although even CAMx's accuracy at significant distances raises questions.[7]

CAMx incorporates hourly, varying, three-dimensional wind speeds and direction, temperature, humidity, and other conditions as well as full-science chemistry algorithms to model ambient air quality changes. It is the only model used in this case that can accurately determine the dispersion of emissions throughout the year; incorporates flue-gas chemistry in the point source plume; accurately accounts for chemical reactions in the atmosphere after the pollutants are emitted; and predicts credible ambient concentration changes that are consistent with what is known about

[5] ALJ CP Report, Conclusion 39 at 100.
[6] ALJ CP Report, Recommendation 4a at 104.
[7] ALJ CP Report, Recommendation 5 at 105, Memorandum at 107.

the science of air dispersion and chemistry.[8] In addition, CAMx is the only model in this case that meets all of EPA's current and proposed air quality guidelines and guidance and it is recommended by the EPA for the modeling of ozone and secondary $PM_{2.5}$ formation.

The ALJ concluded that "CAMx is a reliable, established PGM, and would be appropriate to use in this matter, if the Commission chooses to limit the sources and source locations."[9] The ALJ recognized that CAMx is not suitable to model hundreds of source locations,[10] but also concluded that the Agencies and the CEOs failed to demonstrate that adopting county-by-county values within Minnesota[11] or outside of Minnesota (200 miles from the Minnesota border)[12] is necessary or reasonable. On the contrary, according to the ALJ, nothing in the record indicates that the Commission requires or has expressed a need for this level of detail.[13]

The ALJ's Conclusion No. 16 underlines the importance of accounting for population-weighted exposure because human health impacts constitute a large amount of the damage cost.[14] We agree, and Dr. Desvousges' post-processing analysis of CAMx results takes into account the populations exposed in estimating human health impacts.[15]

### B. The ALJ Appropriately Rejected the InMAP Model as Unreliable and Lacking Peer-Review and History of Past Applications

We agree with all of the ALJ's conclusions regarding the CEOs' InMAP modeling – these conclusions take into account many of the concerns raised by Xcel

[8] Ex. 604 (Desvousges Direct) at 16-18, Schedule 2 at 16-19; Ex. 605 (Desvousges Rebuttal) at 2-3, 20; Ex. 616 (Desvousges Opening Statement) at 1-5.
[9] ALJ CP Report, Conclusion 28 at 98.
[10] ALJ CP Report, Conclusion 24 at 97.
[11] ALJ CP Report, Conclusion 35 at 99.
[12] ALJ CP Report, Conclusion 30 at 98.
[13] ALJ CP Report, Conclusion 35 at 99.
[14] ALJ CP Report, Conclusion 16 at 95.
[15] Ex. 605 (Desvousges Rebuttal) at 20; Xcel Energy's Initial Brief at 16.

Energy. The ALJ concluded that the CEOs failed to show that InMAP is a reliable air quality model and noted that several aspects in its implementation cast doubts on the accuracy of the modeling results, including modeling counties as area sources rather than point sources and calibrating InMAP to correlate with WRF-Chem control scenarios that were developed for measuring emissions from light-duty mobile vehicles.[16] The ALJ specifically concluded that the CEOs failed to rebut Xcel Energy's claims that InMAP skews changes in ambient air concentrations to the east and significantly overestimates externality values compared to CAMx and AP2 modeling.[17] Most importantly, the ALJ affirmed that InMAP is different from other typical reduced-form models, and that there is no evidence in the record of peer-review or a history of past applications in settings similar to this proceeding.[18]

The ALJ's Memorandum summarized her concerns regarding InMAP: "InMAP is innovative, but its results are so dramatically higher than the other parties' results that, given InMAP's lack of peer review and track record, the Administrative Law Judge cannot recommend it."[19] Xcel Energy has maintained the Commission should not establish long-lasting externality values based on a new, experimental model, which has no record of common use or acceptance by the scientific community, and therefore the externality values should not be based on InMAP modeling.[20]

### C. The ALJ Appropriately Concluded that There Are Critical Limits to the AP2 Model's Reliability

Xcel Energy also agrees with most of the ALJ's conclusions related to the application and reliability of the AP2 model used by the Agencies, including AP2's

[16] ALJ CP Report, Conclusions 10-12 at 94.
[17] ALJ CP Report, Conclusion 43 at 101.
[18] ALJ CP Report, Conclusion 9 at 94.
[19] ALJ CP Report, Memorandum at 106.
[20] Hearing Transcript, vol. 6 at 29 (Xcel Energy's Opening Statement); Xcel Energy's Initial Brief at 28-30; Xcel Energy's Reply Brief at 17.

limitations beyond the recommended 50 kilometers, estimating nationwide damages, flaws in the performance evaluation, and modeling of hypothetical plants. We briefly summarize these most significant agreements here.

First, the ALJ concluded that the Agencies failed to overcome the questions raised by Xcel Energy regarding the application of the AP2 model beyond the 50 kilometer distance, contrary to guidance offered by the U.S. Environmental Protection Agency (EPA) for steady-state Gaussian plume models. According to the ALJ, this was particularly troublesome when combined with the fact that AP2 also models individual pollutants separately, in isolation from one another.[21]

Second, the ALJ maintained that the Agencies had failed to demonstrate that AP2 can reliably predict ambient air concentrations or estimate criteria pollutant values across the contiguous United States,[22] and recommended that if damages are to be estimated outside of Minnesota, CAMx is the most reliable model to calculate those costs.[23]

Third, according to the ALJ, the Agencies' performance evaluation of the AP2 model was not reliable, because it was conducted in conflict with established guidelines and against the Boylan and Russell standards. The ALJ noted that the Agencies failed to respond to Xcel Energy's specified and detailed critiques regarding the performance evaluation and instead engaged in circular and unpersuasive reasoning by stating that the positive evaluations themselves were proof that irregularities in the performance evaluation did not matter.[24] The ALJ agreed with Xcel Energy that the AP2 performance evaluation is not reliable or meaningful. Therefore, it does not provide a credible or persuasive basis for claiming that the AP2

[21] ALJ CP Report, Conclusion 44 at 101.
[22] ALJ CP Report, Conclusion 43 at 101
[23] ALJ CP Report, Recommendation 5 at 105.
[24] ALJ CP Report, Conclusions 20-23 at 96-97.

air quality modeling results are accurate or that the EPA-recommended 50-kilometer limit is not relevant in AP2's application.

Fourth, the ALJ confirmed that the Agencies' failed to demonstrate that AP2's modeling of nearly 400 hypothetical sources[25] was reasonable, based on the fact that the estimated damage values for the hypothetical sources were far higher than the damages estimated for the actual, large power plants[26] that were modeled individually.[27] We agree with the ALJ's conclusion regarding the hypothetical facilities, but believe this conclusion should have also been incorporated into her recommendations. Since the ALJ concluded that the AP2 modeling results for hypothetical facilities are not reliable, then the corresponding recommendation would be to limit the use of AP2 to the modeling of actual plants, with the precise location and stack height of the plant.

Based on the full record compiled, Xcel Energy believes that all of these conclusions regarding the AP2 model are appropriate. However, despite finding significant shortcomings in the AP2 modeling, the ALJ recommends that AP2 can be used, but only to estimate damages within Minnesota,[28] and only under one circumstance: If the Commission determines it is appropriate for policy reasons to model a large number of sources in different locations. Accordingly, her alternative Recommendation No. 4b suggests that AP2 could be used to model a hypothetical

[25] For the hypothetical plants, one ton of each pollutant was modeled in the county centroid using the same effective stack height.
[26] Six actual plants (High Bridge, Riverside, Allen S. King, Black Dog, Clay Boswell, and Sherco) were modeled individually in Minnesota and 26 actual plants were modeled individually outside of Minnesota, based on their physical characteristics (e.g., stack height) and precise location. See Ex. 808 (Muller Direct), Schedule 2 at 29.
[27] ALJ CP Report, Conclusions 18-19 at 95.
[28] ALJ CP Report, Recommendation 5 at 105.

facility in each of Minnesota's 87 counties.[29] We disagree with this recommendation and discuss our exceptions to it below in Section V.

Finally, the ALJ's Conclusion No. 17 finds that the Agencies' proposed method to update the externality values for criteria pollutants is not reasonable or reliable,[30] and we concur with this assessment.

### D. Xcel Energy Does Not Take an Exception to the ALJ's Conclusion Regarding Concentration-Response Function, But Takes Limited Exception to VSL by Also Suggesting a Low-End VSL

Although Xcel Energy believes that its approach to estimate concentration-response function and VSL values is based on the best and most recent science, we do take a limited exception to the ALJ's conclusions and recommendations regarding these two issues. Considering the uncertainty in estimating premature mortality risk from $PM_{2.5}$ exposure, we believe a range is a better option than a single value for both the concentration-response function and VSL. For the concentration-response function, we suggest that the Commission could adopt the ALJ-recommended range of 6 percent to 7.3 percent, which is within the range we have proposed (5.3 percent to 7.3 percent).[31]

While we would prefer our proposed VSL range, we can accept the ALJ's recommended VSL value of $7.70 million as the high end of a range.[32] This value is in the upper end of the VSL ranges proposed by the Agencies ($3.7 million to $9.5 million in 2011 dollars) and Xcel Energy ($4.1 million to $7.9 million in 2014 dollars).[33] In order to establish a VSL range, we suggest the Commission also adopt a

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[29] ALJ CP Report, Recommendation 4b at 104.
[30] ALJ CP Report, Conclusion 17 at 95.
[31] ALJ CP Report, Recommendation 3 at 104. Our understanding is that the ALJ recommends a range of 6 percent to 7.3 percent, or alternatively, a single value of 6.8 percent. We believe Conclusion 50 at 102 inadvertently listed the range as 6.8% - 7.3%.
[32] ALJ CP Report, Recommendation 2 at 104.
[33] For a summary of the proposed values, see ALJ CP Report, Conclusion 48 at 102.

low-end value, which could be either of the low VSL values proposed by the Agencies and Xcel Energy, $3.7 million or $4.1 million. Because these modifications do not affect the air quality modeling component we conducted with the CAMx model, we can easily update our damage value calculations timely and cost-effectively, and can provide these results to the Commission upon short notice.

## III. EXCEPTIONS REGARDING THE GEOGRAPHIC SCOPE OF DAMAGES, WHICH SHOULD NOT EXTEND BEYOND 100 MILES FROM THE MINNESOTA BORDER

The ALJ concluded that the question of the geographic scope of damages is a policy matter to be decided by the Commission,[34] and chose not to take a position on this issue. We agree in principle, but think it would have been helpful for the Commission to have a direct recommendation based on the ALJ's opinion of the appropriate geographic scope for estimating criteria pollutant damages. We note, however, that the ALJ recognized in her Memorandum that in the original externalities proceeding the Commission chose to limit the damages geographically, at least in part, because of the impracticability of attempting to accurately determine what the damages are outside of the state. The ALJ continued by stating that *the Commission could make that choice again.*[35]

We have argued that the Agencies and the CEOs have presented conflicting, unconvincing, and sometimes flawed estimates regarding the proportion of damages that occur within Minnesota and outside of Minnesota.[36] The ALJ agreed with us, and concluded "that the preponderance of the evidence failed to demonstrate the percentage of $SO_2$ and $NO_x$ emitted in Minnesota that cause impacts and damages outside the state of Minnesota."[37] According to the ALJ, the evidence shows that

[34] ALJ CP Report, Recommendation 5 at 105.
[35] ALJ CP Report, Memorandum at 107.
[36] Xcel Energy's Initial Brief at 53-55; Xcel Energy's Reply Brief at 9-10.
[37] ALJ CP Report, Conclusion 37 at 100.

damages from primary $PM_{2.5}$ are mostly local and regional, but it is possible that $SO_2$ and $NO_x$ emissions can have impacts at further distances.[38] This is consistent with Xcel Energy's position in this case: Impacts from criteria pollutant emissions are mainly local and regional, and although a small proportion of concentration changes may occur outside of our CAMx modeling area, it is not practicable or reasonable to estimate damages across the entire contiguous United States.[39]

Xcel Energy has discussed many reasons that speak against adopting a national scope for estimating criteria pollutant damages, and has argued that all of these factors should be considered together, including the long-standing Commission precedent, the mostly local and regional nature of criteria pollutants, the significant uncertainty involved in estimating national damages, and the protection of human health through the federal NAAQS and CSAPR regulations.[40]

***Long-Standing Commission Precedence.*** The legislative history of Minn. Stat. § 216B.2422, Subd. 3 does not explicitly address whether the environmental costs should be measured based on their impact within Minnesota or nationwide, but there was a strong preference to focus on protecting Minnesota's economy, environment, and residents. The original Commission interpretation, which estimated criteria pollutant impacts in Minnesota, is consistent with the legislative history.[41] In the initial proceeding, the ALJ and the Commission concluded that unlike $CO_2$, criteria pollutants are local and regional by nature. The Commission found it reasonable to "focus on the effects of by-products that cause the most significant

[38] ALJ CP Report, Conclusion 37 at 99-100.
[39] Xcel Energy's Reply Brief at 10; Xcel Energy's Initial Brief at 52-53; Ex. 608 (Desvousges Surrebuttal) at 35.
[40] See Xcel Energy's Initial Brief at 52-61; Xcel Energy's Reply Brief at 6-10.
[41] Xcel Energy's Initial Brief at 8-9.

costs," and for criteria pollutants this meant "quantifying the damage they cause in Minnesota."[42]

***Regional Nature of $PM_{2.5}$, $SO_2$, and $NO_x$.*** Impacts from criteria pollutant emissions are mainly local and regional – the majority of air quality changes from Minnesota sources will occur in Minnesota or in close proximity to the Minnesota border. It is widely recognized that changes to ambient concentrations from direct emissions of $PM_{2.5}$, $SO_2$, and $NO_x$ will generally be greatest near the source and will decrease with distance – concentrations are typically small at a distance of 50 kilometers. Secondary $PM_{2.5,}$ formed from $SO_2$ and $NO_x$ emissions, tends to travel further; however, the majority of concentration changes will still take place within 100 miles (160 kilometers) from the source.[43]

***Modeling Uncertainty at Further Distances.*** There is substantial uncertainty in estimating national damages from criteria pollutant emissions. Determining damages on a national scope hinges on the ability of models to accurately predict changes in ambient air concentrations throughout the contiguous United States. Uncertainty is significantly increased and estimates become less reliable the further the modeling distance is from the emission source. For example, small errors in wind speed or direction will have escalating impacts as the modeling distance increases from the source. This is especially true for models that rely on steady-state Gaussian plumes, such as AP2, but also applies to other reduced-form models as well as photochemical grid models.[44]

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[42] Docket No. E-999/CI-93-583. *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3*. ORDER ESTABLISHING ENVIRONMENTAL COST VALUES. January 3, 1997 at 15.

[43] Ex. 608 (Desvousges Surrebuttal) at 35; Ex. 119 (Marshall Surrebuttal), Schedule 2 (Xcel Energy's Response to CEO IR No. 11 and No. 12); Xcel Energy's Initial Brief at 52-53.

[44] Ex. 608 (Desvousges Surrebuttal) at 46; Xcel Energy's Initial Brief at 55.

***Uncertainty of Health Impacts Attributable to Very Small Changes in Concentrations.*** Estimating a national scope of damages involves additional uncertainty, because all the models in this proceeding predicted very small ambient air concentration changes at further distances (e.g., 0.00000298 μg/m$^3$ or 0.000000643 μg/m$^3$).[45] AP2, InMAP, and CAMx do not have a limit on how small concentration changes can be calculated; neither do they incorporate any estimate of the variance or uncertainty around the predicted results. What this means is that the models do not report any measures of significance or confidence that could help estimate the validity of the predicted concentration changes.[46]

We take exception to the ALJ's Conclusion No. 54, which states that "the relationship between chronic exposure to $PM_{2.5}$ and all-cause cardiovascular and lung-cancer mortality is linear without a threshold."[47] Here, the ALJ relied on the evidence presented by the Agencies and the CEOs. They both referenced epidemiological studies that supported the linear treatment of $PM_{2.5}$ concentration-response function; however, only *down to 8 μg/m$^3$* or *down to the lowest measured levels*.[48] These concentration levels are much higher than the concentration levels predicted by AP2, InMAP, and CAMx in this proceeding (e.g., CAMx predicted an average change in $PM_{2.5}$ concentration of 0.0000198 μg/m$^3$ within a 100 mile radius from Minnesota).[49] The health studies are simply *not designed to determine health impacts at these low concentration levels, which are beyond the measurement or observation capabilities of today's monitors.* Contrary to the Agencies' and the CEO's claims, epidemiological research has not addressed adverse health effects at extremely low ambient concentration levels (such as 0.001

[45] These examples are AP2 and InMAP average changes in ambient $PM_{2.5}$ concentrations from the Sherco plant beyond one hundred miles of Minnesota. See Ex. 608 (Desvousges Surrebuttal) at 43.
[46] Ex. 608 (Desvousges Surrebuttal) at 44; Hearing Transcript, Vol. 7 at 115 (Desvousges).
[47] ALJ CP Report, Conclusion 54 at 103.
[48] ALJ CP Report, Finding 297 at 91, Finding 301 at 92.
[49] Ex. 608 (Desvousges Surrebuttal) at 43. AP2 predicted an average change in $PM_{2.5}$ concentration of 0.0000205 μg/m$^3$ within the 100 mile radius from Minnesota and InMAP predicted an average change in $PM_{2.5}$ concentration of 0.0000323 μg/m$^3$ within the 100 mile radius from Minnesota.

$\mu g/m^3$) or examined whether the linear application of concentration-response function still applies at very low concentration levels (such as 0.00003 $\mu g/m^3$).[50]

While the linear nature of the concentration-response function has not been established or validated at very low concentration levels, Xcel Energy recognizes that all three models used in this proceeding treated concentration-response function linearly. We understand that this practice increases uncertainty, especially when predicted ambient air concentrations are estimated out to five to eight digits, and is one of the reasons why Xcel Energy opposes estimating nationwide damages.

To estimate mortality damages from $PM_{2.5}$, these very small (and scientifically unmeasurable) ambient concentrations are multiplied by the concentration-response function, then by the value of a statistical life, and finally by the number of people who are potentially exposed to the concentration change. When the damages from $PM_{2.5}$, $SO_2$, and $NO_x$ are estimated nationwide, the externality values increase substantially, simply because the very small concentration changes – that cannot be measured or observed, may or may not cause human health effects, and may or may not cause health effects in a linear manner – can be calculated by computer programs.[51]

***Human Health Protection Through NAAQS and CSAPR.*** Xcel Energy has presented substantial evidence that, from a public policy perspective, there is no need to estimate impacts from criteria pollutants far beyond Minnesota, because federal rules and regulations are already in place to minimize damages from the interstate transport of emissions. Since the last externalities proceeding, there has been considerable change in the regulation of emissions through the National

[50] Ex. 608 (Desvousges Surrebuttal) at 42-44; Hearing Transcript, Vol. 7 at 113-117 (Desvousges). For example, the CEOs only refer to literature that finds linear relationship at *observed* concentrations down to 8 $\mu g/m^3$, but not at very low concentrations levels below that, see the CEOs Initial Brief at 48.
[51] Hearing Transcript, Vol. 7 at 113 (Desvousges); Hearing Transcript, Vol. 8 at 33-34 (Muller); Xcel Energy's Initial Brief at 55-60.

Ambient Air Quality Standards (NAAQS) and the Cross State Air Pollution Rule (CSAPR), which has limited the potential impacts of emissions across state lines. Today, NAAQS are set at levels that are protective of human health and the environment and EPA has determined through CSAPR modeling and required reductions that Minnesota is not significantly contributing to ambient air concentrations of $PM_{2.5}$, $SO_2$ or $NO_x$ in any other state.[52] At the time of the original externalities proceeding, EPA had not kept the NAAQS updated; NAAQS did not reflect the latest scientific knowledge; and regulations on the interstate transport of emissions did not exist.[53] CSAPR now requires strict emission reductions to eliminate any significant impacts of upwind state contributions to ambient air quality in downwind states.[54]

We take exception to the ALJ's Conclusion No. 47, which states that Xcel Energy failed to demonstrate that Minnesota's compliance with the CSAPR standards reduces cross-border damages from criteria pollutant emissions to zero.[55] We have never claimed that the potential damages from Minnesota criteria pollutant emissions would be zero in other states, but indicated that according to EPA analysis Minnesota emissions are not contributing significantly to ambient air quality in other states. We have argued that 1) there are already federal regulations in place to deal with cross state air pollution, 2) CSAPR regulations limit the impact one state can have on ambient air concentrations in downwind states, and 3) Minnesota is in compliance with these standards. Therefore, considering the significant uncertainties involved in nationwide air quality modeling, we do not believe it is necessary or practicable that externality values for criteria pollutants account for damages far beyond Minnesota.

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[52] Ex. 607 (Rosvold Rebuttal) at 2-14; Ex. 617 (Rosvold Opening Statement) at 1-2.
[53] Docket No. E-999/CI-93-583. *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3*. FINDINGS OF FACT, CONCLUSIONS, RECOMMENDATION, AND MEMORANDUM. March 22, 1996, Finding 46 at 23.
[54] Ex. 607 (Rosvold Rebuttal) at 10-14; Ex. 617 (Rosvold Opening Statement) at 1-2.
[55] ALJ CP Report, Conclusion 47 at 102.

There are also requirements in place to ensure Minnesota continues to comply with NAAQS and CSAPR regulations.

Xcel Energy believes all the reasons discussed above – when considered together – form a practicable, reasonable, and persuasive basis not to estimate damages from Minnesota criteria pollutant emissions on a national or interstate basis. We agree with the Commission's reasoning in the original externalities proceeding, where it noted that "the quantification of all environmental impacts, however slight, difficult to measure, or irrelevant," would be a "bottomless and highly speculative task."[56] We respectfully request the Commission estimate damages within our CAMx modeling domain, which extends to approximately 100 miles beyond the Minnesota border.

However, if the Commission determines it is appropriate to extend the modeling area to the entire contiguous United States or some other substantial area outside of Minnesota, we believe the ALJ reached the correct conclusion regarding the model that is capable of doing this. As stated in Conclusion No. 43, "neither the CEOs nor the Agencies have proved by a preponderance of the evidence that their respective InMAP and AP2 models can reliably predict CP externality values across the contiguous U.S."[57] In Recommendation No. 5, the ALJ "respectfully recommends the CAMx model as the most reliable model to calculate those [nationwide] costs."[58]

[56] Docket No. E-999/CI-93-583. *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3*. ORDER ESTABLISHING ENVIRONMENTAL COST VALUES. January 3, 1997 at 12.
[57] ALJ CP Report, Conclusion 43 at 101.
[58] ALJ CP Report, Recommendation 5 at 105.

## IV. EXCEPTIONS REGARDING THE CAMx MODELING

### A. Adding Source Locations to Xcel Energy's CAMx Modeling Is Unnecessary (Recommendation No. 4a)

We continue to believe that Xcel Energy's approach to establish externality values for the urban, metropolitan-fringe, and rural locations – consistent with the current practice and using the most reliable model – is reasonable, practicable, and the best available measure of the criteria pollutants' cost. It would be appropriate for the Commission to accept our modeling results,[59] which the ALJ has already determined to be the most reliable in this case. We take exception to the ALJ's Recommendation No. 4a, which proposes adding two or three source locations to our CAMx modeling and includes some additional suggestions for the locations and modeling parameters. The ALJ's Recommendation No. 4a reads:

> Adopt a model configuration that provides a five- or six-tiered version of Xcel's three-tiered proposed sources and source locations. The Administrative Law Judge recommends that the additional tiers incorporate factors such as nearby topography, vegetation, buildings etc. consistent with the Agencies' recommendations. The tiers could accomplish this by including variations on the rural category to account for rural settings that are isolated versus rural settings that are less so, and possibly a "small town" category. This would enable the Commission to gain additional information beyond the three categories Xcel Energy proposed. If the Commission chooses this option, the Administrative Law Judge respectfully recommends that the Commission choose the CAMx model, if the Commission finds that the CAMx model would be practicable to use with this somewhat expanded scope. The Administrative Law Judge recommends the CAMx model because it is more reliable than AP2.

Xcel Energy used CAMx to model a hypothetical, new coal-fired power plant in three locations: Dakota County (Black Dog facility), Sherburne County (Sherco facility), and Lyon County (Marshall facility). We do not believe it is necessary to include additional source locations to the CAMx modeling. As we will explain in more

[59] Incorporating the final VSL and concentration-response function values as decided by the Commission.

detail in Section V, we modeled the Marshall, Sherco, and Black Dog locations because they are representative of a rural, a metropolitan-fringe, and an urban area in Minnesota. They are consistent with the geographic groupings adopted in the original proceeding, provide realistic potential locations for a new power plant, and are carefully located to constitute a cautious, yet representative approach.

However, if the Commission disagrees with us and chooses to add source locations to CAMx modeling, we emphasize it is important to carefully consider these locations. As explained during the proceeding, the decisions where to site new fossil-fueled resources depend on many factors, such as transmission capacity and proximity to industrial centers, and there are not that many counties in Minnesota that would be potential, realistic locations for a new power plant.[60] We disagree on limiting the new source locations to rural areas or a small town category, as the ALJ suggests. Instead, a northern mid-urban location, such as Duluth, could be a viable option. We would oppose adding any new source locations outside of Minnesota, and continue to advocate that it would be impractical to model out-of-state resources.

In addition, the ALJ's Recommendation No. 4a states that the modeling of the additional source locations should "incorporate factors such as nearby topography, vegetation, buildings, etc. consistent with the Agencies' recommendations."[61] We take exception to this suggestion, and are unclear where the Agencies have made this recommendation, since the AP2 model does not account for these types of factors. Regardless, if the Commission chooses to have additional locations evaluated, we believe it is important that the modeling parameters and assumptions for the additional source locations are the same as in the original CAMx modeling in order to ensure consistency. In addition, we note that the CAMx model does take into account

[60] Ex. 607 (Rosvold Rebuttal) at 25-26; Ex. 617 (Rosvold Opening Statement) at 6; Xcel Energy's Initial Brief at 63-64.
[61] ALJ CP Report, Recommendation 4a at 104.

topography. If any assumptions are modified, such as VSL and concentration-response function, they should be applied consistently to the initial CAMx modeling as well as to the modeling of new source locations. All other modeling parameters should remain intact and consistent, including hourly-calculated plume rise, emission rates, stack parameters (e.g., stack height, flue gas exit velocity, temperature, MBtu consumption rate), and meteorological conditions.

Similarly, the types of damages estimated should remain the same as in the original CAMx modeling, and include impacts on human health, agriculture, building materials, and visibility.[62]

### B. Modeling of Riverside Emissions for Primary $PM_{2.5}$ Does Not Affect Xcel Energy's Final Damage Values (Conclusion No. 27)

Xcel Energy modeled the hypothetical plants as a point source, based on Sherco Unit 1 operational data from 2014, using hourly-calculated plume rise, representative emission rates, representative stack parameters (e.g., height, stack gas exit flow velocity, and temperatures), and hourly-varying meteorological conditions.[63] However, the Riverside facility emission rate was inadvertently used for modeling primary $PM_{2.5}$.[64] All other necessary operating parameters, such as stack height, flue gas exit velocity and temperature, and MBtu consumption rate, were correctly based on Sherco Unit 1 data.

We filed errata and explained in written testimony and legal briefs that the use of Riverside primary $PM_{2.5}$ rate did not impact our final $PM_{2.5}$ externality values because of the linear nature of increased ambient concentrations of $PM_{2.5}$ from direct

[62] E.g., Ex. 604 (Desvousges Direct) at 21.
[63] Ex. 604 (Desvousges Direct) at 18, Schedule 2 at 18-24, Schedule 3 at 20.
[64] The Riverside primary $PM_{2.5}$ rate used was 9.4 tons.

$PM_{2.5}$ emissions.[65] As all parties have discussed, there are two types of $PM_{2.5}$ evaluated in this case: $PM_{2.5}$ can be emitted directly as primary $PM_{2.5}$, but it can also be formed secondarily from $SO_2$ emissions (to form ammonium sulfate, $AmmSO_{4)}$ and from $NO_x$ emissions (to form ammonium nitrate, $AmmNO_3$).[66] Direct or primary $PM_{2.5}$ has no influence on the formation of secondary $PM_{2.5}$.

We further explained that if we had modeled an incorrect amount of $SO_2$ or $NO_x$, our final externality values would have been affected because of the non-linear chemistry of secondary $PM_{2.5}$ formation from $SO_2$ and $NO_x$ emissions. The complex chemical reactions to form secondary $PM_{2.5}$ in the atmosphere depend on the quantity of $SO_2$ and $NO_x$ emissions, the quantity of other chemicals present (e.g., ozone, ammonia), and other factors (e.g., temperature, relative humidity, amount of clouds and sunlight).[67] For example, emissions of $NO_x$ can react and combine in the atmosphere with ammonia to form ammonium nitrate, a form of secondary $PM_{2.5}$. If there is more $NO_x$ present than ammonia, the formation of ammonium nitrate is limited by the amount of ammonia present. This example of a non-linear reaction is not affected by emissions of primary $PM_{2.5}$.

However, the ALJ was not convinced with our attempts to explain why the mistake in direct $PM_{2.5}$ emission rate did not affect our final results. In Conclusion No. 27, the ALJ stated that Xcel Energy failed to recalculate the costs following the discovery of its accidental use of $PM_{2.5}$ emissions data from its gas-fired Riverside facility and failed to demonstrate why the mingling of $SO_2$ and $NO_x$, (which were modeled with the correct emission rate) with primary $PM_{2.5}$ (which was modeled at a reduced emission rate), would not have altered the modeling results.

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[65] An errata was filed on October 13, 2015. Ex. 604 (Desvousges Direct) at 18; Ex. 604A (Errata to Exhibit 604); Ex. 605 (Desvousges Rebuttal) at 5, 39-40, 42; Ex. 608 (Desvousges Surrebuttal) at 2-3, 7-13; Ex. 811 (Muller Surrebuttal), Schedule 1 (Xcel Energy's Supplemental Response to DOC IR No. 16).
[66] Xcel Energy's Initial Brief at 15; Ex. 604 (Desvousges Direct) at 16.
[67] Ex. 608 (Desvousges Surrebuttal) at 12.

Here, we would like to clarify the nature of primary $PM_{2.5}$: It is a particulate directly emitted in the flue gas and it does not react with other chemicals or emissions in the plume. While $SO_2$ and $NO_x$ have complex chemical reactions in the atmosphere, primary $PM_{2.5}$ does not – primary $PM_{2.5}$ is directly emitted, dispersed, and deposited on the ground as the plume moves downwind. An example of a primary particulate would be ash from a wood-burning fire.

Primary $PM_{2.5}$ is treated linearly by the AP2, InMAP, and CAMx models, meaning that the relationship between the $PM_{2.5}$ emission rate and the resulting ambient $PM_{2.5}$ concentration change are linear. That is, if 100 tons of primary $PM_{2.5}$ emissions produce a 10 $\mu g/m^3$ change in ambient $PM_{2.5}$ concentrations, then it is presumed that 10 tons of primary $PM_{2.5}$ emissions would produce a 1 $\mu g/m^3$ change in ambient $PM_{2.5}$ concentrations.

The final externality values are reported and calculated on a cost per ton-basis ($/ton), after the VSL and concentration-response function have been incorporated into calculations. The estimated costs are also assumed to be linear based on the ambient concentration. For example, if a 10 $\mu g/m^3$ change in ambient $PM_{2.5}$ concentration resulted in an estimated cost of $10,000, then it is assumed that a 1 $\mu g/m^3$ change in ambient $PM_{2.5}$ concentration would results in an estimated cost of $1,000. In the end, based on our example of modeling 100 tons or 10 tons of $PM_{2.5}$ emissions, the cost per ton is the same in both examples, the result being $100 per ton.

This simply means that in the end, after the concentration-response function and VSL have been incorporated into calculations, the damage values can be divided by the number of tons modeled for each criteria pollutant to arrive at the $/ton value. Because CAMx (as well as InMAP and AP2) treat primary $PM_{2.5}$ linearly, this ultimately means that it does not matter whether 9.4 tons, 500 tons, or 1,000 tons of

primary $PM_{2.5}$ was modeled.[68] There was no reason or need to recalculate our $PM_{2.5}$ damage values after we realized that we had used the Riverside primary $PM_{2.5}$ emission rate, because the final per ton damage values would have been the same. It is also important to note that none of the other Parties have taken issue with this explanation in their testimony.

## V. EXCEPTIONS TO USING AP2 TO MODEL A LARGE NUMBER OF SOURCE LOCATIONS

### A. It Is Not Reasonable or Practicable to Establish County-Specific Externality Values

The ALJ concluded that the question of how many source locations should be modeled is a policy matter to be decided by the Commission,[69] and chose not to take a position on this issue. Again, we agree in principle, but think it would have been helpful for the Commission if the ALJ had expressed her final opinion on the appropriate number of source locations. In addition, we believe that the ALJ's alternative Recommendation No. 4b (potentially use AP2 to model a source in each Minnesota county) is inconsistent with her Conclusion No. 35 (the county-by-county approach is not reasonable within Minnesota). The ALJ's Conclusion No. 35 reads:

> The Administrative Law Judge concludes that the Agencies and the CEOs did not demonstrate, by a preponderance of the evidence, that their county-by-county source approach within Minnesota is a reasonable approach. It is not reasonable because nothing in the record indicates the Commission requires or has expressed a need for this level of detail in resource planning or certificate of need or related proceedings.[70]

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[68] For example, let's say we modeled 1,000 tons of primary $PM_{2.5}$ and the damage cost is $20,000. From 500 tons of primary $PM_{2.5}$, the damages costs would be $10,000 because of the linearity. In the end, the per ton damage value for each example is $20.

[69] ALJ CP Report, Recommendation 5 at 105.

[70] ALJ CP Report, Conclusion 35 at 99.

We agree with the ALJ, and find her conclusion clear and strong: The Agencies and the CEOs failed their burden of proof to show that it is reasonable to model and estimate separate criteria pollutant externality values for each Minnesota county, and therefore, there is no need to model a source location in 87 different counties. In light of Conclusion No. 35, we are puzzled by the ALJ's alternative Recommendation 4b, which reads:

> Adopt a model configuration that includes all 87 counties in Minnesota, but only out-of-state sources that reflect active EGUs in the out-of-state locations. The Administrative Law Judge recommends that county-specific information not be combined or averaged, but used as the CEOs recommended it be used. In addition, the Administrative Law Judge recommends that the Commission exclude out-of-state sources located in eastern Wisconsin, Michigan, and Illinois. If the Commission chooses this option, or some variation of it that is similar in scope and size, the Administrative Law Judge recommends that the Commission choose the AP2 model, which is generally recognized as a reliable model and would be capable of modeling the much larger number of modeling runs needed with this configuration.[71]

Since the ALJ concluded that the Agencies and the CEOs failed to demonstrate by a preponderance of the evidence that it is reasonable or practicable to estimate separate externality values for 87 Minnesota counties, then this should no longer be an option in this proceeding.

The Agencies and the CEOs modeled a source in each county in Minnesota and in each county within 200 miles from the Minnesota border, a total of nearly 500 sources. Xcel Energy, on the other hand, modeled one source at three representative locations – Marshall (Lyon County), Sherco (Sherburne County), and Black Dog (Dakota County) – to estimate externality values for a rural, metropolitan-fringe, and urban location consistent with the structure of the current externality values.

[71] ALJ CP Report, Recommendation 4b at 104.

We have argued, and continue to maintain, that it is not practicable or reasonable to estimate county-specific externality values. They provide an overwhelming amount of detailed information, but in many cases there is not much difference in the values from county to county.[72] Specific county values also imply precision that does not exist, considering that the values must be produced by reduced-form models, which use annual average data and highly simplified atmospheric chemistry algorithms.[73]

In addition, we believe it is significantly more important to model a few representative sources with an accurate model than a very large number of sources with an inaccurate model. We have presented detailed and substantial evidence to show that neither AP2 nor InMAP provided reliable results, and the ALJ has, for the most part, agreed. Adding more source locations does not improve the quality of AP2 or InMAP modeling results or make them more useful – inaccurate information simply does not get better if there is more of it.

Xcel Energy selected the Marshall, Sherco, and Black Dog locations because they are representative of a rural, metropolitan-fringe, and urban area in Minnesota. They are consistent with the geographic groupings adopted in the original proceeding and are realistic potential locations for a new power plant. The three locations also represent a cautious approach. The city of Marshall has a larger population than a typical rural setting and is located in the western part of the state, allowing air dispersion over a greater part of Minnesota. The Sherco site is located upwind from the Twin Cities in the predominant wind pattern, and the Black Dog site is located in the largest urban area in the state.[74]

[72] Ex. 608 (Desvousges Surrebuttal) at 62.
[73] Ex. 605 (Desvousges Rebuttal) at 26, 65.
[74] Ex. 608 (Desvousges Surrebuttal) at 61; Ex. 616 (Desvousges Opening Statement) at 2.

Finally, Xcel Energy has argued that it is not practicable to develop county-specific values, because they often cannot be used for their intended purpose in the resource planning process and would not provide useful information in the resource acquisition process. Resource planning determines the size, type, and timing of resource additions or reductions – the location of a new resource is typically unspecified, and therefore resource planning uses a generic resource without a specific location.[75] In resource acquisition, externality values are used in the final stage of the process when specific proposals are weighed against each other by the Commission. However, proposals to build new fossil-fueled resources and the location of those resources are driven by factors other than the externality values: transmission capacity, proximity to existing gas pipelines, distance from population and industrial centers, access to water, land ownership, soil conditions, wild life, and costs to build and operate a facility in its specific location.[76] Since the Commission does not have jurisdiction over siting new generating sources outside of Minnesota, establishing values for the nearly 400 out-of-state counties as proposed by the Agencies and the CEOs (approximately 80 percent of their proposed values) would only be relevant in considering possible long-term power purchases from facilities in other states. It is not practicable to develop and maintain county-specific values for only this situation.[77]

When all of the factors discussed above are considered together, a preponderance of the evidence shows it is not reasonable or practicable to develop and maintain county-specific externality values for 87 Minnesota counties (or nearly 400 out of state counties). In Addition, we do not believe there are practicable reasons to model any sources outside of Minnesota, considering that these values would be rarely used. We also take exception to this part of the ALJ's

[75] Ex. 607 (Rosvold Rebuttal) at 25-26; Ex. 617 (Rosvold Opening Statement) at 6.
[76] Ex. 607 (Rosvold Rebuttal) at 25-26; Ex. 617 (Rosvold Opening Statement) at 6.
[77] Ex. 605 (Desvousges Rebuttal) at 30-31.

Recommendation No. 4b, which contemplates modeling active power plants outside of Minnesota.[78]

We respectfully recommend the Commission finds that Xcel Energy modeled a representative source in three locations and adopts externality values for urban, metropolitan-fringe, and rural locations based on our CAMx modeling.

### B. AP2 Is Not Reliable or Accurate to Model Damages Within or Outside of Minnesota

The ALJ recommends, as an alternative, using AP2 to model damages in Minnesota from many source locations, because AP2 "is generally recognized as a reliable model and would be capable of modeling the much larger number of modeling runs."[79] We take exception to this recommendation and believe the appropriate conclusion, based on the complete record, is that the AP2 model and its results are not accurate enough to estimate damages outside of Minnesota, and are also not accurate enough to estimate damages within Minnesota.

The ALJ concluded that the AP2 modeling has serious problems that affect its reliability in general: AP2 was applied nationally against the 50-kilometer distance limit recommended by the EPA; AP2's modeling of the hypothetical plants was unreasonable; AP2 models each pollutant separately in isolation; and the AP2 model performance evaluation was unreliable because it was conducted against established guidelines. All of these are reasons why the ALJ rejected the use of AP2 to estimate damages outside of Minnesota, and these same issues also apply when damages are estimated within Minnesota. Xcel Energy has presented additional evidence why the AP2 results are not accurate; however, the ALJ did not address this evidence in her report.

[78] ALJ CP Report, Recommendation 4b at 104.
[79] ALJ CP Report, Recommendation 4b at 104.

*1. The 50-Kilometer Limit for Gaussian Plume Models, Recommended by the EPA, Also Applies within Minnesota*

In its Direct Testimony, Xcel Energy discussed the EPA guidelines for air quality modeling and emphasized the importance of understanding the nature and limits of different types of air quality models. We cited EPA's guidelines for models that rely on steady-state Gaussian plumes, such as APEEP and AP2, and explained that the EPA recommends a limit of 50 kilometers for reduced-form models that use steady-state Gaussian plume formation.[80] In our Rebuttal and Surrebuttal Testimonies, we criticized the Agencies' application of AP2 to estimate air quality changes and damages well beyond this 50-kilometer limit across the contiguous United States. We argued that the AP2 model cannot reliably predict air quality changes within Minnesota either, considering that 50 kilometers translates to 31 miles. The longest distance from the Minnesota southern border to the northern border is about 400 miles, and the longest distance from the eastern border to the western border is about 350 miles. In fact, the average distance across a single county in Minnesota is greater than 50 kilometers.[81]

The ALJ stated that the Agencies failed to overcome concerns regarding the 50-kilometer limit applicable to AP2, and found this "particularly troublesome in light of the twin concerns posed by the AP2 model's Gaussian plume and the nature of AP2's design that models individual pollutants separately."[82] In his Surrebuttal Testimony, Dr. Muller gave the following reasons why the 50-kilometer limit should not matter: 1) the Agencies were required to use reduced-form modeling; 2) AP2's performance evaluation showed good performance; and 3) Xcel Energy did not

[80] Ex. 604 (Desvousges Direct) at 17, Schedule 2 at 17-19, Schedule 3 at 1-3.
[81] Ex. 605 (Desvousges Rebuttal) at 21-22; Ex. 608 (Desvousges Surrebuttal) at 15, 36.
[82] See ALJ CP Report, Conclusion 44 at 101.

follow EPA's approaches regarding VSL and concentration-response function.[83] None of these explanations are convincing or persuasive.

First, as we have stated, although the Agencies were directed by the Commission to use a reduced-form model, they were not specifically directed to use a Gaussian plume model or to use it to estimate damages beyond the 50-kilometer limit across the contiguous United States.[84] There are other types of reduced-form models that do not rely on steady-state Gaussian plume formation that can be used to estimate air quality changes beyond 50 kilometers, for example, models that rely on non-steady-state Gaussian puff models (e.g., CALPUFF).[85]

Second, we have maintained throughout this proceeding that there are numerous reasons why the AP2 performance evaluation is not reliable and it should not be used as the basis to claim that the AP2 modeling results are accurate or that the 50-kilometer limit does not matter.[86] The ALJ has agreed with us and concluded that "Xcel demonstrated by a preponderance of the evidence that the Agencies' performance evaluations are not reliable"[87] and that the Agencies failed to address the many specific and detailed concerns regarding the evaluation.[88] Therefore, the performance evaluation does not provide proof or evidence that the AP2 results are accurate when the modeling distance is greater than 50 kilometers.

The last argument used by the Agencies shifts the focus to perceived problems in Xcel Energy's approach, but is irrelevant in addressing the 50-kilometer limit for modeling distance. In the end, the main issue here is not explained – why AP2, which relies on a steady-state Gaussian plume formation, should be considered reliable

[83] Ex. 811 (Muller Surrebuttal) at 6.
[84] Xcel Energy's Initial Brief at 28.
[85] Ex. 605 (Desvousges Rebuttal) at 22; Ex. 604 (Desvosuges Direct), Schedule 3 at 1-3.
[86] Ex. 605 (Desvousges Rebuttal) at 6-7, 51-55; Xcel Energy's Initial Brief at 47-50; Xcel Energy's Reply Brief at 24-27.
[87] ALJ CP Report, Conclusion 21 at 96.
[88] ALJ CP Report, Conclusion 22 at 96.

beyond the 50-kilometer limit recommended by the EPA. The EPA sets national standards regarding environmental regulation and provides air quality modeling guidance. One must assume that the EPA had relevant and compelling scientific reasons to set the limit for steady-state Gaussian plume models to 50 kilometers.

We strongly believe that AP2 cannot reliably estimate air quality changes from $SO_2$, $NO_x$, and $PM_{2.5}$ emissions beyond the 50-kilometer limit recommended by the EPA. Therefore, we take exception to the ALJ's alternative Recommendation No. 4b, which suggests that AP2 can be used to model a significant number of source locations, if the geographic scope of damages is limited to Minnesota. AP2 is simply not appropriate to use for distances greater than 50 kilometers, whether damages are estimated inside or outside of Minnesota.

*2. Other Problems in the AP2 Application Also Apply within Minnesota*

Conclusion No. 18 of the ALJ CP Report states that "the Agencies' failed to demonstrate by a preponderance of the evidence that the modeling of their hypothetical plants is reasonable" and the modeling of hypothetical plants "result in far higher damage costs than the Agencies' damage costs for the largest emitters."[89] Based on this conclusion, AP2 should not be used to model hypothetical plants, because the results are not reliable.

The Agencies used AP2 to model six large power plants (the largest emitters) in Minnesota individually based on their specific location and stack height. In addition, over 400 source locations were modeled in each county in Minnesota and in each county within 200 miles from the Minnesota border as hypothetical plants.

Xcel Energy presented evidence that the Agencies' damage values for the hypothetical plants in Minnesota (based on one incremental ton of $PM_{2.5}$, $SO_2$, and

[89] ALJ CP Report, Conclusion 18 at 95.

$NO_x$ modeled in each of the 87 counties) were several times higher than the damage values for the six actual plants, even if they were located in the same county. According to Dr. Desvousges' Rebuttal Testimony, the hypothetical plants have a particularly significant and disproportionate effect on the higher end of the proposed externality values.[90] His Surrebuttal Testimony showed, for example, that for Dakota county the AP2 damage estimates from the hypothetical plant for $PM_{2.5}$, $NO_x$, and $SO_2$ were six times higher than from the actual Black Dog plant. For Sherburne County, the hypothetical plant values were four times higher than the values for the actual Sherco facility.[91] We have questioned what the Agencies modeled as a hypothetical facility because the damage values are so overstated,[92] however, they did not respond or offer an explanation.

Although the ALJ agreed with us and concluded that it is not reasonable to rely on AP2's modeling of hypothetical plants, she suggested that AP2 can be used to model a significant number of hypothetical sources in Minnesota, if the Commission so chooses.[93] We take exception to this conflicting Recommendation No. 4b. If the AP2's modeling of hypothetical facilities is not reliable, then use of AP2 should be limited to modeling actual plants, with the precise location and stack height of the plant. Logically, the ALJ could have recommended that if the Commission determines there is need to model a significant number of source locations, then AP2 could be used to individually model all existing plants in Minnesota, but not 87 hypothetical facilities. However, as Xcel Energy has argued throughout this proceeding, we do not believe that AP2's modeling results from the actual plants are reliable either, as discussed in more detail below in Section V.B.3.

[90] Ex. 605 (Desvousges Rebuttal) at 6, 42-43.
[91] Ex. 608 (Desvousges Surrebuttal) at 19-20; see also Xcel Energy's Initial Brief at 45-46.
[92] Xcel Energy's Initial Brief at 46.
[93] ALJ CP Report, Recommendation 4b at 104.

In Conclusion No. 15, the ALJ found that the Agencies failed to demonstrate by a preponderance of the evidence that modeling individual pollutants separately is an approach commonly used in this field. According to the ALJ, AP2's modeling of $PM_{2.5}$, $SO_2$, and $NO_x$ in isolation of one another without incorporating flue-gas chemistry in the plume is particularly troublesome, when combined with the application of AP2 beyond the 50-kilometer limit.[94] We agree, but also want to emphasize that modeling each pollutant separately affects the reliability of AP2 modeling within Minnesota, not just outside of Minnesota.

Xcel Energy believes there are several other reasons why the AP2 model cannot be considered reliable, even if damages are estimated only within Minnesota. As a reduced-form model, AP2 relies on simplified chemistry and air dispersion algorithms as well as annual average wind speed and direction data. AP2 uses an air quality model component that is based on a source-receptor (S-R) matrix developed using a steady-state Gaussian plume formulation, which assumes the instantaneous straight-line transport of emissions from the source to receptors. In reality, wind speed and direction are constantly changing both temporally and spatially, which impacts the dispersion of emissions and therefore changes in ambient concentrations. Also, AP2 relies on science and data that is outdated and from different time periods: AP2 uses annual average meteorological data from 1990, emissions data from 2011, and is based on an air quality dispersion model approach that was developed more than 40 years ago in 1973.[95]

Because AP2 uses highly simplified chemical transformation algorithms, it is not capable of modeling ozone and secondary $PM_{2.5}$ concentrations reliably. Dr. Muller himself acknowledges that AP2 models chemical reactions in the atmosphere

[94] ALJ CP Report, Conclusion 44 at 101.
[95] Xcel Energy's Initial Brief at 25; Ex. 605 (Desvousges Rebuttal) at 5, 19, 33-34, Schedule 1 at 8 (DOC Response to Xcel Energy IR No. 10); Ex. 811 (Muller Surrebuttal) at 3.

"in a very simple way."[96] The complex chemical reactions to form secondary $PM_{2.5}$ in the atmosphere depend on the quantity of $SO_2$ and $NO_x$ emissions, the quantity of other chemicals present (e.g., ozone, ammonia), and other factors (e.g., temperature, relative humidity, amount of clouds and sunlight). Ozone and secondary $PM_{2.5}$ formation have highly variable seasonal and daily variations that must be accounted for in order to accurately simulate the change in ambient concentrations, for example, ozone and secondary sulfate $PM_{2.5}$ formation is higher in the summer, whereas secondary nitrate $PM_{2.5}$ formation is higher during cooler periods.[97] EPA's current (2007)[98] and proposed (2014)[99] guidance for ozone and secondary $PM_{2.5}$ modeling recommends using photochemical grid models, such as CAMx, which incorporate full-science atmospheric chemistry.[100] Therefore, the limitations of AP2 to accurately model secondary $PM_{2.5}$ and ozone formation from $SO_2$ and $NO_x$ emissions are also related to the very simplified chemistry algorithms, not only to the modeling distance. AP2 is equally unreliable to estimate secondary $PM_{2.5}$ and ozone formation within Minnesota and outside of Minnesota.

Since AP2 is a reduced-form model, it does not consider flue gas chemistry, but instead models $SO_2$, $NO_x$, and $PM_{2.5}$ in isolation from one another, unlike conditions in a real plume.[101] Dr. Muller modeled an equal ratio of each pollutant – one incremental ton of each separately. As Dr. Muller himself characterized, if one ton of a particular pollutant is added to baseline admissions, "the change in concentration is

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[96] Hearing Transcript, Vol. 8 at 29 (Muller).
[97] Ex. 605 (Desvousges Rebuttal) at 34; Ex. 608 (Desvousges Surrebuttal) at 12.
[98] EPA 2007. "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze." April 2007. http://www3.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf
[99] EPA 2014. "Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$ and Regional Haze." December 2014. http://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf
[100] Xcel Energy's Initial Brief at 26; Ex. 605 (Desvousges Rebuttal) at 35-37.
[101] Ex. 605 (Desvousges Rebuttal) at 37-38.

strictly attributable to that ton."[102] In reality, power plants emit all three criteria pollutants together in different ratios and $SO_2$ and $NO_x$ begin chemical reactions in the point source plume. The ALJ concluded that AP2's modeling of each pollutant separately is problematic; the impacts of this shortcoming are similar whether damages are estimated within Minnesota or outside Minnesota.

*3. AP2 Modeling Results Are Also Inaccurate within Minnesota*

We have presented significant, compelling evidence that the AP2 air quality modeling results are unexpected, inaccurate, and inconsistent with what is known about atmospheric dispersion and chemistry of criteria pollutant emissions. For example, AP2 grossly overstates damages from primary $PM_{2.5}$ and $SO_2$ emissions across the contiguous United States by predicting health impacts in every U.S. county. We do not present this evidence here because the ALJ concluded, appropriately, that AP2 cannot be used to reliably model national damages. However, significant parts of our evidence show that *the AP2 modeling results, based on modeling actual plants individually, are unreliable even when damages are estimated in Minnesota.* Since the ALJ CP Report excluded some of this evidence, we discuss it again here.

The following two figures present comparable results for annual average secondary $PM_{2.5}$ concentrations due to Sherco $NO_x$ emissions. Figure 1 shows AP2 modeling results for the Minnesota modeling domain[103] from the actual Sherco plant[104] and Figure 2 shows CAMx modeling results for the Minnesota modeling domain from the Sherco facility.[105]

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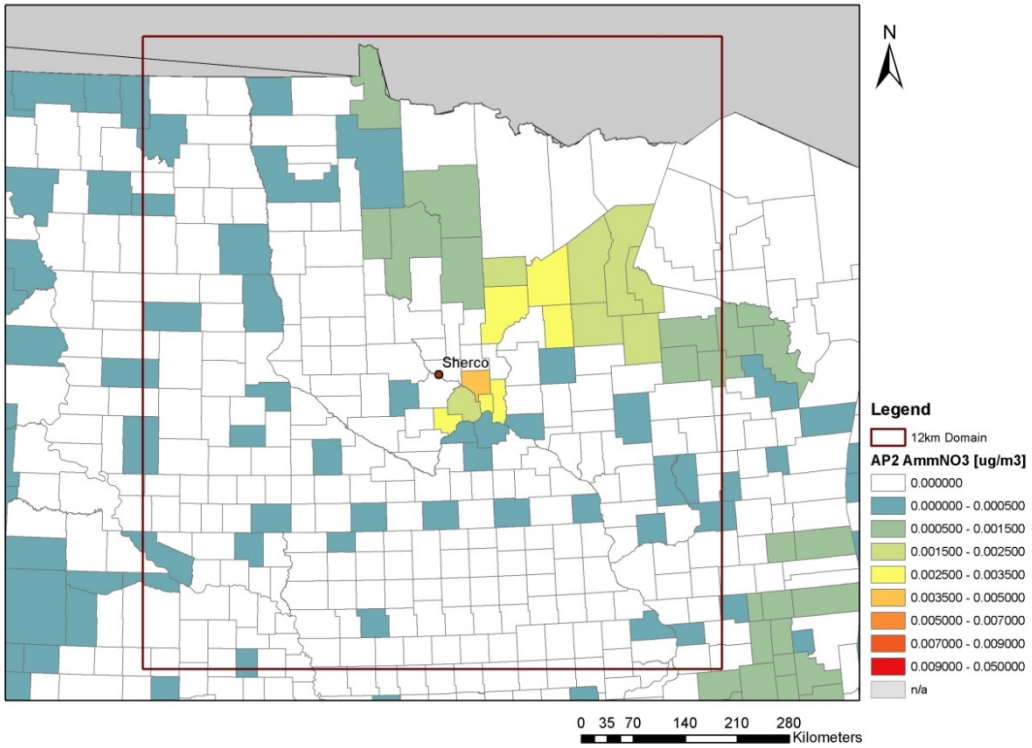
[102] Evidentiary Hearing Transcript, Vol. 8 at 10-11 (Muller).

[103] This is the CAMx modeling domain that encompasses Minnesota and 100 miles from the Minnesota border.

[104] Dr. Muller modeled one incremental ton of $NO_x$ separately based on the plant's actual location and stack height. $NO_x$ emissions are scaled to 3,508.2 tons to be equivalent to what was modeled for CAMx.

[105] A point source was modeled at current Sherco location based on Sherco Unit 1 operational data from 2014, using hourly-calculated plume rise, representative emission rates, representative stack parameters (e.g.,

**Figure 1. AP2 Secondary $PM_{2.5}$ Concentrations within Minnesota Domain from Actual Sherco $NO_x$ Emissions**[106]




height, stack gas exit flow velocity, and temperatures), and hourly-varying meteorological conditions. 3,508.2 tons of $NO_x$ were modeled simultaneously with 1,169.4 tons of $SO_2$ and 9.4 tons of $PM_{2.5}$.

[106] Ex. 608 (Desvousges Surrebuttal) at 24, Figure 3b: AP2 Annual Average Secondary $PM_{2.5}$ Concentrations due to 3,508.2 TPY $NO_x$ Emissions from the actual Sherco EGU in Sherburne County; Ex. 605 (Desvousges Rebuttal), Schedule 5 at 7; Xcel Energy's Initial Brief at 34.

**Figure 2. CAMx Secondary $PM_{2.5}$ Concentrations within Minnesota Domain from Sherco $NO_x$ Emissions[107]**

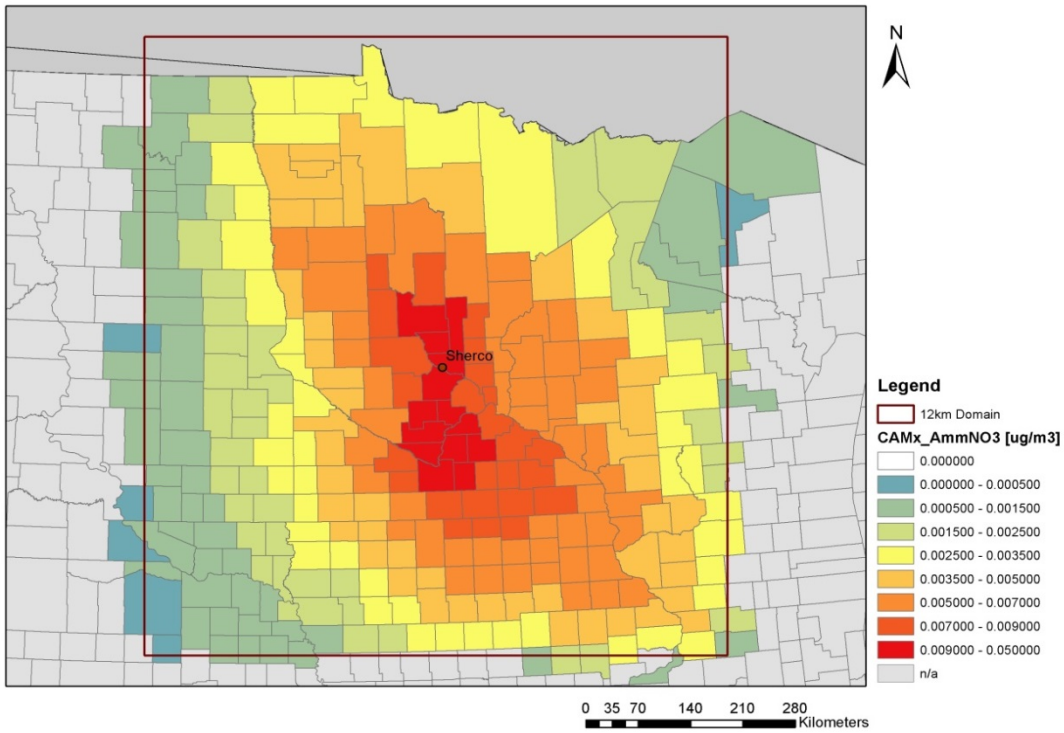



Figure 2 shows that the CAMx results are as expected: The highest secondary $PM_{2.5}$ concentrations are distributed fairly evenly around the Sherco source in all wind directions (north, south, east, and west) and diminish as a function of distance from the facility. High concentration changes are predicted in and near Sherburne County (red and dark orange color) and concentration changes are predicted in every Minnesota county. Figure 1, however, shows very different AP2 results that cannot be accurate, based on what is commonly understood about atmospheric dispersion and chemistry. These sporadic results do not show any secondary $PM_{2.5}$ concentration increases in Sherburne County or, in fact, the majority of Minnesota counties. Most of the map is white and does not indicate high concentration changes (red or dark

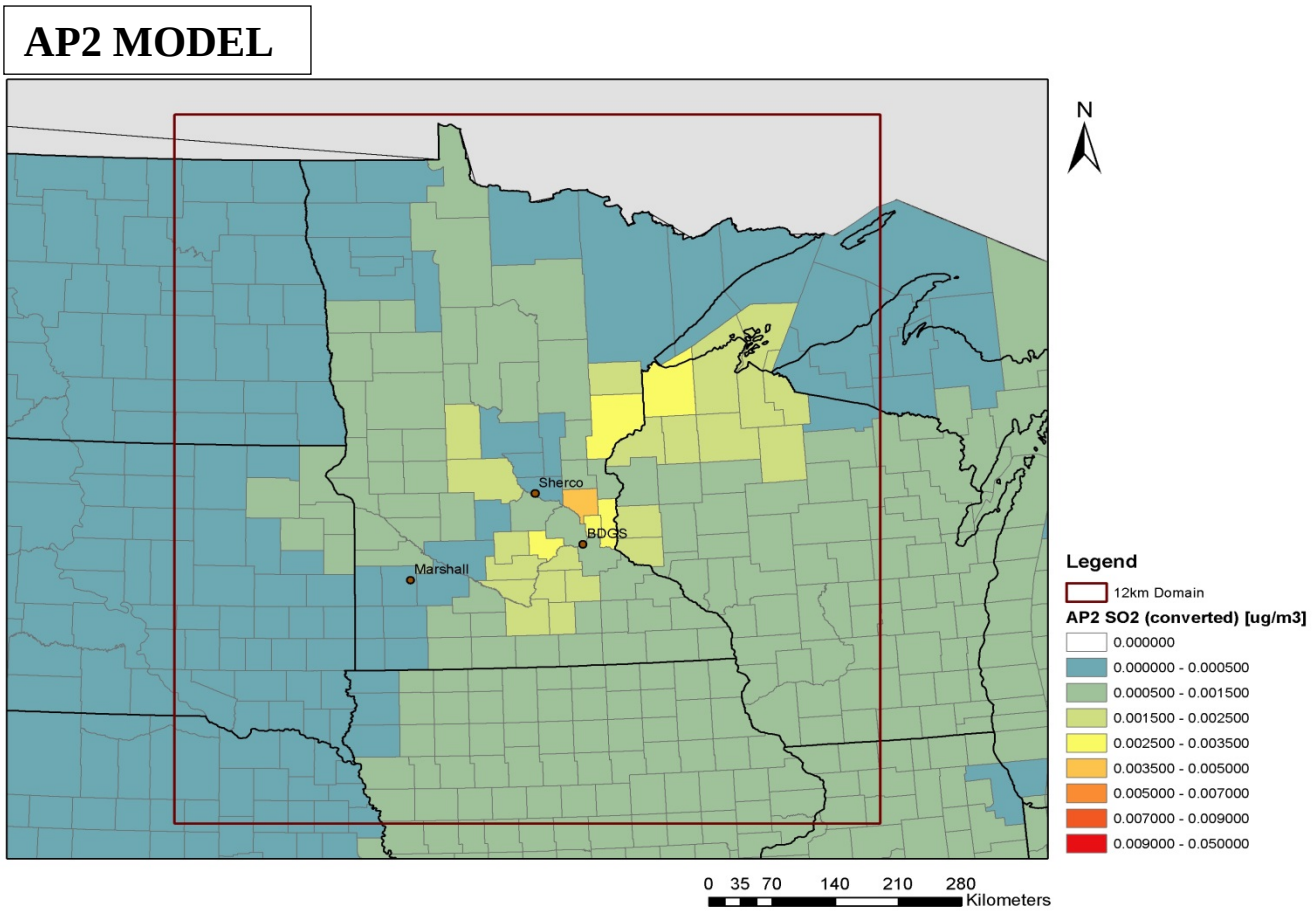
[107] Ex. 608 (Desvousges Surrebuttal) at 23, Figure 3a: CAMx Annual Average Secondary $PM_{2.5}$ Concentrations due to 3,508.2 TPY $NO_x$ Emissions from the Sherco EGU in Sherburne County; Ex. 605 (Desvousges Rebuttal), Schedule 5 at 7; Xcel Energy's Initial Brief at 33.

orange color) in any Minnesota county. We have presented maps in our testimony that showed very similar results for the Lyon County (Marshall) and Dakota County (Black Dog) locations as well, i.e., AP2's modeling results for secondary $PM_{2.5}$ from $NO_x$ skip most of the Minnesota counties and do not show any high concentration changes in Minnesota.[108]

CAMx also predicts much higher ambient concentration changes of secondary $PM_{2.5}$ from $SO_2$ emissions in Minnesota than AP2. Figure 3 below compares AP2 (1st map) and CAMx (2nd map) modeling results for secondary $PM_{2.5}$ from Sherco $SO_2$ emissions. The map for AP2 shows mostly green and blue areas (low concentration changes), while the map for CAMx shows larger areas of orange and yellow (higher concentration changes). Again, we have presented in testimony additional maps that showed very similar results for the Lyon County (Marshall) and Dakota County (Black Dog) locations.[109]

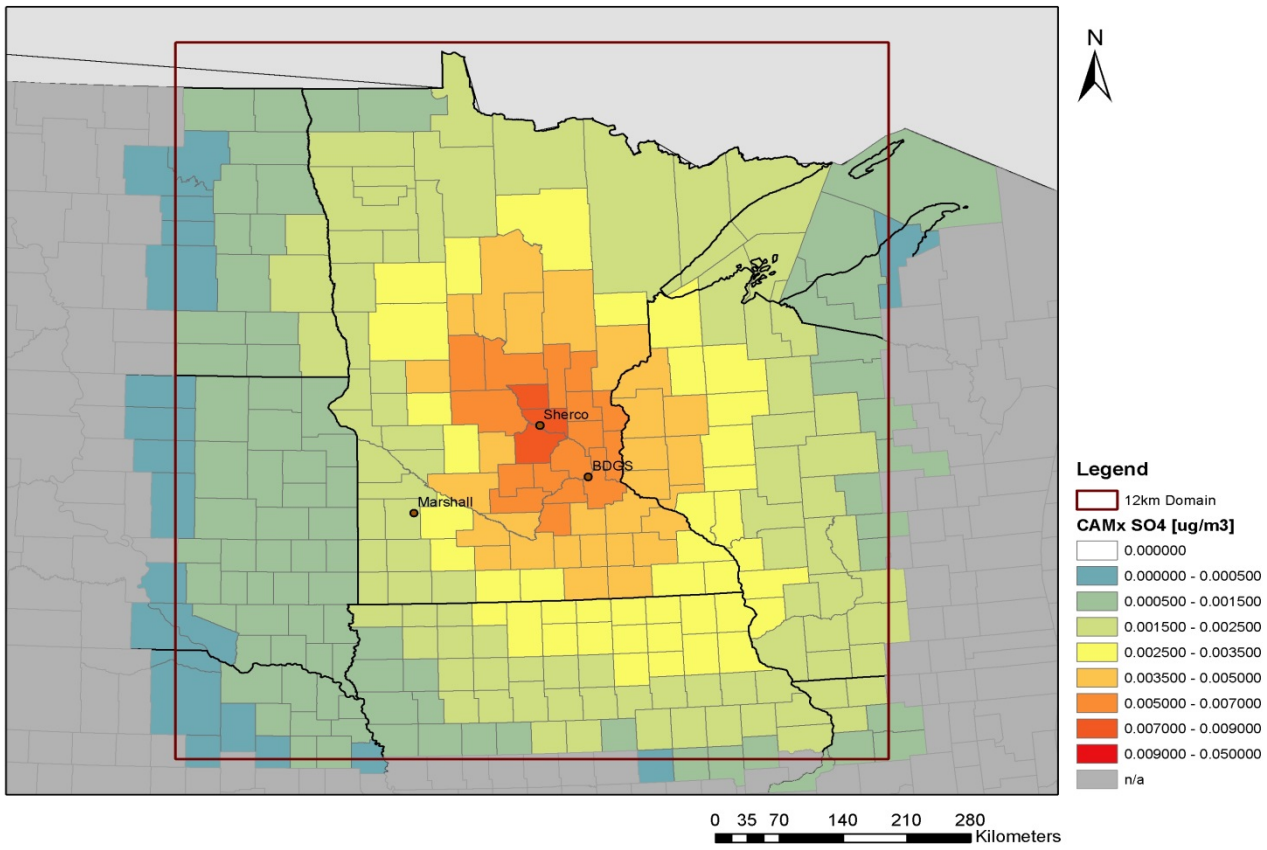
[108] See Ex. 605 (Desvousges Rebuttal), Schedule 5 at 14, 21.
[109] See Ex. 605 (Desvousges Rebuttal), Schedule 5 at 13, 20.

**Figure 3. AP2 and CAMx Secondary $PM_{2.5}$ Concentrations within Minnesota Modeling Domain from Sherco $SO_2$ Emissions**[110]



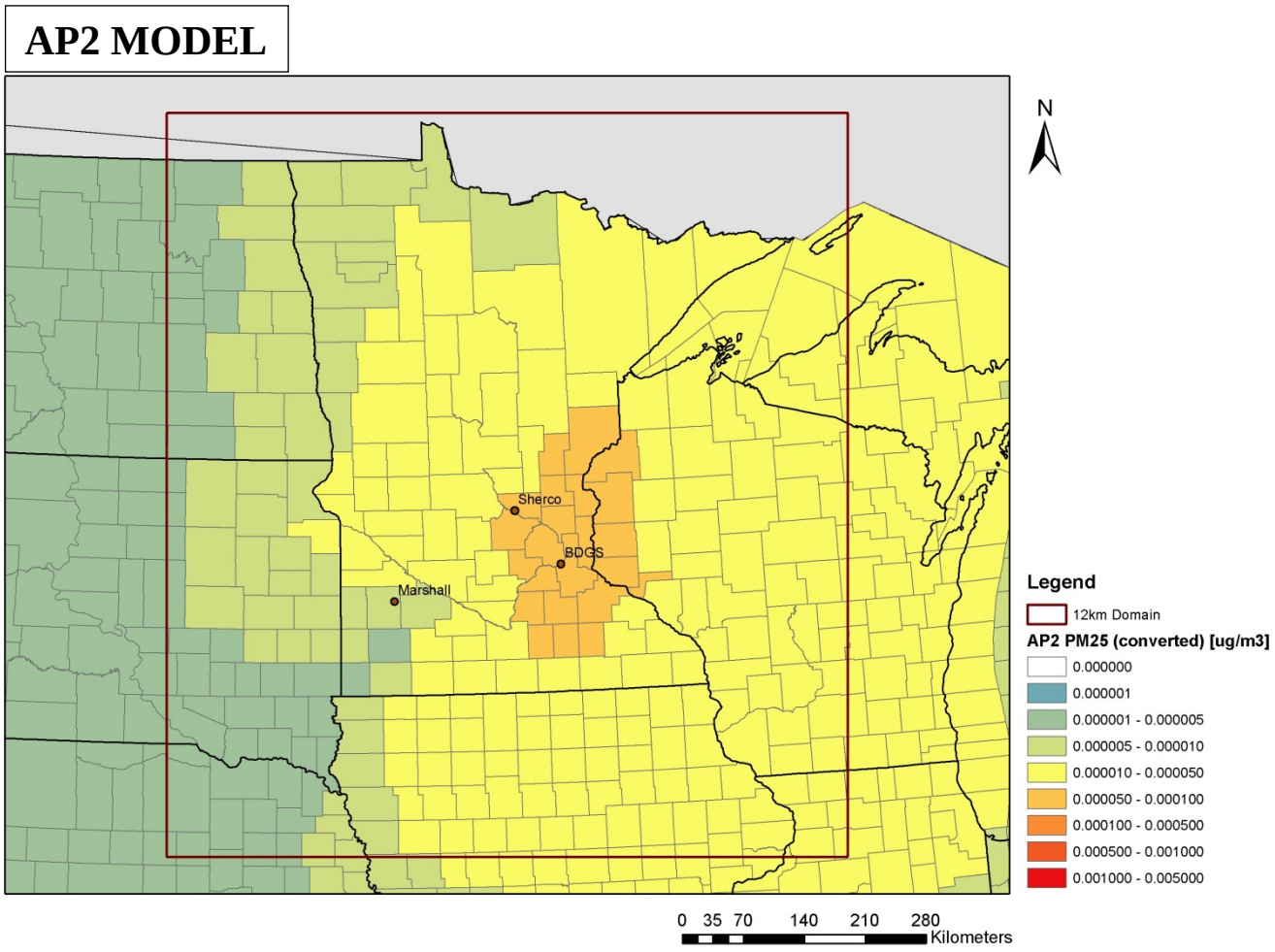

[110] Ex. 605 (Desvousges Rebuttal), Schedule 5 at 6; Xcel Energy's Initial Brief at 42-43. AP2's $SO_2$ emissions are scaled to 1,169.4 tons to equal what was modeled for CAMx.

**CAMx Model**



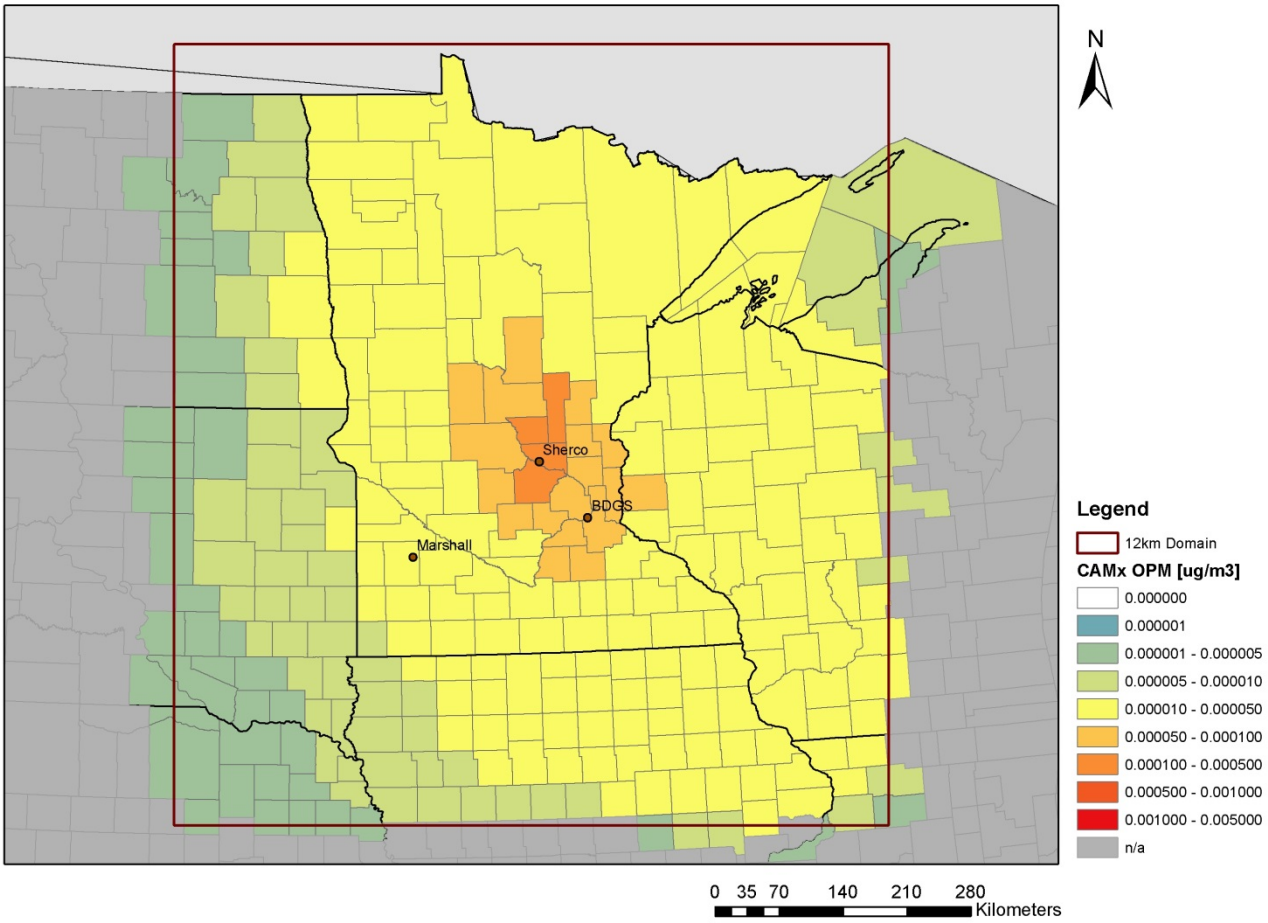

Unlike for $SO_2$ and $NO_x$, the CAMx and AP2 results for direct $PM_{2.5}$ are quite comparable within Minnesota. Figure 4 below compares AP2 (1st map) and CAMx (2nd map) modeling results from Sherco direct $PM_{2.5}$ emissions.

**Figure 4. AP2 and CAMx Direct $PM_{2.5}$ Concentrations within Minnesota Modeling Domain from Sherco Emissions.**[111]




[111] Ex. 605 (Desvousges Rebuttal), Schedule 5 at 8. AP2's $PM_{2.5}$ emissions are scaled to 9.4 tons to equal what was modeled for CAMx.

**CAMx Model**




The Agencies have not disputed the accuracy of the maps presented here, which have been included in our Rebuttal and Surrebuttal Testimonies and Initial Brief. These maps confirm our position – because AP2 uses highly simplified chemical transformation algorithms, it is not capable of modeling secondary $PM_{2.5}$ formation from $NO_x$ and $SO_2$ emissions reliably. This problem is further intensified because AP2 models $NO_x$ and $SO_2$ emissions separately without incorporating flue gas chemistry in the point source plume. It is more difficult to model $SO_2$ and $NO_x$

impacts accurately because of their non-linear nature and complex chemical reactions in the atmosphere, and this is why EPA recommends using photochemical grid models to estimate secondary $PM_{2.5}$ formation from $SO_2$ and $NO_x$ emissions.[112] The inaccuracies of AP2 in modeling $SO_2$ and $NO_x$ affect the results both within Minnesota and outside of Minnesota.

The Agencies gave three arguments to rebut our claims that AP2's modeling results are inaccurate. First, Dr. Muller explained that his modeling showed low $PM_{2.5}$ concentrations due to $NO_x$ because many counties in Minnesota did not have enough ambient ammonium to bind with $NO_x$ to form secondary $PM_{2.5}$ (ammonium nitrate, $AmmNO_3$).[113] However, this explanation is not convincing, because Dr. Desvousges' (CAMx) and Dr. Marshall's (InMAP) modeling results do not show this kind of pattern and had a sufficient amount of ammonium in every Minnesota county to bind with $NO_x$.

Second, Dr. Muller stated that "$NO_x$ is just one of three pollutants at issue in this proceeding, and the one that is least significant in terms of damages."[114] Needless to say, this argument does not address AP2's accuracy at all, rather, it seems to imply that accuracy is not that important when $NO_x$ damages are estimated.

Third, Dr. Muller's main response was that if there were something fundamentally wrong with the AP2 modeling results, these problems would have shown up in the model performance evaluation discussed in his Direct Testimony.[115] However, the ALJ CP Report rightly concludes that the AP2 performance evaluation is not reliable.[116]

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[112] Xcel Energy's Initial Brief at 26; Ex. 605 (Desvousges Rebuttal) at 35-37; Ex. 608 (Desvousges Surrebuttal) at 12.
[113] Ex. 811 (Muller Surrebuttal) at 9; Hearing Transcript, Vol. 8 at 87-89, 148-151, 154-155 (Muller).
[114] Ex. 811 (Muller Surrebuttal) at 7.
[115] Ex. 811 (Muller Surrebuttal) at 8-9.
[116] ALJ CP Report Conclusions 20-23 at 96-97.

The AP2 modeling results have been demonstrated to be inaccurate, unreliable, and inconsistent with what is known about air dispersion and atmospheric chemistry, and AP2's results from modeling $NO_x$ and $SO_2$ within the Minnesota domain are in significant conflict with the CAMx modeling results. Xcel Energy believes the only logical conclusion in this proceeding, based on the preponderance of the evidence, is that the AP2 model should not be used to estimate externality values either within Minnesota or outside of Minnesota. Using an inaccurate model to estimate damage values from a large number of source locations would not give the Commission any better or more useful information. On the contrary, this approach would just yield a greater amount of unreliable information.

## VI. CONCLUSION

Xcel Energy agrees with several significant conclusions reached by the ALJ, including the following:

- The CAMx model, as used by Xcel Energy, is the most reliable and accurate of the three models used in this proceeding.
- The InMAP model used by the CEOs is unreliable and lacks a record of peer review and a history of past applications in similar regulatory settings as this case. It should not be used.
- The AP2 model used by the Agencies cannot be used to model damages accurately across the contiguous United States.
- The model performance evaluation conducted to assess AP2's accuracy was unreliable. Therefore, it does not provide a credible basis to claim that the AP2 results are accurate.
- A concentration-response function range of 6 percent to 7.3 percent is acceptable. A VSL value of $7.70 million is acceptable as a high-end of a

range, but we propose adopting a VSL value of $4.1 million (or the Agencies' $3.7 million) for the low-end of the range.

Xcel Energy has exceptions to the following ALJ conclusions and recommendations:

- The ALJ did not offer a recommendation on the geographic scope of damages. We maintain it is not practicable to estimate nationwide damages; the geographic scope should extend to 100 miles from the Minnesota border, as modeled by CAMx.
- The ALJ recommended including two or three additional source locations to the CAMx modeling. We modeled three representative locations consistent with the current structure of the externality values, and do not believe additional sources are necessary.
- The ALJ concluded that establishing county-by-county externality values for Minnesota is not reasonable because nothing in the record indicates that this level of detail is required. We agree, and believe the ALJ's alternative recommendation to use AP2 to model a hypothetical plant in each Minnesota county is unnecessary, impractical, and inconsistent with her conclusion.
- The ALJ concluded that because the 50-kilometer modeling distance recommended by the EPA applies to the AP2 model, it should not be used to estimate damages across the contiguous United States. We agree, but maintain that the 50-kilometer limit also applies within Minnesota and makes the AP2 modeling results unreliable within Minnesota.
- The ALJ concluded that AP2's modeling of hypothetical sources was unreliable, because the damage values were far higher than for the actual plants that were modeled individually. We agree, but believe the ALJ

should not have then made the alternative recommendation to use AP2 to model 87 hypothetical plants in Minnesota.

- The ALJ concluded that AP2's modeling of each pollutant separately without considering flue-gas chemistry in the plume is problematic and not a common practice. We agree, but want to emphasize that this shortcoming also affects the accuracy of AP2 results within Minnesota.

In summary, the ALJ concluded appropriately that there are various issues with the AP2 model that raise significant questions about the reliability and accuracy of the AP2 modeling results. These shortcomings apply equally whether damages are estimated within or outside of Minnesota. Xcel Energy has presented other significant, persuasive evidence that the AP2 air quality modeling results are unexpected, inaccurate, and inconsistent with what is known about atmospheric dispersion and chemistry of criteria pollutant emissions. Again, this evidence applies to results both within and outside of Minnesota. It also applies to AP2 modeling results from the actual plants that were modeled individually.

The record evidence demonstrates that AP2 grossly overstates damages from primary $PM_{2.5}$ and $SO_2$ emissions in the contiguous United States by predicting health impacts in every U.S. county. AP2 underestimates secondary $PM_{2.5}$ formation from $NO_x$ and $SO_2$ emissions within Minnesota, and the sporadic $NO_x$ results, which skip most Minnesota counties, cannot be accurate. A preponderance of the evidence shows that AP2 is not capable of modeling secondary $PM_{2.5}$ formation from $NO_x$ and $SO_2$ emissions reliably, because it uses highly simplified chemical transformation algorithms and because it models each pollutant separately without considering flue-gas chemistry in the point source plume.

Xcel Energy believes only one conclusion regarding the AP2 model is reasonable, based on the complete record and evidence presented in this case: AP2

modeling results are unreliable and they should not be used as the basis for setting externality values for criteria pollutants. Modeling a large number of source locations does not improve the quality of AP2 results or make the results more useful.

We respectfully request that the Commission accept our CAMx modeling of three representative locations as the basis for estimating criteria pollutant externality values and limit the geographic scope to 100 miles from the Minnesota border as modeled by CAMx. We will incorporate any changes to the VSL and concentration-response function values, as determined by the Commission, to calculate the final externality values. Based on the reasoning above, Xcel Energy requests that the ALJ Report on Criteria Pollutants be amended as identified in Attachment A.

## ALJ Recommendations

1. The Administrative Law Judge respectfully recommends that the Commission approach this matter by first determining the proper geographic scope of damages relevant for consideration in Minnesota proceedings is to be in Minnesota and within 100 miles of the Minnesota border. ~~addressing the following issues:~~

~~a. What is the most appropriate value for the VSL?~~
~~b. What is the most appropriate concentration-response function?~~
~~c. What sources and source locations should be included?~~
~~d. What is the proper geographic scope of damages?~~

2. The Administrative Law Judge respectfully recommends, consistent with the parties' various recommendations, that the Commission adopt a VSL range of $4.1 million to $7.7 million.

3. The Administrative Law Judge respectfully recommends, consistent with the parties' various recommendations, that the Commission adopt ~~a concentration-response function of 6.8 percent, or if the Commission prefers to adopt~~ a concentration-response range to reflect uncertainty, a range of 6 percent to 7.3 percent.

4. The Administrative Law Judge respectfully recommends that the Commission ~~choose one of the following options to~~ determine the costs of CP Externalities based on Xcel Energy's CAMx modeling of three representative locations within the Minnesota domain.~~:~~

~~a. A~~ and adopt ~~a model configuration that provides a five- or six-tiered version of~~ Xcel's three-tiered proposed sources and source locations of rural, metropolitan-fringe and urban scenarios, as modified by ALJ Recommendations 2 and 3. The Administrative Law Judge recommends that ~~the~~ all other modeling parameters and types of damages estimated remain the same as in Xcel Energy's modeling approach. ~~additional tiers incorporate factors such as nearby topography, vegetation, buildings, etc. consistent with the Agencies' recommendations. The tiers could accomplish this by including variations on the rural category to account for rural settings that are isolated versus rural settings that are less so, and possibly a "small town" category. This would enable the Commission to gain additional information beyond the three categories Xcel proposed. If the Commission chooses this option, the~~

~~Administrative Law Judge respectfully recommends that the Commission choose the CAMx model, if the Commission finds that the CAMx model would be practicable to use with this somewhat expanded scope.~~ The Administrative Law Judge recommends the CAMx model because it is more reliable than AP2.

b. ~~Adopt a model configuration that includes all 87 counties in Minnesota, but only out-of-state sources that reflect active EGUs in the out-of-state locations. The Administrative Law Judge recommends that county-specific information not be combined or averaged, but used as the CEOs recommended it be used. In addition, the Administrative Law Judge recommends that the Commission exclude out-of-state sources located in eastern Wisconsin, Michigan and Illinois. If the Commission chooses this option, or some variation of it that is similar in scope and size, the Administrative Law Judge recommends that the Commission choose the AP2 model, which is generally recognized as a reliable model and would be capable of modeling the much larger number of modeling runs needed with this configuration.~~

5. As explained in Conclusion 46, the Administrative Law Judge concludes that the question of geographic scope of damages is a policy matter to be decided by the Commission. Consideration should be given to a strong preference in legislative history and the Commission's long-standing precedent to focus on: criteria pollutant impacts within Minnesota and their effects on Minnesotans; the uncertainty involved in estimating nationwide damages; and, the protection provided through the NAAQS and CSAPR regulations. ~~If the Commission chooses to include the contiguous U.S. or some substantial area outside of Minnesota in the CP externalities costs, t~~ The Administrative Law Judge respectfully recommends the CAMx model as the most reliable model to calculate ~~those~~ externalities costs.

## ALJ Conclusions

16. The Administrative Law Judge concludes that the Agencies demonstrated, by a preponderance of the evidence, that population-weighted exposure is an important measure in the context of this proceeding because human health effects are a large portion of the damage cost. Externalities values proposed by Xcel Energy included impacts of population weighted exposures.

27. The Administrative Law Judge concludes that Xcel's ~~failed to demonstrate the reliability of its CP damages costs because Xcel failed to recalculate those costs following the discovery of its~~ accidental use of $PM_{2.5}$ emissions data from its gas-fired Riverside facility in the emissions data used for the modeling of its hypothetical power plants had no impact on their proposed $PM_{2.5}$ externality values. The Administrative Law Judge ~~is unconvinced by~~understands Xcel's explanation that no recalculation is needed since this error does not have an impact on the $PM_{2.5}$ externality values proposed by Xcel because of the linear nature of increased ambient concentrations of $PM_{2.5}$ from direct $PM_{2.5}$ emissions. Direct $PM_{2.5}$ does not have chemical reactions with $SO_2$ or $NO_x$. ~~Specifically, the Administrative Law Judge concludes that Xcel failed to demonstrated why the simultaneous discharge of $SO_2$ and $NO_x$, which were reported in the correct quantities, and their mingling with the $PM_{2.5}$, which was reported in a greatly diminished amount, would not have altered the results of the modeling in question.~~

47. The Administrative Law Judge concludes that Xcel ~~failed to~~ has demonstrated by a preponderance of the evidence that Minnesota~~'s~~ is in compliance with the standards established by CSAPR, and this is one factor that speaks against adopting a nationwide scope for CP externality values. ~~reduces cross-border CP damages to zero.~~

50. The Administrative Law Judge concludes that 6.0~~8~~% - 7.3% is both reasonable, and an acceptable dose-concentration response function range for Xcel, the Agencies and the CEOs.

54. The Administrative Law Judge concludes that ~~a preponderance of the~~ epidemiological evidence demonstrates the relationship between chronic exposure to $PM_{2.5}$ and all-cause cardiovascular and lung-cancer mortality is linear down to 8 $\mu g/m^3$ ~~without a threshold~~. However, research has not yet determined whether a linear concentration-response function continues to apply at levels below 8 $\mu g/m^3$; all Parties calculated changes in ambient concentration levels of between 0 and 1 $\mu g/m^3$.

## CERTIFICATE OF SERVICE

I, Carl Cronin, hereby certify that I have this day served copies of the foregoing document on the attached list of persons.

xx by depositing a true and correct copy thereof, properly enveloped with postage paid in the United States mail at Minneapolis, Minnesota; or

xx by electronic filing.

**Docket No: E999/CI-14-643**

Dated this 15th day of July 2016.

/s/

_____

Carl Cronin
Regulatory Administrator

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