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August 4, 2016

**--VIA ELECTRONIC FILING--**

Mr. Daniel P Wolf  
Executive Secretary  
Minnesota Public Utilities Commission  
350 Metro Square Building  
121 7<sup>th</sup> 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*  
REPLY 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 Reply Exceptions to the Administrative Law Judge's *Findings of Fact, Conclusions and Recommendations* issued June 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](mailto:james.r.denniston@xcelenergy.com).

Sincerely,

/s/

JAMES R. DENNISTON  
ASSISTANT GENERAL COUNSEL

Enclosure  
c: Service List

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

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  
MPUC Docket No. E-999/CI-14-643

**XCEL ENERGY'S REPLY TO EXCEPTIONS FILED  
BY OTHER PARTIES TO ALJ'S FINDINGS OF FACT,  
CONCLUSIONS AND RECOMMENDATIONS REGARDING  
CRITERIA POLLUTANTS**

August 4, 2016

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## TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	SUMMARY OF XCEL ENERGY’S POSITIONS ON MAIN ISSUES	4
III.	IT IS NOT REASONABLE OR PRACTICABLE TO ESTIMATE NATIONWIDE DAMAGES	7
IV.	IT IS NOT REASONABLE OR PRACTICABLE TO ESTABLISH COUNTY SPECIFIC EXTERNALITY VALUES	15
V.	THE ALJ APPROPRIATELY CONCLUDED THAT THERE ARE CRITICAL LIMITS TO THE AP2 MODEL’S RELIABILITY	19
	A. The EPA-Recommended Limit of 50 Kilometers for Gaussian Plume Models Applies to the AP2 Model	19
	B. AP2’s Modeling of Each Pollutant Separately Affects the Accuracy of Results	20
	C. AP2’s Modeling of Hypothetical Facilities Is Unreliable	21
	D. AP2’s Air Quality Modeling Results Are Inaccurate within Minnesota and Outside of Minnesota	23
VI.	CONCENTRATION-RESPONSE FUNCTION AND VSL	26
	A. The ALJ’s Concentration-Response Function Range Is Based on the Record and Supported by Current Epidemiological Studies	27
	B. The CEOs Continue to Argue for an Extremely High VSL Value Based on an Outdated Study	30
VII.	CONCLUSION	34

## I. INTRODUCTION

Northern States Power Company, doing business as Xcel Energy, respectfully submits this Reply to the Exceptions filed by other Parties 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 continue to support our July 15, 2016 Exceptions and respectfully request the Commission accept our CAMx modeling of three representative locations as the basis for estimating criteria pollutant externality values and limit the geographic scope of damages to within 100 miles of the Minnesota border as modeled by CAMx.

CAMx is a reliable, established photochemical grid model, which is recommended by the U.S. Environmental Protection Agency (EPA) for the modeling of ozone and secondary PM<sub>2.5</sub> formation; meets all of the EPA's current and proposed air quality modeling guidelines and guidance; was specifically designed to model criteria pollutants simultaneously; incorporates flue-gas chemistry in the point source plume; uses full-science chemistry algorithms to model chemical reactions in the atmosphere; and relies on hourly, varying, three-dimensional wind speed and direction, temperature, humidity, and other conditions. The reduced-form models – AP2 and InMAP – used by the Agencies<sup>1</sup> and the Clean Energy Organization (CEOs) do not incorporate any of these features. Most importantly, CAMx is the only model that predicted credible and accurate ambient concentration changes that are consistent with what is known about the science of air dispersion and chemistry.<sup>2</sup>

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<sup>1</sup> The Minnesota Pollution Control Agency and Department of Commerce.

<sup>2</sup> 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; Xcel Energy's Initial Brief at 24-25; Xcel Energy's Reply Brief at 17-18.

The ALJ agreed that CAMx is the most reliable and accurate model of the three models used in this proceeding.<sup>3</sup> We believe Xcel Energy's CAMx modeling results as such – based on the initial geographic scope, source locations, and modeling parameters – are reasonable, practicable, and the best available measure presented in this case to estimate criteria pollutants' cost.

The ALJ in her Report and the CEOs in their Exceptions have proposed significant modifications to our original CAMx modeling: the ALJ recommended adding two to three source locations to the modeling scenarios<sup>4</sup> and the CEOs suggested modeling six large, existing power plants in Minnesota each with three different stack heights.<sup>5</sup> We note that these are completely new proposals, there is no record to evaluate their merits, and no witness has provided supportive testimony. The most critical fact is that the Parties have not been able to respond, since the modeling has not been conducted, the results are not available, and no values have been proposed.

We understand the purpose of this proceeding was to propose externality values for criteria pollutants; three Parties conducted modeling to develop and support proposed values. The ALJ specifically ordered that a Party bears the burden of showing that *the cost value being proposed* is reasonable, practicable, and the best available measure of the criteria pollutant's cost.<sup>6</sup> In addition, the ALJ specified that if a Party wishes to *propose an environmental cost value*, this must be done in the Direct Testimony, or at the latest in the Rebuttal Testimony as a response to another Party.<sup>7</sup>

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<sup>3</sup> ALJ CP Report, Conclusion 39 at 100.

<sup>4</sup> ALJ CP Report, Recommendation 4b at 104.

<sup>5</sup> CEOs' Exceptions at 30-31.

<sup>6</sup> ORDER REGARDING BURDENS OF PROOF, March 27, 2015, Order Point 2.

<sup>7</sup> ORDER REGARDING BURDENS OF PROOF, March 27, 2015, Order Point 8.

Clearly, the Parties were tasked to propose externality values for PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>x</sub> in the Direct Testimony. We believe the ALJ should not have suggested critical modeling changes, but should have recommended values based on modeling that has already been conducted. A mere compliance filing would not provide the Parties an opportunity to research new proposed source locations, different geographic scope options, or modified modeling parameters. This would require a second round of a contested case and filing of new testimony. The Commission has to make its decisions based on the record, and cannot rely on factual information or evidence that is not part of the record. This fundamental rule protects the Parties: they must be allowed to contest the factual information and present evidence.<sup>8</sup>

For example, if any modifications were made to CAMx source locations, new testimony would need to address how many additional sources, if any, are appropriate; where these sources should be located; and whether to model existing power plants or a hypothetical source. Any changes to the Parties' original air quality modeling approaches would prolong this process, require more resource time and cost, and delay establishment of updated criteria pollutant values. Changing the geographic scope for CAMx modeling would involve a completely new modeling effort from the beginning to the end. The same would be true for each new source location. In contrast, modifications to the concentration-response function and value of a statistical life (VSL) would be incorporated in a separate Excel worksheet analysis after CAMx modeling is completed.

In this Reply, we focus primarily on those issues raised by the Agencies and the CEOs in their Exceptions that require additional response. For the most part, we will not repeat arguments or positions advanced in our Exceptions, which remain valid. Section II summarizes our current positions on the main issues. Section III replies to

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<sup>8</sup> See, for example, *Application of Northern States Power Co*, 440 N.W.2d 138 (Minn. App. 1989).

the issues related to the geographic scope of damages and section IV replies to the issues related to the number of source locations. Section V responds to several matters that affect the reliability and accuracy of the AP2 model. Section VI addresses the CEOs' exceptions to the concentration-response function and VSL. Section VII concludes.

## II. SUMMARY OF XCEL ENERGY'S POSITIONS ON MAIN ISSUES

The ALJ concluded that CAMx is the most reliable and accurate model of the three models used in this case<sup>9</sup> and more reliable than AP2.<sup>10</sup> Accordingly, we believe the criteria pollutant externality values should be based on Xcel Energy's CAMx modeling results. We agree with the ALJ that the InMAP model should not be used, because it is unreliable, lacks past application in any regulatory proceedings, and has no record of peer review or acceptance by the scientific community.<sup>11</sup> The CEOs did not file exceptions to these ALJ conclusions.

We do not support the ALJ's alternative recommendation to use the AP2 model to estimate damages within Minnesota, if the Commission determines it is practicable to model a large number of source locations.<sup>12</sup> The ALJ listed several concerns regarding AP2's accuracy, including application beyond the 50-kilometer limit recommended by the EPA,<sup>13</sup> modeling of each pollutant separately, predicting extremely high damage estimates for the hypothetical sources, and conducting an

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<sup>9</sup> ALJ CP Report, Conclusion 39 at 100.

<sup>10</sup> ALJ CP Report, Recommendation 4a at 104.

<sup>11</sup> ALJ CP Report, Conclusions 8-12 at 94, Conclusion 43 at 101.

<sup>12</sup> ALJ CP Report, Recommendation 4b at 104.

<sup>13</sup> EPA 2005. "40 CFR Part 51: Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule." Federal Register, Vol. 70, No. 216, Wednesday, November 9, 2005.

[http://www3.epa.gov/ttn/scram/guidance/guide/appw\\_05.pdf](http://www3.epa.gov/ttn/scram/guidance/guide/appw_05.pdf)

unreliable performance evaluation.<sup>14</sup> All of these flaws in AP2's air quality modeling apply to the results both within and outside of Minnesota.

Even if damages are estimated only within Minnesota, we have presented several other reasons why the AP2 model cannot be considered reliable, including its use of annual average meteorological data from 1990; reliance on annual average wind speed and direction; and use of simplified chemistry algorithms and constant conversion rates to model the formation of secondary PM<sub>2.5</sub> from SO<sub>2</sub> and NO<sub>x</sub> emissions. The EPA's current (2007)<sup>15</sup> and proposed (2014)<sup>16</sup> guidance for ozone and secondary PM<sub>2.5</sub> modeling recommend using photochemical grid models, such as CAMx, which incorporate full-science atmospheric chemistry.<sup>17</sup>

We have also presented significant, persuasive evidence that the AP2 air quality modeling results are unexpected, inaccurate, and inconsistent with what is known about the atmospheric dispersion and chemistry of criteria pollutant emissions. For example, AP2 grossly *overstates* damages from primary PM<sub>2.5</sub> and SO<sub>2</sub> emissions *across the contiguous United States* by predicting health impacts in every U.S. county. Considering that primary PM<sub>2.5</sub> is directly emitted, dispersed, and deposited on the ground (resembling ash from a wood-burning fire), it cannot be accurate that primary PM<sub>2.5</sub> emissions from a Minnesota source would travel to every U.S. county.<sup>18</sup> It is widely recognized that primary PM<sub>2.5</sub> effects are mostly local, which was also acknowledged by the ALJ.<sup>19</sup> On the other hand, AP2 *underestimates* secondary PM<sub>2.5</sub> formation from NO<sub>x</sub> and SO<sub>2</sub> emissions *within Minnesota*, and the results cannot be

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<sup>14</sup> ALJ CP Report, Conclusions 15 and 18 at 95, Conclusion 21 at 96, Conclusion 44 at 101.

<sup>15</sup> EPA 2007. "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub>, and Regional Haze." April 2007.  
<http://www3.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf>

<sup>16</sup> EPA 2014. "Draft Modeling Guidance for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub> and Regional Haze." December 2014.  
[http://www3.epa.gov/ttn/scram/guidance/guide/Draft\\_O3-PM-RH\\_Modeling\\_Guidance-2014.pdf](http://www3.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf)

<sup>17</sup> For a summary, see Xcel Energy's Initial Brief at 25-28; Xcel Energy's Reply Brief at 14-18.

<sup>18</sup> For a summary of our evidence, see Xcel Energy's Initial Brief at 39-41.

<sup>19</sup> ALJ CP Report, Conclusion 37 at 99.



accurate. AP2's random and sporadic modeling results from NO<sub>x</sub> emissions skip over most Minnesota counties, but show secondary PM<sub>2.5</sub> concentration changes in faraway states to the east, west, and south.<sup>20</sup>

We maintain it is not necessary or practicable to develop county-specific externality values – the ALJ also concluded that adopting 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.<sup>21</sup> The Agencies and the CEOs continue to advocate for modeling nearly 500 hypothetical sources (87 sources in Minnesota and almost 400 sources outside of Minnesota). The CEOs also request that the modeling of nearly 500 sources occur at three different stack heights, which will result in almost 1,500 different externality values. We believe this is an overwhelming and unnecessary amount of information. In addition, county-specific values would only provide a false notion of specificity, considering that they must be developed by reduced-form models, which rely on annual average meteorological data, wind speed, and wind direction; model each pollutant separately; and use highly simplified air dispersion and chemistry algorithms. It is a mistaken premise that AP2 (or InMAP) could accurately detect very precise differences in ambient air concentrations from county-by-county sources. Modeling a large number of source locations does not improve the quality of AP2 modeling results, make the results more useful, or add any real specificity to the damage values.

Although the ALJ did not take a position on the geographic scope of damages, we recommend the Commission limit the geographic scope to Minnesota damages.<sup>22</sup> We continue to maintain it is not practicable or reasonable to conduct nationwide air

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<sup>20</sup> Ex. 608 (Desvousges Surrebuttal) at 21-22, 24-25, 29-30. For a summary, see Xcel Energy's Initial Brief at 32-39; Xcel Energy's Exceptions at 33-36.

<sup>21</sup> ALJ CP Report, Conclusion 35 at 99.

<sup>22</sup> To be precise, the CAMx modeling domain of Minnesota and within 100 miles from the Minnesota border should be used.

quality modeling and estimate damages across the entire contiguous United States, considering the long-standing Commission precedent to estimate criteria pollutant damages in Minnesota; the mostly local and regional nature of criteria pollutants; the significant uncertainty in estimating national damages; and the protection of human health and elimination of significant impacts across state lines through federal regulation (i.e., the National Ambient Air Quality Standards [NAAQS] and the Cross State Air Pollution Rule [CSAPR]).

Finally, we accept the ALJ's recommendation regarding the concentration-response function (6 percent to 7.3 percent),<sup>23</sup> which is supported by the record and current epidemiological studies. For the value of a statistical life (VSL), we suggest the Commission treat the ALJ-recommended VSL of \$7.7 million as a high-end of a range and also adopt a low-end VSL of \$4.1 million.<sup>24</sup> We believe a range is a better option than a single value, considering the uncertainty in estimating premature mortality risk from PM<sub>2.5</sub> exposure. The Agencies have also advocated for a VSL range.<sup>25</sup>

### **III. IT IS NOT REASONABLE OR PRACTICABLE TO ESTIMATE NATIONWIDE DAMAGES**

It is a stretch to argue that the geographic scope of damages is a scientific question or that a certain geographic scope is required by Minn. Stat. § 216B.2422, Subd. 3, as the CEOs' Exceptions claim.<sup>26</sup> The statute is silent on the issue, and the current externality values are based on estimating both global damages (CO<sub>2</sub>) and Minnesota damages (criteria pollutants). Although there is a strong preference in the legislative history to focus on criteria pollutant impacts within Minnesota, the statute does not require, nor deny, a Minnesota, national, or global scope.<sup>27</sup> The ALJ, the

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<sup>23</sup> ALJ CP Report, Recommendation 3 at 104.

<sup>24</sup> ALJ CP Report, Recommendation 2 at 104.

<sup>25</sup> E.g., Ex. 808 (Muller Direct) at 41; Ex. 810 (Muller Rebuttal) at 7, 18; Agencies' Reply Brief at 44-46.

<sup>26</sup> CEOs' Exceptions at 5-6.

<sup>27</sup> See Xcel Energy's Initial Brief at 8-9; Xcel Energy's Reply Brief at 5. Our Initial Brief includes a more detailed review of the legislative history of Minn. Stat. § 216B.2422, subd. 3(a).

Agencies, and Xcel Energy agree that the geographic scope of damages is a policy question, however, the CEOs continue to argue this issue.

Unfortunately, the CEOs' Exceptions include several assertions regarding the geographic scope of damages that are not supported by the record. For example, their Exceptions state that a national scope of damages is a "standard practice in modern modeling of air pollution,"<sup>28</sup> and "the state of the art in calculating air pollution damages for criteria pollutants is a national – continental U.S. – geographic scope."<sup>29</sup> There is no testimony in the record to support these misleading claims, which were made for the first time in the CEOs' Exceptions. If anything, the scientific community would probably agree that the geographic scope depends on the context and purpose for which the air quality modeling is conducted.

In addition, the CEOs state that "the ALJ Report additionally found that *modeling in the record* accurately demonstrates that there *are measurable damages* from the criteria pollutants including states at least as distant from one another as Minnesota is to Florida"<sup>30</sup> and cite to the ALJ's Conclusion No. 25. This claim is also misleading, since the ALJ's Conclusion No. 25 in fact reads as follows: "the CAMx model is capable of predicting impacts from CP emissions on ambient PM<sub>2.5</sub> including states at least as distant from one another as Minnesota is to Florida, based on information available on the EPA's CSAPR information website"<sup>31</sup> The ALJ's statement is based on information available from the EPA's website,<sup>32</sup> not "modeling in the record" and the conclusion is that CAMx is probably capable of predicting impacts at faraway distances, not that there "are measurable damages" from Minnesota emissions in faraway states. In addition, as testified during the evidentiary hearings, this particular

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<sup>28</sup> CEOs' Exceptions at 1.

<sup>29</sup> CEOs' Exceptions at 4.

<sup>30</sup> CEOs' Exceptions at 5, citing to ALJ Conclusion No. 25, emphasis added.

<sup>31</sup> ALJ CP Report, Conclusion 25 at 97.

<sup>32</sup> Ex. 620 (EPA CSAPR Spreadsheet). This spreadsheet was introduced by Xcel Energy to rebut claims originally made by the Agencies' witness Dr. Muller in his Surrebuttal Testimony.

spreadsheet contains EPA data from all Minnesota emission sources, not just power plants, which means that the EPA modeled several hundred thousand tons of emissions – not simply one ton from one power plant as the Agencies and the CEOs have done.<sup>33</sup> Most importantly, the ALJ specifically determined that the spreadsheet cannot be used to draw any reliable conclusions about the proportion of impacts within Minnesota and outside of Minnesota.<sup>34</sup>

In their Exceptions, the CEOs repeatedly used language that the environmental values must be set “based on actual damages,”<sup>35</sup> which they argue requires a national geographic scope. However, the CEOs are using the term “based on actual damages” out of the original context and neglect to explain what the proper context is: the Commission has used this term to describe the damage cost approach, which attempts to place an economic value on the net damage caused by an energy source, in contrast to other valuation methods such as willingness-to-pay, cost-of-control, mitigation cost, or risk of regulation.<sup>36</sup> As in the original externalities proceeding, the Commission ordered that the Parties use a damage-cost approach in this docket as well.<sup>37</sup> It is clear that none of the Parties estimated actual damages – all modeling efforts involved hypothetical scenarios run by computer programs and no actual emissions or damages were observed or measured.

The ALJ rightly concluded that the geographic scope of damages is a policy question, and both the Agencies and Xcel Energy have agreed on this. The CEOs have no credible basis to claim that the geographic scope of damages is a scientific

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<sup>33</sup> Hearing Transcript, Vol. 8 at 104-112 (Muller).

<sup>34</sup> ALJ CP Report, Conclusion 36 at 99.

<sup>35</sup> For example, CEOs’ Exceptions at 3, 4, and 8.

<sup>36</sup> Commission’s NOTICE AND ORDER FOR HEARING, October 15, 2014 in this Docket at 4; see also 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 14, FINDINGS OF FACT, CONCLUSIONS, RECOMMENDATION, AND MEMORANDUM, March 22, 1996 at 18-19. See also Xcel Energy’s Direct Testimony for the CO<sub>2</sub> Track for more discussion on this topic, Ex. 600 (Martin Direct) at 65-66.

<sup>37</sup> Commission’s NOTICE AND ORDER FOR HEARING, October 15, 2014, Order Point 4 at 8.

question. Every Party agrees that the key words in the statute are “to the extent practicable,” and practicability, as we have argued, needs to consider and balance many relevant factors. For example, is it practicable to try to estimate nationwide impacts if this compromises the accuracy of the model used and reliability of the results? Is it practicable to attempt to estimate national damages when there are already federal regulations in place to eliminate any significant impacts from cross state air pollution? Is it practicable to conduct nationwide air quality modeling, if the predicted ambient concentrations are extremely small and there is no epidemiological research to verify that they can in fact be associated with health impacts? Is it practicable to estimate nationwide damages if this significantly increases uncertainty? We believe these are clear examples of policy questions.

Our testimony and legal briefs discussed several reasons that speak against adopting a national scope for estimating criteria pollutant damages. When all of these factors are considered together, we continue to maintain it is not reasonable or practicable to expand the geographic scope of damages to the entire contiguous United States. Our Exceptions summarized the arguments in detail,<sup>38</sup> and we list them briefly here:

- *Long Standing Commission Precedent:* In the legislative history of Minn. Stat. § 216B.2422, Subd. 3, 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.<sup>39</sup>
- *Regional Nature of PM<sub>2.5</sub>, SO<sub>2</sub>, and NO<sub>x</sub>:* Impacts from criteria pollutant emissions are mainly local and regional – the majority of air quality changes from

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<sup>38</sup> Xcel Energy’s Exceptions at 11-16.

<sup>39</sup> Xcel Energy’s Initial Brief at 8-9.

Minnesota sources will occur in Minnesota or in close proximity to the Minnesota border.<sup>40</sup>

- *Modeling Uncertainty at Further Distances:* Model estimates become less reliable the further the modeling distance is from the emission source, for example, errors in wind speed or direction will have escalating impacts as the modeling distance increases from the source.<sup>41</sup>
- *Uncertainty of Health Impacts Attributable to Very Small Changes in Concentrations:* All the models in this proceeding predicted very small ambient air concentration changes at further distances (e.g., 0.00000298  $\mu\text{g}/\text{m}^3$  or 0.000000643  $\mu\text{g}/\text{m}^3$ ),<sup>42</sup> but the models do not report any measures of significance or confidence that could help confirm the validity of the predictions.<sup>43</sup> These estimated concentration levels are beyond the measurement or observation capabilities of today's monitors, and epidemiological research has not examined adverse health effects or the linear application of the concentration-response function at these very low concentration levels.<sup>44</sup>
- *Human Health Protection Through NAAQS and CSAPR:* Today, the National Ambient Air Quality Standards (NAAQS) are protective of human health and the environment and the Cross State Air Pollution Rule (CSAPR) requires strict emission reductions to eliminate any significant impacts of upwind state contributions to ambient air quality in downwind states. Minnesota is in compliance with both NAAQS and CSAPR regulations for  $\text{SO}_2$ ,  $\text{NO}_x$  and  $\text{PM}_{2.5}$ .<sup>45</sup> At the time of the original externalities proceeding, EPA had not kept

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<sup>40</sup> 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.

<sup>41</sup> Ex. 608 (Desvousges Surrebuttal) at 46; Xcel Energy's Initial Brief at 55.

<sup>42</sup> These examples are AP2 and InMAP average changes in ambient  $\text{PM}_{2.5}$  concentrations from the Sherco plant beyond one hundred miles of Minnesota. See Ex. 608 (Desvousges Surrebuttal) at 43.

<sup>43</sup> Ex. 608 (Desvousges Surrebuttal) at 44; Hearing Transcript, Vol. 7 at 115 (Desvousges).

<sup>44</sup> Ex. 608 (Desvousges Surrebuttal) at 42-44; Hearing Transcript, Vol. 7 at 113-117 (Desvousges).

<sup>45</sup> Ex. 607 (Rosvold Rebuttal) at 2-14; Ex. 617 (Rosvold Opening Statement) at 1-2.

the NAAQS updated; NAAQS did not reflect the latest scientific knowledge; and regulations on the interstate transport of emissions did not exist.<sup>46</sup>

The ALJ concluded that in general, primary PM<sub>2.5</sub> causes damages that are mostly local and regional in nature, but SO<sub>2</sub> and NO<sub>x</sub> emissions can travel several hundred miles from the source and form secondary PM<sub>2.5</sub>. However, she also concluded there is no reliable evidence in the record to show what proportion of SO<sub>2</sub> and NO<sub>x</sub> emissions from Minnesota sources have impacts outside of Minnesota.<sup>47</sup> Similarly, there is no reliable evidence in the record to determine under what conditions SO<sub>2</sub> and NO<sub>x</sub> emissions from Minnesota travel further away and whether the resulting ambient concentrations are large enough to have impacts several hundred miles from Minnesota.

We have agreed that the ambient concentration changes estimated by AP2, InMAP, and CAMx are so small that they cannot be observed or measured by today's monitors, and that there is no epidemiological research to confirm whether these small changes in concentrations can be associated with health effects or whether the concentration-response function is linear at these small concentration levels. There is no epidemiological research or evidence to conclude that an ambient concentration level of 8.00000298 µg/m<sup>3</sup> would have more adverse health effects than a concentration level of 8.0 µg/m<sup>3</sup>, yet all the models used in this proceeding would treat a change of 0.00000298 µg/m<sup>3</sup> as significant and different than zero.<sup>48</sup> While we have stated that this is the typical way air quality modeling works and an established industry practice to estimate damages from emissions, it is also one of the reasons why we oppose estimating nationwide damages: the further away impacts are

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<sup>46</sup> 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.

<sup>47</sup> ALJ CP Report, Conclusion 37 at 100.

<sup>48</sup> 0.00000298 µg/m<sup>3</sup> is AP2's average change in ambient PM<sub>2.5</sub> concentration from the Sherco plant beyond one hundred miles of Minnesota. See Ex. 608 (Desvousges Surrebuttal) at 43.

estimated from the source, the more uncertainty exists as the predicted changes in ambient concentrations become even smaller.<sup>49</sup>

MLIG claims that Minn. Stat. § 216B.2422, subd. 3(a) requires causation between emissions and health effects, and that the Parties who have proposed environmental cost values must show that the ambient PM<sub>2.5</sub> concentrations predicted by the models in fact cause health damages. MLIG presents four arguments in support of the causality requirement, which we find unpersuasive.

First, MLIG cites case law that relates to constitutionality considerations of legislation, finding that the legislation's means must have a reasonable relationship to the legislative purpose; that the legislation must have a reasonable connection between the actual effects and the statutory goal; and that the legislative tools cannot be based on mere guesswork or speculation.<sup>50</sup> According to these standards, there needs to be a reasonable possibility that whatever means are imposed by legislation can in fact achieve the statutory goals. However, it is a stretch to claim that these standards for legislative constitutionality would also apply to substantive law and set standards for what kind of relationship Minn. Stat. § 216B.2422, subd. 3(a) requires between emissions and damages. In addition, such terms as reasonable relationship, reasonable connection, more than guesswork, or more than speculation do not imply a causal relationship as it is understood in scientific and common language.

Second, MLIG similarly draws conclusion from the Office of Administrative Hearing's rule of evidence, which states that the appropriate burden of proof standard is preponderance of the evidence, unless the substantive law provides a different standard (Minn. R. 1400.7300, subp. 5). Again, it is not convincing to claim that this procedural rule regarding burden of proof would apply to a substantive law matter,

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<sup>49</sup> Hearing Transcript, Vol. 7 at 113 (Desvousges); Hearing Transcript, Vol. 8 at 33-34 (Muller); Xcel Energy's Initial Brief at 55-60.

<sup>50</sup> MLIG's Exceptions at 9-11.



requiring a causal relationship between criteria pollutant emissions and health damages.<sup>51</sup> Proving facts by preponderance of the evidence simply means that the facts presented in favor of proposed externality values must outweigh the facts presented in opposition to the proposed values. This rule does not give guidance on the substantive law matter what kind of relationship is required between emissions and damages.

Third, MLIG stated that in the original externalities proceeding, the Commission “demanded proof of causation between emissions and damages to quantify environmental-cost values” and “construed Minn. Stat. § 216B.2422, subd. 3(a) to require a causal connection.”<sup>52</sup> This is not true – the Commission did not address the issue of causation or specify what kind of relationship is required when environmental costs are associated with each method of electricity generation. The modeling conducted by Triangle Economic Research was based on principles similar to our CAMx modeling in this case, and there was no showing of causation between the predicted ambient concentration changes and damages. As Dr. Desvousges’ Direct Testimony states, his current expert report and air quality modeling build on the foundation created in the original proceeding, updating relevant data (e.g., meteorological conditions, population distributions), the model used (i.e., CAMx), and epidemiological and economic studies.<sup>53</sup>

In their Exceptions, MLIG pulled sentences that included the word “cause” out of context of the Commission’s 1997 Order in the original proceeding, and concluded that because the Commission used this word in a few instances, it means that the Commission requires a causal relationship instead of mere association.<sup>54</sup> However, we can provide many examples from the same 1997 Order where the

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<sup>51</sup> MLIG’s Exceptions at 11-12.

<sup>52</sup> MLIG’s Exceptions at 12.

<sup>53</sup> Ex. 604 (Desvousges Direct) at 9-10, Schedule 2 at 4-5.

<sup>54</sup> MLIG’s Exceptions at 12-13.

Commission used words that imply only association, such as “imposed by,” “attributed to,” “harms associated,” and “contributed to.”<sup>55</sup> The fact remains that the Commission never specifically defined what kind of relationship is required between the PM<sub>2.5</sub> concentrations predicted by the air quality models and the health impacts.

Finally, MLIG refers to definitions of “association” in various dictionaries and concludes that “associated” is synonymous with a “causal” relationship. We do not have a problem with the various definitions of association listed by MLIG, such as something that is connected, joined, or accompanied by each other.<sup>56</sup> However, there is a clear distinction between causation and association, and MLIG neglected to provide dictionary definitions for “causal.” For example, Merriam-Webster defines “causal” as “expressing or indicating cause,” “constituting a cause,” “involving causation or a cause,” or “arising from a cause.”<sup>57</sup> Oxford Dictionary defines “causation” as “the action of causing something” and “the relationship between cause and effect; causality.”<sup>58</sup> According to common and scientific language, causation is different than mere association and would require a cause and effect relationship.

The ALJ appropriately concluded that Minn. Stat. § 216B.2422, subd. 3(a) does not require medical causation between increased ambient concentrations and human health effects in order to establish externality values.<sup>59</sup>

#### **IV. IT IS NOT REASONABLE OR PRACTICABLE TO ESTABLISH COUNTY SPECIFIC EXTERNALITY VALUES**

The Agencies and the CEOs continue to advocate for modeling nearly 500 hypothetical sources – 87 sources in Minnesota (one in each county) and nearly 400

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<sup>55</sup> 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, 16, 18, 22.

<sup>56</sup> MLIG’s Exceptions at 15.

<sup>57</sup> <http://www.merriam-webster.com/dictionary/causal>

<sup>58</sup> [http://www.oxforddictionaries.com/us/definition/american\\_english/causation](http://www.oxforddictionaries.com/us/definition/american_english/causation)

<sup>59</sup> ALJ CP Report at 108.

sources outside of Minnesota (one in each county within 200 miles from the Minnesota border.) In addition, the CEOs request modeling the nearly 500 sources at three different stack heights, which will result in almost 1,500 different externality values. However, it is questionable whether a reduced-form model has the accuracy to develop county-specific values that would provide real specificity based on the source location.

The CEOs argued:

“Therefore, knowing where emissions are coming from is significantly more important than which of the three models the Commission ultimately chooses to use. Any lack of precision in this location parameter ordered by the Commission will likely produce inaccurate values in subsequent planning docket.”<sup>60</sup>

We respectfully disagree. Modeling a large number of sources – or what the CEOs call precision in location – does not automatically mean that the resulting values are more precise or useful. It depends on the air quality model that is used. If the model is capable of accurately predicting very small differences in ambient air concentrations from location to location, then it is true that the damage values would also be more precise. However, if the model cannot accurately predict this level of detail, then the values are by no means more specific just because a large number of sources were modeled.

It is a mistaken premise that a reduced-form model – whether AP2 or InMAP – could accurately predict very small differences in ambient air concentrations from 87 Minnesota locations and 400 out-of-state locations, considering that they rely on annual average meteorological data, annual average wind speed, and annual average wind direction; model each pollutant separately; and use highly simplified air

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<sup>60</sup> CEOs’ Exceptions at 25.

dispersion and chemistry algorithms. A false notion of precision is created when the least accurate models are used to develop the most specific values.<sup>61</sup>

In addition, we have presented detailed and substantial evidence to show that neither AP2 nor InMAP provided accurate or reliable results, and the ALJ mainly agreed. We believe it is much more important to model a few representative source locations with an accurate model than a very large number of sources with an inaccurate model. Adding more source locations does not improve the quality of AP2 or InMAP modeling results or make them more useful – inaccurate information does not get better simply because there is more of it.<sup>62</sup> We also note that it is necessary to model a hypothetical plant to establish the county-specific values, and we have demonstrated that AP2’s modeling of hypothetical sources was beyond any realm of reasonableness or accuracy. The ALJ in her Conclusion No. 18 agreed and found that the Agencies failed to demonstrate that AP2’s modeling of hypothetical plants was reasonable.<sup>63</sup>

There are several other reasons why it is not practicable or reasonable to develop or maintain nearly 500 or 1,500 county-specific externality values. They would provide an overwhelming amount of information, but in many cases there is not much difference in the values from county to county.<sup>64</sup> In addition, the county-specific values would not generally be very useful in the resource planning process, where the location of a new source is typically unspecified, or in the resource acquisition process, where the location of a new fossil-fueled resource is driven by such factors as 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.

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<sup>61</sup> Ex. 605 (Desvousges Rebuttal) at 26, 65; Xcel Energy’s Reply Brief at 12.

<sup>62</sup> Xcel Energy’s Initial Brief at 62-63; Xcel Energy’s Reply Brief at 11.

<sup>63</sup> ALJ CP Report, Conclusion 18 at 95.

<sup>64</sup> Ex. 608 (Desvousges Surrebuttal) at 62; Xcel Energy’s Reply Brief at 12.

The out-of-state values, based on modeling nearly 400 sources, would only be relevant in considering possible long-term power purchases from facilities in other states, since the Commission does not have jurisdiction over siting new generating sources outside of Minnesota.<sup>65</sup>

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.<sup>66</sup>

We completely agree with the ALJ's Conclusion No. 35, which is reasonable, practicable, and supported by the record:

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.<sup>67</sup>

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<sup>65</sup> Ex. 607 (Rosvold Rebuttal) at 25-26; Ex. 617 (Rosvold Opening Statement) at 6; Xcel Energy's Initial Brief at 63-64; Xcel Energy's Reply Brief at 13.

<sup>66</sup> Ex. 608 (Desvousges Surrebuttal) at 61; Ex. 616 (Desvousges Opening Statement) at 2; Xcel Energy's Initial Brief at 62; Xcel Energy's Reply Brief at 11.

<sup>67</sup> ALJ CP Report, Conclusion 35 at 99.

## V. THE ALJ APPROPRIATELY CONCLUDED THAT THERE ARE CRITICAL LIMITS TO THE AP2 MODEL'S RELIABILITY

The Agencies filed exceptions to several ALJ conclusions regarding the reliability of the AP2 model, including its use beyond the 50-kilometer limit recommended by the EPA, modeling each pollutant separately, and modeling of hypothetical plants. We address each of the exceptions briefly here.

### A. The EPA-Recommended Limit of 50 Kilometers for Gaussian Plume Models Applies to the AP2 Model

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, recommended by the EPA for steady-state Gaussian plume models. According to the ALJ, this was particularly troublesome because AP2 also models individual pollutants separately in isolation from one another.<sup>68</sup> The Agencies argued in their Exceptions that this specific EPA guidance applies only to photochemical grid models and not to reduced-form models, but this claim has no basis.

We have referred throughout this proceeding to the EPA *Guideline on Air Quality Models* (40 CFR Part 51, Appendix W).<sup>69</sup> The Guideline was first published in April 1978 to provide consistency in the application of air quality models for regulatory purposes. The EPA describes that “[T]he Guideline serves to identify, for all interested parties, those techniques and data bases EPA considers acceptable” and “it should serve as a common measure of acceptable technical analysis.”<sup>70</sup> The

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<sup>68</sup> ALJ CP Report, Conclusion 44 at 101.

<sup>69</sup> Ex. 604 (Desvousges Direct) at 17, Schedule 2 at 18, Schedule 3 at 2-3; Ex. 605 (Desvousges Rebuttal) at 21-22; Ex. 608 (Desvousges Surrebuttal) at 15, 36; Xcel Energy's Initial Brief at 25-26. EPA 2005. “40 CFR Part 51: Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule.” Federal Register, Vol. 70, No. 216, Wednesday, November 9, 2005.

[http://www3.epa.gov/ttn/scram/guidance/guide/appw\\_05.pdf](http://www3.epa.gov/ttn/scram/guidance/guide/appw_05.pdf)

<sup>70</sup> EPA Guideline on Air Quality Models at 68229.

Guideline specifically states that steady-state Gaussian plume models are not considered accurate beyond a 50-kilometer modeling distance, which is characterized as long range transport.<sup>71</sup> It is an undisputed fact that AP2 relies on steady-state Gaussian plume formation, and therefore the 50-kilometer limit is applicable.<sup>72</sup> The Guideline is not specific to photochemical grid models and applies equally to all types of air quality models, including reduced-form models. The EPA has set the 50-kilometer limit because of gross overestimation bias at further downwind distances.<sup>73</sup> And as we have demonstrated, AP2 modeling in this docket in fact grossly overstated damages from primary PM<sub>2.5</sub> and SO<sub>2</sub> emissions across the contiguous United States by predicting health impacts in every U.S. county.

### **B. AP2's Modeling of Each Pollutant Separately Affects the Accuracy of Results**

The ALJ concluded that the Agencies failed to demonstrate that modeling each criteria pollutant separately is a commonly used approach,<sup>74</sup> but the Agencies disagreed.<sup>75</sup> We recognize that modeling each criteria pollutant separately may be a typical feature for reduced-form models, however, it is a factor that affects the accuracy of the modeling results. Chemical reactions involving SO<sub>2</sub> and NO<sub>x</sub> emissions begin in the point source plume, and although they do not react together, their reactions affect the availability of other chemicals in the plume, for example, the availability of ammonium. Ammonium forms secondary PM<sub>2.5</sub> from SO<sub>2</sub> and NO<sub>x</sub> emissions. As Dr. Desvousges explained during the evidentiary hearing, if SO<sub>2</sub> and NO<sub>x</sub> are modeled separately, as is done in AP2, the same limited amount of ammonium can first bind with SO<sub>2</sub>, and then again with NO<sub>x</sub>, overstating the level of

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<sup>71</sup> EPA Guideline on Air Quality Models at 68237.

<sup>72</sup> Ex. 811 (Muller Surrebuttal) at 6; Ex. 605 (Desvousges Rebuttal) at 19, 21-22; Ex. 604 (Desvousges Direct) Schedule 2 at 17, Schedule 3 at 2-3.

<sup>73</sup> Ex. 605 (Desvousges Rebuttal) at 21-22.

<sup>74</sup> ALJ CP Report, Conclusion 15 at 95.

<sup>75</sup> Agencies' Exceptions at 1.

secondary PM<sub>2.5</sub> formed.<sup>76</sup> In an actual plume, as modeled in CAMx, the same amount of ammonium is not available to bind with *both* SO<sub>2</sub> and NO<sub>x</sub>.

### **C. AP2's Modeling of Hypothetical Facilities Is Unreliable**

The Agencies' Exceptions defend their modeling of the hypothetical sources and indicate that the ALJ misunderstood the purpose for modeling hypothetical plants.<sup>77</sup> We believe the ALJ did understand why the hypothetical sources were modeled, she just did not think the AP2 modeling in this particular case was reasonable, because the estimated damage values for the hypothetical plants were far higher than for the six existing, large power plants that were modeled individually.<sup>78</sup> The ALJ drew her conclusion based on evidence presented in Xcel Energy's testimony.

Dr. Desvousges standardized the AP2, InMAP, and CAMx results for the Marshall, Sherco, and Black Dog locations for the differences in geographic scope and valuation assumptions (the concentration-response function, VSL, Monte Carlo analysis). This allows for the difference in values to be mainly attributed to how the models predict changes in ambient air concentrations in Minnesota and within 100 miles from the Minnesota border.<sup>79</sup> Dr. Desvousges concluded that the AP2 damage values based on the modeling of a hypothetical plant in each county centroid are consistently and substantially higher than the AP2 values based on the modeling of existing power plants.<sup>80</sup> For example, the AP2 damage values for primary PM<sub>2.5</sub> are more than six times higher for the hypothetical plant in Dakota County than for the actual Black Dog plant located in Dakota County. In Sherburne County, the AP2 damage values for the hypothetical plant are almost four times higher than the values

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<sup>76</sup> Hearing Transcript, Vol. 7 at 135-137 (Desvousges).

<sup>77</sup> Agencies' Exceptions at 3.

<sup>78</sup> ALJ CP Report, Conclusion 18 at 95.

<sup>79</sup> See Ex. 608 (Desvousges Surrebuttal) at 17-18; Xcel Energy's Initial Brief at 44-45.

<sup>80</sup> AP2 modeled existing plants individually based on their actual location and stack height.



for the Sherco plant. The same pattern continues for NO<sub>x</sub> and SO<sub>2</sub> damage values, which calls into question what was modeled in AP2 as a hypothetical facility.<sup>81</sup>

The Agencies have responded that the damage values for the hypothetical plants are generally higher because these sources were modeled with a lower effective stack height than the six actual plants, and that this lower stack height “corresponds to most facilities.”<sup>82</sup> However, to our knowledge, the record does not contain information about the height of the lower stack used for AP2 modeling, and the Parties have not been able to evaluate how this height would compare or correspond to the stack height, for example, of an average natural gas plant. In addition, the stack height alone could not explain the very large differences in AP2 externality values as shown in Table 1 below.

**Table 1: AP2 Actual, AP2 Hypothetical, and CAMx Damage Values from Dakota and Sherburne Counties (Values Are \$/Ton of Emissions)<sup>83</sup>**

		Sherburne County			Dakota County		
		Low	Mean	High	Low	Mean	High
<b>PM<sub>2.5</sub></b>	<b>AP2 Actual Plant</b>	6,299	11,437	15,639	7,588	13,784	18,870
	<b>AP2 Hypothetical</b>	24,691	44,884	61,851	47,318	85,984	118,350
	<b>CAMx</b>	6,450	11,724	16,078	10,063	18,305	25,137
<b>NO<sub>x</sub></b>	<b>AP2 Actual Plant</b>	239	1,309	1,805	244	1,250	1,771
	<b>AP2 Hypothetical</b>	1,191	3,049	4,208	2,125	4,625	6,391
	<b>CAMx</b>	2,465	5,347	7,315	2,760	5,755	7,893
<b>SO<sub>2</sub></b>	<b>AP2 Actual Plant</b>	1,850	3,354	4,621	1,870	3,378	4,695
	<b>AP2 Hypothetical</b>	5,204	9,463	13,058	8,471	15,389	21,254
	<b>CAMx</b>	4,543	8,245	11,317	5,753	10,439	14,382

It can be assumed that modeling a very low stack would produce larger concentration changes near the source than modeling a higher stack in the same

<sup>81</sup> Ex. 608 (Desvouges Surrebuttal) at 19-20; Xcel Energy’s Initial Brief at 45-46.

<sup>82</sup> Agencies’ Exceptions at 4; Ex. 811 (Muller Surrebuttal) at 22.

<sup>83</sup> Source: Ex. 608 (Desvouges Surrebuttal) at 19.

location, due to differences in dispersion. However, at the same time, it can also be presumed that the population exposed to the concentrations would be smaller from a low stack, because the emissions would not disperse as far away as they would from a much higher stack. Therefore, it is not certain that modeling a lower stack height would automatically mean that the resulting externality values are significantly larger – or four to six times larger as AP2 shows – this would depend on the combination of ambient concentrations and the population exposed.

The Agencies have not been able to explain why AP2's damage values for the hypothetical plants are so much higher than the values for the actual plants. A general reference to a low stack height is not enough to explain the very large differences between the damage values. The ALJ appropriately concluded that AP2's modeling of hypothetical plants was unreasonable, and the Commission should not establish externality values based on these results.

#### **D. AP2's Air Quality Modeling Results Are Inaccurate within Minnesota and Outside of Minnesota**

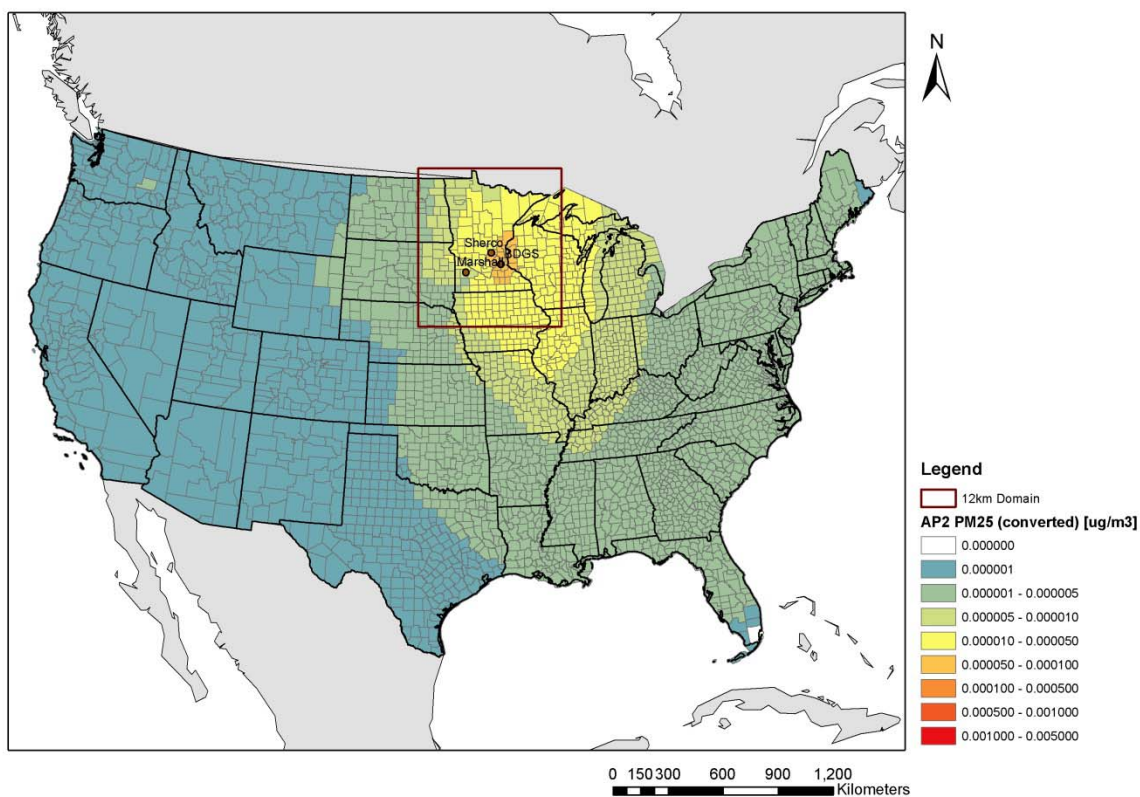
We have presented significant, convincing evidence that the AP2 air quality modeling results are unexpected, inaccurate, and inconsistent with what is known about atmospheric dispersion and chemistry of criteria pollutant emissions. The results are unreliable whether damages are estimated within Minnesota or outside of Minnesota.

The ALJ's Conclusions No. 43 and No. 44 determined that AP2 is not reliable enough to model criteria pollutant impacts across the contiguous United States and it should not be used to estimate nationwide damages. We agree, but do not support using AP2 to estimate damages within Minnesota either, and in our Exceptions summarized evidence showing that the AP2 modeling results are also inaccurate

within Minnesota.<sup>84</sup> We will not repeat that discussion here. Since the Agencies continue to advocate using AP2 to estimate national damages, we will again present evidence that AP2 cannot estimate nationwide damages reliably, and grossly overstates damages from direct PM<sub>2.5</sub> and SO<sub>2</sub> emissions across the contiguous United States by predicting health impacts in every U.S. county.

Figures 1 and 2 below present nationwide AP2 modeling results from Sherco direct PM<sub>2.5</sub> and SO<sub>2</sub> emissions; AP2 modeling results also show similar patterns from Black Dog and Lyon County sources.<sup>85</sup>

**Figure 1. AP2 Direct PM<sub>2.5</sub> Concentrations Nationwide from Sherco Emissions<sup>86</sup>**

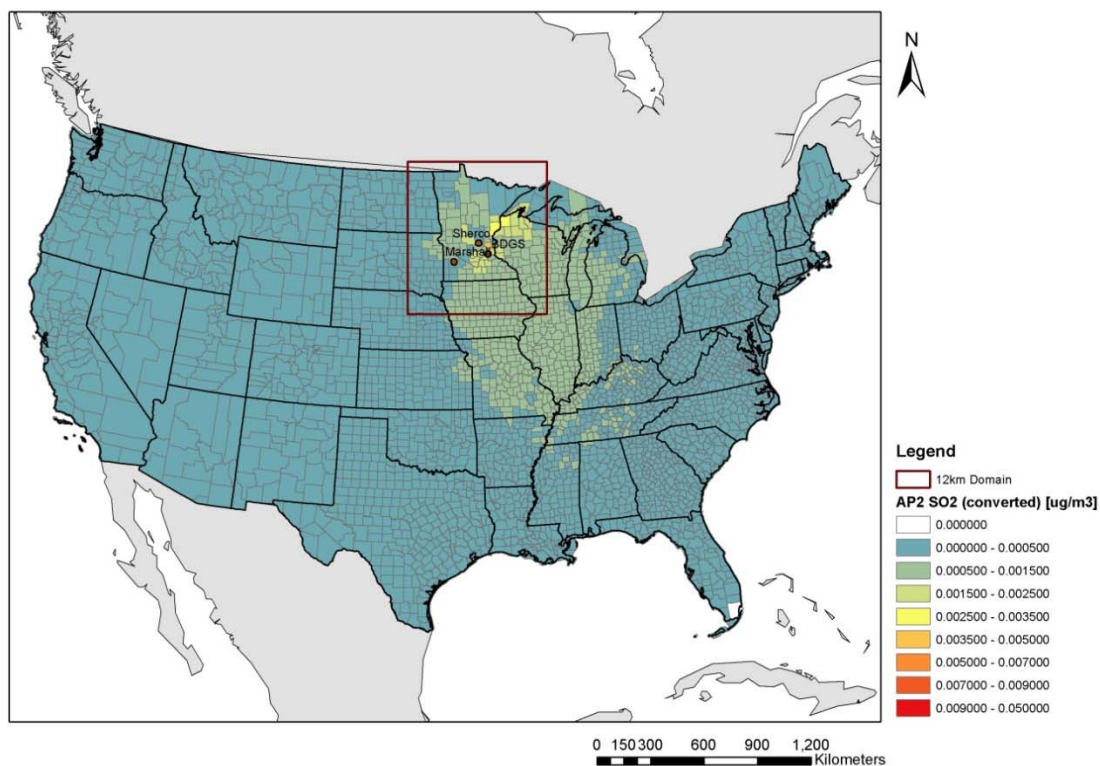


<sup>84</sup> See Xcel Energy's Exceptions at 33-40.

<sup>85</sup> See Ex. 605 (Desvousges Rebuttal), Schedule 5 at 10, 12, 17, 19.

<sup>86</sup> Ex. 605 (Desvousges Rebuttal), Schedule 5 at 5; Xcel Energy's Initial Brief at 40. PM<sub>2.5</sub> emissions are scaled to 9.4 tons to equal what was modeled for CAMx.

**Figure 2. AP2 Secondary PM<sub>2.5</sub> Concentrations Nationwide from Sherco SO<sub>2</sub> Emissions<sup>87</sup>**



Both maps show that AP2 predicts impacts from direct PM<sub>2.5</sub> and SO<sub>2</sub> emissions in every county in the contiguous United States. This means that AP2 significantly over-estimates damages, because it assumes that every person in the United States is affected by PM<sub>2.5</sub> and SO<sub>2</sub> emissions from one Minnesota power plant. Considering that primary PM<sub>2.5</sub> is directly emitted, dispersed, and deposited on the ground (resembling ash from a wood-burning fire), it cannot be accurate that primary PM<sub>2.5</sub> emissions from a Minnesota source would travel to every U.S. county. It is widely recognized that primary PM<sub>2.5</sub> effects are mostly local, which was also acknowledged by the ALJ in her Conclusion No. 37.<sup>88</sup> It is also highly unlikely that secondary PM<sub>2.5</sub> formed from SO<sub>2</sub> emissions from a Minnesota source would travel to every U.S. County.

<sup>87</sup> Ex. 605 (Desvousges Rebuttal), Schedule 5 at 3; Xcel Energy's Initial Brief at 41. SO<sub>2</sub> emissions are scaled to 1,169.4 tons to equal what was modeled for CAMx.

<sup>88</sup> ALJ CP Report, Conclusion 37 at 99.

The Agencies have not disputed the accuracy of the maps presented here, which were included in our Rebuttal Testimony and Initial Legal Brief. Although the Agencies have not specifically addressed our evidence that the AP2 model overstates primary PM<sub>2.5</sub> and SO<sub>2</sub> values by predicting impacts in every U.S. county, their main response to our claims of inaccuracy has been 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 Dr. Muller's Direct Testimony.<sup>89</sup>

However, the ALJ CP Report rightly concludes that the AP2 performance evaluation is not reliable,<sup>90</sup> and the Agencies did not file exceptions to these conclusions.<sup>91</sup> The ALJ found that the AP2 performance evaluation was conducted in conflict with established guidelines and against the Boylan and Russell standards. She noted that the Agencies failed to respond to Xcel Energy's specific 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.<sup>92</sup> The AP2 performance evaluation does not provide a credible or persuasive basis for claiming that the AP2 air quality modeling results are accurate within or outside of Minnesota.

## **VI. CONCENTRATION-RESPONSE FUNCTION AND VSL**

In order to reduce the number of disputed issues, we accept the ALJ's recommendation regarding the concentration-response function (6.0 percent to 7.3 percent),<sup>93</sup> which is supported by the record and current epidemiological studies. However, we suggest the Commission treat the ALJ-recommended VSL of \$7.7

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<sup>89</sup> Ex. 811 (Muller Surrebuttal) at 8-9.

<sup>90</sup> ALJ CP Report Conclusions 20-23 at 96-97.

<sup>91</sup> Agencies' Exceptions at 15.

<sup>92</sup> ALJ CP Report Conclusions 20-23 at 96-97.

<sup>93</sup> ALJ CP Report, Recommendation 3 at 104.

million as a high-end of a range and also adopt a low-end VSL of \$4.1 million.<sup>94</sup> A range is a better option than a single value, reflecting the uncertainty in estimating and monetizing damages from PM<sub>2.5</sub> exposure. We note that the Agencies have also advocated for a VSL range.<sup>95</sup> The Agencies did not file exceptions to the ALJ's conclusions regarding the concentration-response function and VSL, in contrast, the CEOs continue to argue for a very high VSL (\$9.8 million) and for a very high range for the concentration-response function (7.8 percent to 14 percent), which are not supported by the best science or by the most recent epidemiological and economic studies.<sup>96</sup>

Xcel Energy's analysis of mortality risk and VSL is based on the most recent science and reflects the variability of epidemiological and economic studies. Since our combined Monte Carlo simulation of mortality risk and VSL creates a distribution using the mean and standard error values of the selected studies, it is a superior way to address the inherent uncertainty involved in estimating and monetizing human health effects from PM<sub>2.5</sub> exposure. However, the CEOs in their Exceptions continue to challenge and discredit our approach; we respond briefly here.<sup>97</sup> Our Reply Brief included a detailed response to the CEOs' assertions, and we refer readers to review it for a full discussion.<sup>98</sup>

### **A. The ALJ's Concentration-Response Function Range Is Based on the Record and Supported by Current Epidemiological Studies**

We recognize the ALJ's recommendation No. 3 regarding the concentration-response function is in conflict with her conclusion No. 50, as pointed out by the CEOs. However, our interpretation is that the conclusion has a drafting error, and the

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<sup>94</sup> ALJ CP Report, Recommendation 2 at 104.

<sup>95</sup> E.g., Ex. 808 (Muller Direct) at 41; Ex. 810 (Muller Rebuttal) at 7, 18; Agencies' Reply Brief at 44-46.

<sup>96</sup> Ex. 605 (Desvousges Rebuttal) at 74-75; Ex. 608 (Desvousges Surrebuttal) at 53; Xcel Energy's Reply Brief at 37.

<sup>97</sup> CEOs' Exceptions at 12-13.

<sup>98</sup> Xcel Energy's Reply Brief at 27-38.

recommendation states what was intended: either adopt a single value of 6.8 percent (which is in fact Xcel Energy’s mean value) or adopt a range of 6.0 percent to 7.3 percent. This recommended range is very similar to the range we have proposed, 5.3 percent to 7.3 percent, and can be considered a reasonable range supported by Dr. Desvousges’ analysis and the epidemiological studies on which he relied.

Dr. Desvousges’ analysis of the concentration-response function used data from three different studies: a meta-analysis by Hoek et. al. (2013),<sup>99</sup> the most recent paper on the Harvard Six Cities cohort (LePeule et. al. 2012),<sup>100</sup> and a recent paper on the American Cancer Society cohort (Jerrett et. al. 2013).<sup>101</sup> His analysis was the only one that used nine studies from the Hoek et. al. (2013) meta-analysis, which also researched cohorts other than the Harvard Six Cities and American Cancer Society (e.g., persons enrolled in the U.S. Medicare system, registered nurses in 11 states, California public health professionals, and Canadian adults mandated to provide detailed census data).<sup>102</sup> Therefore, Dr. Desvousges’ analysis was much more inclusive and comprehensive than the CEOs’ approach, which used only one point estimate from one individual study of the American Cancer Society cohort (Krewski et. al. 2009) and one point estimate from one individual study of the Harvard Six Cities cohort (LePeule et. al. 2012). There is no doubt that a well-executed, recent meta-analysis should be selected over a single study, because meta-analyses systematically use information from a number of individual studies and prioritize the studies based

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<sup>99</sup> Gerard Hoek, Ranjini Krishnan, Rob Beelen, Annette Peters, Bart Ostro, Bert Brunekreef, and Joel Kaufman. 2013. “Long-Term Air Pollution Exposure and Cardio-Respiratory Mortality: A Review.” *Environmental Health* 12:43.

<sup>100</sup> LePeule, Johanna, Francine Laden, Douglas Dockery, and Joel Schwartz. 2012. “Chronic Exposure to Fine Particles and Mortality: An Extended Follow-Up of the Harvard Six Cities Study from 1974 to 2009.” *Environmental Health Perspectives* 120(7):965-970.

<sup>101</sup> Jerrett, Michael, Richard T. Burnett, Bernardo S. Beckerman, Michele C. Turner, Daniel Krewski, George Thurston, Randall V. Martin, Aaron van Donkelaar, Edward Hughes, Yuanli Shi, Susan M. Gapstur, Michael J. Thun, and C. Arden Pope III. 2013. “Spatial Analysis of Air Pollution and Mortality in California.” *American Journal of Respiratory and Critical Care Medicine*. 188(5):593-599.

<sup>102</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 36, 98-102 (Appendix A).

on the statistical certainty associated with the results (studies with smaller standard errors are assigned higher weights).<sup>103</sup>

The CEOs continue to criticize Dr. Desvousges' Monte Carlo approach and assignment of weights to the three selected mortality risk studies.<sup>104</sup> We note the Monte Carlo approach is not new and it was also used in establishing the values in the original externalities docket. The nature of Monte Carlo analysis *requires* the assignment of weights to the studies that are used to create the distribution. Dr. Desvousges exercised his professional expertise and best knowledge to assign the weights, and it is appropriate that the two individual studies have lower weights (12.5 percent each) than the meta-analysis (75 percent), which is the best synthesis of the available studies and data.<sup>105</sup> Dr. Marshall's judgment was to give a 50 percent weight each to two individual studies, but to ignore a recent, credible meta-analysis (Hoek et. al. 2013), and we do not believe this decision reflects the best science.

Since the original externalities proceeding, literally thousands of papers have been published on the impacts of ambient PM<sub>2.5</sub> concentrations on human health. The studies have followed different cohorts (varying by size, location, age, gender, occupation, etc.) and estimated different health effects.<sup>106</sup> There is no consensus in the epidemiological literature on the appropriate value or range of concentration-response function from PM<sub>2.5</sub> exposure.<sup>107</sup> The CEOs made a misleading assertion in their Exceptions by stating that "the entire academic epidemiological community" agrees that the concentration-response function should be set based on two particular studies, Krewski et. al. (2009) and LePeule et.al. (2012).<sup>108</sup>

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<sup>103</sup> Xcel Energy's Reply Brief at 29-30.

<sup>104</sup> CEOs' Exceptions at 13.

<sup>105</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 37.

<sup>106</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 29-35, Appendix A.

<sup>107</sup> See Xcel Energy's Initial Brief at 27.

<sup>108</sup> CEOs' Exceptions at 1-2.



In summary, Xcel Energy believes the concentration-response function range of 6.0 percent to 7.3 percent, proposed by the ALJ, is well supported by the current epidemiological studies, Dr. Desvousges analysis, and the record in this case. The low-end is based on the recommendation of the Agencies' witness Dr. Muller (which the CEOs' own witness Dr. Jacobs describes as not unreasonable)<sup>109</sup> and the high-end is based on Dr. Desvousges' recommendation.

### **B. The CEOs Continue to Argue for an Extremely High VSL Value Based on an Outdated Study**

The CEOs continue to argue for a single, very high VSL value (\$9.8 million) and to criticize Dr. Desvousges' VSL analysis and treatment of one particular study,<sup>110</sup> a meta-analysis by Kochi et. al. (2006).<sup>111</sup> First, we like to note that the CEOs' witness Dr. Marshall did not use the Kochi meta-analysis for his VSL determination, nor any of the other more recent meta-analyses available (e.g., Mrozek and Taylor 2002;<sup>112</sup> and Viscusi and Aldy 2003<sup>113</sup>). Instead, he uncritically took one point estimate from an outdated EPA meta-analysis from 1999 (discussed in *Guidelines for Preparing Economic Analyses 2000*),<sup>114</sup> which included studies published between 1974 and 1991.<sup>115</sup> We do not consider the CEOs' analysis to be based on the best or most recent science. The EPA is in the process of revising its VSL guidance and considering more recent studies. In the current version of *Guidelines for Preparing Economic Analyses*, the EPA states that although the studies used in the original 1999 meta-analysis "were the best

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<sup>109</sup> Ex. 117 (Jacobs Rebuttal) at 8.

<sup>110</sup> CEOs' Exceptions at 17-18.

<sup>111</sup> Kochi, I., B. Hubbell, and R. Kramer. 2006. "An Empirical Bayes Approach to Combining and Comparing Estimates of the Value of a Statistical Life for environmental Policy Analysis." *Environmental and Resource Economics* 34:385-406.

<sup>112</sup> Mrozek, J.R. and L.O. Taylor. 2002. "What Determines the Value of Life? A Meta-Analysis." *Journal of Policy Analysis and Management* 21:253-70.

<sup>113</sup> Viscusi, W.K., and J.E. Aldy. 2003. "The Value of a Statistical Life: A Critical Review of Market Estimates throughout the World." *Journal of Risk and Uncertainty* 27:5-76.

<sup>114</sup> As his VSL source, Dr. Marshall cites U.S. Environmental Protection Agency, 2000. *Guidelines for Preparing Economic Analyses*, Ex. 115 (Marshall Direct) at 25.

<sup>115</sup> Ex. 115 (Marshall Direct) at 25. See also Ex. 604 (Desvousges Direct), Schedule 2 at 56 explaining that this EPA meta-analysis uses only older studies and has been superseded by the three more recent meta-analyses.

available data at that time, they are sufficiently dated and may rely on obsolete preferences for risk and income.”<sup>116</sup>

Second, we note that the Agencies’ witness Dr. Muller also used the Kochi et. al. (2006) study for his low VSL value, and the CEOs’ witness Dr. Polasky supported using as an alternative VSL value a combined estimate of \$7.7 million from the Kochi et. al. (2006) study.<sup>117</sup> The ALJ recommended a VSL of \$7.7 million, which value was characterized as “appropriate”<sup>118</sup> and “reasonable”<sup>119</sup> by the CEOs’ own witness.

Since the CEOs’ Exceptions repeated their criticism regarding Dr. Desvousges’ VSL analysis and weighting of studies, we once again provide our response here. Dr. Desvousges’ Monte Carlo simulation for VSL incorporated data from three different meta-analyses (Kochi et. al. 2006; Mrozek and Taylor 2002; and Viscusi and Aldy 2003), and data from a recent individual study by Kniesner et. al. (2012).<sup>120</sup> Dr. Desvousges assigned appropriate weights based on his expertise for each study (55 percent, 15 percent, 15 percent, and 15 percent respectively) and used both the mean and standard error values from the four studies.<sup>121</sup> In contrast, the CEOs placed a 100 percent weight on their one chosen study.

Dr. Desvousges used Kochi et. al. (2006) because it is the most recent and up-to-date meta-analysis on VSL; includes results from both stated preference studies and revealed preference (hedonic wage) studies; uses the most advanced statistical methods; and provides several estimates of VSL under different modeling assumptions. Therefore, it is possible and also preferable to select several estimates

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<sup>116</sup> Quoted in Hearing Transcript, Vol. 6 at 165. Xcel Energy offered Appendix B of the most recent version of the EPA Guidelines to the record as Exhibit 614, but it was not admitted (*EPA Guidelines for Preparing Economic Analyses*, December 17, 2010, Updated May 2014).

<sup>117</sup> Ex. 808 (Muller Direct) at 42; Ex. 118 (Polasky Rebuttal) at 8.

<sup>118</sup> Ex. 118 (Polasky Rebuttal) at 8.

<sup>119</sup> Ex. 118 (Polasky Rebuttal) at 13.

<sup>120</sup> Kniesner, Thomas J., W. Kip Viscusi, Christopher Woock, and James P. Ziliak. 2012. “The Value of a Statistical Life: Evidence from Panel Data.” *Review of Economics and Statistics* 94(1):74-87.

<sup>121</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 55.

from the Kochi et. al. (2006) study to reflect the uncertainty and sensitivity in modeling parameters.<sup>122</sup> Dr. Desvousges used as a key measure an estimate from Kochi et. al. (2006) that is based on the complete data from all of the individual studies (this central value was assigned a 35 percent weight). This estimate includes negative values in the raw data, which is appropriate, because both the high and low values of the original studies are treated symmetrically without discarding only the low-end of the values.<sup>123</sup> Dr. Desvousges used two other estimates from Kochi et. al. (2006) and adjusted these two estimates as if the negative values had been included in the raw data and each estimate was assigned a 10 percent weight.<sup>124</sup>

We believe it is appropriate to retain the negative values that were included in the original studies and raw data used by Kochi et. al. (2006) – the negative values were part of the original statistical distribution, affect the mean value, and impact where the median and other percentiles land in the distribution. It would be extraordinary and atypical to remove only low-end values of valid study results.<sup>125</sup>

We note that in the Carbon Phase of this proceeding, negative values were retained in the analysis. The Interagency Working Group (IWG) analysis for Social Cost of Carbon (SCC), one of the three Integrated Assessment Models, the FUND model, predicted negative values at all three discount rates for all five Stanford Energy Modeling Forum (EMF-22) scenarios.<sup>126</sup> However, the IWG did not remove these negative values from the distribution or ignore them when the summary SCC statistics

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<sup>122</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 54.

<sup>123</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 51-52.

<sup>124</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 52, 54-55. One of the estimates included additional studies without a sampling error measure and another was based on an alternative analysis of U.S. only hedonic wage studies.

<sup>125</sup> Ex. 608 (Desvousges Surrebuttal) at 51-53.

<sup>126</sup> Ex. 602 (Martin Surrebuttal), Schedule 1 (July 2015 TSD) at 18-19.

were calculated. Neither did the CEOs request that the negative values be removed from the SCC analysis for the CO<sub>2</sub> portion of this proceeding.<sup>127</sup>

In his VSL analysis, Dr. Desvousges assigned an equal weight, 15 percent each, to two additional meta-analyses (Mrozek and Taylor 2002 and Viscusi and Aldy 2003) and a recent individual study by Kniesner et. al. (2012).<sup>128</sup> The CEOs again suggest that a Monte Carlo simulation should not combine meta-analyses and individual studies. However, based on Dr. Desvousges' expertise, it is reasonable to supplement the selected meta-analyses with an individual study if that study represents more recent research, new data, or better scientific methods. The Kniesner et. al. (2012) study was published six to ten years later than any of the three meta-analyses and collected panel data, which means that it allows for multiple observations per person. There is no commonly accepted best practice that discourages supplementing meta-analyses with single studies in a Monte Carlo analysis, if reasonable and relevant research rationales justify the inclusion of a particular individual study. It was also appropriate to give the Kniesner et. al. (2012) study a weight of 15 percent, because the Monte Carlo analysis used a range from that study (\$4 million to \$10 million), not a central estimate. Including this study was also a conservative choice, because its results slightly increased the final low, high, and central VSL estimates.<sup>129</sup>

In summary, the ALJ's VSL recommendation of \$7.7 million is well supported by the record, and the CEOs' witness Dr. Polasky has characterized \$7.7 million as reasonable and appropriate.<sup>130</sup> However, this value is at the high end of the VSL values proposed by the Parties, and we believe the record supports adding a low-end value to establish a range. The Agencies have advocated for a VSL range to reflect

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<sup>127</sup> Xcel Energy's Reply Brief at 36.

<sup>128</sup> Ex. 604 (Desvousges Direct), Schedule 2 at 55.

<sup>129</sup> Ex. 608 (Desvousges Surrebuttal) at 55-56.

<sup>130</sup> Ex. 118 (Polasky Rebuttal) at 8, 13.

uncertainty, and an appropriate low value could be either the \$3.7 million proposed in Dr. Muller's testimony or the \$4.1 million based on Dr. Desvousges' testimony.

## VII. CONCLUSION

The Commission should adopt externality values that are reasonable, practicable, and the best available measure of the criteria pollutants' cost. Xcel Energy proposed values based on CAMx, which is the only model in this proceeding that meets the EPA's current air quality modeling guidelines; incorporates full-science atmospheric chemistry algorithms; uses hourly, varying three-dimensional wind speed and direction; and models the three criteria pollutants simultaneously with chemical reactions as would be present in a power plant plume. The CAMx air quality modeling produced results that are reliable, accurate, and consistent with the science of air dispersion and chemistry. The Commission should adopt externality values based on our CAMx modeling results as such, keeping the initial geographic scope, source locations, and modeling parameters intact.

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 regardless of whether damages are estimated within Minnesota or outside of Minnesota. Xcel Energy has demonstrated 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. Modeling a large number of source locations does not improve the quality of AP2 results and only gives a false notion of specificity.

The Commission should not adopt externality values based on the AP2 modeling results. Neither should the Commission establish externality values based on the InMAP model – the ALJ concluded it is unreliable and should not be used – and the CEOs have not filed exceptions to these conclusions. The CEOs no longer

appear to have a strong preference for the model used, so long as the resulting externality values are as high as possible. To achieve this, they advocate for a national scope of damages, a very high concentration-response function range, and a very high VSL.

The ALJ in her Report and the CEOs in their Exceptions have proposed some significant modifications to the CAMx modeling. We note that these are completely new proposals, there is no record to evaluate their merits, and no witness has provided testimony to support them. The most critical fact is that the Parties have not been able to respond, since the modeling has not been conducted, the results are not available, and no externality values have been presented based on these new suggestions.

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.

## 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.

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

by electronic filing.

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

Dated this 4th day of August 2016.

/s/

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Regulatory Administrator

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