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November 24, 2015

—Via Electronic Filing—

The Honorable LauraSue Schlatter,  
The Honorable John Oxley  
Office of Administrative Hearings  
P.O. Box 64620  
St. Paul, MN 55164-0620

RE: INITIAL POST-HEARING BRIEF REGARDING CO<sub>2</sub>  
INVESTIGATION INTO ENVIRONMENTAL AND SOCIOECONOMIC COSTS  
MPUC DOCKET NO. E999/CI-14-643  
OAH DOCKET NO. 80-2500-31888

Dear Judges Schlatter and Oxley:

Northern States Power Company, doing business as Xcel Energy, submits this Initial Post-Hearing Brief in the above-referenced docket.

This response has been filed in eDockets and thereby served on the parties to this proceeding. Consistent with the First Prehearing Order, we are also providing a printed version via U.S. mail to your office.

Please contact me at [james.r.denniston@xcelenergy.com](mailto:james.r.denniston@xcelenergy.com) or (612) 215-4656 if you have any questions regarding this filing.

Sincerely,

/s/

JAMES R. DENNISTON  
ASSISTANT GENERAL COUNSEL

Enclosures  
c: Service Lists

**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 INITIAL POST-HEARING BRIEF  
REGARDING CO<sub>2</sub>**

**November 24, 2015**

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**I. INTRODUCTION**

Northern States Power Company, doing business as Xcel Energy, respectfully provides this Brief in support of its proposed methodology to estimate the environmental cost of CO<sub>2</sub> as well as its recommended range of CO<sub>2</sub> values. The Company believes that while the four Federal Social Cost of Carbon (SCC) executive summary values do not represent a reasonable and best available measure of the environmental cost of CO<sub>2</sub>, the underlying SCC methodology and raw modeling outputs should be used as a reasonable and best available starting point from which to develop a range of CO<sub>2</sub> values.

This proceeding involves complex issues of climate change science, economics, and public policy, and they are especially complicated because of the inherent uncertainty in estimating long-term climate change damages as far as the year 2300. The nature of CO<sub>2</sub> contributes to the complexity: it is a global pollutant with long-term impacts.

Several Parties in this case have provided testimony regarding climate change science – for example, whether global warming exists, whether predicted

temperature changes match observed temperature changes, whether the harms from CO<sub>2</sub> emissions outweigh the benefits, whether the Integrated Assessment Models (IAMs) used to estimate the SCC are accurate, and whether the IAMs use appropriate assumptions about equilibrium climate sensitivity and damage functions. Xcel Energy does not have a position on these or other climate science issues that have been disputed in this proceeding. However, other Parties' testimony regarding climate change science and modeling seems to imply that there is an empirically true or correct value of the SCC that can be determined, if we could only agree whose science and models are the best.

Xcel Energy does not share this view. We agree that estimating the SCC depends in part on climate science and modeling capabilities, but it is at least as strongly driven by public policy judgments that do not have an empirically verifiable answer. In other words, the approach to estimate the SCC cannot be a purely scientific or economic exercise, but must take into consideration public policy, and in this case, also the context in which the CO<sub>2</sub> environmental values will be used. We note that Mr. Martin is the only witness in this proceeding who has broad enough knowledge to testify on the Federal SCC methodology, public policy issues, and application context: no other witness possesses comparable carbon policy expertise combined with first-hand experience with public utility commission procedures and integrated resource planning.

The task here, as required by Minnesota law and the Commission Order, is to establish a range of environmental values for CO<sub>2</sub>, based on a reasonable and best available measure. The Parties have proposed various methodologies, which in turn produced very different estimates of the environmental cost of CO<sub>2</sub>; the

recommended values range from negative values to \$136.70.<sup>1</sup> Because of this variety, it is especially important in this proceeding to establish decision-making criteria, which will give the ALJ and the Commission guidance how to sort out and evaluate the diverse proposals.

Xcel Energy clearly articulated in its Direct Testimony reasonable standards for the methodology to develop the environmental cost of CO<sub>2</sub> and recommended a balanced consideration of the following: a damage cost approach as ordered by the Commission; reasonably addressing the inherent uncertainty in estimating climate damages; reflecting the absence of consensus on discount rate choice; using statistically sound methods; reflecting an appropriate level of risk tolerance (which the Company defined as tolerance for the risk that the Commission's adopted range does not include the actual value); minimizing subjective judgments; yielding a practicable range; and being transparent, replicable and updatable.<sup>2</sup>

Throughout this proceeding, Xcel Energy has emphasized that these criteria need to be balanced together and against each other – a balancing exercise that may reveal that the ideal choice based on one criterion might not be ideal in terms of the other criteria. Throughout this proceeding, Xcel Energy has also demonstrated how its proposal meets the recommended standard of review criteria, and why its proposal meets these criteria better than any other Party's proposal. The Company respectfully recommends the Commission adopt its proposed methodology and the resulting range of CO<sub>2</sub> values.

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<sup>1</sup> Based on the Interagency Working Group's (IWG) July 2015 Technical Support Document (TSD), emissions year 2020, 95<sup>th</sup> percentile value converted to nominal dollars per short ton. See Ex. 601 (Martin Rebuttal) at 12.

<sup>2</sup> Ex. 600 (Martin Direct) at 2, 67-69; Ex. 601 (Martin Rebuttal) at 13.

## II. CRITERIA FOR DECISION-MAKING

Deciding on a CO<sub>2</sub> environmental cost range is not a simple matter of looking up a scientifically accepted number or running the most accurate climate model. The decision requires careful weighing of uncertain information, involves controversy, calls for policy judgment, and requires balancing of multiple decision criteria. Xcel Energy has offered the most detailed standards that the ALJ and the Commission can apply to determine the fundamental question in this proceeding – how to evaluate and differentiate proposals that recommend various methodologies and a wide range of values?

The relevant statute in this proceeding, Minn. Stat. §216B.2422 subd. 3(a), states the following regarding environmental costs:

“The commission shall, to the extent *practicable*, quantify and establish a *range* of environmental costs associated with each method of electricity generation. A utility shall use the values established by the commission in conjunction with other external factors, including socioeconomic costs, when evaluating and selecting resource options in all proceedings before the commission, including resource plan and certificate of need proceedings.” [emphasis added]

The statute requires practicability and a range of CO<sub>2</sub> values, and therefore these two statutory criteria should be considered the most important criteria for decision-making. The ALJ in the original Externalities Docket agreed that “using ranges, rather than a precise number, more accurately expresses the reality of this whole process.”<sup>3</sup> The Commission in this proceeding further ordered that Parties

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<sup>3</sup> *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3.* Docket No. E-999/CI-93-583. FINDINGS OF FACT, CONCLUSIONS, RECOMMENDATION AND MEMORANDUM. March 22, 1996. Finding No. 34.

must use a damage cost approach to estimate the environmental cost of CO<sub>2</sub>.<sup>4</sup>

Thus, three criteria are explicitly established in the statute and by the Commission – practicability, the need for a range rather than a single value, and the use of a damage cost approach. Xcel Energy identified additional criteria in its Direct Testimony and proposed that the methodology to develop a CO<sub>2</sub> environmental cost range should be based on a balanced consideration of the following:

- Reasonably address the inherent uncertainty in estimating climate change damages;
- Reflect the absence of consensus on discount rate choice;
- Use statistically sound methods;
- Reflect an appropriate level of risk tolerance, i.e., tolerance for risk that the actual value of future climate change damages may lie outside (above or below) the Commission’s adopted range;
- Minimize subjective judgments;
- Yield a practicable range; and
- Be transparent, replicable, and updatable.<sup>5</sup>

The task of estimating the environmental cost of CO<sub>2</sub> is uncertain no matter what we do, because we have no certain empirical evidence of what will happen in the next 300 years or so. As a society, we will continue to grow, develop, and change. We simply have not experienced future temperature changes or technological innovations, which will affect future economies and may alter the

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<sup>4</sup> *In the Matter of the Further Investigation into Environmental and Socioeconomic Costs Under Minn. Stat. §216B.2422, Subdivision 3.* Docket No. E-999/CI-14-643. NOTICE AND ORDER FOR HEARING. October 15, 2014. Order Point 4. Hereafter referred as Commission’s October 15, 2014 Order.

<sup>5</sup> Ex. 600 (Martin Direct) at 2, 67-69.



historical relationship between emissions and economic growth. Therefore, it is not possible to develop a SCC methodology that is solely evidence-based, and the question becomes how to manage the uncertainty. Xcel Energy has done exactly this by proposing additional standard of review criteria and a methodology that balances these criteria with each other.<sup>6</sup>

Mr. Martin’s Rebuttal Testimony evaluated each Party’s proposal against Xcel Energy’s recommended standard of review criteria. Table 1 below summarizes how well each Party’s recommendation meets the proposed review criteria, with green indicating a criterion is met, yellow that a criterion is met partially, and red that a criterion is largely not met.

**Table 1. Matrix Comparing all Parties’ Proposals to Company’s Criteria<sup>7</sup>**

<b>Criterion</b>	<b>Dr. Hanemann</b>	<b>Dr. Polasky</b>	<b>Dr. Smith</b>	<b>Dr. Gayer</b>	<b>Dr. Mendelsohn</b>	<b>Company</b>
Uses damage costs approach	Green	Green	Green	Green	Green	Green
Reasonably addresses uncertainty	Red	Red	Yellow	Yellow	Yellow	Green
Reflects absence of consensus on discount rate	Green	Green	Red	Green	Red	Green
Uses statistically sound methods	Red	Red	Red	Red	Red	Green
Reflects appropriate risk tolerance	Red	Red	Red	Yellow	Red	Green
Minimizes subjective judgments	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
Yields a practicable range	Red	Red	Green	Red	Green	Green
Transparent, replicable and updatable	Green	Green	Red	Green	Red	Green

<sup>6</sup> Hearing Transcript Vol. 3B at 127 (Martin).

<sup>7</sup> Ex. 601 (Martin Rebuttal) at 37.

### **III. SUMMARY OF THE PARTIES' PROPOSED METHODOLOGIES AND CO<sub>2</sub> VALUES**

Parties' positions in this proceeding can be divided into three main categories: those endorsing the Federal SCC, those opposing the Federal SCC, and Xcel Energy's middle-ground that accepts the Federal SCC raw modeling outputs as a starting point, but proposes different CO<sub>2</sub> environmental cost values than the Interagency Working Group (IWG). Several Parties recommend accepting the Federal SCC methodology and executive summary values exactly as they are (the Department of Commerce, Minnesota Pollution Control Agency, Clean Energy Organizations, Clean Energy Business Coalition, and Doctors for a Healthy Environment). Several other Parties strongly oppose adopting the Federal SCC and either modify the SCC methodology, develop their own methodology, or otherwise argue for different and generally low values (Great River Energy [GRE], Minnesota Power [MP], Otter Tail Power Company [OTP], Minnesota Large Industrial Group [MLIG], and Peabody Energy Corporation [Peabody]). Xcel Energy has reservations about several aspects of the Federal SCC methodology, but nevertheless accepts the underlying methodology and raw modeling data as a starting point to develop CO<sub>2</sub> environmental cost values.

Dr. Hanemann testified for the Department of Commerce and the Minnesota Pollution Control Agency (the Agencies). He advocated adopting the Federal SCC as a reasonable and best available measure, and proposed adoption of the three values representing the average across IAMs at 2.5, 3, and 5 percent discount rates. Based on our understanding of Dr. Hanemann's testimony, he did not propose adoption of the fourth value, based on the 95th percentile across IAMs at 3 percent discount rate, except if the SCC is viewed through the lens of risk management. For emission year 2020, his recommended range is from \$12 (5 percent discount rate average value) to \$62 (2.5 percent discount rate average

value), in 2007 dollars per metric ton, based on the IWG's updated July 2015 Technical Support Document (TSD).<sup>8</sup>

Dr. Polasky testified for the Clean Energy Organizations. He recommended adopting the Federal SCC as a reasonable and best available measure, and proposed adoption of all four executive summary SCC values – the values representing the average across IAMs at 2.5, 3, and 5 percent discount rates and the value representing the 95th percentile across IAMs at 3 percent discount rate, as published in Appendix A, Table A1 of the July 2015 TSD (e.g., \$12, \$42, \$62, and \$123 for emission year 2020, in 2007 dollars per metric ton).<sup>9</sup>

Dr. Rom testified for Doctors for a Healthy Environment. He supported using the Federal SCC as a reasonable and best available measure to estimate environmental cost of CO<sub>2</sub>.<sup>10</sup>

Mr. Kunkle and Mr. Rumery testified for the Clean Energy Business Coalition. They advocated adopting the Federal SCC as a reasonable and best available measure to develop environmental values for CO<sub>2</sub>.<sup>11</sup>

Dr. Smith testified for GRE/MP/OTP/MLIG. She opposed adopting the Federal SCC methodology and values. Instead, Dr. Smith modified five key modeling assumptions made by the IWG and ran the three IAMs with the following alternative assumptions: 1) use the “first ton” or “average ton” approach instead of the IWG’s “last ton” approach to modeling marginal damages; 2) use a modeling horizon to the year 2100 or at most to the year 2140; 3) disregard the 2.5 percent discount rate and use 3 and 5 percent discount rates; 4) base values on U.S.

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<sup>8</sup> Ex. 802 (Hanemann Surrebuttal) at 87-88.

<sup>9</sup> Ex. 101 (Polasky Rebuttal) at 2.

<sup>10</sup> Ex. 500 (Rom Rebuttal) at 8-9.

<sup>11</sup> Ex. 701 (Kunkle Rebuttal) at 2; Ex. 700 (Rumery Rebuttal) at 2.

damages; and 5) account for possible leakage.<sup>12</sup> For emission year 2020, Dr. Smith proposed a range from \$1.62 to \$5.14 (in 2014 dollars per net metric ton). The low value is based on modeling damages from the first ton emitted, a 5 percent discount rate, U.S. damages, and a modeling horizon to the year 2100. The high value is based on modeling damages from the average of the first ton and last ton emitted, a 3 percent discount rate, U.S. damages, and a modeling horizon to the year 2140.<sup>13</sup>

Dr. Gayer testified for MLIG. He did not support the Federal SCC methodology or values, and instead proposed converting the SCC values to U.S. and Minnesota values. The IWG estimated in the February 2010 TSD that U.S. damages range from 7 percent (based on the FUND model's regional estimate of damages in the United States) to 23 percent (based on the U.S. share of the global Gross Domestic Product [GDP] in that year) of global damages. Dr. Gayer proposed applying these adjustment factors to the four SCC executive summary values, and recommended CO<sub>2</sub> environmental cost ranges of \$0.77-\$2.53, \$2.24-\$7.36, \$3.57-\$11.73, and \$6.23-\$20.47 (2010 damage value in 2007 dollars). He also suggested a value of \$0.37 based on Minnesota's share of the global GDP.<sup>14</sup>

Drs. Bezdek, Happer, Lindzen, Mendelsohn, Tol, and Wecker testified for Peabody. They all opposed using the Federal SCC methodology or values and proposed various low options for the environmental cost of CO<sub>2</sub>, ranging from negative values up to \$6 per ton. Dr. Mendelsohn used the DICE model with its internal optimization mode, emission forecasts, GDP projections, and declining discount rate, but changed some other key parameters, including the shape of the

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<sup>12</sup> Dr. Smith did not propose that leakage be addressed in the context of this proceeding, but rather that an adjustment factor for estimated leakage be applied to the emission reductions within Minnesota in the context of specific dockets where the CO<sub>2</sub> environmental cost values are applied.

<sup>13</sup> Ex. 300 (Smith Direct) at 20-27, 33; Ex. 302 (Smith Report) at 45-49.

<sup>14</sup> Ex. 400 (Gayer Direct) at 9-10.

damage function and equilibrium climate sensitivity.<sup>15</sup> Dr. Tol attempted to replicate Dr. Mendelsohn's modifications with the FUND model by using discount rates between 3 and 7 percent and climate sensitivity values between 1°C and 3°C.<sup>16</sup>

Mr. Martin testified for Xcel Energy. He used the Federal SCC modeling output data and defined an initial range from the 25<sup>th</sup> percentile at 5 percent discount rate to the 75<sup>th</sup> percentile at 2.5 percent discount rate, taken of the distribution of 450,000 SCC estimates for a given emission year. The result was an initial range from \$2.48 at 5 percent discount rate to \$67.08 at 2.5 percent discount rate, in 2014 dollars per short ton.<sup>17</sup> This initial range contains approximately 75 percent of all the IAM estimates of the SCC. Then, Mr. Martin equally weighted the SCC values for each of the three discount rates at the low and high ends of the initial range. The final range Xcel Energy proposes is from \$12.13 to \$41.40 and corresponds with the 36<sup>th</sup> and 74<sup>th</sup> percentiles of the IAMs' distribution of 450,000 SCC estimates for emission year 2020.<sup>18</sup>

The various values proposed by the Parties are not directly comparable because they are presented for different emission years, use different units (\$/short ton and \$/metric ton), and use different dollars (nominal, 2007 dollars, and 2014 dollars). In order to facilitate comparison, Xcel Energy converted the proposed values to nominal dollars per short ton for emission year 2020. Figure 1 below shows the converted values.<sup>19</sup>

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<sup>15</sup> Ex. 214 (Mendelsohn Direct) at 14-15.

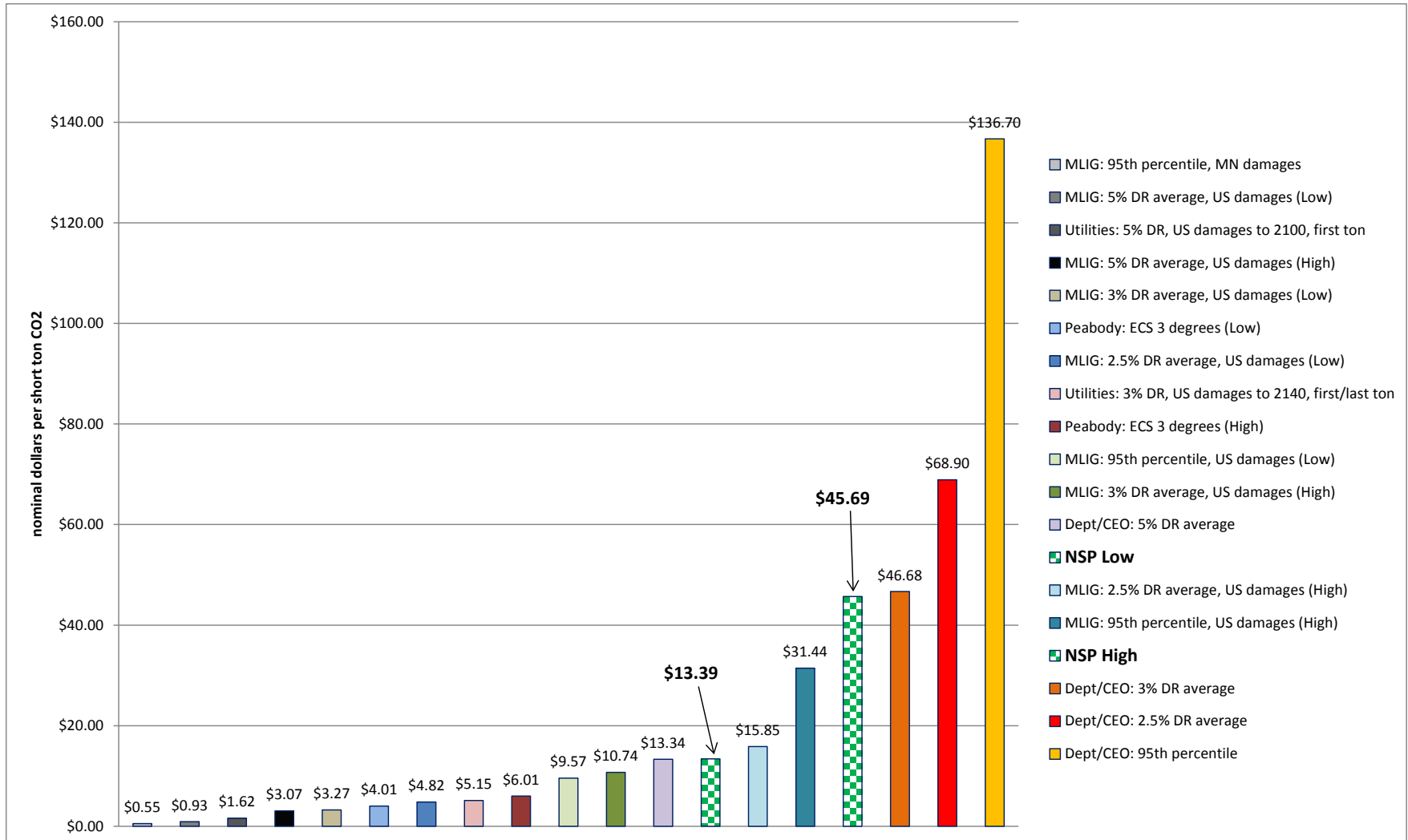
<sup>16</sup> Ex. 236 (Tol Rebuttal) at 5, 8-9.

<sup>17</sup> Updated based on the July 2015 TSD, 2020 emission year, 2014 dollars per short ton. See Ex. 601 (Martin Rebuttal) at 7-8.

<sup>18</sup> Updated based on the July 2015 TSD, 2020 emission year, 2014 dollars per short ton. See Ex. 601 (Martin Rebuttal) at 5-8; Ex. 600 (Martin Direct) at 54-64.

<sup>19</sup> Ex. 601 (Martin Rebuttal) at 12.

Figure 1. Comparison of Parties' Proposed CO<sub>2</sub> Values for 2020 Emissions, in Nominal Dollars per Short Ton.



#### IV. WEAKNESSES OF THE IWG METHODOLOGY

Every Party to this proceeding acknowledges some of the key weaknesses of the IWG's SCC methodology. The three IAMs (DICE, PAGE, and FUND) are simplified, reduced-form representations of the climate system and global economy, but were used because they are the only existing IAMs that also estimate and monetize damages from climate change. In order to make the IAM assumptions consistent and results comparable, the IWG ran the DICE model in a simulation mode rather than in its native optimization mode, and also used standardized exogenous input assumptions for population growth, GDP growth, and emissions (based on the Stanford Energy Modeling Forum [EMF-22] scenarios), as well as for equilibrium climate sensitivity and discount rates.<sup>20</sup> All Parties agree that these changes were a likely tradeoff between model integrity and comparability.<sup>21</sup>

Every Party acknowledges that there is inherent uncertainty in determining some other critical scientific inputs, such as equilibrium climate sensitivity and the shape and parameters of the damage function. All Parties agree that it is impossible to predict with certainty how well and how fast future generations will adapt to increasing temperatures or will reduce CO<sub>2</sub> emissions below the EMF-22 trajectories, and that the IAMs may not fully capture adaptation and mitigation.

Every Party recognizes that the IWG had to make several public policy decisions that are not matters of scientific fact, but subjective by nature, such as the selection of discount rates, the geographic scope of damages, modeling horizon, and the treatment of marginal emissions. Every Party also agrees that although the IAMs

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<sup>20</sup> The IWG chose to use four of the EMF-22 scenarios: IMAGE, MERGE Optimistic, MESSAGE, and MiniCAM. The IWG itself created a fifth, "550 ppm Average" stabilization scenario by averaging the trajectories of the four EMF-22 scenarios. See Ex. 600 (Martin Direct) at 16, Schedule 6 (February 2010 TSD) at 15.

<sup>21</sup> See e.g., Hearing Transcript Vol. 1 at 90-95 (Polasky); Hearing Transcript Vol. 2B at 73, 109-111 (Hanemann); Ex. 214 (Mendelsohn Direct) at 16-17.

themselves and the EMF-22 scenarios have been subject to peer review, the IWG's SCC methodology has not. Finally, all Parties acknowledge that the SCC was originally developed to be used in regulatory impact analyses and the IWG has not recommended its use in state-level decision-making.<sup>22</sup>

However, although every Party recognizes that the IWG had to make difficult modeling, scientific, and policy decisions, it has become clear that the Parties do not agree that the IWG made the right decision on many of the key scientific matters or policy judgments regarding the SCC.

Despite the uncertainties and shortcomings of the Federal SCC, Xcel Energy does not believe that any Party has proposed an alternate methodology that involves less uncertainty, overcomes the weaknesses of the three IAMs, implements better scientific assumptions, or includes less subjective judgment. Xcel Energy examined a number of options, but was not able to identify a damage cost approach that would be a better starting point than the IWG data. The IWG methodology is not perfect, however, the Commission only asked for a reasonable and best available measure.<sup>23</sup> We also believe that the Commission has ruled out the option of doing nothing – keeping the current CO<sub>2</sub> values or waiting until the uncertainty becomes less over time – because it ordered this proceeding now.<sup>24</sup> Finally, the Commission required the use of a damage cost approach, ruling out the use of regulatory cost values as a less uncertain proxy for externalized damages.

Because of the uncertainties and shortcomings of the IWG methodology, we believe it is inappropriate to use the four executive summary SCC values, which are point estimates and give a false impression of precision. Our approach to develop a range of values by balancing uncertainty, practicability, and risk tolerance also

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<sup>22</sup> Ex. 601 (Martin Rebuttal) at 8-10.

<sup>23</sup> Commission's October 15, 2014 Order, Order Point 2.

<sup>24</sup> Hearing Transcript Vol. 3B at 133-134 (Martin).



recognizes that there is a difference between federal-level regulatory impact analysis and state-level integrated resource planning.<sup>25</sup>

The Federal SCC was originally developed to be used in regulatory impact analysis to help estimate whether the overall benefits of a proposed federal regulation outweigh its costs. In this application there is greater tolerance for imprecise estimates, because the key point is whether the benefits exceed the costs, but neither the benefits nor the costs need to be precisely quantified. The SCC may over-estimate or under-estimate the benefits of a proposed regulation, but this is not very important – as demonstrated, for example, in Mr. Martin’s example of the Environmental Protection Agency’s (EPA) regulatory impact analysis of the Clean Power Plan, where in EPA’s view the benefits exceed the costs at all four SCC values.<sup>26</sup>

In resource planning, the imprecise SCC would impact decisions regarding specific resource allocations and options. These decisions involve significant costs, are difficult to reverse, and often have large and long-term implications for electricity rates, environmental impacts, and reliability. Although additional factors are considered in specific resource planning decisions, such as reliability, affordability, and fuel diversity, the SCC would be one factor affecting the decisions. In its July 2015 Response to Public Comments, the IWG stated that the SCC estimates were developed for use in regulatory impact analysis and that the IWG has not recommended their use in state-level decision-making.<sup>27</sup>

Although we disagree with certain aspects of how the IWG chose to summarize its SCC data and present the results, we believe there is no clearly preferable or more sound damage cost approach to use as a starting point for

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<sup>25</sup> Hearing Transcript Vol. 3B at 123-124 (Martin); Hearing Transcript Vol. 4 at 75 (Martin).

<sup>26</sup> Ex. 601 (Martin Rebuttal) at 20; Ex. 602 (Martin Surrebuttal) at 7-8.

<sup>27</sup> Ex. 600 (Martin Direct) at 12-14; Ex. 601 (Martin Rebuttal) at 20-22; Hearing Transcript Vol. 3B at 156-158 (Martin). See also Ex. 101 (Polasky Rebuttal), Schedule 1 containing the IWG’s July 2015 Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, at 40-41.

developing a CO<sub>2</sub> environmental cost range. The three IAMs and the five EMF-22 scenarios were developed by credible authors and have been peer-reviewed. Although the IWG's SCC methodology was not peer-reviewed prior to its publication, it has since then been subject to intensive public scrutiny, review, and comment. In July 2015, the IWG released its written responses to the public comments.

The IAMs and the IWG's methodology rely on climate science as synthesized by the Intergovernmental Panel on Climate Change (IPCC), functioning under the auspices of the United Nations.<sup>28</sup> In the original Externalities Docket, the ALJ and the Commission stated:

“IPCC reports are the most authoritative sources available for information on climate change issues. The IPCC research and peer review process evaluates all available scientific information on factors affecting climate change. Before publication, IPCC research reports are developed by technical committees composed of experts throughout the international scientific community and are subjected to rigorous multi-level peer review process.”<sup>29</sup>

In fact, the IPCC selected more than 830 authors and review editors from over 80 countries to form the author teams that produced the Fifth Assessment Report. They in turn drew on the work of over 1,000 contributing authors.<sup>30</sup> A very large number of researchers from the international science community contribute to the IPCC's Assessment Reports.

Some Parties have pointed out that the IWG has not updated the equilibrium climate sensitivity (ECS), although the IPCC reduced the low end of its estimated range in the Fifth Assessment Report from 2°C to 1.5°C (retaining the high end of the range at 4.5°C). However, the IWG did not use the high and low point estimates

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<sup>28</sup> Ex. 602 (Martin Surrebuttal) at 6; Hearing Transcript Vol. 3B at 121-122 (Martin).

<sup>29</sup> *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3.* Docket No. E-999/CI-93-583. FINDINGS OF FACT, CONCLUSIONS, RECOMMENDATION AND MEMORANDUM. March 22, 1996. Finding No. 87. See also the same Docket, ORDER ESTABLISHING ENVIRONMENTAL COST VALUES. January 3, 1997 at 24.

<sup>30</sup> Hearing Transcript Vol. 3B at 69-70 (Abraham).

or the range as such. It created a probability distribution of the ECS, called the Roe-Baker distribution, and then drew random values from this distribution using the Monte Carlo method (10,000 values for each emission year / discount rate combination). The IWG also indicated in its July 2015 Response to Public Comments that it will address the ECS in its next update of the SCC. Some Parties argued that the IWG should have already updated the ECS to match the IPCC's Fifth Assessment Report range. However, we do not believe that not updating this one uncertain scientific parameter, considering all the other uncertain scientific parameters and policy assumptions involved in the IWG methodology, makes the SCC data unreasonable as a starting point.<sup>31</sup>

In summary, Xcel Energy does not believe it is appropriate to use any of the SCC point estimates from the executive summary of the TSDs. They imply precision that does not exist, given that the SCC was not designed to be used in state-level resource planning and because of all the uncertainty involved in both the scientific parameters and policy assumptions of the IWG methodology. However, we have not been able to identify a better starting point that would use a damage cost approach, and in our opinion, no other Party has proposed one either. We believe a reasonable and best available measure to establish environmental cost of CO<sub>2</sub> for Minnesota is to use the SCC modeling data as a starting point.

## **V. XCEL ENERGY'S PROPOSAL**

Xcel Energy's methodology used the results from all three IAMs and gave them equal weight. DICE, PAGE, and FUND are the only existing models capable of first predicting emissions and temperature change, and then estimating and monetizing damages. We lack the expertise to state that any one of the three IAMs

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<sup>31</sup> Hearing Transcript Vol. 3B at 139-142 (Martin); see also Ex. 101 (Polasky Rebuttal), Schedule1 (July 2015 Response to Comments) at 12.

would be better or sounder than the other two. And running different models or different assumptions would have required us to make many scientific and policy judgments.

Xcel Energy took the IWG's modeling results as they are, and then applied well-accepted statistical methods to derive a range that appropriately balances uncertainty, risk tolerance, and practicability.<sup>32</sup> We managed the inherent uncertainty by retaining all IWG predictions in our analysis (450,000 data points per emission year). This approach implicitly assumes that the future climate change damage value is included somewhere within the probability distribution of the IAM results. We also addressed the uncertainty by acknowledging that the IWG methodology may have incompletely captured both low and high climate change damages. For our initial range, we used symmetric percentiles (25<sup>th</sup> and 75<sup>th</sup> percentiles), which treat low and high damage predictions equally by eliminating both the lowest and the highest predictions.<sup>33</sup>

There are certain things that the IWG's methodology did not do very well to capture the low end of SCC values, which means that it may overestimate damages. The IAMs only partially predict adaptation, which includes any measures taken by future generations to adjust to or alleviate the impacts of warming. The IAMs lack endogenous modeling of technological change and innovation to reduce the CO<sub>2</sub> intensity of economic growth. This means that once the EMF-22 emissions trajectories are set up, future societies are assumed to take no further action to reduce CO<sub>2</sub> damages despite experiencing significant warming and severe damages. In addition, four out of the five emissions scenarios used in the IWG's methodology assume no global mitigation efforts by governments to reduce CO<sub>2</sub> emissions in

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<sup>32</sup> A chart describing the steps in Xcel Energy's methodology is included as Ex. 600 (Martin Direct), Schedule 8.

<sup>33</sup> Ex. 600 (Martin Direct) at 53.

response to increasing damages. These four EMF-22 scenarios are “business as usual” trajectories that do not assume any international climate policy. The fifth “550 ppm average” scenario used by the IWG assumes international coordination sufficient to contain CO<sub>2</sub> concentrations at 550 parts per million.<sup>34</sup>

The IAMs model mitigation, adaptation, and technological change poorly, and it is contrary to current evidence to assume that future societies will not take any action if they face growing temperatures and damages. Even today, tremendous technological innovation is taking place to reduce the CO<sub>2</sub> intensity of energy, and governments at the global, national, and regional scale are working towards effective mitigation, typically by setting targets for the use of renewable energy resources and regulating greenhouse gas emissions from power plants and other sources.<sup>35</sup>

On the other hand, it is possible that the IAMs do not capture very well the high end of SCC values, which means that they may underestimate damages. There may be higher than expected damages under future extreme conditions, which we have not experienced yet and have no evidence of. The IAMs may not fully model “tipping point” damages or damages under more extreme climate scenarios (for example, greater temperature increases than the temperature increases for which the models have been calibrated).<sup>36</sup>

Since nobody knows which of the two omissions is larger – incompletely capturing low end values or incompletely capturing high end values – Xcel Energy has treated low and high damage predictions equally and selected symmetric percentiles (25<sup>th</sup> and 75<sup>th</sup>) that reflect a reasonably low level of risk tolerance.

Xcel Energy has defined risk-tolerance as tolerance for the risk that the

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<sup>34</sup> Ex. 600 (Martin Direct) at 34-35; Ex. 601 (Martin Rebuttal) at 24-25, 47-49.

<sup>35</sup> Ex. 600 (Martin Direct) at 34-35; Ex. 601 (Martin Rebuttal) at 24-25, 47-49.

<sup>36</sup> Ex. 600 (Martin Direct) at 29.

Commission's adopted range of CO<sub>2</sub> values does not include the actual value of future damages, as predicted by the IAM results. We believe that using the 25<sup>th</sup> percentile at 5 percent discount rate to the 75<sup>th</sup> percentile at 2.5 percent discount rate to derive an initial range from the full distribution of IWG estimates at all three discount rates reflects an appropriate level of risk tolerance, because it contains approximately 75 percent of all IAM predictions for a given emissions year, and eliminates 25 percent of the estimates – the lowest and highest damage estimates – which have the least probability of occurring.<sup>37</sup>

Choosing, for example, the 1<sup>st</sup> and 99<sup>th</sup> percentiles would show very low risk-tolerance and include almost all IAM predictions, but produce an impracticably wide range of CO<sub>2</sub> values that would not be meaningful in resource planning (i.e., from negative \$9/ton to \$452/ton). Selecting a range based on the 5<sup>th</sup> and 95<sup>th</sup> percentiles or the 10<sup>th</sup> and 90<sup>th</sup> percentiles would show low-risk tolerance, but still result in an impracticably wide range.<sup>38</sup>

As Mr. Martin has explained, the CO<sub>2</sub> damage cost range adopted in this proceeding should not be so wide that the low and high ends point to diametrically opposite resource plans. No useful information is gained for resource planning if the low value would point toward retiring renewable resources and building fossil-fueled options, and the high value would point toward retiring fossil-fueled resources and building renewable options. A wide range that does not yield meaningful results to guide resource planning decisions cannot be practicable, as required by Minn. Stat. § 216B.2422, subd. 3(a), because it would not provide any useful information for resource planning.<sup>39</sup>

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<sup>37</sup> Ex. 600 (Martin Direct) at 60-63; Ex. 602 (Martin Surrebuttal) at 12-13.

<sup>38</sup> Ex. 603 (Martin Opening Statement) at 2.

<sup>39</sup> Ex. 602 (Martin Surrebuttal) at 12-14; Hearing Transcript Vol. 3B at 149 (Martin).

Mr. Martin is the only witness in this proceeding that has emphasized the importance of establishing a practicable range, based on his policy experience in utility resource planning. In order to establish CO<sub>2</sub> values that are useful, and therefore practicable, this proceeding must take into consideration public policy and the context in which the CO<sub>2</sub> environmental values will be used. The approach cannot be a purely scientific or economic exercise.

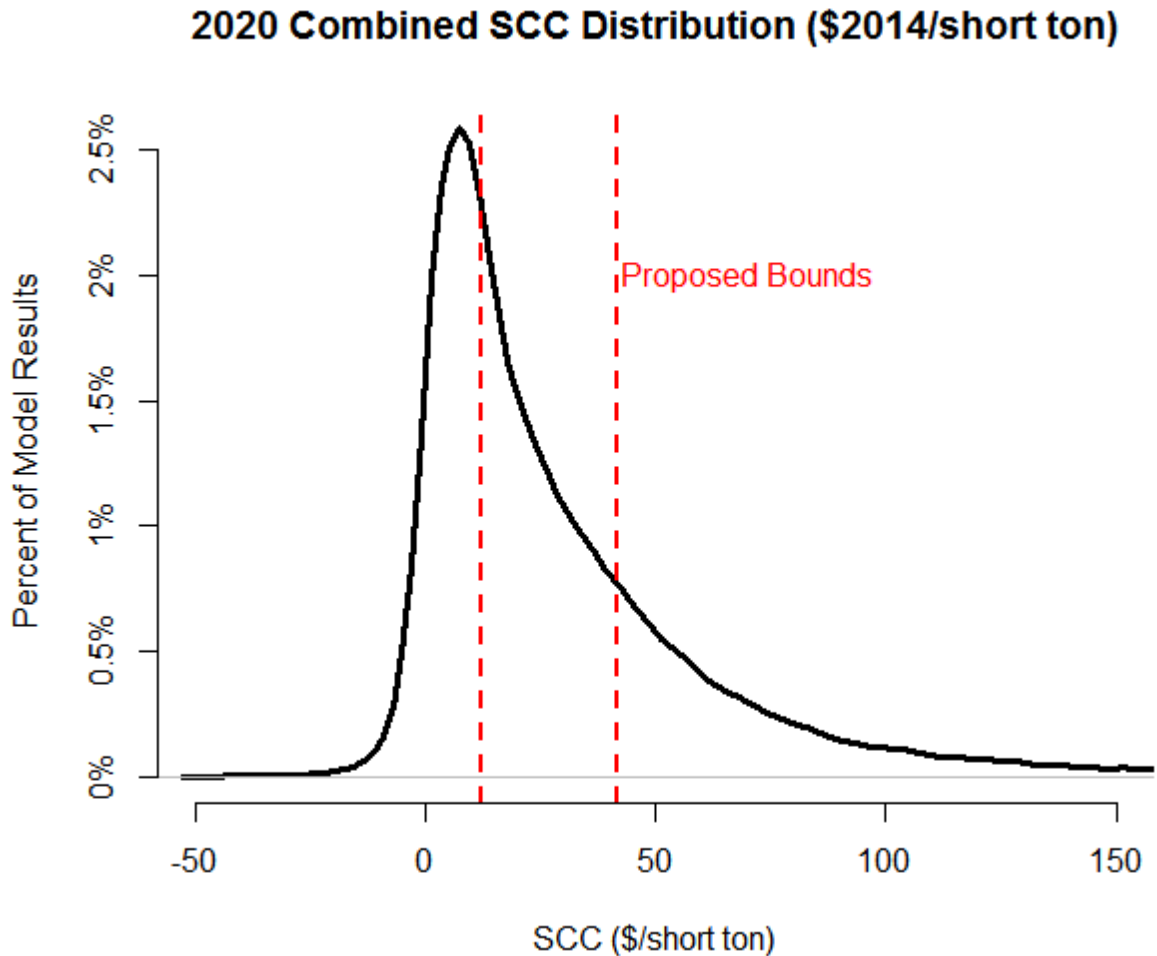
We believe that our initial range, which retains approximately 75 percent of all IAM predictions and equally excludes very low and very high values, reasonably balances uncertainty, risk tolerance, and practicability.

To further minimize subjective judgment, Xcel Energy equally weighted the SCC values for each discount rate at each end of the range. This decision retains all three discount rates (2.5, 3, and 5 percent) used by the IWG and does not substitute Xcel Energy's judgment for the IWG's. Our final recommended range of \$12.13 to \$41.40 corresponds to the 36<sup>th</sup> and 74<sup>th</sup> percentiles of the IWG's modeling results, and excludes more low IAM predictions than high predictions. In total, 74 percent of all IWG modeling results are at or below the high end of our proposed range, which in our view is an appropriate level of risk tolerance. Because of the skewed distribution of SCC values, our range in fact excludes more low values with higher probability than high values with lower probability, as shown in Figure 2 below. Considering the climate change context and concerns that the IAMs do not adequately model damages from large temperature changes, it seems appropriately risk averse to eliminate more values from the low end of the distribution.<sup>40</sup>

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<sup>40</sup> Ex. 600 (Martin Direct) at 63-64; Ex. 601 (Martin Rebuttal) at 5-8; Ex. 602 (Martin Surrebuttal) at 13-14.

**Figure 2: Probability Distribution of IWG Modeling Results with Xcel Energy's Proposed Bookends<sup>41</sup>**



Uncertain science and subjective policy judgments are an element of all Parties' proposals. Our balancing of uncertainty, risk tolerance, and practicability was subjective as well, but not arbitrary, unprincipled, or lacking in statistical foundation. We applied standard statistical methods – taking symmetric percentiles of a set of values is hardly extraordinary – and documented our rationale, methods, and data more explicitly than any other Party. We also provided thorough supporting materials (raw IWG data, statistical software code, and live Excel file results) to ensure that our

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<sup>41</sup> Ex. 600 (Martin Direct) at 65.



methodology is transparent, replicable, and verifiable. None of the other 18 witnesses has offered testimony challenging the accuracy of the statistical calculations presented by Mr. Martin.

Some Parties, however, have challenged the competency of Mr. Martin as a witness in this proceeding.<sup>42</sup> For this reason, we are requesting the ALJ to comment on the credibility of Mr. Martin. There is no question that Mr. Martin stood out as a thoroughly knowledgeable, articulate, and credible witness. He was on the stand for nearly eight hours, and demonstrated a solid and comprehensive understanding of the key issues in this proceeding: the SCC methodology and modeling, public policy matters, and integrated resource planning.

## VI. OTHER KEY ISSUES

### A. SCC Single Point Estimates and the 95<sup>th</sup> Percentile Value

Dr. Polasky and Dr. Hanemann have made recommendations based on the four executive summary SCC values, as published in the most recent, July 2015 TSD. Dr. Polasky proposed adopting all four summary SCC values as point estimates. As far as we understand, Dr. Hanemann proposed a range based on the three average SCC values (\$12 to \$62), but did not recommend adopting the 95<sup>th</sup> percentile value.<sup>43</sup>

The models used in deriving the SCC predict 450,000 values for any given emissions year, and those values range from negative damages (benefits) to damages

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<sup>42</sup> The ALJ denied Peabody and MLIG motions to exclude parts of Mr. Martin's written testimony and stated that Xcel Energy "has shown that Mr. Martin's testimony is probative, competent, relevant and material." *In the Matter of the Further Investigation into Environmental and Socioeconomic Costs Under Minn. Stat. §216B.2422, Subdivision 3*. Docket No. E-999/CI-14-643. ORDER ON MOTIONS BY MINNESOTA LARGE INDUSTRIAL GROUP AND PEABODY ENERGY CORPORATION TO EXCLUDE AND STRIKE TESTIMONY. September 15, 2015. At 13.

<sup>43</sup> Dr. Polasky proposes adopting all four summary TSD values for a given emissions year, as published in Appendix A, Table A1 of the July 2015 TSD (\$12, \$42, \$62, and \$123 for emissions year 2020). Dr. Hanemann proposes a range from the 5 percent discount rate average value (\$12 for 2020) to the 2.5 percent discount rate average value (\$62 for 2020).

of nearly \$1,000 per ton of CO<sub>2</sub> emissions. All four SCC values, as published in the executive summary and Appendix A, Table A1 of the TSDs, are single point estimates, raising problems of false precision. Three of the values represent a simple average of 150,000 IAM predictions for a given discount rate and emission year (three averages for the 2.5, 3, and 5 percent discount rates). The fourth value is the 95<sup>th</sup> percentile value at 3 percent discount rate, presented without its corresponding 5<sup>th</sup> percentile value.

The SCC probability distribution is strongly skewed, with a long right tail of high-damage estimates that have a low probability of occurring (see Figure 2). The average is a poor indicator of central tendency for a non-normal, heavily skewed probability distribution such as the SCC, because the less probable, but very high values pull the mean estimate up. The Commission should not adopt any of the first three summary SCC values, because the mean is greatly influenced by high outliers and because they are all falsely precise point estimates.<sup>44</sup>

There are additional reasons why the Commission should not adopt the fourth summary SCC value (95<sup>th</sup> percentile), which the IWG included to “represent the higher-than-expected economic impacts from climate change further out in the tails of the SCC distribution.”<sup>45</sup> First, nothing in the IAM modeling or results suggest that the SCC is more likely to be the 95<sup>th</sup> percentile value than the 5<sup>th</sup> percentile value. Therefore, it was statistically unsound for the IWG to present one without the other.<sup>46</sup>

Second, while the IAMs’ incomplete modeling of catastrophic damages makes it possible that the SCC is underestimated, the IAMs’ incomplete modeling of adaptation, mitigation, and technological change also makes it possible that the SCC is

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<sup>44</sup> Ex. 600 (Martin Direct) at 25-28.

<sup>45</sup> Ex. 600 (Martin Direct), Schedule 6 (February 2010 TSD) at 2.

<sup>46</sup> See Ex. 600 (Martin Direct) at 29-30; Ex. 602 (Martin Surrebutal) at 16.

overestimated, which the 5<sup>th</sup> percentile value would help capture. That said, both the 5<sup>th</sup> and 95<sup>th</sup> percentile values are highly improbable in statistical terms.<sup>47</sup>

Third, the 95<sup>th</sup> percentile value represents an unreasonably low level of risk tolerance, given that only 5 percent of the IAM model predictions exceed this value.<sup>48</sup>

Fourth, the 95<sup>th</sup> percentile value (\$123 for emissions year 2020) is about ten times higher than the 5 percent discount rate average value (\$12 for emissions year 2020). This difference would create too wide a range to be meaningful for resource planning purposes.<sup>49</sup>

Fifth, the 95<sup>th</sup> percentile value is based on the 3 percent discount rate only, and therefore privileges a single discount rate. No Party has suggested in this proceeding that the 3 percent discount rate is objectively more “correct” than the 2.5 percent and 5 percent discount rates. In fact, most Parties have suggested retaining all three discount rates used by the IWG and treated them equally.<sup>50</sup>

Dr. Hanemann and Dr. Polasky both have indicated during this proceeding that in the climate change context, it is important not to underestimate damages. They do not seem to be as worried about overestimating damages. For example, Dr. Polasky has stated that “[W]ith climate change, high damage outcomes are the ones we should be most concerned about so that ignoring information about potential high damages is particularly problematic,”<sup>51</sup> that “[T]aking action now is a sort of insurance policy against the most catastrophic damages,”<sup>52</sup> and that “[W]e, as a society, should be making decisions that avoid the possibility of catastrophic effect from climate change, or at least we should be making those outcomes less likely by incorporating

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<sup>47</sup> See Ex. 600 (Martin Direct) at 29-30; Ex. 602 (Martin Surrebuttal) at 16.

<sup>48</sup> See Ex. 600 (Martin Direct) at 29-30; Ex. 602 (Martin Surrebuttal) at 16.

<sup>49</sup> See Ex. 600 (Martin Direct) at 29-30; Ex. 602 (Martin Surrebuttal) at 16.

<sup>50</sup> See Ex. 600 (Martin Direct) at 29-30.

<sup>51</sup> Ex. 101 (Polasky Rebuttal) at 37.

<sup>52</sup> Ex. 100 (Polasky Direct) at 16. See also Hearing Transcript Vol. 1 at 119-120 (Polasky).

the SCC into decisions.”<sup>53</sup> Dr. Hanemann has said that setting an externality value for CO<sub>2</sub> “must be seen as fundamentally an exercise in risk management.”<sup>54</sup>

However, this proceeding is not a scientific and economic exercise limited to the climate change context; this is a state-level regulatory process that will affect how regulated utilities in Minnesota will select, allocate, and build resources. In the original Externalities Docket, the ALJ stated that “[T]he possibility of utilities paying more for resources than their environmental benefits justify is just as bad as paying less than their benefits justify.”<sup>55</sup> In the view of the ALJ at that time, in the resource planning context, it is equally undesirable to overestimate than underestimate damages from CO<sub>2</sub>.

The CO<sub>2</sub> externality values established in this Docket will be used in resource planning and certificate of need proceedings, and they will directly affect what kind of resources Minnesota utilities will rely on and build in the future. There simply cannot be a presumption in this proceeding that it is better to err on the side of overestimating than underestimating damages from CO<sub>2</sub>. Dr. Hanemann and Dr. Polasky both are established environmental economists, researchers, and professors. However, they both lack any practical experience with public utilities in general, or integrated resource planning in particular. It is understandable that they did not consider how their recommended CO<sub>2</sub> values would affect public policy in Minnesota, and it is equally understandable that they did not consider the context in which their recommended CO<sub>2</sub> values would be applied. For example, Dr. Polasky specifically stated several times during the Evidentiary Hearings that he only testified

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<sup>53</sup> Ex. 100 (Polasky Direct) at 16.

<sup>54</sup> Ex. 805 (Hanemann Opening Statement) at 2.

<sup>55</sup> *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3.* Docket No. E-999/CI-93-583. FINDINGS OF FACT, CONCLUSIONS, RECOMMENDATION AND MEMORANDUM. March 22, 1996 at 17.

about the SCC and does not “know how the PUC is actually going to use this or how it’s going to get translated into policy.”<sup>56</sup>

## **B. Global Damages**

One of the IWG’s key public policy choices was to determine the geographic scope of damages assessed. Several witnesses (Drs. Mendelsohn, Smith, and Gayer) have recommended that the CO<sub>2</sub> damage cost values that are applied in Minnesota resource planning decisions should only account for damages in the United States or Minnesota, rather than global damages.

On the one hand, Xcel Energy agrees that using the SCC would likely overestimate the benefits of emission reductions in Minnesota, because the SCC values are calculated based on global damages, even though any reductions in Minnesota’s emissions are likely to have little effect on global damages. The likelihood of emissions leakage in an interconnected electricity system would further diminish any effect on net damages.<sup>57</sup>

On the other hand, CO<sub>2</sub> is a global pollutant, and was treated as such in the original Externalities Docket:

“The CO<sub>2</sub> emitted in any particular place on the planet is well-mixed in the atmosphere. Warming in Minnesota, for example, will be caused not just by Minnesota’s CO<sub>2</sub> emissions, but by the global concentration of CO<sub>2</sub>. Similarly, Minnesota’s CO<sub>2</sub> emissions cannot be said to warm Minnesota’s environment any more than they warm the rest of the planet.”<sup>58</sup>

In addition, Xcel Energy agrees with the IWG that there are arguments in favor of focusing on global damages, both in economic theory and in the desire to

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<sup>56</sup> Hearing Transcript Vol. 1 at 82, 138, 178-179 (Polasky).

<sup>57</sup> Ex. 601 (Martin Rebuttal) at 39-40.

<sup>58</sup> *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3.* Docket No. E-999/CI-93-583. FINDINGS OF FACT, CONCLUSIONS, RECOMMENDATION AND MEMORANDUM. March 22, 1996. Finding No. 83.

demonstrate environmental leadership and encourage reciprocity by other jurisdictions.

In case the Commission chooses to establish CO<sub>2</sub> environmental values based on other than global damages, the range we propose could easily be adjusted by applying an adjustment factor based on the GDP of the chosen jurisdiction as a proportion of global GDP.<sup>59</sup>

### **C. Discount Rates**

Xcel Energy's method retained all three discount rates (2.5, 3, and 5 percent) used by the IWG and weighted them equally. Dr. Smith disregarded the 2.5 percent discount rate in her methodology and argued that it is not based on sufficient empirical evidence.<sup>60</sup> Dr. Mendelsohn used DICE2013 model's variable, declining discount rate, which starts at 5 percent and declines to 3.5 percent by the year 2100 and 2.7 percent by the year 2200.<sup>61</sup>

We cannot agree with Dr. Smith that the 3 and 5 percent discount rates are less subjective and more evidence-based than the 2.5 percent discount rate. There is simply no empirical evidence of the preferences and behaviors of distant future generations, and it is necessary to make a policy judgment on the discount rate without such empirical evidence. We believe it would be arbitrary to disregard one of the three discount rates used by the IWG.<sup>62</sup>

There may be economists who argue for an even lower discount rate (e.g., 1.5 percent), but there are also economists who argue for a higher discount rate (e.g., 7 percent). And there are economists, such as Dr. Mendelsohn and Dr. Tol, who prefer

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<sup>59</sup> Ex. 601 (Martin Rebuttal) at 38-40.

<sup>60</sup> Ex. 300 (Smith Direct) at 23-26.

<sup>61</sup> Ex. 216 (Mendelsohn Report) at 16.

<sup>62</sup> Ex. 601 (Martin Rebuttal) at 42-43.

a sliding discount rate, which is tied to economic growth, instead of a constant discount rate.<sup>63</sup> These all seem to be rational options, however, Xcel Energy believes that the IWG's decision to use three different discount rates at 2.5, 3, and 5 percent was a reasonable policy decision, and no other Party has presented convincing reasons to make a different policy decision.<sup>64</sup>

#### **D. Dr. Smith's Proposal**

Dr. Smith proposed several modifications to the IWG's modeling assumptions, and we want to address two of them briefly here. First, she recommended shortening the modeling horizon to the year 2100 or at most to the year 2140.<sup>65</sup> On the one hand, we agree that there is greater speculation and uncertainty further out in time and with higher temperature changes. We also acknowledge that in the original Externalities Docket, the damages from CO<sub>2</sub> were estimated up to the year 2100.<sup>66</sup> On the other hand, CO<sub>2</sub> emitted today has a long atmospheric lifetime, and the IWG attempted to capture all likely costs by covering a timeframe until the year 2300. Without trying to resolve the conflict between these two contradicting arguments, we disagree on the way Dr. Smith tried to deal with the uncertainty by eliminating all damages from CO<sub>2</sub> beyond the year 2100 or 2140. Whether this modification is called a conceptual or analytic tool does not matter: adopting a CO<sub>2</sub> value that has no damages in it after the year 2100 or 2140 does, in effect, ignore those damages and assume they are zero.<sup>67</sup>

Second, Dr. Smith used a "first ton" and "average ton" approach to model

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<sup>63</sup> Ex. 238 (Tol Report) at 4.

<sup>64</sup> Ex. 600 (Martin Direct) at 44-47; Ex. 601 (Martin Rebuttal) at 41-43; Hearing Transcript Vol. 3B at 145-146 (Martin).

<sup>65</sup> Ex. 300 (Smith Direct) at 22-23.

<sup>66</sup> *In the Matter of the Quantification of Environmental Costs Pursuant to Laws of Minnesota 1993, Chapter 356, Section 3.* Docket No. E-999/CI-93-583. FINDINGS OF FACT, CONCLUSIONS, RECOMMENDATION AND MEMORANDUM. March 22, 1996. Finding No. 108.

<sup>67</sup> Ex. 601 (Martin Rebuttal) at 44; Ex. 602 (Martin Surrebuttal) at 30; Hearing Transcript Vol. 3B at 134, Vol. 4 at 54-55 (Martin).

marginal damages, because the IWG modeling treats the marginal ton of CO<sub>2</sub> as if it were the last ton of CO<sub>2</sub> emissions added to the global atmosphere, and therefore effectively assumes no further mitigation by future generations.<sup>68</sup> The IWG ran a “reference” case (including all past and future emissions) and a “pulse” case (adding an incremental ton of CO<sub>2</sub>), and then assigned all the difference in damages to the “pulse” case. We agree that this approach assumes no further actions to reduce emissions in the future and treats the marginal ton of CO<sub>2</sub> as if it were the last ton of CO<sub>2</sub> emissions. However, again, we disagree how Dr. Smith addressed this issue in her modeling. She set all emissions to zero starting in 2020, which is not at all realistic or based on empirical evidence.<sup>69</sup>

Dr. Smith’s modifications simply replace the IWG’s policy judgments with a different set of policy judgments, and her assumptions are by no means more objective than the IWG’s.

#### **E. Proposals by Drs. Mendelsohn and Tol**

Peabody’s witness Dr. Mendelsohn developed his own methodology to estimate CO<sub>2</sub> damages, based on the DICE model only. He used DICE’s internal optimization mode, emission forecasts, GDP projections, and declining discount rate, but changed some other key parameters, including the shape of the damage function and equilibrium climate sensitivity. For example, he created two modified damage functions, which assume no damages until temperatures rise to 1.5°C or 2°C above 1900 levels, and used several ECS values between 1°C and 3°C. Dr. Mendelsohn suggested various CO<sub>2</sub> cost ranges throughout the proceeding. In Surrebuttal, he recommended as the best available measure a range from \$0.30 (no damage until 2°C temperature rise and ECS of 1.5°C) to \$2.00 (no damage until 1.5°C temperature rise

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<sup>68</sup> Ex. 300 (Smith Direct) at 20-22.

<sup>69</sup> Ex. 602 (Martin Surrebuttal) at 30-31; Hearing Transcript Vol. 4 at 47 (Martin).



and ECS of 2°C), although he also mentioned that the current environmental cost of approximately \$5/ton remains a reasonable value.<sup>70</sup> Dr. Tol attempted to replicate Dr. Mendelsohn's modifications with the FUND model by using discount rates between 3 and 7 percent and climate sensitivity values between 1°C and 3°C.<sup>71</sup>

Again, while Xcel Energy does not have a position on the accuracy of the scientific parameters that Dr. Mendelsohn and Dr. Tol modeled differently than the IWG, we note that their positions on the damage function and equilibrium climate sensitivity also differ from the IPCC's Fourth and Fifth Assessment Reports. In addition, Dr. Tol disregarded the 2.5 percent discount rate used by the IWG and included an additional, higher discount rate of 7 percent. Xcel Energy does not believe that Dr. Mendelsohn or Dr. Tol were able to show that their methodologies were a reasonable and clearly better measure than the IWG's SCC.

## VII. CONCLUSION

Xcel Energy's proposal is well supported, reasonably balances the competing interests in this proceeding and, for the reasons presented, should be adopted. We recommend looking at the full range of outputs from DICE, PAGE, and FUND; use sound statistical methods to derive a range that balances uncertainty, risk tolerance, and practicability; minimize subjectivity by equally weighting the three IWG discount rates; and take into consideration science, economics, public policy, and the context in which the CO<sub>2</sub> externality values will be applied. The Federal SCC is subject to significant uncertainty, but we believe that the Commission has ruled out the option of doing nothing – keeping the current CO<sub>2</sub> values or waiting that the uncertainty becomes less over time – because it ordered this proceeding now.

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<sup>70</sup> Ex. 220 (Mendelsohn Surrebuttal) at 33-34; Ex. 216 (Mendelsohn Report), Table 2 at 19. In his Direct Testimony, Dr. Mendelsohn proposed a range from \$4 (no damage until 2°C temperature rise) to \$6 (no damage until 1.5°C temperature rise), based on ECS of 3°C, see Ex. 214 (Mendelsohn Direct) at 2, 5-14.

<sup>71</sup> Ex. 238 (Tol Report) at 8-9.

However, we do not believe that using any of the four executive summary SCC values, as proposed by Dr. Hanemann and Dr. Polasky, is reasonable because of the inherent uncertainty in estimating climate damages, the shortcomings of the IWG methodology, and the fact that the SCC was not developed for state-level resource planning.

The Commission may choose to accept some of the alternative modeling assumptions proposed by Drs. Smith, Gayer, Mendelsohn, and Tol, however, we cannot agree that they are more objective or reasonable than the IWG's modeling assumptions, and we do not believe that they result in a clearly better measure than Xcel Energy's proposed values based on the IWG's modeling.

The low and narrow CO<sub>2</sub> value ranges proposed by Peabody witnesses, Dr. Smith, and Dr. Gayer (generally between \$0 and \$6) do not adequately capture the inherent uncertainty in predicting climate change damages, and reflect an inappropriately high level of risk tolerance, since it is unlikely that the actual future value of damages is within their proposed ranges. Indeed, these proposals essentially ask the Commission to leave its current range of \$0.44 to \$4.53 per short ton unchanged.<sup>72</sup>

As a final conclusion, we would like to emphasize the nature of this proceeding: it is a state-level regulatory process that will affect how regulated utilities in Minnesota will select, allocate, and build resources. Here, there simply cannot be a presumption that it is better to err on the side of overestimating than underestimating damages from CO<sub>2</sub>.

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<sup>72</sup> *In the Matter of the Investigation into Environmental and Socioeconomic Costs Under Minn. Stat. § 216.B.2422, Subd. 3.* Docket No. E-999/CI-00-1636. NOTICE OF UPDATED ENVIRONMENTAL EXTERNALITY VALUES, May 27, 2015.

Respectfully submitted by:

*/s/ James R. Denniston*

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## CERTIFICATE OF SERVICE

I, Jim Erickson, 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.

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

Dated this 24<sup>th</sup> day of November 2015.

/s/

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