

BEFORE THE MINNESOTA OFFICE OF ADMINISTRATIVE HEARINGS

600 North Robert Street
St. Paul, Minnesota 55101

FOR THE MINNESOTA PUBLIC UTILITIES COMMISSION

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In the Matter of the Further Investigation
into Environmental and Socioeconomic
Costs Under Minn. Stat. § 216B.2422,
Subd. 3

MPUC DOCKET NO. E-999/CI-14-643

OAH Docket No. 80-2500-31888

**MINNESOTA LARGE INDUSTRIAL GROUP'S
POST-HEARING
REPLY BRIEF
REGARDING PHASE I (CO₂ TRACK)**

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REPLY INTRODUCTION

A review of initial post-hearing briefs filed in this matter shows that the Clean Energy Organizations (“CEOs”) have treated the federal government’s Interagency Working Group’s federal social cost of carbon (“FSCC” or generically “SCC”) as a “fallback proposition,” ignoring the March 27, 2015 [Burden of Proof Order](#), and shows further that both Doctors for a Healthy Environment and the CEOs improperly urge the ALJs and the Commission to simply rely on the IWG. The ALJs and the Commission have further been invited to make legislative-policy determinations, rather than the adjudicative determinations provided for by Minn. Stat. § 216B.2422, subd. 3. Furthermore, the first round of post-hearing briefs confirms that Doctors for a Healthy Environment and the Clean Energy Business Coalition lack admissible foundational evidence to support adoption of the FSCC. Each of these points is addressed herein.

This reply brief further addresses the central issue of under- and overstatement of damages in the damages functions of the Integrated Assessment Models. The Minnesota Large Industrial Group (“MLIG”) submits that it has established far beyond a preponderance of the evidence that two of the most significant factors in the damages calculations alone cause a massive overstatement of damages and far outweigh any alleged understatement of damages.

This reply brief additionally responds to statements in initial briefs regarding the appropriate damages horizon, geographic scope of damages, and the appropriate marginal ton(ne) to value. Finally, this reply brief provides some additional comments regarding “leakage” and shows that harmonization of the models was a process flaw, rather than an

endorsement of the IWG’s FSCC.

This proceeding is the first real test of the FSCC. The MLIG respectfully submits that the evidence has shown overwhelmingly that the FSCC cannot be adopted for use in Minnesota resource planning and other resource-selection proceedings under Minn. Stat. § 216B.2422, subd. 3, without, at a minimum, modifications in four of its underlying modeling assumptions, to wit, the damages horizon, discount rate, marginal ton, and geographic scope. As applied, the MLIG respectfully submits that the ALJs and the Commission should adopt a range for the environmental cost value of CO₂ of \$0.37 to \$5.14 per net metric ton (in 2014 dollars).¹

ANALYSIS

I. BURDEN OF PROOF

A. The Federal Social Cost of Carbon is not a “fallback proposition”

Most of the parties, including the CEOs, have addressed the applicable burden of proof in their initial briefs, and all of those who did set it forth accurately. It is therefore jarring to see that the CEOs reversed the burden of proof on page 25 of their opening brief.

Under the March 27, 2015 [Burden of Proof Order](#), “[a] party or parties proposing that the Commission adopt a new environmental cost value for CO₂, including the Federal Social Cost of Carbon (“FSCC”), bears the burden of showing, by a

¹ If the Commission desires to afford 100 percent altruistic weight to all other U.S. States, the MLIG supports Dr. Smith’s proposed range for emissions in the year 2020 of \$1.62 to \$5.14 (in 2014 dollars per net metric ton).

preponderance of the evidence, that the value being proposed is reasonable and the best available measure of the environmental cost of CO₂.”² Conversely, “[a] party opposing a particular proposal need *only* demonstrate that the proponent of proposed value cannot meet the preponderance requirement, because the proponent’s evidence is flawed, or the proposal is impracticable.”³ “If the weight of the evidence is evenly balanced, for and against, the *opponent* has met its burden because the proponent will not have achieved the required preponderance of the evidence.”⁴ Notwithstanding this clear Order, the CEOs argue that the FSCC must *de facto* and *de jure* be adopted if another alternative is not proven by a preponderance of the evidence:

Other parties in this proceeding have offered alternative values to the Federal SCC. But none has met its burden to show by a preponderance of the evidence that its proposed value is preferable to the Federal SCC. The Federal SCC is, therefore, the best available evidence.⁵

The CEOs’ conclusion is incorrect. Hypothetically speaking, if no party met its burden of proof, then under the [Burden of Proof Order](#) neither the FSCC nor any of the alternatives offered could be recommended to the Commission. The MLIG has respectfully submitted in its opening brief that there is no factual basis upon which to recommend adoption of the FSCC without modifications to the modeling assumptions underlying the FSCC because (i) there is a great amount of uncertainty built into the

² [Order Regarding Burdens of Proof dated March 27, 2015](#) at 2, ¶ 1.

³ *Id.* at 6 (emphasis added).

⁴ [Burden of Proof Order](#) at 6 (emphasis added).

⁵ [CEOs Initial Brief](#) at 25.

FSCC, which uncertainty is so excessive as to render the outcome of the models entirely speculative and unreliable; (ii) because the IWG’s data is out-of-date; (iii) because the IWG’s process was not peer-reviewed and contains erroneous assumptions; (iv) because the IWG did not follow applicable Office of Management and Budget policies; and (v) because the global geographic scope of the FSCC is not appropriate in the context of the setting of Minnesota environmental cost values in the absence of reciprocity by other U.S. states and by other nations, is not consistent with sound benefit-cost practices, and would demand a dramatic and untenable shift in all state policies if applied broadly.⁶ Xcel Energy, Great River Energy, Minnesota Power, Otter Tail Power Company, and Peabody Energy Corporation, together with Mr. Martin, Dr. Smith, Dr. Gayer, Dr. Tol, Prof. Mendelsohn, Dr. Spencer, Prof. Lindzen, Prof. Happer, Dr. Bezdek, and Dr. Wecker each agree, while every other party at least agrees that the FSCC is based on factors that are “inherently uncertain”⁷ or “uncertain.”⁸

The CEOs’ error is an important one, because it is reasonable to want to provide a real answer to the Commission. However, as a number of parties have correctly pointed

⁶ See, e.g., [MLIG Initial Brief](#) at 22.

⁷ Doctors’ Initial Brief at 3; [CEOs Initial Brief](#) at 24 (“... reasonably account for the uncertainty inherent in the task.”); [Xcel Initial Brief](#) at 3 & 28 (“...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 CO₂ were estimated up to the year 2100.”); Ex. [801](#) (Hanemann Rebuttal) at 32-33; Tr. Vol. 3A at 70 (Dessler). The Clean Energy Business Coalition joined in the [CEOs Initial Brief](#). See [Clean Energy Business Coalition Initial Brief](#).

⁸ [CEOs Initial Brief](#) at 23 (“The fact that there is uncertainty in the functions ...”).

out in their initial brief, “[i]n the past, the Commission has clearly required a reasonable evidentiary basis for proposed values and it has rejected proposed values when they were found to be based on highly speculative estimates.”⁹ The legislative mandate in Minn. Stat. § 216B.2422, subd. 3, “precludes establishment of values based on ‘best guesses,’ ‘guesstimates,’ or surmises.”¹⁰ While the MLIG believes that it has shown by much more than the required preponderance of the evidence supports adoption of a range for the environmental cost value of CO₂ of \$0.37 to \$5.14 per net metric ton (in 2014 dollars),¹¹ the fact of the matter is that if the ALJs find that “none has met its burden to show by a preponderance of the evidence that its proposed value is preferable to the Federal SCC,”¹² and if the ALJs further agree that the burden for adoption of the Federal SCC has not been met, then they are required to so report to the Commission.

B. Simple reliance on “the federal government” is not appropriate

In their initial briefs, both Doctors for a Healthy Environment and the CEOs improperly urge the ALJs and the Commission to simply rely on the IWG. The Doctors submit that:

Despite these limitations, the SCC remains the best

⁹ Initial Brief of Great River Energy, Minnesota Power, and Otter Tail Power Company (“[Utilities Group Initial Brief](#)”) at 6-8. *See also* [Peabody Initial Brief](#) at 19-20.

¹⁰ [Peabody Initial Brief](#) at 19.

¹¹ If, on the other hand, the Commission desires to afford 100 percent altruistic weight to all other U.S. States, the MLIG supports Dr. Smith’s proposed range for emissions in the year 2020 of \$1.62 to \$5.14 (in 2014 dollars per net metric ton).

¹² [CEOs Initial Brief](#) at 25.

available measure of the environmental costs of carbon. It is the only measure that:

1. Is the result of collaborative efforts by objective parties, rather than an individualized effort of a party with a vested interest in the outcome of the modeling;
2. Is widely used in regulatory proceedings at the federal and state levels; and
3. Uses multiple Integrated Assessment Models, thereby providing some compensation for biases in individual models.

Of these features, perhaps the most important is the fact that the SCC is the result of a collaboration. ... It does not represent the views of one particular researcher, or one particular industry. The involvement of a multitude of federal agencies ensured that the resulting product was suitable for a wide range of regulatory activities.¹³

The Doctors also summarily argue that “the SCC represents the collective efforts of a huge number of experts in the fields of climate change and economics.”¹⁴ Meanwhile, the CEOs state that “OMB and the Council of Economic Advisors drew representatives from several federal agencies with pertinent expertise together to form the Interagency Working Group...”¹⁵ The CEOs further argue that “it is difficult to imagine that one model run by one individual could be preferable to the considerable effort several federal agencies have undertaken over many years to aggregate the best scientific and modeling

¹³ Doctors Initial Brief at 18-19.

¹⁴ Doctors Initial Brief at 3.

¹⁵ [CEOs Initial Brief](#) at 10-11.

information available in developing the Federal SCC.¹⁶

For a number of reasons, it is not sufficient to simply “point to the IWG,” as the proponents of the FSCC do here and have done before, including in their experts’ testimony. First, simple reliance on the IWG does not meet the requirements of due process as set forth in the [Burden of Proof Order](#) to make an affirmative showing by a preponderance of the evidence.¹⁷ Secondly, the Doctors’ suggestion that the FSCC was arrived at by a consensus and collective effort “of a huge number of experts in the fields of climate change and economics,”¹⁸ lacks any basis in the record, and in fact is contradicted by the record. Similarly, the CEOs’ claim that the IWG was made up of representatives with “expertise” lacks evidentiary support.

The IWG was made up of only “approximately two dozen participants in total.” This hardly constitutes “a huge number of experts.” The participants were employees of a number of federal agencies, which agencies each independently determined who would attend, while “at least two invited agencies declined to participate.”¹⁹ There is no record evidence about the actual expertise of the participants, as their names and qualifications are not known.²⁰

¹⁶ [CEOs Initial Brief](#) at 36.

¹⁷ [Order Regarding Burdens of Proof dated March 27, 2015](#) at 2, ¶ 1; at 5 (*citing* Minn. Rules Part 1400.7300, subp. 5); and at 6. *See also* [Doctors Initial Brief](#) at 2 (*insisting on decision based on “sound science and economics.”*)

¹⁸ [Doctors Initial Brief](#) at 3.

¹⁹ Ex. [100](#) (Polasky Direct) at Schedule 4 (GAO Report) at 8.

²⁰ *See, e.g.*, Tr. Vol. 1 at 87:19-88:1; 112:9-16; 113:4-9; 152:18-153:1; 156:5-9
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While the IWG’s decisions may have been consensus-based,²¹ the most recent FSCC is not based on the most current (2013) IPCC Fifth Assessment Report, but rather on a report published in 2007, incorporating even earlier scientific developments and articles, and accordingly by definition does not incorporate current climate change science or expertise.²² The Doctors’ statement accordingly lacks merit. For the same reason, it is incorrect for the CEOs to state that the FSCC contains “the best scientific and modeling information available.”²³

Third, as Dr. Smith has pointed out, the FSCC was the result of “the judgments of analysts who use the IAMs on behalf of policy makers.”²⁴ The IWG extrapolated EMF-22 projections by 200 years²⁵ (a decision that has not been peer-reviewed and renders the

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(Polasky). The mere fact that representatives were employed by various agencies and had claimed experience with certain factors does not constitute record evidence of “expertise.” In this case, true experts, with awards and public recognitions, as well as the author of the FUND model, Dr. Tol, *see, e.g.*, [Peabody Initial Brief](#) at 87-88, have been vilified. *Id.* at 90-94.

²¹ Ex. [100](#) (Polasky Direct) at Schedule 4 (GAO Report) at 12.

²² *See, e.g.*, Tr. Vol. 1 at 165:10-15 (Polasky); Ex. [101](#) at Schedule 1 (July 2015 IWG Response to Comments) at 12. *See also* Ex. 405 (IPCC Fifth Assessment Report) [part 1](#) at 16 & n.16 and [part 36](#) at 1110-1111..

²³ [CEOs Initial Brief](#) at 36.

²⁴ Ex. [300](#) (Smith Direct) at 16.

²⁵ Accordingly, the CEOs’ statement that “[t]o account for uncertainty in predicting future economic and technological states, once again the working group relied on an authoritative source and multiple values,” ([CEOs Initial Brief](#) at 17), referring to the EMF 22 exercise scenarios, is inaccurate and misleading. The extension of the data has not been sanctioned or peer-reviewed. For the same reason it is inaccurate and misleading to state that “[t]he scenarios chosen by the IWG are from a source that is ‘recent, peer-reviewed, published, and publicly available.’”

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outcome of the damages calculations speculative),²⁶ made a decision to ignore the OMB’s mandatory directive to reflect a 7% discount rate,²⁷ and made a further decision to ignore the OMB’s mandatory directive to include domestic costs or benefits, even if global costs or benefits are deemed more appropriate.²⁸ There is no evidence that any of these decisions were signed off on by any cabinet member or other high-ranking agency official, while it is certain that the decisions were not signed off on by Congress or the President.²⁹

While the IWG and its members may have had the best of intentions, the government is not without faults. This may be shown by the many government decisions that are overturned by the courts,³⁰ as well as by later recognition of error. *See e.g.*, PL

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(*Id.*) The IWG’s conclusory statement that the IWG’s decisions “produce reasonable results,” (*id.*) accordingly lacks any factual basis.

²⁶ Ex. [302](#) (Smith Direct report) at 23:2-5, 66.

²⁷ Ex. [300](#) (Smith Direct) at 23:11-25:16; Exhibit [417](#) (OMG Circular A-4) at 33-34, 36 (“If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis using a lower but positive discount rate *in addition to* calculating net benefits using discount rates of 3 and 7 percent”) (emphasis added).

²⁸ *Id.* at 15.

²⁹ Accordingly, Dr. Hanemann’s and the CEOs’ criticism of Dr. Smith that she is making a “distinction without a difference” between analysts and “the United States government” is incorrect. *See* [CEOs Initial Brief](#) at 61; Ex. [801](#) (CHECK) (Hanemann Rebuttal) at 15.

³⁰ *See, e.g., Michigan v. EPA*, ___ U.S. ___, 135 S. Ct. 2699 (2015) (EPA interpreted Clean Air Act, 42 U.S.C.S. § 7412(n)(1)(A), unreasonably when it deemed cost irrelevant to the decision to regulate power plants); *Appalachian Power Co. v. EPA*, 294 F.3d 1032, 1054 (D.C. Cir. 2001); *Tex Tin Corp. v. EPA*, 992 F.2d 353, (continued)

100–383, August 10, 1988, 102 Stat 903³¹ and the May 16, 1997, Presidential Apology for the Tuskegee Study.³² In short, those who advocate for adoption of the FSCC must, by a preponderance of the evidence, prove that such value is in fact reasonable and the best available measure of the environmental cost of CO₂ in the Minnesota regulatory context, and may not simply rely on the fact that the FSCC is the product of collaboration between a number of federal agencies seeking to come up with a solution for a different regulatory purpose and environment.³³

C. Minn. Stat. § 216B.2422, subd. 3, requires that the Commission make an adjudicative determination, not a legislative-policy decision

Doctors for a Healthy Environment have suggested that the outcome of this proceeding will be one of many “tools” available to the Commission, which the

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354-55 (D.C. Cir. 1993); *Chlorine Chem. Council v. EPA*, 206 F.3d 1286, 1290-91 (D.C. Cir. 2000); *Il. Comm. Comm’n v. FERC*, 576 F.3d 470, 477 (7th Cir. 2009).

³¹ The stated purposes of PL 100–383, August 10, 1988, 102 Stat 903 are to (1) acknowledge the fundamental injustice of the evacuation, relocation, and internment of United States citizens and permanent resident aliens of Japanese ancestry during World War II; (2) apologize on behalf of the people of the United States for the evacuation, relocation, and internment of such citizens and permanent resident aliens; (3) provide for a public education fund to finance efforts to inform the public about the internment of such individuals so as to prevent the recurrence of any similar event; (4) make restitution to those individuals of Japanese ancestry who were interned; (5) make restitution to Aleut residents of the Pribilof Islands and the Aleutian Islands west of Unimak Island, in settlement of United States obligations in equity and at law; (6) discourage the occurrence of similar injustices and violations of civil liberties in the future; and (7) make more credible and sincere any declaration of concern by the United States over violations of human rights committed by other nations.

³² See <http://www.cdc.gov/tuskegee/clintonp.htm>.

³³ [Burden of Proof Order](#) at 2, ¶ 1.

Commission may use how it sees fit in later proceedings such that accuracy is not important.³⁴ Along a similar line, the CEOs and Dr. Polasky argue that “[an environmental cost value based on local damages, rather than global damages,] would also fail to provide Minnesota with a tool that prepares it for a future in which emitting carbon is not free.”³⁵ Both parties, and Dr. Polasky, overlook the fact that the Minnesota Legislature has issued a specific task to the Commission: “to the extent practicable, quantify and establish a range of environmental costs associated with each method of electricity generation.” Minn. Stat. § 216B.2422, subd. 3. The Commission has previously done exactly that, expressly adopting conservative values, supported by empirical evidence, and rejecting various proposed values lacking evidentiary support.³⁶

Rather than a mere advisory “tool,” the values set by the Commission must, as a matter of law, be used by the utilities when evaluating and selecting resource options in all proceedings before the commission, including resource plan and certificate of need proceedings. Minn. Stat. § 216B.2422, subd. 3. Rejecting similar arguments to those made here by the Doctors, CEOs, and the Agencies,³⁷ the Commission has properly

³⁴ Doctors Initial Brief at 3, last paragraph.

³⁵ [CEOs Initial Brief](#) at 34 (*citing* Ex. [101](#) (Polasky Rebuttal) at 26).

³⁶ *See, e.g.,* [Order Establishing Environmental Cost Values](#) (January 3, 1997) at 26 (rejecting the Residential and Small Business Utilities Division of the Office of the Attorney General’s proposed \$1 - \$11 range on the basis that “support in the record for either endpoint is too weak to be accepted.”).

³⁷ *See, e.g.,* [Agencies Initial Brief](#) at 69 (urging adoption of regulatory policies to “include a degree of risk aversion”) (*citing* Ex. [801](#) (Hanemann Rebuttal) at 60-62). The adoption of “risk aversion” policies is properly a function of the
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recognized that “political argument[s are] not appropriately before the Commission” and that those arguments are properly directed to the Legislature.³⁸

D. Doctors for a Healthy Environment and the Clean Energy Business Coalition have still not introduced admissible foundational evidence to support adoption of the FSCC

In the [MLIG’s initial brief](#), the MLIG noted that Doctors for a Healthy Environment and the Clean Energy Business Coalition advocated for adoption of the FSCC but did not introduce admissible foundational evidence to support adoption of the FSCC. The Business Coalition has joined in the CEOs’ initial brief, and has not separately taken any positions. Mr. Rumery and Mr. Kunkle stipulated, through counsel, that they could not and did not seek to offer any opinion about the best monetary amount to account for the costs or benefits of carbon emissions. (Exs. [437](#) and [438](#).) In the absence of any proffered testimony about the validity or reliability of the FSCC and in the absence of any testimony about the best monetary amount to account for the costs or benefits of carbon emissions, the Clean Energy Business Coalition failed to meet its burden of proof to show that the “value being proposed [by means of the FSCC value] is reasonable and the best available measure of the environmental cost of CO₂,” as required by the March 27, 2015, [Burdens of Proof Order](#),³⁹ Minn. Rules Part 1400.7300, subp. 5, and *In re Quantification of Env’tl. Costs Pursuant to Laws of Minn. 1993, Chapter 356*,
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Legislature, as the duly-elected representatives of the citizens of Minnesota, rather than the Commission.

³⁸ *Id.*

³⁹ [Order Regarding Burdens of Proof dated March 27, 2015](#) at 2 and 6.

Section 3, 578 N.W.2d 794, 801 (Minn. Ct. App. 1998).

Doctors for a Healthy Environment did submit an initial brief, but still has not identified any admissible evidence to suggest that the IWG’s FSCC is reasonable and the best available measure of the environmental cost of CO₂. Even Dr. Rom’s testimony did not contribute, inasmuch as he testified that CO₂ as such is not harmful,⁴⁰ and no differentiation was made between damages allegedly caused by PM_{2.5} and ozone on the one hand and CO₂ on the other hand. As indicated in the [MLIG’s initial brief](#), Dr. Rom does not “propose any specific value” in this proceeding, has not assigned any values to damages that he claims may not be included in the IAMs, and has not provided “any specific way of determining what the right [CO₂ externality] value should be in this proceeding.”⁴¹ Doctors for a Healthy Environment has accordingly failed to introduce admissible foundational evidence to support adoption of the FSCC as developed by the IWG, and has failed to meet its burden of proof to show that the “value being proposed [by means of the FSCC value] is reasonable and the best available measure of the environmental cost of CO₂,” as required by the March 27, 2015, [Burdens of Proof Order](#),⁴² Minn. Rules Part 1400.7300, subp. 5, and *In re Quantification of Env’tl. Costs Pursuant to Laws of Minn. 1993, Chapter 356, Section 3*, 578 N.W.2d 794, 801 (Minn. Ct. App. 1998).

⁴⁰ [Doctors Initial Brief](#) at 11.

⁴¹ Tr. Vol. 4 at 165:1-7; 165:25-166:4.

⁴² [Order Regarding Burdens of Proof dated March 27, 2015](#) at 2 and 6.

II. UNDER- AND OVER-ESTIMATING DAMAGES

The MLIG submits that it has established far beyond a preponderance of the evidence that two of the most significant factors in the damages calculations alone cause a massive overstatement of damages, far outweighing any alleged understatement of damages. The equilibrium climate sensitivity (“ECS”) and the discount rate are both massive drivers in the damages calculations.⁴³ It cannot be legitimately disputed that the FSCC has been calculated using an outdated ECS. It can further not be disputed that the IWG has calculated the FSCC using the consumption rate of interest to reflect how private individuals trade-off current and future consumption, and deliberately excluded the 7% discount rate, on the basis that the 7% discount rate represented “the average before-tax real rate of return to private capital in the U.S. economy,” which “is meant to approximate the opportunity cost of capital in the United States.”⁴⁴ According to the IWG, the use of the 3% discount rate “is consistent with OMB guidance in Circular A-4, which states that when a regulation is expected to primarily affect private consumption—for instance, via higher prices for goods and services--it is appropriate to use the consumption rate of interest.”⁴⁵

The problem with the IWG’s refusal to calculate a 7% discount rate is that federal agencies adopting regulations that primarily affect non-private consumption, cannot fall

⁴³ See e.g., [Agencies Initial Brief](#) at 30-31 (discount rate has “huge impact”); Tr. Vol. 4 at 82:8-10 (Martin) (“the discount rate observes [*sic*] more influence on the results than any other factor”); Ex. [302](#) (Smith Direct report) at 80 (“A very important framing question in the case of regulations that have benefits and/or costs that endure for a long period of time, as is the case with climate policy, is the choice of discount rate.”). See also Ex. [302](#) at 90, Table 14, demonstrating “the large effect that the discount rate has on the SCC values.” See further Ex. [100](#) at Schedule 2 (July 2010 IWG Technical Support Document) at 17. See also Tr. Vol. 1 at 166:12-167:4 (Polasky) (ECS is a “very important driver” in the damages calculations made by the PAGE, DICE, and FUND models).

⁴⁴ Ex. [101, Ex. 1](#) at 21-22.

⁴⁵ *Id.*

back on a 7% discount rate, or even the median between a 3% or 5% discount rate and a 7% discount rate. Thus, when proponents of the FSCC point to a federal agency’s adoption of a regulation using the FSCC in the context of an industrial regulation, it is an ironic showing of the failure of the IWG, rather than its success in this regard—the relevant agency does not have the correct number, because the IWG has refused to provide it.

A. Additional comments regarding the Equilibrium Climate Sensitivity

The importance of the IPCC’s Fifth Assessment Report (“AR5”) has been urged forcefully by the Agencies:

- “[Dr. Gurney] discussed the importance of the IPCC 5th Assessment Report”⁴⁶
- Dr. Gurney “compared the protocols followed by several Peabody witnesses with the much more appropriate protocols followed by the authors of the IPCC 5th Assessment Report”⁴⁷
- “the synthesis supplied by the IPCC is the best comprehensive review of global temperature records”⁴⁸
- “The most authoritative contemporary source is the IPCC’s 5th Assessment Report...”⁴⁹
- “Dr. Gurney reiterated that the IPCC 5th Assessment Report, which is the most comprehensive assessment of research on the issue of CO₂ fertilization and the role of CO₂ fertilization within climate change ...”⁵⁰
- “The most reliable evidence on this topic is the IPCC 5th Assessment

⁴⁶ [Agencies Initial Brief](#) at 8.

⁴⁷ *Id.*

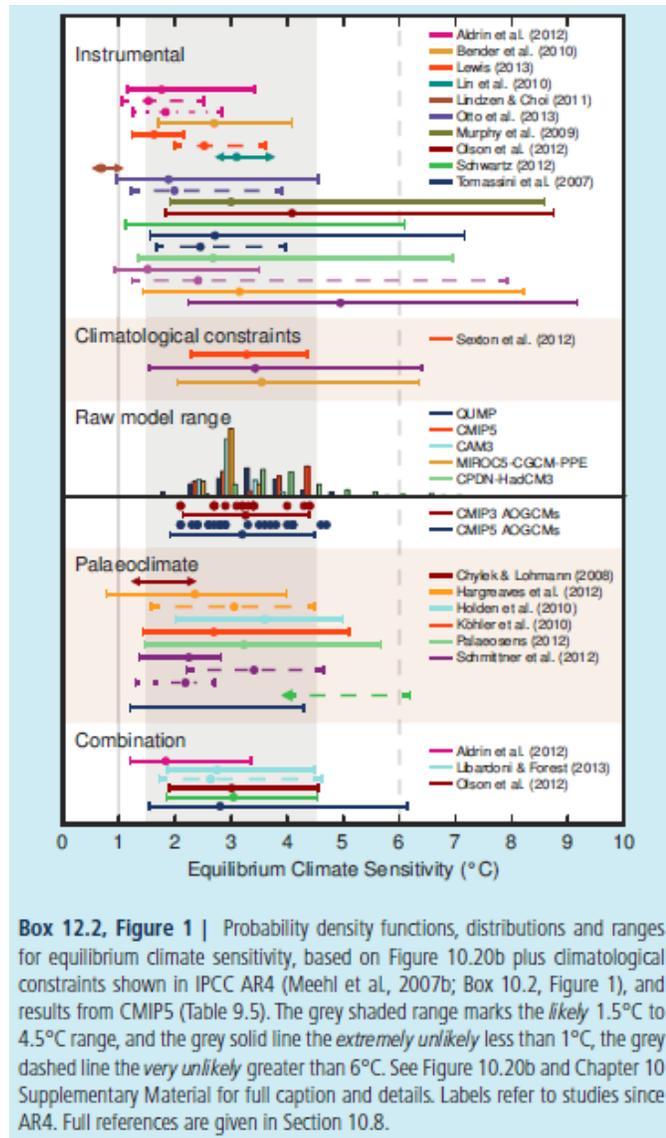
⁴⁸ *Id.* at 24.

⁴⁹ *Id.* at 50.

⁵⁰ *Id.* at 55

Report...”⁵¹

- “The IPCC 5th Assessment Report includes a thorough and comprehensive review of this important metric [the ECS] of the climate system; different aspects are discussed in at least three different chapters. ... The reported range of ECS values are based on multiple lines of evidence, including paleoclimate, model simulations, and instrumental measurements, as is demonstrated in the following figure from the IPCC’s 5th Assessment Report:



(Agency Initial Brief at 91, *citing* Ex. [405 \(AR5\), pt. 36](#) at 1110.) Remarkably absent in

⁵¹ *Id.* at 56.

the Agency's initial brief is reliance on the IPCC's November 2007 Fourth Assessment Report ("AR4"), which advocated a new, higher-range, ECS and a "central estimate" of 3°C. Both were expressly abandoned in AR5, based on "a comprehensive review of the scientific literature" and because of an "improved understanding, the extended temperature record for the atmosphere and oceans, and new estimates of radiative forcing."⁵² The Agencies recognize in this respect that "it would be unreasonable to base a scientific assessment of climate change on an old IPCC Assessment Report rather than the current Assessment Report."⁵³ However, the IWG's FSCC is based on the 2007 AR4, including its higher range (2°C-4.5°C) and "central estimate" of 3°C.⁵⁴

The Agencies try to explain how a return to the *status quo ante* increases, rather than decreases to the SCC, citing Freeman *et al.*⁵⁵ Under the circumstances, this theory must be rejected, however. In Mark C. Freeman et al., *Climate Sensitivity Uncertainty: When is Good News Bad?*, Harvard Kennedy School, Faculty Research Working Paper Series (2015), Freeman focuses only on the change from a 2°C-4.5°C range to a 1.5°C-4.5°C range, calls the lowering of the bottom "good news," but then explains that the willingness to pay would increase ("bad news") because the estimate of its standard

⁵² Ex. [101](#) at Schedule 1 (July 2015 IWG Response to Comments) at 12. *See also* Ex. 405 (IPCC Fifth Assessment Report) [part 1](#) at 16 & n.16 and [part 36](#) at 1110-1111.

⁵³ [Agencies Initial Brief](#) at 34.

⁵⁴ Ex. [101](#) at Schedule 1 (July 2015 IWG Response to Comments) at 12. *See also* Ex. 405 (IPCC Fifth Assessment Report) [part 1](#) at 16 & n.16 and [part 36](#) at 1110-1111.

⁵⁵ *See* [Agencies Initial Brief](#) at 88-90.

deviation would have increased.⁵⁶ Freeman *et al.* overlook—possibly because the article is not peer-reviewed⁵⁷—that the IPCC also announced that the new studies underlying the lowering of the low end of the ECS range “suggest a best fit to the observed surface and ocean warming for ECS values in the lower part of the *likely* range.”⁵⁸ Accordingly, and contrary to Freeman’s assumption that the “decrease in mean is due to a widening of the uncertainty range,”⁵⁹ the uncertainty range has actually decreased, while, simultaneously, the low end of the range has been lowered. This is, in fact, good news, compared to AR4, but it is not reflected in the IWG’s FSCC.

As addressed in the [MLIG’s initial brief](#)⁶⁰ and in [Peabody’s Initial Brief](#), the IWG further has not only ignored AR5, it never applied its Roe & Baker analysis to the full range. As Peabody correctly observed,

The IWG centered its Roe & Baker distribution on AR4’s “best estimate” of 3°C. (Ex. [100](#), Polasky Direct, Sched. 2 (Feb. 2010 TSD), at 13.) As in AR4, two-thirds of the probabilities used by the IWG fell between 2 and 4.5°C. (*Id.*) However, the IWG included far fewer probabilities below 1.5°C than it should have based on AR4. (*Id.*) Instead of 10 percent of probabilities falling at 1.5°C and below, only 1.3 percent did. (*Id.*) In fact, the 10th percentile was nearly at

⁵⁶ Mark C. Freeman et al., *Climate Sensitivity Uncertainty: When is Good News Bad?*, Harvard Kennedy School, Faculty Research Working Paper Series (2015) at 1 (cited in Ex. [801](#) (Hanemann Rebuttal) at 32:6-33:18).

⁵⁷ Freeman (2015), cover disclaimer.

⁵⁸ Ex. 405 [part 36](#) at 1111, first full paragraph (italics in original).

⁵⁹ Freeman (2015) at 2.

⁶⁰ *See, e.g.*, [MLIG Initial Brief](#) at 4, 31-36.

2°C (10th percentile = 1.91). (*Id.*)⁶¹

It should also be noted that under AR5, 5% of the values should have fallen at 1.0°C and below. The IWG placed the 5th percentile of the ECS at 1.72°C, however.⁶² AR5 furthermore reduced the likelihood that the ECS was above 4.5°C. While in AR4 the IPCC still held that “[v]alues substantially higher than 4.5°C cannot be excluded, but agreement of models with observations is not as good for those values,”⁶³ AR5 now provides that “Equilibrium climate sensitivity is ... very unlikely greater than 6°C.”⁶⁴ Yet the IWG’s FSCC is based on a distribution in which 10% of the values are 5.86°C or more and 5% of the values are 7.14°C or more:⁶⁵

Table 1: Summary Statistics for Four Calibrated Climate Sensitivity Distributions

	Roe & Baker	Log-normal	Gamma	Weibull
Pr(ECS < 1.5°C)	0.013	0.050	0.070	0.102
Pr(2°C < ECS < 4.5°C)	0.667	0.667	0.667	0.667
5 th percentile	1.72	1.49	1.37	1.13
10 th percentile	1.91	1.74	1.65	1.48
Mode	2.34	2.52	2.65	2.90
Median (50 th percentile)	3.00	3.00	3.00	3.00
Mean	3.50	3.28	3.19	3.07
90 th percentile	5.86	5.14	4.93	4.69
95 th percentile	7.14	5.97	5.59	5.17

Given the sensitivity of the values to the ECS (see [MLIG Initial Brief](#) at 33-35, identifying a reduction in SCC estimates by 57% to 60% compared to the IWG’s

⁶¹ [Peabody Initial Brief](#) at 77.

⁶² Ex. [101](#) at Schedule 1 (July 2015 IWG Response to Comments) at 13.

⁶³ Ex. [268](#) at 38.

⁶⁴ Ex. 405 (IPCC Fifth Assessment Report) [part 1](#) at 16.

⁶⁵ Ex. [101](#) at Schedule 1 (July 2015 IWG Response to Comments) at 13.

estimates when comparing an ECS fixed at 3°C and an ECS fixed at 1.5°C⁶⁶), the IWG’s combined use of an improper Roe & Baker distribution and its failure to update its modeling render the FSCC grossly unreliable in 2015. It is noteworthy that no proponent of the FSCC has suggested that the IWG’s understatements are anywhere in this 57% to 60% error range.⁶⁷

The ECS problem is exacerbated by the IWG’s use of discount rates that are inappropriate in the Minnesota context of Minn. Stat. § 216B.2422, subd. 3.

B. Additional comments regarding the discount rate

As Dr. Polasky has remarked, “what one assumes about the discount rate matters hugely.”⁶⁸ The MLIG respectfully submits that it has fully addressed the allegations that “Dr. Smith’s exclusion of the 2.5% discount rate is unreasonable”⁶⁹ on pages 46 through 52 of its [Initial Brief](#). Xcel Energy’s position that “[t]here is simply no empirical

⁶⁶ Comparison is against the IMAGE scenario with the fixed ESC of 3. Comparison against the initial IWG assumptions, with the ECS Roe and Baker distribution would yield 60% and 65% reductions.

⁶⁷ Dr. Rom has provided some numbers, but tied those to PM_{2.5} and ozone, and did not provide any CO₂-specific damages. *See* Ex. [500](#) at 13-16. Furthermore, his argument is undermined significantly by the Doctors’ initial brief, which uses erroneous math at page 16 to illustrate, without any support for the numbers used. Rather than illustrating a 90% increase in heat-related deaths, the brief illustrates a 300% increase in heat-related deaths. That brief further shows, on page 15, that mortality will be increasing not only because of heat, but also because of population growth and aging. This is no surprise given the baby-boomer percentage of the world population.

⁶⁸ [CEOs Initial Brief](#) at 18 and 27 (both *citing* Ex. [100](#) at 11); *see also* [Agencies Initial Brief](#) at 30 (“huge impact”).

⁶⁹ *See, e.g.,* [CEOs Initial Brief](#) at 32-33.

evidence of the preferences and behaviors of distant future generations”⁷⁰ supports Dr. Smith’s testimony because planning based on change, when it’s not even sure that there will be change, let alone in what regard, is a prime example of arbitrary conduct.

The MLIG further respectfully submits that it has fully explained why (weighted) inclusion of the 7% discount rate is required for an appropriate application of an ECV of CO₂ in the Minnesota regulatory framework under Minn. Stat. § 216B.2422, subd. 3,⁷¹ given the undisputed fact that “adopting the FSCC could lead to a diversion of private capital and potentially stranded investments,”⁷² rendering application of the IWG’s discount rates inappropriate.⁷³ While Dr. Hanemann disagrees,⁷⁴ it appears that he disagrees with everyone, including Prof. Nordhaus.⁷⁵ Finally, the MLIG respectfully submits that it sufficiently anticipated the Agencies’ reliance on Dr. Hanemann’s faulty reliance on regulations in Montgomery County, Maryland, in Canada, etc. in its [Initial Brief](#).⁷⁶ The MLIG will not repeat those responses here.

Mr. Martin favors effectively blending all of the discount rates, which no party

⁷⁰ [Xcel Initial Brief](#) at 27.

⁷¹ *See supra* at 14-15 and [MLIG Initial Brief](#) at 77-78.

⁷² [Peabody Initial Brief](#) at 71 (*citing* Tr. Vol. 4 at 25:3-8; 85:16-86:14 (Martin)).

⁷³ *See, e.g.,* [Agencies Initial Brief](#) at 121 (acknowledging that the 3% and 5% discount rates are respectively risk-free and risky-investment consumer interest rates).

⁷⁴ Dr. Hanemann reluctantly agrees, however, that future generations will have significantly more income and will be significantly richer than the current generation. (Tr. Vol. 2B at 79:24-80:2).

⁷⁵ *See* [Agencies Initial Brief](#) at 115 (Nordhaus’ discount rate is “too high”).

⁷⁶ *See* [MLIG Initial Brief](#) at 28-31.

supports. However, this blending effectively achieves a discount rate of 3.5%,⁷⁷ and illustrates well the impact of the appropriate discount rate. Comparing a weighted 5.66% discount rate as discussed in the [MLIG's initial brief](#)⁷⁸ with a 3.5% discount rate is approximately equal to comparing a 3% discount rate and a 5% discount rate. This mere 2% difference results in a damages difference of a factor 3.5 (*see* Ex. [307](#) (Smith Table 4A) at line 1 ((2014)\$46.88/net tonne) and line 4 ((2014)\$13.39)). A factor 3.5 is important inasmuch as the outcome of this proceeding “will affect how regulated utilities in Minnesota will select, allocate, and build resources.”⁷⁹ As ALJ Klein expressly recognized in 1996, “the possibility of utilities paying more for resources than their environmental benefits justify is just as bad as paying less than their benefits justify.”⁸⁰

Xcel meanwhile suggests that “most Parties have suggested retaining all three discount rates used by the IWG and treated them equally.”⁸¹ This is an incorrect statement. Neither the MLIG,⁸² nor the Utility Group, nor Peabody supported this concept. The Doctors and the Clean Energy Business Coalition did not address it, while the CEOs and the Agencies objected to the merger of the data.

⁷⁷ $2.5\% + 3\% + 5\% = 10.5\% / 3 = 3.5\%$.

⁷⁸ *See* [MLIG Initial Brief](#) at 77-78 (3% [$\frac{1}{3}$ weight] + 7% + 7% [$\frac{2}{3}$ weight] = 17% / 3 = 5.66%).

⁷⁹ [Xcel Initial Brief](#) at 25.

⁸⁰ Ex. [305](#) (March 22, 1996, Findings of Fact, Conclusions, Recommendation and Memorandum (ALJ Allan W. Klein), Docket 93-583) at 17 and at Finding 36 (“The adopted values should be conservative.”).

⁸¹ [Xcel Initial Brief](#) at 24.

⁸² *See, e.g.,* [MLIG Initial Brief](#) at 65.

The MLIG submits that its “blended discount rate” of 5.66% is arrived at differently than Xcel’s blended data. While Xcel merges different sets of data which address different risk exposures—the 3% discount corresponds to a risk-free consumer rate while the 5% discount rate corresponds to a risky consumer rate—the MLIG’s weighted discount rate takes the lower (risk-free) discount rate and merges it on a weighted basis ($\frac{1}{3}$) based on approximate state-wide relative energy consumption⁸³ with a 7% corporate discount rate ($\frac{2}{3}$).⁸⁴ As set forth in the [MLIG’s initial brief](#), this is a conservative number.⁸⁵

C. Additional comments regarding the appropriate damages horizon

The Commission currently maintains a horizon of the year 2100 for its ECV calculations. The proponents of the IWG’s FSCC argue that the horizon should be extended to 2300, because CO₂ remains at least partially in the air for that period of time. The problem with this basis (as the sole basis for this time horizon) is that as emissions continue in time, the horizon must be extended indefinitely; if one computes to the year 2300 for 2015 emissions, one must compute out to the year 2335 for emissions in the year 2050 and to year 2340 for emissions in the year 2055. This is not workable, of

⁸³ See [MLIG Initial Brief](#) at 77-78 (*citing* Tr. Vol. 4 at 89:4-14 (Martin)).

⁸⁴ $3\% + 7\% + 7\% = 17\% / 3 = 5.66\%$

⁸⁵ See [MLIG Initial Brief](#) at 77-78, putting the 7% in the context of the Commission’s May 8, 2015, approval of Xcel’s capital structure and the rate of return at a weighted pre-tax cost of 7.35% for 2014 and 7.38% for 2015 in Xcel Energy’s Minnesota Electric Rate case, using a 9.72% cost of equity. (See [May 8, 2015, Findings of Fact, Conclusions, and Order in Docket No. E-002/GR-13-868](#) at 61-62.)

course. More importantly, however, is that the proponents of the FSCC have still not established why the goal of obtaining the fullest possible accounting, however speculative, should trump the goal of obtaining an estimate which is supported by a sound evidentiary basis.⁸⁶

The Agencies concede that “the IWG made some assumptions to extend the projections [from the EMF-22 exercise horizon of the year 2100] through 2300.”⁸⁷ The Agencies’ statement is a rather significant understatement, inasmuch as GDP, population, and greenhouse gas emissions trajectories were all extended by 200 years.⁸⁸ In these assumptions, the emissions trajectories for four of the five scenarios assume total carbon consumption that vastly exceeds the total carbon available for consumption.⁸⁹ In other words, the assumptions miss the mark by a landslide.

Furthermore, Dr. Smith has testified that although it is true that CO₂ emissions levels in the five emissions projections used by the IWG and presented in Dr. Hanemann’s rebuttal testimony level off and begin to decline at or around 2200, that does not alter her conclusion that those emissions projections assume an unrealistic level of societal inaction. According to Dr. Smith, temperatures reach the very high levels that they do in 2300 in the models not because of emissions over the next decade, but because of a continued accumulation of unregulated global emissions long after the temperature

⁸⁶ See Ex. [304](#) (Smith Surrebuttal) at 18:13-23.

⁸⁷ [Agencies Initial Brief](#) at 41.

⁸⁸ [Agencies Initial Brief](#) at 41 n.35.

⁸⁹ See Ex. [304](#) (Smith Surrebuttal) at 18:21-19:3

changes start to reach unacceptable levels.⁹⁰ The IWG’s assumption of lack of any mitigation and adaptation in the interim was, according to Dr. Smith, not reasonable.⁹¹ Over the past few days we have seen that Dr. Smith was right and Dr. Hanemann was wrong, as world leaders negotiated an initial framework for mitigation in Paris.

Rather than addressing the merits of the appropriate horizon, the CEOs continue to assert in their [Initial Brief](#) that Dr. Smith used a horizon of the year 2100 or 2140 “based on a recommendation from an MPCA staff member in proceedings before the Commission in 1997.”⁹² However, Dr. Smith already explained months ago that her horizon for a damages calculation is not based on precedent, although that precedent is defensible, whereas the year 2300 is not.⁹³ “Regardless of whether impacts beyond [Dr. Smith’s] recommended modeling horizon may occur, there is an insufficient evidentiary basis to assign a monetized value to those impacts after that horizon [the year 2100 or 2140]. As [she] stated in [her] expert report at page 68, the extrapolations used by the IWG to obtain projections after 2100 have been criticized by EPRI as internally inconsistent and inconsistent with known physical facts such as the estimates of known global fossil fuel reserves.”⁹⁴ Dr. Smith has cogently testified that

EPRI has also criticized the IWG models for failing to account for diversity in potential regulatory outcomes, and the

⁹⁰ *Id.* at 15:7-16:13.

⁹¹ Ex. [302](#) at 72-73.

⁹² [CEOs Initial Brief](#) at 31.

⁹³ *See* Ex. [304](#) (Sep. 10, 2015, Smith Surrebuttal) at 18:21-19:3.

⁹⁴ *Id.*

lack of diversity in the post-2100 forecasts for population, GDP per capita, carbon intensity, net land use CO2 emissions, and non-CO2 radiative forcing. Moreover, and as I also noted in my expert report at 72-73, the IWG's projections also suffer from the assumption that society would permit exceptionally high temperatures to proceed unchecked despite its projected greater wealth and likely advances in technological know-how in response to the projected accumulation of observable climatic changes. Finally, the IWG emissions projections attempt to make predictions regarding the future relative shares of GDP associated with certain sectors and the extent to which these sectors would be affected by significant temperature increases. These problems become particularly pronounced after 2100 or 2140 because values after 2100 are extrapolated in an ad hoc manner from the EMF 22 scenarios (which end in 2100), and because values after 2100 and 2140 suffer from the fact that even the longest-lived technology rarely remains economical to operate more than about 80 years, and that presently foreseeable technological changes could expand the reasonable horizon by about 40 years. Accordingly, any empirical basis which would reasonably support projections out until 2100 or 2140 vanishes after that time.⁹⁵

The MLIG respectfully submits that in the absence of any basis upon which to make decisions and expectations through the year 2300, except rank speculation, maintaining the year-2100 horizon currently used by the Commission is reasonable.⁹⁶

“[Stanford University Energy Modeling Forum (“EMF”)] 22 scenarios that the IWG relies on through 2100 are at least informed by knowledge about current

⁹⁵ Ex. [304](#) (Smith Surrebuttal) at 19:3-20.

⁹⁶ See also [Xcel Initial Brief](#) at 5 (no “empirical evidence of what will happen in the next 300 years or so”).

technologies and technologies presently in development.”⁹⁷ “The degree of speculation grows at an increasing pace after 2100 because even the longest-lived technology rarely remains economical to operate more than about 80 years, and speculation becomes the dominant element of any forecast after about 2140, since even presently foreseeable new technologies will be reaching their obsolescence by then.”⁹⁸ “Furthermore, as technologies change, so too do lifestyles and hence economic value of climatic changes that might be projected in that future era. Accordingly, any empirical basis which would support projections out until 2100 or 2140 vanishes after that time.”⁹⁹

The CEOs have also again suggested that “Dr. Smith approached her task with the objective of lowering the SCC” and that she “attempts to highlight only those possible areas [*sic*] a plausible sounding argument could be made that would lower the SCC.”¹⁰⁰ Dr. Smith has already explained that her “approach was driven by the criteria [she] used in evaluating the IWG’s IAM-based estimates of social cost of carbon, which were those

⁹⁷ Ex. [304](#) (Smith Surrebuttal) at 17:13-22. It should be noted that Dr. Smith has been a contributing participant in several of the Stanford University Energy Modeling Forums (“EMFs”), particularly in EMF 12 (“Controlling Global Carbon Emissions – Cost and Policy Options”) and EMF 13 (“Markets for Energy Efficiency”), where the Gemini-U.S. model was used. Additionally, the NERA PEF climate IAM was included in EMF 14 (“Integrated Assessment for Climate Change”). Dr. Smith has been the supervisor of modeling teams involved in other EMFs, including the EMF project from which the IWG obtained the basis for its five socioeconomic projections, EMF 22 (“Climate Change Control Scenarios”). (See Ex. [300](#) at 9:20-10:10.) Dr. Hanemann has not participated in any EMF.

⁹⁸ Ex. [304](#) (Smith Surrebuttal) at 17:13-22.

⁹⁹ *Id.*

¹⁰⁰ [CEOs Initial Brief](#) at 34.

criteria established in the prior proceeding to determine Minnesota’s environmental cost values.”¹⁰¹ Those criteria, which she referenced on page 16 of the report submitted with her direct testimony (Ex. [301](#)), frequently led her to recommend framing assumptions that result in lower environmental cost values, but that was not always the case. In addition to those criteria, she also considered principles of benefit-cost analysis, risk analysis, and environmental economics in preparing her recommendations.¹⁰²

The Agencies have further suggested that “Dr. Smith has asserted that the analysis of climate impacts should be terminated at 2100 or 2140 because, beyond that time, there could be increases in global temperature under some scenarios and simulations.”¹⁰³ The Agencies are wrong. Dr. Smith instead testified that:

Given that undue speculation in damage estimates arises when temperature increases exceed about 4°C, *undue speculative content in SCC estimates* based on the IWG scenarios and models could be *reduced (but not eliminated)* by limiting the modeling horizon to 2100. (This would simultaneously eliminate the speculation made by the IWG when extrapolating the EMF 22 GDP and emissions projections beyond 2100.)¹⁰⁴

D. Additional comments regarding the geographic scope of damages

The proponents of the IWG’s FSCC invoke precedent (which they reject as a basis for the time horizon) and the fact that “CO₂ is a global pollutant” to justify a global geographic scope. It should first be noted that contrary to the criteria pollutants, CO₂ as

¹⁰¹ Ex. [304](#) (Smith Surrebuttal) at 2:1-3.

¹⁰² Ex. [304](#) (Smith Surrebuttal) at 1:20-2:8. *See also id.* at 2:10-4:4.

¹⁰³ Agency Initial Brief at 105-106 (*citing* via, via Ex. [302](#) at 72).

¹⁰⁴ Ex. [302](#) (Smith Direct Report) at 72 (emphasis added).

such is not a pollutant, as Dr. Rom¹⁰⁵ and Doctors for a Healthy Environment¹⁰⁶ admit. Secondly, it cannot be legitimately disputed that there will be no reciprocity from Minnesota's actions.¹⁰⁷ The question then is whether the global impact of Minnesota CO₂ emissions should be borne by Minnesotans alone in the absence of reciprocity.¹⁰⁸

¹⁰⁵ Tr. Vol. 4 at 162:1-9 (asthma causes); 165:8-11 (CO₂ does not cause asthma).

¹⁰⁶ [Doctors Initial Brief](#) at 11.

¹⁰⁷ *See, e.g.*, [CEOs Initial Brief](#) at 18; [Agencies Initial Brief](#) at 135 (“global emissions have risen significantly over the past 15 years”) while Exhibit [413](#) (MPCA publication) shows a 17% reduction in CO₂ emissions by utilities from 2005-2012 and a 7% reduction in CO₂ emissions overall in Minnesota from 2005-2012 and notes that the “Minnesota’s economy has grown while emitting lower emissions per dollar of gross state product”; Tr. Vol. 4 at 100:21-23 (Martin) (other states and countries are likely to make CO₂ decisions on their own basis rather than in response to Minnesota’s actions); Ex. [601, Martin Rebuttal](#) at 39 (Commission unable to negotiate explicit reciprocity); *id.* at 39-40 (Minnesota’s adoption of a global SCC value – if it shifts resource planning decisions to reduce or even eliminate Minnesota’s CO₂ is likely to lead to emissions leakage in an interconnected electricity system which would further diminish any effect. Meanwhile, because Minnesota has already made significant investments to reduce GHGs, a high SCC could lead to relatively high-cost further actions compared to mitigation options available elsewhere. This means the benefit (reduction in climate damages experienced by Minnesotans) would be small to negligible, while Minnesota utility customers could bear greater direct costs than they would under a resource plan that used a U.S. or Minnesota SCC value); Tr. Vol. 1 at 179:2-7 (Polasky) (does not “really know” whether concept of taxing or regulating to provide a benefit to persons outside the taxing or regulating jurisdiction is highly unusual); Tr. Vol. 3A at 99:2-24; 100:20-23 (Dessler) (no knowledge; China will not act in response to Minnesota’s actions); [Peabody Initial Brief](#) at 85-86 (“No one else will follow and there will be no measurable effect on climate.”) (*citing* Ex. [220](#) (Mendelsohn Surrebuttal) at 35:2-4).

¹⁰⁸ It was the MLIG that elicited the testimony that shows that it takes about one month for CO₂ to circulate around the Northern Hemisphere, such that if the CO₂ above Minnesota were to suddenly vanish, other CO₂ from the rest of the world would take its place in about a one-month period. (Tr. Vol. 4 at 151:20-152:3 (Gurney).) By itself, Minnesota cannot achieve lower atmospheric warming, locally or anywhere else.

This question is addressed at length in the [MLIG Initial Brief](#) at pages 52 through 58 and will not be repeated here. However, it is worthwhile to review the numerous citations to Prof. Pindyck’s article,¹⁰⁹ which has been cited for every possible proposition. First, Prof. Pindyck has been endorsed by the Agencies and their witness, Dr. Hanemann, as “an eminent economic theorist.”¹¹⁰ Prof. Pindyck has shown that “these [IAM] models have crucial flaws that make them ‘close to useless’ as tools for policy analysis.”¹¹¹ Prof. Pindyck’s article has also been cited for the proposition that he does not believe that such flaws should cause the political process to sit back and do nothing. As cited in the [Agencies Initial Brief](#) at 62:

My criticism of IAMs should not be taken to imply that, because we know so little, nothing should be done about climate change right now, and instead we should wait until we learn more. Quite the contrary. One can think of GHG abatement policy as a form of insurance: society would be paying for a guarantee that a low-probability catastrophe will not occur (or is less likely). As I have argued elsewhere, even though we don’t have a good estimate of the SCC, it would make sense to take the Interagency Working Group’s \$21 (or updated \$33) number as a rough and politically acceptable starting point and *impose a carbon tax (or equivalent policy) of that amount*. This would help to establish that there is a social cost of carbon, and that social cost must be internalized in the prices that consumers and firms pay. (Yes, most economists already understand this, but politicians and the public are a different matter.) Later, as we learn more about

¹⁰⁹ See, e.g., [Doctors Initial Brief](#) at 22; [CEOs Initial Brief](#) at 23; [Agencies Initial Brief](#) at 62-63 and 106-107; [Peabody Initial Brief](#) at 30, 105-106, 112; [MLIG Initial Brief](#) at 38 (*citing* Ex. [304](#) (Smith Surrebuttal) at 10:22-11:6).

¹¹⁰ [Agencies Initial Brief](#) at 61 (*citing* Ex. [801](#) (Hanemann Rebuttal) at 36).

¹¹¹ See, e.g., Ex. [228](#) (Bezdek Direct) at 7, 26-27; Ex. [300](#) at 1, 2 3, 5, 22, 30 (Smith Direct); Xcel Ex. [600, pt. 1](#) at 48 (Martin Direct).

the true size of the SCC, the carbon tax could be increased or decreased accordingly.¹¹²

There are a couple of important points to remember here. First, the action suggested by Prof. Pindyck is a political action, within the purview of the Minnesota Legislature or the U.S. Congress, rather than the Commission.¹¹³ Second, contrary to the assignment to the ALJs and the Commission “to the extent practicable, [to] quantify and establish a range of environmental costs associated with each method of electricity generation,” Minn. Stat. § 216B.2422, subd. 3, which task requires the determination of an approximately correct amount, the Legislature has virtually unfettered discretion in setting tax amounts. The Legislature must, of course, consider competing interests, such as jobs and the impact on tax revenue of the potential loss of industry,¹¹⁴ and as a statewide elected body

¹¹² Robert S. Pindyck, “Climate Change Policy: What Do Models Tell Us?” (2013a) *Journal of Economic Literature* 51(3), 860-872 at 870 (emphasis added).

¹¹³ See, e.g., [Agencies Initial Brief](#) at 107 (referencing development of a “stringent abatement policy” which is well beyond the scope of the Commission’s statutory role and the ALJs’ task in this proceeding).

¹¹⁴ For example, under Minn. Const. Art. X § 3, the tax on mines is constitutionally distributed “50 percent to the state general revenue fund, 40 percent for the support of elementary and secondary schools and ten percent for the general support of the university.” Taconite mining companies pay a severance tax that applies to taconite concentrates or pellets produced in Minnesota, which is distributed to various cities, townships, counties, and school districts within the Taconite Assistance Area. This area comprises both current and past taconite mining areas. Funds are also allocated to the Iron Range Resources (IRRRB), which administers the Taconite Environmental Protection Fund; the Douglas J. Johnson Economic Protection Trust Fund; the Taconite Economic Development Fund (sometimes referred to as the Investment Tax Credit); the Taconite Assistance Program; and other loan and grant programs for Iron Range cities, townships, and the taconite industry. See, e.g., http://www.revenue.state.mn.us/businesses/mineral/Pages/Taconite_Production_Tax_Return.aspx.

is better suited to make such social cost-benefit policy determinations.

Important in the context of a geographic scope discussion is that the benefits of the tax envisioned by Prof. Pindyck are not global, but limited to the taxing jurisdiction, which in this case would be Minnesota, and not even nationwide. If Minnesota levies a tax on CO₂ emissions, the revenue is collected in Minnesota. It is not reasonable to assume that the Minnesota Legislature would turn around and distribute those funds in surrounding states, in the absence of reciprocity - such an assumption would be absurd.

In fact, the United States employs the same method. As the parties and the ALJ are undoubtedly aware, U.S. monetary support promises to other countries were doubled on December 9, 2015, in conjunction with the new Paris Climate Change Accord if other countries participate; in other words, if there is reciprocity.¹¹⁵ As Dr. Smith and Dr. Gayer have testified, there is no good reason to adopt a different rule here, notwithstanding the fact that “we’ve done it this way for the past 19 years.” The fact that addressing global GHG emissions in a meaningful way requires all major emitting nations to reduce their emissions significantly, not just the U.S. emitters,¹¹⁶ “leads to exactly the *opposite* conclusion about inclusion of global benefits in the SCC value from what the IWG concluded.” (Ex. [302](#) (Smith Direct report) at 96 (citations omitted);

¹¹⁵ See, e.g., <http://www.lcv.org/media/press-releases/LCV-Statement-on-Secretary-Kerry-s-Announcement-to-Double-Climate-Investments.html>. This citation and the text accompanying this footnote are not intended to introduce new substantive evidence into the case, and the MLIG is not requesting that the ALJs’ decision be based on this new development. The fact that over time the world will, in fact, adapt and mitigate is inescapable, however.

¹¹⁶ Ex. [302](#) (Smith Direct report) at 95-96.

emphasis in original).) See [MLIG Initial Brief](#) at 55-58.

As also set forth in the [MLIG Initial Brief](#), Dr. Gayer noted that there are countless examples of other policies (welfare, public education, tax, national defense) where the benefits and costs are considered for the jurisdiction enacting the program (*e.g.*, “the society”), not the global population, and that demonstrative feelings of altruism could justify considering some benefits outside of Minnesota, but adopting a global measure of benefits would go far outside appropriate and proportional proximity considerations. Policies that, if applied broadly, would demand a dramatic shift in all state policies, including state poverty programs,¹¹⁷ are appropriately reserved to the Minnesota Legislature or Congress.¹¹⁸ Coordination with other states and countries, in a global framework, will lead not only to actual effects unobtainable by Minnesota, but will also dictate a much lower global CO₂ ECV value. Accordingly, unless and until there is a national and international reciprocal system in force, the MLIG respectfully submits that the calculation of the ECV of CO₂ is appropriate based on a local damages assessment.

¹¹⁷ If people across the world are given equal economic standing as Minnesotans, then state transfers motivated by helping the poor should shift away from helping low-income Minnesotans and towards transfers to much more impoverished non-U.S. citizens. Similarly, one could get much more “bang for the buck” by investing in CO₂ and pollution mitigation in other parts of the world, such as India and China, than in Minnesota, which has already invested heavily in cleaner-air modifications. Such policy judgments, however, should be reserved to the Legislature.

¹¹⁸ Lacking a substantive response, the CEOs resort to name-calling and derogatory epithets instead. (See [CEOs Initial Brief](#) at 35.) This is both disappointing and unavailing from an evidentiary point of view.

E. Additional comments regarding the appropriate marginal ton(ne) to value

The CEOs and Xcel Energy have expressed concern about the methodology used to value the “first tonne.”¹¹⁹ Importantly, neither defends the IWG’s “last tonne” approach, which has never been used in Minnesota. It is also not entirely clear how the “average tonne” is currently calculated in Minnesota. The CEOs, and Dr. Polasky, claim that “[Dr. Smith] disagrees with the future emission projections used by the IWG and she therefore changes them.”¹²⁰ But this criticism is false, as Dr. Smith used the exact same emissions trajectories (the quantity of emissions emitted) as the IWG. As Dr. Smith testified, “Nobody is making [any projection of global emissions stopping in 2020]. It’s an analytic device to understand what the lower bound marginal cost per ton is.”¹²¹ Dr. Smith explained that:

Tr. Vol. 2A,

124:21 I was trying to say that the dollar per tons, in
124:22 theory, if we didn't have this historical overburden
124:23 of past emissions that are still in the atmosphere,
124:24 would go down to \$0 per ton. I would know the lower
124:25 bound. But that isn't the case, so I wanted to know
125:1 how low can the dollar per ton conceivably go in
125:2 this model if there were no further emissions.
125:3 What's the starting point of that
125:4 marginal cost curve, given what we can't change,
125:5 which is history. So the lower bound, that's my
125:6 first ton estimate. It just means this is the
125:7 dollar per ton if we were to emit another ton today
125:8 and not assign damages to that ton that we're

¹¹⁹ [CEOs Initial Brief](#) at 29-31; [Xcel Initial Brief](#) at 28-29.

¹²⁰ [CEOs Initial Brief](#) at 30 (*citing* Ex. [101](#) (Polasky Rebuttal) at 10).

¹²¹ Tr. Vol. 2A at 89:14-25.

125:9 emitting today to any future tons that haven't yet
125:10 even been emitted, that Minnesota won't be emitting.
125:11 That it will be some other global parties that are,
125:12 emitting.

125:13 So if you just want to know how low can
125:14 that dollar -- how sensitive is the dollar per ton,
125:15 the marginal dollar per ton estimate, out of these
125:16 models, it gives us an estimate of that. A very
125:17 specific estimate, there's no ambiguity about it.
125:18 That's an analytical device.

125:19 These models are very, very complex
125:20 models. You put in all sorts of emissions and other
125:21 assumptions and they churn through complicated
125:22 scientific equations, and then they churn through
125:23 damage functions that vary. And nobody knows what's
125:24 going inside them, and they pop out a number dollar
125:25 per ton. And then you churn through with different
126:1 assumptions and it pops out a number dollar per ton.

126:2 The question is, what's the underlying --
126:3 there's an implicit underlying dollar per ton
126:4 marginal cost curve that goes from the lowest lower
126:5 bound up to the values that the IWG has projected by
126:6 assuming with 80 percent probability that there will
126:7 be no other changes in emissions and we'll just
126:8 carry more and more future emissions into the damage
126:9 calculation.

126:10 So any modeler who's working with a
126:11 complicated model like this, this is the technique
126:12 you use to back out what the implicit marginal cost
126:13 per ton is in a complicated bottom-up model, and
126:14 that's what I did.

126:15 I could have done lots of things in
126:16 between, but all I wanted to know is how sensitive
126:17 is it? How much different might the number get if
126:18 we used a different forecast that involved some form
126:19 of global reduction, and I didn't try to do every
126:20 kind of projection of global reduction possible
126:21 starting from the business as usual down to zero. I
126:22 just did the two and said the right answer is
126:23 somewhere in the middle.

No other party has sought to determine what the damages value would be if Minnesota

emissions would be stopped, while the rest of the world would continue on a business-as-usual approach. That calculation is important, however, to determine the damage caused by the Minnesota pulse, which is what is being measured in this proceeding. “[E]ven a leader in adopting an externality price without reciprocal actions coming from other states and nations, such as Minnesota, should not assign itself a value that is inflated by the future emissions of those many other entities until that price is being borne by all.”¹²² Dr. Smith’s work allows the ALJs in this proceeding and the Commission to determine how to actually calculate the “average marginal tonne” that as a concept has been used since 1997 as the Commission sets the ECV of CO₂.

F. Additional comments regarding leakage

The purpose of this proceeding is to determine an ECV of CO₂, so that relevant societal costs may be properly internalized by the CO₂-emitting entity. Where emissions move outside the regulated jurisdiction as a result of regulation, it is improper to impose those costs on the remaining Minnesota emitters. Dr. Smith has testified in this regard that the issue of “leakage” may cause significant and unexpected side effects, including, but not limited to, electricity generation shifting to differently-regulated states causing a smaller net CO₂ reduction than anticipated, or even a net total offset (100% leakage) or a net increase in CO₂ emissions.¹²³

As indicated in the [MLIG’s initial brief](#), technically speaking, leakage is not an

¹²² Ex. [304](#) (Smith Surrebuttal) at 24:8-22.

¹²³ Tr. Vol. 2A at 102:9-103:13; 103:24-104:1 (Smith); Ex. [401](#) (Gayer Surrebuttal) at 9:7-10:3.

issue in this proceeding, in that the amount per tonne of the ECV of CO₂ is not affected by leakage.¹²⁴ Accordingly, the MLIG asked that the ALJs express their ultimate findings and conclusions in dollars per (short or metric) *net* ton, allowing the issue to be handled in resource planning proceedings. The Agencies, and Dr. Hanemann, disagree, continuing with a refrain that “[t]he level of GHG emissions in other states is not the responsibility of the Commission” and “the Commission has no responsibility for the aggregate level of emissions in the U.S.”¹²⁵ This is a tremendously short-sighted approach, and it can be said with equal validity that “it is not the responsibility of the Commission to tax for the sake of taxing, to regulate for the sake of regulating, and to increase Minnesota ratepayers’ electric bills for the sake of increasing the electric bills.” Yet, that is what Dr. Hanemann’s and the Agencies’ argument amounts to.

The MLIG respectfully submits that it is the Commission’s responsibility to regulate with care for the consequences of its actions when it reviews a proposed resource plan. To do so, the Commission needs information. It is appropriate that the utilities provide any information they may possess regarding the likelihood of leakage resulting from a proposed resource plan. And to achieve the collection of information and submission of that information to the Commission, the Commission need only ask about leakage and incorporate that into the resource planning through the usage of “net affected tonnes.”

¹²⁴ [MLIG Initial Brief](#) at 83.

¹²⁵ [Agencies Initial Brief](#) at 130.

This is not a novel concept. As previously noted,¹²⁶ in its July 2015 Response to Comments, the IWG stated that leakage “is an important issue for analysts to consider in determining the net CO₂ reductions to be valued in an RIA.”¹²⁷ The IWG accordingly instructed that “[t]he SCC estimates are multiplied by estimates of the net GHG emissions changes to calculate the value of benefits associated with a policy action in a given year. It is in the estimation of net GHG emissions ... that any leakage should be accounted for.”¹²⁸ The application of the ECV of CO₂ to net tonnes allows for the internalization of actual costs, rather than phantom costs, and is the correct way to express the ECV of CO₂.

III. HARMONIZATION OF THE MODELS WAS A PROCESS FLAW

The CEOs and the Agencies both claim in their initial briefs that the IWG was required to harmonize the models, so that they could be compared.¹²⁹ In fact, Dr. Hanemann and the Agencies noted that “prior to the IWG’s study, there had been no comparable IAM model inter-comparison exercise.”¹³⁰ The Agencies further noted that harmonization is “standard practice in inter-comparison exercises,”¹³¹ that “[b]y harmonizing their treatment, this made the models more readily comparable,”¹³² that

¹²⁶ [MLIG Initial Brief](#) at 85.

¹²⁷ Ex. [101](#) at 33.

¹²⁸ Ex. [101](#) at 33.

¹²⁹ [CEOs Initial Brief](#) at 8 and 24; [Agencies Initial Brief](#) at 16-17, 26, 27, 31, 76.

¹³⁰ *Id.* at 16-17.

¹³¹ *Id.* at 26.

¹³² *Id.* at 27.

without harmonization it is “pointless to make a comparison of SCC estimates across the models,”¹³³ and that the DICE, FUND, and PAGE damage functions are “the only damage functions currently available for use in a model inter-comparison exercise.”¹³⁴

These comments show a significant flaw in analysis, namely the concept that the model outcomes should be similar to begin with. This was not an exercise to see how different models handled the same data or to test the models. Presumably that had been done before putting them to actual use; here the individual model’s damage functions were being used for the individual answers. Ironically, the Agencies correctly note that “each IAM embodies each researcher’s ideas as to how one should build a model.”¹³⁵ The entire point of using three different models is to ensure that chances of getting the right outcome are maximized. Averaging the outcomes makes the data usable, as each model was deemed equally reliable. Harmonizing the models removed the model authors’ assumptions, and equated to “putting gasoline in a diesel engine,” as Dr. Mendelsohn testified,¹³⁶ putting the integrity of the models at risk,¹³⁷ and leaving Dr. Tol to wonder what went wrong when the IWG’s outcomes running Dr. Tol’s model were increasing while Dr. Tol’s outcomes, running his own model, were decreasing over the

¹³³ *Id.* at 31.

¹³⁴ *Id.* at 76.

¹³⁵ *Id.* at 16.

¹³⁶ Tr. Vol. 3B at 37:15-38:11 (Mendelsohn). *See also* Tr. Vol. 2A at 112:5-113:2 (Smith).

¹³⁷ *Id.*

same time period.¹³⁸ Rather than showing how great the IWG's process was, the CEOs and the Agencies accordingly showed how flawed that process really was.

CONCLUSION

The MLIG has addressed the two questions posed by the Commission, answering why the FSCC is not reasonable nor the best available measure of the ECV for CO₂ and has provided alternative framing-assumption adjustments to the damages horizon, an alternative discount rate (5.66%), the correct marginal ton (the first and average tons), the correct geographic scope (Minnesota damages or, at most, U.S. damages if the Commission were to provide 100% altruistic weight to all other U.S. states), and has shown why the ALJs and the Commission should express the ECV of CO₂ in net tons to account for leakage.

The MLIG respectfully submits that if the Commission desires to protect important Minnesota values such as the affordability of energy, that it maintain the conservative approach to the environmental cost of carbon recommended by ALJ Klein and adopted in the Commission's January 3, 1997, [Order Establishing Environmental Cost Values](#). As applied, the MLIG respectfully submits that the ALJs and the Commission should adopt a range for the environmental cost value of CO₂ of \$0.37 to \$5.14 per net metric ton (in 2014 dollars).¹³⁹

¹³⁸ See [Peabody Initial Brief](#) at 73-74 (*citing* Ex. [238](#) (Tol Rebuttal Report) at 6-7).

¹³⁹ If, on the other hand, the Commission desires to afford 100 percent altruistic weight to all other U.S. States, the MLIG supports Dr. Smith's proposed range for
(continued)

Respectfully submitted,

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**ATTORNEYS FOR THE MINNESOTA
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(continued)

emissions in the year 2020 of \$0.90 to \$5.14 (in 2014 dollars per net metric ton)
See Ex. [307](#) (Table 4A, copy attached) at lines 32 and 42.

TABLE 4A

Summary of SCC Estimates for Alternative Values, Including Average Ton.¹

	# changes from base inputs	Discount Rate	Time Horizon	Geographic Scope	Which Tonne	2020 SCC Value (2007\$/net tonne)	2020 SCC Value (2014\$/net tonne)
1.	0	3%	2300	Global	Last	\$42.14	\$46.88
2.	1	3%	2140	Global	Last	\$32.53	\$36.19
3.	1	3%	2100	Global	Last	\$22.14	\$24.63
4.	1	5%	2300	Global	Last	\$12.03	\$13.39
5.	2	5%	2140	Global	Last	\$10.70	\$11.90
6.	2	5%	2100	Global	Last	\$9.03	\$10.05
7.	1	7%	2300	Global	Last	\$4.84	\$5.38
8.	2	7%	2100	Global	Last	\$4.26	\$4.74
9.	1	3%	2300	U.S.	Last	\$6.88	\$7.65
10.	2	3%	2140	U.S.	Last	\$5.36	\$5.96
11.	2	3%	2100	U.S.	Last	\$3.97	\$4.42
12.	2	5%	2300	U.S.	Last	\$2.28	\$2.54
13.	3	5%	2140	U.S.	Last	\$1.99	\$2.22
14.	3	5%	2100	U.S.	Last	\$1.77	\$1.97
15.	2	7%	2300	U.S.	Last	\$1.03	\$1.15
16.	3	7%	2100	U.S.	Last	\$0.92	\$1.03
17.	1	3%	2300	Global	First	\$27.59	\$30.70
18.	2	3%	2140	Global	First	\$21.55	\$23.98
19.	2	3%	2100	Global	First	\$15.55	\$17.30
20.	2	5%	2300	Global	First	\$8.43	\$9.38
21.	3	5%	2140	Global	First	\$7.65	\$8.51
22.	3	5%	2100	Global	First	\$6.70	\$7.45
23.	2	7%	2300	Global	First	\$3.65	\$4.06
24.	3	7%	2100	Global	First	\$3.33	\$3.70
25.	2	3%	2300	U.S.	First	\$4.83	\$5.37
26.	3	3%	2140	U.S.	First	\$3.88	\$4.32
27.	3	3%	2100	U.S.	First	\$3.05	\$3.40
28.	3	5%	2300	U.S.	First	\$1.76	\$1.96
29.	4	5%	2140	U.S.	First	\$1.59	\$1.77
30.	4	5%	2100	U.S.	First	\$1.46	\$1.62
31.	3	7%	2300	U.S.	First	\$0.87	\$0.96
32.	4	7%	2100	U.S.	First	\$0.81	\$0.90

¹ The Average Ton figures in Table 4A are derived by taking the average of the first and last ton figures for a given discount rate, geographic scope, and time horizon set forth in Table 4 in the Expert Report of Anne Smith. For example, the average ton for a 3% discount rate, 2300 time horizon, and global scope in Line 33 is derived by taking the averages of the first (line 17) and last ton (line 1) for the same discount rate, time horizon, and global scope.

(Cont'd)

	# changes from base inputs	Discount Rate	Time Horizon	Geographic Scope	Which Tonne	2020 SCC Value (2007\$ /net tonne)	2020 SCC Value (2014\$ /net tonne)
33.	1	3%	2300	Global	Average	\$34.87	\$38.79
34.	2	3%	2140	Global	Average	\$27.04	\$30.09
35.	2	3%	2100	Global	Average	\$18.85	\$20.97
36.	2	5%	2300	Global	Average	\$10.23	\$11.39
37.	3	5%	2140	Global	Average	\$9.18	\$10.21
38.	3	5%	2100	Global	Average	\$7.87	\$8.75
39.	2	7%	2300	Global	Average	\$4.25	\$4.72
40.	3	7%	2100	Global	Average	\$3.80	\$4.22
41.	2	3%	2300	U.S.	Average	\$5.86	\$6.51
42.	3	3%	2140	U.S.	Average	\$4.62	\$5.14
43.	3	3%	2100	U.S.	Average	\$3.51	\$3.91
44.	3	5%	2300	U.S.	Average	\$2.02	\$2.25
45.	4	5%	2140	U.S.	Average	\$1.79	\$1.99
46.	4	5%	2100	U.S.	Average	\$1.62	\$1.80
47.	3	7%	2300	U.S.	Average	\$0.95	\$1.06
48.	4	7%	2100	U.S.	Average	\$0.87	\$0.97